ARIZONA
WATER RESOURCE

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U.S. and Mexican Communities Share River, Concerns

A U.S. conservation organization that works with communities to resolve natural resource issues is involved in a community-based project in Mexico to improve conditions along the Santa Cruz River.

In meetings conducted by the Sonoran Institute with citizens of the riverside towns of Santa Cruz and San Miguel Hidalgo, discussions have focused on how the river has changed during the last 30 or 40 years and how the changes have affected the lives of residents.

A range of problems were identified including picnickers coming from Nogales and overusing portions of the river, pesticide runoff from agricultural land, and livestock overgrazing the area damaging streambanks and affecting water quality, said Mark Briggs of the Sonoran Institute. Another concern is the railroad that runs along the Santa Cruz River on its route between Cananea and Nogales.

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Desert tortoises enjoy the calcium-rich blooms of desert globe mallows. Other fanciers of drought-tolerant plants are eating up the Water Center's first CD-ROM, Desert Landscaping. *See "Special Projects," pp. 6-7. (Photo by Cathy Woodard)*

Constructed Wetlands Treating More of Arizona's Wastewater

Constructed wetlands represent a growth industry, as such facilities are increasingly being used both in Arizona and throughout the nation. In 1990, Arizona only had four constructed wetlands treating municipal wastewater. Today 26 municipal and onsite constructed wetlands are now operating in the state, with at least 24 others either awaiting approval or under construction. (See graph on next page.)

(Constructed wetlands, a technology designed to mimic processes found in natural wetland ecosystems, utilize wetland plants, soils and their associated microorganisms to remove contaminants from wastewater.)

Kris Randall, unit manager for the Arizona Department of Environmental Quality's Municipal Wastewater and Recharge Unit, notes that constructed wetlands especially appeal to rural communities because they cost less than conventional wastewater treatment plants, and these areas have the land such systems require. "Because of those two factors we see rural communities looking at constructed wetlands as their mode of treatment," says Randall.

For example, the town of Jerome recently chose to construct a wetlands to treat its wastewater rather than a mechanical treatment plant. Maintenance of the mechanical treatment plant was to cost about $1,000 per month while the

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cost to maintain the wetland is expected to be "little or nothing." Construction is scheduled to begin this summer.

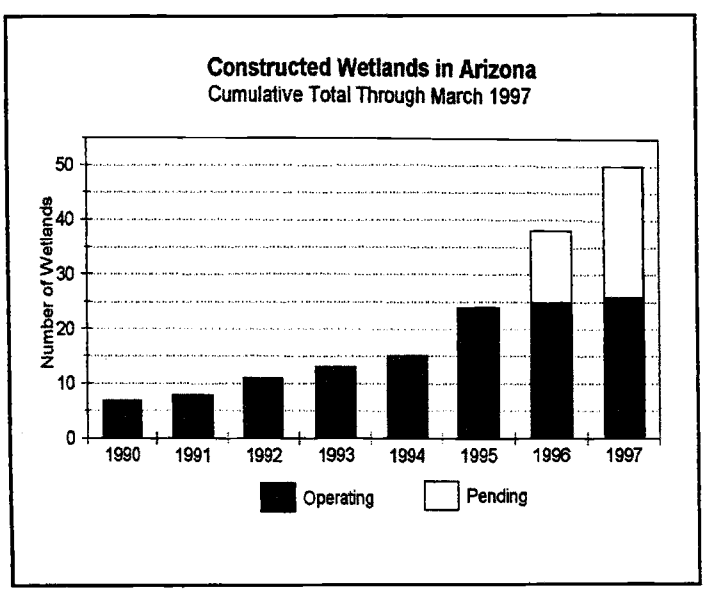
Also, the city of Sierra Vista, along with the U.S. Bureau of Reclamation, is planning a constructed wetland. This project could demonstrate how constructed wetlands can provide environmental benefits. Options for using its treated wastewater include aquifer recharge, to lessen the effect groundwater pumping has on the San Pedro River, and also releasing the treated water directly into the river.

Urban areas also are expressing a growing interest in the potential of constructed wetlands. Kingman's constructed wetland facility began operation in 1994. Thatcher intends to initiate a facility, and Nogales is considering a pilot project. Tucson's Sweetwater facility is expected to be completed by the end of summer or early autumn, and Phoenix's Tres Rios facility is a pilot project to study the possibility of building a full-scale wetland facility.

Along with increased use of constructed wetlands to treat wastewater, more research is taking place to understand its workings. For example, the Constructed Ecosystems Research Facility is a wetlands project devoted to research. Sponsored by the Pima County Wastewater Management Department, with research conducted by the University of Arizona's Office of Arid Lands Studies, CERF provides researchers a setting in which to evaluate the effectiveness of a constructed wetlands facility in an arid land climate.

Also research is an important component in a recent project funded by the Arizona Department of Water Resources. The University of Arizona, the Natural Resources Conservation Service and the Rovey Dairy in Glendale are working together on a constructed wetland project to treat the dairy's wastewater. The project serves a dual purpose, to provide an operating dairy with a working wastewater treatment system and to allow researchers an opportunity to study the workings of a wetland system.

Constructed wetlands are sufficiently recent to Arizona that regulatory agencies generally regard them as non-traditional. "These systems are typically used as part of the treatment train," Randall said.



Efforts are underway to adopt appropriate constructed wetland regulations. ADEQ officials organized a Total Quality Improvement team to identify issues inhibiting wetland construction in Arizona and to recommend solutions to regulatory and technical concerns. ADEQ is in the process of reviewing current agency practices to better incorporate TYI recommendations, Randall said.

Constructed wetlands have varied treatment capabilities and can remove contaminants from various kinds of water. Constructed wetlands are used to treat municipal effluents, industrial and commercial wastewaters, agricultural runoff, stormwater runoff, animal wastes, acid mine drainage and landfill leachates.

A topic of growing interest, constructed wetlands will be the featured topic in the next *Arroyo*, to be published in April. *Arroyo* is a publication of the Water Resources Research Center at the University of Arizona.

Shared concerns continued from page 1

Train accidents have occurred that spilled sulfuric acid into the river.

One of the project's strategy is to sponsor workshops to help deal with problems, said Briggs. For example, people were concerned about what to do in the event of a train wreck along the river. Whom do you call? What kind of help can you get? A workshop might be arranged to acquaint the communities with resources available in Mexico to handle chemical spills.

