ARIZONA
WATER RESOURCE

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Colorado River Compact Exhibit Speaks to Today's Concern

Depending upon the perspective, whether hydrological or legal, the mountains of Colorado and Wyoming or the Colorado River Compact might be considered the source of Colorado River water. Its physical flow originates in the mountains; the 1922 compact, however, is the legal source officials consult to determine basin's and states' allocation to Colorado River water.

Delph E. Carpenter (c. 1917).

At right is the actual signed document, the 10-page compact bedecked in a red silk ribbon. A monument of western water law and the wellspring of the Law of the River, the Colorado River Compact has the status of holy writ in Colorado River management.

The compact along with many other related documents, papers and items are included in a Delph E. Carpenter collection that recently

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No. 6227

United States of America

DEPARTMENT OF STATE

...n whom these presents shall come, Greeting:

...tify That the document annexed is a true copy of the ... River Compact," signed 24th November, 1922, at the ...nta Fe, New Mexico, the original of which is on file ...partment.

In testimony whereof I, Charles E. Hughes, Secretary of State, have hereunto caused the Seal of the Department of State to be affixed and my name subscribed by the Chief Clerk of the said Department, at the City of Washington, this twenty-second day of December, 1922.

Charles E. Hughes
Secretary of State.
By David Davis
Chief Clerk.

Carpenter's copy of the official Colorado River Compact (1922). Both photos from the Delph Carpenter Papers, Water Resource Archive, CSU.

Long Delayed, Nogales Wastewater Treatment Plant Now On Track

Tough issues first had to be worked out

by Joe Gelt

On Dec. 14, the North American Development Bank and the City of Nogales, Arizona, signed a $59.5 million grant agreement for the city to upgrade the Nogales International Wastewater Treatment Plant, located on the U.S. side of the border.

The signing prompted NADB Managing Director Jorge C. Garcés to state, "We are pleased to have finalized this important step, which will allow these improvements to the Nogales Plant to begin next year."

The step Garcés mentions as being finalized was merely the latest step; many other steps were taken over about a ten-year period to reach this point. It has in fact been a long rocky road, involving government agencies at the local, state, federal and international levels, a foreign country and a mix of legal, political and environmental issues. Border issues are notoriously complex.

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Planning Efforts Begin

That the NIWTP treats wastewater from both sides of the U.S-Mexico border — and in fact has the distinction of being the only such plant — complicates efforts to administer the facility. One such effort occurred in the mid-1990s when the U.S. Environmental Protection Agency sponsored a binational wastewater management planning effort. A committee examined various options including whether to treat Mexican sewage in Mexico, in the existing facility or to operate plants in both countries.

Plans for major renovations to the NIWTP took shape. In 1995 a U.S.-Mexico agreement was worked out, with the project concept certified by the Border Environment Cooperation Commission. Also the U.S. Environmental Protection Agency authorized a $60 million grant to cover a portion of the costs. What now needed to be done was to forge an agreement among all interests. This can be a potentially formidable task when an international project is at issue; the task lived up to its troublesome expectations.

The city of Nogales, Arizona, and the International Boundary and Water Commission needed to agree on the details of the project. As co-owners and operators of the NIWTP, they have had an established working relationship, one marked by controversy and conflict over a range of topics. A mix of other government agencies also had a stake in the operations of the plant. Working together was critical to get funds released and improvements underway.

Controversial Issues Block Progress

Hugh Holub, Nogales special projects director, said an issue that proved especially troublesome was that Nogales would be the grantee or sole recipient of the funds and responsible for the completion of the project since the IBWC is not eligible to receive funding. Holub says the city was thus placed in an uncomfortable position, a minority owner of the plant — Nogales uses about 23 percent of plant capacity — but responsible for the completion of the project if it runs over the allotted $59.5 million.

Further, that Nogales was the only eligible grantee restricted the city's options. Holub says, "Our original solution was that we wanted our own plant and they would build their plant, but that got rejected. With the ruling that IBWC was not eligible to receive funding there would have been no money to deal with the international (wastewater) problem." Also a shared facility has cost-benefit advantages.

Operational money also is an issue. EPA pays the capital costs for the facility's upgrade; the IBWC, Mexico and Nogales are expected to pay the O&M costs. These costs are expected to increase with the renovated plant, from about the current $1.5 million to $2.5 million. Holub says that Nogales was justified to expect that IBWC and Mexico would pay a large share of the O&M costs since treating Mexican wastewater uses about 77 percent of plant capacity. Mexico, however, refused to pay the increased costs, much of which would be used to meet U.S. water quality standards. Such standards do not apply in Mexico. Whatever funding IBWC might receive for O&M costs would come from Congress, with all the uncertainties that entails.

Talks were stalled over the lack of assurances that adequate funds to cover O&M costs would be forthcoming, with neither EPA, Nogales nor Mexico able to cover all the costs. With no immediate solution at hand, the parties agreed to work together with the resources that had been committed.

Plant treatment capacity also was an issue. Mexico is limited by treaty to delivering 9.9 million gallons per day of wastewater to the plant, an amount it often exceeds. Mexico could be allocated an amount beyond 9.9 mgpd if it agrees to pay for increased treatment capacity. Mexico has chosen not to pursue this option, preferring instead to build its own treatment facility. Mexico's view is that paying to expand the capacity of NIWTP enables the United States to take more of its treated water, whereas if it built its own treatment plant it could keep its water. Mexico has begun work to design pumping stations and a treatment facility; it is not yet clear when this planned infrastructure will be operational.

This makes Nogales, Arizona nervous. Officials fear that a Mexican wastewater flow in excess of the 9.9 mgpd could result in Nogales, Arizona losing some of its capacity at the plant. The issue gains special importance since Nogales' capacity in the renovated plant has been cut back to 4.1 mgpd from its current 7.3 mgpd. The city, however, believes this a manageable capacity if it is able to solve the inflow and infiltration problems on the International Outfall Interceptor; herein lies another troublesome issue.

The IOI is a pipeline that transports wastewater originating in both communities to the NIWTP. The IOI is in serious need of repair; breaks in the line leak wastewater into the environment and allow extraneous water to enter the system as infiltration and inflow. Nogales has some federal funds to repair the IOI; additional funds, however, may be needed to get the work done.

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U.S. EPA Assists Nogales, Sonora

Along with granting funds to Nogales, Arizona to upgrade the Nogales International Wastewater Treatment Plant, the U.S. Environmental Protection Agency, through the Border Environment Infrastructure Fund, is providing funds to Nogales, Sonora. The North American Development Bank recently awarded over $5.5 million in BEIF grants to Nogales, Sonora to improve its wastewater collection system and over $7 million for the rehabilitation of the municipality's potable water distribution system.

The funds will enable the municipality to begin sewage monitoring and build a sewage water quality monitoring lab. Funds also will be used to improve sewage lines, replacing lines with insufficient capacity and connecting houses that are not now on a sewage line. Another problem to be addressed with the funding is water loss in the delivery system, an amount ranging from 40 to 50 percent.

With EPA assistance Nogales officials are also considering building a municipal wastewater treatment plant. Treaty now permits Mexico to deliver 9.9 million gallons per day of wastewater to the NIWTP at what is essentially a bargain rate. Mexico, however, must pay full cost to treat amounts at the plant over the 9.9 mgpd. Mexico would be saving money, as well as being able to keep its treated water for agricultural purposes, if it operated a treatment plant.

Water Vapors

UA Water Quality Center Funds Arizona Project WET Workshop

Halophytes, aquatic toxicology, aquaculture, and water quality and water security were some of the topics included in a workshop for Tucson teachers sponsored by the University of Arizona's Water Quality Center. WQC Director Ian Pepper provided funds for 25 teachers from nine Tucson high schools to participate in the Dec. 8 workshop titled, "Integrating Water Research with Classroom Instruction." Along with Pepper, Ed Glenn, Dave Walker and Kevin Fitzsimmons discussed their research projects with the teachers.

The workshop resulted from a partnership of the UA Environmental Research Laboratory, the UA Water Resources Research Center's Arizona Project WET Program and Tucson Unified School District. The workshop included discussions and brainstorming activities to identify strategies to engage high school students in relevant water quality studies.

Dr. Kevin Fitzsimmons of the UA Environmental Research Lab discusses aquaculture with teachers attending a workshop titled, 'Integrating Water Research with Classroom Instruction."

