

REFLECTIONS ON WATER POLICY: Collected Columns from *Arizona Water Resource*



COLLEGE OF AGRICULTURE & LIFE SCIENCES
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**WATER RESOURCES
RESEARCH CENTER**

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Foreword

I have contributed a column to the Arizona Water Resource newsletter since joining the University of Arizona Water Resources Research Center in February 2002. As the WRRRC closes the book on the quarterly Arizona Water Resource, I am using this 76th column as the foreword to a compilation of my columns. The compiled volume is being published electronically and posted on the Water Resources Research Center's website. Since 2013, my columns have been the first reading assignment for my graduate water policy class, now entitled "Water Policy in Arizona and Semi-arid Regions". I ask students to come to the second meeting of the class with multiple questions that emanate from their review of the columns. Student questions then guide the second class' discussion and provide me with a glimpse of subjects the students may address in the research papers they write for the class. My rationale for this assignment is that, when I look at my past columns, I see that many of the issues I wrote about in the past continue to be matters of current debate. When I first thought about this column/Foreword, I thought I would identify my favorite columns or those for which I received the most comments. I am pretty sure I received the most feedback for Column 36, "An American in Paris Realizes Arizona Could Do More to Save Water", which in fact is one of my favorites. The high number of comments was most likely due to the photo of me touring the Paris Sewer Museum. Sometimes what is most memorable is where I was when I wrote the column, such as Column 55, "Written from Sea". I wrote that column while on an Alaskan cruise vacation. There are the several columns written during or after teaching my Spring semester graduate water policy class, where I discuss student papers and/or the interesting field trips taken or topics we have covered. There are columns written about other experiences, such as organizing workshops and conferences and working on the Transboundary Aquifer Assessment Program. There are the columns written about other very interesting trips abroad, including that taken in late 2016 with the two International Boundary and Water Commissioners. And there are the issues-focused columns, including several about water planning, water recharge, groundwater invisibility, water conservation and pricing, etc.

Rather than choose my top 10 columns, however, I decided to return to my first column, published in the March-April 2002 Arizona Water Resource and entitled, "Was the GWMC's [Groundwater Management Commission's] Conversation Comprehensive Enough?" In particular, I want to highlight this paragraph: "Because we have been successful at managing our groundwater, no crises exist nor loom on the horizon. As a result, there is no strong sense we should do anything differently. And while the commission and its onlookers engaged in a comprehensive conversation, for the most part the general public and public officials did not. Further education, discussion and debate, therefore, is needed, especially with legislators and likely participants in future legislative debates." Now, many years later, we are at a very critical juncture in Arizona water management as we grapple with how to absorb the expected reductions in deliveries of Colorado River water to Arizona. There is a comprehensive conversation going on as I write this column. The conversation includes Legislators and representatives of the various water using sectors in Arizona. As the impacts of the proposed terms of the Drought Contingency Plan are being explored and debated by a large steering committee, we know that it is more important than ever to build upon the great water management foundations and collaborations that have contributed to Arizona's economic vitality.

The need for education and robust dialogue on water policy and management is as great as ever. Although, the Water Resources Research Center is ceasing publication of the Arizona Water Resource as we know it to keep in step with society's changing approaches to information sharing and enable us to realign Water Resources Research Center resources, I intend to continue to share perspectives periodically through our Weekly Wave news digest. If you do not already subscribe to this Friday e-publication, which includes announcement of our seminars (usually live-streamed) and annual conference, along with short articles, please visit wrrc.arizona.edu/subscribe to add your name.

Compendium cover photos (clockwise from top left): Sorek Desalination Plant; GRIC Governor Stephen Roe Lewis presents calendar stick to WRRRC Director Dr. Sharon B. Megdal and 2015 conference co-chairs Dr. Karletta Chief and Dr. Jean McLain; Southern Avra Valley Storage and Recovery Project



Public Policy Review

by Sharon Megdal

Was the GWMC's Conversation Comprehensive Enough?



In early 2000, I contributed a Guest View to the *Arizona Water Resource* providing a rationale for a “comprehensive conversation” on the Groundwater Management Act 20 years after its adoption. My commentary anticipated the formation of the Governor’s Water Management Commission. As the reader may know, the commission was established in June 2000 and completed its work in

December 2001. It was an arduous task, with volumes of materials reviewed and analyzed, and countless hours spent at meetings.

The 49-member commission’s *Final Report & Recommendations* was a succinct document, including approximately 50 recommendations to improve water management in the state’s five Active Management Areas. To implement the recommendations requiring statutory change, two bills were drafted. The large bill was 141 pages long and included many statutory changes. In contrast, the bill introducing, in certain circumstances, a groundwater withdrawal assessment was five pages.

The stiff opposition the bills met early on did not bode well for their passage. Concern about the situation prompted Senator Herb Guenther and Representative Tom O’Halloran, the bills’ primary sponsors, to consult with various members of the commission. On March 6, Guenther and O’Halloran issued a joint press release announcing withdrawal of the bills. Senator Guenther stated, “The time necessary to review the Groundwater Code ... just isn’t there.” Representative O’Halloran added that review of the proposals “will require a lot of time and focus by the members who, frankly, have other, more immediate problems facing them.”

Balancing the state budget has been the main concern of the Legislature and Governor this legislative session. In the wake of the Alternative Fuels debacle, complex bills will require considerable debate. Finally, in this year of redistricting and reelection, legislators are likely to be extra cautious in their votes. The press of various matters did not leave sufficient time to fully debate the bills’ provisions. Expectations are that the recommendations will be reintroduced next year.

Various other factors also worked against the bills. Due to their complexity and the broad review of the drafts by commission members and other interested parties, the bills were introduced late. It may have been a miscalculation to expect the Legislature to “trust” the 49 members of the commission. Their diverse interests led to compromises on many issues, with recommendations adopted as a package. Further, without a water crisis to add a sense of urgency, support was lacking for some of the proposed reforms. Those who did support the recommendations were not sufficiently organized to actively advocate for passage of the bills. Although the commission process may have educated participants, the educational outreach effort was not broad enough, only benefitting a handful of legislators. So, seeking additional time was indeed justified

We now have some breathing space. Is it reasonable to expect a different outcome next year? What needs to be done differently? Several have argued for the need to go back to basics and educate policy makers – and others – on the groundwater code. Why was it established? How has it been changed? Why are further changes necessary? Some understanding of the commission’s process or water management issues in general would be helpful in answering such questions.

About one-third of legislators were elected, however, for the first time in 2001. That was a quiet, uneventful year for groundwater code amendments, with the water community awaiting the recommendations of the commission. Not many current legislators were participants in the creation of the Central Arizona Groundwater Replenishment District (CAGRDR). With many members not well grounded in groundwater issues, it is understandable that legislators want to ask many questions and have time for debate.

In the piece I wrote in early 2000, I noted that we have made great strides in managing groundwater in the AMAs. I stated, “Twenty years later, we should both congratulate ourselves on our successes and ask the question: Can we manage our state’s precious water resources even better?” I provided the following observations on the need for a look at the code: “While many know that water is an essential resource for a rapidly growing desert state, I would suggest few understand just how we are attempting to ensure sufficient water supplies to sustain our current and growing population and economic activities. Therefore, education of the public as to why we regulate our groundwater use as we do and why some changes may be needed is an important reason to engage in a comprehensive conversation.”

Some have suggested we are the victims of our own success. Because we have been successful at managing our groundwater, no crises exist nor loom on the horizon. As a result, there is no strong sense we should do anything differently. And while the commission and its onlookers engaged in a comprehensive conversation, for the most part the general public and public officials did not. Further education, discussion and debate, therefore is needed, especially with legislators and likely participants in future legislative debates.

I look forward to participating in this educational process. I am hopeful that, after some additional conversation, we will introduce some riparian protection to state water policy, a concern that never made it in the code in 1980, as well as improve the CAGRDR statutes, just to single out a few important commission recommendations.

I also look forward to other follow-on work to the commission process. Not all recommendations required legislative action. Some recommendations acknowledged the inability of the commission, due to time or other limitations, to address some key matters. The latter include the long-term role of the CAGRDR, planning for recovery of stored CAP water, and developing a planning process for addressing the state’s future water needs. ■



Public Policy Review

by Sharon Megdal

The Central Arizona Groundwater Replenishment District – The Need for Some Fine Tuning



The Central Arizona Groundwater Replenishment District (CAGRDR) was created by the Arizona Legislature in 1993. At that time, the Department of Water Resources was developing the Assured and Adequate Water Supply Rules. The AWS concepts under consideration included a significant commitment to use of renewable supplies, particularly in the Phoenix and Tucson Active Management

Areas. Concerns were voiced. Without a mechanism that allowed for utilization of renewable supplies, many would face difficulty in demonstrating that their water use would be consistent with the statutory water management goal, a key requirement for a designation or certificate of Assured Water Supply.

The legislation creating the CAGRDR was both innovative and complex. It established a mechanism for replenishing groundwater use without creating another layer of government. The replenishment responsibility was given to the operators of the Central Arizona Project. Every ten years, the CAGRDR has to develop a plan of operation, which must be approved by the ADWR Director. The first plan was submitted in 1994, a year before the final approval of the AWS Rules.

Because the replenishment obligation could not have been projected with any accuracy, it is not surprising that a lot of guesswork went into the 1994 Plan. Where do we stand as the time for preparing the next plan approaches? The Plan's high-end projection for 2001 replenishment for the Tucson AMA was over 9,000 acre feet (af). Actual replenishment in 2001 was approximately 6,400 af, including replenishment of 5,000 af for Tucson Water, pursuant to a specialized contract developed between the CAGRDR and Tucson. Actual replenishment in the Phoenix AMA in 2001 was approximately 6,700 af, well above the 2,300 acre foot high-end projection included in the 1994 Plan. In the Pinal AMA, where replenishment demand is mitigated by the relatively large amount of groundwater use allowed by the AWS Rules, actual replenishment in 2001 was 20 percent above the high-end projection. Overall, total GRD replenishment in 2001 exceeded the high-end estimate included in the 1994 Plan by 15 percent. More significantly, projected total replenishment obligations for 2014 are now running 57,000 acre feet, far more than 37,500 af shown in 1994 as the high replenishment scenario. Is the rapid growth in replenishment obligation a cause for concern? It is not – if the CAGRDR-related recommendations of the Governor's Water Management Commission are implemented.

As discussed in my last column, the recommendations of the Commission were withdrawn from last session's legislative agenda. It is expected that the recommendations specifically dealing with the CAGRDR will be proposed again next year. If implemented, the most significant of these would establish a replenishment reserve

of long-term storage credits. As noted in the Commission's Final Report, in developing this recommendation, the challenge was "to provide a means of ensuring that the CAGRDR can meet its long-term obligations, at a reasonable price, and still maintain the operational and legal flexibility to maximize the use of short-term supplies as they become available."

Significant effort went into developing the replenishment reserve recommendation. It is important that the Legislature not delay consideration of the proposal beyond the 2003 legislative session. The CAGRDR's members can benefit from implementing this recommendation by taking advantage of the availability of surplus CAP water.

It should be noted that the replenishment reserve proposal was not developed primarily as a means for increasing the state's utilization of CAP water while excess CAP water is available. The operations of the Arizona Water Banking Authority and the pricing policies of the CAWCD Board, in conjunction with increasing demand for renewable water supplies generally, have demonstrated that Arizona can utilize its full apportionment of CAP water. The proposal reflected legitimate concerns that, because the CAGRDR allows for growth to occur without there being "firm" renewable water to supply that growth, there could be price shocks in the future for CAGRDR members. What happens down the road when there is no surplus CAP water available? Will the CAGRDR have planned for this eventuality and secured other supplies at reasonable cost? The replenishment reserve proposal was seen as a means of improving the reliability of the CAGRDR and increasing the likelihood that the CAGRDR's rates remain stable in the future.

Does the replenishment reserve proposal, along with Commission recommendations for improved planning requirements and the ability for member service areas to de-enroll from the CAGRDR, address all the concerns that have been voiced about the CAGRDR? It does not, but it is a very significant start. Additional CAGRDR-related issues were identified, but there was not time for the Commission to examine them. Instead, the Commission recommended that the CAGRDR Board address these additional issues through an appropriate public process. The issues include location of replenishment activities relative to the location of pumping, the need to obtain secure water supplies to meet the CAGRDR's future replenishment obligations, and the long-term role of the CAGRDR. The CAGRDR Board has already begun a process to follow up on this recommendation.

To date, the CAGRDR has been successful in assisting developers and water providers in demonstrating that water use will be consistent with the state's management goals. Implementing the replenishment reserve proposal, strengthening the CAGRDR's planning requirements, and examining the long-term role of the CAGRDR will ensure that this success is continued into the future. ■



Public Policy Review

by Sharon Megdal

Interesting Times for the Arizona Water Banking Authority



In 1996 the Arizona Legislature created the Arizona Water Banking Authority (Authority) to assist with dealing with potential shortages of Colorado River water, water management, Indian settlements, and interstate water banking.

Since 1997, the Authority has been storing excess Central Arizona Project water at sites in the three-county Central Arizona Project service area (Maricopa, Pinal and

Pima counties). Property tax revenues levied by the CAP Board and then transferred to the Authority, as well as General Fund revenues, have been funding this water storage. According to the Authority's most recent Annual Report, through December 2001 the Authority expended \$10.6 million General Fund revenues and \$29 million ad valorem tax revenues. Groundwater withdrawal fees levied annually by ADWR on groundwater withdrawals in the Phoenix, Pinal and Tucson Active Management Areas have been available to the Authority to fund storage primarily for water management and Indian settlement purposes. However, to date no withdrawal fees revenues have been expended for the benefit of the Phoenix and Tucson AMAs. Almost \$10 million and \$2.8 million remained in the withdrawal fee accounts for the Phoenix and Tucson AMAs, respectively. Most of the withdrawal fee revenues collected in Pinal AMA, on the other hand, have been expended. As of the end of 2001, the Authority has spent almost \$44 million of the \$76 million available to it since its inception. The Authority's expenditures have resulted in the accumulation of almost 1.3 million acre feet of long-term storage credits.

The Authority's role is not well known to the public. At a recent workshop on its interstate banking function, the Authority's genesis was reviewed by Herb Dishlip of the Arizona Department of Water Resources. He noted that, although the bill creating the Authority was an outgrowth of discussions regarding interstate water banking, interstate banking was not the primary focus of the authorizing legislation. He commented that the Authority gained legislative approval without much difficulty, because potentially controversial elements were omitted from the bill. In the end, an entity was created that has authority – you could say responsibility – to store Colorado River water for multiple, important purposes but has no legal authority to own and operate storage facilities.

The long-term storage credits funded by ad valorem tax revenues levied by the board operating the CAP are accumulated by the Authority but then are transferred to the CAWCD when there is shortage of CAP water. The Authority is not empowered to recover water for any purpose. Safeguards were written into the authorizing legislation to protect Arizona interests when storage is done on behalf of other states, but how credits accrued through an interstate agreement are "recovered" is still being worked on.

The Authority has some very important responsibilities, but it

faces significant limitations on what it can do. The Authority is last in line as a purchaser of excess CAP water. It is also last in line for the use of storage facilities. These constraints can become particularly important in times when the Legislature is dealing with sizable budget shortfalls and in times of drought. The recent announcement of proposed cuts in water allocations by the Salt River Project is a case in point.

In mid-August, SRP announced that its board will be asked to implement a reduction in water deliveries for only the second time in 51 years. To keep the allocation reduction as small as possible, SRP expects to acquire excess CAP water through purchase or exchange. SRP's announcement triggered announcements by many of its municipal customers that they too expect to offset some of the shortfall in SRP water deliveries with increased usage of CAP water. Increased orders for CAP water by municipal subcontractors and SRP will reduce the amount of excess CAP water available to the Water Banking Authority. Whereas the Authority has accrued on average approximately 255,000 acre feet of credits annually over the past five years, it is possible that well under 100,000 acre feet of CAP water will be available to the Authority for purchase and storage in 2003.

The finalization and implementation of interstate banking agreements are a difficult enough task for the Authority. However, a sizable reduction in excess CAP water affects the Authority's ability to store water for any of its statutory purposes. In the short run at least, there will be less water in storage to firm up CAP water supplies for municipal and industrial subcontractors, which is the Authority's primary objective. Limited water availability will likely result in even more accumulation of groundwater withdrawal fees and postponement of use of these revenues for water management and/or Indian water rights settlements. At a time when Nevada is interested in gearing up its interstate storage activities and finalization of the necessary agreements is pending, there may be precious little water available for interstate storage. This may not affect plans for interstate storage in 2002, however.

Earlier this year, the Authority recognized that Arizona's general fund problems were likely to continue and decided to carry over certain General Fund monies for storage activities in early 2003. In order to avoid interfering with implementing its 2002 Plan of Operation and wishing to satisfy additional demands for irrigation water by farmers, the Authority authorized the storage of approximately 40,000 acre feet of water during 2002 in Pinal County on behalf of Nevada. Will the General Fund dollars intended for carry-forward be tapped by the Legislature to help balance the budget? Will sufficient water be available in the future so that the important functions of the Authority can be achieved?

These are interesting and challenging times for all working on water resource matters. The Arizona Water Banking Authority is no exception. ■



Public Policy Review

by Sharon Megdal

Program Supports UA Water Research, Education and Outreach



A new water-focused grants program is underway at the University of Arizona. This innovative competitive grants program for water resources research, education and outreach is funded through the legislatively authorized Technology and Research Initiative Fund (TRIF). In November 2000, when voters increased funding for education by approving an increase in the state sales tax, the state's university system benefitted. A portion of the tax was dedicated to investment in technology and research-based initiatives. Established by statute (ARS 15-1648), TRIF is administered by the Arizona Board of Regents (Regents), which awards funding in response to university requests.

It was in response to a UA request that the Regents approved funding for a comprehensive water initiative. Known as the Water, Economic Development and Sustainability Program (WEDSP), this innovative project includes research, education and outreach activities and is a collaborative effort among four existing UA water centers. An increase in projected program funding from the fiscal years' 2002 and 2003 level of \$500,000 to \$2,000,000 in fiscal year 2004 is enabling the introduction of the grants program.

Working closely with Dean Eugene Sander of the College of Agriculture and Life Sciences on developing and implementing WEDSP are the directors of the UA water centers: Farhang Shadman of the Engineering Research Center for Environmentally Benign Semiconductor Manufacturing; Soroosh Sorooshian of the Center for Sustainability of Arid and semi-Arid Hydrology and Riparian Areas; Ian Pepper of the Water Quality Center; and Peter Wierenga of the Water Resources Research Center.

The WEDSP mission is to provide science-based technical, economic, legal, and policy expertise necessary for water development, use, and conservation. A business plan was recently requested by the Board of Regents. The business plan, which can be accessed from the Regents' home page (www.abor.asu.edu), is undergoing review by the Regents' Business Advisory Team. It highlights how the UA is leveraging its strengths in academia, research, and local environmental technology industries to further the WEDSP mission.

To date, TRIF funding has enabled each of the funded water centers to expand its work on water resources research. Areas of research interest include but are not limited to evaluating the effects of climate fluctuations on surface water resources, determining how to meet increasing water demands at the same time as groundwater levels are declining, addressing water quality issues associated with high-tech manufacturing as well as water treatment and recycling, and assessing Arizona water resources policies and institutions.

Education and outreach are important components of the WEDSP. In addition to the education and outreach activities of each of the centers, a joint education program has been the recipient of one-fifth of the program's funding in each of the first two

years. Already, TRIF funding has supported the development of high school, interdisciplinary curriculum modules on water resources in a semi-arid environment, a middle-school field trip site at Tohono Chul Park in Pima County, and water resource centers in Cochise and Yavapai Counties. In addition, TRIF has supported the expansion into Maricopa County of Project WET (Water Education for Teachers) and development of a summer teachers institute on water recycling by industry.

An external advisory committee to the WEDSP has been established to provide periodic input on the program's activities, including input on areas of research, possible funding partners, ways of strengthening the program, and mechanisms for information dissemination. Serving on the committee are representatives of private sector companies, including the semiconductor industry, water utilities, and state and federal agencies.

Partnerships are extremely important to the WEDSP. It is expected that TRIF funding will enable faculty and staff to build upon existing partnerships and forge new partnerships. The extent to which resources are leveraged with external funding is a key performance measure for the program. The Regents intend to evaluate the performance of the TRIF-funded programs thoroughly. Less than half-way through its second year of funding, the WEDSP is about to embark on perhaps its most exciting component, one that is unique among the TRIF programs, the competitive grants for UA faculty and staff. The focus will be on Arizona-specific water resources issues. A large proportion of the fiscal year 2004 increase in funding will fund faculty and staff grants, with a smaller portion going to fellowships for undergraduate and graduate students. A request for proposals will be released in early November, with awards announced next spring. The WEDSP grants program is expected to continue for two years beyond fiscal year 2004.

Since joining the Water Resources Research Center in February, I've had the opportunity to participate in the implementation of the WEDSP. It has been exciting to be involved in the enhancement of our ability to understand and address Arizona's water resource challenges. I'll keep you posted!

Update: In a recent column, I wrote about the lack of legislative action on the recommendations of the Governor's Water Management Commission. Many are wondering what will happen next session. There will be an effort by the Central Arizona Water Conservation District Board to obtain legislative support for implementing the Commission's recommendations related to the Central Arizona Groundwater Replenishment District, and there is significant interest in addressing rural Arizona water issues. There also continues to be some activity regarding infrastructure finance. Otherwise, there appears to be no organized effort at this time within the water community to generate legislative support for other Commission recommendations. The obvious but not only reason for this — the dire state budget situation. ■■■



Public Policy Review

by Sharon Megdal

To Be or Not to Be a Good Collaborator on Water Issues

Some "Be's" to heed when working with others



I recently spoke at the Verde Watershed Citizens' Groups Conference, which was organized by the Sedona League of Women Voters. About 85 people assembled on a Saturday in January to discuss how they can better coordinate and collaborate to resolve regional watershed issues. This type of effort is of great interest to me, not only in my current position, but as I reflect upon my past experiences, including serving as

executive director of the now-defunct Santa Cruz Valley Water District and serving on the State Transportation Board for six years. As I thought about what might be useful for this talk, I came up with a "Be" list for working collaboratively. This column is based on the comments I made at the conference.

- Be willing to compromise. Compromise is not a bad thing. The word processing thesaurus includes the following synonyms for "compromise:" cooperation, negotiation, concession, conciliation, finding middle ground, and give and take. Compromise is necessary when developing solutions to complex challenges.
- Be consistent and reliable. While positions may be modified and compromises accepted, consistency and reliability are essential when establishing positions. Once a tentative agreement has been reached, don't attempt to further advance your position. In addition, follow through is important to build trust. If you are representing others in a collaborative process and are unsure whether the entity/group will support a particular position, mention this up front.
- Be willing to put effort into forging alliances and partnerships. Along with helping you attract and leverage existing funds, alliances also increase your visibility as a participant/player at many different levels. The Arizona Rural Watershed Alliance, the Southern Arizona Water Users Association, the Water Conservation Alliance of Southern Arizona and the Northern Arizona Municipal Water Users Association are all organizations that have formed over the past several years. They have enabled their members to pursue programs that meet common needs and to articulate positions more forcefully than if articulated by individual members. Looking for efforts to collaborate with others can result in the often sought "win-win" outcomes. Several recharge projects in the Marana area, for example, benefitted from collaborative efforts. Several partnerships were developed, some including a privately held farming operation.
- Be mindful of institutional settings (e.g. the strictures of established laws and regulations) but recognize that it is possible, within reason, to change laws and regulations. It may be painful, time-consuming and sometimes expensive, but change may be necessary. An example of this is the effort to gain authorization for multi-jurisdictional water facilities districts. The need to facilitate the financing of water projects involving more than one water entity has been under

discussion for several years. The legislation introduced as HB2480 reflects a continuing effort at compromise. (See first bullet above!)

- Be patient and persistent. Most solutions to complex problems require considerable effort. Sometimes the "two steps forward, one step back" experience applies. Other times it may seem like you are going in circles. But if the circles are converging, progress is being made! It takes time to develop and implement plans, programs and projects, with the length of time dependent on a number of variables, including the complexity and funding requirements associated with the effort.
- Be careful what you ask for. For example, you might successfully gain legislative approval for a provision you believe will benefit your effort, only to find out later that the statutory provision impedes future progress. I believe this happened with the Santa Cruz Valley Water District. At the request of the district's board, statutory changes were made to the governance and financing structure of the district. These changes later raised concerns about the district's permanent formation and caused sufficient stir that the district was not permanently established. Another example is the Phoenix Active Management Area gaining statutory authority to establish a groundwater replenishment district, with mandatory membership for AMA water providers. The district, if formed, would have levied a property tax. This funding source was considered important to the success of the district, which, in turn, was viewed as important to the success of the region in reaching safe yield. The property tax concerned city councils, whose approval was a prerequisite to district formation. The district was never established.
- Be willing to put up resources, both monetary and in-kind. The scarcity of financial resources affects our ability to resolve physical resource challenges. Putting up resources is a sign of commitment to the effort and can help attract more resources. This is certainly true of the Rural Watershed Program authorized by the Arizona Legislature and many other successful efforts.
- Be inquisitive — ask questions. Some people are hesitant to ask questions, yet questioning can be very productive. The "no question is stupid" rule applies.
- Be a leader. The value of good leadership is well-recognized. Leading sometimes means taking risks by proposing ideas and project concepts that take some time to germinate.
- Be willing to work hard.

This 10-element "Be" list is by no means comprehensive. While many obstacles may exist to arriving at collaborative solutions to local, regional and statewide water challenges, examples of success are many. We can learn from the failures, the bumpy roads followed, and the successes of collaborative efforts. Sharing these experiences will be a significant part of the Water Resources Research Center conference scheduled for May. (See page 10 for information about the WRRC conference.) I hope to see many of you there! 🏠



Public Policy Review

by Sharon Megdal

Water Bills Included on Arizona's Legislative Agenda

Budgetary worries don't exclude water deliberations



Although attention at the Capitol has focused on budget matters, some bills important to water management are making their way through the legislative process. Their final approval will be evidence that good things can be accomplished even during very tough budgetary times. (Note: At the time of writing, approval of most of these bills was still pending. Bills can be tracked on-line at The Legislature's web site,

<http://www.azleg.state.az.us/>).

HB 2088 establishes a Well Administration and Enforcement Fund at the Arizona Department of Water Resources. Fees for filing a notice of intent to drill a well or obtaining a permit, where required, to drill a well would increase in all areas of the state, although the House and Senate had yet to concur on the amount of the increase. The Senate version increases the fee to \$150 in Active Management Areas and Irrigation Non-Expansion Areas and increases it to \$100 elsewhere.

This legislation is important to provide increased revenues to ADWR, enabling the agency to carry out its mandated responsibilities more effectively. The revenues would go into a special account at ADWR to fund "compliance monitoring, investigation and enforcement activities of the department pertaining to the construction, replacement, deepening and abandonment of wells and capping of open wells." Because of budget cuts, ADWR has had to cut back significantly on its well safety monitoring program. Unlike the revenues for most fees, which are deposited to the general fund, these funds would be appropriated to ADWR. Because this bill involves a fee increase, a two-thirds majority of each house must approve it.

Another important bill would require the Central Arizona Replenishment District to establish a replenishment reserve. Membership in the CAGRDR enables those requesting a certificate or designation of assured water supply from ADWR to establish sufficient utilization of renewable water supplies. The CAGRDR operates in the Phoenix, Pinal and Tucson AMAs. Because the CAGRDR does not have long-term, secure water supplies, storing water in years when excess CAP water is available for meeting future replenishment obligations is prudent. Water available to the CAGRDR is expected to become more expensive over time. In fact, it could be argued that, absent long-term contracts for CAP water, the CAGRDR will incur water costs significantly above that paid by CAP subcontractors. Draw down of the replenishment reserve will help avoid rate shock for CAGRDR members. The bill also extends the CAGRDR's planning horizon from 20 to 100 years. Every 10 years, the CAGRDR must prepare a plan, subject to approval by the ADWR director. Approval of the plan is very important; it enables CAGRDR

members to show their continued compliance with the assured water supply rules.

It will be interesting to see how this planning requirement is implemented. It is one thing for the CAGRDR to estimate its replenishment obligation for 100 years; it is quite another for the CAGRDR to indicate how it expects to meet that replenishment obligation over that time. In addition, the bill allows a member service area (water provider) to de-enroll from the CAGRDR if it can establish it is able to meet the assured water supply requirements on its own.

HB 2478 mandates that ADWR provide a water resources status report every two years. This report is to present important information including: (a) the current status of the state's water supply and any likely changes in it; (b) issues of regional and local drought effects, short-term and long-term drought management efforts and the adequacy of drought preparation throughout the state; (c) the status of current water conservation programs; (d) the current state of each AMA and their levels of progress toward management goals; (e) issues affecting management of the Colorado River and the reliability of Arizona's 2.8 million acre-foot allocation of river water, including the status of issues related to the Colorado River basin states and Mexico; (f) the status of any pending or likely litigation regarding surface water adjudications or other water related litigation and the potential impacts on water supplies; (g) the status of Indian water rights settlements; and (h) other matters related to the reliability of water supplies, and the adequacy of the department's and other entities' resources to meet the state's water management needs. The bill has been amended to include session law language authorizing emergency transfer of groundwater between basins during drought, under a limited set of circumstances.

A testament to compromise is HB 2480, the only bill of those listed that is ready to be transmitted to Governor Napolitano for signature. The bill allows the formation of multijurisdictional water facilities districts. Many conditions must be satisfied prior to forming a district, especially in cases involving a private water company. While issuance of revenue bonds is authorized for a district formed pursuant to this bill, issuance of general obligation bonds is not. The latter source of financing was quite controversial during the Governor's Water Management Commission deliberations. This authority has been considered important by water providers who need to join together to finance water infrastructure projects.

The bills discussed are consistent with recommendations that were included in the Final Report of the GWMC. Their implementation was considered important for furthering good water management in the AMAs. In addition, there are several bills addressing water quality matters, and a bill authorizing Yuma basin groundwater transfer (SB 1248) may make its way through the process.

All in all, at this point in time, it's not been such a bad year for water legislation! 🏗️



Public Policy Review

by Sharon Megdal

Steps to Take to Resolve Water Resource Challenges at Regional Level



The Water Resources Research Center's May conference was deemed a success by those in attendance. The focus was on developing and implementing solutions to water resource challenges at the regional level, rather than at a centralized (state) or local level.

As reported elsewhere in this newsletter (See Vapors, page 3), several speakers offered their insight and guidance. Many important

but simple messages were conveyed at the conference. Attendees were warned not to suffer from "paralysis of analysis"; some actions can be taken while awaiting the data necessary for other decisions. We were told to get that elephant of litigation, which requires significant monetary resources and casts a cloud over decision making, out of the refrigerator. We were reminded to make sure all the issues are on the table. Several speakers acknowledged the problems associated with excluding individuals or groups because you don't want to hear what they might have to say. That there is no single "silver bullet" answer to most complex challenges was highlighted.

While there is no simple or common solution to the multitude of problems and challenges, John Sullivan of Salt River Project provided a useful model for approaching resolution of local and regional water issues. He pointed to four state water success stories: the Groundwater Management Act; resolution of water claims with Indian Tribes; the Central Arizona Project; and the Arizona Water Banking Authority. He noted that each of them required the following three steps: resolving claims to water; legislation at the state and/or federal level; and a method of financing.

Sullivan noted that those addressing water challenges in rural Arizona should look to a similar model. He emphasized that there is a role for the state legislature to play. His message was for the local stakeholders to get behind the legislative establishment of the framework necessary to enable implementation of regionally generated solutions.

Conference speakers provided information about many regions of the state. Certain areas of the state are ripe for action. The

activities of Fort Huachuca and concerns about San Pedro River flows have been central to the endeavors of the Upper San Pedro Partnership. Strong federal interest has assisted in identifying financial resources necessary for studies, and there is active participation of diverse interests in identifying water resource problems and potential solutions.

The Verde watershed is also a hotbed of activity. The beauty of the region coupled with rapid growth rightly has people concerned about balancing the needs of nature with the needs of people. Here, too, there is active participation of diverse interests, and progress is being made in acquiring and disseminating information. Yet, there is significant concern about the activity of new and existing exempt wells in the Active Management Area portion of the watershed and the unregulated drilling in the non-AMA portions of the watershed. There the situation is even more complicated due to the importance of surface water and rights to that surface water.

In the Flagstaff area, conservation is working to reduce water demand in absolute terms. The Gila watershed has learned that collaboration is the key to address water quality as well as quality of life concerns. Limited economic resources are a problem, however.

While many are averse to extending the regulatory reach of the Arizona Department of Water Resources, few argue about the benefits associated with predictable and sensible groundwater regulation. That growth in the AMAs must depend largely on renewable water resources and 100 years of demonstrated physical water supply, for example, is generally acknowledged as being good for the regional economies. Elsewhere, on the other hand, absence of assured water supply requirements may mean less confidence about the sustainability associated with growth.

The local and regional efforts discussed at the conference largely focused on the long-term. People are working in good faith. ADWR is actively facilitating the process of developing solutions, without determining the outcomes. Participants should keep in mind John Sullivan's simple model as they endeavor to develop and implement workable and timely solutions to their water resource challenges. ■■■

Project Wet...continued from page 9

ronmental Quality — cities and towns have to write storm-water plans, and these plans must include an education program. This could provide WET another outreach opportunity. WET has an Arizona non-point source pollution curriculum, developed with an ADEQ grant. WET's use of the curriculum, however, has been handicapped by a lack of water quality funding.

In another development, water education is an important theme in ADWR's Drought Task Force. Its charge includes developing a statewide water conservation education strategy and provides for creation of a conservation education workgroup to

address water conservation.

Schwartz says, "What we are doing is trying to look at what is needed in rural Arizona. Its water education needs are obviously different than the cities. We think that Project WET can meet a lot of the needs in the rural areas."

For more information about Arizona Project WET contact Kerry Schwartz (520-792-9591, X22 or kschwartz@ag.arizona.edu) or check the web site: <http://ag.arizona.edu/AZWATER/wet/>. The National Project WET web site (<http://www.projectwet.org/>) displays WET activity guides and resources. (The July-Aug AWR will feature Arizona Project WET guides and resources.)



Public Policy Review

by Sharon Megdal

We Need to Regulate Well Drilling Throughout the State — but How?



Consider this story. It is March 2000. In an area dependent on groundwater for water supplies, a landowner intends to utilize groundwater to irrigate a golf course, fill five lakes and meet other development water needs. Disputes arise regarding the impacts this groundwater pumping will have on other wells in the area. Officials request to see the hydrologic data supporting the landowner's conclusions that pumping plans will not endanger the wells of surrounding landowners. The requests are denied because ordinances regarding water use do not apply to this particular landowner.

Fast forward to spring 2001. As the landowner's large wells were being completed and utilized, the drying of nearby wells begins. Over the next year, the developer continues to assert there is enough groundwater for at least 50 years and that the new wells rely on a totally separate, abundant aquifer.

One year later, the community discovers that the landowner, who had drilled large wells and assured nearby well owners that the drilling has had no impact on their wells, is trucking in water. The landowner's own wells have run into production difficulties. Due to the critical groundwater situation, the landowner seeks an emergency declaration and exemption from environmental review of plans to obtain additional water sources. Securing bypass of environmental reviews fails. The debate over these plans continues.

I read about this situation recently while visiting San Diego. The events and details are particular to the activities of a specific Indian Nation, with California state laws and San Diego County ordinances part of the issue — and I expect subject to dispute. The story, however, has direct relevance to Arizona.

Outside Active Management Areas, wells other than recovery wells do not require Arizona Department of Water Resources permitting. Only a notice of intent to drill is required. ADWR's (temporary) Well Spacing and Well Impact Rules, which require a demonstration that new wells do not cause "unreasonably increasing damage to surrounding land or other water users from the concentration of wells," do not apply. Outside AMAs, there also is no requirement that new developments show they have an assured water supply for 100 years.

At the top of the list of prioritized major rural water management issues, the Arizona Watershed Alliance listed "lack of local or multi-jurisdictional authority, with enforcement capability, to regulate development activities based on available and sustainable water supplies." The link between water and growth (development) is clear. It's what to do about the link from a regulatory perspective that is elusive. Should there be greater oversight of well drilling in non-AMA areas? In other words, should some type of well spacing and well impact rules apply? Should assured water supply requirements be established for these areas as well?

It is recognized that the prospect of additional regulation of

well drilling is not welcome in many parts of Arizona. Requirements to show absence of adverse effects of well drilling are viewed by some as an infringement of property rights. Yet absence of state law or local ordinances cannot trump the laws of nature. Groundwater supplies must be considered as areas grow. The right to use land is not equivalent to the right to pump other landowners' wells dry. How can situations like that described above be avoided?

Counties with populations greater than 125,000 must include planning for water resources in their comprehensive plans. The statutes require that the plans address the following: "(a) The known legally and physically available surface water, groundwater and effluent supplies; (b) The demand for water that will result from future growth projected in the county plan, added to existing uses; and (c) An analysis of how the demand for water that will result from future growth ... will be served by the water supplies identified ... or a plan to obtain additional necessary water supplies." Yet, the statute also states that the water resources element of the plan does not require new independent hydrologic studies.

If the aversion is really to state-level regulation of water in areas not already under ADWR jurisdiction, perhaps serious consideration should be given to county or regional level regulation. (I write this knowing this concept will elicit howls from some.) And this consideration ought to occur soon. But if the aversion is to regulation no matter what the regulation and who is responsible for it, then we need to do a reality check.

*Absence of state law or local ordinances cannot
trump the laws of nature.*

Sustainable economies require sustainable water supplies. With the Drought Management Task Force addressing the effects of both short-term and possible long-term drought, we must support development and implementation of long-term water supply plans throughout Arizona. In doing so, we should not ignore the possibility that these long-term water supply plans will have some regulatory elements to them. Having growth depend on sustainable water supplies is in the interest of all property owners, from the individual home owner to the owner of large tracts of developable land.

Public policy development involves a lot of give and take, particularly when much is at stake. The manner in which Arizona grows is important. It is in the public interest that water issues be resolved. We are close to settling Indian water rights claims that affect both large metropolitan areas in the state. Approval of the settlements has widespread support. It is important that, as the watershed groups and others consider their options and opportunities to deal with water resource issues, the laws of nature not be ignored.

Everyone wants to avoid dry wells. 🏠



Public Policy Review

by Sharon Megdal

Court Tells ADWR to Set Water-Use Standards for End Users

Time may be at hand to explore options to gallons per capita per day



For some time, the Arizona Water Company, the second largest private water company and eighth largest water provider in the state, has been at odds with the Arizona Department of Water Resources regarding the municipal conservation program.

Its discontent sparked the utility's 1990 suit when ADWR adopted its Second Management Plan. The utility challenged the

plans's water conservation strategy, claiming it was improper to impose gallons per capita per day (GPCD) requirements on municipal providers without directly regulating customers or end users by imposing limits on their water use. The utility also objected to ADWR including Central Arizona Project water within GPCD calculations.

Last year a Superior Court ruling stated that the provision of the management plan by which ADWR imposes maximum GPCD requirements "is vacated and set aside because it fails to address water utilization by end users." ADWR appealed.

In August, the Arizona Court of Appeals issued its ruling in *Arizona Water Company v. Arizona Department of Water Resources*. Although there were other issues involved in the appeal, the Appeals Court considered ADWR's GPCD policy as the central issue.

The three-person Appeals Court panel issued a split decision. While acknowledging the law includes no clear language definitively ordering ADWR to impose end-user conservation measures, the majority found that "it is difficult to read the provisions ... and not develop a firm conviction that the legislature intended just that."

Also at issue was whether the Groundwater Management Act allows ADWR to include CAP water in determining a utility's compliance with the conservation requirements. The Appeals Court rejected Arizona Water Company's position, concluding that ADWR may include use of CAP water when determining GPCD.

Before discussing this opinion, I note that I am not a lawyer. Therefore, the following analysis and viewpoints are not constrained by extensive knowledge of case law.

Regarding the appropriateness of including CAP water in GPCD calculations, all three appellate judges agreed. A ruling otherwise on the issue of CAP water would have been at odds with the entire premise of groundwater management in at least the Tucson and Phoenix Active Management Areas, namely that CAP water is supposed to serve as a substitute for groundwater use and a source of water for a growing number of customers. Excluding CAP water for municipal purposes from calculations determining GPCD compliance would have signaled that it is permissible to use as much CAP water as desired, without consideration of reasonableness of that use or waste. This is at odds with state water use goals.

Regarding the GPCD conservation program, the Court found that the Legislature expected ADWR to develop "a comprehen-

sive management and regulation framework for all phases of the groundwater cycle." The Court directed ADWR to "return to the management plan drawing board and devise appropriate conservation measures ... that include end users." It is interesting the Court did not appear to conclude that including company- or utility-level GPCD requirements in the management plan was inappropriate. Rather, another layer of conservation requirements was ordered.

In my opinion, the minority opinion relating to the GPCD program is the one that makes the most sense. The dissenting judge agrees with ADWR's interpretation of the statutes: "The Department has interpreted the statutes as giving it the authority to regulate end users, but not mandating such regulation. Given the lack of specific statutory language to the contrary, its interpretation is reasonable." The dissent goes on to note that whether it makes sense for ADWR to regulate the end users was not addressed in the record before the Court and "is completely beyond our expertise."

Dissenting Judge Patrick Irvine's states things so well that I am left with little choice but to quote him directly: "[It] is not clear to me that direct regulation of all end users is sensible water policy. ... The Groundwater Code recognizes that water providers are not in identical situations. ... Uniform end user restrictions throughout an active management area, or even a local service area, may not be the most effective conservation method. ... the resources devoted to creating and enforcing individual conservation requirements may be more effectively utilized in other ways. ... this is the type of decision the legislature has left to the Department, not to us."

I am not a big fan of the GPCD program. It has been fraught with difficulties. I support additional flexibility regarding participation in the non-per-capita-per-day program or alternative conservation programs. Many departmental resources have historically gone into development and enforcement of the program. Over 20 years after the passage of the Groundwater Management Act and in the face of declining budgets and increasing expectations regarding departmental activities outside of the AMAs, a modified approach to conservation may be appropriate.