Other strategies also are planned. "I see us doing some hands-on, grass-roots efforts; from possibly a revegetation project along the river, to putting in fences to control cattle, to digging upland wells to keep cattle from riparian areas," said Briggs.

The emphasis of the project, which also involves agencies and organization from both sides of the border, is to tie the ecological health of the river to the economic vitality of the town. Whatever solutions are developed are to have economic benefits to the people or the town.

Along with community work, the project also is involved in long-term scientific monitoring of the Santa Cruz River and its riparian zone. This work is being done by the Departmento de Investigaciones Cientificas y Tecnologicas of the Universidad de Sonora. The information gathered will help measure the success of the project.

The work in Mexico is a logical extension of conservation work being done in southern Arizona's San Rafael Valley. This is the location of the headwaters of the Santa Cruz River. The river then dips into Mexico before turning north into Arizona.

This is the second year of a three-year project. "We hope to get more funding to continue the project and to include other towns," said Briggs. "Our long-term goal is to develop a river corridor protection team made up of people from towns all along the Santa Cruz River in Sonora."

Water Vapors

A sign in a Tucson restaurant reads, "We lose a little on each sale, but we make it up on volume." Even the mathematically challenged would likely sense an incongruity in that computation. What is admirable, however, is the optimism; that, in the face of financial setbacks, the job still will get done.

The University of Arizona's Water Resources Research Center suffered its own financial setback last summer. As part of a budget cutting strategy, the University of Arizona's College of Agriculture cut the Water Resources Research Center's budget by 54 percent, from $351,000 to $160,000. Four positions were eliminated.

While the effects of the budget cut are still being determined, it is obvious that this year will not be business as usual for WRRC. Program activities are being evaluated to decide which can continue and under what reduced circumstances. Sources of outside funding are being investigated that could help support now threatened WRRC projects.

One areas impacted by this loss of funding has been the WRRC's information transfer program. The current plan is for *Arroyo* to continue to be published four times per year. Publication of *AWR* was suspended last summer, and it appeared doomed.

Back from the Grave — Again

AWR's at least temporary resurrection is due more to the encouragement of our readers and irrational staff stubbornness than a grand reversal of fortunes. However, if our sponsors come through for us, we will publish *AWR* six times per year. Wish us luck, and please resume sending us stories, announcements, and letters to the editor. (New sponsors also are welcome.)

CD-ROM, History Published

Despite financial setbacks, this issue of *AWR* features two major new WRRC publications. They represent our most ambitious efforts in two areas — "new media" and Issue Papers. Each is intended to serve unique needs of Arizona's water community.

The first is a multi-media CD-ROM entitled *Desert Landscaping: Plants for a Water-Scarce Environment.* The CD is described in Special Projects, pp. 6-7.

The second major release is our most ambitious Issue Paper to date, a history of Arizona rivers entitled *Arizona's Changing Rivers: How People Have Affected the Rivers.* This publication is described in Publications, p. 9.

Solar Water Treatment?

If sun exposure can treat water and reduce cases of diarrhea, as reported by a recent study, then the low-tech method might be applied in many parts of the developing world. A report published in *The Lancet* said that Kenya's Massai people reduced cases of diarrhea by a third by leaving contaminated drinking water in the sun for several hours before drinking it. The ultraviolet rays destroy many of the microbes that cause diarrhea, which kills between 4 million and 6 million annually. Two groups of children had their drinking water in bottles. One group exposed their water on the roof of their huts at dawn, not drinking it until noon. The other group kept their water indoors. The former had one third less cases of diarrhea.

Water Conservation Redux

With work on the Department of Water Resources' Third Management Plan underway, now is a good time to take note of water conservation practices of yesteryear. The following is taken from Wallace Stegner's memoir, *Wolf Willow, A History, a Story, and a Memory of the Last Plains Frontier.* "There was a whole folklore of water. People said a man had to make a dipperful go as far as it would. You boiled sweet corn, say. Instead of throwing the water out, you washed the dishes in it. Then you washed your hands in it a few times. Then you strained it through a cloth into the radiator of your car, and if your car should break down you didn't just leave the water to evaporate in its gullet, but drained it out to water the sweet peas." Clearly, a conservation standard to which we all can aspire.

ULFs Save Water, Spray Less

If the notion of washing your hands in the same water "a few times" gives pause, then the hygienic implications of brushing your teeth with toilet water might really raise concerns. Yet, research done a few years ago by Charles Gerba of the UA's Department of Soil, Water and Environmental Science suggested that conventional toilets produced bacteria-laden aerosols when flushed, resulting in the same effect. More recent research from Linda Stetzenbach and colleagues at the University of Nevada, Las Vegas, suggests that ultra-low-flow toilets do not disperse measurable amounts of germs when flushed, providing a side benefit to conserving water.

Arizona Water Resource is published 10 times per year by the University of Arizona's Water Resources Research Center. *AWR* accepts news, announcements and other information from all organizations concerned with water. Material must be received by the 14th of the month to be published in the following month's issue. Subscriptions are free upon request.

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News Briefs

Salt, Verde Water Supplies Recovering

The year 1996 was very dry in Arizona. Precipitation for October 1995 through February 1996 was 50 percent of normal for the Salt and Verde watersheds, and snowpack reached only 75 percent of normal by March 1, 1996 (see chart below). This year, precipitation for October 1996 through February 1997 was 83 percent of normal, and snowpack was 100 percent of normal on March 1. Reservoir levels have not recovered, however. Supplies declined from 63 percent of capacity on March 1, 1996 to 47 percent on March 1 1997.