This semester Arizona Project WET CATTS (Collaboration to Advance Teaching Technology and Science) students are working to involve high school students in water related research in and outside the classroom. In some schools students will be setting up aquaculture/hydroponic systems and rainwater harvesting systems. Students will have access to water quality testing kits available through Arizona Project WET Program for in-class work thanks to Pepper and National Science Foundation funding. The students will be working with high school students for the rest of the school year.

ARIZONA WET
Water Education for Teachers

WRRC Spring Conference Coming Up

Work continues on the Water Resources Research Center's Annual Statewide Water Conference, scheduled June 20 and 21. Titled "Providing Water to Arizona's Growing Population: How Will We Meet the Obligation?," the conference is attracting the attention of a wide range of interests including water experts, planners and policy makers, along with leaders in the housing and development industry. Day one will feature a mix of keynote speakers, panel discussions and commentary. Day two, sponsored by the Global Institute Of Sustainability, Arizona State University, is tentatively titled, "A Workshop on Central Arizona's Future Water Supplies: Issues Related to Acquisition and Use of Potential Supplies and Implications for the Rest of the State."

Additional information is available on the WRRC web site: http://cals.arizona.edu/AZWATER/ Registration can be completed on-line or over the phone with a credit card. Call Cas Sprout, 520-792-9591, X 55 or email csprout@cals.arizona.edu for more information about the event.

Winds Blow on Water Expo

Exhibitors at Water Expo 2006 make valiant efforts to hold up their displays against the force of the wind. Water Expo, a Jan 23 event cosponsored by the University of Arizona's Water Sustainabilty Program, was to acquaint Arizona legislators with water projects occurring throughout the state. Conducted on the lawn of the Capitol Building, Water Expo included 46 exhibitors from 9 municipalities, the 3 state universities, multiple state and federal agencies, private water companies and numerous other organizations. The wind-stressed exhibitors are respectively Global Water, Arizona American Water and the City of Glendale's Environmental Resources Department. (Photos: Joe Gelt)

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News Briefs

Kathy Jacobs to Head Water Institute

In its progress from concept to reality, the Arizona Water Institute recently took a major step forward with the appointment of Kathy Jacobs as the institute's executive director. As AWI executive director, Jacobs will be heading a tri-university venture, a collaboration of the University of Arizona, Arizona State University and Northern Arizona University, established to more fully utilize the water expertise of faculty at the state universities.

Jacobs has filled various roles at the UA. Along with her position as water management specialist with the Water Resources Research Center, Jacobs also was professor of soils, water and environmental science and deputy director of the National Science Foundation Center for Sustainability of semi-Arid Region Hydrology and Riparian Areas (SAHRA).

From a UA role that required her to work with multiple water centers and departments, Jacobs is now taking on a new position of coordinating the water research activities of several universities.

Jacobs had worked 22 years at the Arizona Department of Water Resources, beginning as an intern in 1981 and later serving for 14 years as the Tucson Active Management Area director. She was involved in the writing of all three Active Management Area plans, had a lead role in developing the state's Assured Water Supply Rules and worked with the Tucson community to initiate regional recharge planning. In her last year at ADWR she served as project director of the state's Drought Task Force and worked on rural water issues.

See Jacob's Guest View, page 6, for description of the Arizona Water Institute.

Where Have All The Flowers Gone?

The effects of drought vary, from low-level reservoirs to the lack of wildflowers. Whereas low Reservoirs are an expected site — it is business as usual for a drought — the lack of wildflowers brings home that drought can affect our quality of life in significant ways.

Unlike last year, this is not a good year for desert wildflowers. Information posted about Arizona on a web site that tracks flowers for five western states says, "No rain, area is having a record dry spell, outlook for wildflowers is poor at this time." (See www.desertusa.com) For those who remain undaunted and ever hopeful, the Desert Botanical Garden in Phoenix will be posting any reported sightings of wildflowers on its web site www.dbg.org

Photo: Val Little

An "Arizona Daily Star" story advises readers to seek out "tame flowers" since the wild kind is not available. The story lists parks, botanical gardens or museums that have cultivated displays. It also suggests checking residential neighborhoods and resorts.

In an effort to convey some of the pleasures of the wildflower season, the AWR newsletter is reprinting the front-page photo of its March-April, 2005 edition. The photo accompanied a story describing the bountiful wildflower season of last year.

EPA OKs CWA authority for Navajo Nation

The U.S. Environmental Protection Agency recently approved the Navajo Environmental Protection Agency's application to administer Clean Water Act programs. With authority to administer the Water Quality Standards and Certification Programs under Sections 303 and 401 of the CWA, the Navajo Nation can now adopt, review and revise water quality standards for all surface waters within the Navajo Nation.

The tribe will work with the EPA on a government-to-government basis to develop and adopt water quality standards. Once approved, the standards will form the basis for water quality-based effluent limitations and other requirements for discharges to waters within the tribe's jurisdiction.

The tribe is also authorized to grant or deny certification for federally permitted or licensed activities that may affect waters that

Carpenter...continued from page 1

opened, after a year of restoration work, at the Morgan Library at Colorado State University. Much of the collection was donated by Carpenter's two grandsons, Ward and William.

Much of the credit for working out the compact is attributed to Carpenter and his extraordinary ability to navigate the currents and crosscurrents of seven states' water claims, to land an agreement all the states could live with. He wrote, negotiated and promoted the agreement at a time when interstate compacts to resolve water disputes was an untried, untested strategy.

Historic parallels between Carpenter's times and today have been suggested. Critical Colorado River negotiations once again are underway, with basin states maneuvering to ensure sufficient supplies to confront potential and real shortages due to the lingering drought and expected growth and development. Just as Carpenter had to work through a tangle of state interests to reach an agreement, officials today are laboring to forge a drought plan acceptable to all basin states.

In another way also Carpenter might serve as a model, perhaps even an inspiration, for today's officials. He advocated an interstate compact, fearing if the states did not get their house in order the federal government would take charge. Also, he wanted to head off litigation that would be time-and-resource consuming and believed an interstate compact would accomplish this end. Most officials today would gladly shake hands in agreement with Carpenter over these issues.

Arizona Faces New EPA Drinking Water Rules

Effects are not expected to be major

EPA recently finalized two drinking water protection rules, one reducing the risk of disease-causing microorganisms from entering water supplies and the other requiring water providers to limit the amount of potentially harmful disinfection byproducts.

A significant rule-making event, the regulations are the last phase of a rulemaking strategy required by the 1996 Amendments to the Safe Drinking Water Act. Of likely major consequences to some water providers — Los Angeles expects the rules to cost the city billions of dollars to change the way it stores and distributes water — the rules are not expected have a major impact in Arizona.

Increased Monitoring, Treatment for Crypto

Long Term 2 Enhanced Surface Water Treatment Rule increases monitoring and treatment requirements for water systems prone to cryptosporidium outbreaks, a waterborne pathogen. Public water systems relying on surface water sources must now monitor for cryptosporidium. Systems measuring higher levels of cryptosporidium or not filtering their water must provide additional protection. Available options are included within a "microbial toolbox" of treatment and management processes and include ultraviolet disinfection and watershed control programs.

The rule also addresses risks of contamination when systems store treated drinking water in open reservoirs, with water exposed to outdoor elements. It requires that open reservoirs either be covered or their waters receive additional treatment. (Portland, Oregon is considering challenging the EPA rule which would require that the city cover its in-town drinking water reservoirs and build a treatment plant, at a cost of about $200 million.)

In response to the EPA rule, the Arizona Department of Environmental Quality is completing a final draft of its notification to systems within the state likely to be impacted by the rule. These would be systems that measure higher levels of cryptosporidium and as a result would now need to provide additional protection.

The rule will apply to only 55 water systems in Arizona with surface water sources. An ADEQ official says the larger systems are likely ahead of the regulation, with appropriate treatment and management processes already in place. These would include Phoenix, Scottsdale, Glendale and Mesa.

Arizona is likely to have less of a problem with cryptosporidium than other parts of the country that are more densely populated, with back-to-back townships. This results in more waste discharged into rivers with more chance of it affecting a downriver city or town. In Arizona, most of the surface water flows through the Central Arizona Project canals and/or the Arizona canals. These canals were designed to prevent outside surface water flows from entering them. Although done mainly to prevent siltation and blockage, the design serves also to prevent the spread of cryptosporidium.

