

Wildlife Resort to Water Catchments

When most people think of drought they think of possible personal inconveniences. Should they forego their Lake Powell vacation? Will watering vegetation face restrictions? Will water bills go up?

Drought and dry conditions also affect Arizona's wildlife. Shown at right are deer and a bighorn sheep quenching their thirst at an Arizona Game and Fish Dept. water catchment. Water catchments are constructed watering holes that provide water to wildlife during the hottest, driest months. Arizona is a leader among states in constructing and maintaining water catchments. The state has more than 800.

AGFD officials say the catchments are essential to replace natural sources of water that are no longer available to wildlife due to drought and development.

As part of a AGFD research project studying water catchments, cameras were set up to film activity at several sites in the Yuma area to determine which critters used the watering holes. An infrared illuminator enabled night viewing. More than 30 different species were noted, including deer, bighorn sheep, quail, coyotes, bobcats, foxes, bats and doves. The catchments served as a year-round resource but were most heavily used during spring and summer.

Researchers also studied various concerns relating to wildlife use of catchments. They looked at

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Photo: Arizona Game and Fish Department

Marketing Potential of University Water Research Results Increasingly Noted

Universities and private sector find common interests

by Joe Gelt

When a university is said to be in the business of education, research and public service, the word "business" takes on different shadings than when used to describe profit-making activities in the private sector. Universities are not usually thought of as businesses with goods or services to sell — although parents or students struggling to pay tuition bills may at times feel otherwise.

Universities, however, are increasingly committed to marketing their researchers' technical and scientific discoveries, to promote economic development within the state and earn profit to support university operations. In adopting certain policies and procedures and working out cooperative arrangements with private sector organizations, universities nationwide are striving to establish a credible entrepreneurial climate or environment.

The movement has its celebrity achievers. Gatorade and Google were both developed at universities, providing significant profit to the University of Florida and Stanford University respectively.

Water researchers at Arizona universities may not come up with anything as high-profile as Gatorade or Google, but they have the intellectual talent and expertise to contribute to the technological needs of the state's industries and businesses. Although some patenting and licensing of water research results have occurred, the potential exists for much more to be done.

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University Water Resource Patented

The most successful university operation to patent and license water-related work is the University of Arizona's Engineering Center for Environmentally Benign Semiconductor Manufacturing (ERC). A cooperative venture that includes industrial interests, government agencies and various universities, the center conducts research on the specialized water needs of the semiconductor industry. The center has about 30 patent disclosures, with 10 of them water-related.

Some of ERC patents are related to water purification and treatment, including processes that use novel membranes for low-energy ultra-purification of large quantities of water at high flow rates. Other patents deal with novel oxidation methods for removal of trace impurities. There also is patented technology on novel sensors for contamination monitoring in water as well as patented technology for simulation and design of large water recycling systems for recovery and reuse of water in complex industrial settings.

Also, an Arizona State University researcher has patented and licensed a desalination and water treatment process. The process has both large-scale industrial application and the potential for humanitarian use. Its design is sufficiently simple that it can be used in Third World countries in need of purified drinking water.

Other university water researchers are in the process of working out the details for patenting their work. For example, a researcher from UA's Sustainability of Semi-Arid Hydrology and Riparian Areas (SAHRA) has developed a new method of water metering with the likely potential to be patented and licensed.

Water Research Potential

This work may be just a beginning. A recent report, commissioned by the Arizona Commerce and Economic Development Commission and the Arizona Department of Commerce, indicates that university water researchers are likely to have a bright future in contributing to the technological needs of the state's industries and businesses. The Battelle Memorial Institute report evaluated which university research areas could best support state efforts to build an economic future through private-public partnerships between industry, higher education and government.

Released in March, 2004, the Battelle Report singled out the areas of hydrology and water resources for special attention stating, "The University of Arizona is #1 nationally in hydrology; add to that distinction the four water centers, each dealing with a different problem area, and Arizona State University's and Northern Arizona University's contributions, and Arizona has arguably the world's biggest and best water resource portfolio."

Further, the report goes on to say that Arizona has attracted companies and industries committed to sustainability — and has the potential to attract additional such businesses. Viewed as a force to drive future world-wide economic development, sustainability is described as a development that meets present needs without compromising the ability of future generations to meet their own needs. According to the report, the ecological sciences, including water research, have a central role in this present and emerging market. Arizona water researchers might well take note.

Other factors also figure into the potential for increased university-industry cooperation. ERC Director Farhang Shadman believes

the times are propitious for such cooperation because industries have been cutting back on research and are increasingly depending on universities to do basic research and come up with ideas. At the same time, universities are looking to the private sector to fund research. He says, "So the need is mutual."

This promoting of university research products as a marketable commodity is a relatively recent development. Universities serve as an intellectual resource to the state, educating citizens and providing information and expertise to help address state problems and concerns. University researchers have generally undertaken their work as a type of public or community service.

And this tradition continues. For example, the web site for the UA's SAHRA program allows free access to models, algorithms and software and provides instructions and sample sets. A quote on the web site has a decidedly non-marketing slant: "An idea is not a possession. To share it freely is to nudge the door to freedom a little wider open."

Also, not to be overlooked is researchers' commitment to publish. Ian Pepper, director of the UA Water Quality Center says, "The number one goal of all the research we do funded by the private sector is to publish in peer-review journals." He considers the use of research to solve community problems as a "wonderful bonus."