Safe Drinking Water Act Amended

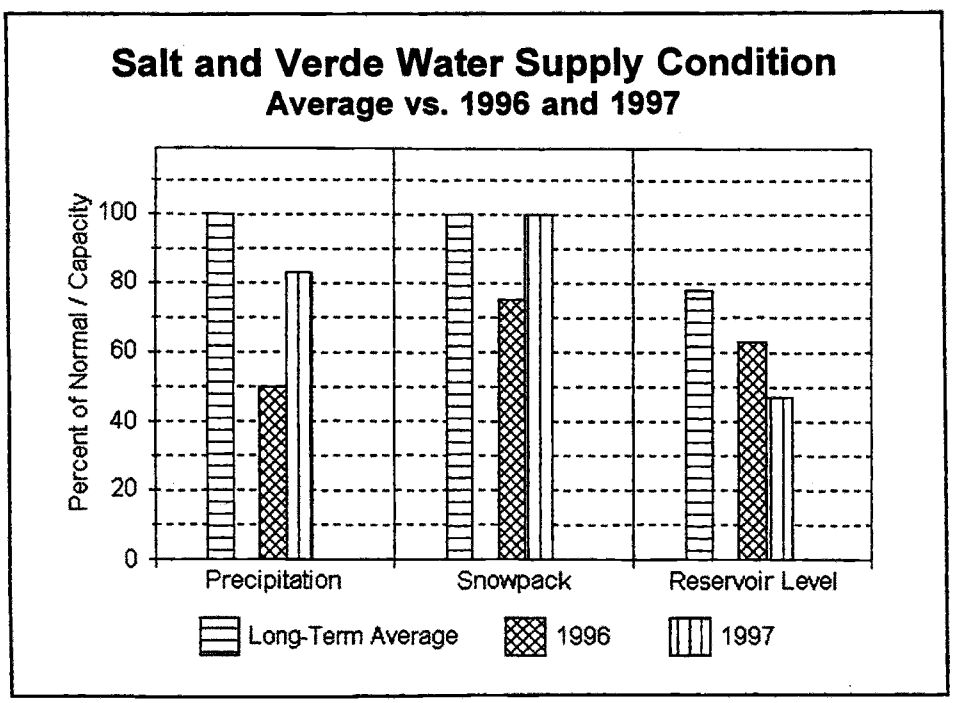
The Safe Drinking Water Act was amended in August 1996 for the second time since its establishment in 1974. Among the changes is a prioritization of contaminant regulation according to health risks, greater attention to the needs of small water providers, and better availability of water quality information to consumers.

Changes in the contaminant selection criteria are to make risk assessment and prioritization part of the selection process. Selection will be based partially on whether there is a meaningful opportunity for reduction in risk from adverse health effects for persons served by the system. And, instead of regulating an additional 25 contaminants every three years as per the 1986 amendments, the U.S. Environmental Protection Agency (EPA) will publish a list of contaminants and then decide whether or not to regulate at least five of them every five years.

EPA is to decide at the time a standard is proposed whether its benefits justify its costs. EPA will continue to establish standards based on affordable technology available, but MCL's may subsequently be adjusted to "maximize health risk reduction benefits at a cost that is justified by the benefits." However, EPA can bypass the requirements of the contaminant selection process and the cost/benefit justification if a contaminant is determined to pose an urgent threat to public health.

The amendments require states to protect drinking water sources by identifying potential contaminants in source watersheds and assessing the susceptibility of the state's water systems to those contaminants. States also are required to establish the legal authority to ensure that new water systems can meet drinking water standards, as well as identify existing water systems needing assistance. And states must implement an operator certification program to ensure that every system has an operator to perform key compliance functions.

The amendments also create state Drinking Water Revolving Funds to assist water providers in meeting the requirements of the Act. Specific funding objectives include source water protection, loans to small and/or disadvantaged water providers, and research on the health effects of contaminants. The funds may be distributed as set-asides or loans. Each state must set aside at least 15 percent of the fund for small water providers.



EPA Targets Rural Wastewater Needs

A $50 million U.S. Environmental Protection grant program will help rural, disadvantaged communities with fewer than 3,000 residents meet wastewater treatment needs. Guidelines and funding allotments for the Hardship Grants Program for Rural Communities were released March 20.

Targeting small, rural communities with outdated or failing wastewater treatment systems, the program will be implemented in conjunction with the Clean Water State Revolving Fund loan program (see previous story). EPA funds states, which in turn provide hardship assistance to communities. For guidelines or further information, call Stephanie von Feck, 202-260-2268 or visit EPA's web site at: http://www.epa.gov/owm/wm04200-2.htm.

Western Water Quality Standards Studied

The U.S. Environmental Protection Agency and the U.S. Congress funded Pima County Wastewater Management Department to undertake a water quality study. Titled the "Arid West

Water Quality Research Project," the project will have significant implications for water quality regulations and treatment in the arid and semi-arid West. Funds from the $5-million grant will sponsor research to develop appropriate water quality criteria for arid regions. The research is to produce water quality criteria to protect species and habitat from ephemeral and effluent-dependent ecosystems.

The project has a regional focus involving wastewater agencies, local governments, tribal interests, state and federal regulators, universities and environmental groups. It is an opportunity for western water and wastewater agencies, working in conjunction with EPA Region IX and others throughout the arid West, to build a scientific basis for appropriate water quality standards for the western ecosystems. (See Announcements, p. 10 for information about a related water quality conference.)

For additional project information contact Pima County Wastewater Management, 201 N. Stone Ave., Tucson, AZ 85701; phone 520-740-6500; fax 520-620-0135.

USGS-Weather Service Joint Use Building Dedicated

Dignitaries and scientists gathered at the University of Arizona on March 21 to dedicate the new Environmental and Natural Resources Building. Envisioned as the first of a three-phase complex, the facility houses the National Weather Service and the U.S. Geological Survey's Water Resources Division, which includes hydrology, GIS, NAWQA, and Glen Canyon Environmental activities.

Locating federal agencies on campuses of research universities is a growing trend. This is the first time, however, that a facility houses both the Survey and the Weather Service. Benefits of the shared facility are expected to include cost savings, greater cooperation between the USGS, NWS and faculty, and enhanced opportunities for students.

Transitions

Placido dos Santos is the new **Border Environmental Manager** for the Arizona Department of Environmental Quality. He comes to the position from the Arizona Department of Water Resources, where he served as the first area director of the Santa Cruz AMA. **Alejandro Barcenas** was appointed the new AMA director. He formerly was Nogales city engineer.

Also in the Santa Cruz AMA, **Steve Abernathy** was named to a Water Resource Specialist (II) position. He takes over a position previously held by **Keith Nelson**, who now is with the Department of Water Resources' Hydrology unit in Phoenix.

Bill Campbell has taken a newly created groundwater technician job with the **Arizona Small Utility Association** in Tucson. Previously, Campbell was a Water Resource Specialist with the Pinal AMA of the Department of Water Resources, where he worked with the grants program and water rights compliance and enforcement.