It is the smaller and midsized systems in Arizona that will likely have to take action in response to the new rule. Among the smaller systems would be communities along the Colorado River as well as some federal and state parks that rely on surface water. Included among the midsized systems are Flagstaff and Yuma.

Disinfection Byproducts More Stringently Regulated

The second rule, the Stage 2 Disinfection Byproducts Rule, was developed to balance the benefits and risks posed by drinking water disinfection. Harmful byproducts can form when disinfectants, such as chlorine, combine with naturally occurring organic matter found in water.

The rule sets more stringent methods for determining compliance by requiring water systems to find monitoring sites where higher levels of disinfection byproducts are likely to occur. These sites are then to be used as new locations for compliance monitoring. If disinfection byproducts exceed drinking water standards at any of these new monitoring locations, water systems must begin to take corrective action.

This rule will apply to many Arizona systems because most of the state's 1600 regulated water systems use a disinfectant to treat their water. Yet not many state water systems are likely to be out of compliance with the new rule since it focuses on trihalomethanes and five haloacetic acids. These are disinfection byproducts formed when a high level of carbon is present in the water that then combines with chlorine and other disinfectants. With naturally occurring organic matter mainly found in surface water sources and not in groundwater, only systems with surface water supplies will be affected; this would be 55 out of the 1600 state regulated systems.

Nationally about 70 percent of water systems are expected to have to change their treatment methods in response to the new rules. Their options are either to use less chlorine or adopt methods that don't rely on chlorine.

lie within the exterior borders of the Navajo Nation.

The Clean Water Act requires that a tribe can be granted this authority only if it is federally recognized, has a governing body to carry out substantial governmental duties and powers, has jurisdiction to administer the programs within the boundaries of its reservation, and is reasonably capable of administering the program.

In February 2001, the Navajo Nation became the first Indian Nation to administer the Safe Drinking Water Act's Public Water Systems Supervision Program after EPA approved its application.

Tribes take on the same responsibility to ensure public health as states when they administer drinking water programs. In applying for primacy the NNEPA had to develop and demonstrate its capability to administer the program, along with adopting appropriate regulations to ensure safe drinking water in public water systems.

Guest View

Arizona Water Institute Forms University Water Research Team

This Guest View was contributed by Kathy Jacobs, executive director of the Arizona Water Institute.

The Arizona Water Institute is a collaboration of the state's three universities focused on supporting community efforts to resolve water problems, promoting economic development through technology transfer, and expanding educational opportunities. Partners in this effort include state agencies, water stakeholders, the governor's office and private sector interests. The AWI began functioning formally in January with my appointment as the executive director. The opportunities that are expected to result from this activity are important from both a strategic and an economic perspective. This entity is expected to be largely self-supporting, and result in significant influx of federal funding, grants and contracts, and private and foundation support. The business plan, just completed by Battelle, shows that the AWI is expected to generate $7.5 million in new annual revenues within 5 years.

The key foci for the AWI are: 1) research, community assistance and analytical support; 2) education, training and professional capacity building; and 3) technology and economic development. The only current support for this multi-pronged initiative is $150,000 from the Arizona Board of Regents' Technology and Research Initiative Fund to support the executive director and related expenses for the first year. It is hoped that a legislative appropriation to the three universities will provide base funding for a small staff (expected to be up to 4 full-time) that will be located in the state agencies and within the universities.

The AWI is structured with an executive committee, made up of the vice-presidents for research (or their designees) at the three universities and the governor's office providing oversight for the executive director. I will work with coordinators on each campus to match faculty within the three institutions to appropriate AWI projects and funding sources, and ensure the timely completion of projects. Existing funding for the coordinators for each campus comes from internal campus funds. New associate directors will be located in the Department of Water Resources, Department of Environmental Quality, and Department of Commerce to ensure that the agencies are given timely and appropriate support by the AWI and to participate in AWI projects. There will be an external advisory committee of water interests, government agency and private sector participants.

A recently completed needs assessment for AWI shows strong interest in collaborating with AWI from a range of individuals, representing local, county, state and federal governments, Indian tribes, watershed alliances, farmers, water companies and private industries. A long list of project needs is being compiled. In addition, within the first few weeks of its initial formation, AWI had offers of collaboration from the National Science Foundation, Central Arizona Project, Salt River Project, Intel, the Nature Conservancy, and several international consulting firms and private businesses, among others.

Four initial projects are underway. Each project is collaborative, involving two or more universities, as well as governmental agencies and public and private sector participants:

1) Arizona Hydrologic Information System: This project will develop the information infrastructure of the AWI and provide access to data relevant to water-related research, technology, planning, education, and outreach from multiple sources within the Southwest. Specific aims of this project are to: a) develop web based "metadata" catalog of known available water resources information; b) design the information backbone for data sharing for the three universities; and c) initiate a collaborative design process for long-term public access, web-based water information system and a phased implementation plan. A catalog of the over 400 university staff and researchers engaged in water activities is accessible at www.arizonawater.org.

2) AWI Water Quality Priority Projects: Two water quality research themes are under way: arsenic and other inorganic contaminants in drinking water and source waters, and emerging contaminants in wastewater. The arsenic project involves research to provide more effective, less expensive means for public water systems to address problematic regulated inorganic contaminants in raw water supplies, with emphasis on compliance with the new, more protective EPA drinking water Maximum Contaminant Level for arsenic. The emerging contaminants project will study contaminants in municipal wastewater and real-time monitoring techniques.

3) Water Conservation Technology Exchange: Intel held a very successful initial forum on Dec. 9 to enhance water conservation technology exchanges between industrial water users, water providers, policy makers, research and educational institutions, and other community groups at the Ocotillo manufacturing campus in Chandler. Additional forums will be held to facilitate technology transfer and to identify research needs in the industrial sector.

4) Meeting Water Management and Planning Needs Within Watersheds: This prototype project is intended to bring the water talent of Arizona's three universities together to address rural and community watershed issues. The initial phase includes collaborative groundwater and surface water modeling and spring monitoring in the Prescott area, involving U.S. Geological Survey, Northern Arizona University and University of Arizona hydrologists. The scope is expected to expand to include long-term water supply planning, drought planning, and vulnerability assessments using new communication and collaboration tools, including participatory GIS and innovative visioning tools.

Next steps for AWI include establishing the external advisory committee, setting up the web site at www.azwaterinstitute.org, working toward long-term financial support, adopting the business plan, and hiring an administrative assistant. For more information, please contact me at kjacobs@ag.arizona.edu

USGS
science for a changing world

Hydrologic Conditions in Arizona During 1999–2004: A Historical Perspective

Introduction

Arizona's climate is prone to extreme changes that range from persistent droughts to frequent local and regional flooding. These changes are evident in hydrologic data collected. Streamflow records indicate that a drought in Arizona during 1999–2004 was the worst drought since the early 1940s and possibly earlier. Droughts result from a decrease in the number of already infrequent storms that bring moisture to Arizona. The drought conditions in the Southwestern United States over the last several years, and especially in Arizona, have resulted in several large summer fires, a decrease in potable water for some smaller communities, and depleted water available for surface water as well as ground-water recharge. An unusually wet December 2004 and January 2005 in Arizona has interrupted the multiyear drought. Dry conditions, however, still prevail in parts of Arizona. It is difficult to conclude, therefore, whether the drought is over or if it will persist.

Figure 1. Locations of 10 long-term streamflow-gaging stations, 10 medium- to long-term gaging stations, and 5 long-term precipitation stations.

