

WRRC Conference Focuses on Water and Growth

Arizona is growing and developing in leaps and bounds, with major building projects considered for outside Prescott city limits, the Chino Valley area, Cottonwood and unincorporated areas close to Sedona and a boom expected down south in Cochise County. The area poised to take the biggest leap and the greatest bound is Mohave County where as many as 200,000 homes could be built over several decades to serve the housing needs of Las Vegas.

A hundred homes here, a couple hundred homes there, several thousand over there, a couple hundred thousand yonder, and it becomes obvious that Arizona is facing big-time development — and big-time water needs.

The University of Arizona's Water Resources Research Center is addressing the critical topic of growth and water with its annual conference titled, "Providing Water to Arizona's Growing Population: How Will We Meet the Obligation?" Scheduled June 20 and 21 in Phoenix, the conference is planned as a dialogue involving various and diverse interests.

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WRRC's Conference, June 20-21: Providing Water to Arizona's Growing Population: How Will We Meet The Obligation?



In a rapidly growing state the urban-agricultural boundary is ever-changing as development encroaches on farm lands. The above photo strikingly shows this situation. It might be viewed as irony or black humor but one can almost imagine the crops in the above picture as landscaping for the apartment complex. The site is located in Chandler near the 101-202 interchange. Photo: Norbert R. Duet

Interconnected Energy/Water Savings and Uses Worked Into Conservation Planning

Importance of energy/water nexus gaining recognition

by Joe Gelt

Just as producing energy consumes water, treating and distributing water requires energy. In other words, water is an energy issue; energy is a water issue. Called the energy-water nexus or connection, the interrelationship of energy and water is an issue getting increased attention.

Many people claim at least a general familiarity with the issue: mention the energy-water connection and they will likely think of dams generating hydroelectric power. The issue now claiming attention is much more complicated than that.

The second greatest U.S. water user after agriculture is the electricity industry. With its operations requiring a reliable, abundant and predictable water source, the industry consumes vast amounts of the resource. Producing electricity from fossil fuels and nuclear energy takes about 190,000 million gallons of water per day or 39 percent of all U.S. freshwater withdrawals. Of that amount, 71 percent goes to fossil-fuel electricity generation.

Considering the situation from the water side of the nexus, great amounts of energy are needed to ensure water supplies: as much 80 percent of the cost of water is attributable to energy costs for treatment and delivery.

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Like groundwater and surface water, energy and water are interrelated issues. Understanding the workings of the nexus is critical to efforts at achieving either energy or water sustainability.

More Energy, More Water Needed

With energy and water demand expected to greatly increase in the future, some see a possible train wreck looming on the horizon. The 2001 National Energy Policy indicates that a growing population and expanding economy will require 393,000 megawatts of new generating capacity by the year 2020. This means 1,300 to 1,900 new power plants, more than one built each week.

Water supplies then become a critical issue to the power industry. Will a sufficient supply of dependable, affordable water be available to produce the energy to meet future needs? This may be problematic.

Population grows, energy demands increase, but freshwater supplies remain relatively constant. More people with more demands means less water to go around for generating energy and for other uses. Further complicating the energy-water situation is that population shifts and movements often occur without due regard to water availability. Areas of growing water demand may not be the same as areas where supplies are available.

For example, the 1990s saw the largest U.S. regional population growth, 25 percent, occurring in the mountain west, a region of generally scarce water resources. The same situation is occurring in the U.S. southeast: growing population, 14 percent since 1990, amidst increasing concerns about water availability. Meanwhile the northeast, which has a relative abundance of water, experienced only a 2 percent growth in population.

A growing population not only uses more electricity but also consumes more food, with the result that the two largest water users — energy and agricultural producers — will likely be competing for limited water resources. Both will need more water to serve additional customers.

In some situations environmental concerns about protecting fish and other aquatic organisms may restrict the amount of water available to generate electricity. Dam releases to benefit the environment may limit the generating capacity of a dam.

The workings of the nexus take on added complications when possible atmospheric effects are considered. Increasing electricity production will likely result in higher levels of atmospheric carbon. This in turn could affect precipitation in uncertain ways, possibly shifting patterns of existing water distribution. This could be to the disadvantage of electricity producers in certain areas.

The future scenario is increased energy needs in the face of limited water supplies. Where will the water come from needed to generate energy? With water scarcity boosting the cost of water, energy will become more expensive. How will more expensive energy affect the cost of water? The nexus bristles with interconnected complications.

Energy-Water Nexus Hits Home

National and regional energy and water trends and atmospheric phenomenon are parts of the big picture. But what about the smaller scale? For example, what significance, if any, does the energy-water nexus have to a family determined to save water? Such a family would need to develop interdisciplinary thinking skills, thinking about energy as well as water, to understand the full energy-water implications of conservation.

Coal is the most abundant fossil fuel, accounting for 52 percent of U.S. electricity generated; each kilowatt hour produced from coal requires a withdrawal of 25 gallons of water. Knowing one kilowatt hour of electricity = 25 gallons of water provides a standard for measuring water use in energy consumption. This information can help build consumer awareness that, like taking a shower or watering vegetation, operating a vacuum cleaner or air conditioner consumes water.

(The amount of water used to generate energy often escapes consumers' attention, not only because it is usually a behind-the-scene, indirect use of water but also because a unit of energy is

somewhat abstract, at least compared to water measured, for example, as gallons. Water used to generate kilowatt hours seems less tangible than water used to grow cotton or oranges.)

Energy Savings vs. Water Savings

Not heeding the energy-water nexus could result in a conflict between energy conservation and water conservation. In the fall/winter 2005-06 *Water Conservation News*, the California Urban Water Conservation Council described such a conflict. The council says consumers have been choosing different types of appliances in response to rapidly escalating energy prices. Some of these energy-saving appliances were developed and then purchased without consideration of water use.

For example, ice makers and home air-conditioners are at their energy-efficient best when using water to remove heat from the refrigerant in condenser coils. At one time, the high cost of water-cooled air conditioners discouraged homeowners from purchasing them. Increased electricity cost now justifies paying the high initial cost of

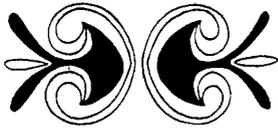
the unit in expectation of down-the-line energy savings. What is occurring is a trade-off, with increased water consumption exchanged for energy efficiency.

To add insult to injury the water consumption of the above energy-saving appliances peaks during the summer months, at a time when water suppliers are urging conservation. The council announced that it is consulting with the California Energy Commission to ensure that water gets due consideration when traded for energy conservation.

Conversely some efforts to save water have come at an energy cost. For example, a device that circulates water from hot water heater to tap ensures the availability of hot water as soon as the faucet is turned on. Water is thus saved but additional energy use results



The energy/water nexus writ large. The decline in Lake Mead's elevation since 1999 prompted the Bureau of Reclamation to initiate a program to modify the turbines at Hoover Dam to increase their electrical generating capacity at lower lake levels.



Water Vapors

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Consider Day One: a topic up for discussion is the different strategies city, town and rural area managers adopt when taking up the issue of water resources and growth. This session has an obvious segue to another morning topic posed as a question: Where is the water coming from? Addressing the question will be a panel of water professionals from diverse organizations.

Not to be neglected are the perspectives of developers, home builders and Realtors to be presented in an afternoon panel session. Another afternoon session takes on the challenging task of explicating the role of the Central Arizona Groundwater Replenishment District. Also in the afternoon various public officials will have their say about water and growth.

Although scheduled as part of the conference, Day Two, a half-day workshop hosted by Arizona State University's Global Institute of Sustainability, is optional and requires separate registration. The Day Two agenda features an in-depth discussion about meeting the long-term water needs of Central Arizona and the implications for the rest of the state. The decisions, infrastructure investments and water management programs this would require will be addressed in a background paper and by a panel discussion. The concluding session will be roundtable discussion of the key policy questions and issues needing to be addressed.

For additional information about the conference check the WRRRC web site: <http://cals.arizona.edu/AZWATER> or contact Cas Sprout at csprout@cals.arizona.edu; 520-792-9591 x55; Fax: 520-792-8518)

Survey Backs WRRRC Conference Topic

A recent survey shows that the Water Resources Research Center focused on an important issue when it titled its annual conference, "Providing Water to Arizona's Growing Population: How Will We Meet the Obligation?"

The WRRRC conference will be addressing the concerns of 60 percent of survey respondents who stated that there is not

enough water to sustain current growth and development in Maricopa County along with the 49 percent who believe there is insufficient water to sustain growth statewide.

The survey of 401 metro Phoenix residents was conducted by WestGroup Research for Valley Forward, a business-based environmental public interest organization.

