ARIZONA
WATER RESOURCE

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Are Constructed Wetlands Health Hazards?

With advantages seemingly outweighing disadvantages, constructed wetlands often are viewed as a win-win situation, promising much and delivering much, from environmental benefits to an inexpensive and effective way to treat wastewater.

The finding of encephalitis-carrying mosquitoes at Tucson Water's Sweetwater wetlands facility, however, shows that health hazards may lurk within those attractive wetlands. A question subsequently raised is whether the public health risk warrants closing any wetlands and/or not building new ones.

Mosquitoes carrying the Western equine encephalitis virus and the more virile St. Louis encephalitis have been found at Sweetwater, a 60-acre wastewater facility and recreation area. Health threats posed by encephalitis-carrying mosquitos, however, are not confined to the Tucson area. The Arizona Department of Health Services reports that a high number of mosquitoes infected

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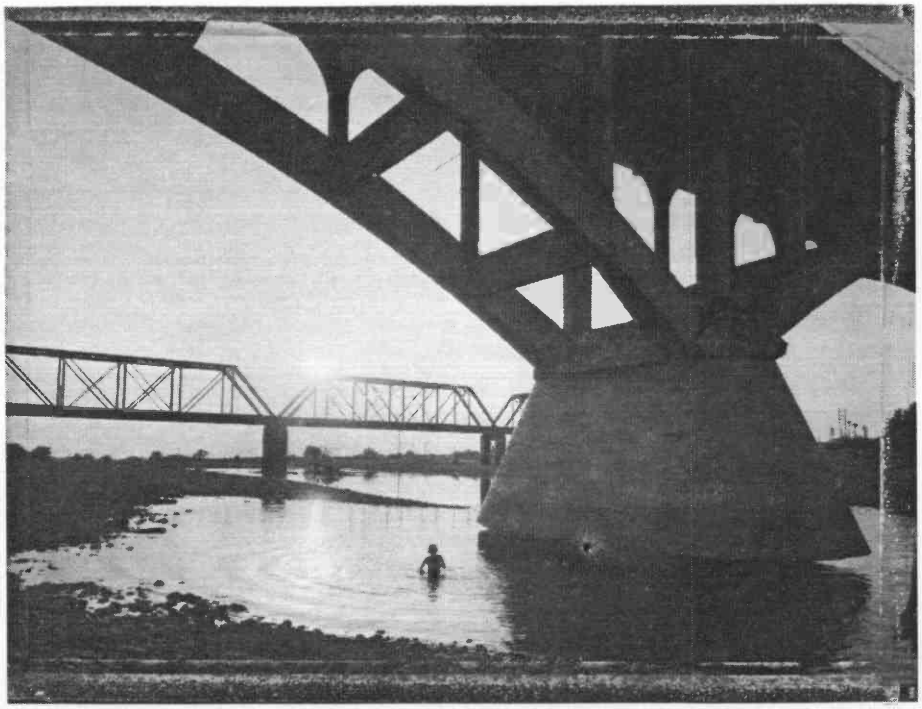

Some scenes too soon become history. The above 1987 photo of a swimmer in the Salt River in Tempe conveys an image of a swimming-hole idyl out of a Huck Finn yesteryear, now that Town Lake covers the area. Filled with Colorado River water, the 224-acre Town Lake is expected to be a centerpiece of an economic boon to downtown Tempe. (Photo: Mark Klett)

Aquatic Fern Threatens AZ Waterways

A small aquatic plant could become a large aquatic problem in Arizona, spoiling recreational activities such as swimming, boating and fishing, threatening fish and wildlife and interfering with irrigation and electrical generation. The culprit is *Salvinia molesta*, a native of South America. In August, clumps of this plant were found floating in the Colorado River below the Palo Verde Irrigation District's drain.

The discovery of the fern near the Palo Verde Irrigation District's canal – the first sighting in Arizona – raised speculation that it might have floated down the drain. That the plant has been found in the drainl itself seems to confirm this. Plants also have been found in the All American Canal in California, but not yet within the Wellton Mohawk Irrigation District.

Listed on the federal noxious weed list, the plant cannot be imported or transported between states, although nurseries specializing in water plants in Phoenix and California have sold it. It is on California's prohibited weeds list, but not on Arizona's. Such a listing would forbid its sale in the state. Nurseries, however, have been warned to eradicate the plant from their stock. Known by various names – giant salvina, Kariba weed, African pyle, aquarium watermoss and koi kandy – the aquatic

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Aquatic Fern Threatens...continued from page 1

with encephalitis were found this summer in a corridor extending through fern reproduces rapidly in calm water, doubling its mass in two to three weeks and forming large floating mats. Mats can be up to two feet thick. The plant grows in ponds, canals, stockponds, pools, slow moving streams and the backwaters of rivers. It gathers in large mats around marinas, docks and other still-water locations. The plant thrives in full sunlight and is drought-tolerant. Not rooted to the bottom, the plant travels by wind, water currents and boats to new locations

Salvinia molesta. Photo: B. Jacobson. AZ Game & Fish Dept.

Multiplying rapidly, *Salvinia molesta* can quickly cover the surface of lakes and streams, preventing sunlight from penetrating the water. The floating mats choke out vegetation and deprive aquatic species of oxygen. The plant diminishes wave action making water more stagnant. It can choke intakes of irrigation systems, power or treatment plants and clog outboard motors. Further, the fern evapotranspires water, and in small ponds can also displace sufficient water to reduce the capacity of a reservoir. Migrating birds needing large open water areas to land and feed would have fewer such areas if the plant overgrows lakes and other bodies of water.

The immediate concern on the Colorado River is that *Salvinia molesta* will seriously degrade waterfowl habitat in the quiet backwaters of the National Wildlife Refuges along the river and interfere with nesting. The strong current in the main part of the river will prevent the fern from becoming a problem in that area of vigorous flow. From its present location on the lower Colorado River, the plant could be transported by recreational boaters either traveling upstream or taking their boats out downstream for use again upstream. Arizona Game and Fish is distributing fliers urging boaters to clean their gear completely after traveling the lower Colorado River.

A Lower Colorado River Rapid Response Team was formed on August 10 and is currently investigating ways of controlling the plant on the Colorado River. An immediate concern is to prevent its invasion into other areas of the state such as the Wellton Mohawk Irrigation District, the Bill Williams River and Lake Havasu and from there into the CAP intake, to travel to Phoenix and Tucson.

Four options for controlling the plant are under consideration.

1. Dry up the river below the Palo Verde intake for a period of time. Although suitable for a small pond, this strategy is not as feasible for a large flow of water. Besides, the fern is able to withstand periods of drought and might survive the ordeal.