Universities' Entrepreneurial Environment

A university researcher works under far different conditions than the legendary solitary inventor tinkering in his garage. University researchers believing they have a marketable product must work through a bureaucracy to patent and license their work. According to Arizona Board of Regents' policy, the university owns whatever products are created by researchers using university resources.

The university's technical transfer office serves as a resource to university researchers seeking to market their discoveries. The office, however, is not a researcher's first stop. Shadman describes a researcher's preliminary steps before approaching the UA Office of Technology Transfer. He says, "A patent disclosure is filed and this goes to the department and the college for review. ... It then goes to the vice president for research and the office of tech transfer. They evaluate it and decide if it is worth patenting." If a product appears marketable, the technical transfer office will pay for the patenting.

The technical transfer office negotiates details with the private sector when working out an agreement to market a researcher's product. Whatever agreements are worked out must be compatible with the way the state and university do business. Shadman says there is no set formula when the university negotiates with a business or industry, with details varying depending upon the unique circumstances of each transaction.

A company that is marketing a research discovery pays the university an annual licensing fee. After the product is commercialized, a percentage of the profits also goes to the university. The university uses a formula to distribute the funds, with a certain percentage going to the university, the college, the department and the researcher.

Complications

When a private sector company negotiates with a university some issues may arise due to a university's unique mission and form of governance. For example, the university's ownership of products

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Water Vapors

Study Says, Water Can Decide Presidential Election

One would be laboring the obvious if insisting on the political significance of water. Water or the lack of it is an issue to inflame political passions, provoke conflict and controversy, sow seeds of distrust among neighboring states and countries, and it makes up the stuff of much local, state, national and international law and public policy.

In short, water is a highly charged political issue.

Yet, a couple of Princeton researchers attribute to water an even a greater political significance than hitherto has been acknowledged. It is a significance worthy of attention during this presidential election year.

An August 30 story in the "New Yorker" on voter behavior reports that in a paper written in 2004 political scientists Christopher Achen and Larry Bartels estimate that "2.8 million people voted against Al Gore because their states were too dry or too wet" as the result of that year's climactic conditions. Achen and Bartels go on to say these voters likely cost Gore seven states, any one of which would have given him the election.

Mark Twain's statement to the effect that everyone complains about the weather but no one does anything about it may not be true. They vote.

Water's Economic Importance

Like its political significance, water's economic importance can be manifested in unlikely ways. The following poem, "Money as Water," is by Kurt Brown.

"Cash flows" "liquid assets" "pooling our resources" —

*it's clear that money falls from heaven,
drops in pennies, nickels, dimes, to gather
in the small depressions of our hands ...*

*It's clear how money
passes through our hands like water,
and our sources, once dried up, leave us
thirsting after more ...*

*How all we have
goes down the drain, and we get soaked.*

WRRC News and Information

The Water Resources Research Center has recently hired a new staff member, and WRRC staff is involved in organizing and teaching a University of Arizona course on Arizona water policy.

WRRC Hires Researcher

Justin Ferris recently joined WRRC as coordinator of applied research. Ferris earned a B.S. in geology at Northern Arizona University and a Ph.D. in hydrology at the University of Arizona. His research areas include general surface-water and groundwater hydrology; fluvial geomorphology and paleoflood hydrology; post-wildfire flood hydrology; and the hydrology and geology of Mars. Prior to joining WRRC, Ferris was National Research Council Post-Doctoral Fellow within the Water Resources Discipline at the U.S. Geological Survey, Denver. The coordinator of applied research position was created to expand WRRC's analysis of public policy issues.

WRRC's Project WET Makes a Splash



The fifth annual "Make a Splash with Project WET Water Festivals" occurred in Arizona on Sept. 24, National Water Education Day. Above is the Ganado festival, held at the Hubbell Trading Post National Historic Site on the Navajo Nation. Festivals were held in Chandler, Safford, Ganado and Phoenix, with 80 teachers, 2200 students, 80 parents and over 240 volunteers participating in the interactive water education events. Photo: John Davison, Flagstaff Water Department

WRRC Director, Specialist Teach AZ Water Policy Course

Water Resources Research Center Director Sharon Megdal and WRRC Specialist Kathy Jacobs will be teaching a University of Arizona course, "Arizona Water Policy," during spring semester 2005. Through readings, research, discussion and presentations, students will be exposed to water resource issues facing Arizona and the West, as well as the public policies devised to address the critical issues. The faculty will discuss and analyze the development and implementation of real-world water policy.



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Arizona Water Resource Staff

Editor: Joe Gelt
jgelt@ag.arizona.edu
Editorial Assistant: Gabriel Leake

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

WRRC Director: Dr. Sharon Megdal

Arizona Water Resource

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

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



News Briefs

Bacteria Used to Clean Up Perchlorate

A single-cell organism has replaced ion exchange as a strategy for reducing the perchlorate threat to the Colorado River from a Kerr-McGee chemical plant in Henderson Nevada. The biologic process was installed to replace an ion-exchange plant that had operated from 1999 to May 2004. The ion-exchange plant was shut down due to corrosion problems.

Veolia Water, an environmental management firm, owns the process and is treating it as a company secret. Not much information has been forthcoming about the bacteria, not even its name. Officials only say it is a single-cell organism occurring naturally and posing no harm to humans.

The "bugs" break down the perchlorate using its oxygen molecules to digest a mixture of ethanol and other nutrients. The water is exposed to the bacteria at least twice as the water is pumped through a series of tanks. The water is then released back into the Las Vegas Wash. The biologic system can clean about 1,000 gallons of contaminated water per minute.