Diane Brossart, Valley Forward president, said, "We have not done a good job of communicating our efforts, as the general public is not confident in how our state and local governments are managing water."

Informing/Entertaining Public

Communicating water information has proven to be somewhat of a conundrum; to get across what needs to be known to those who should know it requires skill, tact and sensitivity. According to Ellen Pragers, in a recent editorial in ENN, it also helps if one is entertaining. She writes, "Within the scientific community we have a poor history of making science relevant, understandable, and yes, even entertaining, to the public."

Perhaps scientists should heed the example of journalists who often blend entertainment with information as two recent drought stories demonstrate. In Tucson, the *Arizona Daily Star* expressed its disappointment in the lack of rain by referring to popular songs. A Jan. 26 story with the head, "A John Denver Kind of Day," began by stating, "We've been singing the chorus from Phil Collins' 'I Wish It Would Rain Down' all month long." The article goes on

NEMO Sponsors Supplement
The University of Arizona's Nonpoint Education for Municipal Officials (NEMO) Program sponsored this issue's supplement with information about the program. We appreciate the opportunity of working with NEMO and its generous support of the AWR newsletter.

to note that expected rain did not pan out "prompting John Denver's 'Sunshine on My Shoulders' to be the earworm of the day."

The *Arizona Republic* talked a lot of sports before getting around to the record-breaking drought. A Jan. 25 article began: "They say records were made to be broken, but some probably won't be. Wilt Chamberlain: 100 points in a single NBA game. Joe DiMaggio: 56 straight games with a base hit. The Chicago Cubs: 97 seasons in a row without a World Series title.

"No one will ever touch those. OK, the Cubs will probably make it to 98. And with Kobe Bryant scoring 81 points Sunday night, maybe 101 points in a pro basketball game is within reach.

"Then there are records that seem invincible but aren't. For example, 101 days in a row without rain in Phoenix."

(A gathering of water professionals, the WRRRC conference will no doubt have its entertaining moments. One can expect, however, a more refined wit and humor than is the stock in trade of journalists. Consider the title of keynote speaker Grady Gammage's talk, "Water, Growth and Sustainability — Is Arizona Heading the Way of Easter Island?")



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News Briefs

Verde River Makes Endangered River List

The Verde River achieved a dubious distinction recently when American Rivers listed it tenth in its annual Ten Most Endangered Rivers list. Coping with growth is the culprit landing the river on the list.

Having purchased a 4,500-acre ranch for its water supplies, the City of Prescott, along with Prescott Valley, plan to build a pipeline from an aquifer located beneath the ranch to serve their growing populations. Plans call for about 8,000 to 12,000 acre-feet pumped annually through the 30-mile long pipeline.

A U.S. Geological Survey report concluded recently that the aquifer provides over 80 percent of the Upper Verde flow.

According to American Rivers, the Big Chino Water Ranch Project, which will cost about \$200 million, poses diverse threats to the river. A reduced river flow could impact various riparian wildlife, such as the bald eagle, several endangered species of native fish, southwestern willow flycatcher and Arizona toad.

The group faults Arizona law for not recognizing the connection between groundwater and surface water, thereby ag-

gravating problems such as those occurring along the Verde River.

American Rivers is calling on the U.S. Army Corps and U.S. Fish and Wildlife Service to do a full Environmental Impact Statement that not only considers impacts on species on land traversed by the pipeline but also the environmental effects of a lowered river level.

City engineers do not view their proposal as posing a threat to the river. They say new wells will pump from areas of the aquifer separate from springs feeding into the river. They believe the Big Chino aquifer holds sufficient water to meet both municipal and environmental needs, and they say they will make up for any reduced river flows that may result.

American Rivers, a non-profit environmental organization, began identifying endangered rivers in 1986; the Verde River has made the list three times.

UA, Mexico Collaborate on Environmental Issues

The University of Arizona's involvement with border environmental issues will increase with the establishment of a U.S. - Mexico Binational Center for Environmental Science and Toxicology.

Funded by a \$1.7 million U.S. Environ-

mental Protection Agency grant, with the state of Arizona contributing an additional \$449,185, the intent of the binational center is to promote Mexico's academic skills in coping with environmental and human health risks, particularly those associated with arsenic and other metals resulting from mining activities.

Collaboration is key to the center's operation; scientists from six U.A. colleges will collaborate with Mexican counterparts at ten universities and research institutes. The participating UA colleges are the colleges of Pharmacy, Engineering, Science, Agriculture and Life Sciences, Public Health, and Medicine. The intent is to share UA expertise and academic strengths with Mexican researchers.

The center also will assist Mexican students by establishing six doctoral positions and three post-doctoral fellowships at the UA in environmental science, engineering and toxicology. Also Spanish-language textbooks and information sheets will be developed addressing regional environmental concerns for use in public outreach.

Water quality is a prime concern of the center. Uncontrolled dumping has resulted in many Mexican cities needing to cope with groundwater threatened by landfill leachates. A collaborative project will look at ways to clean up plumes from such landfills.

Other water issues of concern are the high levels of metals from mining and metal processing industries that threaten the limited groundwater supplies of border populations. Adding to the problem are mine tailing piles, also a source of metal-laden dust. Another concern is the naturally occurring arsenic that threatens groundwater; this is a critical problem in certain areas of Northern Mexico, including the border state of Sonora. Another problem is the intensive pesticide use in the border region has increased exposure to organic contaminants such as organophosphates and organochlorines.

Jay Gandolfi, professor in the College of Pharmacy and Jim Field, professor in the College of Engineering, are co-directing the binational center. They will be coordinat-



Unbeknownst to them, these children are multitasking; by playing on the merry-go-round or roundabout they are pumping clean drinking water from underground boreholes for village use. Called a Play-Pump and installed close to schools, the device uses just two moving parts, transforming childrens' boundless play energy into power to pump water to fill a 30-foot-high, 2,500-liter storage tank. More efficient than conventional hand pumps, the Play-Pump is capable of producing up to 1,400 liters of water per hour. About 600 Play-Pumps have been installed in South African, Mozambique and Zambia. For information about Play-Pumps including ways to donate to the cause check the web site: <http://www.playpumps.org/>

ing with EPA and Mexico's environmental agency, SEMARNAT, to ensure that the center's workshops and educational materials meet Border 2012 cleanup goals.

The U.S. - Mexican border region has become an environmental hot spot, drawing many migrants and busy with manufacturing, agriculture and trade. The environmental consequences challenge governments along the border.

Report: Many AZ Facilities Fail CWA Standards

A recent report examined Arizona's compliance with the Clean Water Act and found the state wanting.

The report stated that between July 2003 and December 2004 more than 44 percent of Arizona's industrial and municipal facilities exceeded their CWA permits at least once by discharging more pollution into state waterways than allowed.

Further, the report states that those Arizona facilities exceeding their CWA permits did so on average by 136 percent, over twice the legal limit. It also states that 54 Arizona facilities reported exceeding their CWA permits during the 18-month period more than 210 times. In some extreme cases, polluters reported 12 instances in which they exceeded their CWA permit by at least 500 percent over the legal limit.

Lela Prashad, public interest advocate

for the Arizona Public Interest Research Groups Education Fund, the organization compiling the report, says the findings are likely conservative, since the data analyzed includes only "major" facilities, not pollution discharged into waters by minor facilities.

The report indicates that the 1972 CWA, despite significant strides having been made in cleaning up U.S. waterways, has not lived up to expectations. More than 40 percent of U.S. waterways are unsafe for swimming and fishing; in Arizona, more than 22 percent of rivers and 10 percent of lakes are impaired.

Report recommendations include increasing EPA funding for CWA enforcement, fully funding the Clean Water State Revolving Fund to help communities upgrade their sewer systems and withdrawing the Bush administration's "No Protection" policy that eliminates CWA protection for many small streams and wetlands.

Titled "Troubled Waters: An Analysis of Clean Water Act Compliance," the report is available on-line at <http://www.arizonapirg.org/>

UA Prof. Wins International Hydrology Award

Jim Shuttleworth, University of Arizona professor of Hydrology and Water Resources, has been awarded the prestigious

International Hydrology Prize.

The IHP is considered the top award in the field — it is described as the Nobel Prize for hydrology science and engineering — and is awarded annually to a hydrologist "who has made an outstanding contribution to hydrology such as confers on the candidate universal recognition of his or her international stature."

Shuttleworth's work was viewed as having an "identifiable international dimension extending beyond both the country of normal work and the specific field of interest of the candidate."

The IHP citation recognizes Shuttleworth "for his innovative international leadership over more than 30 years, contributing to the growth of hydrology into a major discipline of Earth System Science."

