ARIZONA
WATER RESOURCE

Volume 13, Number 6 *May - June 2005*

The Fine Art of Using, Sharing Water

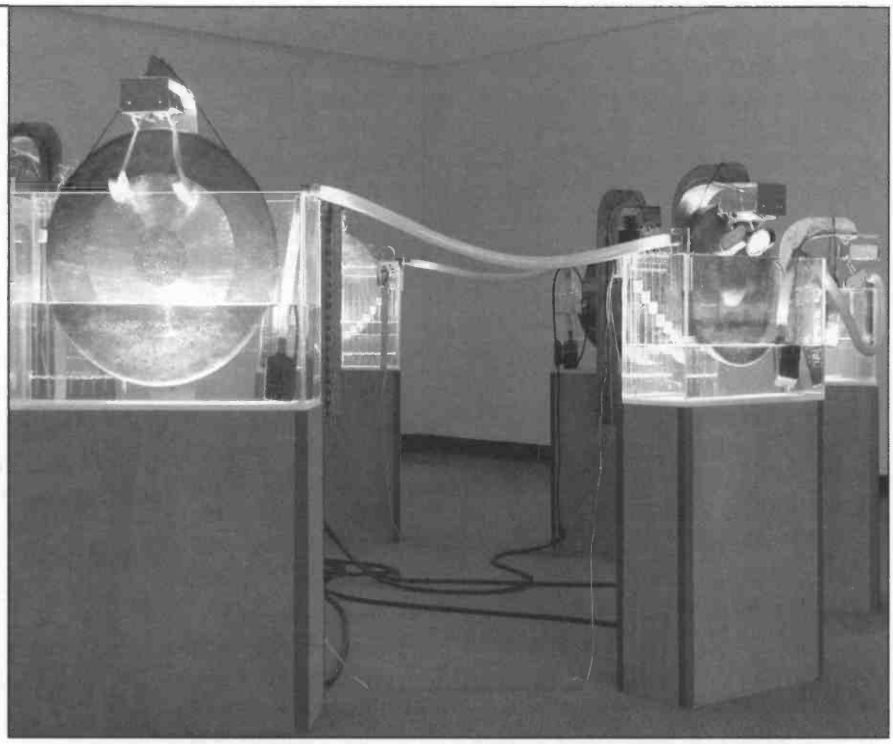
Titled "Sustainable," the art work at right is about using and sharing water resources. Its theme is a central tenet of water use: a limited supply of water means that whatever resources one user consumes could be at the expense of other water users.

The installation consists of seven Plexiglas water tanks arranged in a circle; a gong is suspended in each tank, with a mallet within striking distance. The tanks function as a network, linked together with pipes and a pump. The artists describe their work as a water resource network.

The water tubes that link together the tanks or water gong nodes of the network allow each node to receive water from one upstream neighbor and to pump water to one downstream neighbor. The network is a closed system that distributes water between the seven members. Inspired by the current water resource crisis in the West, the artists have implemented a water resource sharing algorithm for negotiating multiple consumer demands in the face of a limited available water supply. They ask that you consider the system a group of farmers or golf courses, each with high water demands but needing to share and negotiate for the rights to use water.

Each water gong node has a fluctuating water demand need that is periodically updated to reflect the changing or seasonal needs of water users such

Continued on page 4



CONTENTS

Opposing Sides Find Common Ground in Yuma Desalter Controversy

by Joe Gelt

Over the years the Yuma Desalting Plant has produced much more conflict than desalinated water. An effort has recently been made to change this situation, with representatives of both sides of the ongoing controversy working together in the YDP/Cienega Workgroup to identify a set of management alternatives agreeable to all.

The workgroup effort paid off, with controversy defused and common ground reached. Success can be measured twice: a set of recommendations gained general approval and as important, if not more important, a process was worked out that enabled diverse and even antagonistic interests to productively work together.

Central to the controversy is the operation of the YDP. Completed in 1992 at a cost of $250 million, the YDP was intended to treat the highly saline drainage water from the Welton-Mohawk Irrigation District before it flowed back into the Colorado River. Untreated, the drainage water was increasing the salinity of Colorado River water flowing into Mexico.

While the plant was being designed and constructed, the U.S. Bureau of Reclamation built a 53-mile bypass canal to divert the saline water to the Santa Clara Slough in Mexico. Once completed, the YDP operated for a brief period and then shutdown, its services not needed. Credits the United States obtained by lining the Coachella Canal made operation of the plant unnecessary.

The saline water that continued to flow into Mexico boosted the environmental value of the Santa Clara Slough, now known as the Cienega de Santa Clara. Increased vegetative growth provided habitat to at least 95 difference species of resident and

Continued on page 2

Desalter Controversy...continued from page 1

migratory birds including the endangered Yuma Clapper Rail. Once an interim measure to cope with saline runoff, the cienega evolved into an established environmental feature, its continued existence a controversial issue in any proposals to begin operating the YDP.

Pressure Builds to Operate Desalter

With drought stalking the land, water users, including the Central Arizona Project and the Arizona Department of Water Resources, wanted the YDP to begin operating. The approximately 100,000 acre feet of water diverted to the cienega was too salty to qualify as part of the U.S. treaty obligation to deliver 1.5 million acre-feet of Colorado River water to Mexico. With the plant operating, the bypass water could be treated for delivery to Mexico. That obligation now is being met by releasing up to 100,000 acre-feet of water from reservoirs.

The savings for water users was viewed as a loss to the cienega. Environmentalists opposed the plant's operation because the runoff that hitherto flowed to the cienega would be cut off and treated. What flow did make it to the cienega would be a toxic stream of brine from the desalter, threatening the existence of the wetlands.

The situation was summarized by Michael Cohen, senior research associate at the Pacific Institute, and workgroup member. He says, "There was considerable antagonism. The environmental community was sending letters to the governor and making public statement that the desalting plant should never run.

"On the other hand, Arizona water officials were saying the plant needed to be run and had been going to Congress to get riders put on laws saying the Bureau needed to get working on the plant. We were actually on completely opposite ends of the spectrum."

Cooperation Urged

This left the U.S. Bureau of Reclamation in a difficult position, with no clear consensus about what course of action to take. It was a familiar tale in the West: environmentalists vs. water users. In an effort to make headway, David "Sid" Wilson, general manager of the CAP, organized a workgroup he hoped could reach consensus about strategies for both increasing available water supplies and preserving the cienega.

Wilson took on a difficult task. To devise a credible plan, he needed to involve various and diverse interests, recruiting people to the working group with much different points of view. The prospect was not good; sides were drawn and controversy was rife.

A committee of 12 was eventually formed, consisting of a blend of environmental interests and water resource folks. Included within the workgroup were representatives from the Sonoran Institute, Environmental Defense, The Nature Conservancy and Pacific Institute. Also included within the workgroup were officials from CAP, BuRec, ADWR and the City of Yuma. A consultant from Mexico also had a role in the discussions.

Correction

The March-April AWR incorrectly stated that the Arizona Department of Environmental Quality administers the Arizona Water Protection Fund. It is the Arizona Department of Water Resources that administers the AWPF.

Despite their differences, Herb Dishlip, a consultant who facilitated the meetings, emphasized what the members had in common. He says, "They were people who were open-minded and familiar with the issues associated with the Yuma Desalting Plant and the cienega." Open-mindedness, however, did not mean optimism prevailed at the outset.

Workgroup member Peter Culp, an attorney with the Sonoran Institute, says, "I can't say I went in with the highest set of expectations. ... I looked around the room, and it seemed like a lot of engineers, lawyers, and activist folks ... looking at what appeared to be a fairly intractable problem with some very different perspectives on solving it."

Culp, however, had a sense of what needed to be done. He says, "My sense is that a lot of the disputes on the Colorado River are usually framed in a very unproductive sort of environmentalists-vs-water users, Arizona-vs-California sort of way. The extent you can get people to talk through these things you find there is actually more common ground than we realize."

He added, "My experience in this kind of policy work is that the substance of any dispute is only a very small percentage of what is important; what is much more important is the quality of the relationships among the people who are involved."

(That personal relationships matter seems to have been a theme from the very beginning. In relating what helped prompt him to organize a varied-interest workgroup, Wilson gives much weight to his encounter with Jennifer Pitt, a senior research analyst at Environmental Defense, during a Grand Canyon boating trip organized by Bennett Raley, the then assistant secretary for water and science, U.S. Department of Interior. Wilson got the environmental perspective direct and first-hand from Pitt; Pitt later became a member of the workgroup.)

Collaborative Process Worked Out

Ground rules guiding the process included that all meetings would be conducted in closed session. Also, members spoke strictly for themselves; whatever they proposed or agreed to did not obligate their organizations.