2. Spray river with an herbicide such as diquat. This chemical response, however, may pose various problems. Since the fern often grows among other aquatic plants such as cattails or willows, spraying thoroughly becomes a problem. Also, most herbicides are not allowed in drinking water and some harm wildlife, although diquat biodegrades within 48 hours. One approach is to limit spraying for short-term damage control, while relying on another method for long-term control.

3. Manually remove the plants with rakes on boats. This could slow the spread, but 100 percent removal is impossible, especially since many plants grow among cattails where rakes cannot reach. Further, since the plant reproduces rapidly, this would be a short term measure, accomplished with a great deal of expense and labor. In Hawaii, biologists and local residents organized to mechanically remove plants from a lake, using rakes and screens cabled together to sift plants from open water areas. The objective was to restore habitat for endangered nesting birds.

4. Introduce a biocontrol mechanism. A small weevil, *Cyrtobagous salviniae*, is the most likely candidate. This insect was used in Florida with success, although a similar insect *C. singularis* was a failure in India and Africa. Once introduced, however, the weevil may become another exotic species problem. Biocontrol advocates claim this will not happen since the insect is specific to that aquatic fern and dies out once the plant is eradicated. Another problem with this strategy is that it is time-consuming. The permitting process is lengthy, and it also takes time for the weevil to reproduce in sufficient numbers to be effective. Last June, USDA/ARS Aquatic Weed Control Lab initiated an experimental release of the weevil at three east Texas sites.

At its Sept. 15 meeting the task force decided to begin the permit application process to use Diquat and two surfactants (Aqua-King & Thoroughbred) in the drainage canal. Diquat is a contact herbicide, which becomes biologically inert within 48 hours.

What is readily acknowledged is that eradication will be neither easy nor quick. Even the permitting process will slow down eradication, and meanwhile the plant continues to spread. Homeowners in the Phoenix area, for example, had a problem with *Salvinia* in a small home pool and had not fully eradicated it after several months of efforts.

From its origins in South America, *Salvinia molesta* has spread worldwide to areas without killing frost. Its spread is attributed to the aquarium and landscape pond trade. Boats, birds, animals and cars as well wind and water can transport the plant. In Alabama, a flood spread the plant far beyond the reservoir where it first appeared. Ditches near an aquatic nursery in Oklahoma City were found overflowing with it.

Water Vapors

Pacific Proven Puny?

Science continues to define our place in the Universe, belittling humans in the process. The sun doesn't revolve around us, there are billions and billions of galaxies, and planetary systems may be common as dirt. In the latest blow to humanity's self-esteem, planetary researchers at the University of Arizona are positing that we don't even have the solar system's biggest ocean.

Writing in a recent edition of *Science*, Randall Tufts, Richard Greenberg, Paul Geissler and Gregory Hoppa suggest that the new claimant to the crown of water wonderland is Europa, an ice-capped earth-sized moon of Jupiter. They theorize that its textured surface, characterized by tangled loops of ridges and raised areas, is the result of 100-foot tides racing across an ice-covered ocean. Shifts in surface features appear to coincide with Europa's 3 ½ day orbit of Jupiter. The researchers have modeled a relatively thin ice sheet over a global ocean up to 100 miles deep.

Opinions regarding the thickness of the ice vary from less than a mile to over 20 miles. NASA plans to send the Europa Orbiter to dermine not only the existence of an ocean but the thickness of the ice shell as well. Thickness matters to future robotic missions. If an ocean is confirmed, NASA might send later probes to land on the moon's surface, including "hydrobots" to melt through the ice and cruise the ocean deep for signs of life.

Something in the Water

Meanwhile, the search for precursors of intelligent water management in Tucson continues. For the fourth time in 12 years, Tucsonans will vote in November on future CAP water use. Issue fatigue has long since set in with the general populace, which faces another month of its favorite beer and truck ads being displaced by increasingly strident attack ads on both sides of the issue.

There is growing recognition, and some embarrassment within the community over how we are perceived by the rest of the state. This has produced a backlash, with a letter to the editor of a Tucson paper stating that one million people in Phoenix drinking CAP water is one million good reasons why Tucsonans should avoid it. The letter writer's point is obscure, but his heart-felt disapproval of Phoenicians and CAP water is clearly conveyed.

Water Ed. 101

The implications of Tucson's water dilemma, however, extend beyond this basin and should be taken seriously, not only within the state, but beyond in other areas of the country. The broader issue, beyond whether Tucsonans drink or do not drink CAP water, has to do with citizen education and water issues. The questions arising as Tucson struggles with its predicament are questions that await answers in other communities as well, as citizens increasingly are being asked to make decisions about highly complex water issues.

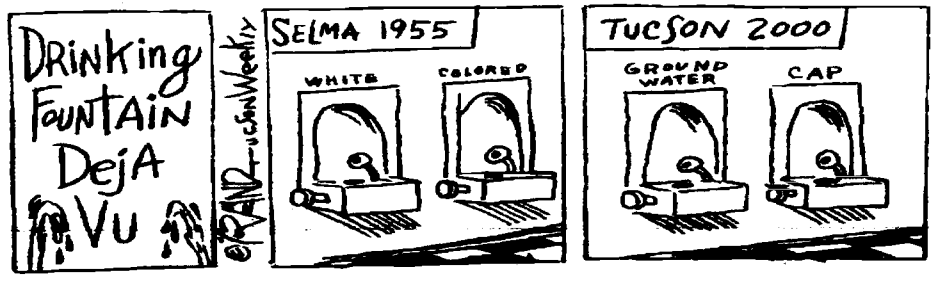
Tucson's prolonged ordeal therefore is worth watching, not just as political theater, but as an exercise in citizen education. Ultimately, the question is whether the people of Tucson will choose wisely in the best interest of the community. To aid the deliberations, efforts are underway to provide citizens with the information they need to make informed decisions. For example, the Arizona Hydrological Society is conducting a series of public workshops scheduled at shopping malls. Tucson Water has stepped up its public and consumer outreach efforts

The University of Arizona has taken an active role in providing water information to the public, through relevant research and by sponsoring a special publication about Tucson water issues, written by the Water Resources Research Center. The WRRC has been acting as a speakers bureau, with staff making some two dozen water presentations for various organizations, from Rotary and Optimist clubs to the Jewish War Veterans and the Humanist Society. Water is getting extensive press coverage, and various water forums are scheduled.

Whatever its final resolution, the CAP question has served to focus water as a topic of public debate in Tucson, with CAP and related water issues getting a healthy airing this season. Hopefully the controversy and the resulting debate, discussion and attempts at humor (see below) will serve to promote greater water awareness, community cohesiveness and even sophistication among Tucson citizen – especially when compared to mouth-breathers living in the Phoenix area.