The International Association of Hydrological Sciences confers the award, along with representatives from UNESCO's International Hydrology Program and the Hydrology and Water Resource Program of the World Meteorological Office.

During the 25 years the prize has been awarded only five U.S. hydrologists have been recipients.

Recognized for his achievements, Shuttleworth at the same time lauded the quality of the UA's HWR program. Ranked nationally as No. 1 in water science and engineering since 1995, the UA's HWR is also referred to as the nation's "water campus."

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from the heat loss of the circulating water and the energy used to operate the pump.

Householders who install a low-flow shower head and are aware of the energy-water nexus realize they are reaping energy as well as water savings. A low-flow shower head saves water; using less water saves energy that would otherwise be used to heat additional water. Further, less water down the drain means less water to be treated, for an additional energy savings. It is a save-save situation.

Many of the scientific questions and technical challenges posed by the energy-water nexus have to do with finding ways to reduce water consumption when generating power, thereby lessening its effect on water quality and availability. Another concern is to reduce the amount of energy needed to treat and distribute water. The key to the quandary is an energy-water conservation strategy that mutually reduces consumption of both, rather than reducing the use of one at the expense of the other.

For example, efforts are underway to build more water-efficient power plants. Since power plant cooling consumes large quantities of water, a promising research track is to develop a cooling process that

reduces or even eliminates water use. Other strategies include treating and using graywater in energy production or tapping into unused water sources such as saline aquifers.

Ways that are being considered to reduce energy use in treating, pumping and distributing water include improving wastewater treatment processes and refining irrigation technology.

Some complain of a dearth of resources to support energy-water research. They point out that while federal funding supports research of both energy and water sustainability, no national research program is devoted to understanding the interrelationship between energy and water.

The issue achieved some official recognition when Congress, as part of the Omnibus Spending Bill of 2005, funded the U.S. Department of Energy to develop a report on the interdependency of energy and water. In response to the directive, the DOE is compiling a National Energy-Water Roadmap Program.

The Sandia National Laboratories in New Mexico is a lead agency in the effort. Its energy-water nexus website (<http://www.sandia.gov/energy-water/>) provides a wealth of information on the issue as well as reports on the results of the three national workshops. ■



Guest View

'Mega-networking' at the Fourth World Water Forum in Mexico City: Looking for Opportunities at a Megaconference

This Guest View is a group effort involving Robert G. Varady, Margaret Wilder, Susanna Eden, Anne Browning-Aiken, Kathy Jacobs and Juan Valdes. All contributors are from the University of Arizona except Jacobs who is executive director of the Arizona Water Institute.

With some 12,500 participants, including us, the Fourth World Water Forum, or WWF4, which convened in Mexico City this past March, was the largest international water conference of its kind.

The gathering provided, as have previous forums, a focal point, a convenient meeting place, for water professionals who otherwise would need to arrange to meet elsewhere, in small groups and at large cost, to discuss specific interests.

The sessions at the WWF4 represented multiple and critical perspectives on timely issues such as integrated water management, global climate change, water pricing, local participation, and water privatization, and at least some of those inside the hall had been participants in protests or alternative forums on the outside in previous days.

Some scholars, stakeholders, and policymakers have disparaged the water forums as expensive, diversionary, and ultimately unproductive. According to this critique, the forums are circuses with too many sessions, too many presentations, and a cacophony of viewpoints. They also tend to exclude underfunded NGO representatives, provide an unseemly venue for hawking water technologies, and end with meaningless, often prepackaged declarations. Some argue that these conferences are too unfocused and therefore contribute little of added value. "More action, less talk" is their conclusion.

We agree that the inner workings of WWF4 were in many ways unwieldy and less than satisfactory. The absence of a detailed agenda frustrated attempts to know who was speaking on what topic at a particular time. The sessions themselves were encumbered with too many talks in too little time, and many sessions ended without time for questions and discussion, much less resolution. In session after session, few people got down to discussing details, developing recommendations, or formulating action items. In addition, "local actions" — the theme of this Forum — such as a case study of Mexico's Lake Chapala-Río Lerma, were commonly presented as success stories rather than as opportunities for acknowledging and learning from failures.

It's fair to say that few attendees would argue that the forum yielded decisive breakthroughs or set the world on a new course toward universally accessible potable water and sanitation. The myriad presentations broke little new ground and the discourse and policy pronouncements were familiar. And the numerous alternative water forums and thousands of protesters in the streets leave little doubt that many felt that the forum did not adequately address their concerns. There are lessons here on inclusiveness of alternative view-

points for the planners of the 2009 forum in Turkey.

But while the critical assessments are not without merit, dismissal of such events solely on the basis of their formal aims and structure misses a significant point. As we observed, much more effectively than disciplinary meetings or topical workshops, these "megaconferences" as they have been called, encourage a kind of "mega-networking" among participants from diverse sectors of the "Water World."

While, the World Water Forums do bring together the old standby heavy-hitter agencies and organizations that may come armed with particular agendas, they also offer a venue to bring in new voices and introduce challenges to prevailing perspectives. Many seemingly chance encounters allowed for valuable "face time" between people who rarely are on the same continent, let alone in the same room. In addition, the powerful magnetic effect of the event allowed groups of participants to advance their organizational objectives by convening useful side meetings. One example was a dinner meeting between three of us and five Mexican colleagues to solidify a planned collaboration on a binational climate diagnostic product for the border region.

A prominent paradigm at the meeting was one which protesters outside the Banamex Center and formal participants within, would probably agree is essential: a focus on the necessity for effective and meaningful local participation in resolving water issues. Sessions and panels organized to look at paradigms for integrated basin management and local participation in water policy decisions provided useful models that may prove to have ripple effects in time.

If there was a new development, it was in the forum's explicit disavowal of private-sector control of water services as a panacea or even a preferred solution for the world's water ills. This recognition can be seen as a clear reaction to protests at the 2003 Kyoto forum and to accusations that the forum's principal organizer, the World Water Council, is an instrument of the globalization movement. And for perhaps the first time, key concepts such as Integrated Water Resources Management, sustainability, and stakeholder participation became palpably mainstream and uncontroversial, thus contributing to what even sharp critics admit as useful movement toward global consensus on water-related policies.

We suspect that like most of the 12,500 attendees, we came away challenged, highly invigorated, and weighted down by the loads of new materials we brought back. Above all, the event allowed each of us to make useful contacts and plan for new collaborations, and to continue to ruminate about the endlessly diverse problems of water management.

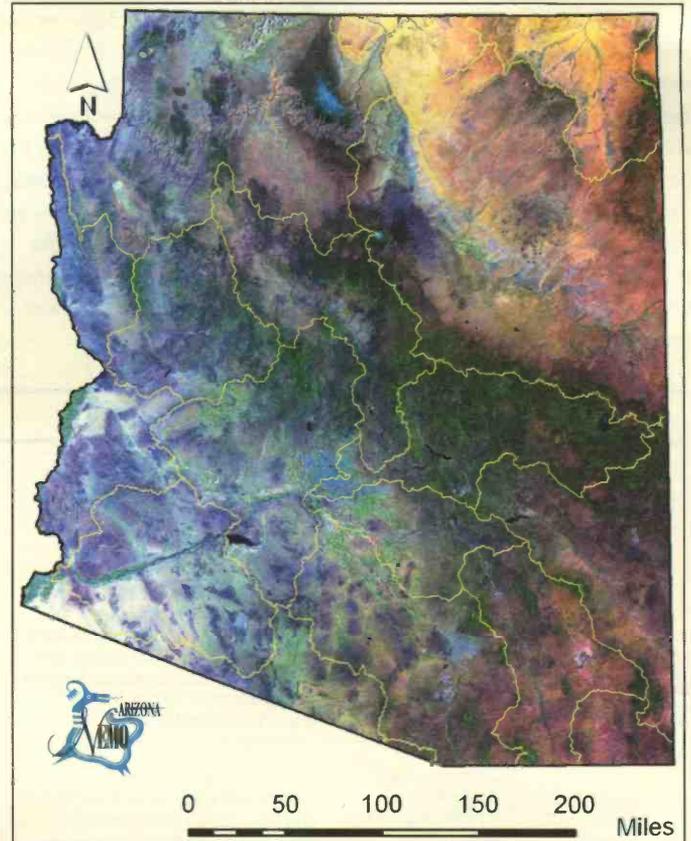
The 4th World Water Forum was held in Mexico City, March 16-22; its theme was "Local actions for a global challenge." ■■



Arizona NEMO: Integrated Watershed Management and Planning

Rural Arizona communities and watershed partnerships are finding mapping support, hydrologic watershed modeling, and land-use planning resources through the Nonpoint Education for Municipal Officials (NEMO) Program of the University of Arizona Cooperative Extension. In partnership with and funded by the Arizona Department of Environmental Quality (ADEQ), the program is also supported by the University of Arizona, Technology and Research Initiative Fund (TRIF), Water Sustainability Program through the Water Resources Research Center. Arizona NEMO integrates watershed management and planning with research-based, professional education in order to engage stakeholders and foster better land-use decisions to protect our water resources. Emphasis is on the linkages between water quality and land use, as well as water quantity and supply.

