

### Researchers Improve Methods to Measure Snowpack

*Snow might be one of the ways to differentiate the sensibilities of hydrologists from others not sharing their professional interest. Whereas non-hydrologists may see the photo at right as a lovely snow scene hydrologists viewing the winter landscape may think of the problems of measuring snowpack to determine spring runoff.*

*With the Southwest and most of the West in the throes of a prolonged dry spell, water resource managers have an even greater need for accurate water availability estimates. Obtaining these estimates depend on the availability of more precise measurement of snowpack. What falls as snow this season later flows as a vital water supply. In fact, spring flow and other surface waters make up 54 percent of Arizona's water supply.*

*The main problem with measuring snowpack in the West is that snow falls over a great expanse of territory, with much of it in inaccessible alpine areas. The stations for measuring the snow are too few and far between to adequately cover the expanse. Further, snow in different areas yield different amounts of runoff or what is called snow water equivalent (SWE), depending upon such variables as soil moisture, slope and snow composition. A consideration of these variables is important when working out SWE*

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Photo: Philip Fortnam

### Perchlorate Emerging as a Likely Arizona Water Quality Issue

*Contaminant also poses food safety threat*

by Joe Gelt

Perchlorate is an increasingly familiar item in the water quality news of the day. It is, in fact, a breaking story, with work underway to determine at what levels it poses a risk to human health and to what extent the contaminant is present in water supplies and produce.

Further, although an issue of national significance — perchlorate is found in 23 states, mostly in groundwater — it is likely to be of far greater concern in western states. This brings up another angle to the developing story: How will perchlorate as a water quality concern affect Arizona?

The issue of perchlorate as a public health hazard is relatively new. The federal government began assessing its health risks in the mid-1990s. Studies indicate that perchlorate can affect thyroid functions, with the result that normal physical and mental growth in fetuses, infants and children can be disrupted. Also exposure to perchlorate can impair adult metabolism and cause thyroid tumors.

Perchlorate is a component of solid rocket fuel and also is used in roadside flares, air bag inflators and in the manufacture of matches. It is highly soluble in water.

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Military bases, aerospace installations and defense contractors building rockets are the primary sources of perchlorate contamination.

The perchlorate contamination of the lower Colorado River is traced to a chemical manufacturing facility located outside of Las Vegas, with the contaminant entering Lake Mead and the lower Colorado River from Las Vegas Wash. From this single-source, perchlorate has become a contaminant to be reckoned with for all downriver users of Colorado River water.

The issue of perchlorate contamination therefore looms more largely in the West than in other parts of the country. In other areas, perchlorate is more likely to have contaminated groundwater, with its effects greatest on those drawing water from a particular aquifer. In the West, the lower Colorado River is the source of the contaminant, a river managed to provide maximum use of its waters, for irrigation and for drinking water throughout the region. This puts an estimated 15 to 25 million people in the region at risk from the contaminant including Arizona water users.

Fruits and vegetables produced in this region are distributed nationally and internationally further expanding the number of people potentially exposed to perchlorate. Along these lines a recent Texas Tech University study raised new concerns about perchlorate by finding the contaminant in milk. Much of the dairy feed in the West is produced with Colorado River water.

Perchlorate is generally acknowledged as posing a health threat. What is not generally acknowledged is an appropriate maximum contaminant level (mcl) for perchlorate. How much is safe? Establishing this figure is key to determining a suitable regulatory path. Complicating the task are the widely varying figures that have been proposed, from a 2002 U.S. Environmental Protection Agency draft assessment suggesting a health-protective standard of 1 part per billion (ppb) to some defense contractors' contention that a level as high as 200 ppb would be plenty safe. The controversy prompted the Bush Administration to request the National Academy of Sciences to review the data and suggest a range for a drinking water standard.

Whatever perchlorate standards currently exist have been worked out by states patchwork fashion, with eight states having adopted advisory-standards. Three of those states draw water from the lower Colorado River: California, Arizona and Nevada. Nevada's standard is 18 ppb. California is in the process of working out a standard, to be issued some time in 2004, probably before a federal standard is adopted. The state is looking at a range of between 2 to 6 ppb. Arizona has a 14 ppb standard.

Arizona's 14 ppb perchlorate standard is an advisory health based guidance level or HBGL. This is in effect a non-enforceable advisory level. The Arizona Department of Health Sciences worked out the perchlorate HBGL through a risk assessment calculation. Initially the DHS came up with a 31.5 ppb based on adult exposure assumptions, later revising it to a 14 ppb to reflect children's higher contaminant intake rates per body weight.

The Arizona Department of Environmental Quality is presently tracking the monitoring efforts of utilities using Colorado River water and awaiting the results of NAS deliberations. EPA's unregulated contaminant monitoring rule requires that water systems serving more than 10,000 people monitor for perchlorate, with only a sampling of systems serving fewer than 10,000 needing to monitor.

Jeff Stuck, ADEQ safe drinking water sections manager, says, "We are helping to gather the information, keeping track of the results and comparing those results with our HBGL, looking for any points where we find the results in excess of the HBGL. It hasn't occurred yet."

Monitoring efforts along the mainstem of the Colorado River recorded perchlorate concentrations ranging from nondetection up to nine. In 1999, ADEQ monitored CAP canal water and found perchlorate concentrations of between 3 and 9 ppb.

ADEQ is looking to the results of the NAS review of the EPA risk assessment for guidance. Stuck says, "We are closely watching the NAS activities, to see what its findings are and then use that information as we move forward on further decisions."