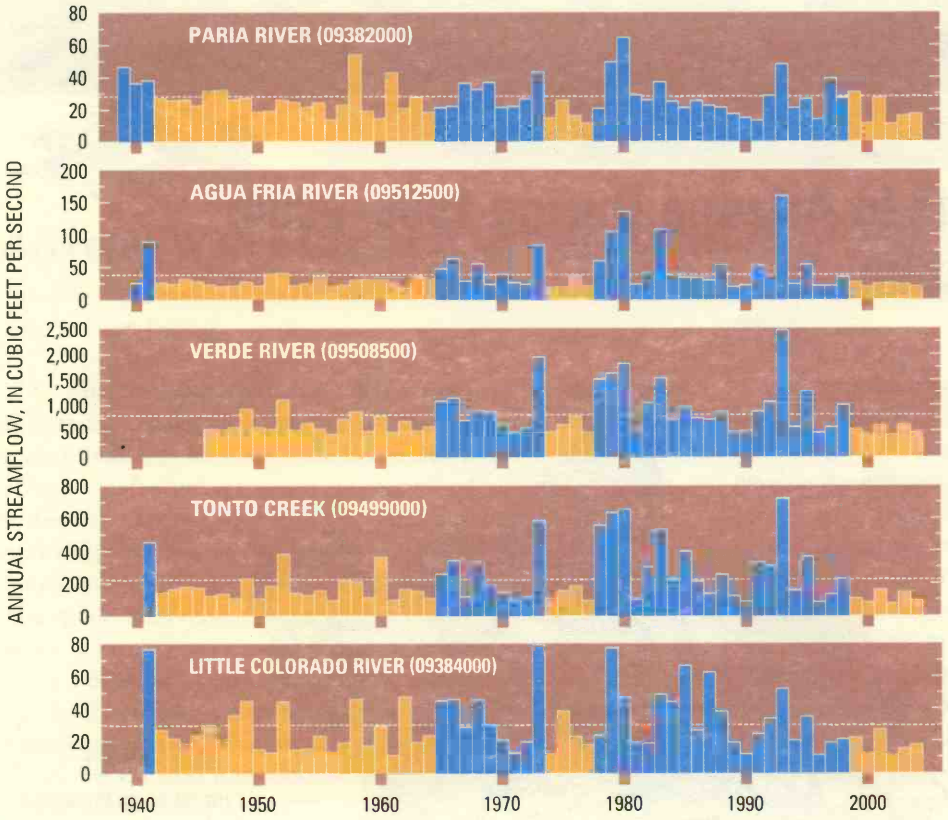
Historical and Current Hydrologic Conditions

Although the spatial and temporal extent of droughts is somewhat difficult to determine, three severe droughts during the 20th century were recognized in a 1989 U.S. Geological Survey National Water Summary (Paulson and others, 1991). The periods of significant statewide droughts, as indicated by records from several streamflow-gaging stations, were recognized as 1932–36, 1942–64, and 1974–77 (figs. 1 and 2; table 1).

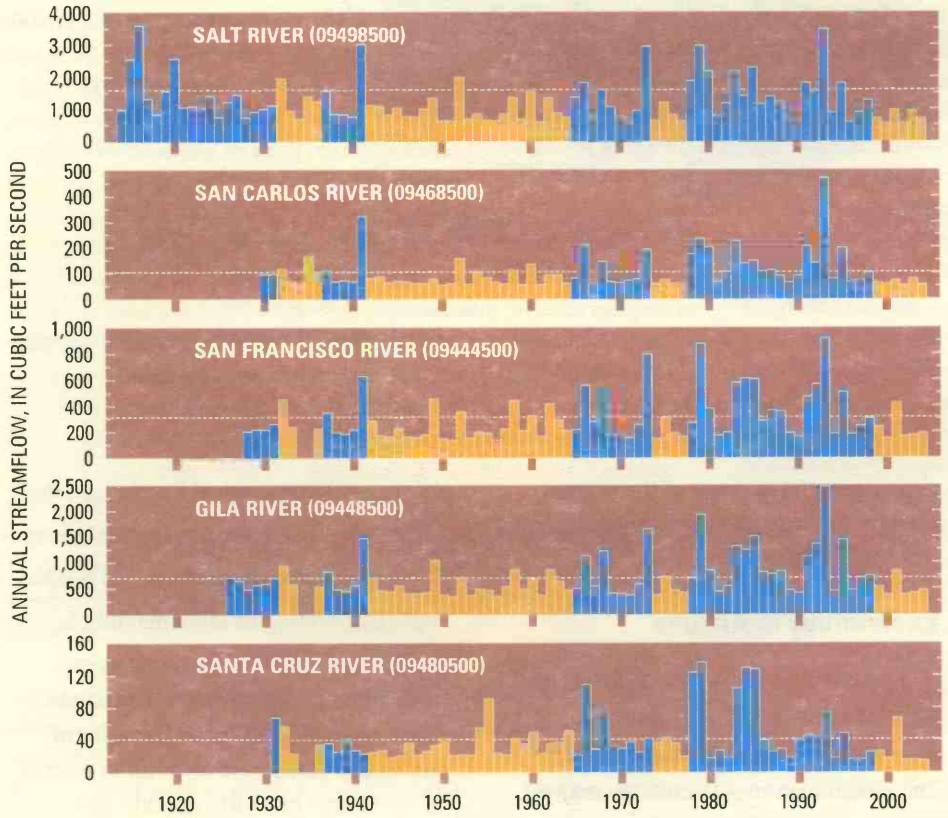
This document utilizes long-term data from streamflow-gaging stations to compare the severity of the current drought to those indicated by Paulson and others (1991; fig. 2).

Climatology in Arizona

Precipitation in Arizona is biseasonal, having both winter and summer regimes (Hereford and others, 2002). The moisture comes from three major sources: (1) Pacific winter frontal storms that can produce significant snowpack in northern Arizona as well as flooding in the central and southern parts of Arizona, (2) subtropical Pacific moisture (dissipating hurricanes or tropical storms) that is generally warmer and can produce regional flooding of large magnitude, and (3) convective storms that occur throughout the State during the summer months. The location and intensity of convective storms are difficult to predict as the storms can form quickly and produce large amounts of precipitation in localized areas. They also generally result in flooding in smaller basins and urban areas, but are not significant for



STREAMFLOW-GAGING STATIONS IN NORTHERN AND CENTRAL ARIZONA, 1939–2004—Drought periods shown in gold; horizontal line indicates long-term average. Record for the Paria River begins in 1923; data for 1923–38 not shown.



STREAMFLOW-GAGING STATIONS IN CENTRAL AND SOUTHERN ARIZONA, 1914–2004—Drought periods shown in gold; horizontal line indicates long-term average. Record for the Salt River begins in 1913; data for 1913 not shown. Gaps in plots after 1914 indicate data are not available.

Figure 2. Annual mean streamflow at 10 long-term streamflow-gaging stations in Arizona.

production of higher flows in main-stem river systems (Paulson and others, 1991).

Additional Information on Hydrologic Conditions in Arizona, 1999–2004

Precipitation data acquired by the National Weather Service can serve as an indicator of drought and flood conditions. Data acquired at five long-term precipitation stations in different parts of Arizona indicate that precipitation during the last 6 years was below the long-term average (fig. 3).

Streamflow in water years (WY) 1999–2004 was compared to historical streamflow data for 20 streamflow-gaging stations in Arizona for this report (table 2 and fig. 1). Included in the 20 stations are 10 long-term stations, as well as an additional 10 medium- to long-term stations (fig. 1). These 20 stations are considered index stations because they have medium to long periods of record and are little affected by flow diversions. The data for the period 1999–2004 for these 20 stations, when compared to historical data, indicate WY 2000 and WY 2002 were two of the driest years during the period of record. Annual discharge for almost all sites for individual years from 1999 to 2004 was well below long-term average conditions, indicating statewide drought conditions since the beginning of WY 1999 (October 1998). Annual discharge exceeded the long-term average only 6 times at the 20 sites from WY 1999 through WY 2004 (table 2). Annual discharge for the 20 sites over this same period of time was less than 10 percent of the average annual discharge 17 times and less than 50 percent 83 times. The drought of 1999–2004 is considered the most severe drought in Arizona since the early 1940s and possibly earlier (table 1). The average streamflow during three drought periods—1942–64, 1974–77, and 1999–2004—was compared to average streamflow for the 10 long-term index stations. Streamflow at the stations was 45 percent of the long-term flow during 1999–2004, 53 percent during 1974–77, and 68 percent during 1942–64 (fig. 2). Data for 1932–36 were insufficient for comparisons with data for 1999–2004.