The Governor's Water Management Commission had a hard time getting to a substantive recommendation regarding conservation. Its Final Report and Recommendations stated that many issues were raised regarding the existing conservation programs, and improvements to current programs were discussed. Yet the only recommendation that came forward was for initiation of "a process to develop a non-profit cooperative association to serve Arizona's need for effective water conservation throughout the State."

Even if ADWR's position is finally affirmed, there is justification for a renewed look at the municipal conservation program, particularly the GPCD program. One way or another, some rewrite of the statutes may be necessary. The parties should agree to work together to see that this be accomplished expeditiously. ■



Public Policy Review

by Sharon Megdal

What Can WRRC Do to Serve Your Water Information Needs?



It has been almost two years since I joined the University of Arizona's Water Resources Research Center and began writing this column addressing water issues of importance to Arizona. This time I am using this column for a different purpose. I will describe some WRRC programs and activities as a way to encourage you to consider what value WRRC has to you now and what we could do to

serve you even better.

In operation since 1957, the center has congressional standing as one of the National Water Research Institutes. We administer the federal 104b grant program in Arizona, using U.S. Geological Survey funds. This is a core activity for interacting with researchers from the other two Arizona state universities. WRRC has had a long-term commitment to statewide outreach and education on state water issues. More recently, we renewed our emphasis on providing expertise on state and regional water management and policy.

The WRRC has been working closely with three other UA campus water centers to develop and implement the Water Sustainability Program, funded by the Arizona Board of Regents using voter-approved education sales revenues. This effort, which is part of the UA Technology Research and Initiative Fund (TRIF) program, has enabled the WRRC to expand its water resources research, education and outreach activities.

People generally know WRRC from its programs and activities. We publish this newsletter, the bi-monthly *Arizona Water Resource*. Editor Joe Gelt writes much of the content. Since joining the WRRC, I have been writing this column. The free publication reaches about 2,400 individuals and is posted on our web site, www.cals.arizona.edu/azwater. In addition, we publish papers as part of an *Arroyo* series and occasional issues papers. We have produced two versions of the Arizona Water Map poster and are in the process of finalizing Version 2 of our popular landscape CD.

If you have not recently done so, I invite you to visit our website. We have added a "Papers and Presentations" tab for recently posted papers including "How Water Management in Tucson, Arizona Has Affected the Desert's Landscape," a paper I wrote based on a presentation I made last spring in Santiago, Chile, and "Managing to Avoid Crisis: A Look at Water Management Efforts in Rural Arizona," a paper Jackie Moxley and I wrote based on our May 2003 conference. The site is also home to selected Power Point presentations given by WRRC personnel. Also it includes information on our upcoming conference and 104b and TRIF grant programs. We also provide web links to many other water resource sites.

Another WRRC component, Project WET (Water Education for Teachers) is an extremely successful program that trains teachers to integrate water resources into the K-12 curriculum. Kerry Schwartz directs the program director, with the able assistance of Dana Flowers who offices with Maricopa County Cooperative Ex-

tenion. The WRRC Project WET organizes the very popular annual Water Festival Program.

Housed at the WRRC, the Water Conservation Alliance of Southern Arizona (Water CASA), directed by Val Little, has its own board of directors representing its membership. It has an extensive involvement in municipal water conservation and greywater use and is expanding its research efforts.

The WRRC's annual statewide water conference is an important center activity. The 2003 conference on regional approaches to water management attracted about 200 people from 40 Arizona communities. Planning is well underway for the April 28, 2004 conference on the future of agricultural water use in Arizona. (See Announcements, page 10, for conference info.) We are already looking forward to the 2005 conference on water and the environment.

In addition, the WRRC provides both on-campus and off-campus speakers the opportunity to make presentations through our "brown-bag" lunch-time seminars, and we often schedule presentations on water issues of interest for international and other visitors.

The WRRC is increasing its water policy work, with the objective of being viewed as a think tank for state and regional water policy. With papers, presentations, lectures and research, WRRC personnel have increased their water policy work. WRRC faculty and staff will work cooperatively with others on campus and with off-campus entities and agencies, including other state universities.

Research underway includes work by Terry Sprouse on border water issues and Kathy Jacobs' work on the connection between climate and water management, particularly in the context of drought planning and the use of scientific information in decision making. Jackie Moxley and I are examining questions related to public versus private ownership of water companies in Arizona as well as looking at changes in agricultural activity over time.

WRRC leadership will soon be changing. College of Agriculture and Life Sciences Dean Eugene Sander recently announced that I will be the director when Peter Wierenga retires as director on June 30, 2004. As we look to the future, we are gathering feedback and input from interested groups and individuals regarding our activities. We held four small-group stakeholder meetings in December, two in Phoenix and two in Tucson, with both internal to the university and external stakeholders included.

I also want to invite your comments and suggestions. In particular, I ask you to consider the following questions: What WRRC activities are of value to you or assist you in your efforts? What other efforts would you like to see us undertake? Are there ways we can be more effective as an independent voice on water resources management and policy, both statewide and regionally (intrastate and interstate)? How can we work together more effectively?

Please email responses by Feb. 6 to smegdal@ag.arizona.edu or mail them to me at the WRRC, University of Arizona, 350 N. Campbell Ave., Tucson, AZ 85719. I look forward to receiving them. 🏠



Public Policy Review

by Sharon Megdal

AZ Public-Private Water Utility Ownership, A Changing Landscape



Privatization of water services is a complex issue. Ownership of many water systems in the state has long been in private hands, especially in unincorporated areas. On the other hand, public ownership of water systems is occurring more often in cities and towns. Historically, as areas have incorporated, municipal water utilities have often assumed the ownership of private systems.

Is there a trend toward municipal ownership of water systems in Arizona? If so, what are the reasons for it? Starting with the hypothesis that the trend in Arizona is toward governmental ownership – or municipalization – of water provision, my colleague Jackie Moxley and I have begun investigating these questions. We started by asking: How many water providers in Arizona have switched from public to private versus private to public in the past 20 or so years? Answering this question is not as straightforward as we hoped it would be.¹

The reason it is difficult to track ownership is that the Arizona Department of Environmental Quality (ADEQ), the Arizona Department of Water Resources (ADWR), and the Arizona Corporation Commission (ACC) all collect and report data for different water provider activities. ADEQ drinking water system data are based on individual system identification numbers and system names, and are often listed for sub-systems of a single system. The ACC, which regulates privately owned water companies statewide, lists private companies in its annual reports on a consolidated basis. ADWR regulates groundwater used by water companies only in Active Management Areas. In addition, the information they report in their management plans, which are issued every ten years, has changed over time. In short, tracking change in ownership is not an easy task.

Because of these difficulties, our results to date are limited but interesting. Arizona mirrors the nation in that roughly 85 percent of its population is served by publicly owned water systems. Approximately 270 active water providers are regulated by the ACC. Many water systems are small. Based on recent information, 18 of the 20 largest water providers in the state are public water companies. The Phoenix Water Services Department, serving about 1.2 million people, is the largest water provider in the state. When aggregated across their individual systems, privately owned Arizona-American

Water Company and Arizona Water Company are the seventh and eighth largest privately owned water companies in the state. Like Arizona Water Company, Arizona-American's customers are spread over several divisions.

Because of difficulties in tracking ownership data statewide, we have first focused on tracking information for the Tucson region over a period of time. Upon examination of ADEQ and ADWR data, we concluded that between 1985 and 2001, there were some trends. First, we saw a general trend toward consolidation of smaller systems into larger systems. There was an 11 percent decrease in the number of providers serving the Tucson area, even though the Active Management Area population increased 34 percent. In this period, six large providers (serving more than 250 acre feet of water annually) were acquired by public water providers. Interestingly, among the small providers, all but one of the eight new service areas are served by private companies. This suggests that private water companies have a significant role in developing areas where an established water provider, be it public or private, is not nearby.

Interviews provided some reasons for the change from private to public ownership. A key reason was the need for additional financial resources to upgrade infrastructure and to comply with changing environmental regulations. According to a 1999 United States Environmental Protection Agency report, the estimated 20-year investments requirements in Arizona for water system transmission and distribution, treatment, storage and other needs is \$1.6 billion. Low profitability of the private operations was also cited as a factor. A Tucson area trend is the formation of Domestic Water Improvement Districts (DWIDs). These can be formed to serve unincorporated areas. In the past 10 years, four new DWIDs have been formed in the Tucson AMA.

We are continuing our research to examine what has occurred in other parts of the state and analyze the implications of public versus private water system ownership. Holding on to subcontracts for Central Arizona Project water had historically posed a problem for private water companies, who could not recover any of the holding costs until the CAP water was considered used and useful. The ACC has recently decided cases that allow for use of CAP water and recovery of the holding costs. Private water company involvement in storage of CAP has increased – for multiple reasons. There is renewed private water company interest in joining the Groundwater Replenishment District and obtaining an assured water designation. We would like to look at water quality compliance and compare performance for public and private water companies.

I expect results will show the trend toward municipalization will continue in and near incorporated cities and towns. I expect we will see consolidation of smaller systems in all areas of the state. Finally, I expect that, regardless of the type of ownership, we will see more sophisticated decision making, as water providers are dealing with the complexities associated with serving growing regions in an ever more demanding regulatory and climatic environment. ■

¹ An interesting note: Often the term "public company" is used to describe a water company that is not in private hands. It can refer to a water company owned by a city or town or a water district governed by an elected board. Recently, I realized use of the term public company could be misconstrued to mean a publicly traded company, such as the large private companies operating water systems in Arizona and elsewhere in the United States. In this column, public means not-privately owned.



Public Policy Review

by Sharon Megdal

Obtaining, Interpreting Water Use Data is Complex Task



In developing the program for the April 28 Water Resources Research Center's conference, "The Future of Agricultural Water Use in Arizona," it seemed unwise to spend precious conference time providing statistical information on historical use of water by agriculture. But gaining perspective on what the future might hold in store usually requires some understanding of the past and present.

Plus, a look at water use trends over time and across regions within the state can be interesting and informative. So, I asked a few water professionals on and off campus to assist in preparing some written materials on agricultural water use to distribute at the conference.

This exercise highlighted a particular challenge, namely determining what we mean by water use. Often people report simple pie chart numbers on the percentage of water used by agriculture in Arizona. But, what do these numbers on water use by the different water using sectors in the state, most notably agricultural, municipal and industrial, tell us? In mid-March, an article appeared in the *Arizona Republic* on water use numbers for the state, as reported by the United States Geologic Survey. These numbers indicated that Arizonans withdraw more than 6.7 billion gallons — or almost 20,500 acre feet — of surface water and groundwater daily. The article reported that about 80 percent of the water is withdrawn for agricultural purposes, with 16 percent going toward municipal uses.

Note that a few different words were employed in the above paragraph. Although I first expressed the question in terms of water "used," I then wrote of "water withdrawal numbers." Water use is not the same as water withdrawn. Think of your own homes. Much of the water used to wash clothes drains through and is piped into the wastewater treatment plant (or for a very few of you a graywater system). The effluent or treated wastewater may then be used, perhaps even by another water-using sector. Some of the water used to irrigate your trees seeps into the ground and recharges the aquifer incidentally. Not all the water delivered to your home is therefore used by you. Similarly, not all water withdrawn by agriculture is used by agriculture.

I consider myself pretty good with numbers. But, when it comes to water, nothing is simple. At one point during the process of trying to understand just what the numbers were reporting, I asked for help. A series of emails from some very knowledgeable people followed regarding water "use" versus "demand" versus "consumptive use" versus "withdrawals." Incidental recharge and return flows were also discussed. We later met to discuss the difficulties of developing the pie chart referenced above.

Developing what might seem like a simple pie chart is not so simple at all. In many parts of the state or for some users, water use is not metered and/or reported. Reporting of groundwater withdrawals is required only in the Active Management Areas. Data indicate that groundwater is the source water for over 40 percent of

the water used in Arizona. How accurate is that number? We don't really know. Consequently, we don't really have accurate statewide data for water withdrawn by any of the water using sectors.

Despite the difficulties in obtaining and understanding water use data, we do have good data on water used in the AMAs, including the heavily populated Phoenix and Tucson areas. And data on the Colorado River and other surface water withdrawals are generally good. The number of harvested acres, which may be a good proxy for agricultural water use, is clearly declining in parts of the state. George Frisvold, my colleague from the University of Arizona's Department of Agricultural and Resource Economics, has worked with me on sorting through the definitional issues discussed above and the data across counties. Data from the *Arizona Agricultural Statistics Bulletin* on harvested acres show that non-Indian agricultural activity has generally declined over the past 20 years in the Central Arizona AMAs but has increased in the Yuma area. Ken Seasholes of the Arizona Department of Water Resources has prepared a short write-up on the difficulty in estimating water usage and, with the assistance of Saied Tadayon

of the USGS, has produced a map showing the distribution of agricultural activity over the state. A short paper written for the conference by John Hetrick and Dave Roberts of Salt River Project shows that water used by non-Indian agriculture in the Phoenix AMA has declined by approximately 11,500 acre feet per year since 1984, which amounts to 1 percent to 1.5 percent per year, although some individual irrigation districts show increases in water use over the same period. In fact, it is interesting that if you look at 1984-2002 water use by non-Indian agriculture aggregated by the ADWR across the state's AMAs and Irrigation Non-expansion Areas, which do not include Yuma, there is no discernable trend (down or up) in agricultural water use. However, like in the Phoenix AMA, the geographic distribution, as well as cropping, has changed.

Lack of accuracy does not eliminate our ability to document important trends. Although agricultural activity is declining in some areas of the state, it remains robust and is growing in other areas. Municipal and industrial demand for water will continue to grow. We are in a drought and water conservation, while always important, is more important than ever. Exercises like the one we've gone through will enhance our understanding of our state's demand for water resources and assist us as we plan for the future. ■

Water use pie chart ingredients are data and pie. The data, however, is often too complex to neatly fit as segmented pieces of a pie.





Public Policy Review

by Sharon Megdal

Should Yuma Desalter Operate? Varied, Complex Issues Are Raised



In May, I visited the Yuma Desalting Plant, which has recently been the focus of much attention. Whether or not the plant is operated has implications for water deliveries to Mexico under U.S. treaty obligations and is important to Central Arizona. It is also important to those concerned about the Cienega de Santa Clara environmental habitat. My visit was very informative.

The U.S. Bureau of Reclamation built the plant to address the high salinity of tail water from the Welton-Mohawk Irrigation District. About 100,000 acre feet of irrigation water applied to district land but unused by crops was flowing back to the Colorado River. Its very high salt content raised concerns about the water. To meet the requirements of Minute 242 of the 1944 treaty with Mexico, the treatment plant was built to remove the salt from the Welton-Mohawk tail water. To keep the salty water from flowing into the Colorado River while the plant was under design and construction, Reclamation built a 53-mile bypass canal. This canal diverted the water to the Santa Clara Slough in Mexico.

The bypass canal was built as an interim measure prior to the plant becoming operational. Completed in 1992, the plant operated only for a short period in 1993. It was shut down due to operational issues. Also, excess Colorado River flows met water obligations to Mexico without operating the plant.

Over the years the Santa Clara Slough, now known as the Cienega de Santa Clara, has benefitted from this "bypass" water. In recognition of the important habitat of the Cienega and surrounding area, the Mexican government declared the region a Mexican National Biosphere. There is significant interest in keeping the Welton-Mohawk tail water flowing to the Cienega. But, at the same time, the water was intended to be used to meet the U.S. obligation to deliver 1.5 million acre feet of water to Mexico annually. During wet years, meeting this obligation has not been of concern. In times of drought, however, every drop of water counts, and the water deliveries to the Cienega do not count toward meeting the U.S. obligation. Many Arizona water interests are concerned that the federal obligation to deliver 1.5 million acre feet of water annually to Mexico be satisfied without causing disproportionately adverse effects to Arizona.

What started out as a water quality issue has essentially become a water quantity matter. With drought conditions persisting, storage along the Colorado River is at very low levels. If Welton-Mohawk water is not treated for delivery to Mexico, that water has to come from elsewhere. Recently, the water has come from storage at Lake Mead. If river supplies, including amounts in storage, are short, Central Arizona Project deliveries are the first to be cut, as the CAP holds the most junior rights to the river. The worst case scenario: The entire 1.5 million-acre-feet CAP entitlement would be cut before others with Colorado River allocations experience cutbacks.

This is why the Central Arizona Water Conservation District, the operators of the CAP, have been advocating operation of the Yuma Desalting Plant.

Water issues are complex. And the question of whether or not to run the Yuma Desalting Plant is no exception. There are multiple implications to consider, including environmental and economic. The U.S. Bureau of Reclamation, with responsibility for operating the Yuma Desalting Plant and managing the Colorado River generally, is considering its options. Governor Napolitano, who recently visited the plant, and others in Arizona are likewise evaluating alternatives. Scrutiny of the complicated modeling of the Colorado River scenarios continues. Significant uncertainties are involved. We know there will be shortages. Their frequency and severity over the next 100 years will determine the impacts on the region served by CAP and the Colorado River watershed more generally. If CAP experiences a cutback, users of non-Indian agricultural water will be the first to be cut back within the Arizona system.

These users of CAP water have rights to use groundwater, but their ability to do so depends on the condition of their well delivery systems, and there could be significant cost implications associated with the re-substitution of groundwater for surface water. The Arizona Water Banking Authority has been storing water on behalf of CAP municipal water users for several years. So, the impact of any future municipal supply cutbacks will depend on their cumulative size relative to the amount of water stored by the bank. If agriculture returned to groundwater and municipal water users began drawing upon stored water, water tables throughout Central Arizona would obviously be affected.

What are the costs and benefits of running the Yuma Desalting Plant to treat the tail water from the Welton-Mohawk Irrigation District? A lot of effort is going into identifying alternatives, including land fallowing in Arizona. Everything depends upon projections and assumptions. The answer to the question is difficult to provide but must be pursued.

Visiting the plant and the adjacent national water treatment research center helped me realize that the Yuma Desalting Plant is an asset, not the "white elephant" it has been called. It can be operated, if not to treat the irrigation tail water, then to treat water for other purposes, such as delivery of Colorado River water to municipalities in Arizona and/or in Mexico.

Yes, issues related to operating the plant are complex. Their resolution will likely require not only careful analysis but compromise and flexibility.

Note: Good background papers on the Yuma Desalting Plant are "The Yuma Desalination Plant: Arizona Perspectives," by Tom Carr, Arizona Department of Water Resources (August 2002) and "Dealing with the Colorado River's Salinity: What is the Future of the Yuma Desalting Plant?" by Sue McClurg, Water Education Foundation (Winter 2003-2004). ■■



Public Policy Review

by Sharon Megdal

WRRC Strives to be Productive Member of the AZ Water Community



This is my first column as director of the University of Arizona's Water Resources Research Center, and I begin my position during exciting times in the water world. We are facing challenges related to providing water to our increased and growing population and to supporting our varied local and regional economies at a time of severe drought.

There is much work to be done and, indeed, the level of effort is high throughout the state.

A recent Battelle Report recognized that Arizona's challenges are similar to those faced by people the world over and recommended making Arizona the "Water Management Capital" of the world. One of the recommended strategies is creating a water sustainability consortium involving all three Arizona state universities. The report also recommended involving all stakeholders in development of a "water policy framework" to be a model for arid lands sustainability throughout the world. It is expected that the private sector and various levels of government will be involved.

The AWR newsletter has previously included information about the UA Technology and Research Initiative Fund, known as the Water Sustainability Program. WSF funded research, education and outreach activities relevant to resolving Arizona-specific water quantity and quality issues. WRRC expects to continue its participation in these and other efforts. Through our programs, we will continue to inform and educate, to facilitate the connections between university and non-university participants, and to provide independent analyses of water policy and management. As director, I intend not only to continue but to expand our activities.

Based on internal assessment and stakeholder input, I have established some WRRC priorities. I will briefly describe them and indicate opportunities for you to participate in our efforts to promote sound water management and policy in Arizona and the region.

WRRC will serve as an effective focal point for the exchange of water resources information and analysis, both on and off campus. I am pleased to have received very positive feedback regarding this newsletter. In addition to the distribution of it via mail, which we intend to continue, we post the newsletter on our web site. We hope to include, as often as possible, special inserts like the U.S. Geological Survey supplement within this issue. The inserts enable us to provide more in-depth coverage on a topical area and to provide a service to those offering financial support for the newsletter.

We will continue sponsoring our annual statewide water conference. The 2005 conference, to be held April 6, 2005 in Tucson, will be on the important topic, "Water and the Environment." On an as needed basis, we will continue to offer "brown bag" seminars on water-related topics, with speakers and attendees both internal and external to the university. We publicize these seminars via email. If you want to be on our email list for the brown bag seminars or if you have suggestions for a program, please contact us at

wrrc@ag.arizona.edu. We intend to continue our high-level presence in conferences, programs and other forums. Recent papers and presentations also can be found on the WRRC web site.

WRRC will continue to collaborate with others on and off campus to address Arizona water resource issues. Interdisciplinary efforts, so important to addressing complex water quantity and quality questions, have flourished under the Water Sustainability Program's competitive grants program, instituted in 2003.

The WSP Education and Outreach component supports a number of activities on campus and throughout the state. Included among its varied activities was a briefing for Legislators. The Safford County Cooperative Extension Water Wagon, funded by a WSP grant, is an attractive, mobile educational trailer. Planning is just getting underway for a Water Day at the Capitol Mall, which is tentatively scheduled for January 25, 2005. It is hoped that many entities, public and private, and all three universities, will participate in this effort. If interested in participating, please contact Dana Flowers (602-470-8086, ext 335 or dflowers@ag.arizona.edu). As discussed above, our annual conference also involves significant opportunities for collaboration through sponsorship and participation.

WRRC will continue to increase its policy analysis activities. During the past few years, Kathy Jacobs and I have joined WRRC. We've brought to campus our knowledge of policies and policy making, gained from lengthy, and in my case, somewhat varied work experiences. To increase our capacity in this area, I have created a new position to focus on applied research. This person will investigate and write about real-world policy and water management matters in a manner understandable to the interested public as well as the water professional. We intend to work with water stakeholders on identifying topics for analysis.

WRRC will continue to increase its involvement with federal and state agencies, Arizona State University and Northern Arizona University and private entities, to identify mutually beneficial, collaborative projects. In addition to administering the 104b grant program in partnership with USGS, WRRC personnel are involved in several projects, including studies for the Army Corps of Engineers and the Bureau of Reclamation to enhance the environment in Arizona as well as a multi-disciplinary project involving Reclamation related to modeling Colorado River flows.

WRRC will continue its strong Water Education for Teachers program. Project WET Director Kerry Schwartz has overseen rapid growth of this program, which means more K-12 teachers are integrating water resource education into Arizona classrooms. Project WET includes the very popular Arizona Make a Splash, Project Wet Water Festival. We are developing a business plan to increase the reach of this special one-day educational program for students.

Space constraints prevent me from providing more details. As I said at the outset, these are exciting times to be working in water resources. The WRRC staff and I look forward to continuing to work with you. 🏡



Public Policy Review

by Sharon Megdal

State Drought Plan on Right Road Despite Some Concerns



After about 18 months of work, the Governor's Drought Task Force sent its recommended Arizona Drought Preparedness Plan to Governor Napolitano. A key part of the Plan is the document, Operational Drought Plan. Also part of the Drought Preparedness Plan is a lengthy document, Background and Impact Assessment Section. A companion report is the Arizona Statewide Water Conservation Strategy. The reports can be found at <http://water.az.gov/gdtf/>

A key question during the latter stages of the Task Force process was to what extent water conservation should be required as a drought response. The plan initially released for public comment included a Conservation Strategy Document and a requirement that locally developed Drought Contingency Plans include a water conservation component. The separate Conservation Strategy focused on developing a water conservation ethic over the long-term, beyond the immediate drought context. But there was no real guidance on what that conservation component of the drought plans should look like. The media and others questioned Arizona's consideration of a drought plan lacking mandatory conservation requirements as drought conditions worsen. The adopted plan included much more in the way of conservation requirements and guidance.

Included in the final document is a five-page table that ties the declared drought stage, which ranges from Normal to Extreme, with actions state government, communities and utilities, and individuals would take. Required and recommended conservation practices become more strict with the severity of the drought. Developed late in the process, the table was not subject to much public comment. It represents a good start, but refinement is needed. For example, under Extreme drought conditions, communities and utilities must prohibit "all public water uses not required for health or safety and publicize enforcement activities to customer[s]." Winter overseeding is to be prohibited, except for golf course greens. Individuals are to "use covers to reduce evaporation from pools."

As I read it, in Extreme drought conditions, water is not to be used for community or public pools but could be used for golf course greens and private pools. Does it make sense for the city pool to close while people can continue to keep their backyard pools full and golf course greens are kept green? A further look is required, and affected parties should have an opportunity to comment.

The Operational Drought Plan includes general recommendations to the Governor. The first recommendation is to seek resources to fund two half-time ADWR positions and funding for a university partner to work on "implementation, assessment and improvements to the Arizona Drought Preparedness Plan." It is important to recognize that proper implementation of the plan will take resources, and this recommendation should be implemented as quickly as possible. ADWR has had its resources cut considerably over the past few years. To maintain momentum, finding the needed resources for ADWR should not have to wait until finalization of next year's budget.

The second recommendation is that ADWR should continue to facilitate coordinated water planning of counties, cities and water providers, with the task assigned to the agency's Rural Watershed Program and Local Area Impact Assessment Groups. (The Plan recommends the formation of the latter group.) This recommendation is recognition that additional work is needed in Arizona's rural communities to enable locally tailored drought plans to be developed.

The third recommendation is very significant. It requires every potable water system (public and private) to develop a Drought Contingency Plan to be submitted to ADWR by January 1, 2006. If implemented, this recommendation would result in hundreds of such plans being due in about a year. The recommendation states: "The Drought Plan must include both mitigation strategies, including a water conservation plan to reduce vulnerability to drought, and response actions." Since implementing this recommendation requires legislative action, the January 1, 2006 due date for the plans may be somewhat optimistic. Some small utilities may not have the staff needed to develop a plan. Also, there are likely unresolved questions regarding the ability or willingness of a private utility to enforce drought plan requirements. There will clearly be further discourse on this recommendation.

The fourth recommendation may be more significant than it appears. It recommends legislation to enable ADWR to require all water systems to provide to the agency consistent and coordinated water supply information. The information is expected to be "used at the state and local level to identify water uses within the system, determine conservation potential, and ensure reductions during times of critical need." Not only does the recommendation not specify exactly what is a water system that would be required to provide this information, the recommendation could be interpreted as suggesting that ADWR may determine water conservation potential rather than the local entities. A major effort would be required to carry out this task. It is not entirely clear to what extent this recommendation relates to drought planning, rather than water supply planning in general, although it is generally agreed that better data are needed outside the Active Management Areas. Further clarification may be needed before local communities not now required to report water use support this.

The fifth recommendation is to assess the merits of an Assured Water Supply program in non-AMAs. The need for economic analysis of the impacts of such a program along with public involvement is acknowledged. With the recent release of a white paper on this subject by the Arizona Policy Forum, this recommendation has strong support in certain quarters and strong opposition in others. A thorough and perhaps heated debate is likely to ensue. But I hope people approach the debate with open minds. Requiring some demonstration of an adequate water supply does not have to be coupled with utilization of renewable water supplies, as in the AMAs in Central Arizona.

The final recommendation is that ADWR immediately initiate Local Area Impacts Assessment Groups. Their task will be "to identify a structure and contacts and to facilitate the implementation of the Arizona Drought Preparedness Plan." The report suggests that the county emergency manager and a county Cooperative Extension agent co-chair these impact assessment groups and that they include representation from local, state and federal agencies and other interested entities. This effort, too, will require much work but is essential if drought plans tailored to local conditions are to be adopted.

There is much, much more to the plan. It proposes to institutionalize the excellent work done by climate experts and resource managers on the Monitoring Technical Committee by making that group permanent. Again, it is important that momentum not be lost and that this important work continues.

It is a long plan that was a long time coming. Its recommendations are significant and are likely to be debated. What should not be debated, however, is that Arizona needs to approach drought response in a deliberate and thorough manner. The work of the Governor's Drought Task Force provides a framework and process for reducing vulnerability to drought throughout the state. ■



Public Policy Review

by Sharon Megdal

Past, Present AZ Town Halls Raise Water Issues Needing Attention



In 1997, I attended my first Arizona Town Hall. The topic was water. This fall, I had the privilege of attending the 85th Town Hall, entitled “Arizona’s Water Future: Challenges and Opportunities,” in a dual role. Because I served as one of the authors of the background research report, I served as a resource consultant to one of the panels. But

I also was a participant involved in the panel’s discussions and deliberations. This was the largest Town Hall ever. Almost 180 people participated. It was a stimulating few days!

To me, there were some marked differences between the atmosphere of this most recent Town Hall and the one several years ago. Seven years ago, a major concern was the formation of new Active Management Areas. I recall the strength of the opposition to the concept of extending state regulation of groundwater beyond existing AMA boundaries. The 1997 Town Hall was very clear on this. The Report concluded that “the AMA model is not the appropriate mechanism for local problem-solving and development of long-term water planning.” The recent Town Hall accepted this conclusion as a given. The focus this time was more on how to meet the informational and financial needs of local and regional efforts to develop and implement water resource plans.

In 1997, the Arizona Department of Environmental Quality was beset by difficulties and its viability as a state water agency was questioned. The report recommended “consideration be given to merging some of ADEQ’s water quality programs into ADWR to ensure continuity in water management. ... One agency should be responsible for coordinating and managing water quantity and quality.” Now on firmer ground, ADEQ wasn’t focused on this year.

Instead, the importance of providing resources to enable the Arizona Department of Water Resources to carry out a much-expanded mission was the focus of much discussion. The importance of this issue can be gauged from a motion unanimously adopted during the plenary session: “The primary recommendation from this Town Hall is that dedicated and secure funding sources be created to finance Arizona’s critical water management, planning and infrastructure needs. Without such secure funding, the other recommendations of this report are not achievable.”

Other recommendations included that ADWR be responsible for collecting and disseminating information about water supplies and demand, particularly in non-AMA areas. It was also concluded that ADWR should be responsible for coordinating long-range, statewide water planning. The report stated: “ADWR must play a central leadership and advocacy role. The Agency’s statewide mission should be expanded and strengthened in the areas of policy development, planning and data collection. ADWR’s strategic plan should be implemented by local policymakers on a regional basis. Town Hall recommends that a primary objective in any planning

process is for ADWR to collect comprehensive hydrologic data on all Arizona water resources, including water quality in conjunction with ADEQ, and disseminate such information throughout the state. It also should lead in the statewide conservation campaign.”

Town Hall’s front-and-center attention to ADWR is appropriate. The state agency would be responsible for carrying out many of the recommendations, if implemented. Fulfilling these new functions would require considerable financial resources and talent, and the agency already is in financial straits, unable perform its current mission. The Town Hall recommended that ADWR receive additional resources to help it meet the challenge of assisting in the resolution of Arizona’s current and future water challenges.

In addition to increased general fund appropriations, it was recommended that “costs caused by growth should be funded by growth” and new funding mechanisms be explored. The funding mechanisms specifically mentioned included bonding (which is really a method of financing), exempt well fees, federal programs such as Water 2025, surcharges, permit and impact fees, private sector donations coupled with tax credits or deductions, property taxes, and user taxes. This is quite an inclusive list, but perhaps the most important part of the primary recommendation is the inclusion of the word “secure.” This acknowledges that it would not do much good if increased revenues generated by new funding sources were used to replace existing general fund revenues.

The serious drought conditions and their implications were covered in the Town Hall background report and reflected in the report adopted at the closing plenary session. Although continuing to grow at a rapid pace, many of the state’s communities have not quantified the water resources needed for expected growth. Town Hall participants questioned whether the general public understands the critical nature of Arizona’s water issues. The Report stated, “In the short term, all Arizonans must be educated about the severity of the [drought] issue, supply limitations and potential solutions.” The Town Hall called for increased water literacy.

The importance of education at all levels was highlighted, with the report emphasizing development of a conservation ethic and recommending that Arizona “take a national leadership role in developing and implementing a new K-12 conservation curriculum that is aligned to the state educational standards.” We at the Water Resources Research Center already are assuming a leadership role. Arizona Project WET, as well as other programs and individuals, have been working on aligning water resource curricula with state standards. We can attest to strong community and water company support for conservation and general water stewardship curricula. Additional resources will enable us to train teachers to integrate water into their instruction and generate the financial resources to support delivery of water education to all Arizona schools.

This was the fifth Arizona Town Hall to address water issues. Let’s see if we can resolve some of these critical water issues prior to the sixth. We have our work cut out for us! 📌



Public Policy Review

by Sharon Megdal

Water Pricing Has Potential to Promote Water Conservation



The pricing of water is an interesting and important topic. The rates water utilities charge are designed to recover the cost of delivering water to customers. That means water prices generally cover the costs of the construction, maintenance and operation of the water delivery infrastructure, from pipelines to dams and canals. Also included are costs of all administrative functions,

from meter readers to outside consultants and lawyers. Yet, no cost is associated with the water molecules themselves. This is true for groundwater, surface water and effluent.

For most goods and services, the price system usually is viewed as a mechanism for allocating scarce resources. Water stands out as an exception, its pricing not generally incorporating a scarcity value of water, despite a general awareness that water is in fact scarce. Water is not sold at a market-clearing price for several reasons. This is partly due to our legal system governing water rights and ownership. It is also due to the general belief that water should not be treated like other commodities, with private interests owning and then selling it at whatever the market-clearing price may be. This may seem paradoxical, and, in fact, introductory textbooks in economics identified the diamond-water paradox years ago. Diamonds are not a necessity but are very expensive whereas water is essential for life but is often free for the taking. The paradox can be explained by the relative scarcity of the two goods. Water has been relatively plentiful relative to demand while diamonds are very scarce and costly to produce.

Due to growing local, national and global populations, fresh water is not plentiful in many locations. In the West, many communities must seek new, often expensive water supplies to serve rapidly growing populations. We see officials imposing water resource fees related to providing water and entering into water transactions to secure necessary water supplies.

Drought has heightened Arizonans' awareness of the imbalances of water supplies relative to demand. Having sustainable state water supplies means acknowledging and addressing actual and potential imbalances between long-term demands and supplies. Work on long-term water balances region-wide has been underway in the Active Management Areas for some time; in other areas work is just beginning.

Using price signals to assist with demand management is not a new concept. A pump tax to discourage groundwater use has been often proposed, and the adoption of conservation rate structures has been advocated and in many cases adopted.

Active Management Areas have a modest groundwater withdrawal fee, established initially to provide funding for the Arizona Department of Water Resources and for conservation and augmen-

tation programs. Statutory change diverted the first component to the general fund. A large portion of the second component funds banking of Colorado River water. Utilizing a groundwater withdrawal fee to discourage groundwater use, however, has not been generally embraced. Governor Hull's Water Management Commission raised the issue but recognized that a significant tax on water would adversely affect certain industries, especially agriculture. Yet, even if it did not apply to all industries, a pump tax could further the goal of reducing water consumption. Designed carefully — for example, it would have to address concerns regarding low-income water ratepayers — a groundwater use surcharge could effectively reduce water consumption, as well as help fund much-needed infrastructure investments or other programs, such as the Arizona Water Protection Fund.

More is at issue, however, than discouraging only groundwater use. Even communities with ample renewable water resources are concerned about a future demand-and-supply imbalance. In emphasizing the need for a statewide "culture of conservation," Governor Napolitano notes this may mean different things to different communities. Work on the effectiveness of different conservation methods is ongoing, and the installment and use of graywater systems and the increased use of effluent has been highlighted. Another viable means of achieving reductions in water usage is through water pricing.

Adopting rate structures to encourage water conservation is increasing, by water companies governed by cities and towns as well as companies regulated by the Arizona Corporation Commission. Predicting the effectiveness of this tool is a complex task due to the price elasticity and income elasticity of demand as well as the nature of the use itself (e.g., indoor versus outdoor use).

If demand for water is price-inelastic, i.e., if the percentage reduction in water use is less than the percentage increase in price, economic models indicate that utility revenues will increase. What then is to be done with the "windfall" or increased revenues? Recovering only the cost of service would require an offsetting rate reductions somewhere in the system. As previously suggested, however, the "windfall" revenues could fund infrastructure or riparian restoration projects, which are attracting increased interest. If demand for water were price-elastic, which according to most studies is not yet the case, reduced revenues would be the issue. In a system requiring revenues to cover at least the cost of service, this would have to be addressed. The task of predicting response to price changes is complex. Price elasticity estimates based on econometric models, where they exist, are considered predictive only for small changes in price. They cannot generally be used to predict behavioral response to large price changes.

Despite these complexities and the difficult equity, legal and other considerations, pricing tools should be in our water policy toolbox. ■



Public Policy Review

by Sharon Megdal

WRRC's Conference Considers What it Takes to Fix an Ecosystem



On April 6 the Water Resources Research Center held its annual conference. Titled "Water and the Environment: The Role of Ecosystem Restoration," the conference provided a forum for learning about environmental enhancement in Arizona. Information, experiences and perspectives were shared, and restoration efforts were "showcased."

Whatever word we use — restore, preserve, maintain or enhance — such projects are designed to improve an environment over and above what would have existed if actions had not been undertaken. But how do we decide which actions to undertake?

Opening keynote speaker Bill Dawson of the U.S. Army Corps of Engineers commented that cost-benefits analyses should not be the sole consideration of environmental restoration efforts. He also noted that it does not matter how we got to the degraded situation, but rather it is important to figure out how to fix it.

Fixing water quality problems is the focus of many restoration efforts nationally. In his overview of restoration projects, Cliff Dahm of the University of New Mexico documented the increase over the last ten to 15 years in river restoration projects in Arizona, the Southwest and indeed throughout the nation. By far, water quality management and riparian management were the two most prevalent purposes of these projects. Measuring the success of restoration efforts through monitoring is important. Julie Stromberg of Arizona State University focused on the question of assessing success through measuring ecosystem improvement and improved system resilience.

A public perception of success, however, also is important. The projects that possibly are most likely to touch the greatest number of people are along the Salt River in Maricopa County. After being rejected by voters in the 1980s, habitat improvement along the Salt River - Rio Salado has become a focal point of multiple jurisdictions and Indian Nations. Improvements are varied. Karen Williams of Phoenix spoke of the importance of restroom facilities, benches, and staging areas for teachers. She was hopeful that benefits would spillover beyond the banks to what are distressed areas of Phoenix.

In "The Cadillac Desert," Mark Reisner spoke of these distressed areas: "Phoenix owes its existence to [the Salt River], but even so it doesn't seem to hold the Salt in high esteem. On both banks, the floodplain is encroached by industrial parks, trailer parks, RV parks, but no real parks. The flood channel itself has been developed to a degree, playing host to establishments which are, by nature, transient: topless bottomless joints, chop shops, cock-fighting emporia. Paris built its great cathedral by its river; Florence its palaces or art; Phoenix seems to have decided that its river is the

proper place to relegate its sin."

Efforts are underway to remedy the remnants of the sad and dismal situation described by Reisner. These efforts, including Audubon Arizona's new nature center at River and Central Avenue, have the potential to improve more than just the non-human environment.

Participants were upbeat and the event's atmosphere was positive despite the general awareness that challenges associated with restoration efforts are substantial. A significant factor for all of these projects is water; water is needed to sustain environmental enhancement efforts. Questions remain about the water supplies or sources necessary to sustain some of these projects along with the long-term costs of water. My own study of environmental restoration efforts in Pima and Maricopa counties provided information on the substantial water requirements and costs of some of the projects studied.

To act early to develop partnerships and involve interested parties was underscored. These partnerships can take many different forms and often involve the private and public sectors. The need for monitoring and multidisciplinary research was clear, both at the front-end of projects as well as after projects are completed. The need for communication at many levels was apparent. Whether relating the reasons for spending millions of dollars on the Lower Colorado River Multispecies Conservation Program or for putting up elk fencing, communicating with the general public and stakeholders is always important. Sometimes the information may elicit an unexpected response. This occurred in Pima County when area residents did not support moving forward with an ecosystem restoration project conceptualized for the Agua Caliente Park.

The need for funding was emphasized. Restoration efforts often take many years and involve significant investments, especially when land acquisition is involved. Partnerships are needed to get things done. The last session of the day, which focused on funding, made it clear that parties will have to be more resourceful to assemble the necessary financial, water and other resources.

Finally, I would be remiss if I did not mention the discussion about the use of the legal system to effect environmental policy. Attorneys Joy Herr-Cardillo of the Center for Law in the Public Interest and Tom McCann of Central Arizona Project agreed that the courts rarely "make" policy. But we all know the threat of lawsuits or actual lawsuits can influence actions taken by involved parties.

The presentations — too numerous to cover here — were informative and attractive, and we have obtained permission to post most of them on the Water Resources Research Center's web site: www.cals.arizona.edu/AZWATER. They are linked to a final agenda showing the speakers and presentation titles.

I thank all of the speakers, moderators and attendees for participating in the conference! 🏡



Public Policy Review

by Sharon Megdal

Summing Up: New Developments in State and WRRC Water Affairs



Worthy of note are some recent developments in water news and affairs, some with statewide significance and some of special importance here at the Water Resources Research Center.

On the state legislative front, many water related bills passed — despite the rain! Space will not allow a complete reporting on such actions; the reader can consult

www.azleg.state.az.us or the legislative report of the Arizona Municipal Water Users Association at www.amwua.org/legislative/legislative_summary.htm for more information.

Several important steps were taken to shore up the financial footing of the Arizona Department of Water Resources. Total ADWR appropriations for fiscal year 2006, which began July 1, are approximately 29 percent over the prior year's appropriations. The \$18.4 million budget includes an additional \$1.5 million in funding for rural studies, restoration of some past budget cuts, and \$1.2 million in new money allocated to ADWR's base budget.