It (perchlorate) could be an issue in the state depending on what NAS comes up with in its review and how that translates

into a risk assessment under EPA's authority. That will tell us whether our utilities are confronting an issue."

Charles Sanchez, director of the University of Arizona's Yuma Agricultural Center, is studying the occurrence of the perchlorate in the state, in both water supplies and irrigated crops. He says, "It is a complicated issue, a water quality issue having food quality implications."

Like many other researchers now studying perchlorate Sanchez got started relatively recently. He says, "It came on my radar screen about four years ago, from the implications of an EPA greenhouse study that lettuce accumulated perchlorate passively."

Sanchez subsequently sampled various kinds of lettuce irrigated with Colorado River water to determine the presence of perchlorate. He found that in head lettuce most of the perchlorate was in the wrapper or frame leaves that are discarded, with little present in the edible portion. He says, "When we moved on to other kinds of lettuce like leaf and romaine we are finding more frequent hits in the edible portions."

He also sampled sweet corn, tomatoes, peppers and cantaloupes. He says, "We are finding trace amounts in some of the fruiting crops, but mostly below our limits of quantitation."

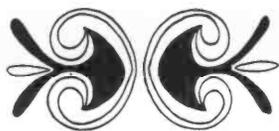
Sampling water at the Imperial Diversion of the Colorado River where over 4.2 million acre feet of irrigation water is diverted, Sanchez has found perchlorate in the range of 5 to 7 ppb.

Any possible perchlorate problem with lettuce could have adverse economic effects in the state. Lettuce is a prime cash crop, and a decline in sales would have an impact on the state's agricultural community.

Sanchez has teamed up with toxicologist Bob Krieger from the University of California, Riverside, with Krieger working on exposure assessments, to find out how much perchlorate a person might be exposed to by eating produce that has been tested and found to contain the contaminant.

Krieger says, "We are using the amount of perchlorate established as a maximum contaminant level in drinking water as a standard. We estimate the exposure from

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## Water Vapors

### Water Resource Workers' Value Often Overlooked

In the public eye, at least when that eye is focused on the glitter of mass entertainment, those laboring in the hydrology and water resources field are without interest, appeal and certainly without glamor. Has any such character ever figured in plots on stage, screen or television, to save the day, solve the mystery, woo the heroine and ride off into the sunset or even add spice and interest to a story? We are not necessarily talking action figures here, simply interesting, likeable, forthright characters.

#### Wastewater worker as antihero

Actually one such character recently came to mind: Ed Norton, sewer worker. With the death of Art Carney, who played Norton as a foil to Jackie Gleason's Ralph Kramden in the TV series "The Honeymooners," many former viewers recalled the antics of the goofy, not-too-bright sewer worker. Attired in a turned-up pork pie hat, open vest over white T-shirt, he would regularly get the goat of the bellicose Kramden.

Norton's job as sewer worker was central to his personality. He played the job and his time in the sewer for full effect, to add color and pungency to his character. It was a fitting tribute to Carney that Norton's sewer sayings were recalled to commemorate his death. Some samples follow:

A sewer worker is like a brain surgeon. We're both specialists.

Like we say in the sewer, time and tide wait for no man.

If pizzas were manhole covers, the sewer would be paradise.

#### Sol Resnik, water resource professional extraordinaire

But of course the water resource field does have its heroes and champions, although their doings are not likely to attract much, if any media attention. By any measure Sol Resnik would be among the ranks.

It is not enough to say such people are outstanding because they take their jobs seriously. Lots of people do that. These people are outstanding because they bring



*Sol and Elaine Resnik at the dedication of the WRRC conference room. About 95 of Sol's colleagues, friends, associates and former students showed up to honor him. (Photo: Joe Gelt)*

something special to their careers, a particular style or commitment beyond a do-the-job-well attitude. They are likely to be personally dedicated to their careers not just committed and have a high regard for all those involved in the work, both those contributing to it and those benefiting from it.

This explains why most of the speakers at the Water Resources Research Center's ceremony dedicating its conference room to Sol Resnik spoke of Sol's human qualities. Sid Wilson, former Sol student and general manager of the Central Arizona Project, described Sol's interest in water as actually an interest in people. Robert Glennon, University of Arizona School of Law professor, described Sol as a truly "gentle man." Such sentiments marked the tone of the Nov. 18 event honoring and recognizing Sol as a sensitive person and an accomplished water resource professional, champion and hero.

May the warmth and sensitivity of WRRC Director Emeritus Sol Resnik preside over all meetings conducted in the Sol Resnik Conference Room.

This issue of the newsletter includes a "Guest View" by Sol Resnik. See page 6.

### WRRC Plans Spring Conference

WRRC is in the process of planning its spring conference, to be conducted in Casa Grande, April 28, 2004. Its topic is "The Future of Agricultural Water Use in Arizona." For the latest information on the event and to sign up to receive further updates see Announcements, page 10.

### New WRRC Director Appointed

Sharon Megdal will become Water Resources Research Center Director when Peter Wierenga steps down from the position effective June 30, 2004. Megdal has been with WRRC since she was hired as associate director in January 2002. Along with her WRRC administrative position, Megdal also is a professor and specialist in the University of Arizona's Department of Agricultural and Resource Economics. Wierenga will be returning to faculty status.



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## News Briefs

### Navajos, N.M., Feds Reach Proposed Water Settlement

A proposed settlement worked out by the Navajo Nation, New Mexico and the federal government holds promise of resolving a 30-year water rights conflict in northwestern New Mexico. NM, Congress and the Navajo tribal government must officially approve the agreement.