Work began with the realization that members had varied backgrounds and experiences with the YDP controversy. Although all were well acquainted with the issues at hand, their information and understanding could be varied and far-ranging. Step one therefore was to develop a common knowledge base among workgroup members. This process enabled members to share their information and think it through with others in the group.

Culp found this a valuable exercise: "I think we developed enough of a common knowledge base that we all learned something new, not just about each other's perspective on the problem but the problem itself. And we were able to see it a little bit more holistically as opposed to seeing it from just our own point of view."

Issues then had to be identified. The workgroup visited the desalter and conducted a meeting at the site. Information was gathered by talking to various people including a Mexican consultant and a representative of the Wellton-Mohawk Irrigation District.

Homework was assigned, with each member working out a solution to the problem. Papers were compared to identify common

Continued on page 12

Water Vapors

Rain Dampens Interest in Water Measures

Ants vs. Grasshoppers

The headlines summarize the story. A headline in a Feb. 4 Arizona Capitol Times article featuring Rep. Tom O'Halleran stated: "Drought Will Bring Water Issues to the Forefront." Several months down the road an Arizona Republic May 5 headline read: "State Zeal for Water Measures Drying Up: Full Reservoirs Scuttle Planning." It is not just baseball games and barbecues that get postponed because of rain; some efforts at water legislation get called off too.

The situation prompted Arizona Daily Star columnist Jim Kiser to comment in print, "Arizona has a grasshopper Legislature while it needs an ant Legislature."

His comment refers to an Aesop Fable in which an ant labors and toils to prepare for the future while the silly grasshopper parties and plays, unmindful his frivolous behavior will cost him dearly in the always uncertain future.

The ant-grasshopper theme Kiser sees playing out in recent legislative action — or rather inaction — is a good one, deserving wider application in water affairs; it adds color, spiritedness and ancient authority to an issue. For example, consider water use. It is an issue with sides drawn between those committed to husbanding water resources and those who show a feckless disregard for future water needs; in other words, between water conservationists and water wasters; between ants and grasshoppers, if you will.

Water conservation is an ant activity. The ant would turn off the water while brushing teeth, install low-flow toilets and showers, take up xeriscaping and change personal behavior and practices to ensure efficient use of water and future supplies. Meanwhile the grasshopper — Oh, that grasshopper! — he would waste water left and right and come up short in the end.

But with all due regard and respect to the industrious ant, the devil-may-care grasshoppers of the world often provide more colorful copy in their utter outlandishness. Consider the following.

Grasshopper's Shower

Once only available at tony spas, the Silver TAG Shower now can be commissioned for home use, for about $120,000. The operation of the device hearkens to the theories and practices of European hydrotherapies: temperatures and pressures vary for different soothing and therapeutic effects.

No one-size-fits-all device, the shower is customized to conform to a person's body shape and size. When programming the shower, a personal profile is compiled to identify a user's physical features and psychological factors: bodily areas suffering stress and discomfort are located, and overall stress level is considered. Body parts are individually measured.

Once in the shower, the indulgent bather, operating a touch-screen panel, can choose up to six different reprogrammable shower frequencies and experiences; he thus is able to savor the restorative effects of 18 showerheads targeting six different body zones. For example, selecting "tonic" varies water temperatures between hot and cold for deep muscle relaxation; an "anti-stress" choice would emit forceful jets of water that systematically move over the body to eliminate muscle tension.

Wiser by far is the ant's low-flow wisdom. Aesop knows that the grasshoppers of the world suffer in the end for their self-indulgent folly.

Back to the Issue

But back to the matter at hand: many believe that the Arizona Legislature was extraordinarily short-sighted in putting off action on important water legislation because of one season of rain. Like the Silver TAG Shower it is a luxury — or is it a folly? — we can ill afford. (See Public Policy Review, page 11, for a discussion of legislative action addressing water issues that did pass this session.)

WRRC's Jacobs Chairs National Science Committee

Katharine L. Jacobs, associate professor and specialist, University of Arizona's Water Resources Research Center, has agreed to chair the National Research Council's Committee to Review the GEWEX (Global Energy and Water Experiment) Americas Prediction Project (GAPP) Science and Implementation Plan. The committee was formed at the request of GAPP program managers to assist in reviewing the recently completed plan.

USGS Sponsors Supplement

This edition of the "AWR" contains a 4-page supplement sponsored by the U.S. Geological Survey to provide information about its work. At the same time, USGS, by sponsoring the supplement, is supporting the publication of this newsletter. We appreciate the opportunity to work with USGS and for the agency's generous support.

Arizona Water Resource is published 6 times per year by the University of Arizona's Water Resources Research Center. **AWR** accepts news, announcements and other information from all organizations

Arizona Water Resource Staff
Editor: Joe Gelt
jgelt@ag.arizona.edu
Editorial Assistant: Gabriel Leake

WRRC web site:
http://cals.arizona.edu/azwater/

WRRC Director: Dr. Sharon Megdal

Arizona Water Resource
Water Resources Research Center
College of Agriculture and Life Sciences
The University of Arizona
350 North Campbell Avenue
Tucson, Arizona 85719

520-792-9591 FAX 520-792-8518
email: wrrc@cals.arizona.edu

News Briefs

Funds Approved for Arizona Archives Building

Arizona will soon have a new state archives building. Among those who will benefit from the new building are people with a personal or professional interest in state water affairs, including researchers, consultants, lawmakers and agency personnel.

The state Legislature approved funding for the $30 million state-of-the-art building, with funding spread over two years, at $15 million per year. The new building will replace the current state archive facility, considered by many to be woefully inadequate. Materials are now literally stored in an attic, in space above the fourth floor of the old capital building built in 1901 and in an off-site facility

Water materials housed in the Arizona State Archives include many unpublished, one-of-a-kind documents, the sole source of some state water records. Archival collections concerning water span many years, from early territorial times to statehood, with historical records from both organizations and individuals.

The lack of adequate space in the current archive facility meant valuable water records were not able to be accepted. Storage space in the planned facility is expected to be adequate for at least the next 25 years.

The new building is to be located close to the Capitol, near 19th Avenue and Jackson Street. Construction could be underway as early as July. The building will include the only conservation lab in the state, for the preservation and repair of historic documents and materials.

This was not the legislative gain many water professionals had hoped for — drought raised expectations that the Legislature would tackle major water related issues — but it is a bright spot nonetheless.

Water, Key to Santa Cruz Valley Heritage Area

A feasibility study for a Santa Cruz Valley National Heritage Area has been completed, and work is now underway to draft legislation seeking congressional approval for the designation. (Check www.cdarc.org for copy of feasibility study.)

A NHA designation helps protect and preserve an area's history, culture, recreational opportunities and environmental features. Water can figure prominently as one of the environmental features. In fact, water plays a central role in the proposed Santa Cruz Valley NHA.

Jonathan Mabry, a consultant with the Center for Desert Archeology, the organization spearheading the effort, says, "The unifying concept of this National Heritage area is the river; in fact, the boundaries of the area are the watershed boundaries." The area would cover approximately 3,325 square miles in southern Arizona.

A NHA is eligible to receive up to $10 million in 50 percent match funding over a period of 15 years. Control of the projects is at the local level, with a board representing stakeholders and interested parties deciding what projects get funded. Boards have wide leeway about the kinds of projects they can fund; funds, however, cannot to be used to purchase land. The National Park Service administers the funding.

What the NHA designation does not do is increase federal regulation and control over public or private lands; nor are any restrictions imposed on area landowners about what they can or cannot do with their land.

Mabry says, "I expect the typical kinds of projects the (Santa Cruz Valley NHA) would support include activities such as riparian restoration projects; I think support also would be available for water quality monitoring like what the Friends of the Santa Cruz River does; also environmental education for the public and especially for school kids."

There are only 27 National Heritage Areas in the United States, with just two west of the Mississippi River. One is Arizona: the Yuma Crossing National Heritage Area, designated because of its importance as a landmark for westward expansion in the 19th century. The Center for Desert Archeology is now organizing an effort to create a Little Colorado River Valley NHA.

Mexican Border Town Gets New Treatment Plant

The Mexican city of San Luis Rio Colorado, located across the border from San Luis, Arizona, is scheduled to begin operating its new wastewater treatment plant in October.

Operation of the plant will resolve some of the problems now resulting from the city dumping its raw sewage into the dry Colorado River bed. The wastewater will now be treated before being pumped. Except during high-flow periods, the Colorado River is dusty and dry crossing the border at San Luis.

The sewage situation in the Mexican community has not had adverse consequences on the Arizona side of the border. David Ford, director of public works for the U.S. city, says only one spilled had oc-

Sharing Water...continued from page 1

as farmers. By turning its water pump on or off, a particular water gong can either conserve or purge water to match the amount in its tank with its need; thus each node is functioning independently. The network, however, only has a finite amount of water; the system therefore is in constant flux, with water circulating through the network and the system itself attempting to achieve equilibrium.