Officials say the biologic system more effectively removes perchlorate from water than the ion exchange method. The system has the additional advantage of treating water for nitrates and other pollutants. The costs to install the two technologies are about equal.

The ability of certain bacteria to break down perchlorate is generally known, and the process was considered for use when perchlorate emerged as a water quality concern in the late 1990s. Researchers have identified various bacteria that eat perchlorate.

Micro-organisms also will be used on an American Pacific Corp. remediation project to begin next year in Henderson. Plans call for adding bacteria to contaminated water, with the water then pumped back into the ground. The micro-organisms will treat the water in the ground.

Arizona water users rely on the Colorado River, especially supplies delivered as part of the Central Arizona Project allocation. The Arizona Department of Environmental Quality has been monitoring perchlorate levels in the state.

Perchlorate can interfere with ability of the thyroid gland to produce hormones controlling growth and metabolism. The Environmental Protection Agency with input from the National Academy of Sciences is in the process of establishing a safe drinking water standard for the perchlorate.

Doctors Debate Drug in Water for Heart Disease

Fluoride in drinking water is a topic to raise the hackles of those doubting its dental benefits and resenting its addition to the public water supply. Meanwhile the water additive plot thickens as doctors in England debate whether drinking water might

be used to administer cholesterol-lowering drugs to the public in an effort to reduce incidents of cardiovascular disease, the biggest cause of death in the United Kingdom.

Dr. John Reckless, chairman of Heart UK, a patient and science charity for cholesterol treatment, and a consultant endocrinologist at Bath University, argued that the disease is being under treated, to the disadvantage of many people who are at risk. Doctors in the United Kingdom are advised to treat people whose 10-year risk of cardiovascular disease is 20 percent. This risk means two in every 10 such people would have a cardiovascular event over the space of 10 years if they were left untreated.

Help might be at hand now that cholesterol-lowering drugs called statins are available at UK pharmacies. Statins have been used to reduce the risk of cardiovascular disease, with studies indicating their use can cut the risk of a heart attack and stroke by a third.

Reckless suggests the threat of cardiovascular disease is sufficiently great to justify adding statins to the water supply because more people need statins than are currently getting them. Further he says statins are safe and effective to treat people at very low levels of risk.

In response to findings that statins may pose a risk to babies, Reckless suggests that statin-free baby water be available.

Report Warns of Rural Water Crisis in Arizona

A recently released report addressed the unresolved issue of managing water in Arizona's rural areas. The report issued by the Arizona Policy Forum, a Phoenix-based policy-research group, warns that failure to take action will have grim results, with water shortages becoming more severe and widespread and local economies suffering the consequences.

In effect, the report recommends that some of the Groundwater Management Act restrictions now enforced only in urban areas of the state be applied in rural areas. It recommends restricting development in areas where long-term water supplies can-

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water quality of the catchments, wildlife diseases, and predator use of catchments to find and kill prey. Partnering with AGFD in the study were the U.S. Army, U.S. Fish and Wildlife Service, and universities in Arizona and California.

Biologists found that the rainwater stored in the catchments had no dangerous or unhealthy chemicals. Also, trichomoniasis, a disease commonly contracted by animals sharing water holes, was not evident in the hundreds of animals the researchers screened. Further, in 40,000 hours

of tape, scientists found only about a dozen events of predation, suggesting that the water catchments do not lower survival rates of indigenous species.

But some researchers still question the necessity of catchments. University of Arizona research biologist Paul Krausman is unconvinced that catchments benefit wildlife. He is conducting studies to determine whether the availability of catchments affect reproduction or survival rates of wildlife. He says, "The studies I've done haven't demonstrated they've been beneficial."

Public's Preferred Sources of Water Quality Information

Information Source	Southwest	AZ	CA	NV
Newspaper	76	73	76	83
Television	66	67	63	79
Environmental Agencies (govt)	55	46	56	62
Environmental Groups (citizen)	47	36	53	39
Consumer Confidence Reports	26	19	27	30
Universities	25	21	26	25
Schools (elementary and secondary)	17	11	19	18
Extension Service	15	16	12	21

The above is Table 6 from a 37-question survey developed by the U.S. Department of Agriculture and Cooperative State Research, Education, and Extension Service to document public awareness, aptitudes, attitudes and actions relating to water quality in southwest states. Table 6 records "Yes" responses to the question: "Have you received water quality information from the following sources?" One of the items that stands out in the above table is that consumer confidence reports do not rank very high as a public source of water quality in-

formation, despite most water users receiving such reports. Compared to citizens in California and Nevada, Arizona water users seem especially negligent about reading their consumer confidence reports.

A later table shows respondents' preferences for the way they want quality information provided to them. The first choice of California and Nevada residents was "read printed fact sheets, bulletins or brochures." This was Arizona residents' second preference after "read a newspaper article or series, or watch TV coverage."

not be demonstrated. Further, the report recommends that local government have the authority to reject projects in such areas. The Legislature would have to approve any changes to state groundwater laws.

More specifically the report recommends three courses of action that could help hold off a water crisis in rural areas. One recommendation is that developers or communities demonstrate a 100-year water

supply as a requirement before new homes are built. Existing law allows builders to sell lots or houses despite unproven water supplies, and even despite engineering reports stating a lack of sufficient water supplies. Subsequent buyers do not have to be appraised of the situation. The result of this regulatory laxity is proliferation of wildcat subdivisions.