The Navajo Tribe for its part agreed to accept 322,000 acre feet annually from the San Juan River and guaranteed that no additional future claims will be filed. In return, the tribe would receive about \$900 million for public works projects. This money would be used to complete an irrigation project as well as pay for a pipeline to supply communities on the eastern side of the reservation with drinking water.

The proposed settlement allots the amount of water the tribe can apply to various uses. These include farming projects and municipal uses, the Animas-La Plata diversion project, the Navajo reservoir as well as what can be supplied to non-Indian farmers and cities in San Juan County. Available supplies were sufficient for the settlement, with no new water sources tapped.

The settlement is dependent on Congressional approval of \$896 million for water projects, with the planned Navajo-Gallup Water Supply Project pipeline the most expensive. This project would pump water directly from the San Juan River, below the confluence of the La Plata and San Juan rivers, and pipe it to Gallup, New Mexico, and to areas within the Navajo reservation, both in New Mexico and Arizona.

In an another Navajo water right development, this time a court case with possibly far-reaching implications to Arizona, the Navajo Tribe has filed suit against the federal government in an effort to obtain recognition of tribal claims to Colorado River water.

### Report: Nation's Dams in Dire Straits

Dire warnings about the state of the nation's infrastructure continue, with a recent report issued by the Association of State Dam Safety Officials that the condition of the nation's dams warrant immediate attention.

The ASDSO report reflects findings of a September American Society of Civil Engineer's report on the nation's infrastructure. That report judged dams in worse shape than they were two years ago when ASCE assigned them a "D" in its "2001 Report Card for America."

For its report ASDSO compiled state and national estimates of the cost of dam rehabilitation. Its task committee concluded that the cost of upgrading or repairing the nation's non-federal dams would exceed \$36 billion. ASDSO plans to ask Congress in the coming year to establish a national dam financing solutions program.

The report estimates that of this amount about \$10.1 billion is needed for dams classified as "high-hazard-potential." States currently regulate more than 10,000 of these structures, and the number is increasing. In 2001, Arizona regulated 88 "high-hazard-potential" dams, a rather significant increase from the 72 the state regulated in 1998.

Arizona's cost to rehabilitate these dams is estimated to be about \$95 million. The state has a Dam Repair Fund but it lacks sufficient resources to conduct the needed repairs.

The "high-hazard-potential" classification does not mean that the dams are hazardous, with a high possibility of failure, but instead that if they did fail they would likely pose a high hazard to life and property.

Also contributing to the concern about the condition of dams is the role they play in flood control. Flood control has gained increased prominence lately, with increasingly more development occurring in historic floodplain areas protected by dams. Their deterioration therefore poses a greater threat to life and property.

Dams, like water utilities, come in all sizes, with many of the dams in the United States and Arizona privately owned, and many are very small. About 50 percent of the nation's dams are privately owned, often by owners without the financial resources to maintain, repair and upgrade them.

TOP 10 BIG DAM COUNTRIES

Rank	Country	No. of dams
1	China	22,000
2	U.S.	6,575
3	India	4,291
4	Japan	2,675
5	Spain	1,196
6	Canada	793
7	South Korea	765
8	Turkey	625
9	Brazil	594
10	France	569

*\*China has nearly half the world's big dams*

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estimates.

Work is being done by researchers Roger Bales and Noah Molotch of the University of Arizona's Climate Assessment for the Southwest (CLIMAS) and researchers from the Southwest Regional Earth Science Application Center to improve methods for estimating SWE across the West. This would lead to greater accuracy in estimating water availability throughout the year.

The method involves interpreting satellite imagery to determine the snow-covered area on the land surface and integrating the information with ground-based estimates of SWE. The method enables researchers to estimate SWE over an entire river basin or more extensive land surface and assimilate the estimates into hydrologic models. A process-based methodology is applied that takes into account basin-wide snowfall patterns, elevation, terrain, local hydrology, solar radiation, air temperature, soil composition and other physical factors affecting total SWE.

## CA Urged to Try a Water Conservation Life Style; Las Vegas Tries Conservation

Arizona may have something to learn about saving water from two of its neighboring states: California and Nevada. The California news is that water conservation may trump reservoir building for obtaining new water supplies. The news from Southern Nevada is that odds don't necessarily favor water conservation when drought pinches.

### Report: Conservation Answer to California Water Shortages

Water use in California cities and what can be done to better conserve water is the subject of a recently published report. Three years in the making, the report is the first comprehensive, in-depth review of water use in urban areas of California, and its results are relevant to Arizona.

In fact, Val Little, director of Water CASA, a consortium of Southern Arizona water providers sharing conservation resources, says Arizona needn't do a similar study since, "There is no need to reinvent the wheel."

*"I had no idea that there was a drought, I'm not conservative with my water at all. In fact, last night I spent half-an-hour thawing chicken under the faucet."*

Quote from University of Arizona student in a Dec. 2 article on drought in the "Arizona Daily Wildcat," the student newspaper.

The study emphasizes that any future search for new water sources should begin with water conservation, the cheapest strategy for increasing water supplies. Called "Waste Not, Want Not," the report concludes that more than building a new reservoir, the state would be better off to encourage citizens to more efficiently manage their household's water use, by installing more efficient bathroom fixtures, sprinklers, washing machines and other appliances.

According to the study the payoff would be that California cities could save about one-third of the water they presently consume or in other words enough water for about 4 million households.