In addition, HB 2174 authorized an Assured and Adequate Water Supply Administration Fund which will include fees received for performing reviews necessary for complying with the state's Assured and Adequate Water Supply Rules. This bill also calls for the ADWR director to review the rules and recommend rule and statutory changes to improve the efficiency of the program. HB 2277 requires public water systems to prepare supply, drought preparedness and conservation plans; thus implementing the key recommendation of the Governor's Drought Task Force. SB 1190 prohibits new exempt wells within 100 feet of the distribution system of a municipal water provider. Proponents of this bill have worked for several years with legislators to craft a bill to prohibit the drilling of a well in the middle of a fully-functioning service area. Wells can still be drilled under certain conditions. SB 1336 established a Rural Water Legislative Study Committee to review information regarding supply and demand in rural Arizona and to identify opportunities to develop alternative supplies and to reuse water. A 14-member committee will have until Dec. 31, 2006 to submit its report. This report is expected to lay the foundation for further discussions regarding water management in rural Arizona. More fine-tuning to the Central Arizona Groundwater Replenishment District's replenishment reserve was accomplished via SB 1235. Finally, some Southern Arizona folks and others worked hard to gain approval of HB 2323. This bill allows tax credits of up to \$200 per house to home builders incorporating graywater systems and/or water harvesting systems. More information on graywater systems can be found at www.watercasa.org.

There has been a lot going on away from the Capitol building. In March, the long-awaited Upper San Pedro Basin Active Management Area Review Report was released. (It is available at the

ADWR web site, www.azwater.gov) ADWR Director Herb Guenther concluded that the region did not meet the statutory criteria for designating the basin as an Active Management Area, a conclusion that has been both applauded and criticized. He did, however, make several recommendations, including additional monitoring, modeling, conservation, and implementation of recharge programs. In late April, the recommendations of the Yuma Desalting Plant/Cienega de Santa Clara Workgroup were released. (See front-page feature and Guest View section of the newsletter for information about this noteworthy achievement.) Regarding the CAGRDR, the process for approval of the CAGRDR Plan of Operations, which is submitted every 10 years, is nearing completion. The document provides the CAGRDR's plans for meeting its rapidly growing replenishment obligations.

Some new ADWR leadership will be very busy with meeting existing and new statutory responsibilities. Karen Smith, formerly of the Arizona Department of Environmental Quality, recently joined ADWR as deputy director. Tom Carr was promoted to ADWR assistant director, Office of Statewide Conservation and Strategic Planning. Most recently, Director Herb Guenther announced the appointment of Sandy Fabritz-Whitney as assistant director for water management.

Here at the WRRC we have some changes to report. Kerry Schwartz, director of Arizona Project WET (Water Education for Teachers), has been promoted to area associate agent with Arizona Cooperative Extension, housed at the WRRC. Features of her statewide program include training teachers to integrate water curriculum into the classroom, developing K-12 water curriculum correlated to state educational standards, and extending the water festival program. Dana Flowers will continue her work for the University of Arizona Water Sustainability Program, with a particular focus on water education programs, in her new position as assistant agent with Maricopa County. Kristine Uhlman, who serves as Arizona NEMO (Nonpoint Education for Municipal Officials) program coordinator, is now affiliated with the WRRC. Her responsibilities for this educational outreach program focusing on land-use decision makers and nonpoint source pollution issues include working on needs assessments for watershed stakeholders and developing and implementing workshops and other outreach media. She will become an area assistant agent in November, 2006.

Last but certainly not least, Professor Aaron Wolf will be joining the UA Department of Geography and Regional Development in August 2006. He is to become the WRRC's associate director. Dr. Wolf is world-renown for his work on the interaction between water science and water policy, particularly as related to conflict and conflict resolution. We look forward to Aaron joining us; more information regarding his important work will be featured in future issues of the newsletter.

Congratulations to all for their accomplishments this spring! 🏡



Public Policy Review

by Sharon Megdal

The Arizona Virtual Water University is Becoming a Reality



During last November's 85th Arizona Town Hall at the Grand Canyon, Governor Janet Napolitano announced her proposal for an Arizona Virtual Water University. Her AVWU concept was to bring together the talents of the three universities — University of Arizona, Arizona State University and Northern Arizona University — to better focus their efforts on state water needs. AVWU

would ensure that Arizona has the tools needed for sustainable water supplies, provide enhanced opportunities for water resources education, and expand the state's water research and technology development.

Since the Grand Canyon meeting a lot of effort has gone into implementing this innovative concept. The Governor's Chief of Staff Alan Stephens has hosted and facilitated the efforts of a working group involving representatives of the three state universities and three state agencies, as well as water stakeholders. I have been a participant in these sessions.

Collaboration among the three state universities is not uncommon. What is unusual, however, are the universities working with the state departments of Commerce, Environmental Quality and Water Resources to identify joint projects and develop a business plan. The idea is that this concerted effort will accomplish more for our state than the typical *modus operandi*. Information, databases and decision tools needed for Arizona communities will be developed to assist decision makers. Enhanced research and development will boost the economy by creating jobs and providing increased opportunities to export knowledge and information. Additional and improved water resources curricula and educational program offerings will be developed.

Efforts to date include the development of a concept paper for the AVWU, which includes a proposed organizational structure. A four-person Executive Committee, comprised of the universities' three vice-presidents for research and the Chief of Staff for the Governor (or designees), will oversee the hiring and work of an executive director. Limited funds have been identified for this effort, although the Arizona Board of Regents recently awarded \$150,000 to assist in hiring the AVWU executive director.

To facilitate on-campus coordination, each university has named a coordinator to work on identifying and implementing projects for both the immediate and near term. The executive director will eventually work with one or more associate directors; these are expected to be housed within one of the three state agencies, Commerce, Environmental Quality or Water Resources. The embedding of AVWU personnel in the agencies is a strategy to keep the work of the AVWU connected with the needs of the state.

Interaction with external stakeholders for input on project priorities and project formulation has occurred, and an External

Advisory Committee will be formed. The chair of the External Advisory Committee is expected to serve as an *ex officio* non-voting member of the Executive Committee. The Arizona Department of Commerce and the Board of Regents have funded a contract with Battelle Memorial Institute for assistance in developing a business plan for the innovative water institute. A needs assessment for the AVWU is underway.

The AVWU working group has identified four projects for immediate work, with each project a collaborative effort expected to involve principal investigators from the three universities. Some limited funding has been identified to start these projects. Each has short-term and long-term objectives. Brief descriptions follow:

Arizona Hydrologic Information System The project goal is to develop AVWU's information infrastructure and to provide access to data relevant to water-related research, technology, planning, education, and outreach from multiple Southwest sources. The project's first phase is well underway. Developed at the UA, the arizonawater.org web site information tool was unveiled at the Arizona Water Summit at NAU. (See Publications, page 7, for a description of this site.) Readers are invited to visit the site which should be a very useful portal for information and interaction.

Water Quality Priority Projects Two water quality themes with long-term implications for water management have been prioritized: arsenic and other inorganic contaminants in drinking water and source waters, and emerging contaminants in wastewater. The specific projects are important for determining human health and ecosystem impacts along with the short-and long-term evaluation and remediation of Arizona water systems.

Water Conservation Technology Exchange This project will establish a forum to promote an exchange of water conservation technology among industrial water users, water providers, policy makers, research and educational institutions, and community groups.

Meeting the Water Management and Planning Needs of the Upper Verde Watershed This project, which is intended as a prototype, will focus technical expertise on the interdisciplinary objective of developing a future water supply and formulating drought management and planning scenarios for the Upper Verde Watershed. This area offers an exciting and timely location to focus the water talent of Arizona's three universities; the tools and solutions worked out to address the local issues will be applicable to regional, national and international water concerns.

The AVWU is truly an innovative concept, one promising multiple benefits to the state. A challenge for all such efforts is obtaining needed resources; it is expected that this creative venture will attract the interest of funding agencies, private donors, and others willing to provide support. This truly is just the beginning.

NOTE: Anyone interested in applying for the AVWU Executive Director position should check the UA's jobs web site, www.uacareertrack.com. 🏠



Public Policy Review

by Sharon Megdal

Much at Stake as Arizona Ponders Perplexing Water/Growth Dilemma



Growth and water are much discussed these days. Will we have enough water to serve Arizona's growing population? Will water now used by agriculture be the future water supplies of our cities? Should the Central Arizona Groundwater Replenishment District limit future membership? Do increasing demands on finite water supplies call for more regulation of water, both inside

of and outside of Active Management Areas? Will a prolonged drought create the ghost (dust!) towns of the future?

The public may not be fully aware that many are at work addressing such questions. Each question is complex and answers to them may change as the robust growth of the Southwest continues.

(A Water Resources Research Center conference will address these issues. Titled "Providing Water to Arizona's Growing Population: How Will We Meet the Obligation,?" the conference will be held June 20 and 21. See page 3 of newsletter for further details.)

Public officials, water professionals and the public are all concerned with having enough water for the needs of the state. Last year's Arizona Town Hall concluded that "Arizonans expect a safe and reliable water supply to support Arizona's diverse and increasing population, sustain our varied economic interests and preserve our wonderful quality of life now and for future generations. Arizonans demand certainty that water will be available to support both consumptive and non-consumptive uses including when they turn on the tap, open irrigation pipes, visit recreation areas and to sustain natural habitats." With more communities bumping up against water-related constraints, it is appropriate to ask: Are going to be able to meet these expectations?

In most parts of the state, long-range water planning involves incorporating usage of effluent (treated wastewater), often treated to high standards. Not long ago effluent was considered a nuisance, a flow to be disposed of. Many communities suspect water will be available for purchase or lease, be it Indian-owned water or agricultural water. But will it be available and on what terms? In many cases the answers are unknown at this time.

Communities are growing into their Central Arizona Project allocations. Those relying on CAGRDR membership to prove an assured water supply face monetary unknowns. As presented about a year ago, the CAGRDR Plan of Operation projected the annual replenishment obligation exceeding 225,000 acre feet by 2035, based on projected membership through 2015. The CAGRDR has virtually no firm supplies for the water needed to meet its replenishment obligations.

How much will replenishment water cost in 2025 or 2035? No one can make intelligent estimates at this point. Should limits be imposed on future CAGRDR membership? The answer to this policy question has significant implications considering CAGRDR's role

in facilitating compliance with the renewable supply use requirement of the Assured Water Supply Rules. The CAGRDR was created in 1993 because developers and others without CAP subcontracts and/or access to CAP infrastructure worried about meeting the requirements of the impending rules. Present CAGRDR members now worry about pressures future membership will place on the cost of replenishment water. Once again, there are many unknowns.

Should water be further regulated within Active Management Areas? While in some quarters regulation is viewed as a nasty concept, uncertainty poses greater troubles to businesses and investors. With several large water utilities updating long-range plans, developers and others perceive more water supply uncertainties now than ten or fewer years ago.

The Groundwater Management Act imposed groundwater use regulations only in the AMAs. With much of Arizona experiencing phenomenal growth the last 25 years, groundwater overdraft has become problematic in non-AMA parts of the state. Watershed and other groups have worked to understand their water supply situations. They have gathered information and data, hoping it will assist them in developing regional water management plans.

The preference is for locally generated approaches to water management as opposed to state-imposed regulations. Laws that require showing water adequacy prior to development approval have been opposed. Opposition has arisen inside and outside AMAs to enacting regulations governing the drilling of wells, which, once built, are exempt from regulation. These proposals have attracted both strong support and opposition. Who is adversely affected by enacting the proposals? Who is adversely affected by failure to act? Often the complete answers to these questions are unknown.

We have all witnessed drought's serious effects. As communities develop drought and conservation plans, we will continue to grow. Our future options to address drought may be different than present options. We don't know we are in a drought when it first begins, and we don't know a drought has ended until some time after its end. Even with this type of uncertainty, we can be prepared for drought if we continue to pursue these planning exercises seriously and not let our guard down because one season's rainfall is plentiful.

Will water be available for the environment? What water quality implications result from increased use of Colorado River water and effluent? Will we develop cost-effective methods to address arsenic or will the new arsenic standards cause water supply problems in Arizona communities? Will Nevada find sufficient water supplies or will an effort be made to change the laws governing Colorado River water allocation?

One column cannot address all these questions; nor can one conference do justice to them. However, we are going to make an attempt to provide a stimulating dialogue on growth and water at our 2006 Conference. We invite you to attend the conference and join the discussion. ■■



Public Policy Review

by Sharon Megdal

Revised AWS Rules, Key to Efforts to Reduce Groundwater Overdraft

“Layperson’s Guide” to final rules would be helpful



When I give introductory talks about groundwater management in Arizona, I note that the linchpin to our approach to reducing groundwater overdraft in the Active Management Areas is the Assured Water Supply Rules. The AWS Rules are of critical importance in forcing — I choose this word deliberately — new municipal demand to

be met with renewable water supplies, either directly or through groundwater replenishment. Certainly, water providers believe they are responsible purveyors of our most precious resource; however, it is not always realistic to expect voluntary actions since significant expenses can result from using renewable water supplies. Investment in water treatment facilities, water storage and recovery facilities, and/or purchase of services from the Central Arizona Groundwater Replenishment District contribute to the high cost of showing that water demand will be met or offset predominantly by renewable water supplies for 100 years.

Like the municipal sector, the industrial and agricultural right-holders have mandatory conservation requirements, established through the Management Plans for each AMA. However, the latter two sectors have no renewable water supply use requirement. In Central Arizona, agriculture’s significant use of CAP water is not in response to law but to special pricing structures that provide economic benefits. Economy also drives industrial rightholders to heavily invest in conservation and reuse technology. In addition, golf courses use reclaimed water in response to ordinances.

The seminal 1980 Groundwater Management Act mandated that a program of assured water supply be adopted. Assured water supply approval processes developed in the 1980s addressed the program’s requirement for a demonstration of a physically available 100-year supply. But it was not until 1995 that the Assured Water Supply rulemaking processes included the renewable supply requirements currently in effect.

The rules are complex, with detailed provisions varying by AMAs. There are designations versus certificates. The AWS Rules do not force all water providers to become “designated.” Designation has the significant, extra requirement that a water provider’s pre-existing municipal demand (not just new demand) switch to use of renewable water supplies. A “certificate” of assured water supply, on the other hand, establishes that a new subdivision will depend on renewable supplies. Pre-1995 demand could continue to rely on mined groundwater.

To establish a 100-year assured water supply the following must be demonstrated: (1) A sufficient quantity of water is physically, legally and continuously available for 100 years to satisfy the water demands of the subdivision or service area; (2) The water source meets water quality standards; (3) The proposed water use is

consistent with conservation standards; (4) The proposed water use is consistent with the AMA management goal (safe yield for several AMAs); and (5) The applicant is financially capable of installing the necessary water distribution and treatment facilities.

Revising the AWS Rules is one among many tasks that the Arizona Department of Water Resources is undertaking. Last session, via House Bill 2174, the Legislature authorized the establishment of the Assured and Adequate Water Supply Administration Fund. This is to include fees ADWR collects for processing assured water supply applications and determining adequate water supply — the less rigorous program in force outside AMAs. The fees are to cover the administrative costs of the program. The bill established an advisory committee to assist the Director in identifying statutory or rule changes to make the application process more efficient. The bill provided deadlines for a report to include the Director’s recommendations for change (December 15, 2005) and required the notice of proposed rule making be filed with the Secretary of State no later than January 1, 2006.

According to ADWR Deputy Director Karen Smith, who conducted a seminar at the WRRRC in late November, the agency, while attempting to make the rules more efficient, has worked to rethink the process and simplify it for themselves. At that time, draft rules were being finished to meet statutory deadlines. ADWR anticipates approval of the rules in May or June 2006, with new fees effective July 1, 2007.

I followed the first rulemaking very closely. Over the years, I have had to explain — without the assistance of an attorney — how the rules work. The initial adoption experienced a long gestation period. Reader friendly concept papers helped people like me understand the rules.

Rule making is an administrative process, with certain formatting and procedures followed. I know from my various experiences, most recently as a member of the Arizona Medical Board, that the gist of the rulemaking often can get tangled in the legalese style of rulemaking language. When the Director submits the notice of rulemaking, I hope a “layperson’s guide” will be circulated. The rules are arguably the centerpiece of our efforts to achieve safe yield in the safe-yield AMAs.

I am likely not alone in needing help in understanding changes to these very important rules. Such assistance not only provides guidance on the changes but a welcome refresher course for the program as well. It could also help us to understand what might be at issue should portions of the assured water supply program be applied to communities outside AMAs. This is a controversial issue and outside the scope of the rulemaking process. But a better understanding of the rules will help us determine the implications of any and all changes to our framework that ensures Arizona communities will grow on sustainable water supplies. ■■■



Public Policy Review

by Sharon Megdal

Water Budget Can Be Monstrously Complicated



Recently, Ken Seascholes, Director of the Tucson Active Management Area, was a guest lecturer at the graduate seminar, Arizona Water Policy, which I teach with my colleague Kathy Jacobs. His was a formidable task, to discuss AMA water regulation and management plans, and he came armed with the “cartoon” pictured here. At first glance, it

could be interpreted as someone’s idea of a multi-armed, scary monster. But, upon closer examination, the figure can be seen as an informative depiction of the groundwater aquifer and the factors to be considered when calculating the Tucson AMA’s water budget.

While space does not permit me to go into the detail Ken did, I am going to attempt an abbreviated explanation here. While the numeric example he provided along with the graphic was for the Tucson AMA, the principles apply generally.

The bottom of the cartoon represents the groundwater aquifer. The big arrow going up in the middle represents groundwater pumping. The hexagon above the pumping arrow represents regional demand, and the top arrow represents the actual consumptive use, or water not returning to the system.

The right hand side arrows represent what occurs to water after it is used but not fully consumed. The right hand arrows pointing to the aquifer represent the water that flows back into the groundwater system through the effluent system and through incidental recharge, as occurs when crops are irrigated, for example.

The arrows on the left going into the aquifer represent natural and artificial inputs. The former includes water flowing into the aquifer from stream beds and washes and mountain front recharge. One of the arrows represents groundwater underflow coming in from another basin. The biggest arrow coming in from the left and pointing into the aquifer represents recharge of CAP water. The top-most left arrow depicts delivery of CAP directly to users to meet their demands. Although direct delivery is not utilized to meet municipal demands in the Tucson AMA, it might be in the future.

The most complicated part of the water budget calculation likely relates to some of the arrows inside the aquifer. They show what happens to water that reaches the aquifer, whether from the

left or right side. If that water is considered stored water pursuant to a storage permit, then various accounting rules come into play. The “bookkeeping” must consider cuts to the aquifer, annual storage and recovery, accrual of long-term storage credits, and credit recovery. The real challenge for me has been understanding how stored water figures into the official water budget. Long-term storage credits for water put into the system provide someone at some

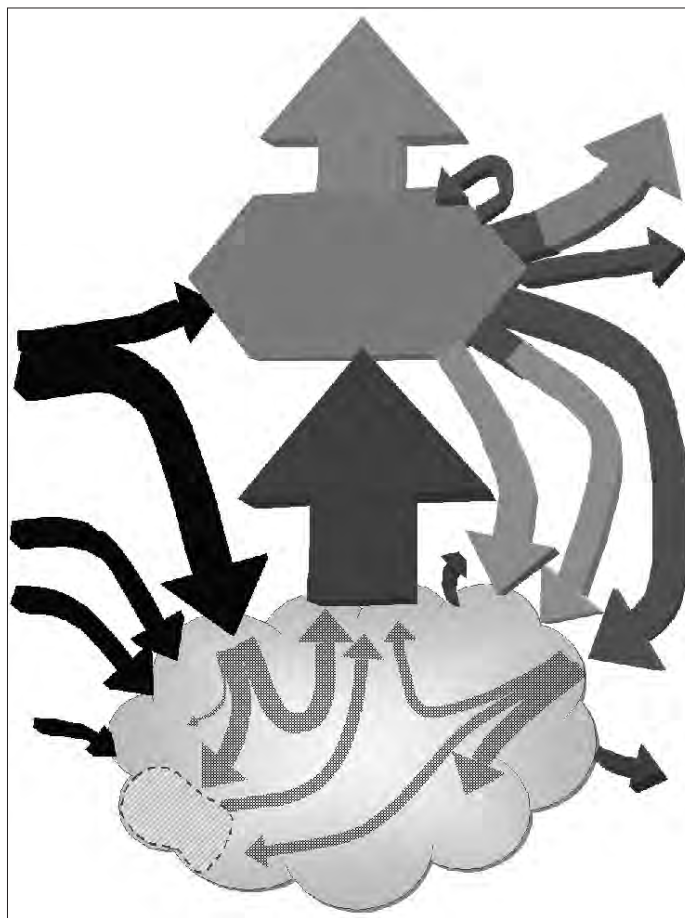
time with the right to pump water out of the aquifer. So, although water has been added to the aquifer through “artificial” recharge, it is off the books when considering the amount of overdraft.

For me an “epiphany” came with Ken’s explanation of his cartoon that, although the printed water budget with all the numbers shows a net artificial recharge number “above the line” indicating the amount of total overdraft, the recharged water subject to future withdrawal is not counted as an addition to groundwater. The 2003 draft water budget

for the Tucson AMA shows over 163,000 acre feet of groundwater overdraft. While that year saw 56,919 of net artificial recharge, that stored water does not reduce the 2003 overdraft.

Ken’s explanation of his cartoon, coupled with the tables, makes it very clear why water stored for future use should be “off the books.” It is great that we are storing water, but we must not forget that it’s being stored so that it can be used in the future. The figures show, at least for Tucson, that we have a long way to go to meet our statutory safe-yield goal by 2025. 🏗️

The Water Budget Monster



Graphic design: Ken Seascholes



Public Policy Review

by Sharon Megdal

Arizona Officials Grapple with Growth–Water Supply Dilemma

WRRC June conference takes on the weighty issue.



Information about this year's Water Resources Research Center conference is front-page news in this edition of the *Arizona Water Resource*. The 2003 WRRC conference considered rural and watershed-based solutions to water management issues. Most issues had to do with growing demands for water, and since then rapid population growth — and drought — has continued. Water professionals in the state continue to discuss the challenges of assuring long-term water supplies and meeting water management objectives, whether statutory or otherwise. Not only water managers but policy makers, the business community and the public are keenly interested in these issues.

In this column I will discuss three water planning situations from different regions of the state, each providing a very different approach to addressing water sufficiency questions. The examples raise the policy questions being deliberated and debated throughout the state.

Proposed developments outside Kingman have attracted much press coverage. Mohave County is not within an Active Management Area and current law allows developments that do not demonstrate an adequate water supply. First purchasers of the property must be informed if the Arizona Department of Water Resources finds a water supply inadequacy; subsequent purchasers are not required to be notified. Questions about the adequacy of water supplies have been raised about huge developments in the area proposed by two builders. Current law does not authorize the Mohave County Board of supervisors to disapprove plans based on water supply determinations.

Corporation Commissioner Kris Mayes, however, has raised the question whether the Arizona Corporation Commission, in the face of an ADWR inadequate water supply finding, has the power to influence the formation of a new water company. Surely no one expects the ACC to make land use determinations; but does the ACC have the power to insist on sufficient water supplies to serve a newly approved service area? This is a bold move in an arena where few options are available. While the debates over policy continue, hydrologists study groundwater supplies in the area.

In Cochise County, at the opposite corner of the state, the Board of Supervisors recently adopted a Sierra Vista Sub-Watershed Water Conservation and Management Policy Plan. In explaining reasons for the plan, the board cites: (1) the special attention this sub-watershed has received from Congress; (2) the county's agreement to assist Fort Huachuca in meeting its water management objectives; (3) the state's Growing Smarter legislation, which "allows all counties to specifically plan for development as it relates to available water resources;" (4) their own Comprehensive Plan, which allows for the establishment of area-specific plans; and (5)

the public consensus regarding pumping water from the aquifer, water reuse and water augmentation.

One of the provisions limits water use for rezoning to a higher density to be "the same or less water than would be used if the property were developed under existing zoning." The policy also requires that new residential development proposed as subdivisions or in rezonings to higher densities "shall conserve water use by incorporating efficient, effective and integrated water pumping, distribution, metering and recharge systems as well as water conservation Best Management Practices." This is another important step toward connecting land use and water supplies outside of AMAs; technical studies continue.

Pinal County provides the third example. Along with State Land and others, the county is looking at the development of a huge tract of state land known as Superstition Vistas. A recent report by the Morrison Institute for Public Policy at Arizona State University offers scenarios for the future of the 275-square-mile land expanse, including one that projects the region's population as 900,000 people in 2060, roughly the equivalent of current metropolitan Tucson.

Released April 6, the report notes that water sufficiency is frequently questioned. It states: "Unlike many other places in the U.S., an area like Superstition Vistas can develop without an immediate local water supply. Rather, it needs to compete successfully for available supplies in the region." The report states that the water analysis performed as part of the larger investigation of the development of Superstition Vistas is likely to draw upon four water sources: Central Arizona Project water, Colorado River water, groundwater and reclaimed water. Average demand is assumed to be 186 gallons per capita per day, the current average for new subdivisions in the metropolitan Phoenix area, with the expected 900,000 people requiring 190,000 acre feet of water annually.

The report notes that demand could vary significantly depending on the design of Superstition Vistas and types of water conservation practices eventually adopted; it concludes that the area should be able to compete favorably for water supplies. Tucson Water could be a point of reference, its current gpcd, including all its supplies and uses, is 177. (The 186 gpcd rate seems high for a new "city" in the desert.)

The above examples underscore that competition for future water supplies could be fierce among different regions of the state, but that new approaches to resolving the growth and water problems are under consideration. With all areas of the state facing rapid growth and varied water resource constraints, the examples point to the need to fully explore both demand and supply side solutions. The WRRC conference in June will include speakers who will touch on these three examples and many more. Please join us! 🏡



Public Policy Review

by Sharon Megdal

Time For Annual State-Of-The-WRRC Report



I devote one column a year to providing an update on developments at the Water Resources Research Center. The end of the fiscal year provides a suitable occasion, so here I go.

The WRRC is like most other organizations, with things at times remaining the same and at other times rapidly changing. WRRC acquired new staff, with Susanna

Eden joining us in November as an applied research coordinator. A University of Arizona Hydrology and Water Resources Department graduate who was previously with WRRC, Susanna worked on a chapter on water and growth for the spring 2006 Arizona Town Hall background report. She is heading the WRRC collaborative effort with the Water Education Foundation to develop an Arizona volume for WEF's "Layperson's Guide" series. The "Layperson's Guide to Arizona Water" is scheduled for completion spring 2007.

Among her many other responsibilities, she is working with me on a report on artificial recharge to be issued as part of our Arroyo series. Predating our bi-monthly newsletter, Arroyo reports in-depth on a single issue. Its regular publication disrupted by resource constraints, Arroyo will get a new life with the publication of the recharge issue.

Carl Bauer will become WRRC associate director this fall, with a joint appointment as professor of geography and regional development. His multi-disciplinary background and work on international water will enhance WRRC's policy work. Kerry Schwartz, who has guided Arizona Project WET (Water Education for Teachers) through much expansion, has been appointed associate specialist, a faculty position providing expanded opportunities for professional and programmatic growth. Arizona Department of Environmental Quality funding supported Kristine Uhlman who, working with UA Professor Phil Guertin, developed Project NEMO (Non-point Education for Municipal Officials). Her appointment this fall as area assistant agent with Extension will provide her faculty status, with an affiliation with both WRRC and Pima County Cooperative Extension. Kristine's work focuses on watershed characterization and mapping.

Kathy Jacobs' appointment as executive director of the Arizona Water Institute, a cooperative venture of the three state universities, has reduced her WRRC commitment. WRRC's collaboration with AWI, however, keeps us working together.

The Arizona Board of Regents' approval of the business plan for the Water Sustainability Program, a project funded by the Technology Research Initiative Fund, enables WRRC to continue its work with UA water centers, faculty and staff on water research, education and outreach that address Arizona water issues. WRRC's Jackie Moxley continues to coordinate this program, its key components including competitive grants, student fellowships, and recruitment and research initiatives. We are pleased about the program's

five-year renewal. (See supplement included within this newsletter for description of new WSP-sponsored projects and list of students who were awarded fellowships.)

We continue to take on varied types of programs, including Terry Sprouse's work on water issues in the Ambos Nogales area and water harvesting. Our newsletter, the Arizona Water Resource, continues to garner praise, particularly features written by editor Joe Gelt.

My position as WRRC director took me to Washington, DC to request continuation of U.S. Geological Survey 104B grants program funding. A small program by federal standards, 104B is nevertheless important to water centers across the country. We are optimistic its funding will be restored. Also I journeyed to the capitol to present testimony to the Water and Power Subcommittee of the U.S. House of Representatives Resources Committee, in support of the "United States-Mexico Transboundary Aquifer Assessment Act" (S 214 and HR 469) which would authorize a study of shared aquifers with Mexico.

The wide interest and participation that our annual

conference attracts testifies to its value as a forum to discuss water resource issues crucial to our state's economic vitality. (See page 9 for some highlights of this year's well-attended WRRC conference, "Providing Water to Arizona's Growing Population: How Will We Meet the Obligation?") On a smaller scale, our brown bag seminar series continues to provide opportunities for information sharing and discussion, bringing together university personnel and community members.

We engaged in some program soul searching and came up with a streamlined mission statement that is prominently displayed in the sidebar.

Those visiting our Sol Resnik conference room, whether for a brown bag session, a community or university meeting or a class, will note recent improvements, thanks to the generosity of Salt River Project and Central Arizona Project.

For more information about WRRC projects and programs check www.cals.arizona.edu/azwater/ (By the way, this too is to become better: our web site is to be redesigned for easier navigation and update.) A colorful new WRRC brochure has been developed and is available for distribution.

We are constantly striving to improve, and we thank you for your support and continued involvement in WRRC-related programs and projects. ■■



WRRC Mission Statement

The University of Arizona's Water Resources Research Center promotes understanding of critical state and regional water management and policy issues through research, community outreach and public education.



Public Policy Review

by Sharon Megdal

Visit Shows Israel Faces Similar Water Management Issues as Arizona



I traveled to Israel this summer to present a paper at a conference and to meet with researchers and other water professionals to learn about Israeli water management and policy. My perception was that, while quite a bit of Arizona-Israeli collaboration on technical water issues seemed to have occurred, less had taken place in the social science and policy arenas. I hoped to build upon recent col-

laboration with an Israeli resource economist. My trip was extremely productive. Fortunately my travels were unaffected by the violence in Gaza; the trouble to the North did not erupt until after I returned to the United States.

I met with officials from the Israel Water Commission and Mekorot (the national water supplier); I also met with researchers from several disciplines and university campuses. I heard conference presentations on issues relating to water for the environment and water levels in the Sea of Galilee.

Although Israel and Arizona have much different systems for managing water resources, the water management issues are very similar: drought, salinity, seawater desalination, effluent re-use, institutions, water pricing, and allocation across water using sectors (including the environment). I will discuss a few of these issues.

The institutional setting for water policy in Israel is changing. The Ministry of Infrastructure's Water Commission had set water allocations and oversaw much water policy. Different ministries handled other water matters, such as water quality and determining allocation of water for the environment. I was told, however, that a new Water Authority, recently established by the legislature, will bring together various ministries to promote better coordinated water management. The head of the Water Authority, to be housed in the Ministry of Infrastructure, will have a five-year appointment and will work with a board of representatives from the various ministries (Agriculture, Treasury, Infrastructure, Environment, Interior Affairs) plus two appointees from the public. Time will tell if the Water Authority, which is just being implemented, will work as envisioned.

Israel has a very centralized approach to allocating water. The country faces the same issues as Arizona does in times of drought: how much water to take out of storage and the extent of water cuts. Israeli agriculture is viewed as a sector more able than the municipal sector to cut back water use during drought. Agricultural water allocations are largely at the discretion of the central government; cutbacks do not depend on voluntary arrangements for water transfers, as contemplated in the western United States. The papers I read in preparation for my trip noted that the agricultural sector represents a strong lobby in Israel; it emphasizes the importance of its operations for providing home-grown food supplies and preserving open space and green areas.

Israel has the advantage of a seacoast. I visited what is said to be the world's largest operating seawater RO (reverse osmosis) desalination plant and surprised Israelis with my interest in seawater desali-

nation. I explained that desalination along coastal California has the potential to enable landlocked Arizona to gain more Colorado River water. Israel, like the United States, has long considered seawater desalination. Repeated droughts there have prompted a program to construct several plants over a five-year period to eventually deliver 315 million cubic meters of freshwater. With construction having begun in 2003, the plant in Ashkelon was built through a public-private partnership as a build-operate-transfer (BOT) facility. Fully operational in 2005, the plant produces 100 million cubic meters (approximately 81,100 af) of desalted water per year. It is a 20-minute process to produce fresh water. Also Israel shares Arizona's interest in removing salts from brackish groundwater, with projects underway in the southern part of the country.

Using detailed hydrologic information, the Water Commission and Mekorot, which supplies about two-thirds of the water used in Israel, have developed a management system to limit the amount of high-salinity water entering the water system from the Sea of Galilee. The Galilee's lowering water levels, however, are a concern, reflective of recent drought conditions and decisions regarding how much water to draw out of storage.

An important global concern is environmental water needs, an issue the Israeli Ministry of the Environment must consider in response to recent legislation. As we in Arizona know, restoring lost riparian areas, necessary for flora and fauna and valued by people, is difficult. Yet Arizona has not developed a strategy for recognizing the environment as a water-using sector. Observing Israeli efforts as well as those of other locales, including Victoria, Australia (the subject of two presentations at the conference), could be of value to Arizona and other semi-arid or arid regions.

Water re-use is an important issue. The Israelis hope to increase agriculture's approximately sixty percent use of the country's effluent to 80 to 85 percent. Arizona's effluent picture is much different, with reclaimed water mostly used for golf courses, turf irrigation and as cooling water for the Palo Verde Nuclear Power Station. Various factors limit Arizona's agricultural use of effluent, including a lack of proximity to sources of effluent, as well as cost and other considerations.

My limited introduction to Israeli water pricing indicated that, as is true elsewhere, water pricing involves economic as well as political/policy considerations. Compared to Arizona, water pricing is a much more centralized function. Prices are set in ways, however, that do not necessarily cover costs of service. Tiered pricing has been introduced in the agricultural sector, and an extraction levy has been assessed to reflect the scarcity value of the water resource, a policy economists advocate but rarely see considered, let alone adopted, by policy makers.

Water resource management concerns across the globe are frequently very similar, although countries often approach them differently. That we can learn from each other's experiences is clear. I hope my visit leads to future collaborations and additional learning opportunities for myself and others. ■



Public Policy Review

by Sharon Megdal

Study of Adequacy of Tucson's Water Supplies Has Broad Application



Arizona's continued rapid growth raises concerns about the connection between growth and water supplies. The issue is on the minds of many; I am frequently asked about the sufficiency of supplies relative to growing demands. After Tucson Water presented its draft long-range plan, *Tucson Water Plan 2000-2050*, representatives of community business groups asked me to help them interpret the plan and

the broad regional water supply picture. Along with explaining aspects of the plan, I also was asked to numerically calculate the number of people able to be supported by known available water supplies in the Tucson region.

Writing a report explaining the context for long-range water planning was an appealing task, although I was at first uncomfortable about the numerical calculation. My concern was that the focus would be on the numbers rather than the context. Nevertheless, I saw the value of providing alternative illustrative scenarios. I agreed to produce the report.

Since the release of *Water Resource Availability for the Tucson Metropolitan Region* this summer, I have presented its findings numerous times. The report appears to have encouraged an understanding of the many factors that help answer questions about the sufficiency of water supplies — and how assumptions regarding these factors affect the conclusions.

What were the report's findings and conclusions? As the Tucson region strives to achieve the statutory management goal of safe-yield, multiple sources of water are available. We are not yet utilizing all of the region's allocated Central Arizona Project water. We use only a small portion of the effluent from the regional treatment plants. More opportunities are available to conserve water. Relying on reasonable assumptions and publicly available information, I concluded that water supplies are more than adequate for the population that the Pima Association of Governments projects will live in the region in 2030: about 1.5 million people. A caveat, however, is that the community needs to make decisions necessary to utilize these supplies, and some water use options could be controversial.

A key factor determining the adequacy of supplies is the rate at which the community utilizes effluent. Effluent will likely be used in the future for more than golf courses and other turf irrigation. Will it be used through recharge and recovery? Will the recovery occur inside or outside the area of hydrologic impact of the recharge? Will effluent be treated using sophisticated and currently costly membrane treatment technology? And a very controversial question: Will the public accept the mixing of treated effluent with potable water? The community has not yet begun discussing these questions as its attention is more focused on the challenge of figuring out the best way to utilize the region's CAP water. But these discussions are on the horizon.

Another important factor is the overall water use of the region, on a per capita basis. Will the mix of commercial activity and the effi-


ciency associated with low-water-using appliances result in a reduction in water use on a per capita basis? Some reduction would be expected, if only because new construction must install low-water use plumbing fixtures. But how much of a reduction? The Tucson Water Plan assumes a gallons-per-capita-per-day (GPCD) total consumption rate of 177 throughout the 50-year planning period. Including all water use in Tucson Water's service area on a per capita basis, this figure was the utility's rate when the plan was formulated in late 2004.

The breakdown of the 177 GPCD is as follows: Residential (indoor + outdoor), 110; Reclaimed water, 4; Commercial and Industrial, 35; and lost and unaccounted for water, 18. I used a GPCD figure of 165 in my report's baseline projections for 2030 and then performed some sensitivity analysis. If consumption were to remain close to the current amount, with population growing 10 percent higher than projected by Pima Association of Governments, water supplies are not expected to stretch much beyond 2030. Remember, however, no projection for 2030 is going to be correct — it all depends on the assumptions!

Findings are consistent with Tucson water managers' views that enough water resources are available to support a substantial increase in the region's population.

Although explaining the regulatory context for water planning, the report did not focus on our region's statutory management goal defined as "safe-yield." Many factors will determine whether the region meets the safe-yield goal, especially groundwater use by the agricultural and industrial water use sectors. Since these sectors operate under a different set of regulations, they could continue to use groundwater for some time. Any reduced water use they achieve does not result in increased water resources for the municipal sector. However, with only 20 years to go to reach the 2025 safe-yield target date, it is more important than ever to keep sight of this goal. And the study did not address the water needs of the environment, a water-using "sector" not recognized by the Groundwater Management Act.

The report's findings are consistent with what water managers in the Tucson region have said for some time: enough water resources are available to support a substantial increase in the region's population. Although the report focuses on Tucson, the methodology applies to any area. The same is true for several of the report's recommendations regarding community engagement in water management planning deliberations. Water management is not just the concern of water managers. This is becoming increasingly evident as we continue to grow statewide and attempt to identify the source of the next bucket of water to meet our ever-growing demand for water.

Water Resource Availability for the Tucson Metropolitan Area is available at the Water Resources Research Center's web site: www.cals.arizona.edu/azwater 



Public Policy Review

by Sharon Megdal

Front-Row View of Federal Water Lawmaking Shows Process Works

U.S. – Mexico Transboundary Aquifer Assessment Act pondered, passed and signed



Otto von Bismarck reportedly once said, “Laws are like sausages, it is better not to see them being made.” I am not sure what to make of this remark since lawmaking, not sausage making, is my interest. It is an interest that recently broadened when I had the privilege of testifying before the Water and Power Subcommittee of the House Resources Committee on the United States-Mexico

Transboundary Aquifer Assessment Act. This bill, numbered S 214 in the Senate and HR 469 in the House, gained final approval in the wee hours of the 109th Congress and was signed by the President on December 22. My previous involvement in lawmaking had been at the state level.

The program’s purpose is to provide state, national and local officials with information to address pressing water resource challenges in the U.S.-Mexico border region. As finalized, the act authorizes the Secretary of the Interior, through the U.S. Geologic Survey, to collaborate with the states of Arizona, New Mexico and Texas, the country of Mexico, and others to conduct hydrologic characterization, mapping and assessments of priority transboundary aquifers. For Arizona, the two priority transboundary aquifers established in the legislation are the Santa Cruz River Valley and San Pedro aquifers. The program is authorized for ten years.

Working on obtaining Congressional approval of this bill was a learning experience. I had once provided written testimony to a Congressional subcommittee, but I had not previously had the opportunity to provide oral testimony.

The acting USGS director and I were the only witnesses. Some unexpected, tough questions came up at the hearing regarding the bill’s connection to the Colorado River and the treaty with Mexico. The Subcommittee chairman held the bill to allow additional comments. Through the assistance of staff to Senators Kyl and Bingaman, respectively, amendments to address multiple concerns with the bill’s language were developed.

In contrast to sausage making, which must be a very messy business, I was participating in a carefully crafted lawmaking process involving compromise and clarification to achieve agreement and support.

As a witness on the bill, I first provided written testimony and then was given a few minutes to present oral remarks at the hearing. The oral remarks were not expected to be the same as the written testimony. I emphasized the importance of the bill by making the following points.

I testified that the transboundary aquifer assessment program will assist federal, state and local officials address critical water resource challenges in the U.S.-Mexico border region. The act will build the scientific foundation for addressing daunting and acute

water resource issues. The program also will serve as a catalyst bringing together the human capital and financial resources necessary to characterize transboundary aquifers. The resulting increased understanding should help resolve many of the currently unquantified — and therefore unresolved — water resource issues.

I emphasized the importance of water to the growing, arid Southwest, especially along the border where population continues to grow rapidly on both sides. Water resource issues become more complex and acute along the shared border where understanding aquifer characteristics is critical to the human health and economic vitality of this region. Along the border many and varied interests need to cooperate and participate to address water issues.

I told how the modeling and data base developed as part of the program will address important water quantity questions including those associated with salinity and toxins. Further complicating border water issues are the different water quality standards and the physical relationship between surface water and subsurface flows associated with transboundary aquifers that raise special challenges.

I also told the subcommittee that the program authorized by this bill will meet a critical need by establishing a partnership of federal, state and local governments, university researchers and others to provide scientific information on transboundary aquifers.

I informed the committee that the need for additional scientific information on water resources is well recognized. For example, in fall 2004, the 85th Arizona Town Hall concluded that “[to] avoid crisis management, Arizona must engage in long-term planning based on good science and data collection that should be made widely available throughout the state.” Town Hall participants were calling for sound science and data as well as the dissemination of the information to avoid crisis. The program authorized by the bill envisions the partnerships necessary to accomplish these tasks.