A second recommendation is that well

drillers demonstrate a 100-year water supply before drilling new wells for residential use. A third recommendation is for a resource fee of \$500 per house to provide matching funds to locate new water sources, purchase water or construct the infrastructure to transport the water. Developers and rural communities pursuing growth will likely oppose these measures.

The report's recommendations do not address one of the more troublesome issues: the availability of new water supplies.

The report notes several areas in the state already water-stressed due to growth. Areas of Douglas, Willcox and the Upper San Pedro Basin have been overpumped. Meanwhile Payson, Pine and Strawberry in the Tonto Creek Basin suffer regular shortages due to shallow aquifers. Drought adds a further water burden to the areas.

Some state officials fear rural communities will interpret such recommendations as outside interference in their affairs. The distrust of government shared by many rural residents colors their perceptions not just of federal policy but also state actions.

The need for water management in rural areas of the state has long been recognized. The 1997 Town Hall report advocated a statewide water planning effort to include representatives of rural communities to plan water management strategies. In 2001, the Governor's Water Management Commission recommended a statewide water management focus to include rural areas.

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created by its researchers can add complications to negotiations. A project currently under legal review involves a university researcher working on a halophyte plant breeding program. Both a private sector entity and the university funded the research. Controversy arose over who has the rights to newly developed lines of plants — the private sector partner or the university.

Consider also a situation relating to a university's status as a public institution and its effect on cost negotiations with private sector interests. Shadman explains: "The university is a publicly funded institution. You have to decide how much taxpayers have already paid and whether they have access to something without paying for it again. Then you have to allow a private company to make a profit. This can be a fine line."

Also the fact that a university's priority is research and teaching adds a constraint. A private company cannot expect to restrict information obtained through a university license if the information could benefit teaching or research.

University Researchers as Entrepreneurs

A key player in a university's effort to market research results is the researcher. Not only is he or she the specialist who best knows the research and its potential, but the researcher has a role in negotiating with private sector interests. To do this effectively requires some entrepreneurial talents.

Shadman says, "Initial contacts have to be made by (the researcher). The academic people have to be there as glue. The industry or company does not know the university, just the princi-

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Guest View

Varied Sources of Water Rights Information Need Preservation

Shelby C. Dudley contributed this Guest View. She is a senior historical analyst at the Salt River Project Research Archives.

The preservation of historic documents is not only necessary for its intrinsic value — who would want to throw away the Declaration of Independence or the signed statute granting suffrage to women? — but also for the potential information that the documents hold. The destruction of documents can leave gaping holes in our collective memory while at the same time lose precious data.

In the Southwest, there are more potential users of water than available supplies can accommodate. Therefore, legal proceedings, legislative action, and negotiated settlements frequently must determine the apportionment of water rights. Experts, by ferreting out documents in various repositories, such as federal, state and local archives, provide information that can establish land and water rights.

The National Archives in Washington, D.C., or at the various branches around the country, contain information on the early settler's path to acquiring a patent on public domain land, including the final proof which can list home improvements, irrigation ditches and cultivated land. Irrigation companies often filed rights of way for canals or reservoirs that were filed with the Bureau of Land Management (originally the General Land Office).

The recorder's office at each county can contain a wealth of information to assist in the reconstruction of land and water development. Warranty and quit-claim deeds might note the transfer of water rights with the sale of the land. Many irrigation companies filed their articles of incorporation and stock transactions with the county. Of particular importance, however, was the filing of notices of water appropriation, which stated the quantity of water diverted, the location of storage and diversion structures, and sometimes the place of use. This notice usually indicated the first intention of a canal company or an individual to divert water for irrigation, mining, domestic, and industrial purposes. Other evidence still needs to be examined, however, to ascertain if the water actually was utilized, because hundreds of notices were filed without a diversion of water ever occurring. The patent files, local and church histories, reminiscences, newspapers and irrigation company records can corroborate the delivery and application of water to the land.

While the county was the original holder of many of these documents, the Arizona State Archives has been in the process of gathering this information to reside in one location in Phoenix. The State is also the owner of its own records, such as the books of the Secretary of the Territory where notices of appropriation and articles of incorporation were also filed. The Arizona Corporation Commission contains the early incorporation papers of irrigation companies as well as subsequent amendments and annual reports.

When water users quarreled among themselves over the division of water, they often went to court to settle their disputes and establish their water rights. Records of these cases reside in dif-

ferent locations; *Huning v Porter* proceedings are still located in the Navajo County Superior Court files, while the limited records of *Hurley v Abbott* are in a scattering of places, including Maricopa County, the National Archives at Laguna Niguel and even in Washington, D.C. The court records can contain the testimony of individuals as to land and water usage as well as maps showing irrigation structures and property owners.

Personal and business records, if available, are also a valuable source of information that should be retained. Irrigation company papers can include lists of shareholders, stock shares, water turns, business meeting minutes and the operational and maintenance files detailing work done on irrigation structures. The culture and social structure of the community can be disclosed by the way people and their property are described in these documents. Local histories, reminiscences, diaries, and church chronicles provide supplementary information on the settlement of a community. As one example, the construction date of a reservoir could not be determined by using government sources, but the reminiscences of a local resident provided the needed information because she recalled bringing lunch to her father and grandfather when they worked on the dam. Because her grandfather moved to Mexico in 1900, her recollections provided the evidence that the reservoir was built prior to 1901.