The study identified toilets as the number one urban water waster, with about 7.3 million six-gallon toilets still in use in California despite programs urging their replacement with 1.6-gallon models. The result: toilets consume about 734,000 acre feet of water each year, about one-tenth of all urban supplies.

The report includes water-saving figures achievable if various conservation strategies were adopted. For example, replacing full-flow toilets would result in a 420,000 acre feet savings each year, sufficient supplies for 840,000 homes. Fixing indoor plumb-

ing leaks would annually save 230,000 acre feet. If a more efficient outdoor water systems were installed, another 360,000 acre feet could be captured.

The report was prepared by the Pacific Institute, a water think tank based in Oakland. Support for its work included \$70,000 in state funding and an additional \$130,000 in foundation contributions.

Some voiced criticism of the report claiming the Institute had a bias toward conservation and therefore slighted any evidence justifying the building of new reservoirs. Findings of the report are to be included in a new California water plan scheduled for completion by the end of the year.

The savings indicated in the report are over and above water savings already achieved in the state through effective water conservation programs. For example, the population of Los Angeles has increased by 700,000 people in the last two decades yet its water demand has remained constant due to improve efficiency.

Val Little says, "I think everyone in Arizona should read the report in its entirety with an eye toward its usefulness here as well."

A copy of the report is available at [www.pacinst.org](http://www.pacinst.org)

### Las Vegas Water Users Evade "Drought Watch"

Southern Nevada Water Authority officials were surprised and dismayed to find that water consumption during October was 0.5 percent more than in October 2002, despite the enactment of water saving, drought-fighting measures.

September water use seemed to bode well when customers of the water authority's seven member agencies cut their actual usage by 11.1 percent. Then came an exceptionally dry, hot October, and water usage spiked. The National Weather Service reported that no rain fell in the area during the month.

The figures are especially disheartening since they are the first measures of residential and commercial water consumption since the summer declaration of a "drought watch."

Water users circumvented the intent of some of the water saving measures. For example, some water users watered their vegetation for longer periods of time when restricted to watering only three times a week. Officials are now considering adopting time limits on the watering of grass, trees, and shrubs.

With the Southern Nevada Water Authority board voting unanimously to shift the Las Vegas region from "drought watch" to "drought alert," more restrictive drought mitigation measures will be set for the beginning of the year. These will include restricting lawn and turf installation, prohibit using commercial and domestic misting devices and ban car washing at houses and apartment complexes.



## Guest View

# Importance of Hydrologic Field Work Often Overlooked

*Sol Resnik, former director and now director emeritus of the Water Resources Research Center, contributed this Guest View.*

I am a hydrologist who happens to enjoy field work. But in my working lifetime I have seen a great difference in the way hydrologic problems are solved. In the 1960s and 1970s, it became fashionable to adopt a mathematical or statistical approach, for use with computers, and to develop hydrologic models.

I am the last person in the world to knock the work that is being done. It is important. But hydrologic field work is just as important, and this is what most people do not want to do anymore, although federal agencies are still doing good field work, for example, near Tombstone. At the university when the Water Resources Research Center had a cutback, the field lab was the first to go.

In the early 1940s, I worked with the Tennessee Valley Authority (TVA), with such world-class hydrologists as Ray Lindsley and Bill Ackerman. These early hydrologists were field oriented. They worked on designing, building, and installing weirs to measure storm runoff as well as equipment to measure amounts of eroded sediment and networks of rain gauges.

When I was at Colorado A&M in the late 1940s, I worked with Ralph Parshall and Carl Rohwer. They had retired from the U.S. Agricultural Extension Service and were now developing low-cost farm irrigation equipment. Parshall developed a flume for measuring flow onto irrigated fields that is still used all over the world. He wrote up the design and flow data tables which were provided through the Extension Service. He did not patent it, although it could have made him very rich. This is unlike today when universities and their scientists patent almost everything they develop.

I also taught hydrology at Fort Collins in the 1940s, and my course outline at that time was completely different than what is used today. There was a much different approach back then. When I was teaching, hydrology included field work, and I made field work 25 percent of the final grade.

Later, when I was teaching at the University of Arizona, this caused a problem. I had an Egyptian student who came from a good family. During the first day of class I had told the students that 25 percent of their grade will be made up of field work, with one afternoon a week out in the field. When the class turned in its reports I did not get one from him, and I called him in to ask what happened.

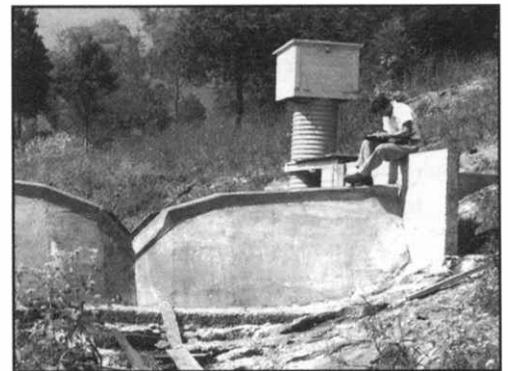
He said in Egypt he did not go out in the field because he had workers go out in the field. He tells them what he wants, and they get it for him. I asked him how he knows what he wants, explaining that each situation is unique, and field work is a way to get the best idea of different situations.

I gave the student a C, although I could have given him a D. UA President Harvill called me in his office and told me that the Egyptian Embassy had phoned him about the student's grade. I

told President Harvill about the importance of field work, and he backed me up.