I noted the widespread support for the bill from governmental and non-governmental entities. In addition, a 2005 United States-Mexico Border Governors Conference declaration emphasized the importance of the program by calling for a collaborative work program that includes “the permanent exchange of data and information regarding surface and ground water along the border...”

Passage of the act demonstrated once again that water policy making is a bi-partisan exercise. All recognize the need for sound information to develop good water policies to ensure needed water supplies to accommodate the rapid growth of the border regions. Funding for this newly authorized program is needed, and the hard work of obtaining federal appropriations now begins.

The University of Arizona’s Water Resources Research Center and its sister centers in New Mexico and Texas are expected to work closely with USGS and collaborators on developing this program. I thank those who helped us get this far and look forward to working on implementing this legislation. 🏠



Public Policy Review

by Sharon Megdal

WRRC Strives to Provide Useful Outreach — Do we serve your needs?



I was recently in Washington for the annual meeting of water center directors from across the country, and I participated in a panel on outreach. My assignment was to describe the Water Resources Research Center outreach efforts and offer some thoughts about what makes an effective outreach program. As I organized my comments, I thought to Google “outreach” to see what

comes up. The website www.thefreedictionary.com provided two definitions, with the first laughably obvious: (1) The act or process of reaching out; and the second with more substance: (2) A systematic attempt to provide services beyond conventional limits, as to particular segments of a community.

High on the list of search results were comments on the Continuing Education portion of the University of Colorado at Boulder web site. Here the term outreach is used “to describe the various ways in which the University extends its expertise for the direct benefit of Colorado communities and other external audiences.” The site goes on to state: “Outreach has traditionally been considered a service activity. However, within a research university, outreach can occur as scholarship that cuts across the University’s teaching, research and creative work, and service missions. Successful outreach is rooted in scholarship and highlights faculty expertise. It draws on knowledge developed through other forms of scholarship and contributes to the knowledge base. Further, federal research agencies such as NSF and NASA increasingly insist that investigators make the outreach component of their research explicit. Outreach activities provide reciprocal benefits to both the community and the academy.”

Outreach is a fundamental to everything we do at the WRRC, a research and extension unit within the UA College of Agriculture and Life Sciences. Extension and outreach are not synonymous, but they do go hand in hand. As I see it, outreach is a two-way process involving various kinds of expertise and activities. Whether I am in the field making presentations or attending meetings, I am gathering, as well as sharing, information and perspective. In addition, outreach is not separable from research and/or teaching. All can be complementary activities. My work may be helpful to practitioners and policy makers, and what I learn from them can help define research and writing projects. I call on experts from the “real world” to review reports and papers and to provide guest lectures in my graduate course in Arizona water policy. I reach out to them for their expertise. Others reach out to me to gain mine. It is all about sharing knowledge and improving understanding.

Effective outreach takes time, a commodity in short supply for many of us, and requires that we be responsive and accessible. We are responsive when we reply to requests from the media or the public. A response also might be working with a potential project partner to design a study or project to meet its needs as well as

WRRC’s programmatic objectives. To be accessible is important as well. WRRC is fortunate to have a location slightly off campus; individuals from the community have easy access to us.

Effective outreach also requires “vehicles,” and the WRRC is fortunate to have several vehicles or outlets. This newsletter is one of our best vehicles. This column provides me an opportunity (with deadline!) to communicate with readers and invite feedback. The *Arizona Water Resource* newsletter provides broad coverage of water affairs and issues. Reaching out is prime activity of newsletter editor Joe Gelt when preparing the publication. After a five-year hiatus, we recently published an *Arroyo* newsletter on artificial recharge. Examining the role of artificial recharge in meeting water policy objectives is a focal point of my research. This single-issue newsletter format is one we will increasingly use for outreach.

Our annual conference provides participants an opportunity to learn and discuss. We try, when appropriate, to join with others in developing the conference program. Participating in Water Expo at the Capitol on Feb. 26 provided an opportunity to reach out to our Legislators. Our brown bag seminar series offers additional opportunity for two-way dialogue and for community-university interaction. We focus on topics we believe to be of broad interest to academics from multiple disciplines and members of the water community. We showcase basic research as well as “real-world” happenings.

An oft used outreach vehicle is the Internet, and we at the WRRC endeavor to make effective and extensive use of our web site, now being redesigned, as part of our outreach effort. We post papers and presentations and link to many other water sites. Of course, conference and community presentations are an essential part of effective outreach.

Outreach may be accomplished through vehicles created for a specific purpose. In partnership with the Water Education Foundation, for example, we are writing a *Layperson’s Guide to Arizona Water*. The Southern Arizona Leadership Council is our partner in developing a fall 2007 Tucson regional water forum. This may take the form of stakeholder meetings focused on a research project. This list of vehicles is long.

Outreach requires “outreachers,” preferably people who like to reach out and interact. To effectively reach out requires hard work and careful planning. Our limited financial and personnel resources means we must be strategic in our outreach, not duplicating what others are doing. It means taking the initiative and seizing available opportunities to deliver needed projects or programs.

I will close this column by reaching out to you and asking you to help the WRRC be a more effective outreach by sharing your thoughts. How can we better reach out? What projects do you want us to consider undertaking? Effective, two-way communication is essential to effective outreach. Call me at 520-792-9591, ext. 21 or email me at smegdal@cals.arizona.edu. I thank you in advance! 📧



Public Policy Review

by Sharon Megdal

Next Generation of Water Experts Explore Varied Real-World Issues



We in the water world are all familiar — perhaps too familiar — with the distinction often made between whiskey and water, that one is for drinking and the other is to fight over. Another distinction often promulgated is that work is the real world and the university is not as real. Consequently it is thought that students leave the university well versed in theory but are not necessarily well ground-

ed with exposure to real-world issues.

Whatever truth there may be to this debatable proposition I know from experience it does not generally apply to the water policy courses taught at the University of Arizona where efforts are made to integrate theory with practice. A course I teach can serve as an example of how we are covering important real-world issues; students are not just getting ivory tower perspectives.

For the past three years I have been teaching a three-unit spring graduate course titled Arizona Water Policy. Co-developed with my colleague, Kathy Jacobs, we team taught the course the first two times it was offered. With Kathy now at the helm of the Arizona Water Institute, I am now solo teaching the course.

Not confined to a single departmental cubbyhole, my course is cross-listed in four colleges and five degree programs and has attracted students with a wide variety of backgrounds and interests. Listed in the colleges of engineering, law, agriculture and life sciences, and social and behavioral sciences, the course has attracted students from a variety of programs. These programs include soil, water and environmental sciences, hydrology and water resources, planning, geography, agricultural and resource economics and arid lands studies. One student was not yet enrolled in a graduate degree program, and I allowed a senior to enroll in this graduate course.

Varied are the students and varied are the guest lecturers featured during the first ten weeks of the classes. Active in the water resource field, these authorities share with students the challenges they face in taking on real-world policy making. This semester the guest lecturers included Ken Seasholes, director of the Tucson office of the Arizona Department of Water Resources, Cliff Neal, general manager of the Central Arizona Groundwater Replenishment District, and Corporation Commissioners Kris Mayes and Bill Mundell.

To further broaden the students' experiences, Saturday field trips are conducted each year to supplement in-class learning. This year's stops included Tucson Water's (idle) Hayden-Udall Treatment Plant, two major artificial recharge sites, and the Sweetwater Wetlands. Surely by any standards these are real-life, on-the-ground experiences.

During the 10 weeks of formal class meetings, we covered a variety of important topics. In addition to covering the fundamentals of the Groundwater Management Act, we focused also on water management issues of non-AMA areas, drought and climate

change, water quality regulation, private water company matters, effluent re-use, recharge and environmental needs for water.

Student participation is an important component of the learning experience. Students are required to complete a research paper on a water policy matter and then make a class presentation. Presentations fill out the remainder of the semester. To select a topic and complete a paper within a semester is not an easy assignment, especially when students are new at policy analysis.

I assisted some students by focusing their attention on topics that interest them and identifying resources to tap, particularly experts to contact for perspective and information. But the papers are theirs, and it is exciting to see how much the students are able to research in a relatively short period of time.

Students selected topics covering a wide range of important issues; the 15 students chose the following topics: effluent use in Pima county; property rights implications of groundwater use regulation; quality and usage of reclaimed water; managing groundwater in the Prescott Active Management Area; growing water demands in Mohave County; draft EIS: for Colorado River interim guidelines for lower basin shortages and coordinated operations for Lake Powell and Lake Mead; preservation and restoration of riparian areas in Arizona; Navajo water rights and Colorado River Compact challenges; protecting water resources in Native America: case studies of drought mitigation in Northern Arizona; water needs for electricity generation; Sonoran Desert Conservation Plan: water needs; the Yuma Desalting Plant: recent issues; the Lower Colorado River Multi-species Conservation Program; culture of conservation: a statewide strategy for water conservation; and the CAGR: insurance policy, bridge or life support?

No arguing with the relevance and importance of these topics. Working with individuals both within and outside the UA, I realize that policy analysis and translation of scientific findings useful for applying to real-world decision making are increasingly expected in research. Just as it is important to introduce physical scientists to policy, it is essential to expose policy-oriented students to the challenges of real-world policy making.

I am pleased that my course is now part of a recently approved graduate Certificate in Water Policy, an option available to students in degree programs as well as students wanting to enroll only in the certificate program. Approved in March, the program aims to strengthen the water policy expertise of both graduate students and working professionals in a wide variety of fields.

I thank all those who helped train the next generation of water professionals, whether serving as guest lecturers, field trip assistants and/or resources for students working on papers; all contributed to the team effort to develop and deliver a meaningful student experience. While its focus was on water policy, I hope the class offered information and provided a policy analysis framework useful to students regardless of career paths followed. I am already looking forward to spring 2008! 🏗️



Public Policy Review

by Sharon Megdal

WRRC's Year-in-Review Highlights Varied and Productive Projects



One of my columns each year is devoted to Water Resources Research Center activities as I highlight some of my recent and ongoing projects. Contrary to what some people think, professors do not take long summer vacations. Summer time is work time, with more time available to work on projects!

In collaboration with Cochise County, some University of Arizona colleagues and I are beginning a project to develop an estimate of water use by owners of domestic wells. Jurisdictions need to understand how water demand increases with population growth. We hope our study methodology, which involves voluntary metering of a population sample, can be applied to other communities deciding to undertake a similar study. The identity of individual water users will be kept confidential. TRIF Water Sustainability Program funding is partially supporting this effort, which will take 18 to 24 months to complete.

I am also currently working with a Northern Arizona University colleague to examine the evolution and effectiveness of the regulatory programs included within the Active Management Area Plans. The Arizona Department of Water Resources, which will soon be developing its Fourth Management Plan for each of the five AMAs, and the Arizona Water Institute are funding the study. My research assistant and I will be conducting stakeholder interviews this summer.

An ongoing project has been examining environmental restoration and enhancement projects in Arizona, focusing on their water requirements. With Bureau of Reclamation funding and graduate student assistance, a survey study of 30 Arizona projects was finalized last summer. A graduate student, who recently graduated from the UA planning program, and I are now completing a related Reclamation-funded study.

We have developed a conceptual mechanism whereby water customers pay for conserved water, with the money being directed into a special fund to be used for purchasing water for environmental purposes. This water conservation banking mechanism, although challenging to implement, deserves consideration by communities interested in finding resources to pay for environmental water needs. The survey study is currently being condensed for publication in the WRRC Arroyo newsletter series. An undergraduate student, whose career objective is to be a science writer, is assisting me with the Arroyo publication.

In collaboration with the UA's Engineering Research Center for Environmentally Benign Semiconductor Manufacturing, a research assistant and I are working on a paper examining high-tech manufacturing water use in Arizona. The desire for more well-paying jobs in Arizona makes it important to understand how the water needs of this segment of the manufacturing sector can be accommodated. Another graduate student is assisting me in a study that characterizes participation in groundwater savings recharge in Arizona. Also,

a paper I co-authored with three attorneys on the Central Arizona Groundwater Replenishment District has been published in a special issue of the Arizona Law Review. (Please contact me if you want a copy of the paper.)

Not all my work is focused on papers and studies. Our annual WRRC conference is always a challenging endeavor, with much effort devoted to developing the program, gaining sponsor support and delivering an informative and engaging event. This newsletter's insert is devoted to our recent, successful conference on water quality regulation. I have begun to develop the program and format for the 2008 conference, which will be a collaborate effort with Central Arizona Project, focusing on Colorado River/CAP water issues.

Also, in collaboration with ADWR, the Pima Association of Governments, and the Southern Arizona Leadership Council, we are developing a program called "A Community Conversation on Water." Scheduled for October 26, 2007 in Tucson, this forum will discuss up-to-date water information, as well as multiple perspectives on water challenges facing the Tucson region. I am an advocate for having people "on the same page" in understanding our water demand and supply situation and our position relative to achieving Tucson AMA's safe-yield goal. Program and registration information will be available in the not-too-distant future.

I recently made a presentation on the recently authorized US Transboundary Aquifer Assessment Program (the subject of my Jan.- Feb. column) to the newly formed Arizona-Mexico Commission water committee. We are hoping that, with broad support, we will be able to obtain federal funding for this program. Stage one of this collaborative process involves developing study plans and priorities for the two Arizona transboundary aquifers specified in the authorizing legislation, the Santa Cruz Valley aquifers and the San Pedro aquifers.

I would be remiss not to mention our efforts to complete the *Layperson's Guide to Arizona Water*, a collaborative undertaking with the Water Education Foundation. My staff has worked hard on the project, with external stakeholders reviewing the work. I look forward to a final draft and a completion of the project.

You may have noticed some commonalities to these sampling of projects. First, most involve significant contributions by research assistants. Interaction with students on projects is a rewarding experience for both me and them. It provides me the opportunity to work with excellent students, both undergraduate and graduate, and they gain work experience. Second, the projects involve collaborations. Through collaboration, more funding is available to employ students, and the work efforts benefit by involving the talents and perspectives of others.

Also, notice the real-world relevance of these efforts, evidence that we at the WRRC are on task with furthering our mission. We are striving to promote an understanding of critical state and regional water management and policy issues through research, community outreach and public education. ■■■



Public Policy Review

by Sharon Megdal

Beachside, Columnist Ponders Arizona's Water Resources' Horizon

Major accomplishments don't always get their just public due



Every summer I spend about two weeks enjoying the cool air, beaches and newspapers of Southern California. My beachside newspaper reading included coverage of speeches of Gov. Schwarzenegger explaining his new \$5.9 billion spending program for California's water system. The call to action was attributed to the confluence of three challenges: climate change, growth and drought.

Reading the articles prompted me to reflect on the status of Arizona's dialogue on water resources management. Fundamentally, our state faces the same challenges as California. How do we ensure that current and future populations have safe and adequate water supplies in the face of rapid growth, drought, and climate change? What investments are needed? What will it mean to Arizona communities when shortages on the Colorado River require cutbacks in water deliveries through the Central Arizona Project? To what extent will municipalities use water currently allocated to agriculture? How big a role does conservation play in meeting future water demands? What will be the source of the next bucket of water? Explaining the soundness of our Active Management Area systems despite various unknowns is often difficult.

Many of us devote considerable time explaining the accomplishments, as well as challenges, of Arizona's water management system. I still refer my students and others to the 2001 Final Report of Governor Hull's Water Management Commission. Although the numbers may be dated, the basic findings still pertain. I also mention the report prepared for the 2004 Arizona Town Hall on water along with many other papers and presentations.

Yet some of our major accomplishments are our best kept secrets, unknown at least to the public. Consider the following: our AMAs have assured water supply rules with more stringent demonstration of water availability for residential growth than anywhere in the country. Consider also that to address the prospects of shortage declaration on the Colorado River, the source of 2.8 million acre feet of Arizona's water supplies, the Arizona Water Banking Authority has stored millions of acre feet of Colorado River water. It might as well be a secret to most residents that we've had this legislatively created body in place for over 10 years. Further, how many people know that our state's water leadership has worked tirelessly to mitigate the impacts on Arizona of its junior priority of the Central Arizona Project? State water officials have vigorously urged the proposal that declarations of shortage will not necessarily mean cutbacks in water to the cities. Even if cutbacks are required, farsighted planning has resulted in water being stored over the last ten years that could be used to mitigate the impact.

The Statewide Water Advisory Group recently focused on wa-

ter management challenges for the non-AMA areas of the state. Its labors paid off when some of its key recommendations became law last legislative session. Non-AMA portions of the state are beginning to stock their community toolboxes with water management tools.

In many ways, we, the people of Arizona, are in this together. As the state grows into its allocation of Colorado River water and water use increases, identifying the water policies and investments to shore up our water future is critical. We need to seriously consider the use of effluent for more than turf irrigation. With improvements to treatment technologies, we will better understand cost and quality implications of alternative approaches to treating various source waters. Many people are greatly interested in the potential of seawater desalinization to expand Arizona water supplies, but at what cost and over what time horizon?

According to foremost experts, climate models agree that the Southwest is going to be on average drier and warmer. Much of the research being done on the implications of global warming cites the need for adaptive management. But what is adaptive management? According to Wikipedia, "adaptive management (AM), also known as adaptive resource management (ARM), is a structured, iterative process of optimal decision-making in the face of uncertainty, with an aim to reducing uncertainty over time via system monitoring. In this way, decision-making simultaneously maximizes one or more resource objectives and, either passively or actively, accrues information needed to improve future management. AM is often characterized as 'learning by doing.'"

A key word here is "uncertainty." Decision making under uncertainty is not new, but the types of uncertainty and the ways they affect decision making may be. For example, information on the length and severity of historical droughts, acquired through tree ring studies, provides input for modeling the Colorado River and scenario building. Improved decision support tools, often crafted in collaboration with university researchers, can help water managers and policy makers understand the options available and the implications of following one path versus another. Development of improved treatment technologies also results from partnerships among the academic, public and private sectors.

We are in this together in the broadest sense — the decision makers, the researchers, the technical and water professionals, and the public. We need to work diligently to develop an understanding of solutions to our water management challenges. We need to be ever-vigilant in implementing our water policies and in monitoring. Inside and outside AMAs, we need to work to identify the assured water supplies to accommodate growth. We ought to watch the responses of California to critical issues like climate change. It is essential that the dialogue on Arizona's water management be broad and deep. 🏠



Public Policy Review

by Sharon Megdal

Water Professionals, Citizens Mutually Benefit at Tucson Water Forum

Goal is common understanding, ongoing dialogue



In my last column, I highlighted the need for broadening and deepening the dialogue on Arizona's water management challenges. On Friday, Oct. 26 the Tucson region took a step in that direction, with almost 300 people attending a community conversation on water, an event co-organized by the Water Resources Research Center, Southern Arizona Leadership Council, Tucson Re-

gional Town Hall, Arizona Department of Water Resources, Central Arizona Project, Pima Association of Governments, and the Southern Arizona Water Users Association.

We carefully planned the event to accomplish several objectives. First, we wanted to attract individuals who do not spend most of their waking hours thinking about water. Second, we hoped to present basic water information in a way to truly interest the audience, without participants suffering what I call the "glazed-over-eyes syndrome." Third, we wanted to include different perspectives on important water issues. Fourth, we desired the event to be conversation-friendly. Fifth, we wanted audience input on questions posed to them. We hoped to do all this and more by employing an interesting and lively format!

I am writing this column two days after the event, on a deadline not allowing time to review written comments and responses to our questions. But I have some immediate thoughts to share about the event and its overriding goal of broadening and deepening the water dialogue. It bodes well for the success of the event that our audience was diverse.

Our first panel helped get us on the same page with information about our current water situation, including progress toward meeting the region's safe-yield goal. Experts included Tucson Active Management Area Director Ken Seasholes, always an excellent source of current information and superb graphics. Our morning panelists encouraged participants to understand that the region's challenges fit into a broader puzzle. They and keynote speaker Rita Maguire provided the backdrop for the day's questions, comments, and, at times, debates.

Even lunch was an opportunity to exchange information, with Tucson City Manager Mike Hein and Pima County Administrator Chuck Huckelberry offering their perspectives and fielding questions. In confronting the future of the Tucson region, both underscored the need for coordinated planning and region-wide discussions. Huckelberry discussed the county's efforts to connect water availability with land-use decision making. In addressing our water conservation ethic, Hein asked the much contemplated question: Why conserve water if we don't know what we're conserving for? (Look for more on this topic in my next column!) The need

for enlightenment, patience and compromise was stressed. With newspapers tending to focus on local interjurisdictional battles, I was heartened by Huckelberry's and Hein's comments; I feel more hopeful that the region's approach to growth and water issues will not be fragmented.

The seven-member afternoon panel shared its sometimes differing perspectives. Figuring prominently in the discussions were climate change and environmental water needs. Madeline Kiser of Sustainable Tucson stressed the importance of improving access to science as well the need to consider the social and economic costs of actions. Andy Laurenzi noted that transportation infrastructure will play a key role in determining the location of people and businesses. Several called for a paradigm shift in our thinking about the future of the region and state. Climate change, coupled with rapid growth, is clearly increasing people's awareness of water management and related uncertainties.

The day's dialogue was truly multi-directional. I look forward to reviewing the audience feedback forms. Participants were asked the following questions: What are the most pressing regional water issues?; What additional water information is needed?; What are the desired outcomes of the meeting?; What type of mechanism do we need to keep the conversation going?; and What message(s) do participants want to convey to regional leaders and decision makers?

I imagine others agree with me that as we devise policy solutions to huge water resource challenges we confront both opportunities and obstacles. Comments about the need for water infrastructure, as well as the fact that water pricing does not reflect resource scarcity, made me think of the possibility of a water use tax, with proceeds going into an infrastructure fund.

Although some shudder at any mention of taxes, it may be time to consider some bold actions to better accommodate the influx of people into the region forecasted by panelist Dave Taylor and others.

The discussion prompted me to think once again about the need for a more diverse economic base. A slump in housing or land development causes the economy of the entire state to suffer significantly. We need to diversify our economic base and recognize that good jobs may be connected to water using activities, like high-tech manufacturing. We should look at an activity's water use as it relates to community goals before judging its acceptability.

End-of-the-day definitive solutions were not expected, nor even possible after a one-day dialogue. We all know water issues are complex and that water is one part, albeit a very critical part, of a larger puzzle. What we hoped to do was emphasize the importance of a common understanding and an ongoing water dialogue. In that we were successful. I thank all involved. ■



Public Policy Review

by Sharon Megdal

“Conserve to Enhance,” Conserve Water to Enhance the Environment

Program would enable water users to apply conservation gains to environmental use



Regular readers of this column know I have often discussed the daunting challenge of meeting the water needs of our growing population. Meeting the water needs of the environment is equally challenging. Mostly silent on the issue of water for the environment, Arizona’s Groundwater Management Act and related water law offer little help in confronting the challenge. Yet maintaining healthy ecosystems is important to Arizona’s economy and our quality of life.

Several years ago, I began to characterize environmental restoration in Arizona. U.S. Army Corps of Engineers funding enabled me to study ecosystem restoration in the state’s two major urban areas, Phoenix and Tucson. U.S. Bureau of Reclamation funding then enabled me to broaden the study to include a total of 30 environmental enhancement projects in Arizona. Completed in 2006, the report, “Projects to Enhance Arizona’s Environment: An Examination of Their Functions, Water Requirements and Public Benefits,” showed that over 60 percent of the projects required supplemental water for revegetation or open water elements.

For some projects, the cost of water was substantial. For 40 percent of these projects, at least one water source was not firm; in other words, no signed contract guaranteed the delivery of a future water supply. The findings highlighted the importance, and in some cases the tenuous security, of water for environmental enhancement projects in Arizona.

Concerned with the problem of increased scarcity of water for both human and non-human needs, my former graduate student, Andrew Schwarz, and I obtained additional Reclamation funding to explore ways that voluntary water conservation by municipal water customers could translate into water for the environment. Our basic premise was if customers knew water they saved could be put to environmental use, they would have an additional inducement to conserve water. In other words, they would be getting added satisfaction from their water-conserving achievements.

To work out the feasibility of such a program, we needed the assistance of experts. Tucson Water staff agreed to work with us on conceptual elements. In addition, we solicited input and feedback from many stakeholders. We originally called the program “Water Conservation Banking” to reflect our original premise of conserved water set aside to meet environmental water needs. We envisioned a “bank” in which water would be deposited based on measured conservation and then withdrawn to use for environmental purposes.

We quickly discovered our concept was fraught with complexities. Early on, stakeholders pointed out that such a program would work only if conservation behavior could translate into dollars that, in turn, could be used to purchase water for the environment. Instead of creating a pool of water, our goal then became converting conserved water into a money account, with the funds used to pur-

chase water for environmental use. The environment would thereby become a water customer.

We considered a number of factors. First and foremost was determining how customers could participate in the program. The program depends on customers volunteering to pay for water they conserved. To determine the amount conserved, baseline water use would need to be established for each participant. We considered alternative baselines, concluding that each customer’s historical water use was the most appropriate baseline. Considering whether utility billing systems could accommodate such a program, we found that structural and technological variables created large differences in the ability to implement the program. We also preliminarily explored the mechanism for the allocation of funds. Stakeholders indicated that the mechanism for fund disbursement to projects would likely depend on program design and size. The details of our findings are included in our report to Reclamation, “Water Conservation Banking: Municipal Water Conservation to Support Environmental Enhancement,” submitted December 2007 and available on the WRRC web site.

We believe we have come up with a novel concept for a “Conserve to Enhance” program. There are two key elements to it. The first is to provide an additional or different incentive for water conservation. The second is to provide funds to purchase water for the environment. The latter can be separated from the former, with an option available to either consider implementing a full-scale conservation program, as described in our report, or a simple check-off type program, with water customers designating they agree to contribute money over and above their water bills to fund environmental enhancement.

Similar to “Green Watts” programs familiar to electricity customers, this type of check-off program would not require establishing a baseline and would not be connected to conservation behavior. Water utilities could implement the program with relative ease, and it would indicate the breadth and depth of interest in securing water for environmental enhancement projects. To implement, criteria would have to be established for contributions, such as a maximum and minimum, and for a mechanism for expenditure of funds, including targeted or eligible projects. This simpler strategy, however, with participation in the program not connected to measured water conservation, would not accomplish our main objective of providing an additional inducement to conserve water.

Growth stresses the environment. Projects to preserve, restore and enhance the environment abound, with many requiring water. Andrew, who now works as Engineer and Water Resources Planner for the California Department of Water Resources, and I believe the merits of a voluntary Conserve to Enhance program warrant additional investigation. We would like to work with individuals and utilities to pilot such a program. We welcome your indication of interest and suggestions. 🏠



Public Policy Review

by Sharon Megdal

Study Raises Issues to Consider in Fourth Management Plan

Fourth Management Plan is next GMA milestone.



We are at a critical juncture in water management in Arizona. We are increasingly relying on known renewable water supplies, particularly Central Arizona Project water. Meanwhile drought continues, and the effects of climate change on our water supplies is unknown. Also uncertain is the amount of water to be reused and for what purposes. The 1980 Groundwater Management Act provides

a framework for groundwater regulation, but, interestingly, regional planning within the Active Management Areas is not mandated. Nor does the GMA address surface water management or regulation of effluent utilization. Further, the GMA offers no assistance to non-AMA areas of the state in any efforts they may undertake to address water management challenges.

In its focus on groundwater management and regulation, the GMA scored some notable results. The act included a management goal for each AMA; mandated an assured water supply program; limited the expansion of agriculture; and required a series of management plans. Amendments later added the very important storage and recovery program. The major requirement for the management plans is conservation programs for each of the major water using sectors — municipal, industrial and agricultural. Conservation programs are considered an important water management tool.

The Arizona Department of Water Resources, the agency responsible for implementing and enforcing the groundwater code, is gearing up for the stakeholder process involved in developing the Fourth Management Plans for each of the five AMAs. What should the Management Plans include? The GMA offered specific direction for the first three Management Plans, particularly relating to their increasing stringency. The law, however, provides far less guidance regarding strategies the fourth and fifth plans would apply to advance the management goal of each AMA. Is that because the framers of the GMA thought we'd be close to achieving the goals by then? Or did they not want to presume what tools would be needed almost 30 years after passage of the GMA? A recent study by Northern Arizona University Professor Zachary Smith, University of Arizona Research Assistant Aaron Lien and me sheds some light on these questions.

The Arizona Department of Water Resources joined with the Arizona Water Institute to fund the study, *Evolution and Evaluation of the Active Management Area Management Plans*. Our research examines the management plans to date for all of the AMAs and includes numerous stakeholder interviews. Framers of the GMA indicated they viewed the management plans as a vehicle for achieving some degree of centralized control to ensure groundwater conservation. They acknowledged the need to provide time for groundwater users to adjust to the new paradigm of water regulation in the AMAs. Management periods were developed allowing for progress toward

management goals over time through conservation, augmentation, reduction in the amount of groundwater used for irrigation, and use of the best available conservation practices. They also indicated that the requirements for the Fourth and Fifth Management Periods were purposely left vague to allow maximum flexibility.

Also interviewed were many water stakeholders, including current and former ADWR staff. An initial study objective was to determine if the effectiveness of the management plans to date could be assessed using data from the management plans themselves. Unfortunately, we were unable to achieve this objective because the information in the management plans is insufficient to gauge effectiveness.

We did find stakeholders holding strong opinions about the conservation programs and the process used to develop them. Overall, the general opinion is that the time has come to shift the management plan focus from regulation toward collaborative, long-term water planning. Many preferred the management plans to be actual planning documents to be implemented, rather than just a set of conservation regulations. If ADWR were to facilitate long-range planning for the AMAs, some shared governance or oversight of the process of plan development would likely have to be agreed upon.

Our study concluded with the following recommendations: ADWR should provide water use data for all sectors on at least an annual basis, with the data reported in a consistent format over time and across AMAs; State of the AMA reports should be produced on a yearly or biennial basis; ADWR should shift its focus to long-term water planning, but still maintain the current conservation programs; and Augmentation and Recharge Program and the Central Arizona Groundwater Replenishment District rules need to be reviewed and updated to ensure fairness.

The report is available at http://ag.arizona.edu/azwater/publications.php?rcd_id=54.

I will conclude by looking beyond our study which did not consider in its scope the management goals themselves or progress toward achieving them. The safe-yield AMAs were given a 45-year time horizon to meet their goal. (The Pinal AMA is the only AMA that does not have a safe-yield goal.) The GMA actually only requires an attempt to balance groundwater withdrawals with natural and artificial recharge, with no penalties imposed for failure to achieve safe-yield. Safe-yield is calculated on an AMA-wide basis.

As the 45-year timeline draws to an end, the AMAs need to understand their position relative to their long-term water management goals. In addition, collective discussions should either reaffirm the goals or suggest modifications to them. The development of the Fourth Management Plan may provide an opportunity to consider these big picture issues. Encouraging a full and open discussion of the issues helps ensure that regional water planning will proceed on a firm and solid footing. 🏗️



Public Policy Review

by Sharon Megdal

An American in Paris Realizes Arizona Could Do More to Save Water



I traveled to Paris in June to give a lecture sponsored by the Parisian water provider Eau de Paris and Centre National de la Recherche Scientifique. A government-funded research organization administered by France's Ministry of Research, CNRS and the University of Arizona recently entered into a four-year Joint International Unit on Water, Environment and Public Policy. The unit's purpose is to foster international, interdisciplinary and collaborative social science and water policy work.

In preparation for this trip, my first to Paris, I carefully perused my Rick Steve's tour book and was intrigued to read about a tour of the world's first underground sewer system. Located blocks from where my daughter and I were staying, Le Musée des Ecouts de Paris (The Paris Sewer Museum) earned a lukewarm rating — one-diamond signifying it is "worthwhile if you can make it" — yet was described as "fascinating, if slightly stinky."

Descending the steps to the underground museum adjacent to the Seine River, I was eagerly greeted by several young women, their enthusiasm likely the result of the museum often being overlooked by tourists who much prefer Notre Dame, the Eiffel Tower or the Louvre, attractions we also visited. I mentioned that I worked in water resources, prompting one young woman to provide me documentation along with the usual visitors' brochure. The self-guided tour included English translations. A display of special interest to me noted: "In 1977 the City covered about 10,000 hectares ... and had 2.1 million inhabitants. The suburbs, for their part, covered about 76,000 hectares and had almost 8 million inhabitants. This underlined the importance of water policy."

I was very excited to see water policy underscored, and I was struck by Paris' celebration of its water system, including its sewers. I thought the museum was very beneficial, a reminder to the community of its water history and the great engineering feats that have been accomplished. Museum coverage extends to the modern day.

I acquired very useful information from my Sewer Museum tour and a visit with the Directeur de l'Exploitation, Bruno Nguyen, at Eau de Paris. With the perspective I gained, I was struck with the differences between Paris and our state's two largest urban areas. An extremely densely populated city with plentiful water, Paris has long had two systems for potable and non-potable water deliveries, with non-potable water used for street cleaning and other outside uses.

My lecture focused on urban water management in Arizona and highlighted many of the water management challenges associated with living in a water-scarce, rapidly growing area. Challenges include: regional drought; uncertainties associated with climate change; growth in Arizona and the Colorado River region; water management outside the Active Management Areas, including water quantity assessments; water quality; use of effluent for potable and other water needs; access to and utilization of other renewable sup-

plies; interstate and border water issues; the surface water/groundwater interface; riparian areas and other environmental considerations; and implementing effective conservation programs.

Discussion following the lecture focused on pricing of water and conservation efforts. I had no problem discussing pricing, noting that few places in the world incorporate scarcity in pricing of their water. I noted that water prices reflect the cost of extraction/diversion, treatment and delivery. We all expect water to become more costly over time because the cost associated with obtaining, treating and delivering water will increase over time. By how much and how quickly are the questions. Our system of water pricing associates no value to the water molecules themselves.

Questions were raised about conservation programs in Arizona, and although I could speak to some of what we do with tiered pricing and municipal conservation programs, I felt somewhat at a loss in discussing why we were not doing more water conservation. In preparation for my presentation, I did some quick calculations to compare use of potable water by Parisians on a per capita basis and the figures for Tucson Water customers. Although not entirely comparable, on a per capita basis, Tucson water use is easily twice as high as that for the Eau de Paris service area. It seemed to me then and still seems to me that we have considerable capacity to conserve more than we do.

Tucson, Pima County and many other entities around the state are placing renewed emphasis on conservation programs, and the Arizona Department of Water Resources is poised to develop conservation programs for the Fourth Management Plans in the Active Management Areas. I came home thinking that although conservation alone won't solve our water scarcity dilemma, we still need to better educate water users about conservation and the sources of our water supplies.

My Paris adventure served to renew my conviction that convincing Arizona water users to do more to conserve water is a necessary and relatively low-cost way of addressing scarcity. 🏠



Sharon Megdal at an underground Paris attraction — Le Musée des Ecouts de Paris (The Paris Sewer Museum) Photo: Bryce Megdal



Public Policy Review

by Sharon Megdal

WRRC Soldiers On In Face of Bittersweet News and Budget Woes



This column is a bittersweet one. I say this because this issue of the newsletter marks the end of an era: Joe Gelt is retiring as Water Resources Research Center editor/writer after working tirelessly at the center for over 20 years. A key accomplishment during those years has been his involvement in launching this newsletter, the *Arizona Water Resource*.

The newsletter bears his personality, and its success must be attributed to him. Along with the *AWR*, Joe's other writing assignments included the *Arroyo*, WRRC's other newsletter, which Joe also helped establish, as well as the myriad reports the WRRC has submitted over the years.

I knew Joe would retire someday, and the someday is now. That's the bitter part of the news. There is, however, a positive side to sweeten and lighten bitterness. Along with Joe having more time to work on personal writing projects and to indulge in personal interests, he will continue working at WRRC part-time. Over the next several months, we'll be figuring how this will be reflected in the frequency, format and length of the newsletter. I hope to hire a part-time associate editor, but with recent and looming budget cuts, this may not be possible with existing revenue streams. Although the WRRC has done a lot with limited resources, the current budgetary realities are of sufficient concern that I feel a need to inform you, our readership, about our efforts to continue to meet your expectations and our own aspirations.

When I was preparing to become WRRC director in 2004, I convened meetings of stakeholders to ask what they liked about the WRRC and what they would like to see more of. Their most common positive comment had to do with the quality of this newsletter. Many indicated that they look forward to reading it and appreciated receiving a paper version.

The WRRC has always sought funding to cover the production costs of the newsletter, including layout. The newsletter serves an important information transfer and outreach function. Further, through this column, it enables me to communicate with readers, providing information about water policy and WRRC matters.

More recently, we've offered organizations that help pay production costs the opportunity to include an insert in the newsletter. Fortunately many have taken advantage of this opportunity over the years to work with us. We thank all of you who have done so, and I invite others to contact me about newsletter sponsorship and support.

We hope to continue our recent tradition of publishing an *Arroyo* each winter. The *Arroyo* is our single-issue newsletter, now back on track after an hiatus from 2002 until 2007. The 2007 issue focused on recharge, and the 2008 issue was on river restora-

tion. In early 2009, we plan to publish an *Arroyo* focused on water re-use. Claire Landowski, the E.L. Montgomery & Associates summer intern, continues to work with us on this upcoming issue.

As Joe and the WRRC move through this transition, we hope to maintain the quality you expect of us. Please do not hesitate to contact me with any feedback you might have and join me in wishing Joe well.

All of our publications are posted on our web site. We were able to secure grant funds through the US Geological Survey 104b program to hire a part-time applications systems analyst. John Dale joined us in August and is helping us maintain and improve our web site. (See Vapors, page 3, for more information about work on the WRRC web site.) The WRRC has administered the 104b grant program, authorized by the Water Resources Research Act, since 1964. For years now, this federal funding has been zeroed out each year. Securing continued federal funding, even for an established program such as this one, can be challenging. The funding has remained flat for many years, with the real purchasing power of the grants program diminishing over time. Nevertheless, this funding is critical to the WRRC, and I will again visit Washington this winter, along with water institute directors from other states, to request continued funding of this important national program.

Along with the water institutes in Texas and New Mexico, the WRRC is seeking federal support for the recently inaugurated U.S.-Mexico Transboundary Aquifer Assessment Program. This federally authorized program, signed by President Bush in late 2006, is carried out in partnership with the U.S. Geological Survey. Work in progress includes an inventory of investigations and reports pertaining to the Santa Cruz shared aquifer; we expect similar work on the San Pedro to follow in the very near future. The authorizing legislation allows U.S. funds to be expended in Mexico for binationally prioritized assessment studies pending a 50 percent cost share (cash or in-kind) from Mexican resources. We are actively working with stakeholders from each binational aquifer, including representatives from Sonora, Mexico and the Mexican federal government. We recently had the two Arizona aquifers accepted for case study by the UNESCO Internationally Shared Aquifer Resources Management Initiative.

Space constraints prevent me from providing more of an overview, but please visit our web site and those of our affiliated programs, such as Arizona Project WET and Arizona NEMO, to obtain more information. More than ever, partnerships are essential to fulfilling our mission of promoting an understanding of critical state and regional water management and policy issues through research, community outreach and public education. We look forward to working with you! 🏠



Public Policy Review

by Sharon Megdal

Much Done, Much More to Do to Develop Needed State Water Plan



I have been thinking quite a bit about water planning. Water managers and leaders throughout the state have been discussing the many challenges associated with meeting the water demands of our state's growing population. We've experienced several years of drought conditions, and climate change models predict the Southwest will become drier and hotter. Even in the best of cir-

cumstances, we know there is a need to identify additional water supplies to meet expected growth in water demand.

Many water providers acknowledge this need. The 2004 Operational Plan of the Central Arizona Groundwater Replenishment District recognizes the need. The Central Arizona Water Conservation District has initiated its ADD Water Process, which focuses on how new water supplies would be shared — and paid for — by those within the Central Arizona Project service area. The actual sources of additional water are yet to be determined. The Upper San Pedro Partnership has been working on identifying options for additional water supplies. Yavapai County is a hotbed of activity regarding growth and water supplies. Also to be considered in any water supply inventory are the remaining unsettled Indian Nation water rights claims.

But, on a statewide basis, do we have readily available and reliable estimates of how much water is needed where and in what time frame? Do we understand how restrictions on water supplies in one area of Arizona may affect water demand in another? How effective will demand side management be in reducing the need for expensive infrastructure, including treatment facilities? What cushion will Arizona Water Banking Authority storage provide? I learned at a recent national conference that most western states have a state water plan. Should Arizona have one, too? What are the consequences of continuing to look at these matters in a fragmented rather than comprehensive way? A statewide examination would enable us to develop a complete picture of needs, including infrastructure, and priorities and strategies for meeting those needs, as well as to identify supportive legislative actions. Options for paying for infrastructure and water supplies would necessarily be included.

Some might think that sufficient water planning is done in the Active Management Areas, home to more than 80 percent of Arizona's population. The director of the Arizona Department of Water Resources approves Management Plans for the AMAs, but they are not truly water plans. Rather, they are conservation regulations, as mandated by the 1980 Groundwater Management Act, as amended. Historically, they have included an assessment of an AMA's progress in meeting its statutory

management goals, along with projections and other useful information, but they have not included plans for achieving these goals.

We are on the cusp of preparing the Fourth Management Plans for the AMAs. The ADWR is preparing assessments for each of the AMAs, but these assessments have not yet been released. Given the two-year lag between official promulgation of the Management Plan regulations and their effective dates, it is clear that the Fourth Management Plans will not be effective before some time in 2011 at the earliest. What should be done if it appears unlikely that one or more of the safe-yield AMAs would not meet this statutory management goal by 2025?

Beyond the AMAs, future growth is expected to be robust, the current downturn notwithstanding. The Statewide Water Advisory Group has been considering the water needs of different parts of the state. While SWAG recommendations have resulted in state legislation regarding adequate water supplies outside the AMAs, the SWAG's charge is not to do water planning.