David Birchfield, assistant professor in Arizona State University's Arts, Media and Engineering program, created Sustainable, with faculty members David Lorig and Kelly Phillips collaborating on the project. It was exhibited at the ASU Computing Commons Gallery.

Sustainable will be presented at SIGGRAPH, the 32nd annual conference on computer graphics to be conducted at Los Angeles this summer. Also, Sustainable will be part of a European electronic arts festival in the fall, 2005. For more information about the exhibit including future showings check the web site: http://ame2.asu.edu/faculty/dab/sustainable.php

Project Evaluates Current State of U.S. River Restoration Efforts

A comprehensive database has been compiled of more than 38,000 river and stream restoration projects nationwide and includes information about projects in Arizona and the Southwest. The intent of the National River Restoration Science Synthesis Project is to evaluate the current state of river restoration in the United States to determine common elements of successful projects.

The study found that more than one-third of U.S. rivers are listed as impaired or polluted; it is expected that the importance of river restoration will increase in the future, exerting a greater influence on environmental management and policy decisions.

(Acknowledging the importance of river restoration, the Water Resources Research Center dedicated its annual conference to the issue. Titled, "Water and the Environment: The Role of Ecosystem Restoration," the conference showcased various projects underway in Arizona. The conference was conducted April 6.)

Although some restoration project are major undertakings and have celebrity status — for example, the Lower Colorado River Multispecies Conservation Plan — most such projects are small-scale, concerned with less than 1 km of stream length. As a result, limited, if any information is available on the application and results of many of these projects.

For example, the researchers found that current projects' databases were highly fragmented, with information often entered on an ad hoc basis or by volunteers. The reliability and usefulness of such databases therefore were in doubt. In response to the situation, the researchers developed methods for the unbiased collection and cataloging of river and stream restoration projects.

The study found that the past decade experienced an exponential growth in the number of river restoration projects in the United States; since 1990 over a billion dollars have been spent annually. The most common goals of such projects are to enhance water quality, manage riparian zones, improve in-stream habitat, allow fish passage and stabilize stream banks.

Little monitoring is being done, with only 10 percent of the projects with records documenting monitoring results. What records are available are often not appropriate nor available for use in assessing the ecological effectiveness of restoration activities.

Information from the study will enable interested individuals to analyze the extent, nature, scientific basis and success of stream and river restoration projects throughout the nation. This in turn will provide a criteria for practitioners and policy makers to make decisions relating to prioritizing, implementing and funding restoration projects.

The database is the work of an interdisciplinary team of scientists mainly from academic departments and government agencies, including the Southwest Biological Science Center at the U.S. Geological Survey in Tucson.

Graph Credit: Jennifer Follstad-Shah, Dr. Cliff Dahm, Dr. Steve Gloss

curred during the ten years he has been there, and it was quickly cleaned up.

Ford says, "I am glad to see it happen. ... They can get lines out to the people so they don't have to rely on cesspools and septic tanks." He adds, "It hasn't been all that long ago, in 1995, when we finished getting people in a large area off septic tanks and on sewer lines here in San Luis, Arizona."

During the first phase of the plant's operation about half the city's population will be served. The plant will later be expanded to provide service to the entire population.

Grants and loans from the North American Development Bank are funding the project.

Proposed Bill Assists Rural Areas Meet Water Needs

Small rural communities, tribes and water association would benefit from legislation recently introduced into the U.S. Senate. The Reclamation Rural Water Supply Act of 2005 (S.895) would authorize the U.S. Department of the Interior, through the Bureau of Reclamation, to establish a program to plan, design and construct rural water supply projects to reliably deliver potable water to homes and businesses.

Introduced by Sen. Jeff Bingaman, D-NM, and Pete Domenici, R-NM, the bill would authorize $20 million a year for planning new water delivery infrastructure and would establish a loan guarantee program within BuRec to help communities finance new water projects and pay for maintenance on existing water systems.

The bill is in response to many rural communities lacking the financial resources to pay for new water projects. According to recent U.S. Environmental Protection Agency data, small systems serving populations of 3,300 or less have $37 billion in total funding needs. The Indian Health Service's

Continued on page 7

Guest View

Insiders Laud Honest and Open Process in Yuma Desalter Plant Talks

Diverse interests work together to take important first step

This Guest View is a collaborative effort of Peter W. Culp, an attorney with the Sonoran Institute, David S. "Sid" Wilson, general manager of the Central Arizona Project and Thomas Carr, assistant director for statewide water conservation and strategic planning, the Arizona Department of Water Resources. They all were members of the Yuma Desalting Plant/Cienega de Santa Clara workgroup.

Since the Yuma Desalting Plant/Cienega de Santa Clara workgroup completed its report in May of 2005, our proposal has begun to generate a dialogue among the Colorado River community. Although many reviewers have focused on the elements of this solution, much of the interest in the workgroup process has focused as much — or even more — on how a diverse group composed of environmental organizations, water users, and state, federal, and city officials managed to reach consensus in the first place. Conflict, not compromise, has been the rule on the Colorado River, and these same interest groups remain entangled in a variety of other ongoing, seemingly intractable disputes over the management and allocation of water on the river.

In many ways, the dispute over the YDP and the Cienega de Santa Clara could be seen as a microcosm of a larger set of issues that face the Colorado River as a whole. Particularly in the West, most disputes over the allocation of water are framed in a discourse of entitlement — the rights of user A vs. user B, of cities vs. farms, of Arizona vs. California, of humans vs. the environment — to water. This discourse all but inevitably frames controversies in an "us-versus-them" mentality that encourages conflict, distrust, arms-length relationships, and inhibits open discussion. In this context, many disputes become zero-sum. It is difficult to reach consensus — or even compromise — when one side has to agree to lose.

The process we followed played a large part in our ability to overcome these tendencies and reach toward consensus. First, we enlisted the help of a knowledgeable, neutral facilitator who helped the group work effectively and efficiently, took the lead on developing our discussions into a common written document, and established and enforced a timeline and a process to keep us moving forward. Secondly, we recruited knowledgeable individuals who could approach the problem with the level of expertise necessary to think through the problem at an appropriate level of complexity. Third, the group was kept small, but nevertheless represented a balanced and broad range of interests. Fourth, a series of ground rules were established, including confidentiality, honesty, and a commitment to active participation in an intense schedule of meetings.

Finally, and perhaps most importantly, the group began its work by spending several months pooling information, sharing perspectives, getting to know one another, and developing a collective understanding of the problem. These measures ensured an honest and open process, while helping to develop a relationship of trust and an atmosphere of friendship among the participants.

A key realization that emerged from these discussions was that the problem we were trying to solve had in fact been framed in a zero-sum context: either to continue to provide water for the cienega to the detriment of U.S. users, or to operate the YDP at the cost of the cienega. In this narrowly framed debate, there could be no compromise because someone would have to agree to lose. Once we could move past these narrow positions and view the problem in terms of a broader range of issues facing the Colorado River, the value of a more flexible approach to managing the bypass water became evident, and the problem became easier to solve.

For example, the workgroup eventually came to recognize that the bypass flow doesn't necessarily need to be replaced during high reservoir conditions; rather, it may make more sense to take proportionately more aggressive steps to prevent shortages that could be caused by the bypass during low reservoir conditions. Similarly, we realized that a more flexible approach to the quality and quantity of water deliveries to the cienega, tied to monitoring and adaptive management, could actually enhance the resource while potentially requiring less water

Together, this group ultimately identified the objectives of its work as follows: 1) reduce or eliminate the risk of shortage to U.S. users as a result of the bypass flows; 2) ensure the maintenance and/or enhancement of the environmental values in the cienega; 3) maintain compliance with binational water quality requirements; and 4) preserve the status quo with respect to the allocation of permanent rights to Colorado River water. After ten months, the group completed a white paper that outlined an inter-related set of long-term and short-term measures that would meet all four of these objectives. The final report is available for download from CAP's website at www.cap-az.com

The workgroup believes that the development of a solution set that satisfies both water managers and conservation interests is in itself a significant accomplishment. However, this is just the first step in resolving the bypass flow controversy. Education and information outreach, follow-through with federal, state, local entities and the public, the development of support from other Colorado River Basin states, and initiation of a federal decision making process and binational discussions with Mexico will all be necessary. Nevertheless, the fact that a diverse group of stakeholders could seek out and find common solutions lends hope that future collaborative efforts could yield similar results in the future.

Our hope is that the U.S. will act quickly to implement these recommendations and avert further conflict over this difficult issue, while encouraging the efforts of others who are interested in finding collaborative solutions to other tough Colorado River issues.

(See front-page feature of this newsletter for further discussion of this issue.)