The use of original documents permits the historic record to help determine the past

water and land usage and establish rights to those precious resources. Without the preservation of such records, significant decisions might be made without the whole truth being present. While a notice of appropriation or a court case might not be the Declaration of Independence, it can be just as significant to the property owner who wants to establish his own rights. By preserving our heritage we also document our rights. ■

Plans Proceed for State Archives Building

In 2004, the Legislature allocated \$2 million for planning the new State Archives building. Archive holdings will include state water records. Construction is expected to start in July of 2005, and should take two years to complete. The total cost of the 130,000 square foot building is estimated at \$35,000,000.

Because of the large cost of the building, members of the Friends of Arizona Archives (FAZA) are seeking additional, private funding from corporate sponsors and foundations. Private sector funds will be used in conjunction with additional Legislative appropriations to begin construction. To donate, or for more information about the building, visit <http://faza.net>

UA Water Sustainability Program Funds New Projects

Completed and ongoing work demonstrates program progress

The University of Arizona's Water Sustainability Program involves a campus-wide collaboration of scientists and educators and is coordinated by four UA water centers. (Engineering Research Center for Environmentally Benign Semiconductor Manufacturing; Center for Sustainability of Arid and semi-Arid Hydrology and Riparian Areas; Water Quality Center; and Water Resources Research Center). WSP's origin was a November 2000 voter approved increase in the state sales tax to support education. Funds derived from this source were used to establish the WSP as well as support six other UA initiatives.

WSP is fulfilling the intent of the legislation by increasing university-industry partnerships and enhancing educational opportunities for students. New research innovations are being developed to resolve Arizona specific water issues. A continuing program effort is the expanded delivery of water information and quality education programs to K-12 students, university students, elected officials, state and local government agencies, the private sector and the general public.

WSP, now in the fourth year of a five-year program, consists of various components, each with a different strategy to promote water knowledge and understanding. Following are descriptions of the grants and fellowship programs.

Competitive Grants Program

The grants program is now in the second cycle of funding to support UA water research, education and outreach. Thirty-one projects have been selected in these two cycles through an expert review process and have received a total of \$2.2 million. About 70 faculty and staff from 22 departments/schools/units, across five colleges are working on these projects in cross-disciplinary collaborations. Over 80 student opportunities through paid positions or research assistantships have been created.

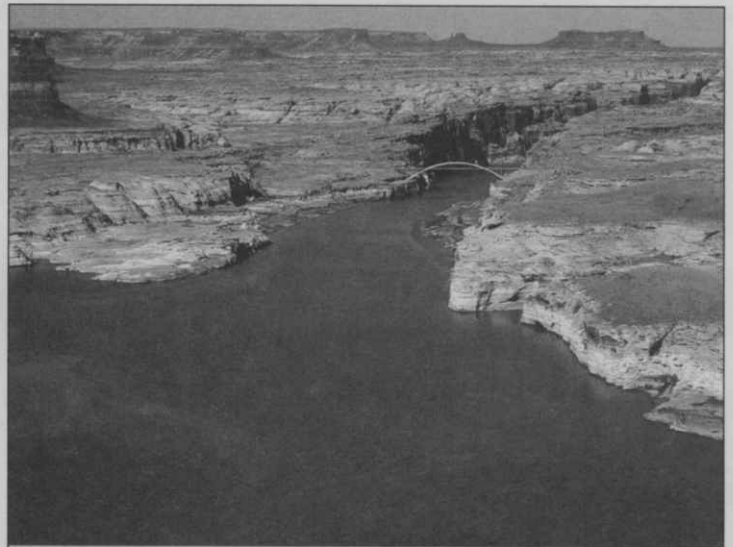
Approximately 75 new partnerships with city, county, state and federal agencies, the private sector, schools, and NGOs, providing direct dollar matches, in-kind contributions, and consultative input, have been formed. These projects have attracted close to \$600,000 in direct dollar support from off-campus sponsors.

Eleven new WSP projects were recently selected to receive funds. Four projects will be completed by December, 2004 (see sidebar, page 2) and 16 multi-year projects continue (see sidebar, page 3) In sum, 13 of the 31 projects focus on water quality issues, ten projects concern water supply, and eight pertain to water education, although many projects overlap these categories.

Following are summaries of newly WSP-funded projects. They address the issues of water quality, supply and education.

Water Quality Projects

Arsenic Mobilization and Transport from Water Treatment Residuals in Landfills. \$25,000. Dr. Wendell Ela, Dr. Eduardo Sáez, Dept. of Chemical and Environmental Engineering.



The above shows drought conditions at Lake Powell, (June 29, 2002 top, March, 2003 bottom). See page 2 for description of research project (Jacobs et al.) that takes a multi-pronged approach to enhancing Arizona's water supply reliability from the Colorado River. (Photos: John Dobrenwend)

Current technologies for the removal of arsenic species from drinking water rely on the use of solid sorbents such as activated alumina or synthetic ferric hydroxide minerals. When the sorption capacity is reached, the arsenic-laden sorbents are disposed in non-hazardous landfills. Preliminary work in the lab has shown that these residuals will leach high arsenic concentrations under normal landfill conditions, thereby posing a renewed threat of soil and groundwater contamination. This project will quantify arsenic content in landfill leachates as dissolved species and, perhaps more importantly according to early results, as species adsorbed on colloidal particles.