USGS's Adult Aquifer Ed.

The USGS's reputation for technical expertise is reflected in publication titles such as "Hydrogeologic Data Used to Generate Three-Dimensional Representation of Multilayered Aquifer." In a welcome change from such daunting titles, a recent USGS press release announced, "Ground-Water Deficit Causing Weight Loss in Northwest Tucson." It described a study using precise measurements of gravity to measure changes in the amount of groundwater beneath northwest Tucson from 1995 to 1998. Loss of groundwater from the aquifer is causing the pull of gravity to decrease, and "Your weight has declined as well, according to Isaac Newton, but don't celebrate the side benefit of your weight loss; it's far too small for you to notice." Now if only a link could be established between conserving water and weight loss.



Tucson's CAP water debate takes a weird turn. (Comic courtesy of Rand Carlson and the "Tucson Weekly")

News Briefs

AZ May Gain As California Ends Water Feud

What is good news for Arizona and other Colorado River Basin States, California's three biggest users of Colorado River water have reached an historic agreement that should end the state's long-standing practice of using more than its allotted share of the river. A key provision of the agreement breaks new ground by allowing water districts with surplus water to transfer their excess to areas with greater need. Essentially this means thirsty cities can purchase water from farmers.

The settlement was long awaited by Indian tribes, Mexico, Arizona and the other basin states that share the waters of the Colorado River. State's feared that they would not get their share of surplus river water because of California's excess use.

Further, states have been reluctant to negotiate with California about additional supplies unless the state could demonstrate a commitment to reduce its demand over a set period of time. With California scaling back its use, a more equitable sharing of the river is expected to be worked out, with Arizona better able to protect its long-term water supply.

The settlement is expected to have a ripple effect touching on various weighty issues that await resolution. For example, the settlement should boost efforts of the U.S. Bureau of Reclamation to define criteria the Secretary of the Interior will use when declaring surplus water on the Colorado River. Both Upper and Lower Basin States have a stake in how and when surplus water on the Colorado River is declared.

The states are anxious to resolve the issue of surplus river water before the prevailing weather patterns change that have caused above-average precipitation for the last 20 years. Agreements to share water resources are less likely during times of greater water scarcity.

Objections Raised to San Carlos Water Settlement

Major interests and individual citizens have filed objections to the proposed San Carlos Apache Tribe water rights settlement. The cities of Globe and Safford joined by the Central Arizona Water Conservation District (CAWCD) filed a motion to vacate the approval process. Judge Susan Bolton of Maricopa Superior Court determined, however, that arguments made by the moving parties were more appropriate as formal objections to the settlement.

Gov. Jane Hull joined objectors to the settlement, claiming it is bad public policy and contrary to state and federal law. Hull's objection to the settlement showed some disagreement within state government since two state agencies, the State Land Department and Game and Fish, had been involved in negotiating the settlement.

The city of Globe's objection is due to differences with the tribe over groundwater pumping near the reservation border. The City of Glendale and the CAWCD are objecting to the proposed settlement because they say it differs from the one Congress approved in 1992. They also allege that water allocated to the tribe would significantly affect the objectors' water rights. Fourteen individuals also filed objections on various grounds, although several have since withdrawn their objections.

In an 85-page report, the Special Master of the Arizona General Stream Adjudication also recommended that the settlement be rejected. The report and its recommendations are available on the web site www.supreme.state.az.us/wm. Judge Susan Bolton is conducting an Oct. 18 hearing on the Special Master's report and objections to it. This hearing could result in rejection of the proposed settlement.

Various other hearings on the settlement were conducted during August and September, with a trial scheduled to commence on October 27 before Special Master John E. Thorson.

Nogales, ADWR Reach AWS Agreement

Dodging a September 30 deadline, the City of Nogales and the Arizona Department of Water Resources have signed a stipulated agreement that gives Nogales six more months to demonstrate a 100-year assured water supply. Under the terms of the agreement, ADWR will not revoke the city's current status as an Assured Water Supplier, and Nogales will not approve new subdivisions or non-residential water uses of five acre-feet per year or more.

Annual water demand in Nogales currently is about 4,500 acre-feet, and the city has a proven 100-year supply of about of about 4,500 acre-feet. Two options to expand the water supply to meet current and future demands are being pursued. Deep wells have been drilled in the Portrero wellfield, currently the source of about half the city's supply. According to Nogales attorney Hugh Holub, well drillers hit bedrock at depths that prove the aquifer is deeper and holds more water than ADWR has assumed. ADWR has yet to receive the well testing reports.

Another new water source is the Guavavi wellfield on the 400-acre Wingfield Ranch. Nogales purchased the ranch in 1991 for $3 million and spent $1.6 million to develop its water resources. Upon completion of a pipeline from the wellfield to the distribution system and submission of a hydrologic report, ADWR will include this water source in the assured water supply calculation.

Holub believes that these new water sources will be on-line and the issue resolved in the near future. Longer-term supply options for Nogales include delivering and/or recharging its share of effluent from the International Wastewater Plant located a few miles north of Nogales.

Law Suits Filed to Protect Aquatic Species

Two laws suits are afoot to protect aquatic species. In one action, a Tucson-based environmental group filed a lawsuit in federal court against Interior Secretary Bruce Babbitt for not taking action on

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Law Suit...continued from page 4

petitions submitted last summer. The petitions requested federal action in determining whether the Chiricahua leopard frog and the Gila chub should be granted endangered species status.

The suit claims that, by failing to release a notification statement within 90 days to explain whether an investigation is warranted, the U.S. Fish and Wildlife violated the Endangered Species Act. If, in fact, an investigation is warranted, the ESA then requires the agency to publish a proposal for protecting species or habitat.

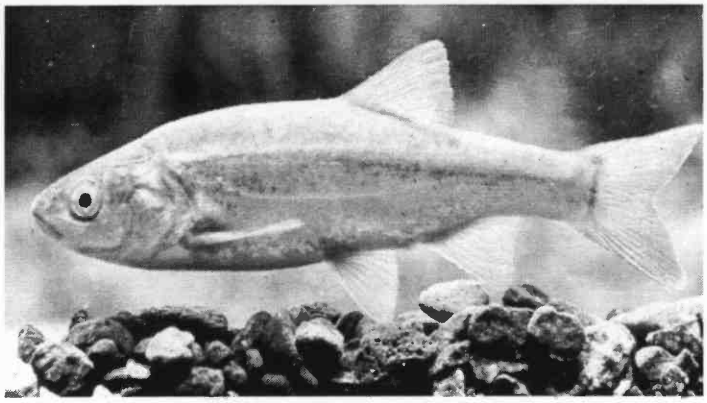
Fish and Wildlife response to the petition was a letter explaining that both species are already listed as "candidates" for an endangered classification; therefore the 90-day notification process did not apply. The response did not satisfy the Center of Biological Diversity, the organization that initiated the lawsuit. Noah Greenwald of the center said the frog has been on the candidate list since 1991 and the minnow since 1982.