Table 1. Chronology of major and other memorable floods and droughts in Arizona, 1862–2005

[Modified from Paulson and others, 1991]

Flood or drought	Date	Area affected	Remarks
Flood	Jan. 19–23, 1862	Gila and Colorado Rivers	Severe at Yuma. Wet year in Verde and Bright Angel Basins, but not in upper Salt River Basin
Flood	Feb. 18–26, 1891	Central Highlands	Phoenix and Yuma flooded. In Clifton, 18 deaths, $1 million in damage
Flood	Nov. 27–30, 1905	San Francisco to Verde Rivers	Several severe to moderate floods, particularly at Phoenix and along the lower Gila River
Flood	Jan. 19–22, 1916	Central Highlands	Intense rain on melting snow produced large flows in central Arizona; 4 deaths, $300,000 in damage
Flood	Aug. 21, 1921	Phoenix (Cave Creek)	Six inches of rain in 2 days flooded 4,000 acres and the State capital building; $240,000 in damage
Flood	Sept. 27–29, 1926	San Pedro River and Mexico	Tropical storm. Peak flow 2–3 times any other in 70 years; $450,000 in damage
Drought	1932–36	Statewide	Effects differed among basins
Flood	Mar. 14–15, 1941	Central Arizona	One of several storms that caused general runoff and filled reservoirs
Drought	1942–64	Statewide	Severe long-term drought interrupted by several wet periods
Flood	Sept. 26–28, 1962	Brawley and Santa Rosa Washes	1 death; $3 million in damage, mostly to agriculture near Casa Grande
Flood	Dec. 22 1965 to Jan. 2, 1966	Verde, Salt, and Gila Rivers and Rillito Creek	First large flow through Phoenix since reservoirs were built on Verde River (1939); $10 million in damage
Flood	Dec. 5–7, 1966	Grand Canyon to southwestern Utah	Mudflows and channel erosion damaged Indian ruins that had been undisturbed for 800 years
Flood	Sept. 5–7, 1970	Tonto Creek to Hassayampa River	Labor Day weekend floods in recreation areas. Reservoirs stored most runoff; 23 deaths, $8 million in damage
Flood	Oct. 17–21, 1972	Upper Gila River	Tropical storm; 8 deaths, $10 million in damage
Drought	1974–77	Statewide	Most severe in eastern Arizona
Flood	July 17, 1974	Safford (Holyoke Wash)	Thunderstorm produced flow of 1,740 cubic feet per second from 0.85-square-mile drainage basin
Flood	Oct. 1977 to Feb. 1980	Central and southeastern Arizona	Seven regional floods. Phoenix declared a disaster area three times; 18 deaths, $310 million in damage
Flood	July 26, 1981	Tucson (Tanque Verde Falls)	Flash flood at recreation area on Sunday; 8 deaths. Two larger peak discharges in the same week were not noticed
Flood	June 20 to Aug. 7,1983	Colorado River	Upper basin rain and snowmelt. First reservoir spill since Hoover Dam was built (1935); $80 million in damage
Flood	Oct. 1–3, 1983	Santa Cruz to San Francisco Rivers	Record floods on 18 streams; two peak discharges doubled 65-year-old records; 8 deaths, $226 million in damage
Flood	Winter 1993	Statewide	Resulted from extremely intense El Niño; breach of Gillespie Dam on Gila River
Drought	1999–present (2005)	Statewide	Extensive and abundant fires (Rodeo-Chedeski fire, for example) and decreased water supplies statewide

Although streamflows generally were low in Arizona during 1999–2004, floods during the winter of 2005 were substantial—to the point of filling reservoirs in central Arizona. The climate of Arizona, however, naturally tends to extremes—large floods and severe drought conditions are common. Determining whether this was an interruption to a longer drought, or the beginning of wetter years in Arizona, therefore, is difficult. Data acquired at 20 medium- to long-term streamflow-gaging stations, however, indicate the period 1999–2004 was the driest since the early 1940s and possibly earlier.

—Jeff V. Phillips and Blakemore E. Thomas

(Figure 3 and table 2 on next page)

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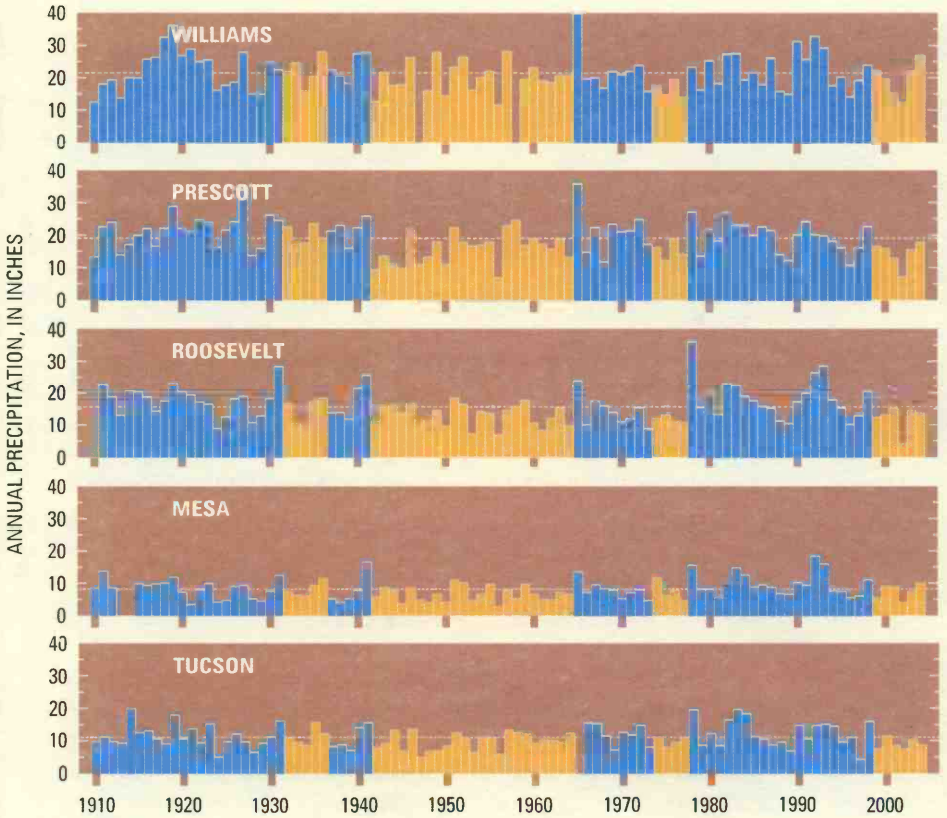

Figure 3. Annual precipitation at five long-term stations in Arizona. Drought periods shown in gold; horizontal line represents long-term average. Gaps in plots after 1910 indicate data are not available.

Current streamflow conditions in Arizona can be obtained from **http://waterdata.usgs.gov/az/nwis/rt**

Historical streamflow conditions can be obtained from **http://waterdata.usgs.gov/az/nwis/sw**

For more information contact:

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az.water.usgs.gov

Table 2. Percentage of average annual discharge for 20 selected streamflow-gaging stations during water years 1999–2004

Site	Number	Site Name	Period of Record	Percentage of average annual mean discharge for indicated water year					
				1999	2000	2001	2002	2003	2004
1	09382000	Paria River at Lees Ferry	1924–2004	109	41	96	39	57	62
2	09512500	Agua Fria River near Mayer	1940–2004	49	17	38	40	34	17
3	09508500	Verde River below Tangle Creek	1946–2004	51	36	65	32	68	40
4	09499000	Tonto Creek above Gun Creek, near Roosevelt	1941–2004	24	8.0	58	3.1	52	17
5	09384000	Little Colorado River above Lyman Lake	1941–2004	65	17	88	15	33	44
6	09498500	Salt River near Roosevelt	1914–2004	40	22	70	23	70	41
7	09468500	San Carlos River near Peridot	1930–2004	29	18	45	11	56	17
8	09444500	San Francisco River at Clifton	1928–2004	67	26	150	33	37	44
9	09448500	Gila River at head of Safford Valley	1921–2004	62	29	130	31	38	49
10	09480500	Santa Cruz River near Nogales	1931–2004	45	12	205	4.0	5.0	1.6
11	09490500	Black River near Fort Apache	1958–2004	31	13	73	15	66	40
12	09496500	Carrizo Creek near Show Low	1952–2004	18	11	28	35	55	26
13	09424450	Big Sandy River near Wikieup	1967–2004	5.0	3.8	61	4.1	13	44
14	09397500	Chevelon Creek below Wildcat Canyon	1948–2004	17	6.7	80	0	48	24
15	09504500	Oak Creek near Cornville	1941–2004	55	41	63	34	83	55
16	09510200	Sycamore Creek near Fort McDowell	1961–2004	5.0	.61	52	.23	36	2.7
17	09505350	Dry Beaver Creek near Rimrock	1961–2004	25	5.0	48	.8	77	20
18	09485000	Rincon Creek near Tucson	1953–2004	25	17	190	4.4	14	45
19	09497980	Cherry Creek near Globe	1966–2004	35	16	53	12	35	16
20	09379200	Chinle Creek near Mexican Water	1965–2004	110	19	49	74	34	43

Legislation and Law

High Court Upholds Districts' Water Rights Transfer

The Arizona Supreme Court ruled against landowners who argued that irrigation districts lacked the authority to relinquish rights to Central Arizona Project water when negotiating water rights with the federal government.