USGS
science for a changing world

Arizona Water Resource Supplement
May - June 2005

USGS REPORTS EXAMINE WATER QUALITY IN NORTHERN ARIZONA

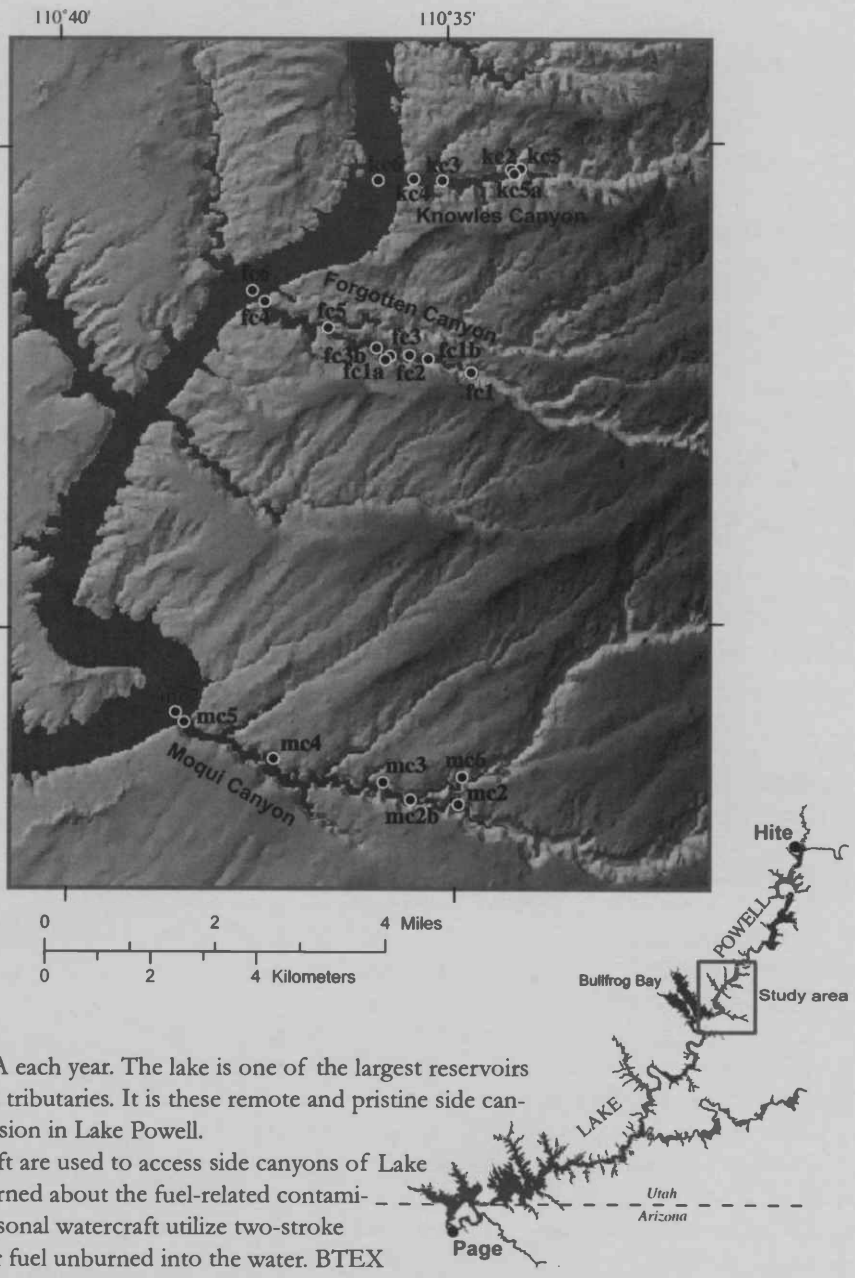
Following are two recent U.S. Geological Survey reports from Arizona District Hydrologists describing water quality studies in Northern Arizona. The first report summarizes information in U.S. Geological Survey Scientific Investigations Report 2004-5120, by Bob Hart and others. The study examines water use and water quality in multiple side canyons of Lake Powell. For more information contact Robert J. Hart, U.S. Geological Survey, 2255 N. Gemini Dr. Flagstaff, AZ 86001, 928-556-7136, or by email at bhart@usgs.gov. The USGS publication describing this study can be accessed online at http://water.usgs.gov/pubs/sir/2004/5120/

EFFECTS OF VISITOR USE ON WATER QUALITY IN THREE SIDE CANYONS OF LAKE POWELL

by Robert J. Hart

The U.S. Geological Survey (USGS) and the National Park Service (NPS) work in partnership to provide hydrologic information needed by NPS managers to make scientifically defensible management and policy decisions related to the quality of water resources within the National Park system. As part of this partnership, the USGS, in cooperation with the Glen Canyon National Recreation Area (GLCA), determined the effects of visitor use on water quality in three high-use side canyons during 2001 and 2002 (figure 1).

Figure 1. *Location of study area and sampling sites in Knowles, Forgotten, and Moqui Canyons, Lake Powell.*



Water-Quality Issues of Lake Powell

Between 2 million and 3 million people visit the GLCA each year. The lake is one of the largest reservoirs in the world and consists of more than 90 side canyon tributaries. It is these remote and pristine side canyons that visitors seek for boating recreation and seclusion in Lake Powell.

Personal watercraft and other motorized watercraft are used to access side canyons of Lake Powell, and the GLCA has become increasingly concerned about the fuel-related contaminants that are introduced into the water. Nearly all personal watercraft utilize two-stroke engines, which can discharge about 30 percent of their fuel unburned into the water. BTEX compounds, including benzene, toluene, ethylbenzene, and xylene, and methyl-tertiary-butyl ether (MTBE) are some of the volatile organic compounds (VOCs) that are fuel by-products emitted by personal watercraft and other motorized watercraft. Other VOCs, total petroleum hydrocarbons (TPHs), and oil and grease also can be released into Lake Powell by general motorboat use.

Houseboat use and poor camping practices along the lakeshore also can be a source of contaminants to the lake and beach areas. Organic wastewater compounds (OWCs) can derive from domestic products that include detergents, disinfectants, human drugs, food byproducts, and insect repellents. GLCA has human-waste disposal facilities on the lake, but contamination still occurs from accidental spills or from visitors purposefully discharging waste into the lake or along its beaches.

Sample Design and Strategy

Knowles, Forgotten, and Moqui Canyons (figure 1) were selected for sampling on the basis of several factors, including their easy access from two marinas in the area, Bullfrog and Halls Crossing. Knowles Canyon was closed to visitor use for the duration of the study and thus was used as a control site for observing changes in water quality. Four data-collection trips were completed over a 2-year period and occurred during the high-visitor use period (Memorial Day through Labor Day) and during the low-visitor use period (following Labor Day through the end of May). Six to nine sites were sampled in each side canyon during each sampling trip.

Presence of Contaminants from Visitor Use

VOCs, TPH, oil and grease, and a variety of OWCs, including metal complexing agents, surfactant degradation products, antioxidants, caffeine, antimicrobials, steroids, and hormones, were evaluated in this study because of their presence in domestic wastewater and the potentially adverse human health and ecological effects. Even though Knowles Canyon was closed to visitor use, a few compounds associated with visitor use were detected; however, concentrations of these compounds were very low.

VOCs, TPH, and Oil and Grease

Seven of nine regulated VOCs, including the BTEX compounds, were detected at higher concentrations during the high-visitation period than during the low-visitation period in Forgotten and Moqui Canyons. Concentrations generally were less than laboratory detection limits (LDLs) during the low-visitation periods. Also, BTEX concentrations did not exceed the maximum contaminant levels for drinking water established by the States of Arizona and Utah. Benzene ranged from less than the LDL to 3.1 µg/L. The highest concentrations of toluene, ethylbenzene, *o*-xylene, *m* and *p*-xylene, total xylene, and MTBE were 3.8, 0.2, 2.4, 3.5, 5.9, and 3.0 µg/L, respectively, and occurred in Moqui Canyon during the high-visitation periods. Concentrations of MTBE were detected in all three side canyons but were far below the nonregulatory drinking-water advisory recommended by the U.S. Environmental Protection Agency.

TPHs were not detected in Forgotten and Knowles Canyons but were detected above the LDLs in Moqui Canyon. Concentrations of oil and grease were slightly above the LDL of 1 mg/L at some sites; concentrations ranged from 1 to 4 mg/L.

OWCs

A variety of OWCs (33 of 79 analyzed) were detected in trace amounts in the three canyons. Several OWCs can be introduced unknowingly to Lake Powell from materials used in boat manufacturing (for example flame retardants added to plastics). Environmental processes can attenuate concentrations of many of the trace OWCs that are introduced. Although dilution plays a significant role in decreasing concentrations, biodegradation, photolysis, volatilization, and sorption also reduce concentrations or remove compounds entirely. Water-quality regulations have not been established for most of the OWCs detected; however, the accumulative effect of OWCs can be potentially harmful to humans and to the biota of water systems.