ADWR has been very busy compiling the *Arizona Water Atlas*, which is a far-ranging source of information by planning areas of the state; information included in the *Atlas* is available on line at www.azwater.gov. The web site states that currently available water-related information for the State of Arizona has been "collected and synthesized" in order to provide a comprehensive overview of regional water supply and demand conditions, identify water resource issues facing Arizona communities, identify missing information and how information access could be improved, and initiate a renewed and more systematic effort by the department to assist Arizona water planning projects and develop solutions. The *Atlas*, however, is not a state water plan. If we don't take advantage of this up-to-date assembly of data, will we be missing an opportunity to understand better the implications of where we are heading?

Do we have the capacity to develop a state water plan, given the shortage of financial resources and the great demands on staff resources at ADWR? Do we have the political will to consider the many difficult questions associated with future water supplies and how to pay for them? Or conversely, can we afford not to develop a state water plan? Do the complexities necessitate taking a big-picture look? If the collective will to develop a plan materialized, could we establish a process for developing the plan that is inclusive and transparent? Can we use development of the Fourth Management Plans to launch a statewide effort?

I would greatly appreciate your sharing your thoughts regarding these many questions by writing to me at smegdal@cals.arizona.edu. ■



Public Policy Review

By Sharon Megdal

Payoffs From Water-Saving Practices May Have Down-the-Line Costs

Reduced wastewater flows due to graywater use is a concern



Practicing water conservation is generally acknowledged to be a good thing. Everyone recognizes that one way to lessen the need to find new water sources to supply growing populations is through demand side reductions or water conservation. As with most water management issues, however, complications invariably arise. One's perspective may depend on what kind of water is being

conserved and where.

Where legal, capture of rainwater or installation of graywater systems reduces demand for potable water. (It is worth noting that states have different statutes governing these practices.) Tucson, long a leader in water conservation, recently became the first city in the country to require rainwater harvesting for new commercial properties and graywater stub outs for new residential properties.

Admittedly, one can't assume that redirecting water use away from the potable system translates into less overall water use. It may just be a replacement of one type of water with another. However, electricity and treatment costs associated with the potable system will be reduced if household demand for potable quality water is reduced. Such water substitution would seem to be a good news for water supply and management agencies. But is it?

A recent newspaper article reported that the Southern Nevada Water Authority is opposed to installation of graywater systems in the Las Vegas area. More reuse of water at the household level means less water delivered to the wastewater treatment plant. For SNWA, this means lower discharges of treated wastewater into the Colorado River and, therefore, reduced return-flow credits. That is, reduced flows to and out of the wastewater treatment plant translate into a reduction in SNWA's overall withdrawal of water from the Colorado River system.

Discouraging graywater use seems to be a strange message to come from the agency that has received national attention for its efforts to replace turf with low water use landscaping. Yet SNWA is being consistent in its focus on reducing outdoor water use which does not result in reduced flows through wastewater treatment facilities.

But it seems a mixed message to say that at the same time outdoor water use should decrease, households must use potable quality water for other outdoor uses. While graywater use may reduce return flow water, it also reduces by a like amount the need to withdraw Colorado River Water for outdoor uses. The SNWA policy position reduces household choice and conveys the message that more use of potable water is better than less use.

Las Vegas is not the only community concerned about reduced wastewater flows associated with greater use of graywater systems. There are two general concerns. One relates to the operation of the wastewater collection system itself. Older systems have been engi-

neered so that dishwasher and washing machine output would flow through the sewer system to the treatment plant, providing relatively clean water to mix with the not-so-clean stuff that flows through the system. The graywater flows are needed to push the solids through the mostly gravity based, engineered systems. Reduced graywater flows could lead to some waste collection problems. For example, the City of Phoenix is experiencing increased wastewater treatment costs due to reduced flow in total water volume while having the same or increasing amounts of solid wastes.

The other concern relates to water quantity, although it works out differently in Arizona than in Las Vegas. In Arizona, outflows from wastewater treatment plants have value as a component of a community's water supply portfolio. Whether through recharge and recovery or through enhanced treatment and delivery to turf or industrial users, water reuse is growing in importance to Arizona communities.

There are other concerns regarding water conservation or increasingly efficient water use. Reduced return flows from agricultural water use, for example, may have adverse impacts on riparian or other systems that rely on those flows. Another concern relates to "hardening" of water demand. If people become so efficient in their water use, fewer less painful opportunities exist for water conservation in situations of natural drought or water cutbacks, such as those being experienced in California due to the cutbacks in water flowing to Southern California through the State Water Project.

In Arizona, we've seen a move to best management practices for all water using sectors in the Active Management Areas; the Groundwater Management Act requires regulatory conservation programs in AMAs. Whereas the industrial conservation programs have long been based on best practices according to industry standards, we've seen a move to BMPs in the agricultural and, more recently, the municipal sectors.

It is important that the effect of moving away from a quantified water conservation target be monitored. After all, we do not want to see per capita consumptive use rates going up as a result of these changes to the regulatory programs! It is important that homeowners remain vigilant regarding their water use as they install rainwater or graywater systems.

I am now nearing the end of another spring semester when graduate students in my water policy class make presentations on their research. It is gratifying that they are connecting the collection of information with its use to consider policy options. Not that I necessarily need such a reminder, but working with them on their papers reminds me how complex evaluating alternatives and implementing water policies can be. Water conservation is no exception. Since water conservation policies are complex and can have unintended consequences, they must be monitored and evaluated, with the public informed to better understand their cost and effectiveness. ■■■



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? 



Public Policy Review

By Sharon Megdal

Organizing International Workshop Provides Much Behind-the-Scenes Learning



In keeping with the featured theme of the current newsletter, which is the Arizona, Israeli, and Palestinian Water Management and Policy Workshop, my column, usually devoted to water policy matters, will instead discuss some of the lessons learned organizing the event. The broad significance of the workshop along with the challenges and details associated with its planning provided fertile grounds for learning.

The value of interdisciplinary teamwork was evident from the outset. A core group of four individuals of varied backgrounds conceptualized the workshop. Only two of us, Robert Varady, Deputy Director of the Udall Center for Studies in Public Policy, and I, have water policy/management expertise. Anne Betteridge, Director of the Center of Middle Eastern Studies, and Ed Wright, Director of the Arizona Center for Judaic Studies, are experts in other fields. We worked consistently over a lengthy period to develop a broad but balanced program, our varied perspectives and backgrounds ensuring a program of diverse perspectives.

Not to be overlooked are others who contributed significantly to our planning process, including Chet Phillips, graduate research assistant at the Water Resources Research Center. Multiple perspectives and backgrounds at the early planning stages were essential to program development, including consideration of cultural differences.

Another lesson learned was the value of seed funding and the necessity for taking some risk. When our initial request for outside funding was unsuccessful, we confronted the dilemma of lacking financial backing but receiving enthusiastic response to the initial invitations to participate. Significant thought went into the selection of workshop dates and the location. We were concerned if we abandoned our plans or moved the workshop to a different date, we would lose momentum. In the absence of other funding, WRRC committed Technology Research Initiative Funds to secure the hotel site. (The WRRC is a participant in the TRIF-funded University of Arizona Water Sustainability Program, administered by the Arizona Board of Regents. Arizona voters approved TRIF funding in 2000, with funds derived from an increase in the state sales tax to support education.)

Our persistence in seeking financial backing resulted in obtaining grants from the UA Foundation, the National Science Foundation, the U.S. Israeli-Binational Science Foundation and others. We were heartened by these successes that validated our view that the workshop would be timely and with significant value. Our decision to move forward despite lack of firm outside funding also was validated, although it involved some risk.

Another risk had to do with planning to hold the workshop in Tucson, rather than in the Middle East. We were asking approximately two thirds of the attendees to travel to Tucson rather than one third traveling to the Middle East. Logistics, however, required

we hold a UA-sponsored workshop in Tucson. We could not have overseen the detailed development and delivery of the workshop otherwise. More importantly, the UA serving as a neutral host was a benefit recognized by the participants.

Two main purposes guided the workshop: (1) to identify pressing water issues related to long-term water sustainability through educational presentations and facilitated dialogue among participants; and (2) to develop a targeted, international collaborative research program that addresses research gaps and opportunities. We limited the workshop to invited participants to better achieve the goal of identifying research projects. This approach, however, did not preclude inviting the public to a special evening event. Attracting over 200 people, this no-cost event enabled interested members of the public to hear Israeli and Palestinian officials discuss pertinent water issues and to ask questions.

The workshop succeeded in furthering cross cultural understanding of local and regional water needs.

Unable to attend the public event due to obligations at home, Dr. Shaddad Attili, Chairman of the Palestinian Water Authority, one of our two keynote speakers, offered to send video-recorded comments and a staff person to participate in the discussion. The public therefore was able to benefit from the perspectives of Professor Uri Shani, director general of the Israeli Water Authority, as well as those from the PWA, via DVD, thus fulfilling our plans and expectations for the public event. Lesson learned: Commitment to finding solutions coupled with flexibility enabled us to deliver an informative public event.

An important feature of our workshop was the participation of young scholars, including undergraduate and graduate students. Students participating in the second full day of the workshop contributed significantly to the discussions and no doubt benefitted from them. The workshop is the first step in the development of a research and science diplomacy program to undertake collaborative research projects addressing critical water management needs of communities in each region. These young scholars demonstrated their interest in participating in future projects.

The workshop succeeded in furthering cross-cultural understanding of local and regional water needs. Further, it began to establish the trust essential to collaborative research projects and proposals and encouraged the recognition of shared goals. In addition to the development of several joint project proposals, an edited volume with papers from the workshop is planned.

My final lesson to share: Although considerable work over a long period of time went into developing and delivering the workshop, the real work truly has just begun. 🏗️



Public Policy Review

By Sharon Megdal

Now's the Time to Fit Together the Pieces of an Arizona Water Plan



Over time, I have become more and more convinced that Arizona needs to do a better job of planning for our water future. We face water challenges within and outside of the Active Management Areas. I suspect no person knowledgeable about our complex water issues would deny we face challenges associated with growth and limited water supplies. Significant uncertainties abound, including those associated with flows of the Colorado River.

A recent survey suggests that Arizonans recognize water as a major issue needing investment. The Center for the Future of Arizona's Gallup Web survey of 831 Arizonans asked that they prioritize six options for the best use of their tax dollars. The greatest number of respondents (28 percent) chose: "Adopt a water management plan that protects water supplies for the entire state." Rural areas and small cities registered greater support for water management planning than other sectors, at 28.7 and 29.6 percent respectively. Otherwise, little difference existed in the opinions by geography, attachment level, or age when it comes to water.

The next most popular policy option (21.5 percent) was "balancing population growth with preserving open space and recreational opportunities." Other options included mass transit systems, new highways and roads, improved interstate transportation and high speed Internet. Admittedly, survey results merely suggest what policies or investments citizens are likely to support in the future. Results clearly depend on the structure of the survey instrument itself. Nevertheless, they suggest that citizens recognize the need for investment in water infrastructure.

What do I mean by water planning? I recently responded to this question by stating that I would begin simply by identifying (1) what water needs have been identified by jurisdiction/water provider; (2) which entities may be looking at the same water sources (such as the Colorado River); and (3) where economies of scale could be realized for infrastructure investments. It was suggested that I call the exercise a "Needs Assessment" rather than a "State Water Plan." I have no problem with that; that is exactly what I am suggesting we do. One has to know the needs before one can identify the solutions.

So, by all means, let's get people together to talk about their needs and see where solutions overlap. Let's engage in a sustained discussion — in other words, we don't go home after collecting data — about water sustainability in Arizona. Let's discuss the water needs of current and future residents, agriculture and industry (including energy), as well as water needed to support the environment. Let's also talk about issues that may not be on the horizon for many of us. For example, the May issue of *Southwest Hydrology* iden-

tified carbon sequestration as an issue. What if efforts to sequester carbon in deep aquifers limit our future ability to use aquifers? Very few experts are discussing the treatment of poor quality groundwater as well as efforts to sequester carbon.

The Arizona Department of Water Resources has worked long and hard to collect the data presented in its water atlas. We need to take a collective look at that data and see what additional information we need to gather. We need communities throughout Arizona participating, much as they do with transportation planning.

Resources necessary to support a needs assessment, however, are limited since Arizona is cutting agency budgets. This makes it difficult to carry out existing tasks, let alone take on an assignment as significant as a statewide needs assessment/planning exercise. But all the work does not have to be done by ADWR. If we put our heads together, we can perhaps come up with a strategy involving the universities, and loaned executives from local governments, water agencies, industry and non-governmental organizations.

Arizona Cooperative Extension will be visiting some of Ari-


zonia's communities to conduct water listening sessions. County Extension and campus personnel will listen to communities' questions and concerns about water. This winter, we will host a visit by the director of the Oklahoma Water

Megdal on Blue Ribbon Panel

WRRC Director Sharon Megdal has been invited to join the Blue Ribbon Panel on Water Sustainability, established to provide advice to the Arizona Department of Water Resources, Arizona Department of Environmental Quality and the Arizona Corporation Commission. A prime task of the multi-agency collaboration will be to focus on increased water conservation and water recycling.

Resources Research Institute to hear about their participation in Oklahoma's water planning. At the WRRC, we recently received a grant from the Nina Mason Pulliam Charitable Trust (see page 3) to assess methods used to quantify the water needs of the environment, which will enable us to work more closely with stakeholders currently involved in this important work. Numerous stakeholders, including those outside the three-county Central Arizona Project service area, are participating in the ADD water process. Future needs of water providers and Central Arizona Groundwater Replenishment District are being considered. The Arizona Investment Council funded a study of water-related infrastructure needs that is posted on its web site.

The point is that many pieces of the puzzle are already being assembled. What we need is an overlay to bring the parts together for a comprehensive look at water and water-related infrastructure needs.

I continue to use the half-full, half-empty glass to summarize our water management situation. Some may say we cannot afford to undertake a needs assessment/planning exercise with the economy in a slump. Knowing that growth and prosperity will return to Arizona, I can only ask the question: Can we afford not to? 



Public Policy Review

By Sharon Megdal

Applied Outreach Strategies, a Priority in Awarding UA Distinguished Outreach Professorship



I was very pleased to be notified in mid-March that I am to receive the highest University of Arizona honor for outreach and will officially be awarded the title University Distinguished Outreach Professor at the Winter 2010 Commencement. The nomination submission included a letter of nomination, several outside supporting letters, and a personal description of my approach to

outreach and scholarship along with documentation. Following are edited and abbreviated portions of my personal statement entitled “Improving the environment and quality of lives through research-based outreach and education on water management and policy.”

My life work has focused on questions related to public policy and how government can better meet its policy objectives. My training as an economist and my life experiences provide the analytical framework and background for my scholarly activity at the UA. My work, which focuses on the water management and policy challenges that confront communities, integrates the local, regional, state and global communities in a multi-directional fashion. My research, teaching and outreach are fully integrated and designed to evaluate policy practices and options, with the goal of improving practices in order to resolve water management challenges.

This integration is fundamental to my outreach practices. I regularly educate individuals who come from many different backgrounds, teaching them about water management practices and challenges. I accomplish this through participation in many types of local, regional, state, national and international forums. Knowledge alone is not sufficient for effective outreach. Effective communication and the sharing of knowledge require truly caring about connecting — engaging — with the audience. Not only do I speak to audiences, but also I empower them to learn more. In addition to the primary subject matter, I provide useful references and resources. I often make connections that are useful building blocks to carrying out and/or obtaining funding for my research programs.

Because outreach programs that effectively share knowledge and information should not be limited to presentations I conduct personally, I have endeavored to provide successful forums for others to engage with those knowledgeable about water management, both as scholars and practitioners. Since joining the Water Resources Research Center in 2002, I have planned and presided over seven successful statewide water conferences. These conferences, which have become a signature product of the WRRC, provide a unique opportunity for individuals of many different perspectives and professions to meet in Arizona to discuss a water matter/challenge of statewide importance.

I initiated the WRRC’s successful Brown Bag Seminar series, whose audiences are about evenly split between the UA community and the broader community. The WRRC Brown Bag seminar series


and annual conference reflect my belief that connecting researchers, policy makers, students and the public will result in better understanding of water management issues and thereby lead ultimately to better policy outcomes.

I am very much involved in outreach when training future generations about water management and policy sustainability by teaching the graduate level course Arizona Water Policy, which I have taught each spring since 2005. I offer the students a policy-based course of instruction that brings high level policy makers into the classroom. The benefits to this are two-way. The students benefit from the expertise of the guest lecturers; the guest lecturers appreciate the opportunity to interact with the graduate students. Guest presentations are connected to class readings, and the connections often extend to the students’ research papers. I see a significant impact of my ability to connect course instruction and research with real world water managers and policy makers in the enhanced training I give to the future water and environmental leaders of Arizona, the nation and the world.

Of course, responding promptly to requests for information, which often involves knowledge acquired through research, is a fundamental aspect of my outreach, as is my involvement in WRRC publications. When I joined the WRRC in early 2002, I started this public policy column. I’ve not missed a single issue, this being column number 43. Resuming annual publication in 2007 of the *Arroyo* after a five-year hiatus is another example of my desire to take research findings and UA knowledge to the broader community. (I am gratified that the just released *Arroyo* on the water energy nexus, written by WRRC staff and a student intern, has already generated very positive feedback.)

I try to contribute to policy making through research based outreach. On my own initiative or on request, I have undertaken analytical studies that connect my academic training and real world experiences. Outreach is sometimes part of my research methodology. Several of my projects have involved interviews of water policy and management professionals, decision makers, and representatives of the business community, NGOs, and the public. In addition, my work on environmental preservation and enhancement has involved significant outreach, as has my international work related to the Middle East and to the U.S. Mexico border.

My 2008 election to a six-year term on the Board of Directors of the Central Arizona Project demonstrates how my public service complements and is therefore integral to what I do at the UA. I use my expertise to reach out and actively engage in making water policy and managing our precious Colorado River water. In the process, I gather information and make contacts useful to my research, teaching and outreach activities.

Working to make a difference through outreach is a way of life. I thank all those who work with me, and I sincerely appreciate every thank you I receive from people and organizations I’ve touched. 



Public Policy Review

By Sharon Megdal

A Summer Thought — Partnerships Are a Strategy For All Seasons



Summer time is often a time for travel and reflection. Reflecting on different aspects of my work during my summer travels, I see a constant theme emerging — the importance of effective partnerships. By partnerships, I mean people working together to effectuate change and improve water management. For example, our annual conference, dedicated to fostering good water and

environmental leadership, relied on partnerships for its success.

This was fitting, that a conference devoted to leadership should rely on partnerships since partners work together as a team, and teams require effective leadership to be productive. Partnerships imbued with the sense of good leadership enabled many individuals to work countless hours to develop an interactive and varied conference program. The numerous and varied perspectives resulted in a conference design that attracted much acclaim.

In the larger context, I think we all recognize that partnerships are fundamental to resolving the water management challenges we face. The legislatively required Water Resources Development Commission (Chapter 329 of Second Regular Session of the 49th Arizona Legislature) demonstrates the critical importance that varied perspectives be represented. The newly formed commission consists of 15 members, appointed by the director of the Arizona Department of Water Resources, along with nine ex officio and six legislative members. Although it is not explicitly required to develop a state water plan I am encouraged that the commission is charged with assembling much of the information that would go into a state water plan or needs assessment.

Elements include: compiling the projected water needs of each county in the next 25, 50 and 100 years; identifying and quantifying water supplies currently available in each county; identifying potential water supplies for use in meeting additional demands for the same time periods; identifying any legal and technical issues associated with the use of those supplies; and identifying potential mechanisms to finance the acquisition of water supplies and infrastructure required to treat or deliver water supplies. Finally, the commission is asked to make recommendations regarding the need for further studies and evaluations. All of this work is to be completed by October 1, 2011.

This is quite an undertaking, especially for ADWR, an agency that suffered a substantial budget cut and staff reduction to less than 100. Many will have to work in partnership for the commission to meet its mandate. The law explicitly identifies as sources of technical support ADWR, the Central Arizona Water Conservation District, the Arizona Water Banking Authority and rural water study groups. I would expect technical assistance from many more partners, including the water using sectors, the universities and the U.S. Geological


Survey, among others.

Partnerships are likewise extremely important to the U.S. Mexico Transboundary Aquifer Assessment Program, in which I have been involved since its inception. The University of Arizona is working closely with USGS, the U.S. and Mexican Sections of the International Boundary and Water Commission, Mexican state and federal water agencies, ADWR and others to implement the Arizona Sonora portion of this program. Differences in legal structures and the roles of government agencies have required us to carefully work through multiple layers of agreements to undertake binational work in a manner officially recognized by both countries.

In early July, I had the privilege of discussing the importance of partnerships at the Scientific Segment of the 19th Session of the International Hydrological Programme Intergovernmental Council, housed at UNESCO in Paris. The title of the session was “Hydrological Sciences for Policy Responses to an Uncertain Global Change Future.” The only social scientist of the six speakers, I highlighted our efforts to build a shared vision of approaching priority issues in the Santa Cruz and San Pedro aquifers. Some factors affecting policy responses to global change across national borders are very similar to those within our state. They include: differing rates of urbanization, population growth and economic growth; predictions for hotter and drier climate; and aquifer recharge that depends on ephemeral, intermittent and/or effluent discharges. I underscored the importance of collaboration of multiple agencies and universities to aquifer assessment and other studies to provide decision makers with information needed for water management.

Whether the task is developing leadership or furthering sound water management at the transboundary, state, regional or local water management level, it takes time to establish and maintain effective partnerships. Perseverance, flexibility, creativity, respect for different perspectives, appreciation of the need for multiple types of expertise, and good and regular communication are all required.

Turning to another matter, this one closer to home, a time of transition is at hand regarding an issue we at the Water Resources Research Center take a great deal of pride in — communication. Joe Gelt, editor of the AWR newsletter, who has been partially retired since 2008, will be making a full-time commitment of it. This newsletter is his last. Joe was involved at the beginning, when this newsletter was initiated in 1992, and has been editor and the primary writer since then. His many features and articles, covering a broad range of issues over the years, have been a valuable source of information for many people interested in water. His work has brought him and the WRRC numerous accolades. We are going to miss his contributions tremendously and hope he will think of us as he writes interesting articles in his spare time.

Given our resource constraints, we are now considering our options for the format (possibly moving to on-line publication only) and frequency of the newsletter. Meanwhile we will continue to print the annual *Arroyo* newsletter each winter, with the next issue focusing on desalination. I welcome any suggestions/comments you may have. My email address is smegdal@cals.arizona.edu. 



Public Policy Review

by Sharon Megdal

Uncertainty: Are We Running Out of Water?



This column focuses on an issue that permeates our state and regional water management challenges: uncertainty. Here are just a few of the uncertainties affecting Arizona's demand and supply picture. Given the downturn in our national and state economies, will Arizona's population grow slower than expected? Will water use patterns change significantly as drought continues? What water supplies will the Central Arizona Groundwater Replenishment District use to meet its long-

term replenishment obligations? To what extent will we reuse our waste water? Will environmental water needs be factored into our water planning? How much and what type of water supplies will be used to meet growing demand for energy, especially given the focus on renewable energy sources? Will water supplies delivered through the Central Arizona Project be curtailed to a significant extent due to shortages on the Colorado River? What will water cost in the future? Perhaps the most fundamental question I hear asked related to uncertainty is "are we running out of water?"

Major studies are underway to help get a handle on these uncertainties. The *Final Report of the Blue Ribbon Panel on Water Sustainability* contains many recommendations related to water reclamation and reuse and has recommended more focused Arizona-based investigation on the water-energy nexus. The Water Resources Development Commission, whose report is expected in October 2011, is working on projections of water supplies and demands and estimates of water infrastructure costs. The Central Arizona Project continues to work on securing water for CAGRDR replenishment to meet its legally mandated obligations. The ADD (Acquire, Develop, and Deliver) water process is looking at meeting future demands. But what water will actually be available for these purposes and at what cost remains unknown. Much work is focused on modeling the Colorado River and understanding the implications of drought and climate variability/change. Holding junior priority to Colorado River water, CAP has to be very concerned about shortage declarations.

I'd like to single out this last issue for further discussion because it is receiving so much media attention. On October 29, 2010, the website 247wallst.com posted the article "The Ten Biggest American Cities That Are Running Out Of Water" (<http://247wallst.com/2010/10/29/the-ten-great-american-cities-that-are-dying-of-thirst/>). The website bills itself as "providing insightful analysis and commentary for U.S. and global equity investors." The ranking was based on the July 2010 NRDC (Natural Resources Defense Council) study, "Climate Change, Water, and Risk: Current Water

Demands Are Not Sustainable" (<http://www.nrdc.org/globalwarming/watersustainability/>). The 247wallst.com report has Tucson as number eight, Las Vegas as seven; Phoenix as three; and Los Angeles number one! Four of the major cities in the Lower Colorado River Basin were among the top 10 and the reasons are related to Colorado River flows. This is some of what was written for Tucson: "Currently, the Tucson region uses about 350,000 acre-feet of water per year. At this rate, Tucson's groundwater supply, which now provides the majority of the city's water, has a very limited life span. In addition to this, the city is currently bringing in 314,000 acre-feet per year from the Colorado River under the Central Arizona Project. However Tucson is growing rapidly... This, combined with the political uncertainty of the Central Arizona Project allocation, places Tucson at extreme risk for future water shortages." About Phoenix they write: "Like many of the other western cities on this list, Phoenix is extremely dependent on water imported from the Colorado River. This is because nearly half of the water the city's residents use comes from this significant source. As the Colorado River Basin enters the eleventh year of its drought, the city's reliance on the river may soon become a serious problem. If the drought continues, water deliveries to Arizona could potentially be cut back. To keep up a sufficient water supply, Phoenix is adopting an aggressive campaign to recycle water, replenish groundwater and try to dissuade over-consumption. Time will tell if these measures will be enough."

The article and the NRDC report reflect the uncertainties associated with Colorado River supplies delivered through the Central Arizona Project. Regardless of inaccuracies, inconsistencies or omissions, the information presented begs the question: what are we in Arizona doing to address the uncertainties? In fact we are doing a lot. The Arizona Water Banking Authority has stored considerable water for future shortages. The seven basin states, with the Department of Interior, crafted shortage-sharing regulations designed to limit impacts to municipal water users when a Colorado River shortage is declared, something now considered more likely than just a short time ago. Utilities are engaged in scenario planning and adopting multi-pronged strategies, including increased conservation, for meeting growing demands.

However, publicly accessible information at the sites people are most likely to go for information appears limited. My searches of the CAP and Arizona Department of Water Resources websites found little information that would be handy for reporters and others interested in how Central Arizona is preparing for a declaration of shortage on the Colorado River. While we cannot necessarily reduce the uncertainties, we can and should explain to the public how the water community is addressing them. Working in partnership with others, the WRRC may need to add this task to its to-do list. 🏗️



Public Policy Review

Sharon Megdal

Back to Fundamentals—On Economics and Water Pricing

Some readers of my column may not know that I am an economist by training. As a graduate student and at the start of my professional career, I focused on government tax and expenditure policy as well as applied statistical/econometric work. The closest I came to the study of water resources was taking an undergraduate class in environmental economics. I started out my professional career as a member of the Economics faculty at the University of Arizona. It was not until I was appointed to fill a vacancy on the Arizona Corporation Commission (ACC) in 1985 that I was introduced to water matters as a regulator of private water companies. For those unfamiliar with the ACC, it is Arizona's statewide public utilities commission. It is a constitutionally established and elected body. I was appointed to fill a vacancy on an interim basis, until the next general election.


In late 1991, in what was another interesting development in my career path, I became the Executive Director of the regional water district that came to be known as the Santa Cruz Valley Water District. It was in that role that I became fully immersed in water. The district was formed on a temporary basis with an interim board and was charged with developing an operating plan that defined the district's role in augmenting the water supplies of the Tucson AMA. I learned a great deal during this interesting, challenging and ultimately frustrating experience. The district was dissolved in 1994 due to a veto exercised by the City of Tucson board member when the interim board voted on permanent formation of the District. I subsequently became a water resources consultant. In 2002, after almost 16 years away from academia, I joined the Water Resources Research Center. I tell you all this because I find the perspectives gained from my training as an economist and my ACC and water district experiences very relevant to my work today.

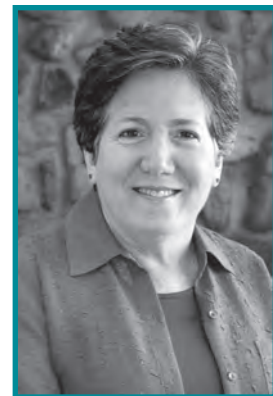
My experience as an ACC Commissioner helped me realize that fundamental principles of microeconomics were the most important to consider when establishing policy, particularly that related to water pricing. People respond to pricing signals. Prices do affect demand. Here's just one example. During the first half of the 1990s, there was significant concern about the underutilization of the water made available to Central Arizona through the Central Arizona Project canal. There was more supply of CAP water than demand and California had access to water left in the Colorado River by Arizona. I served on a Task Force created by the Director of the Arizona Department of Water Resources to consider options for increasing use of CAP water. It had been expected that, once available, the agricultural sector would use CAP water in place of groundwater. But for most irrigators the CAP water was more expensive to use than groundwater, and there were no regulations in place preventing the use of groundwater. The result was what an economist would have predicted. The agricultural districts chose to use lower cost groundwater. Making a quantity of CAP water avail-

able to agriculture did not translate into its use. The relative costs associated with alternative and available water supplies mattered. Weather conditions mattered, too: 1993 was a particularly wet year.

Some of my recent work connects water pricing with another topic in which I have been interested since my days at the ACC: public versus private ownership of water systems serving Arizona communities. The Arizona Water Infrastructure Financing Authority (WIFA) releases annually a rate survey of water systems throughout Arizona. Information on system connections, water deliveries, pricing structure and ownership is included, making it possible to look at differences associated with public versus private ownership. According to the 2008 WIFA Water and Wastewater Residential Rate Survey (www.azwifa.gov), almost three of four water systems in the state are privately owned. Private water companies are smaller on average, having about 16 percent of the water connections in the state and delivering less than 11 percent of water sold in that year. Whereas five publicly owned systems had more than 100,000 connections, no privately owned system was that large. One of the most interesting findings relates to the prevalence of tiered rate structures where the cost for additional water increases as more water is used. Such a rate structure is considered an effective mechanism for encouraging conservation. Back in the days when I was an ACC Commissioner, there was some resistance to adopting tiered rate structures. One of the reasons was concern that water companies might over-earn or exceed their revenue requirements if water use did not decrease. It took some time before increasing block pricing caught on at the ACC. But things have changed, particularly in recent years.

Examination of the WIFA data for 2003 and 2008 shows that while only 97 private water companies had tiered rate structures in 2003, 153 companies had them in place in 2008. Coupling this with the fact that private water companies typically self-initiate rate setting proceedings at the ACC, this increase is remarkable. It shows what can happen in a short period of time when policies of a rate-setting body change. Of the publicly owned water systems, whose rates are set by local governing bodies rather than the ACC, 65 and 75 had tiered rate structures in 2003 and 2008, respectively. I should note that the total number of water systems was a bit higher in 2003 (437) than in 2008 (424).

The manner in which water regulation is practiced, including rate setting, affects our ability to meet regional and state water policy objectives. We are continuing this work at the WRRC and look forward to sharing our results with you. 



Conference Covers the Five Es of Desalination

By Sharon Megdal, Director



By all accounts, the Water Resources Research Center's 2011 conference on Salinity and Desalination in the Southwest was a success. Over the course of the conference, the excellent speakers did a phenomenal job of covering the challenges and opportunities associated with using desalination technology to address pressing water supply challenges in Arizona, the broader region, and worldwide. Holding the conference at the Pivot Point Conference Center on the Colorado River in Yuma allowed us to see

restoration efforts and visit the Yuma Desalting Plant. The conference benefitted immensely from our collaboration with the U.S. Bureau of Reclamation.

The pages of this newsletter cover some of the information shared, which included technological, environmental, financial, regulatory, environmental, educational, historical, international, and political perspectives. I am going to summarize some of my take-away messages in the context of the framework presented by Shivaji Deshmukh, Assistant General Manager of the West Basin Municipal Water District, which serves several communities in the Los Angeles area. He underscored the importance of four Es to the incorporation of desalination technology, whether for recycling treated wastewater or desalinating seawater: Energy, Environment, Education, and Economics.


While sound engineering (a fifth E) is a prerequisite to utilization of any technology, engineering itself is not the determinant of our ability to deploy desalination technology. Engineering, as well as research and development, influences the economics or cost of technology. The full costs of technology depend on a host of factors, including the energy used and environmental impacts. The dynamic relationship between energy and water is well recognized, if not always well understood. The type and cost of energy required for desalination are quickly mentioned in discussions of desalination plants. Is the energy carbon-intensive? Does production of the energy itself require a lot of water? The other item quickly mentioned is brine disposal. What happens to the brine stream from the desalination plant? What are the economics and environmental implications of discharging it? Examples discussed at the conference included: conveying it 22 miles to a well site for deep injection, as is done by El Paso Water Utilities; discharging it back into the source water, as is done at seawater plant sites; and transporting it to the Ciénega de Santa Clara, as is done with the Yuma Desalting Plant brine stream.

In addition to the panel addressing the environmental implications of operating the Yuma Desalting Plant, there was considerable mention of environmental implications of desalination. Adriana Rodriguez of the Mexican national water agency CONAGUA, spoke about Mexico's desalination program. When I asked her about the potential to build a desalination plant in the Sea of Cortez, something that Arizona water entities have studied, she cited concerns about the environment. When discussing the possibility of building a plant at Rosarita, Baja California, she

noted the environmental impact of brine discharge. This plant has potential to serve some of San Diego's needs. While some seem to see the partnership with Mexico as a way for Californians to export the environmental impacts of desalination, I do not see it that way. Mexico is a very sophisticated partner on water matters. Binational arrangements will have to incorporate sufficient benefits for all partners and address environmental impacts. The recently completed test run of the Yuma Desalting Plant provides an example.

Education is a critical piece of the puzzle. Educating policy makers and the public is key to moving forward with long-term investments. We heard about Israel's desalination strategy, as well as that of Australia, where conditions associated with severe drought spurred action. California's cutbacks of water deliveries from the State Water Project were a wake-up call to residents of Southern California. We also heard about the efforts of the West Basin Municipal Water District, where the public has accepted investment in high-level treatment of wastewater for use by industry as well as general municipal customers. West Basin has also invested in a sophisticated education center for its customers. Education efforts require resources, too, but the payoff can be great. Teachers from the Yuma area attended part of the conference and participated in a workshop conducted by Arizona Project WET. They heard about the complex considerations and costs associated with desalination and toured the water quality center operated by Reclamation at the YDP site. They will surely take what they learned back to the classroom. The conference, however, was just a very small part of the education efforts that are needed by our communities and the State.

Economic considerations permeate all decision making. Understanding the trade-offs associated with alternative policies is critical. The test run of the Yuma Desalting Plant was a conference focus. Now that it is complete, what will the future of this plant be? Will it return to its dormant status? Will the investment be made in re-piping the plant, something we heard was necessary? Should it be made? When the Bureau of Reclamation's reports and other analyses, including the results of the environmental studies being led by Karl Flessa of the University of Arizona, are completed, they will serve as the foundation of much discussion. Other discussions will ensue in Arizona regarding desalination of brackish groundwater and treated wastewater. It is important that we consider carefully the economic implications of alternative courses of action.

We have our work cut out for us. As noted by Deputy Reclamation Commissioner Kira Finkler, in her talk at dinner, we are experiencing long-term drought conditions at a time of severe budget limitations at all levels of government. Michael Galbadon of Reclamation likewise underscored the importance of ensuring long-term access to water for all water using sectors. For many, desalination is or will become an important component in making water supply portfolios sustainable and resilient. I thank all those who attended, spoke, sponsored or contributed to the conference in other ways. Thanks for participating in our joint exploration of the challenges and opportunities associated with desalination in the Southwest. 

Visit to Oregon Offers Insights into Successful Collaboration

By Sharon Megdal



Addressing the water challenges associated with providing water for Arizona's second 100 years will require stewardship, innovation, and collaboration. It took collaboration to get the Salt River Project and Central Arizona Project built. It took collaboration for the recent test run of the Yuma Desalting Plant, a focus of the WRRC's 2011 annual conference held last April in Yuma, Arizona. This year's conference, scheduled for January 24, 2012, is being planned in collaboration

with ASU's Morrison Institute for Public Policy, and it will focus on some of the water-related choices that will have to be made throughout the state. While past water projects of significant scale and cost were the chosen pathway to increasing water supply, lack of financial capital as well as questions about future water security for our communities are now critical determinants of solutions that will meet our state's future water needs. Will we recycle water like Orange County, California? Will we see significantly more use of gray water and rainwater by households? Can conservation forestall the need for large investments? What about meeting the water needs of our natural environment? Dialogue and collaboration are critical to determining the paths we take.

In late August 2011, the WRRC had the opportunity to convene approximately 20 agricultural and environmental stakeholders from Arizona to visit Central Oregon. The purpose of the trip was to build communication channels among the representatives of both sectors and to learn about successful examples of collaboration. We spent the better part of a week visiting areas where the agricultural/ranching community and what is often referred to as the conservation community (although I think we all are members of the conservation community) have developed approaches to water stewardship that satisfy the interests of both sectors. It is hoped that the actions undertaken will enhance stream flow to aid the spawning of wild salmon and other fish habitat. The trip was made possible by a grant from the Walton Family Foundation and was planned in collaboration with the WRRC's sister organization at Colorado State University, the Colorado Water Institute. A group from Colorado made a similar trip in mid-September.


We visited the John Day-Prairie City area, the Three Sisters-Deschutes River region, and sites in Klamath Falls. In each area, we met with ranchers and conservation organization representatives to hear about their successful efforts. We ate lunch at a park in Prairie City, at an organic farm in Three Sisters, and at the Agency Ranch in the Klamath basin. Among the things we saw: wild salmon spawning; an extremely productive organic farming operation; an elk ranch; streams, creeks and even headwaters; beautiful open grazing pastures; a state-of-the-art fish screen and ladder; and so much more. More importantly, we heard about the various efforts

to conserve or redirect water through adjustments to irrigation practices and replacement of leaky irrigation systems. We heard about these efforts from the project collaborators, all of whom took time from their busy schedules to share their experiences and break bread with us.

We learned so much. While recognizing that Oregon and Arizona have very different water endowments and uses, a few of the lessons learned are equally applicable to our situation. First is the importance of drivers and what I will call enabling mechanisms. Oregon state law has some innovative provisions relating to leased and transferred water rights. The regionally important Bonneville Power Authority is required to address salmon issues and this requirement has resulted in a source of sizable funding for the voluntary arrangements between ranchers/farmers and conservation organizations. We also learned that developing and implementing the various programs took considerable time and often relied on multiple funding sources. We heard how some projects, such as the Three Sisters Irrigation District fish ladder and screen, were able to take advantage of one-time or short-term funding opportunities. In other cases, federal programs that provide funding through the U.S. Department of Agriculture were important. Unfortunately, the future of some of these programs is uncertain due to changing federal priorities. Of critical importance were the relationships developed among the parties. Trust is a necessary condition for effective partnerships. Its development also takes time. Along with feeling the beautiful air, we could feel the strength of the relationships of the people working within and across the organizations.

While Arizona and Oregon are so very different, we share many similarities. We share a love for the natural beauty of our state and a desire to be good stewards of its resources. We recognize our challenges and have a commitment to develop solutions to them. It is important for us to open up the channels of communication so that we can build the trust that is required for developing the partnerships needed for solution formulation and implementation. Money helps, too, and this is currently a challenge for us all. Key factors to success will include: trust, staying power (hard work!), communication, collaboration, commitment, leverage, drivers, and enabling mechanisms.

The participants in the Oregon field trip engaged in extensive dialogue at the sites and on the long bus rides between them. Many commented on the value of the one-on-one or small group discussions that occurred among the Arizonans. They are looking forward to more learning and communication here in Arizona. I am, too!

As one of the many opportunities we will have for learning and dialogue on meeting Arizona's water needs in our second 100 years as a state, please consider participating in our January 24, 2012 conference. Information on it can be found at the WRRC web site, www.cals.arizona.edu/azwater. 



By Sharon Medgal



I am taking my first-ever sabbatical this Spring semester. My travels and fact-finding will include lectures in Israel and Australia about water policy under conditions of growth and scarcity. I expect to speak about transboundary aquifer assessment and water banking at the Sixth World Water Forum in Marseille, France. I consider myself lucky to have the opportunity to share our region's water management innovations, along with our challenges. Sharing

experiences and lessons learned is very important for identifying pathways to meeting water management goals. Identifying commonalities actually makes the world seem smaller and gives me the sense that, although many water issues are local or regional, we truly are in this together.

In November 2011, this view was reinforced by my visits to water sites in the Middle East and Mexico. In Israel, I spent two days visiting projects sponsored by the Jewish National Fund of the United States (JNF-USA). Located in the city of Be'er Sheva in the Negev desert, the Be'er Sheva River Park started in the 1990s as a river restoration project. It has grown into a massive water, environment and economic development project, which is transforming the riverfront into the largest municipal park in the country. The ongoing work reminded me of the river restoration sites in Phoenix and Tucson. In fact, in November 2010 I met Itai Freeman, director of this large-scale project, when he spoke of this project and I spoke about successful restoration in central Phoenix. It was gratifying and informative to see the on-the-ground progress they've made in just one short year. I also visited two school-sites, one on a kibbutz and one in Jerusalem, designed by Amir Yechieli, where toilets are being flushed with rainwater collected on site. I saw well drilling activity in Northern Israel, where a new well field will provide supplemental watering of tree orchards when surface water supplies are insufficient. Nearby, I saw the site of a devastating 2010 forest fire. In Jordan, I visited the site in the Jordan Valley, Deir Alla, where grey water is expected to be collected from homes, treated with a specially designed filter, and delivered to nearby farms. The Jordan Valley Authority provides blended wastewater to the Jordan Valley, the largest agricultural region in Jordan. The site for the grey water facility lacks public sewage services, and freshwater supply from the municipal network is limited. The filter, designed by the Jordanian Royal Scientific Society team with whom I've had the pleasure of working, employs a simple low-cost technology suitable for use by local residents and farmers.