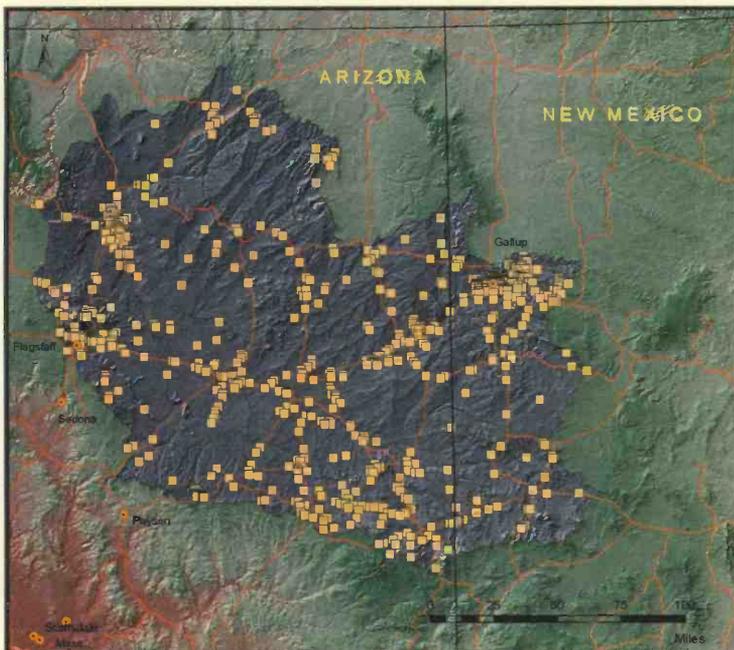
Nonpoint source water pollution—pollution that originates from a broad or diffuse area—results from a variety of human land uses, such as increased urbanization, agricultural practices, abandoned and orphaned mine sites, forestry activities, home septic system failure, and construction site activities. These pollution sources cannot be controlled at a single location and can only be curbed by implementing land management practices with land-use decision makers at multiple levels. NEMO recognizes that management of nonpoint source pollutants is most effective when coordinated on a watershed basis, and by reaching the land-use decision makers across the watershed. A watershed is the area of land that catches rain and snow and drains into a wash, stream, river, lake or



False color satellite image, taken Spring 2000. 6-digit HUC boundaries delineated by the Natural Resource Conservation Service, U.S. Department of Agriculture.

groundwater. In Arizona most watersheds eventually drain to the Colorado River. Reaching the land-use decision makers means working with municipal officials, federal and state land managers, and private land owners to implement best management practices to protect water quality. Watershed boundaries ignore political boundaries, such as county lines, so coordinating land-use decision makers within a watershed often results in a partnership of diverse stakeholders.

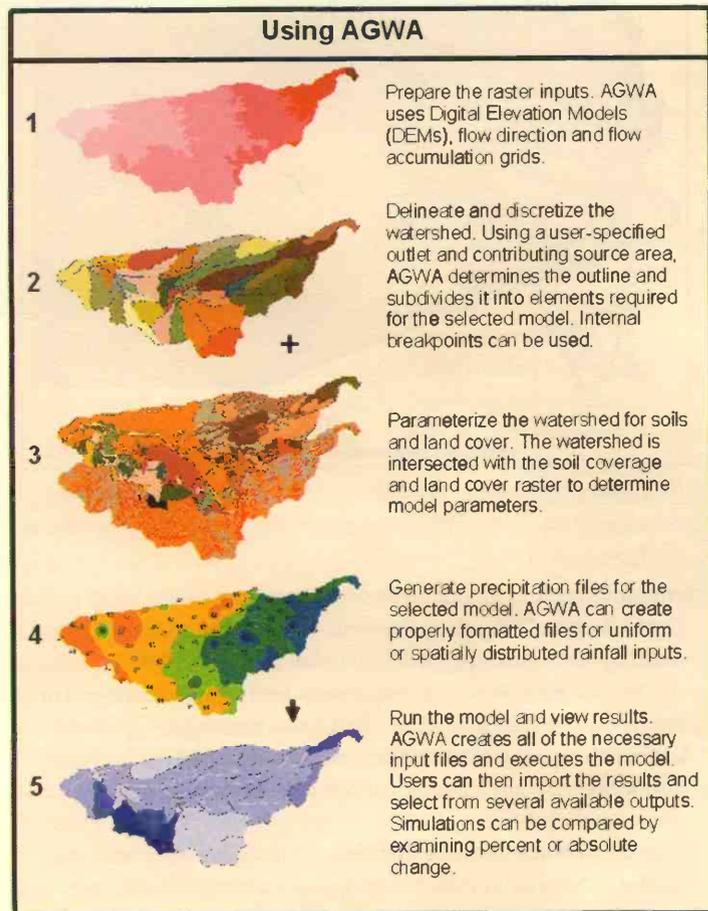
At the national level the NEMO program has been very successful in helping to mitigate nonpoint source pollution and protecting natural resources through better land use and land use planning. First conceived nearly a decade ago by the University of Connecticut Cooperative Extension, the National NEMO Network is a confederation of programs based in Land Grant Universities across the United States, with each program implementing projects important to local concerns. Three years ago Arizona NEMO was the first to adopt the national NEMO approach to conditions in the semiarid, western United States, where water supply is limited and many natural resource problems are related to the lack of water, as well as water quality.



Little Colorado River Watershed mine site locations in Arizona and New Mexico. The highly mineralized soils in mining areas, coupled with abandoned mine sites, contribute metal pollutants to streams and lakes.

Today, 31 states, including most of the western states, are partnered across the NEMO Network. Arizona NEMO is unique among the National Network in that our scope includes the use of geographical information systems (GIS) to simulate and predict impacts of land-use, with a goal of numerical modeling of each watershed across the state.

Planning and assessment in land and water resource management are evolving from simple, local-scale problems toward complex, watershed-wide regional ones. Such problems have to be addressed with numerical models that can compute runoff and erosion in large (basin scale) complex watersheds with varying soils, land use and management conditions. GIS provides the framework within which spatially-distributed data are collected and used to prepare model input files and evaluate model results. GIS-based tools, such as the Automated Geospatial Watershed Assessment - Soil and Water Assessment Tool (AGWA - SWAT), are being used by the Arizona NEMO program to illustrate the effects of land use practices on runoff and erosion, and to support watershed-wide land use management decisions.



In Arizona, excessive sediment is the principal nonpoint source pollutant in 36 percent of the 409 stream miles classified as impaired by ADEQ in 2004. The impact of nonpoint source sediment pollution is over three times greater than impairment caused by the next leading constituent, dissolved and particulate metals derived from abandoned mine sites.

The USDA-ARS Southwest Watershed Research Center and the University of Arizona Advanced Resource Technology Group (ART), in cooperation with the U.S. EPA Office of Research and Development, have developed AGWA to facilitate simulation of the impact of land management practices on water and sediment yields on a watershed scale. AGWA-SWAT is one component of the AGWA tool-box of hydrologic simulation. Based in Tucson, the Southwest Watershed Research Center conducts research with a focus on the unique hydrology of our semi-arid climate and topography. In developing AGWA, research was supported by field experimentation at the USDA Walnut Gulch Experimental Watershed, near Tombstone, Arizona.

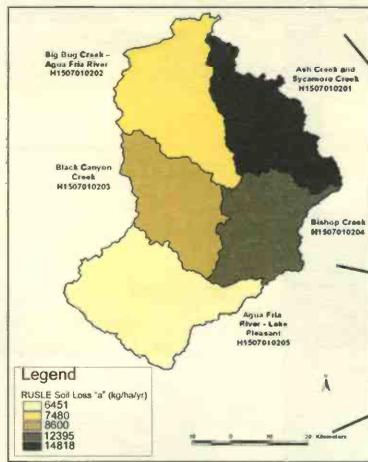
A program within the School of Natural Resources, ART provides leadership in such areas as GIS environmental database design and development, application of cartographic and spatial analysis for agriculture, natural resources, and rural development, as well as AGWA modeling support. In addition to being the home of the Arizona NEMO program, the ART Group provides the primary focus for research and extension in cartographic and spatial analysis for the College of Agriculture and Life Sciences at the University of Arizona.