Trace amounts of cholesterol (biogenic steroid), caffeine (beverages), N,N-diethyltoluamide (DEET, an insect repellent), octylphenol-2 ethoxylate (OPEO-2, a nonionic surfactant), and beta-sitosterol (plant steroid) were among the most commonly detected OWCs in Forgotten and Moqui Canyons. Several OWCs, including cholesterol and caffeine, were detected in Knowles Canyon during the study; however, inputs of these OWCs from sources other than recreational visitors are unlikely.

Concentrations of ethylenediaminetetraacetic acid (EDTA), although low, were detected in most of the samples collected from the side canyons. This wastewater indicator cannot be tied to visitor use in the side canyons. It may be entering Lake Powell from the many wastewater-treatment plants along the tributaries within the Colorado River Basin. The nonylphenol-ethoxycarboxylate acid (NPEC) compounds also were detected in several samples collected from the side canyons.

The only compounds detected in the steroid and hormone analysis were stanalone, cholesterol, coprostanol, and estriol. Stanalone is a semisynthetic analog of dihydrotestosterone, a byproduct of testosterone. Cholesterol is a common biogenic molecule and is a fecal indicator of all biota, whereas coprostanol is a specific mammal fecal indicator and is associated with sewage waste. Estriol is one of three estrogens normally produced in the human body.

Additional Information

The results from this study, specifically the characterization of contaminants in side canyons of Lake Powell and their association with visitor use from watercraft and other sources of human interaction with the lake, can be used by the GLCA to make defensible managerial and policy decisions related to water quality. For more information contact Robert J. Hart, U.S. Geological Survey, 2255 N. Gemini Dr., Flagstaff, AZ 86001, 928-556-7136, or by email at bhart@usgs.gov. The USGS publication describing this study can be accessed online at http://water.usgs.gov/pubs/sir/2004/5120/

The following article, written by Steve Monroe and others, summarizes results from a recently published Scientific Investigation Report 2004-5146 on the chemical characteristics of ground-water discharge along the South Rim of the Grand Canyon in Grand Canyon National Park, Arizona. The USGS publication can be accessed online at http://water.usgs.gov/pubs/sir/2004/5146/ Contact Stephen Monroe, U.S. Geological Survey, 2255 N. Gemini Dr. Flagstaff, AZ 86001, 928-556- 7141, or by email at samonrie@usgs.gov if you have any questions or comments.

GEOCHEMICAL ASSESSMENT OF SPRINGS ALONG THE SOUTH RIM OF GRAND CANYON, 2000 - 2001

by Stephen A. Monroe

Importance of Springs along the South Rim of Grand Canyon

Springs flowing from the south rim of Grand Canyon are an important resource of Grand Canyon National Park, offering refuge to endemic and exotic terrestrial wildlife species and maintaining riparian areas. Population growth on the Coconino Plateau has increased the demand for additional development of ground-water resources, and such development could reduce spring discharge and affect the sustainability of riparian areas within the park. In addition, springs are an important source of drinking water for hikers and are culturally and economically important to Native Americans living in the region.

How existing and proposed ground-water development outside the park will affect the spring resources within the park is unknown. Few wells have been developed on the Coconino Plateau, and knowledge of subsurface geology in the region is limited. Additionally, little is known about the current and potential effects of human activities, such as wastewater treatment plants, landfills, and historic mining, on the ground-water systems.

Program Overview

This study was designed to provide baseline data on springs and creeks issuing from the Redwall-Muav Limestone aquifer in the core-use area along the south rim, from Red Canyon Spring in the east to Boucher East Spring in the west. Data were collected during the period May 2000 to September 2001 and contain information on 20 springs and creeks including water chemistry, discharge, quality, and the residence times of ground-water discharged at the springs. Rock samples representing the major stratigraphic units of Grand Canyon were collected near the Bright Angel Fault and analyzed for mineralogy and selected isotopes.

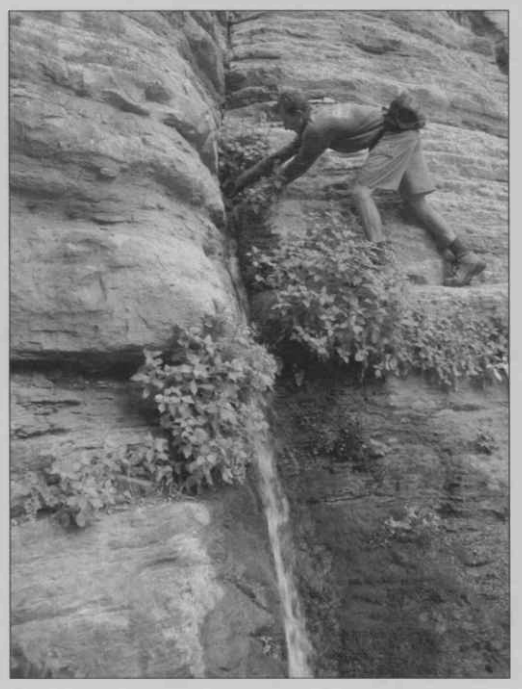
Whenever possible, water samples were collected at the point where water discharges directly from bedrock. Each spring and creek is associated with one or more of five types of geologic characteristics: bedding planes, fractures, channel alluvium, hillslope alluvium, or travertine deposits.

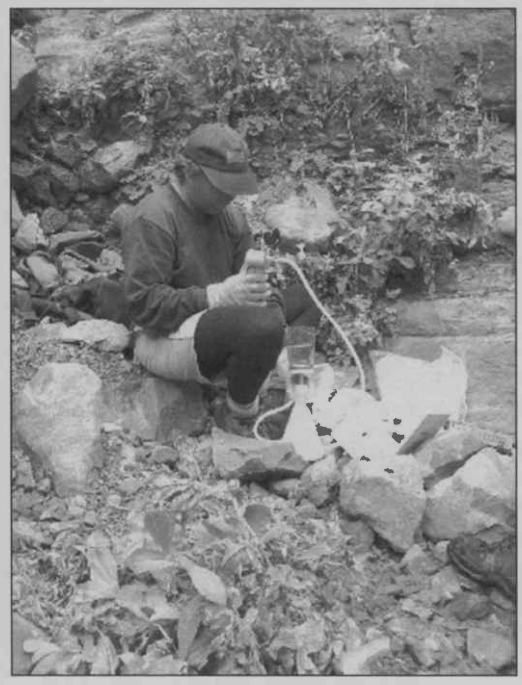
Regional Overview

The south rim of Grand Canyon is a steep escarpment extending from the Coconino Plateau to the Colorado River with a vertical relief of about 1,500 m. The rim is characterized by numerous short, steep side canyons and differs from the north rim of Grand Canyon in that it has smaller tributary canyons and no extensively developed karst systems. The regional dip of south rim Paleozoic strata is south, away from Grand Canyon. There is little or no surface-water flow on the Coconino Plateau, and flow in the side canyons derives from storm runoff or spring discharge. Most springs near the south rim of Grand Canyon are small (discharge less than 1.5 L/min).

The primary water-bearing unit of the Coconino Plateau near Grand Canyon is the Redwall-Muav Limestone aquifer, generally found 500 m to 700 m below the land surface. Most of the major springs near the south rim of Grand Canyon discharge from this aquifer. In the study area, the aquifer is bounded on the north by the Colorado River, on the west by structural controls near the Aubrey Cliffs, on the east by a generally defined ground-water divide near the Little Colorado River, and on the south by a generally defined ground-water divide near Williams.

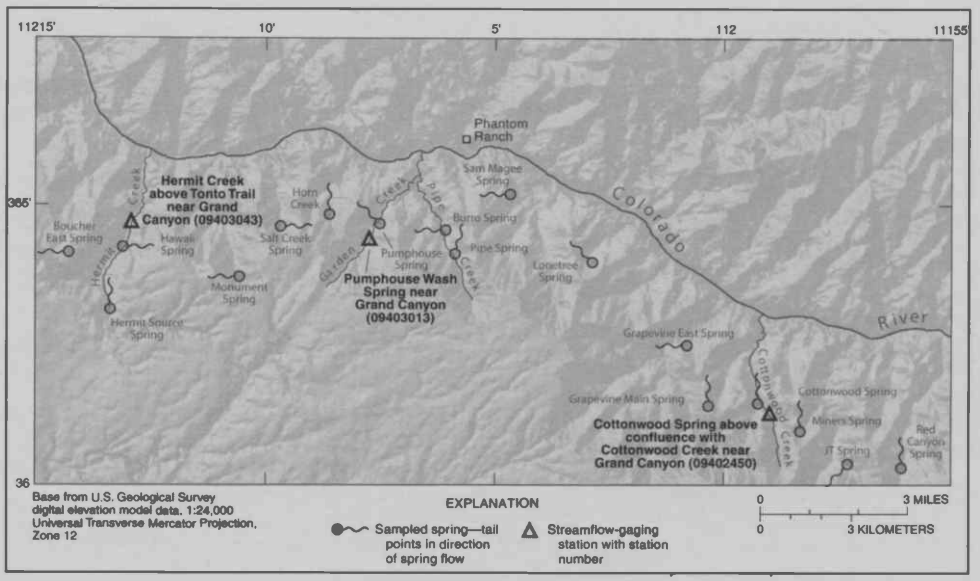
Water-bearing units near the south rim of Grand Canyon are recharged primarily by precipitation that infiltrates volcanic rocks and the Kaibab Formation in the higher altitudes of the Coconino





Sample collection and processing at Monumenet Spring

Plateau. Faults and fractures, many widened by dissolution, create zones of secondary permeability that could be the primary controls of ground-water movement. Numerous breccia pipes occur on the Coconino Plateau. Breccia pipes found in this region are the result of solution collapse in the Redwall Limestone and a stoping of overlying rock units and may be significant because secondary mineralization associated with these features can potentially influence water chemistry, and because breccia pipes can potentially act as conduits for ground-water flow.