A coincidence of timing had me visiting two water bodies, thousands of miles apart, that serve as flyways for many bird

species, one in Israel, the other in Mexico. The first was Agamon Ha'Hula, the "little lake" in the Hula Valley in the northern part of Israel. This successful restoration project, funded by Keren Kayemet L'Israel - Jewish National Fund (KKL-JNF), involved restoring water to an area that was previously drained to increase arable land. The results of the drainage were so severe that, over time, spontaneous underground combustion resulted. The restored area involves a small lake that now attracts many bird species, including migrating euro-asian cranes. At dusk, they swoop into the lake area to sleep for the evening. What a sight to see – and sounds to hear. The little lake is a focal point for eco-tourism and outdoor recreation, with trails established for bicyclists, and motorized tours enable visitors like me to see the splendor of the migrating cranes. The thought that came to mind is a variant of "if you build it, they will come," namely, "if there is water, the birds will come."

In late November, I had the honor of being hosted by the Mexican Commissioner of the International Boundary and Water Commission Roberto Salmón Castelo and accompanied by U.S. IBWC Commissioner Edward Drusina for a visit to the Cienega de Santa Clara. On our way to the Cienega, another important flyway, we visited a Mexicali wastewater treatment plant and adjacent wetlands site. It is expected that the additional treatment provided by the wetlands will produce water suitable for reuse.



Lake Hula, Israel wetlands provide welcoming habitat for waterfowl.

The development of the wetlands, still under construction, is being steered by the Sonoran Institute and Pro Natura. Both nongovernmental organizations had expert staff on hand with us for the day. We crossed a bridge over the Rio Colorado, where the water in the river is agricultural return flows. We lunched at a riparian restoration site, which has received Mexican federal governmental funding to provide short-term employment. Then we arrived at the Cienega and boarded small boats. We saw wonderful bird habitat. It

was inspiring to see this site, about which I had heard so much. The Cienega has significance to the issue of operating the Yuma Desalting Plant – the water that would be directed to the YDP for treatment currently flows into the Cienega. An important part of the recent YDP test run was a historic binational agreement to send additional water to the Cienega in order to mitigate impacts to this wetland, along with an environmental monitoring program implemented by a team of US and Mexican scientists. A monitoring report is expected soon.

Visiting Agamon Ha'Hula, the Cienega de Santa Clara, and the several other sites reinforced the importance of seeing things with one's own eyes and exchanging information and lessons learned. The connections to our region are obvious: river restoration, rainwater harvesting, grey water filtration, water for people and agriculture, drought and fire. These projects also underscore the crucial roles of public-private partnerships and dedication to finding solutions to difficult water challenges. I look forward to sharing my sabbatical experiences in future columns! 🏡

PUBLIC POLICY REVIEW

By Sharon Megdal

Arizona's Experience a Model for Groundwater Governance



I have been traveling internationally much of the time since my sabbatical started at the end of February. I spent just over one month in Israel as a Lady Davis Visiting Professor at The Hebrew University of Jerusalem, during which time I traveled to Marseille, France for the World Water Forum. In April, I spent some time in Montevideo, Uruguay attending the first regional consultation of the global Groundwater Governance Project (see groundwatergovernance.org and

the Guest View in the Winter 2012 issue of this newsletter). The Project is designed to bring attention to the importance of groundwater for many regions of the world and to identify best practices or frameworks for good groundwater governance. Most recently I visited Australia, home to the famous Murray-Darling Basin and the object of much interest by water professionals. While I learned a lot during all of these trips, what these experiences have driven home is that, although we have a lot of opportunity to improve groundwater management in Arizona, we have accomplished a lot, and some aspects of our framework can be a model for other groundwater-dependent regions.

Why do I say this? Because I learned that Australians are very interested in our approach to banking Colorado River water and aquifer recharge. I spoke to this topic when addressing researchers at CSIRO, Australia's national science research organization, and staff members at the Murray-Darling Basin Authority. While in Adelaide, I met CSIRO aquifer recharge expert Peter Dillon, who is responsible for writing the thematic paper on aquifer recharge for the Groundwater Governance project. After some one-on-one discussions and review of documents, he is featuring Arizona's approach to managing groundwater storage in his paper.

While at the World Water Forum, I spoke about water banking as a means of connecting surface water and groundwater use, even though Arizona's law considers them separately. Listening to others speak about how, in the context of large basins dominated by river systems, groundwater use and aquifer health are often-times overlooked, I sat there thinking, "that's not the case in Arizona!" We have given much attention to groundwater use, particularly in the Active Management Areas, and careful consideration of both the strengths and the weaknesses of our management approach can inform other efforts, such as the Groundwater Governance Project.

Along with UA colleagues Bob Varady, Andrea Gerlak and others, I have had the pleasure of working with the policy team for the Groundwater Governance Project. One important and challenging task for the project was to offer a working definition

of groundwater governance. We have built off of some existing definitions to define groundwater governance as "the process by which groundwater resources are managed through the application of responsibility, participation, information availability, transparency, custom, and rule of law. It is the art of coordinating administrative actions and decision making between and among different jurisdictional levels – one of which may be global." Here in the United States our decentralized approach to water management requires coordination of activities among different jurisdictions. We also have regulations that require government to conduct its business in an open, transparent way. In Arizona, our framework often establishes general rules but then allows individual water users and providers to determine how to meet the regulations. We do see that information is necessary for good decision making, even though obtaining information on groundwater and aquifers can be costly and time consuming.

I do not wish to suggest that others adopt our framework without careful consideration, as we have numerous outstanding issues to address. In Arizona, we do little management of groundwater unless an area has been designated an Active Management Area. While 80 percent or more of the state's population lives in an AMA, large areas of the state, including regions wholly dependent on groundwater, are not in an AMA. Knowing the rate at which groundwater is being depleted is important, as is knowing how much water is in storage. Additional conservation efforts and well spacing rules could benefit non-AMA regions. Requiring proof of adequate water supplies prior to subdivision development is also a regulatory issue receiving much attention. Within AMAs, where 100 years of assured water for new municipal development must be demonstrated, exempt wells, securing the water supplies for the Central Arizona Groundwater Replenishment District, and addressing areas with localized draw-down are just some of the issues water managers face. Planning for the recovery of the millions of acre feet of water stored is still ongoing, though the possibility of an official declaration of shortage on the Colorado River appears more likely than it seemed just one year ago. The list of outstanding issues is long.

In my presentations I often show a glass that is either half-full, or half-empty, depending on how optimistic or pessimistic I feel. I started this column focusing on the half-full part. Arizona's groundwater management framework can serve as a model for others; there are many things we are doing well. But the framework is not without problems. It's the half-empty part that we need to keep sight of because (1) we need to continue to manage water resources well on behalf of residents of Arizona, and (2) when we share our expertise, we help others and we can learn how to improve upon what we do and devise an even better system. 🏠

PUBLIC POLICY REVIEW

By Sharon Megdal

Better Understanding Needed of Link Between Water Conservation and Rates



Demand-side management is an essential and well-recognized component of our water management strategies. Yet, like most water topics, water conservation programs are complex and multi-faceted. It is my sense that there is generally a preference for conservation programs that provide incentives over compulsory regulatory programs with penalties. Many like to encourage conservation through tiered pricing programs, where the cost to the

consumer of incremental units of water increases as more is used. Yet there are some challenges associated with gaining acceptance of utility conservation programs. I'd like to discuss a few of them in this column and note that the issues are not unique to water. Rather than delve into the efficacy of alternative conservation programs, itself a difficult and not-fully-explored topic, I examine some of the implications of conservation program implementation.

Whether utilities are privately or publicly owned, large components of the costs are fixed. Only a certain proportion of the costs of delivering water vary with the amount of water delivered. Fixed and variable costs both are covered by rates. Utility rate structures vary quite significantly across Arizona. (See my article, "The Role of the Public and Private Sectors in Water Provision in Arizona, USA," *Water International*, March 2012, Vol. 37, No. 2, 156-168 and the annual survey done by the Arizona Water Infrastructure Financing Authority for summaries of this variation.) Most utilities charge a monthly service fee, which may or may not include some water, and then charge for incremental water used by the customer. For example, the charge per 1,000 gallons may be set at a fixed dollar amount, may vary by season, or may vary depending on the amount of water consumed. In other words, there are many ways a utility's revenue requirement may be met. We see those setting utility rates balancing multiple objectives, such as: enabling the utility to cover its reasonable costs, with a rate of return on investment if privately owned; keeping rates affordable for water for basic needs; and discouraging wasteful or unnecessary consumption. Over time, we have seen more adoption of increasing block rate structures, especially since the mid-1980s, when I served on the Arizona Corporation Commission, the body responsible for regulating the rates of privately owned utilities. This greater use of increasing block pricing has been encouraged and applauded as a conservation strategy because it is thought that higher water prices will lead to less water consumption.

Recently, several water utilities have seen overall water consumption and/or per capita water consumption decline. In the case of the City of Flagstaff, for example, there was a determined effort to reduce overall water consumption. In some


cases, the decrease in per capita consumption resulting from a rate increase has exceeded that projected. Whatever the cause of the decrease in consumption, the fixed costs of service have to be covered in rates. If some of the fixed costs are included in the per-unit water charge, which is often the case, rates then have to increase for the very same set of customers. Assuming the fixed costs are necessary and reasonable, it's simple math. The fixed costs are spread over fewer units sold.

Not surprisingly, customers do not like this upward spiral, as I'll call it. This summer, some letters to the editor in the *Arizona Daily Star* commented on this very matter in the context of Tucson Electric Power (TEP). On July 9, 2012, one wrote the following about TEP's request for a rate increase: "TEP is going to up your rate because you, and/or friends and neighbors did the right thing and bought more energy-efficient appliances that use less electricity—and now, TEP needs more of your money to make up for the good that you and others did? Does the expression 'No good deed goes unpunished' make sense to you now?" Another letter writer states: "I get it. Use less through conservation and good energy practices and get charged more. One of the reasons for the [proposed] rate increase is the loss of revenue due to customers using less energy...So, TEP is telling us to use less so it can charge more to make up for the shortfall. Go figure." Finally, one writer in fact connects TEP's proposed rate increase to water rates, writing: "This week in Tucson our water rates went up because we conserved. Today we read that TEP wants to raise rates because we conserved..." The writer then comments on the impacts of such rate increases on those least able to pay.

There are programs in place to help low income individuals pay utility bills, but there are also questions about whether all those eligible for such programs are aware of them.

Also affecting rates are the costs of the conservation programs themselves. If rebates are offered by a utility, unless a toilet or appliance manufacturer is offering the rebates or a grant is funding the rebates, the customers are paying for the costs of the rebate program and other components of the conservation programs.

Utility directors and those who set water rates are trying to encourage water use reductions through conservation programs and rate setting. They themselves may be in the unenviable position of being punished – that is, being criticized – for doing the right thing when rate setting time comes around.

Getting through some of these issues can be facilitated by education programs, which themselves cost money. Educating all of us about the opportunities to conserve water could go a long way toward reducing some of the rancor come rate setting time. People do not like surprises. These days water planning is about examining alternative future scenarios. We can and should do a better job of anticipating the outcomes of conservation programs and policies, including their implications on rates. 

PUBLIC POLICY REVIEW

By Sharon B. Megdal

Israel Water Management Program Provides Rich Learning Experience



As regular readers of this column know, I've been speaking to the benefits of learning first-hand about water management in other parts of the country and world. During the first half of November, I had the pleasure of exploring water management in Israel with nine others from our region. Through seven days of site visits and interaction with top water experts, we learned about the region's successes as well as challenges. This uniquely designed Israel Water Management Program included stops at sites of

historical water significance, tours of state-of-the-art water treatment facilities, and stops at areas of environmental restoration and/or concern. The program was followed by participation by half of our group in the four-day biennial Drylands, Deserts and Desertification (DDD) Conference at the Sede Boqer campus of the Ben Gurion University. At the conference, three of us shared information and perspectives at a session, entitled "Water Management in Arizona and the Lower Colorado River Basin: Good Practices and Long-term Challenges".

Both the water management program and the conference provided a rich framework for placing our local, state and regional water management into perspective. They provided evidence that many things are possible when stakeholders collaborate. They underscored the value of developing strategies and action plans for implementation, including financing plans. There were ample examples of successful approaches as well as situations where action plans are needed. I would like to touch on a few that are particularly relevant for Arizona and the Lower Colorado River Basin.

The first is wastewater treatment and reuse. Israel is known as a leader in the use of recycled water by agriculture. About 80 percent of treated wastewater is reused. This high level of reuse is critical to meeting the water needs of Israel's agricultural sector. Not all water used by agriculture is recycled water. Depending on the crops and location, freshwater or brackish water may be used. However, not all household and industrial waste is properly collected and treated. Raw or inadequately treated sewage flows into streambeds. Progress is being made, but environmental problems associated with lack of proper collection and treatment persist. Although the transboundary political issues are quite different, a look at how the U.S. and Mexico have worked together at the border, particularly in recent years, could perhaps be instructive.

Another example is brackish water desalination. Israel's well-known accomplishments with seawater desalination were discussed with us at the Hadera plant. There we met with Abraham Tenne of the Israel Water Authority and Boris Liberman of IDE, the private company that has built the large reverse osmosis plants currently operating in Israel. Great strides are also being made in brackish water desalination. We visited the Granot plant, which has been undergoing expansion for some time. Arizona will likely construct more brackish water desalination plants in the future.

A major issue associated with inland desalination is disposal of the brine. The brine from the Granot plant is transported to the Mediterranean Sea. However, a plant located close to the conference site in the middle of the Negev desert far from the Mediterranean pumps the brine to evaporation ponds, which I saw during a field trip associated with the DDD conference. I was the only one on the tour bus super-excited to take a photo of the setting sun's reflection in the evaporation ponds; I've already used the photo in multiple presentations! The Yuma Desalting Plant was predicated on discharge of the brine to what is now known as the Ciénega de Santa Clara. As additional plants are built, Arizona will have to consider its options for brine disposal, which could include evaporation ponds. Time will tell if a possible disposal alternative is well injection, the mechanism employed at the Kay Bailey Hutchinson desalination facilities in El Paso, Texas, which I visited in late September.

Common to our regions are dry or trickling streams and rivers and interest in restoration. The mighty Colorado River rarely flows to the Delta. We heard the many reasons for low flows of the Jordan River below the Sea of Galilee and the concomitant reduced flows into the Dead Sea. Gidon Bromberg, Israel Director of the NGO Friends of the Earth Middle East, told us about collaborative efforts to improve the Jordan River. FOEME has operations in Israel, Jordan and the Palestinian Territories. Those who saw the documentary movie Last Call at the Oasis will recall seeing the three regional directors standing together discussing the Jordan River.

From representatives of the Dead Sea Works, a privately held company, we learned about some of the many complex implications associated with potash processing operations. We also heard about proposals involving desalinating water from the Red Sea, which are the subject of a World Bank study. At the Israel Water Authority we were briefed on Israel's Master Plan and we visited with the consultants working on the wastewater master plan. Here the difference between Israel's centralized approach to water planning, management and pricing and our region's decentralized approach are apparent. There, all municipal customers on the national system pay the same price for water. In our region, water prices for municipal customers vary significantly by water system.

We saw and learned so much more than I can touch on in the limited space of this column. We saw natural beauty as well as polluted streams. We saw water features of historical significance, as well as examples of deployment of state-of-the-art technology. Historically and currently, water in desert and semi-arid regions is precious. As populations grow, the challenges associated with providing safe and reliable water supplies grow. Resolving the many challenges will require creativity, tenacity and partnerships. I think we all came away from the program with renewed resolve to work collaboratively to identify and implement solutions appropriate for our region.

Note: Our independent program benefited from the participation of a professional tour guide and a liaison from the Jewish National Fund. JNF provided extensive in-kind assistance in planning the itinerary and throughout the visit. 🏡



By Sharon B. Megdal

The Colorado River Basin Water Supply and Demand Study: A Call to Action



In December 2012, the U.S. Department of Interior released the Colorado River Basin Water Supply and Demand Study, with officials referring to it as a “Call to Action”. This massive study, which can be accessed from the web site of the U.S. Bureau of Reclamation, was three years in the making. It involved a diverse set of partners and stakeholders from the seven Colorado River Basin states, many of whom contributed significantly to the data and analyses. Its Executive Summary and 89-page Study Report

summarize the effort’s methodology and findings. The Executive Summary states: “The purpose of the study was to define current and future imbalances in water supply and demand in the Basin and the adjacent areas of the Basin States that receive Colorado River water over the next 50 years, and to develop and analyze adaptation and mitigation strategies to resolve those imbalances.” Most notably, it then states that the study did not propose a set of solutions but rather “a common technical foundation that frames the range of potential imbalances that may be faced in the future and the range of solutions that may be considered to resolve those imbalances.”

The Study Report does a nice job of explaining potential scenarios and their resulting imbalances and summarizing the options for addressing the imbalances, with costs, time frames, and potential water yields noted. The list of solution options is, by and large, not surprising. Some commentary has focused on the very expensive and costly water importation options. However, the cost, legal, political and environmental feasibility challenges of a few of the options are well recognized.

Some have noted that the report documents what we already know. We know that the Colorado River Compact allocations were based on a wet period and that average flows are expected to be lower than the commitments, if we can call them that, of water. Dry periods may be more severe than even the tree ring records suggest due to changes in climate. We know the population and economies of the regions served by Colorado River water have grown and will continue to grow. We know that the economies of some regions, such as Central Arizona, are more vulnerable to Colorado River shortage than others. We know that water utilization and precipitation patterns affect the water demanded by and available to all of the water using sectors – municipal, agricultural, industrial and natural.

The water management challenges of the region have been well studied and documented. Almost 20 years ago, in 1995, the American Water Resources Association published a special issue of *Water Resources Bulletin*. Entitled Severe and Sustained Drought: Managing the Colorado River System in Times of Water Shortage, the 13 collected papers cover the following topics: tree ring records, hydrologic scenarios, drought impacts, legal and institutional options, social implications, environmental effects,

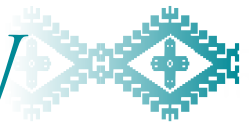
competition for water resources and valuing drought damages, hydrologic and economic impacts of drought under alternative policies, and mitigating impacts. The volume’s introductory article by Robert A. Young notes that solution options were divided into three groups: “those pertaining to operating rules presently in effect; those pertaining to potential changes in existing rules; and those which pertain to the feasibility of making such changes via negotiation, litigation, or legislation.” Young’s article concludes with acknowledgement of the following limitations: “Because of the large geographic scale, the technical complexity of the problem, and the limited resources and time available to the research team, the results must be considered as partial and tentative.” Young acknowledged that the broad effects of inadequate precipitation and environmental impacts could not be addressed as well as the authors would have liked, and measures of water demand were generalized based on local data. In 1995, however, the publication represented a comprehensive summary of the state of knowledge.

In the intervening 20 years, the region has grown significantly. Institutional arrangements not anticipated, such as interstate banking, have been enacted. The Colorado River Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lake Powell and Lake Mead and the Interim Shortage Sharing Guidelines were adopted in 2007. Minute 319 to the 1944 U.S.-Mexico Water Treaty, which was signed in November 2012, agrees for a five year period to share water shortages and surpluses across the border. We are adapting to a changing and uncertain landscape – or should I say waterscape – but all recognize that we must do more.

Let’s embrace the study as a Call to Action. The study involved many partners, public and private. It was subject to external peer review. It projects 3.2 million acre-feet (3,947 million cubic meters) as the imbalance between water supply and water demand in the study area by 2060. Of course, the 3.2 million figure is only an estimate, and we know that projections are usually wrong – especially those 50 years out. The actual imbalance may be lower or it may be higher. The debate should not be on the figure but on what we do to prepare ourselves. If it turns out that we unexpectedly enter a very wet period and we have over-prepared, we can all congratulate ourselves – or others can congratulate us posthumously – on what an excellent job we did of water management. However, if we do not take action now to develop the strategies to addressing imbalances, we will have failed doing for future generations what past generations have done for us, namely identifying the path(s) to water security. 🏡

Note: The WRRC has a limited number of hard copies of Severe and Sustained Drought, *Water Resources Bulletin*, Volume 31, No. 5, October 1995 available for sale at the 1995 cost of \$15 plus shipping. Proceeds support the work of the Water Resources Research Institutes, as authorized by the Water Resources Research Act of 1964 and 1984 as amended, of the Powell region. The WRRC received a copyright release from the American Water Resources Association and a digital version of the volume is posted at <https://wrrc.arizona.edu/publications/other/severe-sustained-drought>.

PUBLIC POLICY REVIEW



On Defining and Achieving Water Security

By Sharon B. Megdal



When planning the Water Resources Research Center's 2013 annual conference on water security, we knew that the definition of water security was complex. We decided we would not define it for the speakers and attendees, but rather let an understanding of water security emerge from the conference discussions themselves.

In the Winter 2013 issue of our Arizona Water Resource newsletter, the guest view by University of

Arizona professors Robert Varady and Christopher Scott defined water security as constituting "the sustainable availability of adequate quantities and qualities of water for resilient societies and ecosystems in the face of uncertain global change." In his conference keynote address, Anthony Cox of the Organisation for Economic Co-operation and Development (OECD) offered that water security entails "maintaining an acceptable level of risks – in terms of water shortage, excess, pollution, and freshwater system resilience – for society and the environment, today and in the future, through the effective and efficient application of water and water-related policies." By explicitly incorporating the concept of risk, Cox's definition builds off of that provided by D. Grey and C. W. Sadoff in the journal *Water Policy* (2007 Volume 9, p. 545), who define water security as "the availability of an acceptable quantity and quality of water for health, livelihoods, ecosystems and production, coupled with an acceptable level of water-related risks to people, environments and economies."

In *Water Security and the Global Water Agenda*, an analytical brief issued in 2013 by UN-Water, we find the following definition: "The capacity of a population to safeguard sustainable access to adequate quantities of and acceptable quality water for sustaining livelihoods, human well-being, and socio-economic development, for ensuring protection against water-borne pollution and water-related disasters, and for preserving ecosystems in a climate of peace and political stability."

While different, these definitions focus on the same goals. Water security is a concern locally, regionally and world-wide. It relates to both water quality and water quantity. It pertains to human health, economic vitality and natural systems. Risks and uncertainties must be considered when assessing the water security of communities and regions.

Attaining water security is a shared responsibility, a fact that was highlighted in a statement issued by the High Level Forum convened in conjunction with the full-day celebration of World Water Day (March 22, 2013) in The Hague. The year 2013 has been declared by the United Nations as the International Year of Water Cooperation, and, in this context, the statement noted that water security "will be of growing importance" and water matters require adequate attention to prevent water crises. Regarding who is responsible for water security, it stated: "Governments play a key role in securing water for

competing demands; however the quest for a water-secure world is a joint responsibility and can only be achieved through water cooperation at local, national, regional and global level and through partnerships with a multitude of stakeholders ranging from the citizens to policy makers to the private sector."

Although this last statement is perhaps obvious, it never hurts to be reminded that development of water policy requires a cooperative and inclusive approach. It requires involvement of stakeholders of many types. The development of sound water policy also requires education and sharing of information. These efforts are as important as those focused on development of technologies for water purification or predictive systems for floods and climate impacts.

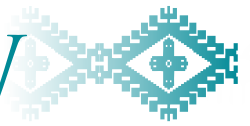
Along with colleague Robert Varady, whom I cited above, I had the privilege of attending the World Water Day program in The Hague, which fell between two other international meetings we attended. The first was a consultation of the global Groundwater Governance project (see www.groundwatergovernance.org). At this meeting, I presented results of an initial survey we conducted of the groundwater governance practices of the U.S. states. Part of the World Water Day session in The Hague entailed breakout sessions of about 100 people each. Within the breakout entitled "water cooperation helps preserve water resources and protect the environment", my table focused on the geographic scale of activities. The final meeting I attended was a two-day conference convened by OECD that focused on water governance world-wide. The purpose of the OECD gathering was to kick off a process that will follow up on the water governance recommendations of the Sixth World Water Forum held in March 2012 in Marseilles, France.

These more globally focused gatherings provide me with an opportunity to learn about the experiences of others in water policy making and management, as well as to share our local, statewide and regional practices with others. As I have noted previously in my columns, there is great value in sharing lessons learned, including successes, partial achievements, and failures.

Not surprisingly, there was much commonality to the themes and discussions of the various meetings. Some main take-away messages connect to the goal of achieving water security. There is a recognized need to involve a broad set of stakeholders, especially land use planners and decision-makers, in efforts to address water security and water management challenges. Involving the private sector in the broad range of issues was also highlighted at all three sessions. Elements of the private sector have technological know-how and financial expertise to contribute. The benefits of greater involvement of the private non-governmental (NGO) sector were likewise noted. The general need for more education at all levels and dialogue was underscored.

I think it is safe to say that, regardless of its precise definition, all agree identifying pathways to water security is something on which we need to work together. Agreement on this, however, is the easy part. Achieving water security over the long-term, the "future" referred to in Anthony Cox's definition, is a much more difficult task that will require our continued efforts. 🏡

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! 🏔️

Shortage Projections May Inspire Changes in Thinking

By Sharon B. Megdal



For almost 20 years, Arizona has been preparing for a shortage on the Colorado River through the Arizona Water Banking Authority (AWBA). As I see it, the Legislature created the AWBA in 1996 for two primary purposes. The first was to put our Colorado River allocation, particularly that portion delivered through the Central Arizona Project (CAP), to full use. The second purpose was, given CAP's low priority in times of shortage, to store water

for the future time when a Colorado River shortage would prevent delivery of subcontract water. This latter purpose had several elements to it, namely firming up or making deliveries more reliable for municipal & industrial uses, Indian water, and some on-river communities in times of shortage. The AWBA was also authorized to perform interstate water banking, which it has, pursuant to agreement with Nevada, and store for water management purposes.

The AWBA, one of the best-kept secrets of Arizona government, has been working diligently. About 3.2 million acre feet (MAF) of Colorado River water have been stored for intrastate purposes, with another 700,000 acre feet stored on behalf of Nevada. The history and activities of the AWBA are well documented on the agency's web site, azwaterbank.gov.

Despite more than a decade of drought in the Colorado River watershed, a Colorado River shortage has yet to be declared. Water stored in Lakes Mead and Powell and one very wet winter a few years ago have postponed a declaration. While researchers have been offering probabilities of shortage for some time, the Bureau of Reclamation's December 2012 Colorado River Basin Water Supply and Demand Study provides a clear reminder that Colorado River flows are expected to be variable. The future gap between water demand and supply was projected for the basin for several scenarios based on data provided by the seven basin states. Arizona's imbalance in demand and supply has itself been documented in the 2011 report of the Arizona Water Resources Development Commission (WRDC) and is projected to reach 1 MAF by 2060.

While Reclamation's Basin Study may have been referred to as a "call to action", a report on Colorado River operations released by Reclamation on August 16, 2013 has been termed a "wake-up call". Based on the methodology agreed to by the seven basin states and adopted by the U.S. Secretary of the Interior, releases from Lake Powell into Lake Mead in 2014 are projected to be 750,000 acre feet less than in 2013 and the lowest release since Lake Powell was filled. This means that we are more likely to reach the trigger point for a shortage declaration, which is a Lake Mead elevation of 1,075 feet. In

fact, the report projects a two percent probability of shortage declaration in 2015, and a 50 percent chance in 2016.


What would a shortage declaration in 2016 mean for Arizona cities and towns relying on Colorado River water? Actually, the water supplies for the cities and towns would not be affected by a shortage of the magnitude envisioned. Those impacted would be farmers and users of what is termed excess CAP water – water under contract to some entity but not actually ordered in a given year. It has been the existence of excess CAP water that has allowed the AWBA to store the water stored to date.

Though the AWBA has stored a significant amount of water for authorized purposes, its activities are not meant to address imbalances between supply and demand identified by the WRDC. Additional strategies are needed. One approach that should be high on our list is matching water quality with the intended use. Why should we be using potable quality water for outdoor uses when lesser quality water can do? Many communities already match quality with use to some extent by reusing effluent for outdoor irrigation. Individual property owner use of harvested rainwater and grey water is another way of reducing demands on potable water supplies.

A more radical change in water utilization would be reuse of highly treated effluent for meeting potable water demands. The investigation and implementation of this once-shunned option is noteworthy. Not only are communities considering indirect potable reuse, where the highly treated wastewater is blended with other waters through groundwater recharge or mixing with surface water, but direct potable reuse is subject to more active discussion. The WRDC report projected the availability in the year 2100 of between .7 and 1.3 MAF of additional reclaimed water.

But has the public gotten over the "yuck factor"? Will Orange County soon be joined by San Diego and El Paso? What about communities in Arizona? We may be observing changes in thinking as we experience extended drought and better understand wastewater treatment technologies. The National Research Council highlighted potable reuse as one of the many options considered in its 2012 report, *Water Reuse: Potential for Expanding the Nation's Water Supply through Reuse of Municipal Wastewater*.

During my annual summer get-away to San Diego, I visited the San Diego Water Purification Demonstration Project. The city whose citizens rejected a "toilet to tap" proposal in the late 1990s has a pilot project that is treating wastewater to very high standards using reverse osmosis and ultra violet/advanced oxidation. This extremely high quality water is being mixed with surface water – of lesser quality actually – in a reservoir and then put through a conventional surface water treatment plant for eventual delivery to customers. The pilot plant was designed for public accessibility; people can easily sign up for a tour. An Independent Advisory Panel has had a key role in this effort.

San Diego's approach should be watched carefully by others, including Arizona communities. It is important to keep our minds open to the full range of water management and utilization options as we consider strategies for meeting future water demands. 

Key Messages for CRWUA Highlight Arizona's Achievements, Yet More Efforts Are Needed

By Sharon B. Megdal



The Colorado River Water Users Association (CRWUA) Annual Conference, held December 11-13, 2013, had “Colorado River—Committed Collaboration” as its theme. Each year water users and officials from throughout the Colorado River Basin convene in Las Vegas to discuss the current status of Colorado River management and policy. An integral component of the conference is the state caucus breakfasts held prior to the Thursday

plenary sessions. Almost 200 people participated in the Arizona breakfast, where a new 15-minute movie about Arizona water accomplishments was shown and updates on some key water matters were provided.

A very interesting document, entitled “Arizona Key Messages for CRWUA,” was shared at the breakfast. This unsigned and undated document reflects the messages that Arizona’s water leadership would like shared both within and without our state’s boundaries. The following nine points are reproduced for your consideration.

1. *Arizona, along with the other six Colorado River Basin States, may be facing short-term water supply shortages and long-term future water supply and demand imbalances. Arizona has prepared for these realities for decades and has demonstrated leadership in water management for over a century. With more than 125 years of experience in adapting to one of the most arid climates in the US and due to our junior priority status on the Colorado River, Arizona has been proactively building resilience and implementing innovative water management strategies to secure dependable water supplies for our future.*

2. *Arizona leads the nation with rigorous water conservation and sustainability laws that protect Arizona water users and reduce reliance on the use of unsustainable groundwater supplies in the State’s most heavily populated areas. With its requirement of a 100-year renewable water supply for all new development, together with water conservation mandates for municipal, industrial and agricultural water users, through oversight of the Arizona Department of Water Resources, Arizona’s comprehensive 1980 Groundwater Management Act is known as one of the most robust water management laws in the United States.*

3. *Since implementation of the 1980 Groundwater Management Act, agricultural water users in Central Arizona have taken significant steps to dramatically improve irrigation efficiency. In the CAP service area, agricultural water users exceed the State of Arizona’s mandatory 80% efficiency target through lining of canals, laser-leveling of fields, conversion from flood irrigation to sprinkler and drip systems, and use of automated and real-time delivery systems. These water users have invested*

more than \$750M to improve irrigation efficiency (~\$3,600/ac).

4. *Municipal water users have also heavily invested in the implementation of water conservation strategies resulting in part from the adoption of the 1980 Groundwater Management Act. Over 80 percent of Arizona’s population resides in active management areas with statutorily mandated water conservation requirements. In the areas served in whole or in part by the Central Arizona Project and the Salt River Project, over 90% of the population is served by cities that have implemented Best Management Practices.*

5. *Water conservation is not limited to Central Arizona. Water providers throughout the state are statutorily mandated to adopt water conservation and drought plans and to submit those plans to the Arizona Department of Water Resources. Moreover, in the Yuma area where up to 90% of the Nation’s leafy vegetables are produced between the months of November and March, increases in irrigation efficiencies have allowed agricultural water users to increase production all while using the same amount of water that was used in 1970.*

6. *Arizona also leads the nation in the implementation of water efficient reuse programs. More than 95% of treated wastewater generated within Central Arizona (including areas served by the Central Arizona Project and the Salt River Project) serve beneficial uses including agriculture, municipal, groundwater recharge, power generation, industrial, and turf irrigation. Additionally these water supplies support ecologically vital wetland restoration that benefits our unique southwestern flora and fauna, as well as helping to achieve the State of Arizona’s water management goal of Safe-Yield for the Phoenix and Tucson Groundwater Basins.*

7. *Arizona’s engagement in collaborative long-term planning and comprehensive strategies has allowed for the underground storage of over 3.2 million acre-feet of water to provide back-up supplies to Arizona’s municipal, industrial, and Native American water users in times of shortages on the Colorado River. Arizonans have invested more than \$250 million to build facilities and to deliver and store water underground through the Arizona Water Banking Authority for use in the CAP and Mohave County Water Authority service areas. Equally significant investments in underground water storage have also been made by water providers and private entities to store additional water supplies underground to reduce their vulnerability to shortages. However, a shortage in the near-term on the Colorado River ... will directly curtail the water supply available to Central Arizona Project agricultural water users.*

8. *Arizonans are committed to collaborating with the Basin States, Mexico and Federal partners to implement proactive measures to reduce the near-term risks caused by the drought as well as address water supply deficits and long-term imbalances between supply and demands in the Colorado River system.*

9. *No single action or project will address the imbalances. Arizona’s water management leaders are committed to continuing to be proactive in developing and enhancing conservation and reuse opportunities as well as exploring the development of new water supplies through augmentation and desalination. New infrastructure, bold investments, and collaboration are essential for Arizona to continue to secure its water supply future.*

These messages point to both our accomplishments and our challenges. Arizona must address its water challenges so that 50 or more years from now, a list of accomplishments— not failures—can be circulated to future CRWUA attendees.

As we prepare for our April 8, 2014 conference on Closing the Gap Between Water Supply and Demand, I am interested in hearing your reactions to these talking points. Please take a few minutes and email your thoughts to me at smegdal@email.arizona.edu. 📧

Learning Globally, Acting Locally

By Sharon B. Megdal



I am writing this column on March 22, 2014, World Water Day (WWD) from my home in Tucson. In 2012, I spent part of WWD teaching a high school class in environmental studies in Nazareth, Israel. In 2013, I participated in the premier WWD program in The Hague. This year, I am spending this day reflecting on the two-way relevance of global connections.

For several years now, I have had the pleasure of being part of a binational team working on a transboundary aquifer assessment effort along the United States-Mexico border. We are nearing completion of binational reports for the Santa Cruz River and San Pedro River aquifers. These bilingual reports, which have been prepared within the Cooperative Framework established in 2009 by the International Boundary and Water Commission (IBWC), represent an unprecedented degree of cross-border coordination of mapping and data integration. The nature of our aquifer assessment collaboration, along with the binational collaboration on matters related to the Colorado River, where I have had less personal involvement, are of interest around the world. The IBWC and its processes for development and adoption of joint reports and Minutes to the 1944 Water Treaty, such as the historic Minute 319, can serve as models to approach transboundary efforts elsewhere.

Speaking of the Colorado River, in the past year, I worked on the paper, “A Tale of Two Rivers: Pathways for improving water management in the Jordan and Colorado River Basins”. Though the basins are far apart geographically, my three co-authors and I argue that there are common factors with respect to available policy and management options. Analysis of these factors provides insights into the similarities and divergences of the basins’ respective future pathways.

In the past year, I also continued to work on a grey water project in the Jordan Valley with colleagues from the Jordanian Royal Scientific Society. The pilot project is designed to stretch water supplies in one of the most water-stressed countries in the world. Water collected from homes is treated through a system using local filtration materials. The resulting water is then used for agricultural irrigation. In Arizona, we, too, make use of grey water – or more generally recycled water – for non-potable uses to preserve potable quality water for uses that require meeting drinking water quality standards. A recent survey of grey water policies by an Israeli researcher showed Arizona to be a leader in grey water use regulations and policies.

I have written before about the global interest in and relevance of Arizona’s groundwater management framework. As the utilization of groundwater increases to meet growing demands for water, there is increasing interest in Arizona’s framework for groundwater storage and banking. My direct

involvement in groundwater recharge goes back over 20 years, to when I served as Executive Director of the (now defunct) Santa Cruz Valley Water District. It continues to this day through my service as a member of the board of directors of the Central Arizona Project and through my Arizona Water Policy class. Our class field trip focuses on artificial recharge as a mechanism for storage and treatment. I have recently collaborated with an Australian colleague and a CAP analyst on first a presentation and now a paper, entitled “Water banks: Using managed aquifer recharge to meet water policy objectives”. The paper describes the workings of the Arizona Water Banking Authority and the reasons for its implementation. For almost 20 years the statutorily authorized AWBA has been storing excess Colorado River water for times of shortage. The paper goes on to explore conditions under which water banking could successfully be applied to other parts of the world, including Adelaide, South Australia. A recent international symposium, ISMAR 8, which was held in Beijing in October 2014, has led to a special issue of the journal *Water* on the policy and economics of managed aquifer recharge (MAR). I am serving as lead guest editor and look forward to the compilation of papers on this subject from around the world.

These and other projects with international dimensions – including work with colleagues from the University of Arizona, UNESCO and OECD on water governance – have applications here in Arizona. Interactions with international experts provide valuable opportunities to show the relevance of our water management successes and challenges and learn from experiences abroad. However, there is no region in the world that I am aware of that has it all figured out. And water management challenges are too complex for a cookie-cutter approach. Nevertheless, efforts to identify best practices for groundwater governance, as just one example, can have relevance at all geographic levels. (See www.groundwatergovernance.org and www.wrrc.arizona.edu/groundwater.)

There is general agreement around the world that education at all levels and effective, inclusive stakeholder engagement and dialogue are crucial to the identification, adoption, and implementation of sound water management practices. In many cases, the obstacles to adoption are not engineering or financial, but rather political or institutional. Decision makers will want to know there is public support for their selected options. Institutional mechanisms that allow and encourage dialogue may not exist in some locales.

Many of the approaches, particularly some of those being contemplated to close Arizona’s supply-demand gap, require considerable advance planning. While the experiences of others around the world can and often will be of assistance to us, in the end the solutions in Arizona – and around the world – will most often be designed at the local and regional levels.

Postscript: The WRRC conference panel that focused on “how” we close Arizona’s gap underscored the importance of leadership. When faced with policy choices and difficult tradeoffs, implementation of solutions will require champions and involvement of a diverse set of players. More on this in our next newsletter! 🏡

Complex Water Management Issues Require Thorough and Ongoing Dialogues



By Sharon B. Megdal

We in Arizona justifiably speak of our water management accomplishments. The Groundwater Management Act, the completion of the Central Arizona Project, the storage by the Arizona Water Banking Authority, and our recharge statutes have put the most populous parts of our state on a strong footing. We have prepared for anticipated Colorado River shortages by negotiating with the other Colorado

River Basin states for shortage declaration criteria that would result in more frequent shortages but more limited cutbacks to Municipal & Industrial (M&I) and Indian deliveries. The Water Banking Authority has stored millions of acre-feet of water for times when shortage would be deep enough to affect M&I and Indian CAP water subcontractors. However, challenges remain. The 2012 Bureau of Reclamation *Colorado River Basin Water Supply and Demand Study* was termed a “call to action”. More recent information on the condition of the Colorado River and the probability of a shortage declaration has been referred to as a “wake-up call”.

Notably, the term “structural deficit” was used in association with Colorado River allocations in a recent Central Arizona Project white paper, entitled “The State of the Colorado River”. The paper states: “The continued decline in Lake Mead is due in large measure to the structural deficit that exists in the Lower Basin. Simply put, the Lower Basin uses about 1.2 million acre-feet more each year than it receives from Lake Powell and from side inflows. If steps are not taken in the next few years to correct the structural deficit, there is increased likelihood of conflict among the Basin States, the United States and Mexico.” This is a most sobering acknowledgement. The briefing paper can be found at <http://www.cap-az.com/documents/meetings/05-01-2014/9.%20Colorado%20River%20Report%20May%201%20Board.pdf>.

The text continues: “It is the responsibility of all Lower Basin states and water users and the United States to take action to close the structural deficit. Augmentation may be an effective long-term solution, but immediate action is needed to avoid critical reservoir elevations. The only available near-term options are those that reduce system losses and reduce consumptive use in the Lower Basin.”

Regarding the state of our water resources and addressing Arizona’s water challenges, Kathleen Ferris, Executive Director of the Arizona Municipal Water Users Association, recently wrote in her blog: “We are desert dwellers who hope for the best and plan for the worst. Keeping the big picture in mind and having the foresight to make the bold choices and investments needed in these challenging times will ensure that we maintain our resilient water supplies.” CAP Board President Pam Pickard wrote in the *Arizona Daily Star*: “If the drought continues unabated, the previously agreed-upon shortage sharing measures may not be sufficient to compensate for the Lower Basin (Arizona, Nevada and California) continuing to use more water than it receives each year. Ultimately, the extended drought on the Colorado River can only be addressed by reducing demand, curbing system losses and adding new supplies.” Elsewhere in this newsletter, you can read additional perspectives on closing the gap between water supply and demand.

I often include a slide, shown here, in my many presentations that I formerly called my “Issues and Challenges” slide. More

recently I have changed its title, adding the word “solutions”. While not exhaustive, this list gives a flavor of our solution options and sources of uncertainty. In these presentations, I also point out that many are working diligently to identify solutions for both the near term and the longer term.