Arsenic in Arizona: Evaluating the Economic Costs and Hydrogeologic Feasibility of Non-Treatment Methods. \$37,200. Dr. Steven Stewart, Dr. James Hogan, Dept. of Hydrology and Water Resources.

Recently the EPA lowered the arsenic drinking water standard to 10 ppb and set January 23, 2006 as the compliance deadline. To date, wellhead treatment has been the primary focus of compliance efforts. Evaluation of the hydrogeologic applicability and economic costs of non-treatment methods such as well modifications to seal off high-arsenic zones or improvements in yield from low-arsenic zones will be carried out. Non-treatment methods typically have high initial costs, but these costs are offset by lower long-term maintenance and monitoring costs. Such methods may be especially beneficial for small providers and in the development of new groundwater resources.

Perchlorate Removal from Ground and Irrigation Water Using Low-Maintenance Biofilters. \$28,785. Dr. Jim Field, Dr. Reyes Sierra, Dept. of Chemical and Environmental Engineering.

Perchlorate is an emerging water quality issue in Arizona. Perchlorate is detected in groundwater and surface water used for human consumption and irrigation. Natural occurring microorganisms readily metabolize perchlorate to safe end-products

when supplied with suitable electron donating substrates (e-donor). The objective of this project is to develop a low maintenance biofilter system for treatment of perchlorate in contaminated water based on slow-release insoluble e-donors. Several biofilter concepts will be tested for their applicability to perchlorate removal from groundwater, irrigation water and anion exchange brine.

Assessment of the Microbial Water Quality of Individual and Small Systems Groundwater Supplies in Arizona and Appropriate Treatment Technology for its Control. \$50,000. Dr. Martin M. Karpiscak, Office of Arid Lands Studies; Dr. Charles P. Gerba, Dept. of Soil, Water and Environmental Science.

Arizona has more non-disinfected drinking water supply systems than any state. All of these systems depend on groundwater, which is subject to contamination by enteric waterborne pathogens originating from septic tanks and leaking sewer lines and water based pathogens. In addition, Arizona has many rapidly growing areas dependent on septic tanks for treatment of household waste. Lake Havasu is the largest community in the United States totally dependent on septic tanks for treatment of its sewage. The goals of this project are to: 1) assess the microbial quality of individual and small system non-disinfected groundwater systems in Arizona; 2) identify potential sources of contamination, and 3) evaluate appropriate technology for enhancing the microbial quality of the drinking water in these systems.

Detection of Viruses in Drinking Water using Raman Spectroscopy. \$16,215. Dr. Mark R. Riley, Dept. of Agricultural and Biosystems Engineering; Joseph H. Simmons, Dept. of Materials Science and Engineering.

The goal of this research is to develop a rapid and specific method for quantification of viruses in drinking water. Current methods for detecting disease-causing viruses in drinking water typically require many days to several weeks. We aim to use resonant surface enhanced Raman spectroscopy coupled with biochemically-mediated microbial recognition to quantify waterborne viruses. This approach will be highly specific, rapid, and could be operated as a continual monitoring scheme. This approach has the potential to quantify as little as ten's of organisms and thus satisfies the criteria for a practical scheme to ensure the safety of drinking water.

Effects of Water Quality on "Rapid Blight" Disease of Turf grass. \$43,065. Dr. Mary Olsen, Dr. David Kopeck, Dr. Mohammad Pessaraki, Ms. Donna Bigelow, Mr. Jeffrey Gilbert, Dept. of Plant Sciences.

Rapid blight is a new disease of cool season turfgrass that has been associated with poor quality water (non-potable) in Arizona and ten other states. The causal organism, a species of *Labyrinthula*, is a unique organism

First Round of WSP Projects Concludes



Four one-year Water Sustainability Program projects are winding down.

Eduardo Saez and his group in Chemical and Environmental Engineering have developed an innovative and potentially cost-effective alternative for the destruction of trichloroethylene and perchloroethylene during site remediation. This modified fuel cell shows promise for adaptation to field-

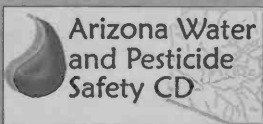
scale use that is of particular interest to the Arizona Department of Environmental Quality for Superfund site clean-up.

A multi-media distance educational CD on Arizona Water and Pesticide Safety produced by Louis Carlo and Paul Baker of the Department of Entomology will deliver information and pesticide safety guidelines on the protection of groundwater, canals, and watershed environments to be released through CALS-mart, libraries, education organizations and UA Cooperative Extension.

A handbook and website on Arizona water sources, quality, regulations and home water treatment options will soon be available to help consumers make informed choices about the need and use of home water treatment devices.

An interactive display on the hydrology of caves and mountain block recharge was recently

installed at Kartchner Caverns. It has the potential to reach 200,000 visitors per year and will help efforts to improve the hydrologic literacy of the general public.



Multi-Year WSP Projects Study Various Issues

Sixteen Water Sustainability Program projects received multi-year funding. The focus of these continuing projects are water quality, water supply and education. Project topics are listed below:

Water Quality

- Microbial studies to date on bacteria, viruses and protozoans have revealed the ubiquitous presence of antibiotic resistant bacteria and endotoxins in biosolids that can lead to water quality problems when used as soil amendments;
- A new cell culture line is being modified to allow more diverse detection of human enteric viruses in drinking water;
- The first molecular detection method has been developed for *Naegleria fowleri*, linked to 2 deaths of children in Peoria who consumed non-disinfected ground water;
- Estrogenic activity has been shown to decrease in effluent by 75 percent over 23 miles of the Santa Cruz. Wetlands treatment dramatically decreased concentrations within 6 days;
- Quantification of endocrine disruption in susceptible vertebrates that live in these effluent dominated waters is in progress;
- Projects aims to quantify denitrification activity in nitrate contaminated desert soils and to delineate microbial pathways of nitrogen transformation in disturbed desert ecosystems.