The spotted frog once occupied aquatic sites ranging from southeastern Arizona to southwest New Mexico and northern Mexico and is now found in less than 90 sites in that area. The Gila chub is an 8-inch minnow once found in creeks and deep pools throughout the Gila Basin, but now residing in fewer than 15 waterways.

The lawsuit claims the habitats of both species have been harmed by livestock overgrazing, groundwater pumping and dam construction. Further, the introduction of exotic species, such as large-mouth bass and bull frogs, are said to contribute to their decline.

In other legal action, a coalition of environmental and sport fishing groups has filed a federal lawsuit to protect the Rio Grande cutthroat trout in Colorado and New Mexico streams. The intent of the lawsuit is to force the U.S. Fish and Wildlife Service to list the species as endangered or threatened. The lawsuit follows a denial of a request made last year by the same coalition that the agency list the species as threatened or endangered.

The trout is native to the Colorado River system of Southern Wyoming, the Western Slope of Colorado and central and eastern Utah. Although the states are managing the remaining fish populations to ensure its survival, coalition members do not believe efforts are adequate for protecting the trout.



Gila chub is an 8-inch minnow (Photo: John Rinne/U.S. Forest Service)

Weeds galore. Because of plentiful monsoon rains, Tucson's palm-lined ways are weed-choked as well. Meteorologists with the National Weather Service declared this year's monsoon to be the third longest in the state since 1948, extending from June 25 to September 25. Further, the 1999 summer monsoon was the 12th wettest in the state since 1911. The Tucson International Airport recorded 7.77 inches of rain during this monsoon season, compared to 6.86 inches last year. Phoenix received 5.19 inches of rain compared with 3.57 inches last year. The Foothills palo verde, which usually blooms in the spring, is blooming now in response to the generous monsoon rains. (Photo: Joe Gelt)

Arizona Water Resource is financed in part by sponsoring agencies, including:

Arizona Department of Environmental Quality
Arizona Department of Water Resources
Arizona Hydrological Society
Arizona Municipal Water Users Association
Central Arizona Water Conservation District
Geraghty & Miller
Metro Water District
Salt River Project
Tucson Water
USGS Water Resources Division
Water Conservation Alliance of Southern Arizona

Stream of History

Before CAP There Was...

by Barbara Tellman

The Central Arizona Project is only the latest in a series of successful – and unsuccessful – schemes to increase Tucson's water supply. By 1890, Tucsonans were beginning to wonder where they could get enough water to satisfy their burgeoning population, now approaching 8,000 people.

A couple of entrepreneurs, Frederick Maish and Thomas Driscoll had the innovative idea of building a canal from the Canoa Ranch (about where Green Valley is today) to the big city. Maish and Driscoll were old hands (relatively speaking) at the water business. Maish had built Silver Lake southeast of Sentinel Peak (A Mountain) and the two men had a great deal of experience in cattle ranching.

In 1887, the two men incorporated the Canoa Canal Company and proceeded to begin construction of a canal to take water to Tucson. In recognition of his civic mindedness, Maish got to serve as mayor of Tucson from 1889-1893. The Canoa-Tucson canal, however, was not to last. Its end came in the big floods of 1890-1891 when the canals washed out.

This failure, however, did not discourage other entrepreneurs. Frank and Warren Allison began work in 1891 on a canal near the foot of A Mountain. By 1893 they were hard at work on a reservoir with banks twenty feet high. Two years and many miles of canals later they were irrigating over 5,000 acres of land.

Between 1891 and 1894, the Santa Cruz Water Storage Company began work on a series of dams to capture Santa Cruz River water and divert it through canals. The largest dam (1,925 feet long and 96 feet high) would be six miles north of Nogales, with a canal leading to Tubac. It would then connect with 20 smaller reservoirs north along the river towards Tucson. The British investors, however, lost confidence in the project and it was abandoned.

By a special Act of Congress in 1889, the Pima Land and Water Company began an ambitious project to capture waters of the Rillito River. The Act granted it a right of way across the Ft. Lowell Military Reservation in return for a water supply for the military. In 1892, George Roskruge, the project engineer, began work on designs for a storage reservoir and dams in Sabino Canyon. The investors (this time from Ohio) also lost confidence and this project, too, did not materialize, although some ditches were built for water diversions.

A more successful water importation project involved drilling a well at San Xavier in 1893. Within a year, however, the water supply proved inadequate, although 1,782 cords of mesquite wood were burned to fire the steam pump. By 1898, the Parker and Watts Water Company had upgraded the system with a high pressure pump and 26 miles of new water main to bring the water to the city.

Major source was "Diversity through Adversity: Tucson Basin Water Control Since 1854." Doug Kupel. Master's thesis, History Department, University of Arizona

H20 Conservation Notes

"Wildcat" Graywater Use Studied

by Val Little

The Water Conservation Alliance of Southern Arizona (Water CASA) is in the midst of a year-long study of residential graywater usage in the Tucson area. Water CASA is specifically interested in actual – not perceived – health risks associated with this water source and also the number of systems currently in use. Our goal is to determine whether current regulations on graywater systems can be substantially simplified without increased risks to public health, thereby enabling more people to economically make use of their graywater and to substantially decrease groundwater pumping for outdoor use.

The Arizona Department of Environmental Quality (ADEQ) wastewater regulations, which require extensive treatment, have discouraged widespread development of graywater systems in the state. Very few homes in the Tucson area using graywater systems are in compliance with current legal requirements. Since ADEQ is presently initiating rule development to redesign the reuse program, it is timely to consider what the appropriate regulatory controls for graywater should be.

Our study, begun in spring of 1999, is funded through Arizona's Department of Water Resources' Conservation Assistance Grant Program and includes cooperative support from ADEQ, Pima County Department of Environmental Quality, the University of Arizona's Water Resources Research Center and the UA Department of Microbiology.

The primary objective of this collaborative project is to conduct field studies of operating graywater systems in the Tucson area to evaluate current practices and resultant graywater quality impacts. Ten sites were selected from twenty-five responses received from a newspaper article and television report announcing the study. Because these are "wildcat" sites and are not legally permitted, the participants were assured anonymity.