Let me say very clearly that we are not in a water crisis, but also clearly state that we face some very serious challenges. This is the time for attention and participation of *all* stakeholders, not only the water community. We need to work with the Arizona Department of Water Resources as it engages in the dialogue envisioned when it released its “Strategic Vision

for Water Supply Sustainability”. We need active and continuing education and dialogue on these matters in order to foster better understanding of these challenges. Only if we understand them, can we develop and implement the necessary multi-faceted solutions, which are unlikely to come cheaply or quickly. We must work together. It is time for all to engage. 🏡

Complex Water Management Issues, Challenges, and Solutions

- Growth and the need for additional supplies (competition)
- Drought/climate variability
- Water-energy nexus
- Water quantity assessments
- Water quality
- Desalination
- Use of recycled water for potable and other water needs
- Access to and utilization of renewable supplies
- Transboundary water issues
- The surface water/groundwater interface
- Riparian areas and other environmental considerations
- Water rights settlements
- Conservation programs
- Water storage and recovery (water banking)
- Groundwater replenishment
- Water cost/pricing
- Water planning

Uncertainty!



Collaborative Efforts Yield Numerous Publications



By Sharon B. Megdal

Because this issue of the *Arizona Water Resource* has a focus on research, I thought I'd use this space to talk about some recent collaborative work. This year has been a very busy one, with attention focused on a number of water policy and management topics at multiple geographic scales.

I have been busy guest editing, along with my Australian colleague

Peter Dillon, a special issue of the journal *Water* on the policy and economics of managed aquifer recharge (MAR) and water banking. This special issue grew out of our involvement in ISMAR9, the October 2013 triennial international conference held on MAR. The papers published to date can be accessed at no charge at http://www.mdpi.com/journal/water/special_issues/MAR. Arizona's water banking efforts are featured in the paper, "Water banks: Using managed aquifer recharge to meet water policy objectives," which I wrote with co-authors Peter Dillon and K. Seasholes. The paper summarizes the purpose and performance of the Arizona Water Banking Authority in the context of Colorado River shortage conditions and Arizona's statutory framework for storage and recovery, along with the applicability of water banking to Australia.

Another paper that features international comparative analysis is "A Tale of Two Rivers: Pathways for improving water management in the Jordan and Colorado River Basins," coauthored with A. Chen, A. Abramson, and N. Becker. We argue that there are common factors with respect to the policy and management options of these two basins that may provide insights into the similarities and divergences of their respective future pathways. These factors are regional water supply and demand pressures, water governance, transboundary issues, and demand for environmental flows. This paper is forthcoming in a special issue of the *Journal of Arid Environments*. I draw upon the analytical framework of this paper in my invited October presentation at the international conference on "The Rehabilitation of the Lower Jordan River (Phase A) and the Development of the Border Region Between Israel and Jordan along the Jordan River."

Sustainable agriculture has been the focus of some publications. My collaborators from the Jordanian Royal Scientific Society, A. Ghrair and O. Al-Mashaqbeh, and I published the paper "Performance of a Grey Water Pilot Plant Using a Multi-Layer Filter for Agricultural Purposes in the Jordan Valley," which appeared in the July 2014 issue of the journal *CLEAN – Soil, Air, Water*. The article addresses the water quality results for an installed pilot filtration system, which was built with natural locally available materials. The results indicate that the filtration system has worked well and is potentially transferable to other locations in the developing world.

The edited volume *Convergence of Food Security, Energy Security, and Sustainable Agriculture*, with an October 2014 release date, includes

the chapter, "Impact of Technology and Policy on Sustainable Agricultural Water Use and Food Security." I was a coauthor of this chapter, along with M. Alam, G. Kruger, and D. Songstad, who also served as the book's lead editor. The chapter considers the sustainability of irrigated agriculture and acknowledges the associated challenges of avoiding degradation of water and soil quality and adverse impacts on the environment. The chapter points to the need for convergence of agricultural producers, society, and policy makers to develop strategies of adjustment and acceptance of future agricultural water use.

I have continued working with University of Arizona colleagues A. Gerlak and R. Varady and graduate student Ling-Yee Huang on examining groundwater governance and management. Our paper, "Groundwater Governance in the United States: Common Priorities and Challenges," has been accepted by the journal *Groundwater*. Survey responses revealed that states' legal frameworks for groundwater differ widely in recognizing the hydrologic connection between surface water and groundwater, the needs of groundwater-dependent ecosystems, and the protection of groundwater quality. The states also reported a range in capacity to enforce groundwater responsibilities. California's recent approval of major groundwater legislation points to the crucial importance of groundwater in meeting water demands. Identifying good governance and regulatory frameworks will be evermore important as many areas experience increasing demands for water, along with diminished surface supply reliability.

Supply and demand imbalance was the focus of a policy brief I wrote for the National Agricultural and Rural Development Policy Center, entitled "Facing an Uncertain Colorado River Basin Future." This policy brief highlights key questions communities should consider as they plan for their water future. Questions include the extent to which communities control their water resources, available financing mechanisms, and how collaboration among communities and water agencies can assist in preparing for alternative water futures. The policy brief can be accessed at http://www.nardep.info/uploads/Brief20_UncertainColoradoRiver.pdf.

More locally, graduate student Nate Delano and I followed up on a recommendation of the "Tucson Regional Water Assessment Task Force Think Tank Report" by examining alternative approaches to regional water management. Our article, "Regional Water Management Collaboration," was published in the March 2014 issue of *The Water Report*. Study of four regional organizations showed that collaborative efforts typically grow out of distinctive regional needs. We concluded that efforts toward greater cooperation among regional water stakeholders should focus on the Tucson region's unique water situation, rather than an external model for water collaboration. The paper is at <https://wrrc.arizona.edu/publications/other/regional-water-management-cooperation>.

I look forward to continuing to foster and participate in collaborative efforts, including several not mentioned due to space limitations, so that I can do my small part to develop sound water management, policy and governance strategies. Such strategies are crucial for achieving policy objectives related to sustaining communities large and small, feeding the world's population, and supporting natural systems. 🏡

15 Water Wishes for 2015



by Sharon B. Megdal

I am writing this column after attending the annual conference of the Colorado River Water Users Association (CRWUA), held December 10-12, 2014 in Las Vegas. This year's conference focused on both the challenges facing the region and some great accomplishments. Despite these accomplishments, there is much to wish for the future.

In the end-of-year spirit, I thought I would use my column to put forward some water wishes for 2015. Not all center on the Colorado River, but I'll start out with a few that do.

1. I wish that people both inside and outside the professional water community would watch the movie shown at the CRWUA opening plenary session. Entitled "Challenged but Unbroken: Sustaining the Colorado River," this 9-minute movie effectively captures the essence of where we are with Colorado River supply and demand. It discusses the long-term drought, the structural deficit, and the growing demands associated with growth. The movie can be accessed at CRWUA.org.

2. As I say frequently, I wish to see the general public get excited but not alarmed about water. Actions will be required in Arizona and the Colorado River Basin to close the gap between demand and supply. Some of the paths to addressing the gap are long-term and will be expensive. An informed public will assist decision makers in selecting among options.

3. I wish to see additional public information and education campaigns, including the new video-based project we are working on at the WRRC called ClipStack™.

4. I wish to explore developing an electronic billboard campaign that shows Lake Mead elevation levels and links to sources of information about what these levels mean for Central Arizona Project water deliveries. It could be an interesting way to engage the public.

5. I wish for good precipitation in Arizona and the Colorado River Basin so that Lake Mead and Lake Powell levels rise and our lands are not so parched.

6. I wish to see continued efforts to publicize and build upon the great cooperation associated with the Minute 319 Colorado River Pulse Flow, because it demonstrated how the partners, working with the International Boundary and Water Commission, enabled something not thought doable just a few years ago. It showed the great power of binational collaboration across NGO and academic communities, water suppliers, and governments. I recommend people watch the Robert Redford narrated movie, *Renewal – A Reborn Colorado River Once Again Finds Her Path to the Sea*. It can be accessed at <http://youtu.be/TODV7FW746s>.

7. I wish that each and every water user, regardless of size and type of water use, conserves water. There is great opportunity to use water more efficiently. Conservation should be part of every region's approach to closing the gap between supply and demand.

8. I wish to build on the extensive engagement effort

involved in formulating the "Roadmap for Considering Water for Arizona's Natural Areas" (see insert to this issue). Developing pathways requires creativity and cooperation across water-using sectors. This WRRC project benefitted from extensive input and engagement of many, including our very dedicated project steering committee. We should keep putting our heads together to identify voluntary options for addressing the water needs of our state's natural areas.

9. I wish for a productive dialogue on Arizona's Strategic Vision for Water Supply Sustainability. The vision document released by Arizona Department of Water Resources in January



2014 can be accessed at http://www.azwater.gov/AzDWR/Arizonas_Strategic_Vision/.

10. I wish that we determine our solution paths here in Arizona and throughout the Colorado River Basin before a crisis develops. It might take some event(s), however, such as a shortage declaration on the Colorado River, to interest the general public and spur action. Although we do know a shortage declaration is likely, even without one, Arizona will voluntarily use less Colorado River water over the next three years pursuant to the recently signed Memorandum of Understanding to leave water in Lake Mead with the hopes of forestalling a shortage declaration.

11. I wish that the students enrolled in my graduate class in Arizona Water Policy are highly inquisitive and interested in water resources as a key component of their careers.

12. I wish for an informative and stimulating WRRC 2015 annual conference, which will focus on Tribal water management and be held June 9-10, 2015.

13. I wish to continue and expand WRRC partnerships in the coming year. Partnerships are essential to everything we do. Please look at the partnership metrics we compiled as part of our annual strategic planning metrics reporting. The WRRC's strategic plan and metrics, along with our Annual Reports, can be found at <https://wrrc.arizona.edu/about>.

14. I wish for continued success of the WRRC's many programs, projects, and activities. Please visit our web site or contact us to learn how you can become engaged.

15. And, of course, I wish every water stakeholder (everyone) a healthy and productive 2015!! 🍷

Connecting Students to Water Policy and Management in Practice



by Sharon B. Megdal

One of the highlights of the **graduate course in Arizona Water Policy I** teach each Spring semester is our class field trip. The annual outing provides students with the opportunity to see in practice what we have been exploring in the classroom and through readings. This year's field trip, conducted on March 27, 2015, included stops at Tucson

Water's Advanced Oxidation Plant for removing localized groundwater contaminants, the Southern Avra Valley Storage and Recovery Project for recharging Colorado River water for current and future use, and the Sweetwater Wetlands for further processing of treated wastewater. Each site represents an important component of Tucson Water's water supply portfolio and overall groundwater management strategy. In addition, the students visited Central Arizona Project's Twin Peaks Pumping Station, where they saw the CAP canal and the pumps that push water uphill. They also visited Pima County's new Agua Nueva Water Reclamation Facility, which replaced the old (and smelly!) Roger Road Wastewater Treatment Plant and where they saw modern lab facilities used for water quality monitoring. In addition to packing all of this into a one-day field trip, a lunch hosted by BKW Farms provided the group with an opportunity to hear about how growers in the region have re-introduced production of organic White Sonora Wheat, originally brought to the region in late 17th century.

My Arizona Water Policy class uses Arizona water as the basis for examining water policy and management options for states and regions beyond our own. Throughout the semester, external experts serve as guest lecturers, and each student must write a paper for the course that explores a particular water-related challenge and policy approaches to resolving it. The guest experts cover timely topics, including water banking and Colorado River shortage, water quality regulations and policy, municipal water planning, agricultural water use, and sustainable water practices at multiple geographic scales. As evidence of the relevance of the course to students in many disciplines and programs, five academic programs at the University of Arizona list the course. This cross listing is consistent with the

widespread recognition that addressing water issues in practice requires a multi-disciplinary approach. Course size is limited to 15 in order to enable a truly interactive and participatory experience throughout the semester.

This course is just one of many choices included in the curriculum for a relatively new graduate program at the University of Arizona, the **Master's degree program in Water, Society, and Policy**. In order to help prepare them for jobs in public agencies, private businesses, and non-governmental organizations, the program offers students considerable choice of coursework. In lieu of a research-based thesis, the program's capstone requirement is a six-unit Master's Project. As noted in the brochure for the program: "All students complete a Master's Project selected in consultation with a faculty advisor. Projects are as unique and diverse as the students that participate in this program. [The student] may produce a professional paper, internship report, series of public presentations, public outreach activity with associated background materials, water-focused curriculum, or other substantive product." (<https://wrrc.arizona.edu/WS-and-PDP>)

This Master's Project connects the student with an external organization with which to work for a minimum of 270 hours on aspects of water management and policy important to the host entity. Students have connected with a diverse set of organizations. I assist my students in identifying a potential host and in reviewing the "scope of work" developed in consultation with the host. Students have connected with different types of organizations, including a large city, a grass-roots sustainability coalition, a business-oriented water coalition, and a foreign scientific research institute. Project work is finalized by a summary report to the student's advisor and a final

presentation, which is open to faculty and students involved in the program, the project host, and invited guests. In order to provide additional learning outside the formal classroom, students in the Water, Society and Policy program must also take two semester-long seminars open only to students in the program. In the Spring semester, when I am responsible for the seminar, students attend water-related seminars and lectures offered by schools, departments, and programs across the University of Arizona and then meet as a small group to discuss them. Many of the seminar speakers are water management practitioners.

Feedback confirms that connecting students with those who focus day-in and day-out on the many water management challenges we face at the community, regional, national, and international levels is valued by all involved. Developing and implementing solutions to the myriad water challenges will require contributions from many disciplines and organizations and meaningful interaction among us all. 🏡



Details Matter



by Sharon B. Megdal

The two big water stories of the western United States and perhaps the nation are California's water crisis and the potential for a shortage declaration on the Colorado River. Both are manifestations of drought conditions, as California has experienced a multi-year drought in its critical watersheds and the Colorado River Basin is in its 15th year of drought. The implications for the two states are different thus far. While California is experiencing a widespread water crisis, Arizona is not. California has only recently enacted groundwater management legislation. Arizona has managed groundwater in designated Active Management Areas (AMAs) since 1980. The Arizona Water Banking Authority has been storing water underground for almost 20 years in preparation for potential shortages. California does not have such extensive groundwater storage.


Many point to Arizona's groundwater management and water storage as evidence of sound water management and good planning. As I respond to inquiries about Arizona water management practices, I try to include details that are important to understanding both the strengths and the limitations of Arizona practices. I would like to use this column to discuss just a few of the details I think are necessary to developing a complete picture of the state's water situation.

My first example is the Arizona Assured Water Supply (AWS) Rules for the AMAs, a foundational element of groundwater management. The AWS Rules, which require demonstration of a 100-year water supply for new subdivisions, are complex and vary across Arizona's five AMAs. A detail not often mentioned is that, per the AWS Rules, the demonstration of 100-year physical availability of water may depend on water pumping to a depth of 1,000 feet below land surface. The Arizona Department of Water Resources (ADWR) examines carefully the hydrological studies related to physical water availability and performs very strict accounting of groundwater use, recharge, and replenishment. Yet some potential for localized aquifer draw-down remains. Though this matter is well-recognized by the water community and has been the subject of discussion and policy proposals, it is as yet not fully resolved.

My second example refers to another complex component of the AWS Rules, namely provisions related to meeting the rules' requirement that water use be consistent with the AMA management goal through membership in the Central Arizona Groundwater Replenishment District (CAGRDR). Pursuant to 1993 state legislation, the CAGRDR operates in Maricopa, Pinal, and Pima counties and is governed by the Central Arizona Project (CAP) Board, on which I sit as an elected member representing Pima County.

The CAGRDR is required to replenish for its members what is reported as excess groundwater pumping under the AWS Rules. CAGRDR membership is voluntary; many have availed themselves of the opportunity to join in order to develop. The CAGRDR is statutorily required to develop a Plan of Operation every 10 years. The plan submitted to ADWR in December 2014 is awaiting approval. The details I want to mention here relate to CAGRDR membership and costs. The CAGRDR must accept members that qualify pursuant to statute, regardless of the gap between water supplies secured by the CAGRDR and projected replenishment obligations. The Plan of Operation identifies water supplies that are potentially available for meeting the projected replenishment obligation. These supplies may turn out to be very expensive. CAGRDR plans and activities are not commonly on the radar screen of the water customer affected by the costs of replenishment. For some customers, CAGRDR charges show up only annually as an assessment on the property owner's property tax bill. All involved need to receive detailed information on what the framework for membership, operations, and assessment of charges means for current and future CAGRDR members and customers.

My third example of the importance of details relates to the pertinent date for an official declaration of shortage conditions for the Colorado River. Guidelines adopted by the U.S. Secretary of Interior specify the first curtailment to Colorado Water deliveries when Lake Mead's water level is projected to be "at or below elevation 1,075 feet and at or above 1,050". For CAP, the associated cutback will be 320,000 acre feet (an acre foot is 325,851 gallons of water). This amounts to just over 20 percent of CAP's annual entitlement of 1.5 million acre feet. Per the priorities established for CAP water deliveries, a cutback this significant will have impacts, particularly to central Arizona agriculture, CAGRDR replenishment, and water storage by the Arizona Water Banking Authority. Communications regarding shortage typically mention these impacts, along with reporting that deliveries to Municipal & Industrial Priority or Indian subcontractors will not be affected. The relative security of water deliveries to these customers is extremely important to communicate. In addition, I would like to note this important detail: there will be an impact on cost for those who do receive CAP water as CAP's fixed costs are spread over fewer units of water sold. The exact impact to the residential water customer will depend on the utility serving that customer. The good news for the short-term is that, even though Lake Mead's water level fell below 1,075 this June, precipitation in the Colorado watershed during May makes it very unlikely that a shortage will be declared for 2016. Another detail: the declaration depends on the water level projected for January 1, 2016 by the U.S. Bureau of Reclamation in August, 2015. A similar schedule for shortage determination pertains to future years. While it does seem that we can breathe a sigh of relief in the very short-term, a shortage declaration remains probable in the next few years.

More information about these important matters can be found on many web sites, most specifically those of ADWR, CAP, and the U.S. Bureau of Reclamation. 

Collaborative Conference Planning and Continuing the Dialogue

by Sharon B. Megdal¹, Karletta Chief², and Jean E. McLain³



GRIC Governor Stephen Roe Lewis presents calendar stick to WRRRC Director Dr. Sharon B. Megdal and conference co-chairs Dr. Karletta Chief and Dr. Jean McLain.
Source: Melanie Lenart

The University of Arizona Water Resources Research Center conference, *Indigenous Perspectives on Sustainable Water Practices*, was held on June 9-10, 2015. Since our first conference, *Local Approaches to Resolving Water Resource Issues*, in 2003, the WRRRC has organized annual conferences on topics of statewide importance, with the goal of engaging speakers and audiences in thought-provoking and informative dialogue. Recent conferences have focused on water issues faced by Arizonans, including potential water shortages in the Colorado River, groundwater security, and growing urbanization. Although sessions at previous conferences included speakers on tribal water issues, we realized that an Arizona-based conference focused solely on indigenous perspectives and practices related to sustainable water management was lacking.

Active planning of the 2015 Conference actually began in March 2014, when the WRRRC Conference, *Closing the Gap Between Water Supply and Demand*, included the unique insights of individuals from several Native communities. The message of these individual indigenous voices was that water is life. Not only does it sustain livelihoods, including ranching, farming, fishing, hunting, and gathering of medicinal plants, but it is revered as sacred and used in cultural practices. They taught their listeners that water is the foundation of the identity of many indigenous peoples, as it acknowledges the connection to Mother Earth and Father Sky, and is an integrating component that connects the land, five fingered people, four legged animals, and plants through a continuous cycle. Much of this message was new to the audience, confirming the need for a conference on water in Arizona from indigenous perspectives – a conference covering a wide informational range, from the legal intricacies of water rights to the spiritual and ceremonial views of water.


And so it was that nine months before the 2015 Conference, co-chairs Dr. Karletta Chief and Dr. Jean McLain formed a Tribal Advisory Committee that represented tribal water management, leadership, and grassroots. The Committee worked tirelessly, surveying tribal and non-tribal stakeholders to identify conference

topics and speakers. The conference title was developed using an online questionnaire, and *Indigenous Perspectives on Sustainable Water Practices* resulted from blending several title ideas. The 10th anniversary of the 2004 Arizona Water Settlements Act stimulated a partnership with the Gila River Indian Community, which hosted the conference, providing generous support and assisting in conference planning, logistics, and tours.

It is not an overstatement to report that the 330 conference attendees were fully engaged throughout. Starting with two pre-conference tours on the morning of June 9, and ending with an expert panel late in the afternoon on June 10, two days were filled with education, energy, and exchange of viewpoints. GRIC Governor Stephen Roe Lewis welcomed participants, remembering family lessons on giving back to the community to effect change. In his opening comments on day two, Arizona State Senator Carlyle Begay noted that the event represented "...a very much needed conference, generating a lot of great discussion, a lot of great insight, and most importantly great ideas in moving our community forward in discussions about the future of our water resources." From the opening keynote delivered by John Echohawk, founder of the Native American Rights Fund, an active conversation ensued, promoted by the positioning of open microphones for audience dialogue. Speakers on the podium and at the microphone were often passionate, at times moved to anger and to tears as they discussed the history of indigenous water rights, current efforts to restore cultural heritage, and paths forward to sustainable water management. The spirituality of the gathering was celebrated with multiple prayers and panelist comments.

In addition to incorporating multiple perspectives in the agenda of invited speakers, an equally important goal was to attract a diverse audience. From the early planning, WRRRC staff met with representatives of tribal and non-tribal lands throughout Arizona. Press releases sent to news outlets statewide increased interest in rural areas. A conference invitation was sent to top tribal officials and disseminated through various Native American networks. We are pleased to report that the conference attracted registrants from 49 municipalities and 13 tribal nations throughout Arizona.

Elected officials at the federal, state, municipal, and tribal levels also attended. We received generous support from various sponsors whose contribution we greatly appreciate and are acknowledged in this newsletter. For more information and links to speaker presentations, go to: <http://wrrc.arizona.edu/WRRRC-conference-2015/home>.

We close with a hope and a request. Our hope is that this newsletter extends the exchange of information and perspectives on sustainable water practices beyond the two-day conference experience. Our request is for feedback on what else we can do together. Should there be an effort to organize a similar conference on a broader regional scale, such as the Four Corners? We would like to hear from you. Please email your thoughts to us at smegdal@email.arizona.edu, kchief@email.arizona.edu, and mclainj@email.arizona.edu. 

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It's Time for Action



by Sharon B. Megdal

Las Vegas is the site of December's Colorado River Water Users Association (CRWUA) annual conference. All the basin states and Mexico are in attendance, with Arizona representation usually the largest. This year's conference marked the first time there were concurrent sessions. It turns out that a statement made during the session I did not attend has caught my attention. Writer Tony Davis

reported in the December 27, 2015 edition of the *Arizona Daily Star* on the presentation made by Jeremy Aquero, a Las Vegas economic analyst, during a session on drought. (I went instead to the concurrent session on agriculture.) Davis reports that Aquero stated: "We are not going to conserve our way to prosperity, or build our way to prosperity, and we are not going to stop growth on our way to prosperity. It will take a master-plan approach to all of those things."

Where do we in Arizona stand in terms of planning for a secure water future?

The strategic vision document released by the Arizona Department of Water Resources (ADWR) in early 2014 listed the options for meeting Arizona's future water needs. They include the following: increased conservation; water augmentation through multiple mechanisms; greater water reuse; possible water exchanges; and addressing some legal, regulatory, and financing issues, including the general stream adjudications and tribal water rights. See www.azwater.gov/AzDWR/Arizonas_Strategic_Vision/.

In November of 2015 a large group convened by Arizona Town Hall to address "Keeping Arizona's Water Glass Full" identified six priorities for action: 1) Move forward with Arizona's Strategic Vision for Water Supply Sustainability; 2) Create and fund mechanisms to finance water supply and new infrastructure; 3) Appropriately fund and staff ADWR; 4) Education; 5) Conservation and Augmentation; and 6) Legal reform. The full report of the Town Hall can be found at aztownhall.org.

In late December, Governor Ducey appointed his Water Augmentation Council (Council), chaired by ADWR Director Tom Buschatzke, to deliberate on specific steps by "investigating long-term water augmentation strategies, additional water conservation opportunities, and funding and infrastructure needs to help secure water supplies for Arizona's future."

It is indeed time to move to specific action plans that can gain legislative approval, where necessary, and community support. The former will require arriving at action plans that can garner support from multiple geographic and economic interests. Although water legislation has been sparse in recent years, last year's vote to approve extension of the tax levied by the Central Arizona Water Conservation District to fund water banking and Central Arizona Project operations proves that widespread support can

be forthcoming even for measures that require local taxation. Gaining broad community attention and support will require extensive public engagement. High-level treatment of brackish groundwater, seawater, or wastewater will be costly, and the same can be said about the transportation of water, especially in the era of reduced federal funding for infrastructure. In the end, it is the water consumer who pays. Hence, water consumers – all of us – must be educated as to the options and their costs.

When we consider options for closing the demand-supply gap, water conservation is often at the top of the action list for individuals and businesses. In the context of conservation, we from the water sector often speak to the savings from conservation by existing users, whether through changing out toilets, reducing outdoor watering, and/or other water use efficiencies. Planning for new uses must also be considered. How we design our communities and buildings will determine future water use. The work of landscape and building architects, along with land use planners, is highly important. I believe this nexus between design and water use will become even more important in the future. As an educator of university students, particularly at the graduate level, I see the high value of interdisciplinary training, such as we offer through the Master's Program in Water, Society, and Policy and Ph.D. program in Arid Lands Resource Sciences. As a member of the Arizona Cooperative Extension faculty, I see the great opportunity to work with communities throughout Arizona to develop greater understanding of the available options and opportunities to work together. And as a researcher, I see the need to gain greater understanding of the tradeoffs associated with alternative water conservation, treatment, and use strategies.

In all these roles, I see the value of sharing practices and lessons learned with others. For almost a decade, I have been studying the water management strategies of Israel and have shared some of our region's successes, particularly related to transboundary water management, through lectures and other exchanges. I have worked with researchers in Jordan to explore household use of graywater, a water source of great interest in growing, water-scarce regions. While each region's water supply portfolio and water use practices depend on history, values, law, socioeconomic conditions, and other factors, the options for meeting future water needs are similar. They involve demand-side management, deployment of technology, education, and development of acceptable financing and funding strategies, which may include public-private partnerships. Such partnerships, which are foundational to Israel's large-scale seawater desalination, are already playing a greater role in the Southwest. Both regions already see substantial reuse of water, with water recycling likely to play a greater role going forward in Arizona.

Throughout all deliberations, we must consider the implications of our land and water use patterns on Arizona's quality of life and economic vitality. Our water future will require continued technological and policy innovation. A great example of the latter is Arizona's framework for recharge and water banking. Heraclitus is said to have observed that "the only thing that is constant is change." I have great optimism that we will adapt to changing conditions. Though we face challenges, not having the water supplies available to meet future needs is not an option. 🏡

It's Spring! Time to get out in the field!



by Sharon B. Megdal

Spring Semester is always busy and exciting for me, particularly because I teach my graduate course, Arizona Water Policy. Each year the course is a bit different. Because the course attracts students from many different programs, there is always an interesting mix of student backgrounds and interests. Also, while we cover some of the same

topics every year, others vary, depending on what out-of-town experts may pay a visit or what water happenings have recently occurred. Regardless of the variations, one thing remains constant – our all day field trip, about which I have written before. This year the field trip took place on March 4.

I truly believe that getting out in the field is an extremely important way to learn about Arizona water policy and management. We can talk all day about recharge and water banking, the Central Arizona Project (CAP), and water reuse, but there is nothing like seeing these things firsthand. Indeed, the day of site visits and briefings is the first thing to be scheduled on the syllabus, and all enrolled students are asked to try to allocate the full day to the class outing.

Our day starts with a stop at Tucson Water's Advanced Oxidation Process (AOP) Plant and continues on to Tucson Water's Southern Avra Valley Storage and Recovery Project (SAVSARP). The AOP plant treats polluted groundwater to very high standards for delivery to Tucson Water's customers. At SAVSARP, vast amounts of CAP water are stored for current and future recovery and use. We then go on to CAP's Twin Peaks Pumping Plant, where the students learn firsthand about CAP's reliance on power to pump water uphill from the Colorado River all the way to Tucson. Lunch at the White Stallion Ranch, hosted by BKW Farms, provides a perfect backdrop for reflection and conversation, along with learning about White Sonoran Wheat production in our region. We then go on to Pima County's new Agua Nueva Water Reclamation Facility, which was built and is operated through a public-private partnership with CH2M. There we learn about state-of-the-art wastewater treatment, as well as effluent recharge. The final stop is Tucson Water's Sweetwater Wetlands, where wetland treatment and effluent recharge basins operate. The Sweetwater Wetlands, which is open to the

public during daylight hours, is truly an oasis in the desert and a favorite birding spot.

The field trip follows the "life cycle" of water use in the Tucson region: groundwater pumping and clean-up, groundwater recharge, water banking, Colorado River water delivery, energy requirements, wastewater treatment and reuse, and some agricultural water use. Although we start out at and return to the urban core, we are in the desert as we ride through Saguaro National Park West and parts of the Avra Valley. We interact with people who make sure we have safe and reliable water supplies and are very grateful for the expertise shared with us by the professionals who meet with us at our various stops. Some are even with us throughout the day! That professionals are so generous with their time shows the value they place on training our next generation of professionals, academicians, and leaders.

My hope is that through spending this busy day in the field, my students gain greater appreciation for the complexities of water management as practiced in our region and also see ways they might contribute to resolving the complex water challenges we face throughout our region, country, and world. The field trip experience provides this important context to my students: a student recently wrote, "...the field trip counts among the most educational days in my time at the U of A".



Arizona Water Policy Class on Their Spring Field Trip, March 4, 2016. Source: Sharon B. Megdal

During the Spring Semester, I also convene a seminar course for the master's program in Water, Society, and Policy. This one-unit course is designed to expose the students to a multitude of water topics through seminar attendance and group discussions. We engaged in lively discussions about the various seminars they've chosen to attend across campus.

Spring is also when we hold the WRRRC Annual Conference, which is covered elsewhere in this newsletter, with more coming in the Summer issue. Preparing for the conference involves a whirlwind of activities on the part of WRRRC staff and student workers. This year's topic, #AZWaterFuture – Tech, Talk, and Tradeoffs, enabled us to cover issues ranging from "wicked problems," such as Colorado River structural deficits, to innovative solutions, including drip irrigation, technology, and education at all levels and through different approaches. Speakers addressed the difficult tradeoffs associated with living sustainably in the desert and the important dialogues to address these tradeoffs, such as through the Governor's Water Augmentation Council. While one day can only touch on these important issues, I hope that the conference fostered thought and further dialogue. I sincerely thank all speakers and participants. We at the WRRRC will continue to do what we can to bring diverse voices to the conversation and exchange of ideas. 🏡

A New Approach to Raising Water Awareness: Beyond the Mirage



by Sharon B. Megdal

The Water Resources Research Center is proud to have partnered in the Beyond the Mirage project. Beyond the Mirage got its start as an alternative approach to water education and engagement. While both the *Layperson's Guide to Arizona Water* and *Keeping Arizona's Water Glass Full*, the background report for the 107th Arizona Town Hall held in November 2015, introduce readers

to Arizona water issues, today's busy schedules and reliance on finger-tip information suggested a new approach was warranted to assist the public in becoming more water-aware. The WRRRC's External Advisory Committee confirmed our plans to develop a new and different platform for water information through partnership with Cody Sheehy and the Communications & Cyber Technologies team of the University of Arizona College of Agriculture and Life Sciences. Envisioned as a multi-part project, Beyond the Mirage would include: (1) a series of short, informative video clips, which the viewer could stack into individualized mini-documentaries; (2) a feature-length documentary, professionally produced in cooperation with Arizona Public Media, with John Booth as our key AZPM partner; and (3) classroom learning media for K-12 students. The clips would include a range of topics and voices. The documentary would be designed to take a broad perspective to a regional or national audience. The WRRRC's role would be to collaborate on identifying important content and interview opportunities, as well as working with Cody and team to review and perfect clips prior to launching the clip stacking web site. Arizona Project WET Director Kerry Schwartz led the K-12 work that engaged middle school students in stack building and sharing. Throughout the effort, Brittany Xiu, Ashley Hullinger, and particularly Susanna Eden worked diligently with Cody, the creative genius behind it all.

Full of ideas and enthusiasm — and with some seed money from the University of Arizona Technology and Research Initiative Fund (TRIF) — the team knew that external resources were needed. The Arizona Community Foundation and its partners presented an exciting and very timely funding opportunity when they announced the New Arizona Prize. It was fortunate that the first competition, the Water Consciousness Challenge, “sought the best digital strategy to raise Arizonans’ consciousness about our water future”. In early April 2015, after a thorough and highly competitive process, the Beyond the Mirage team was awarded the \$100,000 prize.

In addition to getting the team together, providing encouragement, and being interviewed, I worked with Cody on the footage filmed in Israel in October 2015, where he used his drone and other professional equipment transported into and out of Israel. We spent five intensive days visiting constructed

facilities and natural water sites and talking with several experts. It was a pleasure to see Cody in action. I cannot say enough about his professionalism and ability to quickly absorb new concepts.

The web site BeyondtheMirage.org, which includes over 250 video clips, an artificial intelligence system to guide navigation, and a platform for assembling individual documentaries, was launched in March 2016. I encourage readers to visit the site, view clips, and assemble their own video stacks. In my Arizona Water Policy class, small groups of students assembled mini-documentaries of five minutes, which we then viewed together. It was a fun exercise and interesting to see how the focus of the groups differed. The documentaries can be saved on line, but more importantly they can be shared through social media or email link, effectively spreading water consciousness.

The feature-length documentary, *Beyond the Mirage: The Future of Water in the West*, was screened and broadcast in April in Tucson. KUAT Channel 6 premiered a 75-minute version of the documentary, which was followed by a panel discussion. In May, KAET Channel 8 in Phoenix aired the 60-minute version of the documentary, which is the version now available on DVD or BluRay. Many have asked if they can access the movie online. Unfortunately, but for good reason, on-line distribution is not yet



offered. The team recently received the good news that the film will be made available through the American Public Television (APT) Exchange to public television stations across the country. As explained in the release issued by AZPM, “American Public Television is a leading syndicator of high-quality, top-rated programming”. APT’s policies require that documentaries it airs are not publicly available before they have been aired. Therefore, live-streaming will have to wait until sometime in 2017.

Something that I learned during this project is that, in order for a documentary to be considered for Public Television, the filmmaker must maintain total control over the creative content. This means that, while WRRRC staff could do fact checks and share in the end-of-movie credits, Cody was the decision-maker regarding film content.

I am pleased to have been part of the Beyond the Mirage team. The full set of supporters and partners for Beyond the Mirage can be found on the web site. I offer my most sincere thanks to all who contributed their time, expertise, encouragement, and resources. The BeyondtheMirage.org platform is an extraordinary tool that should be kept dynamic and up-to-date. It is true that this will take more resources, but the significant water issues facing our state and region make it imperative that we do so. 🇺🇸

The Invisible Water

by Sharon B. Megdal



Water policy discussions around the globe are focusing on groundwater and how to improve its governance and management. Growing water demands and changing climate's influence on temperature and precipitation patterns have underscored the importance of groundwater – the invisible water.

Groundwater meets about 40 percent of Arizona's annual water uses. While the Colorado River, which also satisfies about 40 percent of Arizona's annual needs, is receiving a lot of attention, with the Central Arizona Project's "Protect Lake Mead" campaign and other efforts to raise awareness of work being done to forestall and maybe even avoid shortage, efforts to manage our groundwater resources wisely deserve at least equal attention. Those of us who work in the water sector in Arizona know how important groundwater is to communities and economic activities throughout the state. We regularly cite the centrality of Arizona's 1980 Groundwater Management Act, which implemented a strong regulatory framework for groundwater utilization in designated Active Management Areas. But because these provisions do not apply statewide, even here in Arizona, where groundwater management seems second nature, groundwater overdraft continues to be a challenge.

National and global attention is focusing on the importance of good groundwater governance and management. The www.groundwatergovernance.org site published a series of important documents as part of multi-year project to share information on good groundwater governance practices. The project's purpose was "to influence political decisions thanks to better awareness of the paramount importance of groundwater resources and their sustainable management in averting the impending water crisis". I had the pleasure to participate in the early phases of this effort.

Recently, I have been involved in two other collaborative efforts to improve groundwater governance and management. The Groundwater Visibility Initiative (GVI) represents a joint effort of two national organizations, the American Water Resources Association (AWRA) and the National Groundwater Association (NGWA). I was part of the small, dedicated group that planned the GVI workshop held in April 2016. One outcome is the recent article "Making Groundwater Visible", which appeared in the September 2016 issue of AWRA's publication, *IMPACT*. The article, which reports on the results of the workshop, points to how groundwater's physical invisibility has led to its omission from many water policy, governance, and management discussions. The key findings are summarized in the article as follows: (1) Governing and managing groundwater require working with people; (2) Data and information are key; (3) Some "secrets" remain; (4) We need to take care of what we have; (5) Effective groundwater management is critical to an integrated water management portfolio that is adaptive and resilient to drought and climate change; and (6) To be robust, policies of the agriculture, energy,


environment, land-use planning, and urban development sectors must incorporate groundwater considerations.

The second effort emerged from the 9th International Symposium on Managed Aquifer Recharge (ISMAR9), which was held in Mexico City in June 2016. A working group formed to develop the document "Sustainable Groundwater Management Policy Directives", which was published in English and Spanish and has its own six summary points or directives. (I) Recognize aquifers and groundwater as critically important, finite, valuable and vulnerable resources. (II) Halt the chronic depletion of groundwater in aquifers on a global basis. (III) Aquifer systems are unique and need to be well understood, and groundwater should be invisible no more. (IV) Groundwater must be sustainably managed and protected within an integrated water resource framework. (V) Managed Aquifer Recharge should be greatly increased globally. (VI) Effective groundwater management requires collaboration, robust stakeholder participation, and community engagement.

Engagement has been a key focal area in water governance efforts, such as the Water Governance Initiative by the Organisation for Economic Co-operation and Development, in which I participate. An overview of a substantive report on stakeholder engagement produced through this OECD initiative was published in a special issue of the journal *Water: Water Governance, Stakeholder Engagement, and Sustainable Water Resources Management*. WRRC colleague Susanna Eden and collaborator Eylon Shamir joined me in guest editing this collection of papers, which are all freely available online at [//www.mdpi.com/journal/water/special_issues/water-gov](http://www.mdpi.com/journal/water/special_issues/water-gov).

I encourage readers to take a look at this collection of papers, several of which relate to Arizona groundwater. "Modes and Approaches of Groundwater Governance: A Survey of Lessons Learned from Selected Cases across the Globe", by Varady et al. considers Arizona water banking as one of its case studies. Ballester and Mott Lacroix look at public participation in water planning in the Ebro River (Spain) and Tucson basins. Eden et al. report on the stakeholder participation component of a project that used hydrologic and climate modeling to help water users and managers understand how climate variability affects groundwater storage and recharge in the southern end of Santa Cruz Active Management Area. Mott Lacroix and Megdal's article on the "stakeholder engagement wheel" drew from multiple Arizona regions, and Chief et al. consider Arizona tribal nations' water use in their paper, "Engaging Southwestern Tribes in Sustainable Water Resources Topics and Management".

Finally, I would be remiss if I did not mention the important work on groundwater assessment being carried out along the US-Mexico border. The binational Transboundary Aquifer Assessment Program has produced a report on the San Pedro Aquifer in English and Spanish and is completing a similar report for the binational Santa Cruz Aquifer.

Groundwater is a critically important resource for Arizona and much of the world. People are coming together to emphasize the need to understand this resource and manage it better. At the University of Arizona Water Resources Research Center, we endeavor to contribute to efforts to share best practices for groundwater assessment, governance, and management. Please visit <http://wrrc.arizona.edu/programs-research> to find out more. 



Public Policy Review

Bridging Through Water

by Sharon B. Megdal

Since my first professional visit to Israel in 2006, I have endeavored to connect that region and ours through sharing water management challenges and solutions. In late Fall I had the honor of traveling to Israel, the West Bank, and Jordan with the two International Boundary and Water Commission (IBWC) Commissioners, Edward Drusina (U.S.) and Roberto Salmón (Mexico). The IBWC addresses binational Colorado River and Rio Grande-Rio Bravo management, operates binational wastewater treatment plants, and is involved in environmental restoration, water desalination, and reuse efforts. IBWC has coordinated the Transboundary Aquifer Assessment Program, with which I've been involved since its inception. In September 2015, the Commissioners expressed to me their interest in visiting the Middle East to engage in dialogue through sharing experiences and knowledge. When in Israel the very next month to speak at WATEC, the biennial international water expo, I met with Gidon Bromberg, Israel Director for EcoPeace Middle East, a Jordanian, Palestinian, and Israeli environmental organization. At our meeting, we identified the anchor for the Commissioners' visit – their participation as speakers in EcoPeace's November 2016 conference on transborder governance and management of the Lower Jordan River.

With expert staff from the U.S. Embassy in Tel Aviv, Consulate in Jerusalem, and Embassy in Amman, we planned an intensive program of high-level meetings and site visits in Israel, the West Bank, and Jordan, respectively. Preceding these official meetings, we spent November 19 touring the Lower Jordan River with Mira Edelstein of EcoPeace staff. This day provided important background for the conference.

November 20, our day in Israel, included visiting the Yad Hanna Wastewater Treatment Plant, which is located just on the Israel side of the Green Line and wall separating the West Bank and Israel. Treating the wastewater from the West Bank communities of Nablus and Tulkarem and Israel's Emek Hefer region to avoid contamination of the Alexander creek and the surrounding aquifer currently lacks a comprehensive bilateral approach. We then visited Israel's (and the world's) largest reverse osmosis desalination plant, the Sorek plant. The plant's 16 inch vertical membrane design allowed for a much reduced plant footprint in a region where land scarcity is also a challenge. Desalinated water for municipal and industrial purposes, along with large-scale reuse of water for agriculture and continued conservation in all sectors, has enabled Israel to fulfill its master plan for addressing the water demands of the nation. We then met with Senior Deputy Director General Oded Fixler at the Israel Water Authority, the body responsible for water allocations and pricing, who introduced the first phase of the Red-Dead project, discussed below. Finally, we met officials with the national carrier Mekorot, who provided additional information on how Israel manages its national water and wastewater systems.