In effect, the landowners alleged that they, and not their irrigation districts control CAP water used on their land; the consent of each landowner in the district would therefore be required to modify any agreement specifying the terms of CAP water delivery to the districts.

Colorado Irrigation District to Lease Water for Non-Agricultural Use

Shareholders in the Pine River Irrigation District in Colorado want to lease unused water for non-agricultural uses, with ranchers and farmers in the district looking to lease as much as 2,000 acre feet per year to the proposed La Plata Archuleta Water District located in rural southeast La Plata County.

Members of Voluntary Shareholder Pool Inc. recently signed an agreement enabling them to lease unused water through the irrigation district. In October 2003, PRID shareholders had rejected such leases.

A judge in a water-court hearing later said that individual shareholders are allowed to pool water to lease, although water-court approval may be required.

The exact number of PRID shareholders joining the group has not been announced, although pledges from voluntary donors exceed the 2,000 acre feet that the drinking-water district seeks.

The case had special significance because the water at issue was to be used as part of the Gila River Settlement Act; a decision favoring the landowners could have required significant reworking of certain aspects of that act.

Resolving the issue required determining whether individual landowners are third-party beneficiaries of the subcontracts that their irrigation districts worked out for receiving CAP water or whether according to water law individual landowners have acquired vested rights appurtenant to the land to receive subcontracted water.

Passage of the Arizona Water Settlement Act brought the issue to the forefront. The product of many years of negotiations, the act is fundamentally concerned with settling Indian water rights. By resolving such rights, however, the AWSA serves the interest of non-Indians; they acquire greater security about their water supplies with the threat of tribal litigation reduced.

The irrigation districts had an important role in the very complex, lengthy negotiations leading to the act. The districts agreed to various terms including relinquishing certain subcontract rights back to the United States, with the rights to be used to settle Indian water right claims. The districts conducted landowner elections to ratify the relinquishing of subcontract allocations. The majority of landowners supported the action; some who did not sued to prevent surrendering of the contract CAP rights.

Pinal Superior Court found in favor of the landowners agreeing that each owned a vested right to receive priority CAP water from their respective district through October 2043 (and longer when extensions may be exercised) and that their right to receive priority water is "appurtenant" to their lands.

The case then went to the Arizona Supreme Court which overturned the superior court's decision. In presenting their case to the court, the districts argued that the issue is deserving of extraordinary relief and without an adequate remedy by appeal. Delay in correcting the ruling in this case was said to jeopardize the entire Arizona Water Rights Settlement since extensive and specific governmental and legal approvals must be obtained in full no later than December 31, 2007.

Court: Groundwater Pumper not Liable for Neighbors' Loss

In a decision that may not surprise those well versed in Arizona groundwater law, a court recently ruled against pecan farmers who sued a nearby landowner whose groundwater pumping caused a significant drop in the water table resulting in a loss of their orchards.

Abbott Laboratories, a neighboring landowner of the pecan farmers, two Casa Grande married couples, pumped groundwater to build a storage basement under its facility. In its application to the Arizona Department of Water Resources, Abbott, which is an Illinois corporation, stated it would pump the groundwater into an on-site retention basin so that it would sink back into the aquifer. ADWR required that Abbott annually report its dewatering activity to the agency. ADWR issued the corporation an emergency de-watering permit for 2.07 acre feet.

Encountering much more water than anticipated, Abbott increased its pumping to drain the construction project, with the result that 122 acre feet of groundwater was eventually pumped. Abbott did not seek a permit to pump the additional groundwater.

The increased pumping caused the retention basin to fill to capacity; Abbott channeled the excess groundwater to flow off the property. Pumping ended about March 1998.

Meanwhile the pecan farmers' water table, which was 16 feet below the surface prior to Abbott's pumping, dropped to 32 feet, the depth of the basement on the Abbott property. Their trees died, and the farmers sued Abbott on grounds of negligence and nuisance. A district court awarded the farmers $1.2 million, a ruling

Continued on page 10

Publications & On-Line Resources

Report Evaluates U.S. Tap Water

A recent Environmental Working Group report titled "A National Assessment of Tap Water Quality" examined water quality data collected by 42 states including Arizona from 1998 to 2003. EWG obtained data from nearly 40,000 water utilities, serving 231 million people; over 22 million water samples were examined. (The survey included 795 Arizona water systems serving 4,873,881 people.)

The report found that the water samples contained 260 contaminants; 141 of these contaminants are unregulated, with no safety standards established and an additional 119 for which the Environmental Protection Agency has set health-based limits.

According to EWG the top 10 states with the most contaminants in their drinking water are California, Wisconsin, Arizona, Florida, North Carolina, Texas, New York, Nevada, Pennsylvania and Illinois.

EWG found the nation's utilities have over a 90 percent compliance with enforceable health standards, demonstrating their commitment to comply with safety standards once they are developed.

For a copy of the report and access to a database that allows searches by state, chemical and number of people exposed see http://www.ewg.org/tapwater/findings.php

An Introduction to the Central Arizona Groundwater Replenishment District

Justin Ferris, National Weather Service, National Oceanic and Atmospheric Administration; Sharon B. Megdal, Susanna Eden, Water Resources Research Center, University of Arizona.
The paper is available at the WRRC website at http://www.ag.arizona.edu/AZWATER/presentations/eseries/CAGRD.pdf

This short paper provides information about the role of the Central Arizona Groundwater Replenishment District. Its intent is to familiarize the reader with this complex organization and the important role it plays in assisting developers and water providers in complying with the Assured Water Supply Rules. The paper describes the program's purpose, activities, goals and the services it provides to its members. The paper also touches on the complicated issue of CAGRD financing: who pays and how much. Also analyzed are CAGRD's long-term plan of operation and some issues related to long-term operations.

Hydrogeologist as Hero

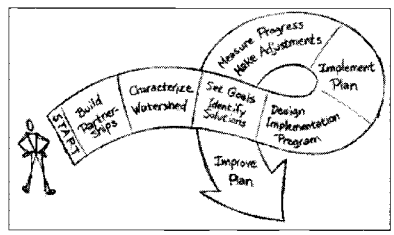
Taking popular entertainment as a measure one might likely conclude that the those laboring in the hydrology and water resources field lack glamor, sex appeal and heroic qualities. Has any such character ever figured in plots on stage, screen, television or in books, to save the day, solve the mystery, woo the heroine and ride off into the sunset, or even to add spice and interest to a story?

Those who have noted this lamentable omission will undoubtedly be pleased to learn that "Tropic of Fear," a recently published thriller, features a hydrogeologist as a worthy protagonist. Author Ron Terpening, a University of Arizona professor of Italian, says, "The University of Arizona has a strong department of hydrogeology, so I thought, well, I can use that as the occupation for Stanek." An opening chapters takes place in the UA Harshbarger Building.

According to the publisher, "Tropic of Fear" is a political thriller, a tale of high adventure, and a powerful dramatization of the lust for power."

"Tropic of Fear" can be ordered at http://www.ronterpening.com/

EPA Invites Users to Test its Watershed Management Guide



The U.S. Environmental Protection Agency's Office of Water has published a guide to watershed management as a tool in developing and implementing watershed plans. The draft "Handbook for Developing Watershed Plans to Restore and Protect Our Waters" is aimed toward communities, watershed groups, and local, state, tribal, and federal environmental agencies.

EPA is making this draft document widely available with the purpose of having it used and tested by a variety of watershed partnerships, whose advice will be considered in developing the final version. Comments should be addressed to watershedhandbook@epa.gov no later than June 30, 2006.