The second objective of the project is a survey to determine the status of graywater usage in the Tucson area. We intend to estimate the percentage of residences using graywater as well as collect information on the type of graywater, amount of use and application techniques. The survey will also evaluate public awareness of graywater reuse in an attempt to assess what some of the barriers are to increased utilization of this water resource. Our goal is to obtain 500 or more responses to the survey.

After this summer's sampling and analytical work is complete, we expect to have good characterization of graywater and its impact in typical residential landscape and garden irrigation settings. Some of the identified controls that contribute to good quality graywater and safe application can be used by ADEQ in new rules for graywater reuse permits. Greater understanding of graywater may lead to a simplified permitting process, as well as accurate public education about appropriate graywater reuse.

The Water CASA Residential Graywater Study will be completed at the end of 1999 and results will be given wide distribution shortly thereafter.

Book Claims Lawyer Betrayed Hopis in Black Mesa Coal/Water Deal

In 1966, the Hopi Tribe signed a lease with Peabody Coal allowing the company to mine coal on Black Mesa. It was a momentous decision, with far-reaching implications since Black Mesa coal helped fuel the development of central Arizona. For example, power from the Navajo Generating Station that burns Black Mesa coal is used to pump CAP water. Some people say the deal was not to the advantage of the Hopi people, and many observers believe that John Boyden, the Hopi tribal lawyer, also represented Peabody Coal when he advised the tribe to sign the lease. Peabody's use of groundwater on Black Mesa and its possible effect on the Hopis remain an active issue. The following is an excerpt from Charles Wilkinson new book, "Fire on the Plateau," in which the author describes evidence of Boyden's link with Peabody. (Wilkinson, a law professor at the University of Colorado, Boulder, will be a participant at the University of Arizona's College of Law conference, "Environmental Restoration: Challenges for the New Millennium." See "Announcement" section for conference details.)

John Boyden always denied that he ever represented Peabody Coal Company. There were always contrary rumors, however, supported by the fact that in the critical years of 1966 and 1967 Peabody Coal was listed as a client of Boyden's firm in Martindale-Hubbell, the professional directory for lawyers. Boyden himself dismissed the allegations: "You may be sure that I have represented the Hopi Tribe for a good many years and have never represented any other client whose interests in the subject matter were adverse to the Hopi Tribe at the time of such representation." When the charges continued after Boyden's death, John Kennedy, Boyden's law partner, explained that the firm's small amount of work for Peabody "was done by an office mate — and that Boyden was unaware of the relationship." Kennedy angrily denounced the accusations of Boyden's tie with Peabody as "baseless, unfair and inaccurate."

Peabody Coal itself denied any conflict involving Boyden, the Hopi, and the company. In 1979, the Indian Law Resource Center, conducting research for its "Report to the Hopi Kikmongwis" on the Boyden-Hopi issue, wrote Peabody concerning the matter. The general counsel to Peabody responded by saying that Boyden had never represented Peabody. He acknowledged that Boyden had done work for Kennecott Copper in 1968, when it acquired Peabody in a major corporate transaction, but emphasized this was not direct representation of Peabody: "It is important to stress that Mr. Boyden represented the buyer [Kennecott] and its lenders in this transaction and did not represent Peabody." The general counsel added that he had discussed the matter thoroughly with one E. R. Phelps, Peabody's vice-president for engineering during the 1960s, with responsibility for the Black Mesa mines: "Mr. Phelps does not recall any situations where Mr. Boyden represented anyone other than the Hopi Tribe other than the situation described above where Mr. Boyden represented Kennecott and its lenders in the transaction whereby Peabody was acquired in 1968."

Yet all the denials now ring hollow. And although I suppose that John Boyden will be on my mind whenever I go to Black Mesa, his dealings weighed especially heavy on me at Home Dance this day. Just a week ago, I had received a phone call, late at night, from my research assistant, Cherche Prezeau. She is quite a proper young woman and I don't believe she had ever called me at home before, much less at such a late hour, after 10 P.M. She was calling from Salt Lake City, where I had asked her to go in order to finish our review of John Boyden's papers.

"Charles, I'm really sorry to bother you so late, but I just had to call. I spent most of the day in the University of Utah library. They recently put out a whole new batch of John Boyden's papers. They've never before been open to the public."

"Charles, there's a whole file on his work for Peabody Coal. I can't even begin to tell you how bad it is. All I can say is. I'm driving back tomorrow and I think you had better read it right away."

I spent the next evening going over the file, and it was a sickening, depressing experience. It literally caused my stomach to hurt and I've had that same feeling every time I have returned to that file.

The Boyden papers that my other research assistant, Brian Kuehl, had found two years earlier were highly significant. They contained newspaper accounts identifying Boyden as Peabody's lawyer and a transcript of his appearance before a Utah administrative board on behalf of Peabody in connection with a proposed power plant that would use coal and water obtained by Peabody from Black Mesa. This was the situation that presented a conflict with his work for the Ute, as well as the Hopi.

These new documents, however, went much further, and were far more detailed and graphic. The file, labeled "Peabody Coal Company," contained correspondence between Boyden and Peabody Coal executives and representatives. It also contained his attorney billings for work done for Peabody between 1964 and 1971.

Boyden's representation of the Hopi against the Navajo in the land dispute may indeed have been loyal and tenacious. His role as tribal attorney in the development of Black Mesa, however, paints a very different picture. There is no longer any question that he violated his high duty to the Hopi by working concurrently for Peabody Coal during the decisive years of the 1960s. The correspondence was very substantive and, as well, showed a close, ongoing personal as well as professional relationship between Boyden and Peabody officials. Several letters to and from Peabody executives discuss water and mineral rights on Black Mesa. His main correspondent at Peabody was E. R. ("Ed") Phelps — the same E. R. Phelps who, in the 1979 letter from Peabody to the Indian Law Resource Center, could not "recall any situations where Mr. Boyden represented anyone other than the Hopi Tribe." The salutations in Boyden's letters to Phelps in Boyden's capacity as Hopi attorney were "Dear Mr. Phelps." In his Peabody role they were "Dear Ed."

Boyden worked actively for Peabody over the seven-year period. Among other things, he reported on his meetings, on behalf of Peabody, with the governor of Utah and the state engineer. The file shows that Boyden represented Peabody in October 1964 at a hearing in front of the Utah State Land Board; he urged the board to sell Peabody land for a proposed power plant that would

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Publications

Use of Constructed Wetlands for Stormwater Runoff (Video-recording)
Produced by Gary Goff, Rebecca Schneider, Paul Curtis, and Glen Palmer
Modern-day impermeable surfaces such as roads and parking lots increase stormwater runoff, accelerating erosion and downstream flooding. The runoff transports contaminants like sediments, nutrients, road salts, oils, and pathogens to rivers and lakes. This video shows developers, natural resource managers, community planners, educators, as well as the general public how properly constructed wetlands moderate flow extremes and improve water quality. Benefits from these wetlands include enhanced groundwater recharge, aesthetic appeal, and the creation of a wildlife habitat. The 20-minute video shows how wetlands function to reduce pollution, explains appropriate design elements, highlights success stories, and suggests sources of assistance for planning and constructing a wetland. The video is available from Cornell University Resource Center, 7 BTP, Ithaca, NY 14850 for $19.95.