Area map showing south rim springs

Water Quality and Residence Times

The water discharging at most sites was a calcium magnesium bicarbonate type; however, the water chemistry of each spring was distinct from that of all other springs and creeks and did not appreciably vary over the course of the study. Although collection of samples from the point of issuance was emphasized, at Cottonwood and Monument Creeks samples were collected both from the point of spring issuance and downstream from the point of issuance in the alluvial channel. Water-chemistry data for samples collected from the point of issuance differ considerably from data for samples collected from the downstream sample site. The observed changes in chemistry in Cottonwood and Monument Creeks indicate that the chemical and physical processes occurring during the transmittal of water through the alluvium are dynamic and variable and are influenced by processes such as adsorption or precipitation.

Concentrations of several constituents at some springs in the study area approached or exceeded U.S. Environmental Protection Agency (USEPA) Maximum Contaminant Levels for drinking water (MCLs). MCLs are based on quantity of consumption and are intended for public drinking-water supply systems and not the occasional user. Nevertheless, values above the MCLs represent a concern for water users and wildlife. Arsenic and uranium were higher than USEPA MCLs at some sites. Arsenic concentrations were highest at springs near the Grandview-Phantom Monocline; Miners, JT, and Red Canyon Springs all contained concentrations above the MCL. Uranium concentrations and gross alpha radioactivity were highest at Horn Creek and Salt Creek Spring. The average uranium concentration at Salt Creek Spring was equal to the MCL. Nitrate and selenium approached the MCLs or exceeded standards set in other countries at some sites. Nitrate concentrations were highest in the Monument Creek drainage, and those samples collected at the spring were the highest in the drainage. Selenium concentrations at Salt Creek Spring were the highest in the study. Whereas these concentrations do not approach the MCL, they exceed the drinking-water limit set by several other countries.

Multiple water samples for oxygen ($\delta^{18}O$) and hydrogen (δD) isotopic analysis were collected at most sites during multiple seasons. The $\delta^{18}O$ and δD values vary little across samples from all sites. A local meteoric water line for the south rim of Grand Canyon was constructed using $\delta^{18}O$ and δD analyses of precipitation samples collected between 1989 and 2002 from a site near the south rim of Grand Canyon. The $\delta^{18}O$ and δD data for precipitation have a strong seasonal pattern; winter precipitation samples were isotopically lighter than summer precipitation samples. The $\delta^{18}O$ and δD values for water samples collected from sites that discharge from the Redwall-Muav Limestone aquifer near the south rim of Grand Canyon do not show a clear seasonal pattern in isotopic composition and are most similar to winter precipitation. The $\delta^{18}O$ and δD data for most sites indicate that recharge occurs on the Coconino Plateau; however, the presence of an evaporative signature for some sites suggests isotopic fractionation due to evaporation prior to or after discharge from the spring. The strontium-87/strontium-86 values for water samples collected at sites east of the Bright Angel Fault are more radiogenic than values for samples from sites west of the fault, indicating differing flow paths. Ground-water residence times estimated using radiocarbon dating techniques ranged from modern to about 3,400 yr. Tritium and carbon-14 results indicate that ground-water discharged from the Redwall-Muav Limestone aquifer at most springs and creeks is a mixture of young and old ground waters, suggesting that water discharging from the aquifer at these sites follows multiple flow paths and has multiple recharge areas.

Additional Information

For more information contact Stephen Monroe, U.S. Geological Survey, 2255 N. Gemini Dr., Flagstaff, AZ 86001, 928-556-7141, or by email at samonroe@usgs.gov. The USGS publication describing this study can be accessed online at http://water.usgs.gov/pubs/sir/2004/5146/

Legislation and Law

EPA to Adopt Stricter Rules on Lead in Drinking Water

New rule expected by early 2006

The Environmental Protection Agency is initiating a plan to ensure that stricter measures are applied to protect water users from lead in their drinking water. The recently announced plan will strengthen, update and clarify current requirements that water utilities and states test for and reduce lead in drinking water.

The recently announced plan involves proposing changes to the agency's Lead and Copper Rule by early 2006. EPA issued the LCR in 1991 to reduce lead in drinking water by requiring water utilities to reduce lead contamination by controlling the corrosiveness of water and, as needed, replace lead service lines used to carry water from the street to the home. Under the Safe Drinking Water Act, state agencies take a lead role in enforcing the LCR.

Under the LCR, if 10 percent of required sampling show lead levels above a 15 parts per billion action level, the utility must take a number of actions to control corrosion. The utility must also conduct public education to inform consumers of actions they can take to reduce their exposure to lead. If lead levels continue to be elevated after anti-corrosion treatment is installed, the utility must replace lead service lines.

The proposed regulatory changes to the LCR will involve stricter monitoring requirements to ensure that water samples reflect the effectiveness of lead controls and will clarify the timing of sample collections and tighten criteria for reducing the frequency of monitoring. Also, utilities will be required to notify states prior to changes in treatment to enable states to provide direction or require additional monitoring. Further, water utilities will be required to notify occupants of the results of any testing that occurs within a home or facility.

The changes also address lead service line management with measures proposed to ensure that service lines testing below the action level are re-evaluated after any major changes to treatment which could affect corrosion control. Also EPA will update and expand 1994 guidance on testing for lead in school drinking water and will emphasize partnerships with other federal agencies, utilities and schools to protect children from lead in drinking water.

It is uncertain what effect the new rules will have on Arizona. Jeff Stuck, safe drinking water section manager at the Arizona Department of Environmental Quality, says, "It is difficult to say what impact they will have because EPA has not finalized them. They have talked generally about what they will be, but the devils are in the details; so it is difficult to say."

Stuck adds, "We do not see a lot of lead problems. Typically Arizona does not have highly corrosive water, and so we don't have the lead problems that some of the eastern states do."

Lead is a highly toxic metal that was used for many years in products found in and around homes. Even at low levels, lead may cause a range of adverse health effects including behavioral problems and learning disabilities. Not originally occurring in water, lead is picked up as water passes through pipes and household plumbing fittings and fixtures that contain lead. Water leaches lead from these sources and becomes contaminated.

Because virtually all lead enters water after it leaves the main system and flows to individual homes and buildings, the LCR is the only drinking water regulation requiring utilities to test water at the tap. This explains why individual homes will have different levels of lead in their tap water due to the age or condition of pipes, plumbing materials and fixtures or other factors. For this reason, customer awareness and education are important components of the LCR and state and water utilities lead reduction programs.

More information on National Review of LCR Implementation and Drinking Water Lead Reduction Plan is available online at: http://www.epa.gov/safewater/lcrmr/lead_review.html Information about lead in drinking water is available online at: http://www.epa.gov/safewater/lead or by calling the Safe Drinking Water Hotline at 1-800-426-4791. Information about lead around the home is available online at: http://www.epa.gov/lead or from EPA's National Lead Information Center (NLIC) at 1-800-424-LEAD

Rural Water Needs...continued from page 5

estimates indicate that approximately 20,000 American Indian and Alaska native households lack potable water supplies. Small and rural communities often lack the bonding capacity to raise the capital required for these projects.

Along with providing assistance to communities in identifying water supply projects, the bill also would establish a federal loan guarantee program within BuRec. The program would provide federal backing of loans that small communities take out for municipal and industrial water infrastructure. This backing would allow rural communities to obtain loans at much lower interest rates than loans not guaranteed by the federal government.

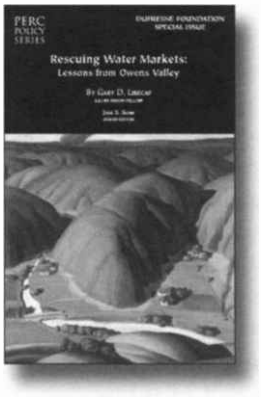
Also, by expediting BuRec's appraisal and feasibility study process, the bill would allow communities to study the best approach to meet their water supply needs. The legislation is intended to assist towns with populations less than 50,000 that meet certain loan criteria.