The draft handbook is available online at: http://www.epa.gov/owow/nps/watershed_handbook

A free copy can be obtained from the National Service Center for Environmental Publications 800-490-9198 or ncepimal@one.net. (EPA document number EPA 841-B-05-005.)

Water Availability for the Western United States-- Key Scientific Challenges

The above USGS report examines Western water availability, the modern role for science, and the value of monitoring and research to ensure an adequate water supply. Ensuring stable water supplies has grown more complex as the challenges facing water managers continue to mount, especially in the West. This report brings together findings from a wide variety of USGS studies and data in a manner that will help citizens and public officials better understand changing water situations in the West and the ways that new scientific understanding can support wise management of the resources. The report cites examples and scientific challenges from four basins in the West that have significant water availability and sustainability concerns: Middle Rio Grande Basin, NM., the Greater Los Angeles area, San Pedro Riparian National Conservation Area, AZ, and the Upper Klamath Lake, OR. The report can be obtained by calling 1-888-ASK-USGS or viewed online at http://pubs.water.usgs.gov/circ1261/

Special Projects

Study Offers Cost Benefit Analysis of Water Conservation Measures

Titled "Evaluation and Cost Benefit Analysis of Municipal Water Conservation Programs" (ECoBA), this study responds to the need for a more rigorous evaluation of conservation measures. The actual water savings of such measures are not readily available because their results are not often studied and evaluated. What quantifiable information about water savings, costs, etc. is available are usually estimates used to justify implementing the water-saving program in the first place.

The water conservation studies that are in fact done generally focus on the water-saving potential of a particular strategy. Not receiving as much attention are the costs that utilities incur when adopting such strategies. The purpose of the ECoBA study is to help water managers get the biggest water-saving bang for the buck by determining the actual water savings of various strategies and the costs a water provider incurs to save an acre foot of water by adopting a particular strategy.

The water-saving measures the report discusses are audits, device giveaways, washing machine rebates, landscape conversion, toilet rebates, toilet distribution, rate cases and other programs.

ECoBA researchers view determining the actual cost of conservation measures as an issue of growing importance. They say water providers will find that saving "the next increment of water" is going to be an increasingly elusive quest, requiring greater expenditures. The study intends to provide the accurate and detailed information needed to make informed decisions to increase the amount of water saved per staff hour and dollars expended on demand management efforts.

The project analyzed 88 separate cases — a case is defined as one year of a program — from 42 different programs offered by 30 utilities; the programs operated between 1994 and 2003. Participating utilities varied greatly in size, from 1,500,000 customers to 13,500.

Participants' water-use data covered two calendar years prior to their participation in the program (premeasure) and two calendar years after their participation (postmeasure).

Actual water savings from a particular conservation measure was computed using both pre-measure and post-measure water-use data and participant and control groups' water-use data. Mean water use was then calculated for the pre-measure and post-measure of both groups. Water savings were determined as the difference in the percent increase (or decrease) of average control group and participant water use from pre-measure to post-measure.

Costs or benefits accruing over time were projected into the future; one-time costs or benefits were not. Water savings and benefit data were extrapolated according to the estimated lifespan of the measure.

Individual chapters are devoted to discussions of each water saving measure, describing the participating utilities, the type and number of programs implemented and the research results.

FINDINGS OF NOTE

—Toilet rebate programs showed only 63 percent of the predicted water savings, while toilet distribution programs showed 228 percent of what was predicted in water savings.

— Audit programs and washing machine programs attracted significantly higher water users than typical.

— Landscape conversion programs attracted significantly lower than typical water users.

— The greatest variation in range of savings was seen with washing machine rebate programs followed by toilet distributions.

Excluding the single ordinance, class, and surcharge programs analyzed:

— Toilet distribution programs showed the greatest savings per participant (27,000 gallons annually) followed by landscape conversion programs (22,000 gallons annually).

— Toilet distribution programs showed the greatest persistence in savings from year one to year two after the program, saving 77 percent more water per participant the second year after the program compared with year one.

— Audits showed the highest costs to save an acre foot of water ($1,284) followed by landscape conversions ($1,099).

— Toilet distributions showed the lowest cost to save an acre foot of water ($181).

— Landscape conversions showed the highest per participant costs to the utility and other funders ($650) followed by toilet distributions ($330), toilet rebates ($151), washing machine programs ($144), audits ($116), and device giveaways ($4).

Ranges:

— The tightest range of savings per participant was realized with toilet rebate programs, followed by device giveaways (consistently little or no savings).

— The most variable range of savings was with washing machine rebate programs followed by toilet distributions.

Side note: there was a relationship between the size of the utilities studied and the cost to save an acre foot of water.

The report includes an interactive calculator to enable utilities to analyze and evaluate their own water conservation programs.

Val Little, director of the Water Conservation Alliance of Southern Arizona (Water CASA), and Rebecca Gallup coordinated and conducted the research. Funds were provided by Water CASA, a consortium of Southern Arizona water providers. Additional grant funding was provided by the U.S. Bureau of Reclamation Science and Technology Program, the University of Arizona Water Sustainability Program, the Arizona Department of Water Resources and the City of Tucson Water Department.

The report is available on line at: www.watercasa.org

Announcements

Water Reuse Conference in Phoenix

The Water Reuse Foundation will be conducting its 10th Annual Water Reuse Research Conference May 15-16 in Phoenix. Titled "Advancing the Science of Water Through Research," the conference provides a forum for water reuse and desalination research professionals to interact, network and discuss current and future research needs and trends. The conference is dedicated to showcasing the latest results of "cutting-edge" research on water reuse and desalination. The conference is touted as the one "you need to attend to learn what will likely become the mainstream, accepted technologies in 5-10 years." For additional information check: http://watereuse.org/Foundation/2006conf/index.html

Molecular Modeling Workshop

Cave Creek Arizona Photo: Harry Ridgway

A molecular modeling workshop, "Workshop on Molecular Modeling Fundamentals in Water Treatment Applications" will be held April 26 -28 at the Southwest Research Station in Portal, Arizona. The purpose of the 2-day technology-transfer workshop is to provide scientists and engineers with a working knowledge of molecular modeling fundamentals and how these principals may be applied to address technical and scientific issues in water treatment, wastewater reclamation and ultrapure water production. Workshop details and registration information is posted at: http://www.desertwildlands.com/workshop/modelingworkshop.htm

AZ Hydrological Society Call for Abstracts

The Phoenix Chapter of AHS is soliciting abstracts for papers and posters to be presented at the 19th Annual Symposium, "Water & Water Science in the Southwest — Past, Present, & Future," to be conducted in Glendale, Sept. 13 - 16. AHS solicits descriptions of projects and research from hydrologists, geologists, engineers, planners, water policy and legal professionals and teachers. The conference will focus on the past, present state, and future of water, water use, and water science in the semi-arid Southwest. Abstracts are due no later than April 21. For additional information check the AHS web site: http://www.azhydrosoc.org/

CAP Provides Award for Research

Papers are accepted all year for Central Arizona Project's Award for Water Research; first place award is $1,000 and second place $500. Graduate and undergraduate students at any Arizona college or university are eligible to apply. Research should focus specifically on water issues affecting Central and Southern Arizona and the Colorado River. Papers can address legal, economic, political, environmental, or water management issues, as well as any other issue that might be of interest to CAP or Arizona water users. Deadline to submit papers is June 1. To apply, submit the entry form, the complete paper and a one-page abstract to Vicky Campo at vcampo@cap-az.com or apply online. Visit CAP web site http://www.cap-az.com/ then click "award for research" under "public info".

AZ Riparian Council Call for Papers

The Arizona Riparian Council has issued a call for papers for its 20th annual meeting to be conducted April 27 - 29 at the Museum of Northern Arizona in Flagstaff. The theme of the conference is "Riparian Issues: Reflections on Our Past and Challenges for Our Future." All topics related to riparian issues may be submitted. Abstracts should be between 250 and 500 words and attached to an email in PC format in either Word or WordPerfect (preferred) and sent to Cindyu.Zisner@asu.edu Abstracts can also be faxed or mailed to Cindy D. Zisner, Arizona Riparian Council, Global Institute of Sustainability, Arizona State University, PO Box 873211, Tempe, AZ 85287-3211. Abstracts and forms must be submitted by March 20.