1998 Arizona Agricultural Statistics
United States Department of Agriculture and The University of Arizona
With most supplies of agricultural commodities large and prices low, it is difficult to look back over 1998 with much optimism. This statistical guide is designed to provide decision-making information to Arizona's farmers and stockmen. For copies of report contact: Arizona Agricultural Statistical Services, 3003 N. Central Ave., Suite 950, Phoenix, AZ 85012-2994; phone: 602-280-8850. Arizona agricultural information also can be found on UA or USDA web sites: http://ag.arizona.edu and http://www.usda.gov/nass/

The Quality of Our Nation's Waters
U.S. Geological Survey
As part of a series of nontechnical publications, the USGS reports some of the major findings of the National Water Quality Assessment Program on water quality issues of both regional and national concern. This report focuses on issues that stem from nutrients and pesticides found in our water supplies and their effect on the aquatic ecosystem and drinking water standards. To obtain a copy of the report contact the USGS at 703-648-5716 or by email: nawqa_info@usgs.gov

Downstream: Adaptive Management of Glen Canyon Dam and the Colorado River Ecosystem
Jeffrey Jacobs
Since the early 1980s, the effect of Glen Canyon Dam operations on downstream resources in the Colorado River ecosystem has been the subject of multiple studies. As part of that effort, the Grand Canyon Monitoring and Research Center issued a report in 1997 titled *Long-Term Monitoring and Research Strategic Plan.* This report critiques the plan and evaluates its likely effectiveness in promoting the Center's research and monitoring programs. To order the report, contact the National Academy Press; phone: 800-624-6242; web site: http://www.nap.edu

NOAA's Drought Information Website
The National Oceanic and Atmospheric Administration has set up a web site to monitor the drought currently plaguing parts of the nation. The site includes updates, current information, background information, links to state drought centers and other involved agencies, along with various and sundry information pertaining to drought. The site is located at http://www.drought.noaa.gov

Black Mesa...continued from page 7

use Black Mesa coal and water, Boyden forcefully argued Peabody's side on water rights – -a presentation that included Peabody's statement that a "possibility is to obtain Indian water rights."

Indeed Peabody did lease water as well as minerals from the Hopi when the Hopi Tribal Council saddled itself with a very bad business deal by approving the lease for the Black Mesa Mine. The tribe received 3.335 percent of gross sales (the royalty for the Navajo Tribe was the same), which was below accepted royalty rates at the time. Even worse, the lease did not have any reopener – a standard provision allowing renegotiation after an agreed period, usually ten years. By 1978, just eight years after Peabody began mining the coal, a confidential Interior Department audit concluded that the royalty rate did not "accurately reflect or compare with current rates." The return was "only a little more than half of what the [federal] government is receiving" for coal leases on federal public lands.

The Black Mesa lease had other undesirable features from the Hopi standpoint. It allowed Peabody control over much more land than was customary or, apparently, legal – 40,000 acres as compared to the limit of 2,560 acres in the federal regulations for Indian leasing. For the right to take 4,000 acre-feet of Hopi water each year, in a lease signed at the height of the rush on the Colorado Plateau's limited water supply, Peabody paid the Hopi the laughable rate of $1.67 per acre-foot.

Special Projects

NAU Program Serves State's On-Site Wastewater Needs

A Northern Arizona University program is helping people in rural, unincorporated areas of the state handle wastewater treatment problems. Soil conditions in northern Arizona often are not suitable for traditional septic systems. Operating a septic system in areas lacking suitable soil conditions can result in serious environmental problems.

Alternative systems are available, but usually at high costs, as much as $20,000. With increased homebuilding and development occurring in rural areas, there clearly is a need to determine if these alternative systems are viable alternatives to conventional septic systems.

To help meet this need, NAU has developed an On-Site Wastewater Demonstration Program, which is actually an on-site demonstration/research/training facility. The latter title better describes the wide range of activities in the new program.

Demonstration Arizona is identified as a market for alternative on-site treatment technologies. The NAU facility will demonstrate the efficacy of various alternative technologies and improvements in conventional technologies, that either are in use or are being considered for use in severe site conditions of the state.

Research The program functions as a research facility for a newly emerging graduate engineering program and for faculty from various related disciplines with an interest in decentralized wastewater treatment and disposal. Data collection sites were incorporated into the design of the project. Comparison data will be reported for the demonstrated technologies so that the efficacy of each can be examined.

Education/Training Training is provided for on-site professionals in such specialized topics as site evaluation, construction, and construction inspection. Basic training is also provided that examines conventional and alternative technologies and their interaction with the environment. Outreach training will soon be provided to homeowners, real-estate professionals, and other interested groups indirectly involved with the on-site industry. A clean water area has been incorporated into the program site so that safe hands-on training can be accomplished.

Twenty units of the nearby multi-story, married student housing complex are the source of wastewater for the project. NAU students and faculty are conducting the testing and applied research at the site.

The program's facility includes two fully functional systems (Treatment Trains One and Four). The first is a standard septic tank followed by a pump chamber that delivers the anaerobic treated effluent to one of eight trench "technologies". The second system is an aerobic treatment unit followed by a pump chamber delivering aerobically treated effluent to a Wisconsin mound. The treatment trains are cross-connected to allow the redirection of the anaerobic effluent to the mound and the aerobic effluent to the trenches so effluent treated to different degrees can be matched up with a wider range of disposal options.