When I went to India they did not have the money that TVA had, to buy such equipment as recording rain gauges, water recorders, and equipment for measurement of eroded sediment. I had to collect data in other ways, less accurate but much less expensive.

For example to obtain river flow records, I painted foot marks from zero at the river bed to the bottom of the bridge on one of the pillars of a bridge. As you crossed the bridge you could quickly see what the reading was and make a note



*Resnik doing field work for the TVA, Aug. 1942, at Claypole Weir in Thompson Creek area in Virginia.*

of it. Over time you had readings of the height of the river at the bridge and could change that information into flow records, (Q in cubic feet per second) with the use of a rating curve.

Since  $Q = \text{Area of flow (ht x width, ft}^2) \times \text{Velocity of flow, ft/sec}$ , using a bridge where the width of flow is a constant, the rating curve can be easily developed by noting the velocity of flow at a low, medium, and high flow. The velocity can be measured near the bridge by timing a float over a measured distance.

Cheap methods for gathering data were needed. Although these may not be as accurate as other devices, they were better than nothing. I tried to work in this message whenever I lectured in places like China.

I recently got a message from a consultant in India who said for some reason the groundwater in his area was getting saltier and more polluted, and he did not know why. The area is right on the coast, and he did not know it was due to sea water intrusion. He never tested the waters, the seawater or the polluted groundwater. How do you come up with an answer if you do not know what the cause of the problem is? But this is what you pick up by doing a little testing, a little field work.

The new sophisticated modeling methods are good for big areas. If you have the right data, you can come up with some very good models, and it takes a country like this one to develop the models. There may be comparable areas in countries like India and Africa where these models can be used, although every situation is different; hence you have to put some real data in those programs. Unfortunately, it is easier to sit before a computer than go out and fight the heat and the rain to collect data. ■



## Legislation and Law

### Bill Takes Middle Path in Fort's Water Use Responsibilities

*Flow of San Pedro again at issue*

More controversy further troubled the waters of the San Pedro River when recent legislation took on the issue of Fort Huachuca's responsibility for water use in the Sierra Vista area. The provision was a detail tucked within the bulk of the recent \$401 billion defense bill.

The provision cheered some fort supporters while many environmentalists say it was not as bad as it could have been, but it was bad nonetheless.

Central to the issue is preserving the flow of the San Pedro River. To what extent water use at Fort Huachuca and neighboring Sierra Vista affects its flow is a question that has spawned controversy and law suits. Environmentalists argue that growth in the area is tapping groundwater resources that otherwise would replenish the river. This poses a threat to riparian vegetation that is habitat for the abundant bird life in the area, including endangered species.

In response to the controversy, the U.S. Fish and Wildlife Service last year issued a biological opinion stating that 54 percent of the 64,655 people living in the watershed were associated with the fort. The agency concluded the fort was therefore responsible for 54 percent of the water use in the area, including water consumed by people not living or working on the post.

The fort's conservation responsibilities would then be based on this number. The army went along with the opinion, although some area residents feared the opinion would jeopardize the operation of the fort. Environmentalists on the other hand were pleased with the fort being assigned responsibility for so much water use. It is a federal installation and therefore subject to the Endangered Species Act.

This is where matters stood when Rep. Rick Renzi, R-Ariz introduced a provision releasing the fort of responsibility for all off-post water use. The House initially approved the measure but as it worked its way through legislative channels a compromise measure won the day. Worked out by Sen. John McCain and others, the measure excluded the Renzi provision. It still, however, exempts the fort from water use completely unrelated to its presence.

The compromise measure also directs the Upper San Pedro Partnership with producing a report outlining a strategy for the watershed to follow to achieve "safe yield" by 2011. The partnership is a consortium of 17 government agencies, the Nature Conservancy, Audubon Arizona and a private water company.

In some ways this assignment might be seen as a plus for the partnership since it establishes federal recognition of the consortium. Also some funding was authorized to work on the report.

The bill also requires the U.S. Secretary of the Interior to file a report by Dec. 31, 2004 that "must identify impediments in current

Federal, State and local laws that hinder efforts of the Upper San Pedro Partnership to mitigate water use."

Some argue the compromise bill provides the mechanism for working out solutions for limiting water use and preserving the flow of the San Pedro. Others view the action as delaying tactic, a way to put off taking any significant steps.

### Irrigation District Must Meet Drinking Water Standards

The Arizona Department of Environmental Quality recently issued a consent order requiring the Wellton Mohawk Irrigation and Drainage District to follow federal standards for surface water providers. The order requires district officials to comply with new federal regulations that apply to open-canal public water systems delivering water for domestic purposes. Such delivery systems must now comply with Safe Drinking Water Act standards.

Previously, open-canal providers were not defined as a public water system. In an effort to safeguard drinking water for residents using water from open-canal providers, the Safe Drinking Water Act was amended to allow their regulation.

ADEQ officials say that the canal water, particularly when including surface water runoff from nearby crops, could contain numerous contaminants. These could possibly be harmful to individuals who may use it for household purposes.

The district provides water through a 350-mile system of concrete-lined open canals for customers in the Wellton Mohawk Valley, along the Gila River approximately 30 miles east of Yuma. Although the water is mostly for irrigation, its potential for household use necessitated the consent order.

The consent order calls for the district to ensure customers are not using untreated surface water for household purposes such as drinking, cooking, bathing or oral hygiene. Households now tapping into the canal will be required to buy drinking water from an approved vendor or be cut off from the canal. WMIDD has 180 days from Oct. 30 to compile a list of potable water providers for its customers.