Within the ART laboratory facility, NEMO staff (consisting mostly of graduate students) collects the standardized spatial datasets to develop input parameter files to simulate watershed runoff and erosion in target watersheds with AGWA-SWAT. Modeling for three large-scale watersheds, the Bill Williams, the Verde, and the Upper Gila, has been completed. The Agua Fria, Middle and Lower San Pedro, and the Little Colorado River Watershed models are in progress with anticipated completion by November of 2006. Model simulations identify subwatershed areas vulnerable to increased sedimentation and erosion due to soil and slope conditions as well as land use practices across the watershed. Model results are reported in ADEQ-approved watershed-based planning documents published on the web at www.ArizonaNEMO.org.

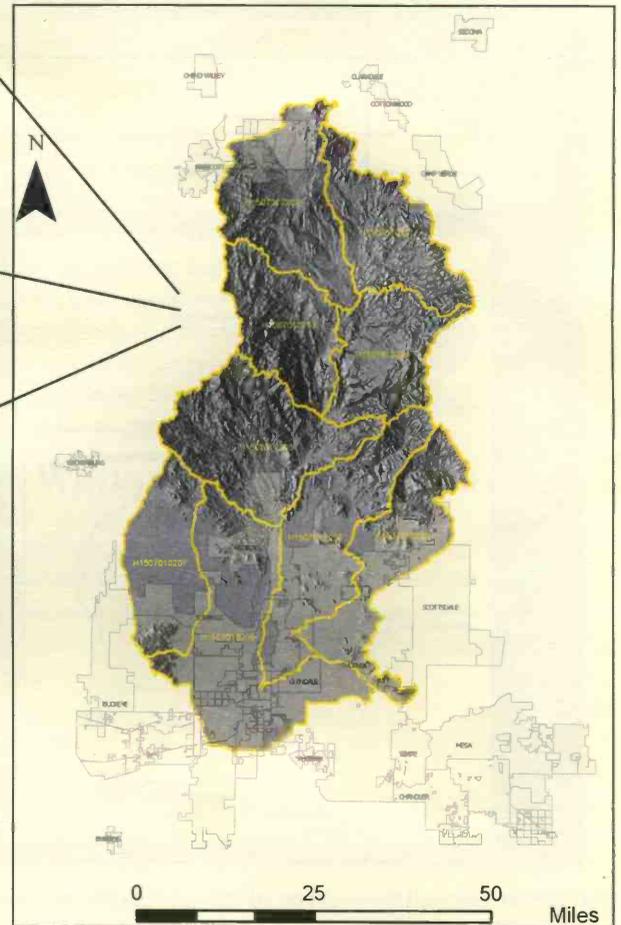
NEMO Watershed-based plans are being developed on a 6-digit HUC (Hydrologic Unit Code) basis. A hydrologic unit is a drainage area delineated to nest in a multi-level, hierarchical drainage system. Its boundaries are defined by hydrographic and topographic criteria that delineate an area drained by a river system, a reach of a river and its tributaries in that reach, a closed basin(s), or a group of streams forming a coastal drainage area. Each hydrologic unit is identified by a unique hydrologic unit code (HUC) consisting of two to twelve digits based on the six levels of classification in the hydrologic unit system. For example, the Colorado River System is divided into two, 2-digit HUC addresses, HUC 14 for the Upper Colorado Region and HUC 15 for the Lower Colorado Region below Lees Ferry. In Arizona, the 6-digit HUC watersheds range in size from approximately 5,400 square miles of the Bill Williams Watershed (HUC 150302) to the 27,050 square miles of the Little Colorado River drainage (HUC 150200 - 21,704 miles in Arizona, 5,346 square miles in New Mexico). The Bill Williams contains twenty-one 10-digit HUC subwatersheds and the Little Colorado consists of ninety-four 10-digit HUCs.

Watershed-based plans are holistic documents designed to protect, restore, and manage the watershed. The NEMO plans pro-

vide a careful analysis of the sources of nonpoint source water quality problems, their relative contributions to the problems, and the alternatives to solve those problems. Furthermore, the NEMO watershed-based plans present proactive measures that can be applied to protect water bodies. The plans include watershed characterization in addition to the AGWA-SWAT modeling discussed above. Characterization includes physical, biological, and social/economic data in a GIS database format, as both mapped and tabulated data, that has been collected from available existing and published data sources. The characterizations represent an inventory of natural resources and environmental conditions that affect primarily surface water quality. In addition, the characterizations provide mapping and education outreach material to stakeholders and watershed partnerships.



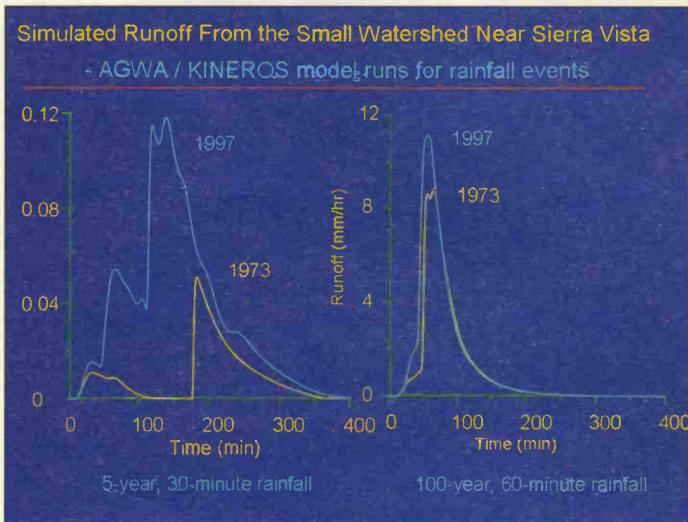
Subwatershed soil loss as simulated by modeling of the Upper Agua Fria Watershed.



The Agua Fria Watershed, shown as "Hillshade" to depict topography, showing the metropolitan area of Phoenix and the highlands of the watershed, near Prescott, Arizona.

The NEMO plans also provide subwatershed classification within the 6-digit HUC watersheds based on nonpoint source water quality problems. The classifications include the identification of and mapping of important natural resources and the ranking of 10-digit HUC subwatersheds on the likelihood of pollutant contribution to stream water quality degradation. Ranking of vulnerability is supported by the AGWA-SWAT modeling results coupled with GIS analysis of other attributes within each subwatershed. The plans also recommend the management measures and best management practices that should be implemented to protect or improve water quality.

In addition, the NEMO Watershed-based plans follow guidance based on EPA's 2003 Guidelines for the Award of Section 319 Nonpoint Source Grants. The United States Congress amended the

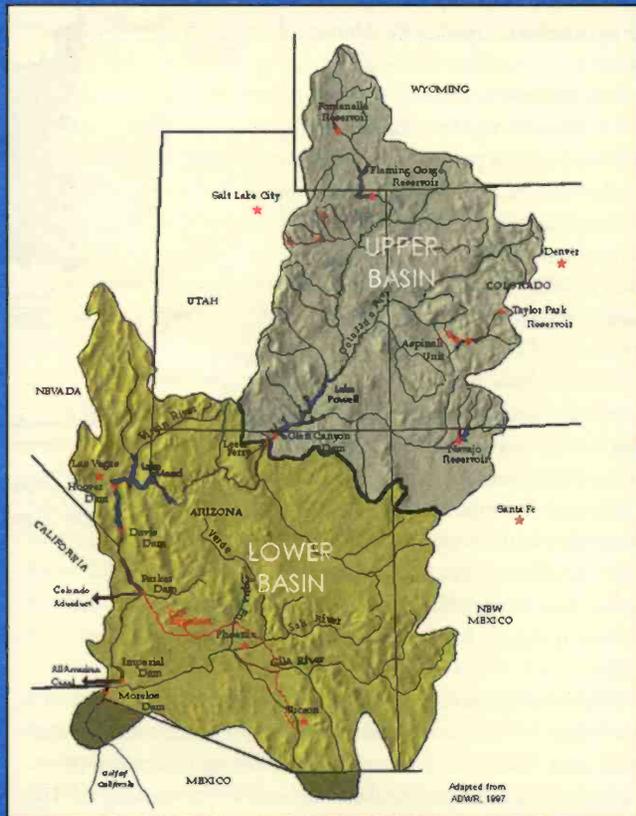
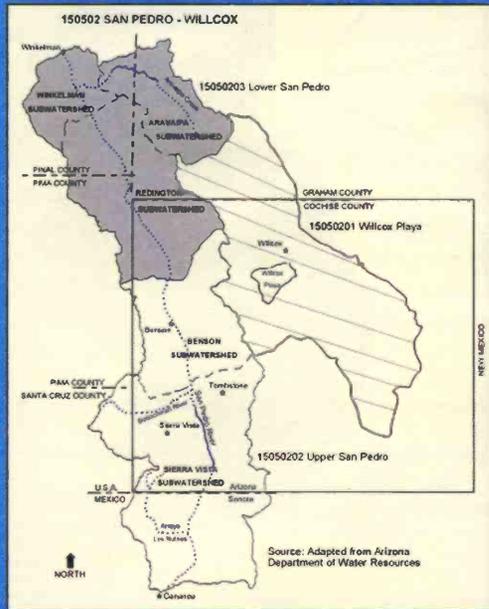


Hydrographs showing the 5-year, 30-minute rainfall event have significant change in watershed response compared to larger events which have more water but the change is not as dramatic.