Tim Henley was named manager of the **Arizona Water Bank** in July 1996. **Jimmy Jayne** was appointed technical administrator of the Water Bank. Henley formerly headed the Colorado River Management Section of the Arizona Department of Water Resources. That position was taken over by **Tom Carr**, who was in Program Management for the Department.

Trish McCraw has transferred within the Arizona Department of Water Resources from head of the Arizona Water Protection Fund to a position in the **Colorado River Management** Section of the Surface Water Management Division. No replacement has yet been named to head up the Water Protection Fund.

Peter Wierenga is the Acting Director of the **Water Resources Research Center** at the University of Arizona. Wierenga, a soil physicist, also heads the Department of Soil, Water and Environmental Science in the UA's College of Agriculture. He recently was elected a Fellow of the American Geophysical Union. Former Water Center Director **Hanna Cortner** began a one-year sabbatical in January. Former Senior Research Specialist **Mary Wallace** is completing her PhD and teaching in the School of Renewable Natural Resources.

Vic Baker became the new head of the **Department of Hydrology and Water Resources** at the University of Arizona in August of 1996. He succeeds **Soroosh Sorooshian**, who remains as a professor in the department. Vic Baker was formerly a professor of Geosciences with a joint appointment at the Lunar and Planetary Lab at the UofA. He has retained both of these appointments.

Two key figures from the early years of the UA's Hydrology department recently passed away. **Eugene Simpson**, longtime professor and former department head, died in December at the age of 78. Simpson was a pioneer in the field of hydrogeology, and was among the first to recognize the need to protect groundwater from radioactive materials and other contaminants. His career at the University of Arizona stretched from 1965 through 1985, and included considerable research for the Nuclear Regulatory Commission and abroad on the subject of pollutant movement through fractured rock of low permeability. **Daniel Evans**, professor emeritus, died in late November at the age of 76. Evans began his 26-year career at the University of Arizona as a professor of agricultural chemistry and soils in 1963. The following year, he joined the hydrology program, eventually serving twice as department head. His research program included extensive work for the U.S. Nuclear Regulatory Commission.

Karen Heidel is the acting head of the Arizona Department of Environmental Quality's Water Quality Division. She stepped in after **Kim MacEachern** left ADEQ earlier this year.

Special Projects

Desert Landscaping CD-ROM

Water conservation as a concept is almost universally supported. In practice, however, water conservation programs can be difficult to implement and even harder to evaluate. Yet, the potential of water conservation to enhance the value of Arizona's scarce water resources cannot be ignored. That potential is high for municipal water uses, the fastest-growing demand sector. It is particularly compelling for outdoor water uses such as landscape irrigation, in part because indoor demand becomes effluent, which can be used or recharged, while outdoor demand is lost through evaporation and evapotranspiration.

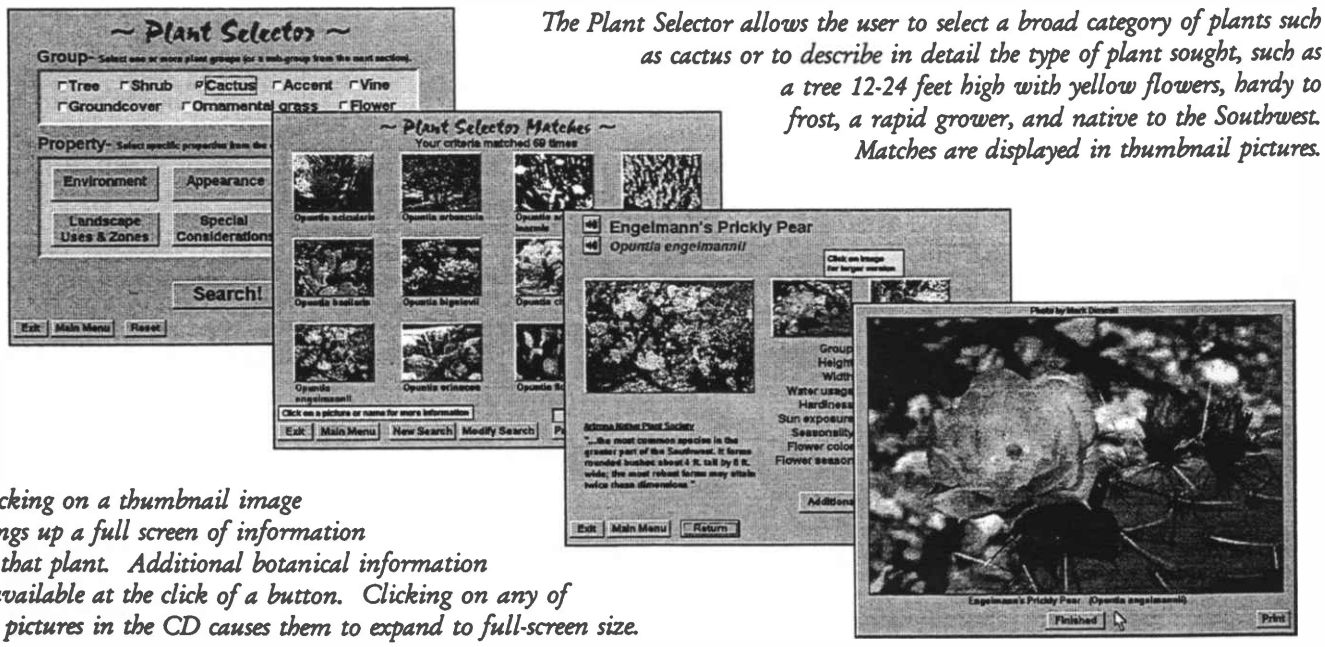
Still, significant barriers to water-efficient landscaping remain. These include the difficulty of eradicating existing turf, the growing aversion to landscapes that take water conservation to extremes (so-called zero-scapes or hardscapes), and difficulties in selecting drought-tolerant plants that will create an inviting outdoor area.

The need for a more comprehensive, easy-to-use information source on drought-tolerant landscaping was recognized by the Groundwater Users Advisory Committee of the Arizona Department of Water Resources' Tucson Active Management Area. In 1995, they funded a conservation assistance project submitted by the University of Arizona's Water Resources Research Center to develop a multi-media CD-ROM on landscaping with drought-tolerant plants. A year of development produced *Desert Landscaping: Plants for A Water-Scarce Environment.*

The heart of the CD-ROM is a multi-media data base on some 600 drought-tolerant landscape plants. There are nearly 100 items of information for each plant, including common and botanical name, size and growth characteristics, water, sun, soil and temperature needs, xeriscape zone, flower color and season, growth rate, habitat value, area of origin, and dozens of others. In addition, there are multiple pictures of each plant, including a whole-plant shot, a close-up of its flower or seed pod, and the plant within a landscape. Pronunciations of the common and botanical names also are included.