Our focus on November 21 was West Bank briefings and included meeting U.S. Consul General for Jerusalem Don Blome and Palestinian Water Authority Minister Mazen Ghonaim. Minister Ghonaim explained how water is a political issue. He noted that the Joint Water Committee between Israel and the Palestinian Authority has not officially met for six years, which impedes project approval. He suggested that our region could be of some assistance through special training of technical teams from their region. Our afternoon concluded with a visit to Halhul Reservoir, a large reservoir serving the Hebron area of the West Bank. USAID invested significantly in this project, designed to improve the reliability of the region's water supply.

On November 22, we crossed into Jordan to meet in Amman with His Royal Highness (HRH) Prince El Hassan bin Talal, U.S. Ambassador to Jordan Alice Wells, Minister of Water and Irrigation Hazim El-Nasser and other top Ministry officials, and Minister of Planning Imad Fakhoury. HRH explained the multiple resource challenges Jordan faces and the importance of considering the human and physical environments holistically. HRH spoke to the importance of governance and partnerships and distributed to each of us the report “Cost of Non-Cooperation of Water: Crisis of Survival in the Middle East”. We later visited the Samra Wastewater Treatment Plant, a huge plant south of Amman that processes 70 percent of the wastewater treated in Jordan. The outflows of this modern plant are mixed with surface waters before being delivered to farmers. This plant is the first Build-Operate-Transfer project in Jordan, with USAID among the list of sponsoring partners.

Later on November 22, we arrived at EcoPeace’s conference, “Water Security and Sustainable Development for our Common Future”, which drew over 300 participants. The next morning I had the honor of moderating the panel that featured the Commissioners and representatives of basin organizations from the Balkan Siva River Basin, Southern Africa, and the Rhine. Their presentations focused on the reasons for formation of the transboundary commissions and their accomplishments. It was interesting that disasters and/or major political events were a catalyzing force for collaboration. For the U.S. and Mexico, it was the April 4, 2010 earthquake. For the Rhine River basin, it was a pharmaceutical industry fire. The Sava River Basin became international upon the dissolution of the former Socialist Federal Republic of Yugoslavia. Following the panel, we participated in a discussion with representatives from the Jordan Valley.

Throughout the many dialogues, Commissioners Drusina and Salmón explained how IBWC conducted business and emphasized the importance of good and regular communication. Similarities between the two regions were discussed, including the differential in per capita incomes of the populations sharing borders and waters. I believe those with whom we met were impressed by IBWC’s functionality and accomplishments. Truly significant agreements have emerged from the 1944 Treaty governing the Colorado and Rio Grande-Rio Bravo Rivers. I see opportunities for further interactions, including possible trainings. Our region can learn from how the Middle East has deployed large water projects involving state-of-the-art technology and public-private partnerships.

It is encouraging that Israel and Jordan are collaborating on a desalination and water exchange project, something that has been discussed conceptually in the Lower Colorado River Basin. This project entails: (1) desalinating Red Sea water at a plant located in Jordan, with some water sold to Israel for use in the Arava Valley; (2) delivering brine mixed with Red Sea water to the Dead Sea to offset some of the Dead Sea’s water losses, with possible hydroelectric power production that utilizes the elevation differences; and (3) selling freshwater



November 22, 2016 high-level meeting in Amman, Jordan. From left to right, H.E. Minister of Water and Irrigation Dr. Hazim El-Nasser, His Royal Highness Prince El Hassan bin Talal, U.S. Ambassador to Jordan Alice Wells, Commissioner Edward Drusina and Commissioner Roberto Salmón.



Sharon Megdal, Commissioner Drusina, Jerusalem Consul General Donald Blome, and Commissioner Roberto Salmón. November 21, 2016.



November 19, 2016 stop at the southern tip of the Sea of Galilee.

from Israel’s Sea of Galilee to Jordan. An additional component of the project is the sale of water from Israel to the Palestinian Authority for the West Bank. The Red-Dead project is an example of how water management can be a bridge rather than a source of conflict.

Both regions face significant water challenges going forward. I am hopeful that continued dialogue and cooperation within and across the regions can lead to even more bridging through water. 🌊



Public Policy Review

A Spring Full of Productive Activity!

by Sharon B. Megdal

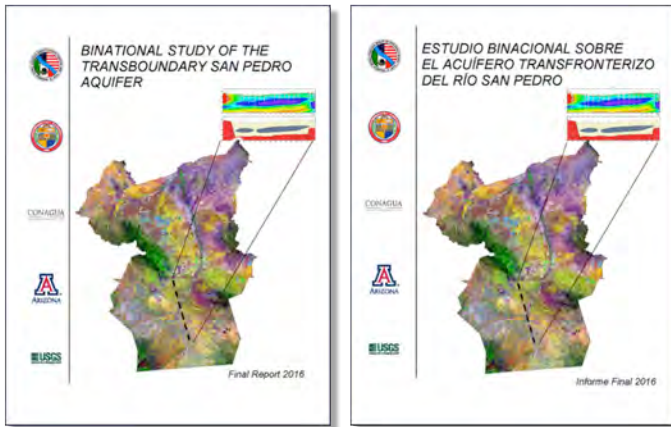
Spring semester is always a busy time of year. I teach my graduate Arizona Water Policy class and convene a seminar class for the Master's program in Water, Society, and Policy. Students are completing theses, projects, and examinations as they ready for graduation. The Water Resources Research Center recently held its Annual Conference, which it has done every year since 2003.

While I am confident that students enjoy their classroom learning opportunities, getting out in the field is – at least for me – a course highlight. Early in March, visitors from Sonora, Mexico joined my class for our annual field trip to Tucson Water's recharge and wetlands sites and Central Arizona Project's Twin Peaks Pumping Plant, with a great outdoor lunch at the White Stallion Ranch in Marana hosted by BKW Farms.

The WRRRC's Annual Conference provides another mechanism for exploration. We were pleased with and thankful for the strong interest in this year's topic, "Irrigated Agriculture in Arizona – A Fresh Perspective", and the contributions of all of our speakers, moderators, sponsors, and attendees. Although we could not take well over 300 people into the field to learn about irrigation practices and cropping patterns in Arizona, we sincerely hope that attendees at our March 28, 2017 conference found the presentations and commentary we brought to them informative and interesting. The WRRRC's Annual Conference is designed to address a topic of statewide importance and bring together participants

from throughout Arizona and beyond to share information and to learn. This year's participants came from about 35 Arizona communities and from eight other states in the US, Washington, DC and Sonora, Mexico. The conference benefitted tremendously from the input and assistance of an engaged conference advisory committee. For attendees and non-attendees, we have posted the presentation videos and, when available, power point slides: <https://wrrc.arizona.edu/conferences/2017/agenda>. Please take a look. And please mark your calendars for next year's conference! Our 2018 Annual Conference on "The Business of Water" will be held on March 28 at the University of Arizona Memorial Student Union. We received very positive feedback on this topic, which is broadly construed to include water financing, water rates, public-private partnerships, water commodification and marketing, and more. Let me know your thoughts about topics and perspectives to include by emailing me at smegdal@email.arizona.edu.

This has been a busy semester for research project work as well. In particular, work continues on various aspects of the binational Transboundary Aquifer Assessment Program (TAAP). Late in 2016 we announced the official release of the Binational Study of the Transboundary San Pedro Aquifer, a key product of the binational TAAP. The International Boundary and Water Commission posted the peer-reviewed report in English (https://www.ibwc.gov/Files/San_Pedro_Binational_Report_En_01122017.pdf) and Spanish (https://www.ibwc.gov/Files/San_Pedro_Binational_Report_ESP_Final_2016.pdf). We continue to work on completing a similar report for the transboundary Santa Cruz aquifer. WRRRC research analyst Jacob Petersen-Perlman and I have written an invited book chapter explaining how the TAAP effort is consistent with the information sharing goals of the United Nations International Law Commission's Draft Articles

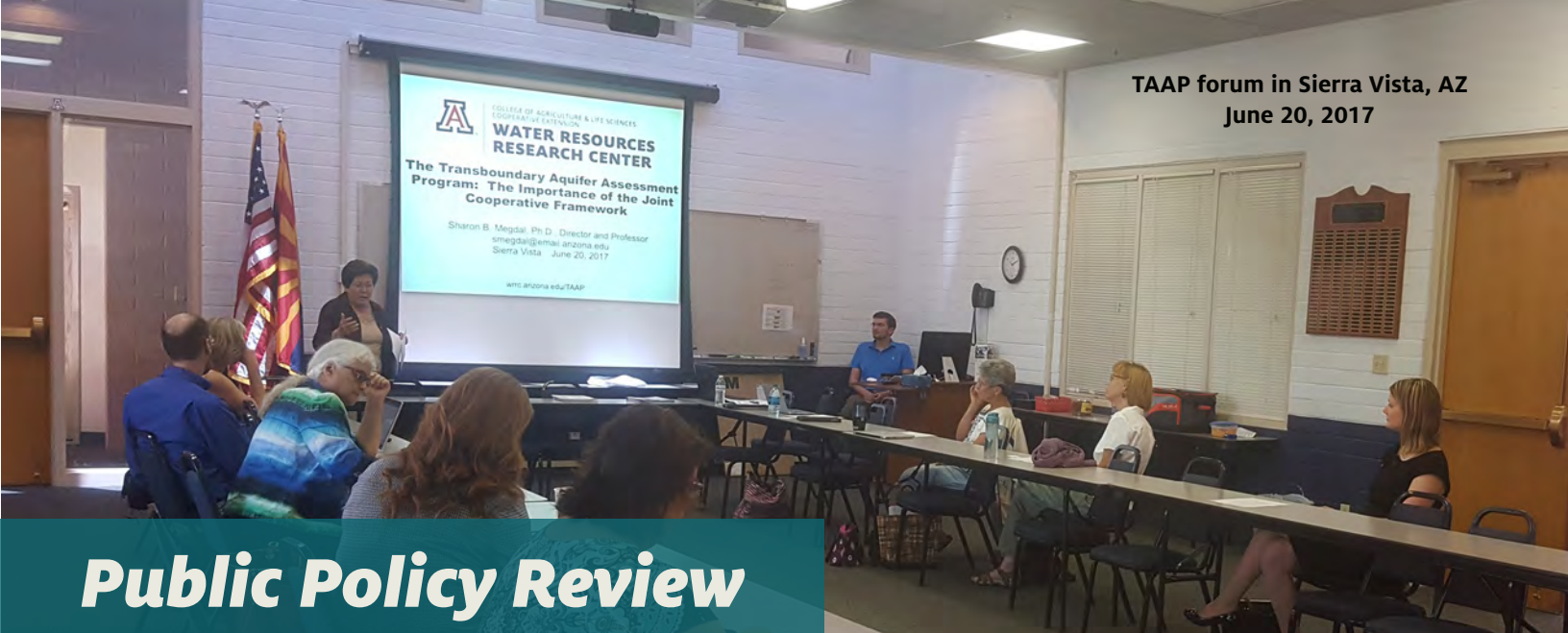


Covers in English and Spanish of the Binational Study of the Transboundary San Pedro Aquifer.

on the Law of Transboundary Aquifers. Graduate student Elia Tapia, whose excellent translation and GIS mapping skills are reflected in the published San Pedro Study, is working on expanding our understanding of the relationship between precipitation and groundwater utilization patterns at the border. We will soon release a synopsis of the San Pedro Study in both English and Spanish and our binational team will speak to the many facets of this study effort at the May international World Water Congress in Cancún, Mexico and

the June national conference of the Universities Council on Water Resources in Ft. Collins, Colorado. At the World Water Congress, a multi-part special session considering shared waters of North America will feature participants from all regions involved in TAAP. They will speak to the program's scientific and modeling accomplishments, along with some of the institutional and legal considerations. There I will discuss the importance of the 2009 Joint Report of the Principal Engineers Regarding the *Joint Cooperative Process United States-Mexico for the Transboundary Aquifer Assessment Program*, which has guided this important binational collaborative effort. The robust cooperative process for the Arizona-Sonora portion of the TAAP involves the U.S. and Mexican Sections of the International Boundary and Water Commission, U.S. Geological Survey, Comisión Nacional del Agua (CONAGUA), University of Sonora, and University of Arizona. It can serve as a model for federal-university partnerships and binational studies that go well beyond aquifer assessment. More information about the TAAP, particularly the Arizona-Sonora portion of the program, can be found at <https://wrrc.arizona.edu/TAAP>.

I look forward to the culmination of Spring semester activities. And of course, the work will continue, which I look forward to as well! 🌍



Public Policy Review

The Cooperative Framework for the Transboundary Aquifer Assessment Program: A Model for Collaborative Transborder Studies

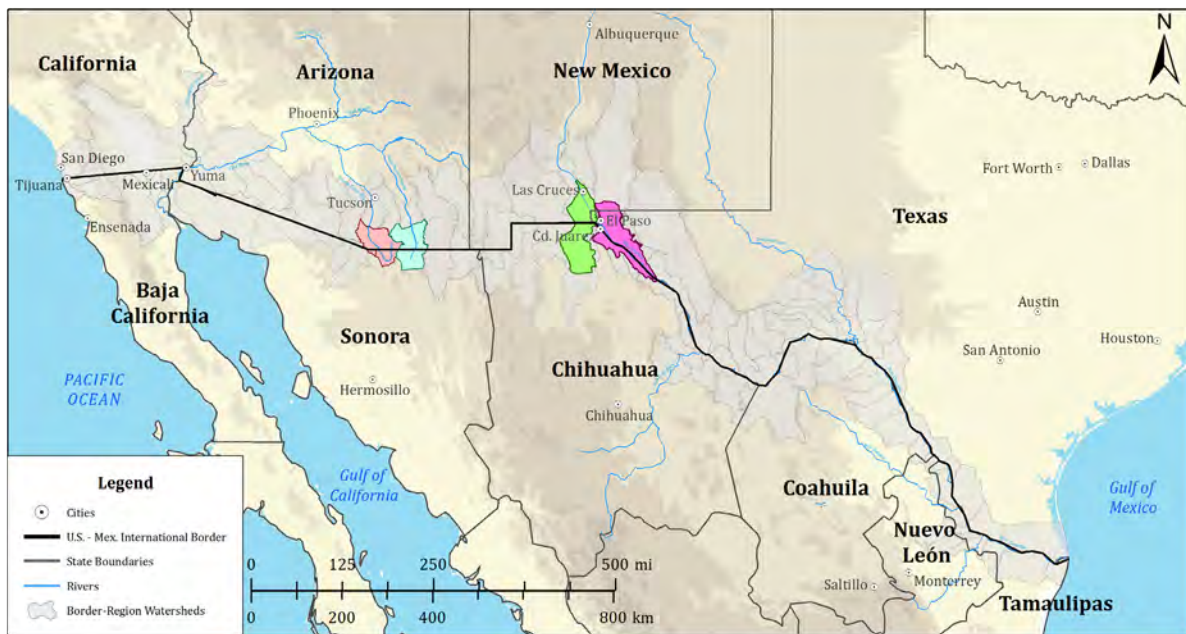
Sharon B. Megdal

Being part of the team working on the Transboundary Aquifer Assessment Program (TAAP) continues to be gratifying. The International Boundary and Water Commission's (IBWC) recent publication of the *Binational Study of the Transboundary San Pedro Aquifer* (San Pedro Study) marked a milestone. This publication is noteworthy in that it is a first-ever binationally prepared, fully bilingual aquifer assessment, and because it was subject to peer review on both sides of the border. Also noteworthy is the framework for cooperation that has guided the team's multi-disciplinary and trans-disciplinary collaborative assessment work. Signed on August 19, 2009, IBWC's "Joint Report of the Principal Engineers Regarding the Joint Cooperative Process United States-Mexico for the Transboundary Aquifer Assessment Program" (Cooperative Framework) took considerable time to develop. The successful ongoing collaboration confirms the value of the time spent at the front-end to develop the Cooperative Framework. The team was able to persevere despite uncertain and very limited funding and the challenges of working in different languages and across an international border. I believe strongly that the Cooperative Framework can serve as a model for both transboundary water studies across the globe, whether or not focused on groundwater.

By way of background, TAAP got its start on the U.S. side with the signing of U.S. Public Law 109-448, the Transboundary Aquifer Assessment Act, in late 2006. I had the honor of serving as the sole non-federal witness at the May 2006 House of Representatives subcommittee hearing on the proposed legislation. The Act articulated U.S. interest in engaging in

binational aquifer assessments of specified priority aquifers. While the Act indicated that IBWC would be consulted "as appropriate", it soon became clear that IBWC involvement would be central to development of the type of assessment authorized by the Act. (For more information on the IBWC, including the Commissioners and staff for the U.S. and Mexican sections, see ibwc.gov and cila.sre.gob.mx/cilanorte.)

The Cooperative Framework establishes that the binational program will be called the Transboundary Aquifer Assessment Program and that the IBWC will serve as the Binational Coordinating Agency. It confirms that the U.S. and Mexican sections are aware of the value of developing an understanding of the aquifers used by both countries. The Cooperative Framework acknowledges the need to develop a team of binational experts to assess aquifers, exchange data, and if necessary, develop new datasets. The document states that the "IBWC, under this joint cooperative process, will provide the framework for coordination of binational assessment activities conducted by U.S. and Mexican agencies, universities, and others participating in the program," ... "to improve the knowledge base of transboundary aquifers between the United States and Mexico". Additional key provisions include assuring that both countries concur on transboundary aquifer assessment activities and specifying binational technical advisory committees for each identified transboundary aquifer. The IBWC was named as the official repository for binational project reports to be published in Spanish and English. Importantly, IBWC is responsible for developing a joint program and for determining whether a proposed aquifer study is in the interest of both countries. The IBWC also coordinates with agencies for both countries in defining the scope of the assessment and facilitating agreement on work plans. However, the Cooperative Framework specifies that "each country will be responsible for any costs on projects conducted in its territory, in addition to selecting the participants and consultants to carry out the studies in that country. Each country may contribute to costs for work done in the other country, and the IBWC will coordinate any flow of funds across the border." The six principles of agreement, which appear toward the end of the three-page document, make it clear



Transboundary Aquifer Assessment Program Aquifers of Focus. Source: Water Resources Research Center


that each country is free to undertake its own studies when such are limited to one side of the border.

The six Principles of Agreement are as follows.

1. Activities described under this agreement should be beneficial to both countries.
2. Aquifers to be jointly studied, as well as the scope of the studies or activities to be done on each aquifer, should be agreed upon within the framework of the IBWC.
3. The activities should respect the legal framework and jurisdictional requirements of each country.
4. No provisions set forth in this agreement will limit what either country can do independently in its own territory.
5. Nothing in this agreement may contravene what has been stipulated in the Boundary and Water Treaties between the two countries.
6. The information generated from these projects is solely for the purpose of expanding knowledge of the aquifers and should not be used by one country to require that the other country modify its water management and use.

There is much global interest in governance and management of transboundary groundwater. The international legal community and others have for some time been advocating for UN adoption

of the 2008 Draft Articles on the Law of Transboundary Aquifers (Draft Articles). I pointed out that the Cooperative Framework is consistent with two important provisions of the Draft Articles in my first international presentation on TAAAP at Stockholm's World Water Week on August 20, 2009, (the day after the signing of the Cooperative Framework) and again as recently as the 2017 World Water Congress in late May. Both "Article 7, §2: General Obligation to Cooperate" and "Article 8, §2: Regular exchange of data and information" speak to the desirability of cooperative study.

A common understanding of aquifer conditions is a first step in efforts to explore binational governance and management. Disagreement about groundwater conditions is likely to lead to different perspectives on approaches to groundwater management. Because it is beyond the scope of TAAAP responsibility, the expert team has been silent on the prospects for binational groundwater management along the U.S.-Mexico border. Instead, the TAAAP team has focused on expanding shared knowledge and understanding. Since 2009, the Cooperative Framework has facilitated successful completion of the San Pedro Study, with completion of a similar study for the transboundary Santa Cruz aquifer in progress. In addition, binational efforts are continuing for the other TAAAP aquifers, as shown on the map of TAAAP transboundary aquifers. The basic elements of the Cooperative Framework can serve as a model for others engaged in transborder studies. The Cooperative Framework, a link to the San Pedro Report, and other information on TAAAP history and activities, particularly for the Arizona-Sonora transboundary aquifers, can be found at wrrc.arizona.edu/TAAAP. 



Public Policy Review

Photos, clockwise from top left: View of reception area for Cutting-Edge Solutions to Wicked Water Problems conference; Conference co-chairs Dror Avisar and Sharon B. Megdal; Sorek Desalination Plant field trip participants; Panel at Sept. 12 WATEC conference; Central Arizona Project Board members Jennifer Brown and Mark Taylor with Sharon B. Megdal.

Photographers: Gefen Ronen Eliraz, Jennifer Brown, and Michelle Baruch

Comparing Experiences and Lessons Learned: The September 2017 International Conference on Cutting-Edge Solutions to Wicked Water Problems

by Sharon B. Megdal

My work focuses on water policy and management. For over a decade, I have been comparing the policies and management approaches of Israel with those of Arizona and the Colorado River Basin. This multi-faceted effort has involved several visits to Israel, where I have studied their management strategies and often speak about our region's water matters. Water recharge and banking, transboundary water and wastewater, groundwater management and governance, and conservation are among the issues compared. This calendar year started with a new opportunity, namely to co-chair a water conference co-convened by a U.S. organization, the American Water Resources Association (AWRA), and the Water Research Center at Tel Aviv University (TAU). On September 10-11, 2017, the conference "Cutting-Edge Solutions to Wicked Water Problems" was held at Tel Aviv University's beautiful Porter School of Environmental Studies building. Professor Dror Avisar, Water Research Center Director, served as conference co-chair. It was great to work with Professor Avisar, whom I did not meet in person until the day before the conference!

Wicked water problems are difficult to formulate and solve. (See <https://wrrc.arizona.edu/wicked-water-problems>.) Some examples are overuse or over-allocation of surface water and groundwater, impacts of long-term drought or changing

climate, the imbalance between growing demands for water relative to supplies, and transboundary water and wastewater challenges, including pollution. Different regions face different problems, but the pathways to solutions often have common or similar elements. Israel is well known for its leadership in deployment of desalination technology, drip irrigation, and water reclamation, which has enabled it to address the scarcity of natural freshwater resources. While Israeli water management has influenced the work of others across the globe, we must acknowledge that institutional and governance factors, along with those related to geographic and physical variables, will shape the policies we see implemented. The key thrust of the conference was to discuss the pathways to solutions so to learn from each other's experiences and/or research. The active sharing and learning occurred through conference keynote addresses, technical presentations, field trips, and meals and hallway conversation. And learn we did!

In addition to speakers and attendees from the U.S. and Israel, experts from Mexico, the United Kingdom, and Hong Kong participated. The opening keynote speakers set the stage. Felicia Marcus, Chair of the California State Water Resources Control Board, emphasized the need to look at the whole of the problem(s), including difficult-to-predict game-changing influences, such as those associated with climate. Scale is important to consider: the population of California is more than four times that of Israel and the economy of this single state in the U.S. would rank about sixth among countries world-wide. Starting with a bit of humor, she invoked Godzilla in her first slide to evoke the horror of the wicked water problems situation. She emphasized that California's Water Action Plan includes a mix of approaches. Her presentation underscored a concern water managers often speak to, namely that it will take a crisis to spur actions that many have known were advisable, but difficult to implement, due to political and cost considerations. In California, the worst drought in

modern times served as the wake-up call and led to adoption of conservation mandates and groundwater management legislation. She emphasized the need to recognize the sometimes harsh realities and take bold actions.

Professor Eilon Adar of the Zuckerberg Institute for Water Resources at Ben Gurion University of the Negev provided an overview of how Israel has addressed the wicked problem of water scarcity. Often during the conference the saying “necessity is the mother of invention” came to mind. In Israel, the scarcity of naturally occurring usable water relative to demand made “bridging over the water shortage” the primary water management goal. Key strategies included: improving water utilization efficiency for irrigation and other water applications; conservation; water reuse; and management of water quantity and quality. “New” usable water was created through treating and reclaiming wastewater and desalinating seawater and brackish groundwater. Like California, responding to crisis has figured into the timing of Israel’s water management actions. Drought conditions during the early part of this century resulted in changing agricultural water allocations and water pricing, which led to a renewed look at seawater desalination and the current situation where the quantity of desalinated water exceeds 70 percent of the quantity for municipal use. Key take-away messages were that water has economic value and its management needs care and attention through a holistic and coordinated approach.

Remarks on “Immigration and the Water Crisis” by TAU Vice Rector Professor Eyal Zisser helped provide a regional geopolitical backdrop to the discussions. Conference attendees received the most up-to-date information on the Red Sea-Dead Sea Project (Project) by Oded Fixler, Senior Deputy Director General, Israel Ministry of Regional Cooperation. He serves as the Israeli lead for the Joint Advisory Board with Jordan for the Project. His address covered the details of this cutting-edge and complex program to address partially the water scarcity challenges faced by (1) Jordan, whose significant water demands occur in the northern part of the country, (2) a key agricultural area in the south of Israel, and (3) the West Bank. A 2013 Memorandum of Understanding signed by Israel, Jordan, and the Palestinian Authority enabled the parties to move forward with what may be the first phase of a much larger effort to desalinate Red Sea water. The Project involves building a plant in Jordan. Some of the desalinated water will be sold to Israel. Israel in turn will provide water from the Sea of Galilee in the North to Jordan. The Project includes delivery of water to the Palestinian Authority for the West Bank, further demonstrating its regional importance. Also incorporated are energy features and the pumping the seawater desalination plant’s brine discharge to the Dead Sea to offset some of the decline in Dead Sea water levels – another truly wicked water problem of the region.

Field trips were offered to the IDE’s Sorek Desalination Plant, the largest reverse osmosis desalination facility in the world,

and to Netafim’s drip irrigation manufacturing facility at Kibbutz Hatzerim in the Negev Desert, where participants learned about the technology in drip emitters and life on a kibbutz. In addition, those who did not participate in the field trip to Sorek were able to take a virtual tour of the Sea of Galilee (Lake Kinneret), conducted by Dr. Doron Markel, Unit Head for Monitoring and Management of Lake Kinneret and Its Watershed. This was followed by a screening I hosted of the award-winning documentary *Beyond the Mirage*, which connects some of the wicked water problems of the lower Colorado River Basin and Arizona to Israeli water management. (See <http://beyondthemirage.org/>.)

Two tracks of technical presentations on wicked problems as well as strategies to address them featured experts representing academic institutions, government water agencies, the private sector, and non-governmental organizations. Low Jordan River and Colorado River flows, low inflows into the Sea of Galilee and Lake Mead, transboundary wastewater and associated pollution problems, water banking programs, water quality monitoring, water use efficiency, and water treatment were just some of the topics covered. For a more complete overview of the topics, along with contact information for the lead presenters, please consult the final program. (<http://awra.org/meetings/Israel2017/> and <http://watec-israel.com/preview-program/>.)

It is hard to convey the excitement associated with the conference in words. This was the first visit to Israel for many participants, some of whom were joined by family members. Several combined the conference experience with other exploration of this small country. For me and others, this conference was followed by participation in the biennial international WATEC conference and expo (<http://watec-israel.com/>), where discussion of wicked water problems carried over into the panel on water scarcity and abundance. See <https://wrrc.arizona.edu/panel-remarks-watec> for a summary of my panel comments.

I am grateful for the many positive comments I received before, during, and after the conference. Organizing a conference always takes a lot of work, and co-chairing an international conference was something new for me. It involved dealing with many issues that either do not arise or arise less frequently when chairing a domestic conference, whether local or national. While it did not involve too many sleepless nights for me, it did involve many early mornings of calls and emails working across the 10-hour time difference. I wish to offer my most sincere thanks to all those who helped make this conference successful. In addition to the speakers, I wish to shout out special thanks to Ken Reid and staff at AWRA, Dror Avisar and his colleagues at Tel Aviv University, and conference collaborators Netafim, IDE Technologies, Tel Aviv University, International Arid Lands Consortium, WATEC, and, last but not least, the University of Arizona Water Resources Research Center! 🌍



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. 🌍



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Public Policy Review

Photo: Cynthia Campbell

The Business of Water is Everyone's Business

by Sharon B. Megdal

On March 28, 2018, the Water Resources Research Center held its annual conference. The topic, The Business of Water, was selected to bring attention to the myriad ways monetary considerations influence water management decisions and investment. The presentations and panel discussions throughout the day illuminated the variety of innovative approaches to infrastructure funding, water transactions, and water-based environmental and economic improvements deployed throughout Arizona and the West.

Financial considerations influence the way we think about investments in water projects. Our opening keynote speaker, Ian Lyle of the National Water Resources Association, noted the uncertainties associated with looking to Washington, DC, for assistance with water infrastructure funding. At the regional and local levels, projects may benefit from Public-Private Partnerships, such as those discussed by our opening panel. Large water treatment or conveyance projects require considerable work and can take many years to complete. The panel speakers, who represented a wealth of experience working on complex financing projects and partnerships, addressed the risk assumed by the private sector. Although there are risks, investors value the "safe space" that water projects represent once they are completed. The private sector can be more creative and agile than the public sector, but the risk assumed comes with a price.

The conference section on water transactions focused on their many forms, complex nature, and ethical aspects. Gila River Indian Community Governor Stephen Roe Lewis, who was introduced by University of Arizona President Robert C. Robbins, highlighted the importance of self-determination and the rocky road that led up to the 2004 Arizona Water

Settlements Act. He explained how the many water projects are addressing the needs of all water using sectors, including the environment, and spoke to GRIC (Gila River Indian Community) educational efforts. Governor Lewis informed the audience on how they have looked to alternatives to water leasing and how partnerships have contributed to propping up Lake Mead water levels to forestall declaration of shortage for the Lower Colorado River region by the U.S. Secretary of the Interior.

The panel that followed further elaborated on the complexities, lessons learned, and ethics of water transactions. Attorney Peter Culp emphasized the need to improve the use of the water resources we have through investments, and City of Phoenix Water Resources Management Advisor Cynthia Campbell explained how partnerships with others have enabled Phoenix to enhance water system efficiency and sustainability. I had the privilege of reading Morrison Enterprises Chairman Richard Morrison's thoughtful commentary on water ethics (see Guest View). I would like to focus here on the part of his comments on which I received the most feedback, namely his discussion of the tie between policy choices and economic justice. He wrote that economic justice should have the following six attributes: equal respect and concern for all, special concern for the poor and oppressed, recognition of basic human needs, human freedom, contributions to the well-being of the community, and the fulfillment of our obligations to future generations. He explained how his experience working on Native American water settlements led him to acknowledge that requiring human freedom may conflict with fulfilling obligations to future generations. He commented: "In other words, in the exercise of our freedom in the present day, we may elect to maximize the economic benefit to ourselves through the marketing of a resource that will be needed by future generations of people living where the water came from in the first place. So, sometimes decision making with reference to even widely adopted principles will be difficult." Indeed, the many tradeoffs associated with water transactions, including those related to economic justice, are varied and complex.

In recognition of our region's proximity to and relationship with Mexico, the luncheon program focused on water resource management and infrastructure investment issues in the border region. The International Boundary and Water Commission and the North American Development Bank facilitate water and wastewater investments and management in the border region. IBWC Commissioner Edward Drusina and NADBank Chief Sustainability Officer Salvador López Córdova explained that, like elsewhere, funding availability will determine infrastructure investment opportunities.

The Environment and the Business of Water panel provided insights into innovative programs being accomplished through funding partnerships involving NGOs and philanthropic organizations. Through leadership from not-for-profit organizations, but often with support from for-profit businesses, we are witnessing greater consideration of water for natural systems in water-related investments. While water use by the municipal, agricultural, and industrial sectors are regularly if not always well measured, the environment tends to be the forgotten sector. Most recognize that recreation, tourism, and property values depend on the condition of our natural environment. Nevertheless, the not-well-measured water requirements of healthy natural systems have limited legal standing in Arizona. A paper I co-authored in 2011, entitled "The forgotten sector, Arizona water law and the environment" (*Arizona Journal of Environmental Law and Policy* 1(2), pp. 243-293), discussed the importance of voluntary transactions in bringing the environment to the table as a water-using sector. In fact, as the panel illustrated, this has happened since publication of the article.

The panel on Water and Economic Opportunity, which included featured speakers from Yuma, Clarkdale, Tucson, and Phoenix, underscored how water availability and innovative water projects enhance the vibrancy of our local economies. Whether we live along rivers, mostly dry riverbeds, or not near rivers at all, carefully planned water systems and water features contribute to economic development and the enjoyment of the places in which we live.

Clearly, the business of water affects us all. Despite successes, we live where water supplies are limited relative to water demands. Closing speaker Arizona Department of Water Resources Director Tom Buschatzke underscored some key challenges Arizona faces. Whether communities depend on groundwater or surface water, challenges abound. Moreover, their nature changes over time.

Fostering understanding of Arizona's water resource challenges, along with the opportunities to address them, is a key priority of the Water Resources Research Center, and our annual conference is a signature WRRRC program. We thank the excellent speakers, the more than 300 people who attended the conference, and the conference sponsors for contributing to a meaningful and informative dialogue. Finally, I would like to extend my personal thanks to the staff and conference volunteers, including the Conference Planning Committee, for their contributions.

Conference presentations and related materials can be found at <https://wrrc.arizona.edu/conference-2018-agenda>.



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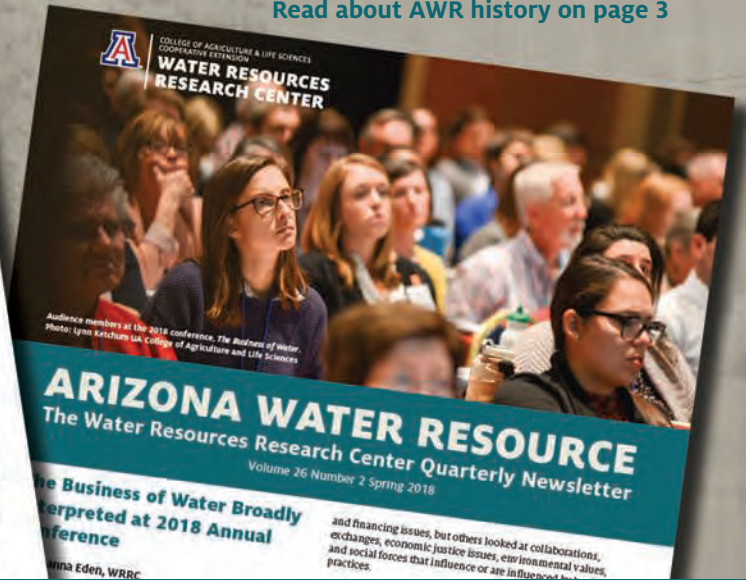
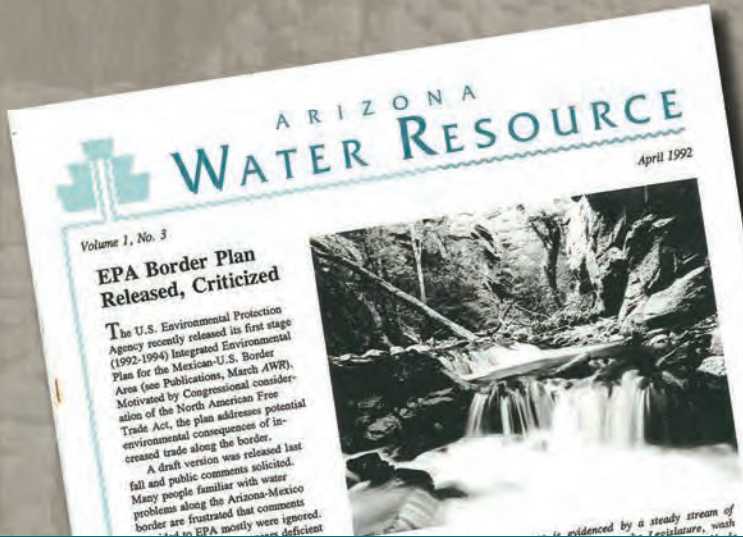
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Reflections on Change and Continuity in WRRC Outreach

by Sharon B. Megdal, Ph.D.

This is my 75th *Arizona Water Resource* (AWR) column since joining the WRRC in February 2002. When I interviewed for the Associate Director position, which I held until becoming Director in July 2004, I expressed interest in contributing a policy column to the newsletter on a regular basis. Over 16 years later, I am pleased to say that I have not missed an issue. It is also with somewhat mixed emotions that I am using this column to inform our readership that we will cease publishing the AWR with the Fall 2018 issue.

We transitioned from printing and mailing the newsletter to an all-digital format in 2017. While that saved some funds, publishing the newsletter on a quarterly basis continues to strain our resources. We started our Weekly Wave e-news digest about six years ago as a means of consolidating email announcements, particularly those about the WRRC annual conference and our sponsored seminars. The Weekly Wave, published as the bi-weekly Summer Wave during the University of Arizona's summer break, has evolved into a mechanism for us to share news as well as announcements in a more concise and flexible format, something more consistent with today's communications platforms.

During 2017, we at the WRRC took a look at how we deploy staff and student resources and engage with our varied stakeholders. Given resource constraints and the changing nature of how we receive and share information, we recommended to the WRRC External Advisory Committee that we discontinue the AWR. We also recommended that we use the Weekly Wave to carry some AWR features, such as occasional commentary from guest writers and my column. The WRRC External Advisory Committee, and others with whom we have shared our recommendations, concurred. Producing the Weekly Wave is truly a team effort. We look forward to continuing to communicate with our stakeholders and welcome your thoughts as to the Weekly Wave's content going forward. If you are not already a subscriber, please sign up at <https://wrrc.arizona.edu/subscribe>.

At the current time, we plan to continue the production of our annual *Arroyo* newsletter, which focuses on a single topic linked to our annual conference. The 2018 issue, *Water and Irrigated Agriculture in Arizona*, was published in May. With the hiring of a summer research intern, we are working on the 2019 issue based on our March 2018 conference, "The Business of Water". The current and past *Arroyo* issues can be found at <https://wrrc.arizona.edu/publications>.

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Public Policy Review

Our efforts to connect our stakeholders to up-to-date information and insights through seminars continue throughout the year. While we do tend to slow down over the summer, we have had the opportunity to schedule two seminars by international experts. The first was held on June 15 and featured Dr. Shafick Adams of South Africa's Water Research Commission. Dr. Adams' lecture on diversification of South Africa's water supplies under conditions of drought was well-attended and included strong on-line participation. The second seminar, on July 18, featured two experts from the Arava desert region of Israel. Their presentation on food, water, and energy in the Arava region included discussion of renewable energy deployment in this water-scarce region. We offer live streaming of our seminars and post recordings of them, subject to speaker permission. Information on our sponsored and co-sponsored seminars is shared via the Weekly Wave and can be found on our web page <https://wrrc.arizona.edu/brown-bag-seminars>.

The WRRC's annual signature outreach and engagement event is our conference. We are still working on the date and location of our 2019 conference. Our goal for the annual conference is to bring together varied insights and information on a topic of interest and importance to the State. Especially for those who have not attended recent conferences, I refer you to our conference web page, <https://wrrc.arizona.edu/conference>.

As you can tell, a key tool for engaging with our stakeholders is through the WRRC website <https://wrrc.arizona.edu>. We endeavor to keep our outreach and programmatic pages up to date and post reports, bulletins, and publications, subject to copyright restrictions. Also included among our postings are our annual reports and strategic plan metrics. We provide access under the Programs tab to extensive information on Arizona Project WET (<https://arizonawet.arizona.edu>), as well as our programs on water quality, groundwater, transboundary aquifer assessment, water harvesting, and water planning and research carried out in various locations across Arizona. We offer presentations on water resource related topics to diverse audiences throughout the year and, while we do not post them all, I am happy to share mine with you on request. My Curriculum Vitae, which can be found at <https://wrrc.arizona.edu/director>, lists my presentations.

We hope you have enjoyed reading the *Arizona Water Resource* over the years. Past issues can also be found on our website. Our final Fall 2018 issue will feature water news resources that have emerged in the last few years, a comment from an *Arizona Water Resource* founder, and a retrospective look at my columns. Regarding my columns, in recent years, I have asked the students in my Spring graduate class to read them and formulate questions as their first assignment. (For those with interest in enrolling, this class, Water Policy in Arizona and Semi-arid Regions meets weekly during the Spring semester on Friday mornings from 9:00 to 11:30 at the WRRC.) In my final AWR column, I intend to highlight some of my favorite columns.

I do not want to pass up this opportunity, however, to mention a few of my past columns that relate to the Lower Basin Drought Contingency Plan (LBDCP). Anyone who pays attention to the news will know that Arizona has recently renewed its public dialogue on how to approach LBDCP structure and implementation in Arizona. We have known for some time that Arizona would face cutbacks in deliveries of Colorado River water through the Central Arizona Project. In Fall 2013, I published the column entitled "Shortage Projections May Inspire Changes in Thinking". In the Winter 2014 issue, I discussed the talking points on Arizona's water achievements and challenges, which had been circulated in December at the Colorado River Water Users Association annual conference.



This electronic billboard concept from the Winter 2015 AWR Public Policy Review shows Lake Mead level as of January 2015. Source of bucket graphic: Central Arizona Project

Published a year later, the column, "15 Water Wishes for 2015", is one of my personal favorites. More than one of my wishes relates to Colorado River conditions and actions to take. Wish number four was "to explore developing an electronic billboard campaign that shows Lake Mead elevation levels and links to sources of information about what these levels mean for Central Arizona Project water deliveries. It could be an interesting way to engage the public." And wish number 10 was that "we determine our solution paths here in Arizona and throughout the Colorado River Basin before a crisis develops. It might take some event(s), however, such as a shortage declaration on the Colorado River, to interest the general public and spur action. Although we do know a shortage declaration is likely, even without one, Arizona will voluntarily use less Colorado River water over the next three years pursuant to the recently signed Memorandum of Understanding to leave water in Lake Mead with the hopes of forestalling a shortage declaration."

As always, I welcome your feedback via email (smegdal@email.arizona.edu), including any you might have on the billboard idea, which I still like! 🙏



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