Clean Water Act (CWA) in 1987 to establish the Section 319 Nonpoint Source Management Program because it recognized the need for greater federal leadership to help focus State and local nonpoint source efforts. Under Section 319 of the CWA, States, Territories, and Indian Tribes receive grant money which supports a wide variety of activities including technical assistance, financial assistance, education, training, technology transfer, demonstration projects, and monitoring to assess the success of specific nonpoint source implementation projects. Consistency of the NEMO plans with the key elements of the EPA Guidelines allows ADEQ to prioritize funding to stakeholders and watershed partnerships implementing projects within the NEMO prioritized subwatershed areas.

Several watershed partnerships across the state have been successful in obtaining ADEQ 319 grant funds to implement projects in watershed areas identified by NEMO as vulnerable to nonpoint source water quality concerns. For example, AGWA-SWAT was applied by NEMO to illustrate the effects of land use on runoff and erosion across the Upper Gila Watershed and identified several subwatershed areas vulnerable to water quality degradation due to nonpoint-source sediment. NEMO prioritized the location of stream restoration projects to address sediment within the Upper Gila Watershed. Working with NEMO, the Gila Watershed

Description	Proper Name	HUC
Region	Lower Colorado	15
Sub-region	Middle Gila	1505
Basin	San Pedro-Willcox	150502
Sub-basin	Willcox Playa	15050201



Partnership selected the location of stream restoration projects within NEMO 10-digit HUC subwatershed areas of concern. The Partnership received two competitive grant awards, with funding support totaling \$182,600 from the ADEQ's Water Quality Improvement 319 Grant Program in 2005. The Kaler Ranch Erosion Control Project included extending and improving road drainage culverts and stream bank protection structures to preserve, protect and improve water quality by reducing sediment discharge and excess organic input to the San Francisco River (tributary to the Gila River). The Central Detention Dam Rehabilitation Project included debris and sediment clearing and invasive vegetation removal.

The arid climate and unique hydrology of Arizona, coupled with increased urbanization and development, will only exacerbate the trend toward increased nonpoint source water pollution. To ensure the sustainability of water resources, community character, and long-term economic health of Arizona, careful water management practices and wise land use decisions are critical.

Because of this, the Arizona NEMO program has become an important partner for land-use decision makers, resource managers, and watershed groups across the state.

Contact Kristine Uhlman, Arizona NEMO Program Coordinator, at kuhlman@ag.arizona.edu or 520 621 5951.

Nonpoint Education for Municipal Officials: NEMO



Avanyu, the NEMO Logo

Kristine Uhlman, R.G., NEMO Program Coordinator, D. Phillip Guertin, Ph.D., Associate Professor, and Lainie Levick, Senior Research Specialist

The University of Arizona
School of Renewable Natural Resources
College of Agriculture and Life Sciences

Found in the spiritual mythology of the ancient Zuni, Hopi and Pueblo cultures, Avanyu is the name for the water serpent, "one who lives in the water below the earth, and one who carries us through the water of change."

Avanyu is a mythical sea-serpent, the guardian of the mountain springs across the Pueblo cultures of the American Southwest. The Avanyu petroglyph was created long before Europeans set foot on this continent, and is believed to date back to the Anazazi, the "Ancient Ones." According to tribal wisdom, those who poison the water must face Avanyu's fiery revenge.



Legislation and Law

Rule Proposes Mitigation Banking to Preserve Wetlands

“Mitigation banking” is a concept figuring prominently in the Bush administration’s proposed Clean Water Act revision that outlines strategies to offset losses of wetlands to farming and development. Wetlands include swamps, bogs, fens, marshes and estuaries.

According to the proposed rules if on-site and in-kind mitigation are not workable options, developers could purchase mitigation banking credits from companies in the business of restoring damaged wetlands or creating new wetlands in areas remote from the habitat being destroyed. Their purchase of mitigation credits would demonstrate that developers are in fact taking appropriate mitigation actions, although at a site removed from where development activities are causing environmental harm.

According to the U.S. Environmental Protection Agency and the Army Corps of Engineers the approach is good for the environment and good for business. They say it will set clear national standards for wetland protection and will expand the country’s “wetland base.” Business opportunities also will arise with this market-based approach. George Dunlap, the Army’s deputy assistant secretary, says it would “help to develop a cottage industry” in mitigation banking.

Army Corps and EPA officials argue that the proposed rules enable officials to take a watershed approach when granting wetland mitigation permits; they cite a 2001 National Research Council study that supported such an approach to ensure better compliance with the Clean Water Act Section 404 program.

Army Corps officials also say the proposal represents a “new paradigm” that goes beyond an enforcement approach to permitting to espouse a compliance-based approach. Further for the first time developers would have to include a mitigation plan in their wetland permit applications; a five-year monitoring period also would be required.

Environmentalists are wary that mitigation banking will in fact prove a better strategy for replacing lost wetlands. Some are concerned that the proposed rule would justify officials disregarding on-site mitigation options for an off-site project with less habitat or pollution-cleansing value than an on-site project. In other words, mitigation banking could allow an end run around sound environmental planning in favor of profit and economic returns.

Environmentalists are also concerned that the rules would OK wetland preservation as suitable compensatory mitigation under various circumstances, not just the more vigorous standard of wetland creation. Quoting the proposed rule, they note that one such circumstance is where “preservation is determined by the district engineer to be appropriate and practicable.”

Environmentalists say it is a business friendly-rule, profitable to those in the business of mitigation banking and favorable to the interest of developers. Officials counter that the rule is science-based, sets clear national standards for wetland protection and responds to

recommendations in the NRC report. Further they say adopting the rules will result in an expansion of the country’s “wetland base.”

In turning to business to improve compliance, the proposed rules would undoubtedly benefit companies in the business of creating swamps, marshes and streams. They will act as mitigation bankers; developers would buy credit from such companies to compensate for wetlands and streams they may fill in.

Comments on the proposed rules, published in the March 28 Federal Register, must be submitted on or before May 30.

More Wetlands or Just Politics?

Bush administration officials interpret a recent report as proof that the president’s promise to preserve and restore the nation’s wetlands is being fulfilled; others are not so sure, interpreting the report’s results along the lines of Groucho Marx’s remark: “There is less here than meets the eye.”

(In the spirit of the occasion, President Bush pledged on Earth Day 2004 to restore or protect as much as 3 million acres of wetlands over the next five years.)

Submitted by the Interior Department’s Fish and Wildlife Service, the National Wetland Inventory stated that in 2004 the United States had about 108 million acres of wetlands; this represented a net gain of 191,800 acres since the last report in 1997. So far so good. Accounting for most of the U.S. wetland gain, however, are 715,300 acres of what officials call shallow-pond-type wetlands, with this wetland type gain used to offset the continued loss of 523,000 natural wetland acres; hence the 191,800-acre net gain.

Some are hailing the alleged wetland increase as the nation’s first net gain in wetlands in a half-century of government record-keeping.

The rub is that the new shallow-water wetlands are mainly artificial bodies of water, including ornamental lakes, stormwater retention ponds, wastewater treatment ponds, aquaculture ponds and golf course water hazards; whereas what is being lost are the traditional and natural wetlands including marshes, swamps, fens and other water-saturated ecosystems.

Environmentalists say quantity is trumping quality, with artificial wetlands accorded equal value with traditional and natural wetlands. Called the nurseries of life, natural wetlands filter pollutants and sediments, control flooding and erosion, provide habitat to fish, shellfish and wildlife and are resting places for migratory birds.

Some view the claim of a wetland gain as bogus as a previous administration’s announcement that ketchup is a vegetable.