Gathering all the necessary information and pictures for such a massive data base was greatly assisted by a 22-member project advisory panel consisting of many of the foremost experts on desert plants in the Tucson and Phoenix metropolitan areas. The group included nursery owners, professors, master gardeners, and landscape architects. Individual panel members made available their photo and slide collections, provided data for particular plant categories, verified data base entries, and pronounced botanical names. As a group, the panel discussed issues of how people seek information on plants, how to warn of plant shortcomings such as poisonous seeds or invasiveness, and served as a sounding board for prototype user interfaces. Towards the end of the project, several panelists served as beta testers.

The programming challenge was to provide users with multiple ways to seek information on low water-use plants through an intuitive and attractive program interface. The final design provides analogs to three common ways of



The Plant Selector allows the user to select a broad category of plants such as cactus or to describe in detail the type of plant sought, such as a tree 12-24 feet high with yellow flowers, hardy to frost, a rapid grower, and native to the Southwest. Matches are displayed in thumbnail pictures.

Clicking on a thumbnail image brings up a full screen of information on that plant. Additional botanical information is available at the click of a button. Clicking on any of the pictures in the CD causes them to expand to full-screen size.

obtaining information on desert plants — looking them up in a reference book, visiting a botanical garden, and questioning a plant expert. The reference book analog is an alphabetized list of plant names, which the user can switch between common names and botanical names. A name is selected either by typing it or clicking on it with a mouse.

The botanical garden analog is a series of award-winning landscapes, including front and back yards, patio areas, and poolsides. After selecting a landscape, the user explores it with the mouse. As the mouse cursor passes over particular plants, their names pop on screen. Clicking on a plant selects it.

The plant expert analog is the CD's Plant Selector. This is perhaps the most useful approach for selecting plants. From a screen of plant attribute categories, the user first selects one or more broad plant categories, such as trees or groundcovers (see screen shots, bottom of previous page). At this point, the user can search for all plants in that category, or can narrow the search by selecting plant characteristics. For example, one can search for deciduous vines with blue flowers that can withstand full sun and is native of Africa. The search displays matching plants as small "thumbnail" pictures. Clicking on one of these pictures selects that plant. If the search produces too many or too few matches, the search criteria can be tightened or relaxed.

The plant selector can be used as a research tool to answer questions and discover patterns among desert plants. How do the colors of flowers vary with the time of year in which they bloom? Why are so many trees native to Australia relatively short-lived? What percent of drought-tolerant shrubs are native to Africa? What color flowers attract hummingbirds?

Regardless of the approach used to select a plant, or which plant is selected, the program displays the same basic plant information screen (see screen shots). Common and botanical names and their pronunciations, pictures, basic information and a quote from a plant book or authority all are displayed. More detailed botanical data, such as leaf description and area of origin, are revealed by clicking the "additional information" button. Every picture on the CD can be enlarged to full screen size by clicking on it, and all screens can be printed out.

While the heart of the program is the searchable plant data base, other useful information is included. The Landscape Tips section covers 24 topics including selecting plants, what is a desert, how to kill bermuda grass, a primer on native plant laws, how to attract wildlife to your garden, and the fundamentals of insect and disease control. Over 200 screens of information address the most common questions and problems facing the desert landscaper.

Other features include a plant trivia game and bibliography. The trivia game tests your knowledge of drought-tolerant plants and deserts with hundreds of questions organized into six categories and three levels of difficulty. An illustrated bibliography reviews 24 of the most valuable desert plant reference works, describing the particular strengths of each.

A follow-up grant from the Tucson AMA is being used to develop touch-screen electronic kiosk versions of *Desert Landscaping*. The goal is to make the information available in public places to all persons, even those completely unfamiliar with computers, mice and keyboards. Eventually, some kiosks will be permanently located in public places such as botanical gardens, while others are temporarily placed at water conservation events and plant shows.

Desert Landscaping is the product of much of the staff of the Water Resources Research Center, some extension personnel, a dedicated expert advisory panel, and dozens of others. Their combined talent and expertise, as well as their deep interest in water-efficient landscapes, is reflected in this CD-ROM.

The CD-ROM represents the Water Center's ongoing efforts to use "new media" to more widely and effectively disseminate water resource information. Clearly, traditional print media still is highly useful means of communication, and will constitute the bulk of the Water Center's publications for the foreseeable future. But new media has unique strengths as well, and additional publications in the form of CD-ROMs and Web sites are being planned.

Desert Landscaping is available for either Windows or Macintosh computers with double-speed or faster CD-ROM drives. Hardware requirements for PCs are a 486 or Pentium-class CPU, Windows 3.x, NT, or Win95, and 4mb RAM (8mb highly recommended). A sound card is optional. Requirements for Macintosh systems are a Centris 650 (68040, 25 mHz) or better, System 7.1 or later, and 8mb RAM (12mb highly recommended).

Desert Landscaping Order Form

Name _____

Address _____

_____

City _____

State _____ Zip _____

Please indicate your computer platform:

__ Windows 3.1, 3.11, WFW, Win95 or OS/2
__ Macintosh OS

Copies of the *Desert Landscaping* CD-ROM are $25 each* (includes shipping).

Make out a check or money order to the University of Arizona and send to:

Water Resources Research Center
The University of Arizona
350 N. Campbell Ave.
Tucson, AZ 85719

* Call 520-792-9591 for information on quantity orders.

Publications

The following two publications are recent issues of Arroyo, *a quarterly newsletter of the University of Arizona's Water Resources Research Center. Individual copies, as well as subscriptions are available without charge from the Water Resources Research Center, University of Arizona, 350 N. Campbell, Tucson, AZ 85721; 520-792-9591; fax 520-792-8581; email wrrc@ccit.arizona.edu.*

Holding Back the Waters — Dams as Water Resource Monuments
Joe Gelt, Vol. 9, No. 2. Although the Arizona dams attracting most attention are the giant, multi-purpose dams on the Salt and Colorado rivers, these are not typical of most dams in the state. Of the 439 dams in the state, most are much smaller, many serving a single purpose such as stock pond, mine tailing, or flood control. Regardless of size and purpose, however, all dams are links in a human engineered system to store water and control its use.