WMIDD officials questioned the need for the new regulation arguing that people who get canal water sign a contract indicating they are aware that the raw Colorado River water is unfit to drink. Further, they argue that most of their customers who are getting water from the canal are hooked up to a treatment plant. Some in the area viewed the directive as unjustified government interference in the rights of citizens to make their own choices.

ADEQ Director Steve Owens says, "This type of agreement will help ensure that clean, safe drinking water is available for residents in this area. We are pleased that the district is working toward implementing the changes outlined in the order, and we feel certain that this can be done within the required time period." ■



## Publications & On-Line Resources

### Photos Document Changes Wrought by Nature and Man

#### The Changing Mile Revised

Raymond M. Turner, Robert H. Webb, Janice E. Bowers and James Rodney Hastings, University of Arizona Press, 334 pp., \$75 cloth. To purchase call 800-426-3797

As indicated by its title, *The Changing Mile Revisited* is a revisited not a revised edition of *The Changing Mile*, published in 1965. It is a revisited edition because it greatly expands the earlier book's scope. Using repeat photography, the 1965 volume provided sets of photographs, with photographs taken throughout the Sonoran Desert region in the late 1800s and early 1900s paired with photographs of the same location taken many decades later. *The Changing Mile Revisited* extends the time period with even later photographic coverage, into the late 1990s.

Repeat photography is a technique for studying environmental changes over time, a scene changing in response to natural and human events. The book's photos are the visual evidence, with the accompanying text discussing the causes of the changes. For example, in direct, non-technical language, the authors consider within a single chapter the influences of Indians, Spaniards and Mexican, with changes wrought by Anglo-Americans get-

ting a chapter unto themselves. Information studied to account for environmental changes includes precipitation records. *The Changing Mile* provided an analysis of the rainfall records since 1895. The later book updates the data by analyzing rainfall from 49 climate stations in southern Arizona and Sonora.

The book mainly features vegetative changes occurring in landscapes over time, although changes to waterways also are evident in some of the photographs. For example, the photographs to the right are of Sonoita Creek.

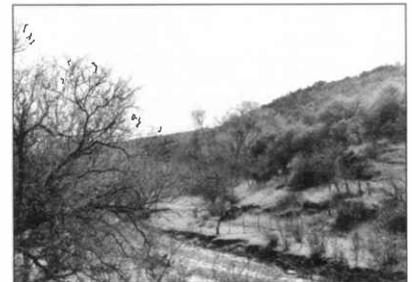
In the 1895 photo, heavy livestock use is evident, with a few young cottonwoods the only trees visible along the stream. Recent erosion has toppled several cottonwoods. The unweathered vertical banks indicate recent downcutting.

In 1962, a mesquite bosque covers the flood plain, with seep willow fringing both sides of the creek. Other vegetation now growing within the riparian area include walnut, netleaf hackberry, skunk-bush, canyon grape, Goodding willow, Texas mulberry and poison ivy.

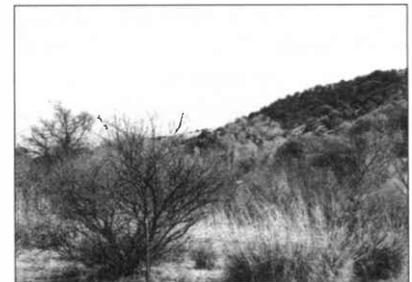
By 1998, the channel of Sonoita Creek had deepened and is now several yards below the old valley floor and is supporting a rich growth of riparian plants.



ca. 1895



1962



1998

### New AZ Online Water Newsletter Debuts

The sources to tap for Arizona water information continue to expand with the Nov. 25 launching of the *Arizona Water News*. This free, weekly, on-line newsletter describes itself as "an instant clipping service," for people needing to keep up with water and waste issues. The premier edition included in-state news clippings from Sierra Vista, Yuma, Payson, Bullhead City, Tucson and Phoenix, along with news releases from the Arizona Department of Environmental Quality and the Central Arizona Project. Although its primary focus is Arizona, the newsletter also provides clippings from out-of-state sources, to cover water issues of regional and national interest. Brown and Caldwell publishes the Arizona Water News. Subscriptions are available to officials and employees of agencies directly involved in managing water resources. Agencies may request subscriptions for their consultants, lawyers or other advisors. To subscribe

complete the form at <http://www.bcwaternews.com/>

### New Journal, a Guide to SW Environmental Research

The newly launched *Southwest Environment Research News* is a guide to the scientific literature on applied environmental research, with each issue presenting news of recent research gleaned from hundreds of scholarly journals, reports, books and internet services. Covered topics include wildlife biology, forest ecology, hydrology and water-resources management, hazardous wastes and pollution, and law and public policy. The first issue will be published in January, and there will be ten copies per year, with an annual subscription rate of \$189. For more information or to subscribe contact Environment Research News Service, P.O. Box 65027, Tucson, AZ 85728-5027, phone: 520-888-9774.



## Special Projects

### Yuma Project Restores Lower Colorado Wetlands

*Project could serve as model for more extensive efforts*

Restoring the natural conditions of the Colorado River is an issue now in the spotlight, with various projects underway. These range from a regional, three-state partnership to a Yuma community consensus-building effort.

Yuma's immediate goal in undertaking a project to restore 1,200 acres of wetlands along the Colorado River is to develop an environmental feature to boost the local economy. Not to be overlooked, however, is the broader goal of the Yuma East Wetland Project. Officials hope a successful project will serve as a model for other efforts to restore extensive reaches of the Lower Colorado River.