On May 11, Bureau of Reclamation Commissioner John W. Keyes III testified before the Senate Committee on Energy and Natural Resources and expressed the administration's support for a "Reclamation rural water program with adequate controls and guidelines," as outlined in S. 895.

Keyes was cautious about the loan guarantee provision, calling it a "potentially valuable innovation" that could be applied beyond the rural water program.

Senators Bennett (R-Utah), Johnson (D-S.D.) and Murkowski (R-Alaska) cosponsored the bill.

Publications & On-Line Resources



Study says LA-Owens Valley Deal Benefitted Both Sides

Owens Valley Offers Water Trading Lessons for Today

That Los Angeles was guilty of villainous deeds in acquiring Owens Valley water is a generally held belief. Writes Marc Reisner in his book, *Cadillac Desert*, "Los Angeles employed chicanery, subterfuge, spies, bribery, a campaign of divide-and-conquer and a strategy of lies to get the water it needed. In the end, it milked the valley bone-dry, impoverishing it, while the water made a number of prominent Los Angeleans very, very rich." Also, the 1974 movie, Chinatown, shows the Southern California city up to no good in its Owens Valley dealings. Such portrayals have given water trading a bad name.

Gary Libecap, head of the Karl Eller Center in the Eller College of Management at the University of Arizona, revisits the Owens Valley issue. In his recently published paper, "Rescuing Water Markets: Lessons From Owens Valley," Libecap states that misperceptions have clouded the issue. He says many Owens Valley farmers were willing sellers of their water. And, yes, the value of Los Angeles County land and buildings did increase by 600 percent between 1900 and 1930, but so did the value in land in Owens Valley. In fact, Libecap finds that Owen Valley landowners "did better by selling to Los Angeles than remaining in irrigated agriculture."

Libecap intends to do more than just set the account straight. He discusses some real problems that had to be confronted and overcome in working out the Owens Valley water trading deal; these are issues water trade negotiators face today. Libecap cautions negotiators that water trades can founder on the following obstacles: valuation disputes, bilateral monopoly and third-party effects. These were hurdles to overcome during the Owens Valley negotiations; they remain issues negotiators of water trades must contend with today. Libecap sees Owens Valley as an opportunity to learn from the past.

This paper is part of the Property and Environment Research Center Policy Series that addresses markets and environmental issues. Libecap's paper is available at the PERC web site: www.perc.org or contact Jane Shaw (shaw@perc.org) for a hard copy.

Climate Science and Drought Planning: The Arizona Experience

Katharine L. Jacobs, associate professor and specialist, Dept. of Soil, Water and Environmental Sciences and Water Resources Research Center, University of Arizona; Gregg M. Garfin, program manager, CLIMAS, Institute for the Study of Planet Earth, UA; and Barbara J. Morehouse, associate director ISPE, UA.

The authors describe Arizona's recently developed drought plan that they believe could be helpful to other states. They state, "It is hoped that Arizona's approach to integration of a wide array of hydroclimatic information into the planning process and its emphasis on framing decision criteria in terms of vulnerability and adaptation will provide enhanced drought management approaches that may be useful to other states. Interaction among drought planners and iteration of drought plans based on shared experience and new knowledge offers opportunities for operationalizing adaptive management of drought and its impacts across the United States." This article appeared in the April edition of the Journal of the American Water Resources Association; contact Katherine Jacobs (kjacobs@ag.arizona.edu or 520-792-9591) for a PDF version.

CD-ROM Assists Small Utilities Meet Arsenic Rules

The CD-ROM, Point of Use Reverse Osmosis: Complying With Arsenic Regulations in Small Drinking Water Systems, is an interactive training tool to help engineers bring small water systems into compliance with arsenic regulations using point-of-use reverse osmosis technology. Features include: activities and cost calculators to illustrate point-of-use reverse osmosis concepts; glossary flash cards to increase familiarity with pertinent terminology; and logbook records to document completed work in hard-copy format. Online and downloadable version of the program is available at http://tacnet.info/pouro Individual copies are distributed free by the National Drinking Water Clearing House. Call 800-624-8301 or 304-293-4191; refer to product #DWCDTR20. The product was produced by the Montana Water Center, Montana State University, with funding provided by the Environmental Protection Agency.

Photo: Joe Gelt

Bonnie Colby signs a book at a reception held at the University of Arizona's Water Resources Research Center. Colby, co-authored along with John Thorson and Sarah Britton, the recently published "Negotiating Tribal Water Rights, Fulfilling Promises in the Arid West." (The book will be reviewed in the July - August Arizona Water Resource newsletter.) WRRC and the UA Center for Sustainability of Arid and semi-Arid Hydrology and Riparian Areas hosted the event. Check the UA Press website for information about the book: www.uapress.arizona.edu.

Special Projects

Biomonitors Use Living Organisms to Test Water Quality

The January-February issue of the Arizona Water Resource *newsletter discussed biomonitoring and Arizona's involvement in a Rocky Mountain Consortium biomonitoring study of people exposed to arsenic in drinking water. Biomonitoring was defined as assessing human exposure to natural and synthetic chemicals by sampling and analyzing a person's tissues and fluids. Biomonitoring was said to be a rapidly developing field of research.*

Biomonitoring in this sense is not to be confused with biomonitors. Whereas biomonitoring is a process measuring human exposure to chemicals, biomonitors are a class of monitors that assess the toxicity of water samples by monitoring the behavior of living organisms. The following article discusses the use of biomonitors to detect contaminants in water.

In some ways, the use of biomonitors to evaluate or test water is a marriage of high tech with what might be considered low tech. Its reliance on advanced electronics and fast computers characterizes biomonitors as high tech; this technological sophistication is then used to monitor the behavior of living organisms responding to pollutants in water. An early example of a biomonitor in action would have been if television monitors were available to observe the behavior of caged canaries when lowered into a mine shaft to test for poison gas.

An early and very basic biomonitor was an aquarium filled with water. The behavior of fish within the aquarium was observed to note changes related to pollutants that entered the water.

Organisms now being used by biomonitors to detect water pollutants include fish, mussels, daphnia, algae and bacteria. Whatever the organism the strategy is the same: biomonitors closely observe or track the organism to note any changes in its behaviors or properties caused by stress resulting from the presence of toxic materials. Biomonitors are not able to identify the pollutant causing the changes or irregular behaviors; instead they raise an early alarm that a pollutant is in the water. Further investigation, including specific chemical analyses, may then be warranted.

Different organisms vary in their sensitivity to different substances, and they display different behaviors. Consider mussels: mussels are particularly effective as biomonitors because of their large filtering capacity, sensitivity and longevity. In response to toxicity in water, a bivalve closes its shell. Measuring the opening of the shell and recording how frequently it opens are ways to determine stress. A baseline of a mussel's normal behavior is determined; the clam's response in test water is then compared to the baseline to determine the presence of toxicity.

Daphnia, a common freshwater water flea the size of a head of a pin, is considered an especially effective biomonitor. This is because the daphnia's behavior drastically changes, its calm movements in non-polluted water becoming hyperactive in water containing certain pollutants. In the daphnia toximeter, sample water continuously flows through a chamber containing eight to ten daphnia. A camera capable of taking 25 pictures per second observes the daphnia, with an online computer analyzing the data.

Various movements of the daphnia are evaluated including speed, height in the chamber, distance from other daphnia, etc. A statistically significant deviation of the norm triggers an alarm. Daphnia toximeters have been used worldwide including during the 2002 Winter Olympics in Salt Lake City; it was part of an early warning system for source water contamination.

The various systems are generally priced between $10,000 and $50,000; operating costs are rather modest, consisting mostly of replacement costs of organisms and electricity.

The presence of a great number of pollutants, many of them unable to be monitored continuously, if at all, has prompted the use of biomonitors. Some biomonitors measure a rapid response to elevated concentrations of a wide range of toxic compounds; others assess low-level chronic contamination by persistent, bioaccumulative toxins such as biocides, pharmaceuticals and pesticides.

Recent developments in biomonitoring include a class of devices relying on fast computers that monitor water quality in real-time, on-line, and at any point in the source. Digital video recording, signal analysis and computer advances are tools for measuring nuances of an organism's behavior within seconds of exposure to toxic substances in a source water. Much work, however, remains to be done, with most of the technologies in the preliminary evaluation stages of development.

Biomonitors, mostly relying on daphnia, have been used in areas of Europe since the 1970s, mainly for monitoring the water quality of rivers. Their use in the United States has been very limited. For water quality monitoring, this country generally relies on chemical analysis to identify contaminants. A drawback to relying strictly on this approach is that the only toxins that are identified are those the analysis was conducted to find. Also, a chemical profile does not assess the synergistic effect of compounds of different substances, whereas biomonitors respond to mixtures of toxic compounds without precalibration.