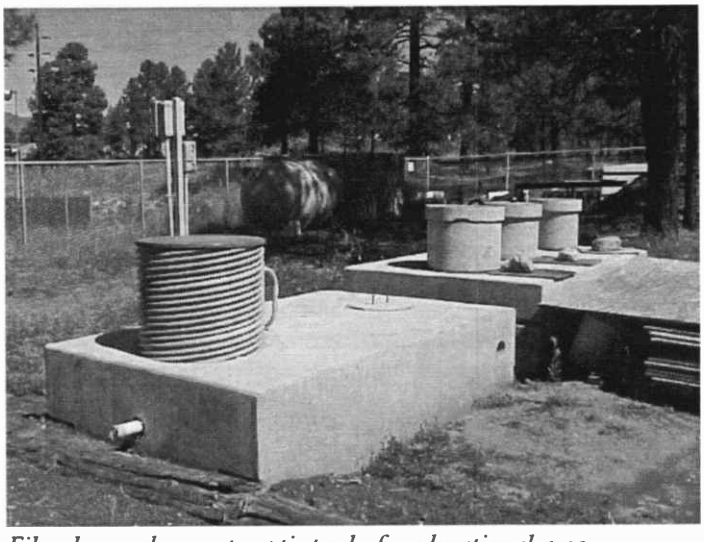
A third system (Treatment Train Three, which is not yet fully functional) consists of a septic tank/pump chamber. Water is pumped through a ratcheting valve that diverts septic tank effluent to one of three areas: 1) an intermittent sand filter 2) a peat filter or 3) an above grade chamber disposal system. Effluent from the sand filter will be pumped to a second above grade chambered system. This above ground chambered system uses innovative disposal technology that has not yet been approved by the state. The two chambered systems are both partially constructed. The effluent from the peat system is pumped to a drip irrigation field.

All systems are connected to an advanced system control and data acquisition (SCADA) system and all treatment trains will eventually be controlled by the SCADA system. Two more treatment trains are being developed bringing the total to five.

The NAU project joins other efforts in the state also dedicated to educating citizens about on-site treatment. The Association of Arizona County Health Department Directors holds an annual training and technical conference. Also, the University of Arizona, through its agricultural extension service, is beginning to develop educational outreach programs to educate the public about septic systems and alternative on-site technologies.

The $1.1 million program has been a cooperative venture. The Non-Point Source Pollution Unit of the Arizona Department of Environmental Quality is providing $200,000 per year for five years from EPA 319 funds. Arizona Public Service donated 7.2 acres on the southern edge of the NAU campus adjacent to an APS substation and the married student housing complex. Private sector industry has donated equipment and resources and provided technical advice.

Paul Trotta, the associate professor at NAU's College of Engineering and Technology, heads the On-Site Wastewater Demonstration Program and is working on coordinating state on-site efforts with his participation in the newly formed On-Site Wastewater Association of Arizona (OWAC). For more about the On-Site Program and the OWAC, visit www.cet.nau.edu/wdp



Fiberglass and concrete septic tanks for educational area.

Announcements

Science/Law Interrelate at Upcoming Conference

On November 11- 13 the James E. Rogers College of Law, University of Arizona, will host an interdisciplinary conference: "Environmental Restoration: Challenge for the New Millennium." The conference will draw together nationally recognized speakers from the fields of history, hydrology, ethics, biology, ecology, philosophy, environmental policy, public administration, economics and law to discuss environmental restoration. A key focus of the conference will be the interrelationship between science and law. For further information contact Vicki or Donna at the Development Office, James E. Rogers College of Law, The University of Arizona; phone: 520-621-8430.

Heritage Grant Funding Available

The Arizona Game and Fish Department is seeking applications for funding through its Heritage Grant Program. The various funding focuses are: urban wildlife/wildlife habitat; public access; environmental education; school yard grants; and identification, inventory, acquisition protection and management of sensitive habitat. Applications for the next funding cycle are due November 30. For additional information contact: Robyn Beck, Heritage Grants Coordinator, Funds/Planning Section, Arizona Game and Fish Department, 2221 W. Greenway Road, Phoenix, AZ 85023; phone: 602-789-3530; web site: http://www.gf.state.az.us

Call for Abstracts: WATERSHED 2000

WATERSHED 2000, an international specialty conference, is scheduled for July 9-12, 2000 in Vancouver, British Columbia, Canada. The conference will explore national and international challenges to managing watersheds and will bring together environmental professionals for a showcase on integrated resource management and environmental protection principles using watershed-based approaches. Abstracts are being accepted on various water issue topics and must be received before November 15. For consideration, mail abstract and completed information sheet to: Technical Programs-WATERSHED 2000 Abstract Water Environment Federation, 601 Wythe St., Alexandria, VA 22314-1994; phone: 703-684-2400; fax:703-684-2413.

Conference on Hydrological Issues of 21st Century

The theme of the annual meeting of the American Institute of Hydrology and the Fourth USA/CIS Joint Conference will be "Hydrological Issues for the 21st Century: Ecology, Environment and Human Health." The conference objective is to promote a continuing forum for scientific and technical exchange among scientific communities, government agencies and U.S. environmental businesses and to encourage partnerships between research and educational institutions, regulatory agencies and industry. The conference is scheduled November 7-10 in San Francisco. For additional information contact: American Institute of Hydrology, 2499 Rice St. Ste. 135, St. Paul, MN 55113-3724. phone: 651-484-8169; fax: 651-484-8357; email: alhydro@aol.com; web site: http://www.alhydro.org

AWRA Conference on Watershed & the ESA

Practical solutions for today's water problems are a principal thrust of the annual conference of the American Water Resources Association. The conference entitled "Watershed Management to Protect Declining Species" will be held Dec. 5-9 in Seattle. Three panel discussion, 158 platform presentations and 30 poster presentations will highlight innovative methodologies and case studies for protecting of endangered species in a variety of environments. Sessions representing ESA programs from all over the country will present changing water management practices to restore endangered aquatic species. Topics will cover state-of-the-art presentations on a wide variety of topics such as watershed analysis, water quality, hydrology and water policy. For additional information contact: AWRA, 4 W. Federal St., P.O. Box 1626, Middleburg, VA, 20118-1626; phone: 540-687-8390; fax: 540-687-8395email: info@awra.org; web site: www.awra.org

National Geographic Society Grants

The National Geographic Society is awarding grants ranging from $15,000 to $20,000 for scientific field research and exploration. Of particular interests are multi-disciplinary projects involving environmental issues such as bio-diversity and habitat and the effect that human population have on them. Candidates should possess a Ph. D. or the equivalent and a minimum of three articles published in peer-reviewed professional journals; although occasionally doctoral candidates are considered. For more information contact: Committee for Research and Exploration, National Geographic Society, P.O. Box 98249, Washington, DC 20090-8249; phone: 800-647-5463; email: jfintel@ngs.org; web site: http://www.nationalgeographic.com/research/grant/rg1.html

UCOWR Call For Papers

The University Council on Water Resources' July 31- Aug.4, 2000 annual meeting in New Orleans is titled "Living Downstream in the Next Millennium: Reconciling Watershed Concerns with Basin Management." Sessions will focus on water quality issues and watershed management. Papers, displays, posters and sessions are encouraged on any domestic or international water resources related topic. The deadline for abstracts is Nov, 10 and should be sent to: Jeffrey Ballweber, Water Resource Research Institute, PO Box AD, Mississippi State, MS 39762; phone: 662-325-3620; fax: 662-325-3621; email: ballweber@engr.msstate.edu

Calendar of Events

RECURRING

Arizona Hydrological Society (Flagstaff). 2nd Tuesday of the month (during the school year), Meeting times and locations may vary, NAU, Southwest Forest and Science Complex, 2500 S. Pine Knoll Dr., Room 136, Flagstaff. Contact: Abe Springer 520-523-7198, email: abe.springer@nau.edu.