Court...continued from page 7

that was overturned by a federal Appeals Court.

The three-judge panel referred to a 1957 Arizona Supreme Court ruling that stated that common law doctrine in Arizona allows groundwater pumping if the water is extracted for a reasonable use on the property from which it is taken. If such terms are met, the pumper incurs no liability to adjoining landowners for damages resulting from groundwater depletion on their lands.

That some of the groundwater was channeled off the property was immaterial to the court. It stated that according to Arizona law withdrawn water does not have to be used so long as it is extracted for a reasonable beneficial use.

Abbot acknowledged that its removal of excess water violated the permit's conditions and that the required annual reports were not properly filed. Abbott agreed to pay a $6,508 fine to the state.

In his concurrence, Judge Jerome Ferris stated, "If we were not bound to follow the Arizona Supreme Court, I would urge that Arizona's reasonable use doctrine no longer depend solely upon whether the use of the water benefits the property from which it is extracted. Accounting for the amount of water used, considering the utility of competing waters uses, and acknowledging the rights of adjacent water users seems especially important in an arid, rapidly growing state like Arizona."

Public Policy Review

by Sharon Megdal

Water Budget Can Be Monstrously Complicated

Recently, Ken Seasholes, Director of the Tucson Active Management Area, was a guest lecturer at the graduate seminar, Arizona Water Policy, which I teach with my colleague Kathy Jacobs. His was a formidable task, to discuss AMA water regulation and management plans, and he came armed with the "cartoon" pictured here. At first glance, it could be interpreted as someone's idea of a multi-armed, scary monster. But, upon closer examination, the figure can be seen as an informative depiction of the groundwater aquifer and the factors to be considered when calculating the Tucson AMA's water budget.

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

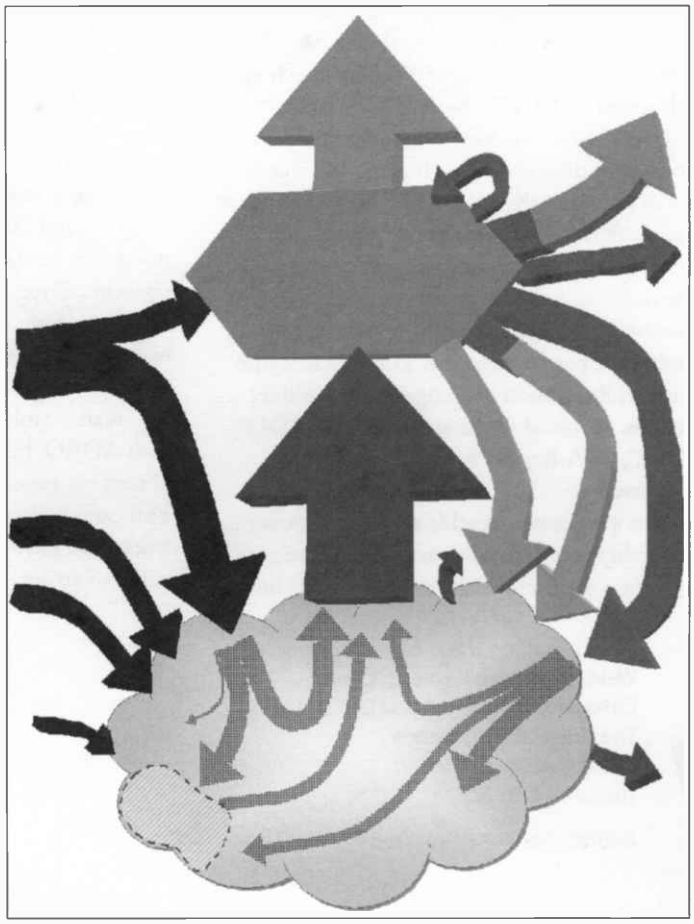
The bottom of the cartoon represents the groundwater aquifer. The big arrow going up in the middle represents groundwater pumping. The hexagon above the pumping arrow represents regional demand, and the top arrow represents the actual consumptive use, or water not returning to the system.

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

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

The most complicated part of the water budget calculation likely relates to some of the arrows inside the aquifer. They show what happens to water that reaches the aquifer, whether from the left or right side. If that water is considered stored water pursuant to a storage permit, then various accounting rules come into play. The "bookkeeping" must consider cuts to the aquifer, annual storage and recovery, accrual of long-term storage credits, and credit recovery. The real challenge for me has been understanding how stored water figures into the official water budget. Long-term storage credits for water put into the system provide someone at some time with the right to pump water out of the aquifer. So, although water has been added to the aquifer through "artificial" recharge, it is off the books when considering the amount of overdraft.

The Water Budget Monster



Graphic design: Ken Seasholes

For me an "epiphany" came with Ken's explanation of his cartoon that, although the printed water budget with all the numbers shows a net artificial recharge number "above the line" indicating the amount of total overdraft, the recharged water subject to future withdrawal is not counted as an addition to groundwater. The 2003 draft water budget for the Tucson AMA shows over 163,000 acre feet of groundwater overdraft. While that year saw 56,919 of net artificial recharge, that stored water does not reduce the 2003 overdraft.

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

Nogales...continued from page 2

Progress Mandated

While some issues awaiting resolution delayed progress, other developments urged in the other direction, that conflicts be resolved and work on the facility begun. For example, the plant posed an environmental and public health hazard, with illegal high discharges into the Santa Cruz River and polluted runoff entering the Nogales Wash. The situation became even more critical during the high flows of the rainy season. Action was clearly called for.

Also urging action was a court decree. In March 2000, the Sierra Club filed suit alleging ongoing and continuous Clean Water Act violations at NIWTP. The result was a court-approved consent decree that the plant's operations be brought into compliance with federal public health standards by 2004. The deadline came and went, with no remedial actions taken.

Added to the above was the threat that funding could be lost. The money allocated to the project in 2000 was still unspent. With federal funding now more difficult to obtain, EPA began to look at the unspent $59.5 allocated to NIWTP as a possible source of funds for use in other U.S.-Mexico border projects that showed progress. This use-it-or-lose-it dilemma made it clear that something would soon need to be done to get the Nogales project moving.

The Arizona Department of Environmental Quality took the funding threat very seriously; the agency was anxious that water quality standards be met and permitting violations resolved. ADEQ got actively involved in the planning process, taking on a leadership role in bringing the parties together. The U.S. Institute for Environmental Conflict Resolution was engaged to conduct conflict resolution sessions. Involved in the sessions were ADEQ, the city of Nogales, IBWC, EPA-Region 9, NADB and BECC.

ADEQ Makes a Difference

According to most people knowledgeable about the situation, ADEQ assuming a leadership role proved a turning point in getting the various parties to adopt a more conciliatory attitude and be willing to negotiate issues. Also contributing to the conciliatory mood were the conflict resolution sessions. These developments provided a needed fresh start.

Policy and technical committees were formed to help get the work done. The latter, chaired by Chuck Graf from ADEQ and made up of senior engineers of involved organizations, was especially effective in forging a working relationship among all interests. To focus their efforts they concentrated on engineering issues, avoiding as much as possible the more controversial topic of funding. That would be addressed later.

The technical committee scored an early success that demonstrated the value of teamwork and established a sense of momentum to take on other tasks. The success had to do with repairing the leaking IOI. Plans called for its replacement, a project estimated to cost about $40 million that would drain much of the funds needed for work on the NIWTP. The technical committee studied the problem and found that the IOI could be repaired rather than replaced, at a great cost savings. The technical committee was ready to take on the NIWTP.

The committee continued its work, eventually working out a consensus about the technical specifications of the project. This was a major step forward in getting work started on the plant.

One indication that progress is in fact being made is the position taken by the plaintiffs in the case that resulted in the unmet consent decree. Joy Herr-Cardillo, the attorney representing them, says, "...as long as real progress is being made we have not gone back to the courts. As long as the parties are in good faith moving forward then the plaintiffs are satisfied."

Karen Smith, who was involved in the project when working with ADEQ, believes the outcome was a "huge success." She says, "From my experience it is unusual because it has been successful. You can go along the border and see nightmares from Tijuana on, where you have projects with this many organizations trying to come to an agreement. It is very tough."

Arizona Water Resource

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