Saving Endangered Species Poses Water Policy Challenge
Joe Gelt, Vol 9. No. 3. The Endangered Species Act has wide legal implications, but ESA's enforcement is broadest, most complicated when applied to habitat and species that rely on water. As a result, the law has special significance in Arizona and the West. Here historical, geographical and political factors contribute to make water a highly charged public policy issue.

Hydrology and Water Resources in Arizona and the Southwest
This volume is the proceedings of the 1996 meeting of the Hydrology Section of the Arizona-Nevada Academy of Science conducted at the University of Arizona. Papers are included on topics of current interest to land and water managers of the Southwest. Copies are available while supplies lasts by sending a $10 check made out to M. Baker, Jr, A\NAS, 29 W. Silver Spruce, Flagstaff, AZ. Fax 520-556-2130 for more information.

Chronicle of Community
This new triquarterly publication is devoted to exploring evolving ideas of community in western United States as grassroots groups, businesses, government agencies, and others work out natural resource issues. The winter issues included an interview with Betsie Rieke, director, Natural Resource Law Center at the University of Colorado, reflecting on the role of federal resource managers in building community. Subscriptions are $33 a year for institutions and $24 for individuals. Contact The Chronicle of Community, P.O. Box 8291, Missoula, MT 59807-9906.

Staking Out the Terrain: Power and Performance Among Natural Resource Agencies, Second Edition
Jeanne Nienaber Clarke and Daniel C. McCool. This new edition provides a current and comprehensive analysis of key federal agencies managing natural resources. Along with offering a wealth of historical detail and an analysis of current policy conflicts over natural resource management, the authors also examine current trends in water and land management and put forward an innovative proposal to reshape federal natural resource administration for the twenty-first century. Paperback: $19.95; Hardcover: $59.50 from State University of New York Press, State University Plaza, Albany, NY 12246-0001.

Arizona WET, K-6 Curriculum on Nonpoint Source Water Pollution
Working closely with numerous state agencies, school districts, and universities the Arizona WET (Water Education for Teachers) program produced a comprehensive Arizona-specific, K-6 nonpoint source water pollution curriculum. Funded by the Arizona Department of Environmental Quality, the curriculum contains pertinent teacher information and 25 hands-on student activities. The materials have received regional and national recognition as unique teaching materials for students whose first language is not English. The curriculum is available for $15 from the Water Resources Research Center, University of Arizona, 350 N. Campbell Ave., Tucson, AZ 85721; 520-792-9591; fax 520-792-8518.

The University of Arizona Press recently published the following two books that have to do with water affairs. Order from the UA Press, 1230 N. Park Avenue, Suite 102, Tucson, AZ 85719; 800-426-3797; in Arizona or outside cont. U.S. 520-626-4218.

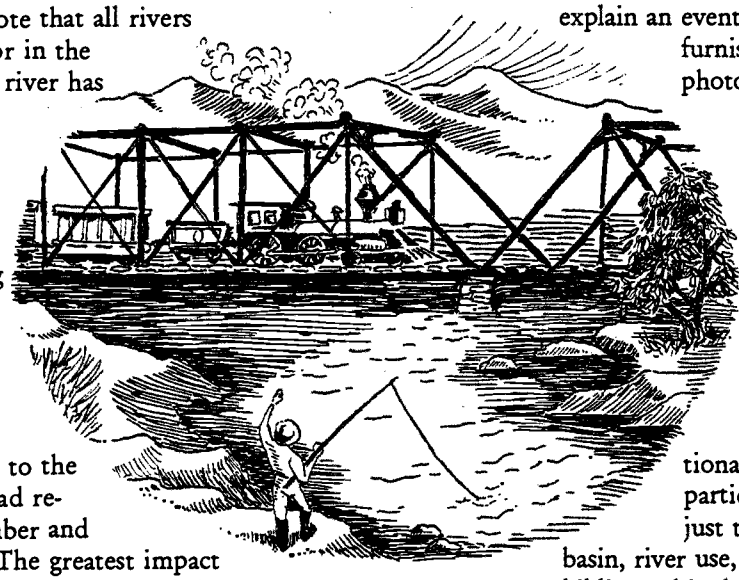
Riparian Ecosystems Recovery in Arid Lands: Strategies and References
Mark K. Brigg. As riparian ecosystems decline throughout the Southwest, only few recovery projects have been evaluated. By emphasizing evaluation of riparian ecosystem, so that the cause of degradation can be understood, and by offering general approaches that can be tailored to specific situations, this book provides a holistic approach to riparian recovery. Readers will be better able to judge whether recovery expenditures are likely to produce desired results. Cloth: $45; Paper: $19.95.

Canals and Communities, Small-Scale Irrigation Systems
Edited by Jonathan B. Mabry. From the mountains of South America to the deserts of northern Africa to the islands of south Asia, people have devised myriad ways of moving water to sustain their communities and nourish their crops. This book presents case studies and comparative essays about local institutions for managing water resources. This volume can serve as source book for social scientists and development planners investigating the cultural ecology of irrigated agriculture, the ethnology of cooperative social formations, the politics of collective-resource institutions, and the sociology of rural development. Cloth: $47.50.

Arizona's Changing Rivers: How People Have Affected the Rivers

Barbara Tellman. Rivers write their own histories in geological records, recording the mighty natural forces that created and formed rivers, canyons and valleys. Yet, river histories also are needed. *Arizona's Changing Rivers* provides a history of human influences on the state's rivers. Like geological forces, such influences have profoundly affected Arizona rivers.

The book is careful to note that all rivers were not equally affected, nor in the same way. As a result, each river has its own history, to be viewed in the context of the human events and occurrences that took place in the area.



For example, the coming of the railroad, built along the Little Colorado River, greatly affected the river. Land ownership changed, with the federal government granting large blocks of land to the railroad. Building the railroad required vast quantities of lumber and water. Bridges were built. The greatest impact of the railroad, however, was that it opened the area to settlement. Ranchers and cattle moved in.

In contrast, the Bill Williams River is relatively unaffected by human activities. The river is remote, inaccessible by roads and railroads, and the area is unsuitable for agricultural and urban development. Even the operation of Alamo Dam, humans' most profound influence on the river, is being modified to mitigate its effects. Much of the land along the Bill William River is public land and is being preserved and restored.