Arizona Hydrological Society (Phoenix). Usually 2nd Tuesday of the month. Contact: Christie O'Day 602-379-3087 ext. 224.

Arizona Hydrological Society (Tucson). Usually 2nd Tuesday of the month. Contact: Laura Davis 520-326-1898.

Arizona Water Banking Authority (Phoenix). Next quarterly meeting will be held on Dec. 15th at the ADWR in Phoenix. Contact Kim Kunasek 602-417-2418

Arizona Water Protection Fund Commission. Contact: Irma Lisa Horton 602-417-2400 ext. 7016.

Arizona Water Resources Advisory Board. Contact: Kathy Donoghue 602-417-2410.

Central Arizona Water Conservation District. Usually 1st and 3rd Thursdays of the month, time to be determined one week before. CAP Board Room, 23636 N. 7th St., Phoenix. Contact: Ardis McBee 602-869-2210.

City of Tucson Citizens Water Advisory Committee. Usually 1st Tuesday of the month, 7:00 - 9:00 am 310 W. Alameda, Tucson. Contact: John O'Hare 520-791-5080 ext. 1446.

Maricopa Association of Governments/Water Quality Advisory Committee. Contact: Lindy Bauer 602-254-6308.

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

Phoenix AMA, GUAC. Scheduled monthly, please call. Conference Room A, 500 N. 3rd St., Phoenix. Contact: Mark Frank 602-417-2465.

Pima Assoc. Governments Water Quality Subcommittee. Usually 3rd Thursday of the month, 9:00 am 177 N. Church St., Suite 405, Tucson. Contact: Greg Hess 520-792-1093.

Pinal AMA, GUAC. Usually 3rd Thursday of the month, 2:00 pm. Pinal AMA Conference Room, 1000 E. Racine, Casa Grande. Contact: Randy Edmond 520-836-4857.

Prescott AMA, GUAC. 2200 E. Hillsdale Rd., Prescott. Contact: Phil Foster 520-778-7202.

Santa Cruz AMA, GUAC. Usually 3rd Wednesday of the month, 9:00 am, Santa Cruz AMA Conference Room, 857 W. Bell Rd., Suite 3, Nogales. Contact: Kay Garrett 520-761-1814.

Tucson AMA, GUAC. Usually 3rd or 4th Friday of the month, 9:00 am, Tucson AMA Conference Room, 400 W. Congress, Suite 518, Tucson. Contact: Kathy Jacobs 520-770-3800.

Tucson AMA, Safe Yield Task Force. Every Wednesday. Contact: Kathy Jacobs 520-770-3800.

Verde Watershed Association. Contact: John Parsons and Tom Bonomo, VWA Newsletter Editors, Verde Watershed Association, P.O. Box 4595, Camp Verde, AZ, 86322. 520-567-2496. Message phone: 520-649-9978, email: obarc@sedona.net; website: http://www.vwa.org

Water Users Association of Arizona. 2nd Friday of the month at noon (except in September). Call for reservations and exact location. Contact: Paul Gardner, 480-987-3240.

Yavapai County Flood Control District Board of Directors. Contact: Ken Spedding, 520-771-3197.

UPCOMING

November 15-17, Groundwater Foundation Fall Symposium : Understanding and Addressing Risks to Groundwater will be held on in Atlanta, Georgia. The goal of the symposium is to increase understanding of risk as it relates to groundwater and its potential impact on human and ecological health. For information contact: The Groundwater Foundation, P.O. Box 22558, Lincoln, NE 68542-2558; phone: 800-858-4844; fax: 402-434-2742; email: info@groundwater.org

December 2-3, 44th Annual New Mexico Water Conference will be held at the La Fonda on the Plaza in Santa Fe, New Mexico. The title of this conference is "The Rio Grande Compact: It's the Law!" The conference will cover the history of the compact, how it works and meeting future compact obligations. For futher information contact: New Mexico Water Resource Research institute, MSC 3167, Box 30001, Las Cruces, NM 88003; check website: wrri.nmsu.edu for updated information about conference.

Submit calendar, announcement, or publication information to Chris Hudson, WRRC; phone: 520-792-9591 x16; fax 520-792-8518; email crhudson@ag.arizona.edu

Wetlands.... continued from page 1

with encephalitis were found this summer in a corridor extending through Pima, Pinal and Maricopa counties.

In an average year in Arizona, five Culex mosquitos samples test positive for encephalitis.This year there have been 18 positive test, including 11 in Maricopa County.The prolonged monsoon season probably contributed to the increased numbers.

The immediate concern is to take measures to control the spread of the mosquitoes and eliminate present conditions that favor their breeding. A larger issue, however, also is to be examined. Watering the desert landscape to create ponds, lakes, and wetlands has become a favored activity in communities throughout Arizona, as people increasingly prize the amenities water provides. There are now six large wetlands projects and more than 40 smaller ones in Arizona.

Wetlands replacing the cienagas that once existed in the region attract the mosquitos that at one time bred in the cienagas. Bringing back wetlands brings back the mosquitoes.

Do disease-carrying mosquitoes pose a sufficient threat to Southern Arizona to justify abandoning plans to construct future wetlands? University of Arizona entomologist Henry Hagerdorn believes the risks to public health are indeed high. To him building wetlands in an urban area with a history of malaria and encephalitis is not a good idea, even when weighed against the recreational and environmental amenities such wetlands provide.

Other scientists disagree saying mosquitoes do not present an insurmountable problem.They say the problem developed at Sweetwater because city and county officials ignored advice about the need to take measures to control mosquito breeding. They say future projects can be better designed, if not to eliminate all mosquitos, at least to control their breeding and to significantly reduce the threat to public health.

Such measures include fast water flows to discourage mosquito breeding and ensure more efficient spread of insect poisons; more deep water sections to hold the temperature down, creating less favorable breeding areas; better circulation of wetland waters; and less dense vegetative area.

Further, some scientists say that even currently operating wetlands with mosquito problems, such as Sweetwater, can be fixed without major re-engineering. For example, about three years ago the Tres Rios wetlands in Phoenix had a mosquito and encephalitis problem. Remedial action included opening areas once clogged with dense vegetation, introducing mosquito-eating fish and expanding deep-water areas.

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