Water Supply

- A preliminary comprehensive decision support simulation model has been developed by Lansey's inter-disciplinary group that incorporates water conservation, treatment and quality changes in water supply across residential, industrial and agricultural uses, and is now in testing mode.
- Another decision support model modified specifically designed for surface water quality assessment and management at the watershed level is also in the works.
- A third model that has improved on existing evapotranspiration models for riparian areas to integrate environmental water needs into water management plans, is now available, further input continues.

- A drought plan tailored to Arizona developed in conjunction with the Arizona Drought Task Force is analyzing drought information both regionally and through time, has identified the vulnerability of communities to drought and generated education and outreach programs for stakeholders.
- Adding to hydrologic information, a paleo-climate study will enhance understanding of past events in Arizona water history and consequences in the future.
- Quantifying mountain front recharge through the use of isotopes will improve understanding and estimates of recharge processes in groundwater supply

Water Education

- The Water Wagon, a mobile education trailer to bring water education to K-12 students, has been developed and is now on the move offering hands-on displays on hydrology, biology and chemistry to students and teachers in southeastern Arizona.
- Water resource kits and training to help classroom teachers effectively teach water education to their students are being delivered to Arizona schools. In year one, WATER: Water in Arizona, Teaching Resources has reached 49 teachers, 675 students, 15 educators, 2 graduate students, with plans to roughly triple those numbers in years 2 and 3.
- Needs of the Green Industry are being addressed in northern Arizona through a program that will include an educational web site, publications, demonstration projects, workshops, and a small network of automated weather stations to monitor water demand resulting from evaporation, all designed to improve the efficiency of landscape irrigation and reduce water consumption.
- Furthering conservation efforts is a project focused on analyzing costs and benefits of regional, municipal and industrial water conservation programs and strategies, to determine actual water savings. Results will be used to create a reference document and interactive Web site so that decision makers can maximize water savings for dollars spent on conservation efforts.

that previously has been described only in association with marine and hypersaline systems. It was described as a pathogen of turf at the UA in 2003. The objective for this project is to determine specific components of water quality that contribute to disease development in turf in Arizona and that define the growth parameters of the pathogen.

Water Supply Projects

Enhancing Water Supply Reliability through Improved Predictive Capacity and Response. \$73,750. Kathy Jacobs, Dept. of Soil, Water and Environmental Science; Dr. Bonnie Colby, Dept. of Agricultural and Resource Economics; Dr. David Meko, Laboratory of Tree-Ring Research; Dr. Bart Nijssen, Hydrology and Water Resources/Civil Engineering and Engineering Mechanics.

This project is a multi-pronged approach to enhancing Arizona's water supply reliability from the Colorado River. It

will: a) assess current U.S. Bureau of Reclamation use of climate information in river modeling; b) identify strategies to better utilize paleoclimatology, climate forecasts and climate change predictions to improve water supply predictive capacity for the lower Colorado River and the Central Arizona Project; c) evaluate existing state and federal management tools to translate improved predictive capacity into enhanced supply reliability for water users and d) develop practical supply reliability strategies for use by municipalities, irrigation districts and other stakeholders.

Patterns of Hydrologic Connectivity on a Desert Riparian Landscape. \$32,759. Dr. Ed Glenn, Dept. of Soil, Water and Environmental Science; Dr. John Kupfer, Dept. of Geography and Regional Development; Dr. Dave Meko, Laboratory of Tree-Ring Research.

The restoration and conservation of riparian landscapes in arid landscapes is fundamentally linked to a working knowledge of

landscape form and function. One understudied but important component is hydrologic connectivity. In this research, a combined field and experimental approach using tree rings to reconstruct hydrologic connectivity on the San Pedro National Riparian Conservation Area will be employed. Previous reconstructions of local hydrology using ring widths have not been successful so it is proposed that the development and analysis of false-ring chronologies could be used to indicate spatial and temporal patterns of channel drying and attendant decreases in groundwater depth.

Early Irrigation Termination of Cotton as a Drought Mitigation Strategy. \$32,842. Dr. Russell Tronstad, Dept. of Agricultural and Resource Economics; Dr. Jeffrey C. Silvertooth, Dept. of Soil, Water and Environmental Science.

Research of the economic impact of growing a very reduced season cotton crop that utilizes much less water than traditional protocols is proposed. This very reduced season has never before been researched. The basis for our economic assessment will be field trials of five different irrigation termination dates and twelve modern varieties. Impacts on revenue (lint yield and quality differences) and production costs will be quantified. A primary benefit of this research is quantifying the marginal value of water for the entire cotton growth cycle, thus, identifying how to manage cotton as part of a possible drought mitigation plan.

Characteristic Flood Response of a Burned Catchment: Sabino Creek Basin, Arizona. \$56,001 Dr. Ty Ferré, Dr. Brenda Ekwurzel, Dept. of Hydrology and Water Resources; Dr. Bart Nijssen, Dept. of Hydrology and Water Resources/ Civil Engineering and Engineering Mechanics.