Speaking at the official release of the report Interior Secretary Gale Norton acknowledged that shallow-water wetlands are not the real thing but added, “Even in ponds that may not be the best quality wetlands, they are still better than not having the wetland.”

A copy of the report is available at: http://wetlandsfws.er.usgs.gov/status_trends/national_reports/trends_2005_report.pdf 



Publications & On-Line Resources



ADEQ Offers New GIS Web Site

Arizona Department of Environmental Quality has created a Geographic Information System Web

page providing environmental data and information on facilities and sites throughout the state. A link to the GIS page is available from ADEQ's Web site at <http://www.azdeq.gov> and clicking the "GIS eMaps" link. Users are able to access information about facilities and cleanup sites within ADEQ's jurisdiction. The page features information from ADEQ's program divisions: air quality, tank programs, waste programs and water quality.

New Web Site Provides ADWR Groundwater Data

The University of Arizona's Center for Sustainability of semi-Arid Hydrology and Riparian Areas has announced a new Web application — a searchable interface for the Arizona Department of Water Resources' Ground Water Site Inventory database, the agency's main repository for statewide groundwater data. GWSI consists of field data collected on 43,000 wells by personnel from the Hydrology Division or the U.S. Geologic Survey dating as far back as 1914. The information in GWSI is constantly updated by ongoing field investigations and through a statewide network of water level monitoring sites.

The easy-to-use web interface, developed by SAHRA computer database expert Ramon Vazquez and graduate student Guillermo Ponce-Campos, features searches by decimal latitude/longitude, latitude/longitude in D/M/S, well ID number, cadastral, or by

clicking and zooming on an interactive map. Outputs include time series plots of depth to groundwater and maps of wells meeting search criteria.

The GWSI project received financial support from the USGS and the UA's Water Sustainability Program; a panel that included several consultants provided technical review. This is the first installment of a larger Arizona Wells and Groundwater Database designed to help homeowners, water professionals and state agencies easily locate well information. See: www.sahra.arizona.edu/wells

Our Water, Our Future: Policy Options to Safeguard Water Resources in Arizona

Arizona Public Interests Research Group (Arizona PIRG)

Arizona PIRG, a public interest advocate, expresses concern about Arizona's water supplies, seeing the state's finite, limited supply of water being stretched between new, fast accumulating demands. It notes that Arizona's population is projected to double by 2030, with much of this growth occurring in rural regions, areas with minimal protections or regulations on water and its use. The report notes that according to the U.S. Bureau of Reclamation, Arizona could face a potential water supply crisis by 2025; existing water supplies may not then be adequate to meet demands for people, farms or the environment.

The report identifies and discusses policy solutions that can ensure that Arizona will have enough water to prosper, now and in the future. A pdf version of the report is available at: <http://www.arizonapirg.org/AZ.asp?id2=22597>

Pesticides – Assessing and Managing the Problem

Pesticides in the Nation's Streams and Ground Water

U.S. Geological Survey. Robert Gilliom, Donna et al. The report, Circular 1291, is available at <http://water.usgs.gov/pubs/circ/circ1291>, or by calling 1-888-ASK-USGS, or by fax 303-202-4693.

This report describes the occurrence of pesticides in streams and groundwater during 1992-2001, concluding that pesticides are typically present throughout the year in most U.S. streams in urban and agricultural areas, they are less common in groundwater. The report found that pesticides are seldom at concentrations likely to affect humans, although in many streams, particularly those draining urban and agricultural areas, pesticides were present at concentrations that may affect aquatic life or fish-eating wildlife. Robert Hirsch, associate director for water, said "the USGS assessment provides the most comprehensive national-scale analysis to date of pesticide occurrence in streams and groundwater. Findings show where, when, and why specific pesticides occur, and yield science-based implications for assessing and managing pesticides in our water resources." For additional USGS information on pesticide assessment see: <http://water.usgs.gov/nawqa/>

▲ DANGER



Pesticide storage area.

Water and Pesticide Safety CD

Louis Carlo and Paul Baker, University of Arizona Dept. of Entomology and Cooperative Extension.

The use and misuse of pesticides due to drift, over application, and unsafe storage have resulted in the accumulation of pesticide residues in Arizona waterways. This CD explains the problem of pesticides in state waterways and teaches safety guidelines to protect community health and environmental quality. A multimedia educational tool, it uses interactive learning modules to illustrate the basic principles of pesticide safety. Section one offers basic pesticide application topics to help protect water resources. Section 2 focuses on water and safety practices and includes eight learning modules to teach ways to reduce the risks of pesticide exposure and environmental contamination of water supplies. A limited number of free copies are available, to order check: <http://cals.arizona.edu/pito/>

The development of the CD was supported by a grant from the UA Water Sustainability Program, funded through the Technology and Research Initiative Fund.



Special Projects

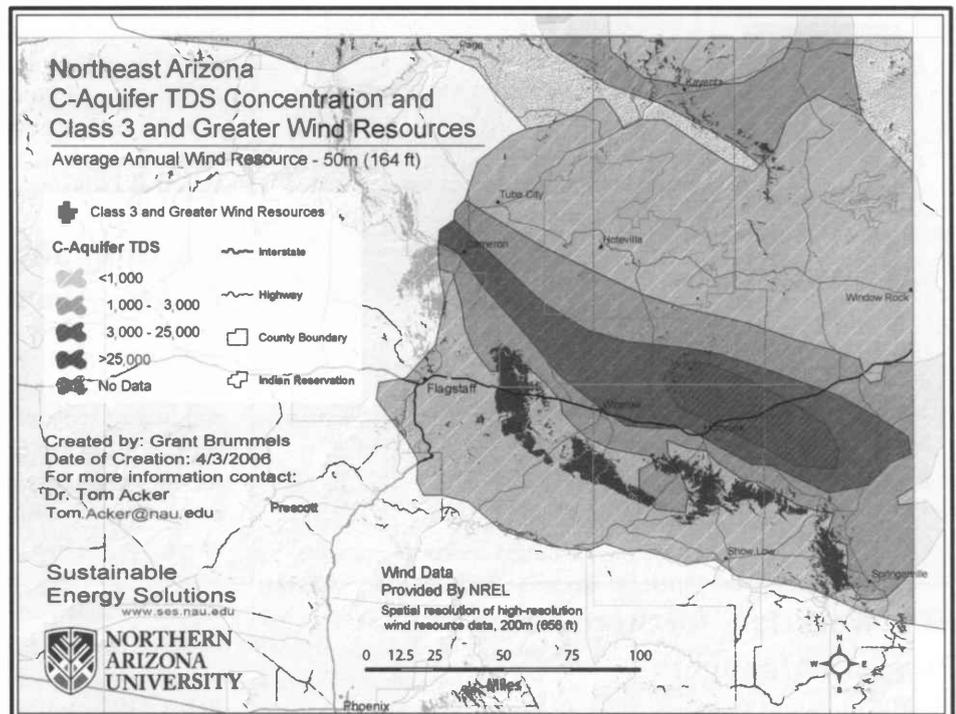
AZ Has Potential to Desalinate Brackish Waters With Wind Energy

There are many areas throughout the United States and especially in the West where growth is significant and water resources are strained. In many of these areas, brackish or saline groundwater is an unused but potentially valuable resource. These brackish water sources have been unused largely because desalination technologies have historically been energy intensive and therefore have been expensive to implement. However, as water and energy prices continue to increase, there is an opportunity for wind powered desalination to play a role in meeting the nation's water needs.

To identify locations where wind powered desalination might be feasible, it is important to understand the geographical distribution of available saline water resources, wind energy, and locations where water consumption is increasing while resources are limited. A technique was developed to display critical wind/desalination related information for northeastern Arizona on Geographical Information System maps that could be used to identify the most promising locations for the potential use of this technology. Relevant data resources were located, digitized, and entered into a GIS system, then used to create informative maps.

Northeast Arizona was selected for a focused regional map because it possesses many of the characteristics typical where desalination may be of interest: growing water demand, lack of abundant potable water resources, available brackish and saline water resources, and wind energy resources. The regional map provides information sufficient to identify which communities/water users in the region may want to give serious consideration to desalination technologies and consider supplying the electrical needs of the desalination equipment with wind power.

Data layers in the analysis include dissolved solids concentration of the C-aquifer, wind power density (wind class 3 and higher), electricity transmission lines, major population centers, and other relevant information. The USGS was the primary source for water resource information, and the National Renewable Energy Laboratory for wind energy information. Because the USGS data do not exist in a georeferenced format, they were georeferenced for this study. Favorable areas for follow up study include those with wind power class 3 or higher wind resource, shallow (less than 500 feet) saline groundwater or high dissolved solids quality/shallow groundwater, and co-located population centers or electrical transmission lines.