The YEWP covers 1,418 acres immediately upstream from Yuma, an area bounded on the north and south by Colorado River levees, on the west by the Ocean-to-Ocean Bridge and on the east by the Gila-Colorado River confluence. Plans call for restoring aquatic, wetland and riparian habitats to benefit wildlife species living in this area of the Lower Colorado River.

The project's biological assessment states that the targeted area is "one of the most ecologically altered landscapes in the Southwest," its

natural conditions undermined by a century of environmentally destructive events including flow regulation, channelization, non-native species invasion, mining, wildfires and unregulated dumping.



*Yuma East Wetland researcher wades through swamp. (Photo courtesy of Fred Phillips)*

The area is now a wasteland of exotic salt cedar and giant cane.

Restoration strategies include converting fallow agricultural land into sheet-irrigated cottonwood/willow habitat; restoring flow through degrading marshes; planting dense cattail and bulrush; and revegetating riverbanks and other suitable riparian areas with cottonwood/willow, mesquite and other native species.

YEWP also will feature opportunities for cultural preservation, environmental education and low-impact, non-motorized recreation. Project plans call for the construction of natural-history

interpretation centers and recreational facilities. The U.S. Corps of Engineers recently granted the project a 404 permit.

YEWP, a component within the broader Yuma Crossing National Heritage Area, grew and evolved as part of a collaborative strategy, with stakeholders and various interests working together with Heritage Area officials to ensure a community-based, cooperative effort. Participating on the team working out project details were the Quechan Indian Nation, the City of Yuma, Yuma County, private landowners and farmers. The effort showed results in 2001 when 28 stakeholders agreed to a restoration plan

Charles Flynn, Yuma's riverfront development manager, says, "We essentially met people's concerns, fears and needs up front. For example, we said to farmers, in and adjacent to the levees, that this is not going to be some kind of sacred preserve that will affect their farming practices or their property rights. ... If they choose to farm within the levee on their private property they can do it."

Flynn stresses that all involvement in the project was voluntary "We don't want even a whiff or scent of any kind compulsion. ... That creates a better sense that they can opt in or opt out, it is their choice."

Flynn says they are seeking agricultural conversion funds to pay farmers who are willing to participate in the project by converting their farmland to habitat. Such funding would enable project officials to pay farmers the going rate for land rental. Further, the farmer might be paid to clear the land and to maintain and irrigate planted trees.

Flynn says the contract includes a hold harmless clause to allow farmers at the end of the lease the option of returning lands to agriculture regardless of its condition at that time. Flynn, however, adds "I believe that ultimately, at least within the levee, farmers will come to understand that owning mature habitat is worth more than other uses they could put their land to."

By undertaking river restoration the project will be gaining mitigation credits. These credits certify that a certain amount of restoration has in fact taken place, and they are useful in attracting additional funding for the project. Mitigation credits also may be a negotiable commodity, with their value increasing over time. Farmers could profit by owning mitigation credits.

Some landowners outside the project area remain skeptical, fearing that some down-the-line development may work to the landowners' disadvantage. Flynn says, "We are very aware of this tension between private property rights and environmental mitigation, and we try to work through it."

The involvement of Quechan Indian Nation — it owns between 40 and 50 percent of the land — was essential to the success of the project. Flynn says efforts were made to bridge past historical and cultural differences by working with the tribe and meeting its concerns. He says the tribe's support of the project was partly motivated by the land having once been an ancestral farming and hunting area. Restoring the land to some semblance of its condition 100 years ago therefore has a cultural significance to the tribe.

*Continued on page 12*



## Announcements

### AWWA Offers Free Vulnerability Assessment Seminars

The American Water Works Association will be offering the seminar, "Vulnerability Assessments for Small and Medium Water Utilities," at no cost to employees of utilities serving less than 50,000 customers. The hands-on seminar is built around the Risk Assessment Methodology for Water and will guide attendees through creating an action plan. Utilities will learn how to identify threats, how to plan and prioritize for the assessment, and how to assess risks. The seminar will be conducted in six different locations across the country including Prescott, AZ on Mar. 2 - 3, at the Prescott Resort and Conference Center. Seminar registration and information can be found at <http://www.awwa.org/education/seminars/>. The AWWA seminars are conducted as part of program funded by the U.S. Environmental Protection Agency.



### WRRC Planning AG Water Use Conference

What is the future of agricultural water use in Arizona? This is the central question to be addressed at the Water Resources Research Center's spring conference, also billed as a conference-dialogue. The event is planned as an opportunity for representatives of the agricultural sector to discuss their views of this water future, with attendees encouraged to participate in discussions. Scheduled April 28, 2004 in Casa Grande, the event is a joint venture involving WRRC and the University of Arizona's Department of Agricultural and Resource Economics. More details on the conference will be distributed in early 2004. For additional conference information, including sponsorship information, contact Jackie Moxley, 520-792-9591 ext. 17 or [jmoxley@ag.arizona.edu](mailto:jmoxley@ag.arizona.edu). To be placed on the conference email or mailing list, contact Stephanie Lopez, 520-792-9591 ext. 11 or [smlopez@ag.arizona.edu](mailto:smlopez@ag.arizona.edu).