A drawback to biomonitors is that false-positive results can arise due to environmental variables other than contaminants such as temperature changes or low oxygen. Other limiting factors include the high cost for more sophisticated biomonitors and the maintenance requirements for the living systems. Also, a basic concern has been raised about the accurate interpretation of biomonitor signals. Improvements in this area will result in biomonitors achieving greater recognition and value.

The Environmental Protection Agency is currently conducting research on various biomonitor technologies including the algae toximeter, daphnia toximeter, clam monitor and fish monitor. The primary objective of the research is to evaluate the ability of biomonitoring analytical results to discriminate among various classes and groups of contaminants.

The Environmental and Water Resources Institute considers biomonitors as an "emerging technology whose full potential has yet to be felt in the water quality field."

Announcements

Arizona Water Summit

Northern Arizona University's Center for Sustainable Environments is coordinating the Arizona Water Summit, to be held August 3-5, at the University Union and Field House, NAU, Flagstaff. The event will bring together tribal representatives, university researchers, water managers and government officials to discuss water resources, water management and water conservation in Arizona and the Southwest. Session topics include "Climate Change and Water Resource Management," "Creating a Culture of Conservation," "Water and Electricity," and "Urban Water Sustainability." A special track throughout the conference features tribal representatives discussing indigenous perspectives on water and preparing a statement for the 2006 World Water Forum in Mexico City. The Wednesday evening dinner speaker will be Winona La Duke, and Governor Janet Napolitano will keynote the Thursday evening banquet. For more information about the Water Summit check the CSE website: http://www.environment.nau.edu/ or contact Gary.Deason@nau.edu

The Arizona Water Summit is part of five days of events on the NAU campus focusing on sustainability which also includes the Department of Commerce Tribal Energy Workshop on August 5 and the 2005 Southwest Sustainability Expo August 4-6. The latter event will showcase sustainable businesses, products and services in the areas of energy, water, transportation, forest products, community development, and green building, For more information about the Sustainability Expo contact Julye.Evans@nau.edu

Nonpoint Source Monitoring Workshop

The 13th National Nonpoint Source Monitoring Workshop will be September 18 -22 in Raleigh, North Carolina. Titled "From Projects to Programs: Enhancing States' NPS Management Programs Through Lessons Learned from NPS Monitoring Projects," the conference will focus on the effectiveness of best management practices in improving water quality, effective monitoring techniques and statistical analysis of watershed data. Topics discussed will include riparian area and stream protection/restoration, education and outreach on NPS pollution control and monitoring low impact development. For more information, go to http://www.ncsu.edu/waterquality/nmp_conf/

Arizona Hydrological Society Symposium

The Arizona Hydrological Society will hold its 2005 symposium, "Conservation and Innovation in Water Management," Sept. 21-24 in Flagstaff. It will include a conservation forum featuring panelists from several major metropolitan areas — Tucson, Phoenix, Los Angeles, and Las Vegas — as well as from Flagstaff, Prescott, the Hopi Tribe, and the Navajo Nation. Friday's concurrent technical sessions will cover topics ranging from policy issues to watershed, groundwater, and water quality studies. The policy sessions will focus on regulation, water resource development and management, drought management, and conservation. The watershed sessions will address stream-aquifer interactions, surface-water assessments, and watershed impacts. The groundwater sessions will discuss groundwater education and flow-and-transport modeling. For additional symposium information check: www.azhydrosoc.org/news3.html

Water Quality Improvement Grant Program RFP

The Arizona Department of Environmental Quality is requesting applications for funds under the Water Quality Improvement Grant Program. Eligible projects are those that implement on-the-ground water quality improvements to manage nonpoint source pollution in Arizona. Approximately $1.5 million is available for multiple awards. Each applicant must provide 40 percent matching funds. The funds are provided by section 319(h) of the Clean Water Act, administered by the U.S. Environmental Protection Agency. The deadline to submit grant applications is 3 p.m., Oct 5. For additional information about the grant application check the Water Quality Improvement Grant Program Web site: http://www.azdeq.gov/environ/water/watershed/fin.html. The 2004 - 2007 Water Quality Improvement Grant Manual, which includes information about the grant program and applications, can be downloaded from that site.

USDA-CSREES Call for Abstracts

A call for abstracts has been issued for the U.S. Department of Agriculture - Cooperative State Research, Education and Extension (USDA-CSREES) Conference to be conducted February 5-9, 2006, in San Antonio. Abstract proposals for oral and poster presentations will be accepted July through September. Concurrent sessions will feature approximately 100 oral presentations in the following areas: agricultural best management practices, rural environmental protection, conservation and resource management, watershed assessment and restoration. In addition, space is available for 150 posters and exhibits to highlight results on research, education, and extension programs addressing water quality and quantity issues locally, regionally and nationally. Submit abstracts to: http://www.soil.ncsu.edu/swetc/waterconf/2006/main.htm

Public Policy Review

by Sharon Megdal

Summing Up: New Developments in State and WRRC Water Affairs

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

On the state legislative front, many water related bills passed — despite the rain! Space will not allow a complete reporting on such actions; the reader can consult www.azleg.state.az.us or the legislative report of the Arizona Municipal Water Users Association at www.amwua.org/legislative/legislative_summary.htm for more information.

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

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

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

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

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

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

Congratulations to all for their accomplishments this spring!

Desalter Controversy...continued from page 2

elements and differences. Dishlip describes this stage of the process as finding "all the pieces of the puzzle; at the end we had to fit the pieces together to come up with common recommendations."

According to participant Patrick Graham, state director of The Nature Conservancy in Arizona, the puzzle had many pieces. He says, "We developed various scenarios, and we began mixing and matching. At one point there were so many different positions and options on the table it seemed almost overwhelming. With Herb (Dishlip) facilitating, the group was able to reduce the number."

Collaborative Report Developed

Meeting monthly for nine months, the workgroup developed a white paper, "Balancing Water Needs on the Lower Colorado River: Recommendations of the Yuma Desalting Plant/Cienega de Santa Clara Workgroup." The recommendations offer a series of strategies to both preserve the cienega and operate the YDP. As recommendations they offer potential solutions to the dispute.

In brief, the workgroup plan calls for voluntary and compensated water forbearance, pumping groundwater in the Yuma area, operating the YDP and upgrading its capability to produce a municipal-quality water supply and maintaining the cienega habitat. (A copy of the report is available on the CAP website, www.cap-az.com or the Water Resources Research Center's website, http://www.cals.arizona.edu/AZWATER A Spanish version is being prepared.)

In some ways getting all members to agree on all recommendations was a balancing act. Graham says, "I think everybody came away with a view that there were things in it they liked better than other things, but they all could live with everything that was in there. ... If you pick one thing out or two things out then it upsets the balance that went into getting the package together."

What course of action BuRec will actually pursue is uncertain, especially during these lean economic times. Larry Dozier, deputy general manager of CAP, speculates about the effect the recommendations may have on BuRec. He says, "I think having this on the Bureau's plate will help them in formulating their position, but I do not think it will be panacea for them because it will take money. This is a beginning, not an end. It is a starting point."

Momentum Must Be Maintained

Workgroup members say that an important goal is to maintain the momentum now that the document is completed. They hope that the commitment and energy that went into developing the collaborative ideas will carry over beyond the release of the report. To encourage a carry-over effect, they included action items at the end of the report to prompt responsible agencies to get started on actions related to the recommendations.

Graham says, "I think the real work is yet to begin. The real work will be moving these recommendations forward. ... We charted a path moving beyond conflict where people hopefully can start pushing in the same direction. That certainly is very encouraging."

Whether the success in this situation will inspire collaborative efforts in other Colorado River disputes remains a question. Graham speculates about the matter. He says, "My experience is that people need to have something they can gain and something they can lose ... (and) they will stay at the table to work things out. I don't know enough about upper and lower basins issues to know whether we are that point. You would think that with the threat of shortages people would want to move beyond their historical positions and start looking at common objectives."

Although members generally felt positive about the process, one of the participants, Roger Gingrich, water resource coordinator, City of Yuma, registered a complaint. He considered the workgroup's accomplishments as truly newsworthy and complains that the media did not properly cover the event. He says if Pitt told Sid to take a hike that would be considered news. He says, "I think it was news we were able to work together for a beneficial result. The (news) ought to have been, 'Gee whiz! They were able to do something'."

Arizona Water Resource

Water Resources Research Center
College of Agriculture and Life Sciences
The University of Arizona
350 N. Campbell Ave
Tucson, AZ 85721

Address Service Requested

NON-PROFIT ORG.
US POSTAGE
PAID
TUCSON,ARIZONA
PERMIT NO. 190

THE UNIVERSITY OF ARIZONA
TUCSON ARIZONA