Additional detailed information deemed important indicators of the likelihood that desalination technology could be applied are: population of select communities and their average water demand, peak water demand, well production capacity, saline water production, groundwater production, water retail price, average energy cost to produce water, peak power demand, and energy retail price. The regional map proved useful in indicating which communities in the region are best situated to benefit from wind powered desalination. An important aspect in interpreting the maps is the proximity of wind power resources with readily accessible saline water and areas with the potential need to develop the saline water resources. Since current desalination technologies require grid-quality AC electricity to operate, it is not necessary that the wind and water resources be co-located. While the economics of desalination indicate that co-locating electrical generation with the saline water resource is desirable it is not technically necessary. What is necessary is that the wind resources have access to a non-constrained transmission plant to the desalination plant.

The following, all from Northern Arizona University, are involved in the project. Abe Springer, Dept. of Geology; James Janeczek, Dept. of Civil Engineering; Tom Acker and Jan Theron, Dept. of Mechanical Engineering; Mark Manone, GIS Specialist, Dept. of Geology; Grant Brummels, GIS Specialist, Sustainable Energy Solutions Group; Sean Martin, Civil Engineering Student.

The work was funded by the National Renewable Energy Laboratory, National Wind Technology Center. 



Announcements

Arizona Water Protection Fund Grants



The Arizona Water Protection Fund Commission is initiating its FY 2007 grant cycle. The Commission anticipates that approximately \$3 million will be available for grant awards and will be accepting applications for all project categories (capital, research and water conservation). The FY 2007 Grant Application Manual will

be available at all grant application workshops or can be downloaded from the AWPf web site at: www.awpf.state.az.us. To receive a mailed copy contact Rodney Held or Reuben Teran at 602-771-8528. Grant Application workshops will be held in Show Low, Safford, Prescott, Phoenix, Flagstaff, Lake Havasu, Sierra Vista and Tucson. Please see the web site or grant application manual for details. Grant applications are due on June 14 by 3:00 p.m. The Commission will make grant award selections on Oct. 16.

EPA Workshop for Stormwater Program Managers

A two-day workshop will be conducted to assist stormwater managers to reduce pollutants in urban runoff and comply with National Pollutant Discharge Elimination System (NPDES) Phase II stormwater requirements. The workshop will provide in-depth training on illicit discharge detection and elimination, post-construction runoff controls, construction management, and public education and involvement. A small fee will be charged to help cover some conference costs. A workshop will be conducted in Phoenix, Aug. 14-15; registration will open soon http://cfpub2.epa.gov/npdes/courseinfo.cfm?program_id=0&outreach_id=200&schedule_id=922

UCOWR Conference Focuses on Freshwater Availability

Titled "Increasing Freshwater Supplies," the Universities Council on Water Resources' annual conference will be in Santa Fe, New Mexico, July 18 - 20. The conference is addressing the concern that increasing freshwater supplies is a critical need, especially in the drought-stricken western United States. The conference will focus on increasing freshwater availability for human uses through all practicable means, from emerging desalination technologies to artificial recharge to conservation programs based on changing human behavior and will serve to exchange experiences and inform participants of cutting-edge innovations relevant to this essential regional and global challenge. For additional information check the UCOWR web site: <http://ucowr.siu.edu/>

Navajo Nation Drinking Water Conference

The Third Annual Navajo Nation Drinking Water Conference, titled "Meeting Future Demands for Quality Drinking Water," will be conducted June 12 - 14 at the Navajo Nation Library Museum and Visitors Center, Window Rock, Arizona; the Navajo Nation Environmental Protection Agency's Public Water Systems Supervision Program is hosting the event. For more information contact Valerie Spencer or Michelle K. Silver 928-871-7755 or visit <http://www.navajopublicwater.org/Conference.html>

CA Groundwater Resources Association, Call for Abstracts

The Groundwater Resources Association of California has issued a call for abstracts for its annual meeting titled, "Assessment, Use, and Management of Groundwater in Areas of Limited Supply," Sept. 21-22 in San Diego. In many basins of California, groundwater is a marginal resource due to the hydraulic properties of sediments, water-quality characteristics, recharge amounts, basin size, or other factors. This year's annual GRA meeting will focus on the assessment, use and management of groundwater in areas of limited supply. Abstracts for papers and poster presentations are invited; abstracts must be submitted by June 2. For additional information contact: Bill Pipes, 559-264-2535, wpipes@geomatrix.com or Sarah Raker, 510-628-3234, slraker@mactec.com

Water Education Workshop in Flagstaff

"Healthy Forests, Healthy Water, Healthy People" an Arizona Project WET/Project Learning Tree workshop will be conducted in Flagstaff, June 27 - 29, with a focus on K-8, home-school and agency educators. The workshop will be conducted at the Arboretum at Flagstaff and is sponsored by the City of Flagstaff and The University of Arizona, Cooperative Extension. A \$25 fee will be charged. For additional information contact: Wade Albrecht 928-774-1868 x 25, walbrech@ag.arizona.edu, or 928-774-1868 x 25, Angela Gelsino 520-792-9591 x 26, agelsino@ag.arizona.edu or Josie Tanner, 520-792-9591 x 27, josie@cals.arizona.edu

Call for Papers, Aquifer Recharge Meeting

The 6th International Symposium on Managed Aquifer Recharge, the world's preeminent conference devoted entirely to aquifer recharge, will be held from Oct. 28 - Nov 2, 2007 in Phoenix. The symposium is being organized by the Arizona Hydrological Society in partnership with IAH/AIH, ASCE/EWRI, UNESCO and NWRI. It will highlight technical sessions from a range of subject areas, poster sessions, workshops, and tours of innovative aquifer recharge projects. This is the first call for papers/abstracts; abstracts must be received no later than Oct. 15, 2006. For more detailed information or to register for the symposium, check: www.ismar2007.org



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! 🏡

Cloud Seeding for World Dominance

Seemingly a case of turning swords into ploughshares, weather modification, now being hailed as a promising water resource tool, was once viewed as a potent weapon in the Cold War, with saber-rattling value in confronting the Soviet threat.

An article in the January *Harper's* magazine, "Owning the Weather," relates that the United States sought to "own the weather" as a military strategy to ensure political dominance after World War II. It quotes General George C. Kenney of the U.S. Strategic Air Command as saying in 1947, "The nation which first learns to plot the paths of air masses accurately and learns to control the time and place of precipitation will dominate the globe."

In 1957, the Army Signal Corps, the Office of Naval Research and the Air Force contracted with General Electric to conduct early cloud seeding experiments.

The weather-modifying potential of nuclear weaponry was even considered. Atomic scientist and computer pioneer John von Neumann, who was in charge of developing and stockpiling nuclear weapons, believed that the United States must always be first before the Soviet Union in weather control. Achieving and maintaining U.S. world dominance depended upon it. Neumann participated on an advisory committee that discussed "possible effects of atomic and thermonuclear explosions in modifying the weather."

The strategic benefits of controlling the weather were seen as far-ranging, from fighting the evil empire to promoting the health and well-being of the deserving. U.S. proposals included creating harvest-destroying drought in the Soviet Union. In an application that might attract contemporary Arizona interest — if such strategies could be taken seriously — a drought-mitigation plan called for

detonating atomic bombs off the west coast of Africa to increase the monsoons of the Sahel area.

A January 1958 *Newsweek* article titled "The Weather Weapon: New Race With the Reds" did not waste time discussing whether the know-how was available to control climate but jumped to the question, "Which nation will do it first, the United States or the Soviet Union?"

As late as 1996 a panel of Air Force officers submitted a white paper, "Weather as a Force Multiplier: Owning the Weather in 2025" extolling the military capability of weather modification. It stated "Such a capability offers the war fighter tools to shape the battlespace in ways never before possible. It provides opportunities to impact operations across the full spectrum of conflict and is pertinent to all possible futures." (The document is available on-line at <http://csat.au.af.mil/2025/volume3/vol3ch15.pdf>)

This chest-thumping adds a virile note to the recent decision of officials of the Colorado River Basin states to consider cloud seeding as a method to increase snow fall, thereby replenishing Colorado River flow. The first step is to hire a consultant who will evaluate cloud-seeding to determine its feasibility and then come up with recommendations about its possible use in the region. The U.S. Bureau of Reclamation offered encouragement by estimating that seeding could produce up to 67 percent of Arizona's supply of Central Arizona Project water.

Despite a recent growing interest in cloud seeding, mostly prompted by drought-induced water shortages, the scientific jury is still out about whether seeding really works and to what extent. ■



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