Another strength of the book is its historical perspective. It views historical effects or influences as layered, each wave of settlers and explorers — Indians, Spanish and Americans — using the land and rivers differently. Indian agriculture tended to make less demands on rivers, although they did divert rivers for irrigation. Americans built dams for greater control and use of rivers.

The book also points out that the changes that first occurred locally and for a specific purpose become cumulative, with wide and broad application. The Spanish first brought cattle to southern Arizona to feed occupants of missions and presidios. Later large-scale ranching greatly affecting land and rivers.

A reading of the book leaves the lasting impression that an historical account of the influence of human affairs on Arizona rivers is a varied and colorful story. It includes diverse events and happenings, from the bursting of the Walnut Grove Dam on the Hassayampa River that killed over a 100 people, to an Arizona governor threatening war with California to protect Arizona's claim to the Colorado River.

A book offering an historical and cultural perspective on rivers serves to remind policy makers of the big picture. Not only are their decisions and actions affected by hydrology and the principles of public policy, but they also are to be understood as part of an ongoing historical and cultural tradition. The Central Arizona Project may be seen as the Indian irrigation ditches writ very, very large.

The text includes many sidebars, with quotes and varied information and details. These may further explain an event, add an historical detail, or furnish a touch of humor. The many photos are from various historical eras. The plethora of sidebars and photos serve to break up the text, to act as swirls and eddies to the main flow of the discussion.

Arizona's Changing Rivers is 200 pages in length, containing 160 maps, charts and illustrations. Key maps and graphs are presented in a full-color section. Navigational aids allow the reader with a particular information need to find just the material on a particular river basin, river use, or historical era. A companion bibliographic data base on floppy disk contains nearly 2,000 entries.

Arizona's Changing Rivers is available for $15 or $17.50 with bibliographic data base from the University of Arizona's Water Resources Research Center, University of Arizona, 350 N. Campbell, Tucson, AZ 85719; 520-792-9591; fax 520-792-8518; email wrrc@ccit.arizona.edu.

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Geraghty & Miller
Metro Water District
Salt River Project
Tucson Water
USGS Water Resources Division
Water Utilities Association of Arizona

Their contributions help make continued publication of this newsletter possible.

Announcements

Law Conference Set on Dams

The Natural Resources Law Center of the University of Colorado announced its 18th annual summer conference, to be conducted on-campus in Boulder, June 2-4. The conference, "Dams: Water and Power in the New West," includes the following topics: restructuring the electric utility industry, FERC relicensing of hydropower facilities to improve environmental protection, divestment of federal facilities and visions for the future of western water developments. For additional information contact the Natural Resources Law Center, University of Colorado School of Law, Campus Box 401, Boulder CO 80309-0401; phone 303-492-1286.

Wetlands Conference Scheduled

In honor of American wetlands month, Communities Working for Wetlands has scheduled a conference for May 7-9 in Alexandria, VA. The conference is for people interested in community-based wetlands conservation who will share their experiences and thus expand their wetlands knowledge. Participants are to learn to build contacts and networks for working more effectively within communities, with government programs and the private sector. Registration fees are student, $95; nonprofit/government, $265; and regular, $385. For more information, call Terrence Institute 800-726-4853.

Call for Abstracts

A call for abstracts has been issued for the "Symposium on Environmental, Economic and Legal Issues Related to Rangeland Water Developments," to be conducted in Phoenix, November 13-15. The symposium is sponsored by Arizona State University's Center for the Study of Law, Science, and Technology in cooperation with various cattle, range, environmental and regulatory agencies and organizations. Submit abstracts not exceeding 500 words to Rosalind Pearlman, Center for the Study of Law, Science, and Technology, Mail Stop 7906, Arizona State Univ., Tempe, AZ 85287-2124; phone 602-965-2124; email: Pearlman@asu.edu.

SW Power and Water Symposium

The Southwest Public Power and Water Symposium will be held in Anaheim on April 30-May 2. Topics include: regional water issues; water supply outlook: surpluses, banking and marketing; threatened and endangered species protection; perspectives of stakeholders; and activities of the 105th Congress. For details phone: 510-778-0313.

Artificial Recharge Symposium Set

The 8th Biennial Symposium on Artificial Recharge of Groundwater will be conducted in Tempe, June 2-4. The theme of the conference is "Recharge for the People" and is sponsored by the Arizona Hydrological Society, Salt River Project and U.S. Water Conservation Laboratory. Areas to be covered include water supply, water reuse, environmental benefits, recharge methods and projects. Registration fee will be about $100. The American Society of Civil Engineers will conduct a pre-conference recharge short-course on June 1: $295 for ASCE members and $345 for non-members. For additional information contact Suzanne Kirk, Dames & Moore, 7500 N. Dreamy Draw Drive, Suite 145, Phoenix, AZ 85020; phone: 602-861-7452.

Call for Papers

The American Water Works Association and the Water Environment Federation announce a call for papers for their Water Reuse '98 conference, to be conducted February 1998 at Orlando, Florida. Water Reuse '98 will provide a forum for professionals involved in all aspects of water reuse, including water and wastewater engineers; utility managers; water quality specialists; public affairs managers; local, state, and federal agencies; and agricultural interests. For copy of the call for papers contact Susan Miller, AWWA Water Resources Engineer. Phone 303-347-6181

Water Quality Research Conference

Pima County, under Public Law 103-327 through the Environmental Protection Agency, has been awarded $5 million to sponsor research to develop appropriate water quality criteria for the arid regions of the United States. (See "News," p. 4.) A conference, limited to 150 persons, will be held in Tucson, April 23-25 to identify the significant regulatory/scientific research issues, develop a research agenda and initiate the process for soliciting proposals and awarding research grants. For additional information contact Pima County Wastewater Management Department, 201 N. Stone Ave, 8th Floor, Tucson, AZ 85701; phone 520-740-6500.

ASCE IAHR Congress

The American Society of Civil Engineers (ASCE) will hold its 27th International Association for Hydraulic Research Congress August 10-15 in San Francisco. Themes include: groundwater: an endangered resource; managing water: coping with scarcity and abundance; and energy and water: sustainable development. For more information on the WEB: http://ogee.do.usbr.gov/iahr.html, or contact Adnan Alsaffar, Bechtel Corp., 9801 Washingtonian Blvd., Gaithersburg, MD 20878-5356; phone 301-417-3175; fax: 301-963-2878.