### Fellowship, Award Available for Student Water Research

#### Graduate Fellowships for Water Research

The National Water Research Institute is offering fellowship of up to \$15,000 to graduate students conducting research related to water resources. To be considered for an NWRI Fellowship for the next academic year, you must submit an application by March 1. The application must include: a letter of inquiry describing your research goals; a resume; a letter of endorsement from your faculty advisor; a 3-4 page research proposal; and verification of enrollment as a full-time graduate student. Fellowships are awarded July 1 of each year. Mail application to: NWRI, Attn: Fellowship Program, 10500 Ellis Ave., P.O. Box 20865, Fountain Valley, CA 92728-0865; or for more information check: [www.nwri-usa.org](http://www.nwri-usa.org) or call 714-378-3278. NWRI is a non-profit organization dedicated to promoting and funding research in the fields of water science and technology.

#### CAP Offers Graduate, Undergrad Research Awards

Papers are accepted all year long for the Central Arizona Project Award for Water Research. Eligible participants include graduate and undergraduate students at any college or university in Arizona. Papers submitted for this award should focus specifically on water issues affecting central and southern Arizona and the Colorado River and should represent the student's original, unpublished work. Papers can focus on 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. The first place award is \$1,000 and second place is \$500. Finalists will be selected in May, and the winners are invited to present their research at the Arizona Hydrological Society's annual symposium, expenses paid. For additional information about the award check "public info" Information" in the Central Arizona Project web site: <http://www.cap-az.com/>

*Perchlorate...continued from page 2*

the produce relative to the amount in water." The mcl figures represent no-effect levels since they are the upper limits of a safe drinking water range. Water with perchlorate levels up to these figures is presumed safe, with no health effects.

Figuring that a person drinks two liters of water per day, Krieger then estimates the exposure from the produce relative to the amount in the water. He says he looks at different population groups with characteristic consumption patterns. "There is a lot of data for the consumption of various commodities. ... We can make age specific determinations; in some cases even geographical ones."

Summarizing his research thus far Krieger says, "I can tell you categorically we have no alarming information, nor any information

with toxicological implications."

Krieger and Sanchez are now working on a more thorough survey, with more extensive sampling. They anticipate similar results.

Sanchez also wants to look into the extent that perchlorate has contaminated groundwater sources in the lower Colorado River region. He says, "We have no data to indicate to what extent groundwater sources have been tainted through their interaction with surface waters." He says such a study would have broad implications for other areas in the western United States that are recharging Colorado River water.

Sanchez and coworkers are also seeking funds to study biotic and abiotic factors affecting the transport, transformations, and distribution of perchlorate in the environment. ■



## Public Policy Review

by Sharon Megdal

### What Can WRRC Do to Serve Your Water Information Needs?



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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

*Colorado Wetlands...continued from page 9*

The tribe also gained other kinds of advantages by cooperating with YEWP. For example, project officials worked with the tribe to open the Ocean-to-Ocean Bridge connecting downtown Yuma with the Quechan community and its casino. Also, the potential for operating water taxis from tribal lands to development in downtown Yuma is being discussed.

Although designed for local impact, i.e. the Colorado River in the Yuma area, project officials believe YEWP can have a broader influence on restoration work planned for the Lower Colorado River region, from the international border to below Davis Dam. YEWP's broader influence could be achieved by working with the Lower Colorado Multi Species Conservation Program, a project that is planning and conducting restoration work in the extended area.

MSCP is a regional partnership with broad and varied membership. Made up of representatives of Arizona, Nevada, and California, along with various stakeholders and water and power agencies along the Lower Colorado River, MSCP is developing a multi-species conservation program to protect sensitive, threatened and endangered species of fish, wildlife and their habitat.

A monumental undertaking, MSCP is a work in progress, with efforts now underway to develop a comprehensive plan, a task expected to be completed in 2004. The plan is expected to be operational by 2005 and implemented over 50 years, at an estimated cost of \$600 million. Identifying areas most suitable for restoration is a MSCP priority. Success in such areas would establish the project's credibility and build momentum for its future work. It is in this regard that Flynn believes YEWP can contribute to MSCP efforts.

He says, "Our goal is to have a meeting of the minds at some point with MSCP as it completes its plan by the end of 2004."

Flynn thinks MSCP might want an early action project to demonstrate an effort that meets its requirements. He says the Yuma project would be a good candidate for this role, to help get other MSCP projects up and started.

He says, "The reason we are a good candidate is that we have done the hard work of consensus building and all the technical work to reach the point of getting the permit." Cooperation would provide a two-way advantage, with both projects benefitting. MSCP could help fund the Yuma project while YEWP could provide mitigation credits for the larger project.

That YEWP operates on a smaller scale than MSCP gives the Yuma project a planning and operational advantage. In discussing differences between the two projects Flynn says, "The comprehensive community-based planning we have done with property owners and stakeholders is hard work. It has taken us three years, and to multiply that by 1,000 stakeholders and property owners up and down the river, it becomes an almost an impossible task. ... Just the planning challenge, to get the environmental compliances and all the documents completed along with consultations with all the tribes and property owners is a monumental undertaking"

He says, "I am sure they (MSCP) wish they could do in macrocosm what we have done in microcosm."

Flynn has other reasons he believes YEWP could play a productive role as a MSCP demonstration project. A relatively large city, Yuma has an airport that would provide officials and other visitors access to the restoration project. Also the wetlands are located at the edge of the city, further ensuring ready access to the site.

He says, "I think the restoration of the Lower Colorado River is such an enormous task that frankly I can't imagine not using every resource, both BuRec's and any community-based resource to get these projects off the ground." ■■



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