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Calendar of Events

RECURRING

Arizona Hydrological Society (Flagstaff). 2nd Tuesday of the month (during the school year), 7:00 pm NAU, Southwest Forest and Science Complex, 2500 S. Pine Knoll Dr., Room 136, Flagstaff. Contact: Abe Springer 520-523-7198.

Arizona Hydrological Society (Phoenix). Usually 2nd Tuesday of the month. April 8th, 5:30 pm, Monti's La Casa Vieja, 3 West 1st Street, Tempe. May 13th, beach volleyball, time and location to be announced. Contact: Cortney Brand 602-954-6781.

Arizona Hydrological Society (Tucson). 2nd Tuesday of the month, social 7:00 pm, speaker 7:30 pm. April 8 - Michael Bradley, University of Arizona Department of Hydrology, "Privatization of Water Rights and Water Companies." 1550 E. Prince, Tucson. Contact: Marla Odom 520-881-4912.

Arizona Water Protection Fund Commission. 4th Wednesday, 10:00 am, Willcox (if meeting is held in April or May). Contact: Tricia McGraw 602-417-2400, ext. 7168.

Arizona Water Resources Advisory Board. TBA, possibly for May. Contact: Kathy Donahue 602-417-2410.

Central Arizona Water Control District. Usually 1st and 3rd Thursdays of the month. April 17, May 8, May 22, time be determined one week before, CAP Board Room, 23636 N. 7th St., Phoenix. Contact: Ardis McBee 602-870-2210.

City of Tucson Citizens Water Advisory Committee. April 8, May 6, 7:30 am 310 W. Alameda, Tucson. Contact: Martha Aros 520-791-2666.

Maricopa Association of Governments / Water Quality Advisory Committee. April 14, 10:00 am Room 103, 1820 W. Washington, Phoenix. Contact: Wendy Bower 602-254-6308.

Maricopa County Flood Control Advisory Board. 4th Wednesday of the month, 2:00 pm 2801 W. Durango, Phoenix. Contact: 602-506-1501.

Phoenix AMA, GUAC. April 2, 9:30 am, Conference Room A, 500 N. 3rd St., Phoenix. Contact: Mark Frank 602-417-2465.

Pima Assoc. Governments / Water Quality Subcommittee. Usually 3rd Thursday of the month, 9:00 am. 177 N. Church St., Suite 405, Tucson. May 15 meeting subject to change. Contact: Gail Kushner 520-792-1093.

Pinal AMA, GUAC. Usually 3rd Thursday of the month, 3:00 pm. Pinal AMA Conference Room, 1000 E. Racine, Casa Grande. Contact: Randy Edmond 520-836-4857.

Prescott AMA, GUAC. April 21, 10:00 am, 2200 E. Hillsdale Rd., Prescott. Contact: Phil Foster 520-778-7202.

Santa Cruz AMA, GUAC. April 9, 9:00 am, Santa Cruz AMA Conference Room, 857 W. Bell Rd., Suite 3, Nogales. Contact: Alejandro Barcenas 520-761-1814.

Tucson AMA, GUAC. April 18, 9:00 am, Tucson AMA Conference Room, 400 W. Congress, Suite 518, Tucson. Contact: Kathy Jacobs 520-770-3800.

Verde Watershed Association. Contact: Tom Bonomo, VWA Newsletter Editor, c/o Verde R.D., P.O. Box 670, Camp Verde, 520-567-4121.

Yavapai County Flood Control District Board of Directors. 1st Monday of the month in Prescott, 255 E. Gurley St.; 3rd Monday in Cottonwood, 575 E. Mingus. Contact: YCFCD, 255 E. Gurley, Prescott, 520-771-3196.

UPCOMING

April 17-18, **Arizona Water Law: 5th Annual Conference Focusing on Current Water Rights, Supply and Quality Issues**, La Posada Resort, 4949 E. Lincoln St., Scottsdale, AZ 85253. Registration fee is $395. Hosted by CLE International. Contact: Kristin Mildenberger 303-377-6600.

June 2-4, **8th Biennial Symposium on Artificial Recharge of Groundwater**, Arizona Hydrological Society, Salt River Project, U.S. Water Conservation Laboratory, and Arizona Department of Water Resources, Tempe, AZ.

August 18-21, **Western States Non-Point Source Symposium.** Hosted by the Utah NPS Task Force and the Environmental Protection Agency Region VIII. Olympia Park Hotel, Park City, Utah. Submit paper proposals to: Jack Wilbur 801-538-7098.

September 18 & 19, **10th Annual Arizona Hydrological Society Symposium.** Carefree Inn, 37220 Mule Train Road, P.O. Box 3500, Carefree, AZ, 85377-3500. For reservations call: 1-800-637-7200, special room rates available. Entertainment and other activities planned for Sept. 17th and 20th. For more information contact: David Kirchner 602-572-1114.

Submit calendar, announcement, or publication information to Jim Henderson, WRRC at 520-792-9591 x51; fax 520-792-8518; email wrrc@ccit.arizona.edu.

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Tucson AMA Conservation Grants

The Arizona Department of Water Resources is accepting applications for funding of conservation assistance projects to benefit the Tucson AMA. The projects are to assist Tucson AMA water users in meeting Second Management Plan conservation requirements and in reaching the Tucson AMA's water management goals. The program provides funding for research, implementation and educational conservation programs. Between $150,000 to $170,000 will be available. Deadline for applications is May 2. Application packets will be mailed upon request by contacting Shirley Dynes, 520-770-3800. Christina Bickelmann Kuranz, water conservation specialist, will provide assistance in making out the application, 520-770-3816.

Water Education Conference Set

The American Water Resources Association (AWRA) and the Universities Council on Water Resources (UCOWR) will hold their annual symposium from June 29-July 3 in Summit County, Colorado. Titled "Water Resources, Education, Training and Practice: Opportunities for the Next Century," the symposium includes opportunities summarizing the current state-of-the-art in water resources education and practice. All levels of water resources education will be included from K-12 to higher education to life-long learning. Registration deadlines are early bird May 23: AWRA or UCOWR members $265, non-members $310; pre-registration: members $285, non-members $330; after June 16, register at the conference: members $305, non-members $350. Student rates available. Contact: Ken Reid, AWRA, 703-904-1225.

ARIZONA WATER RESOURCE

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