Land resource managers need better post-fire impact monitoring tools and improved metrics for evaluating mitigation strategies. Using recently burned Sabino Creek Basin as a study area model simulations and field measurements will be combined to: a) determine the relative importance of changes in soils and vegetation to changes in flood response; b) evaluate the potential impact of existing fire mitigation measures on flood response; and c) develop alternative mitigation scenarios as needed. In addition, we will collaborate with the Flandrau Science Center and SAHRA to enhance a summer science camp (Camp Wildfire) and with the United States Forest Service and SAHRA to develop a public education exhibit for display at the Sabino Canyon Visitor Center.

Water Education Projects

Spanish-Language Landscape Water Conservation Program for the Green Industry. \$8,777. Vicki S. Richards, Pima County Cooperative Extension/Low 4 Program.

A large percentage of Green Industry personnel speak Spanish. Currently, there are very few public educational programs for this sector of the industry. However, these personnel are making many of the landscape and water management decisions for commercial and residential landscapes. The Low 4 Program runs a successful, recognized landscape water conservation program for the Green Industry called \$martscape. Many landscape and nursery employers would like to send additional employees to

\$martscape training but their employees do not speak, understand and/or read English. Funds requested would allow for printed material translation and matching funds would pay for conducting a \$martscape training series with Spanish-speaking instruction.

Student Fellowship Program

The WSP has funded 18 outstanding students studying diverse areas of water resources specific to Arizona through the WSP Student Fellowship Program. Graduate students receive awards of \$16,000 to \$20,000; undergraduates receive \$4,000 to \$5,000. These funds support and encourage their continued studies in water resources.

The following graduate students have been awarded TRIF fellowships: *Joe Abraham*, Assessing Drought Vulnerability in Northern Gila County, Department of Geography and Regional Development, Advisor: Andrew Comrie; *Matthew Baillie*, Quantifying San Pedro River Inflows to Improve Riparian Sustainability Efforts: A Geochemical Tracer Approach, Department of Hydrology and Water Resources, Advisor: Brenda Ekwurzel; *Gina Chorover*, Living on the Edge: Mitigating the Impact of Development near Riparian Areas through Community Design and Land Stewardship, School of Landscape Architecture, Advisor: Margaret Livingston; *Carla De Las Casas*, In-place Regeneration of SVE Loaded GAC Using Fenton's Reagents, Department of Chemical and Environmental Engineering, Advisors: Wendell Ela and Bob Arnold; and *Derya Sumer*, GIS Interface with a Groundwater-Dynamic Simulation Model, Department of Civil Engineering and Engineering Mechanics, Advisor: Kevin Lansey.

The following undergraduate students have been awarded TRIF fellowships: *Liese Beenken*, Water Recycle and Reuse, Department of Chemical and Environmental Engineering, Advisor: Kim Ogden; *Erin Gleeson*, Development of a Decision Support Model to Assess Water Use by Different Riparian Communities, Department of Hydrology and Water Resources, Advisor: Paul Brooks; *Nicholas Nelson*, The Effect of Biosolids Application on Water Quality in Arizona, Department of Agricultural and Biosystems Engineering, Advisor: Chris Choi; and *Yvonne Resendez Young*, Enhancing the Understanding and Importance of Granting Instream Flow Water Rights in Arizona, School of Natural Resources, Advisor: Peter Ffolliott.

Water Sustainability Program

Water Sustainability Program
College of Agriculture and Life Sciences
The University of Arizona
350 N. Campbell Ave.
Tucson, AZ 85721

phone: 520-792-9591 ext. 17
fax: 520-792-8518
wsp@uawater.arizona.edu

<http://uawater.arizona.edu>





Legislation and Law

Colorado River Pact Ensures Water, Power Delivery

Interior Secretary Gale Norton recently signed an agreement with representatives of Arizona, Nevada and California to protect wildlife and native species along the Colorado River. The Lower Colorado River Multi-Species Conservation Memorandum of Agreement stipulates \$625 million over 50 years to protect rare fish and wildlife along a 300-mile section of the Colorado River from Lake Mead to Mexico.

The environmental protection plan was needed to avert possible water delivery delays and hydropower cutbacks that affect major water purveyors in California, Arizona and Nevada. The agreement is to ensure that habitat is protected while guaranteeing sufficient Colorado River supplies to meet the needs of the major water purveyors and to maintain power generation. The river provides water and power to 20 million people in the three states.

The agreement is the result of an eight-year effort to work out a broad conservation plan for the Lower Colorado River. The plan will create 8,100 acres of riparian, marsh and backwater habitat for 27 species of fish, birds, mammals, reptiles and plants including some endangered species. These include the southwestern willow flycatcher and several native fish, such as the bonytail and humpback chubs and the razorback sucker.

The plan has the distinction of being the largest river habitat project ever proposed under the Endangered Species Act.

Work on the plan began in response to concerns that the U.S. Fish and Wildlife Service's 1994 designation of critical habitat for four endangered fish species could adversely affect power and water resources in the Lower Colorado River. The critical habitat designation imposes certain restrictions on federal activities in the designated area.

Officials say the agreement ensures ESA compliance for the three states over the next 50 years, in the face of existing and future Colorado River water transfers, potential drought and shortage river management operations, and hydropower operations. With efforts to share and relieve shortages of the drought-struck Colorado River intensifying, varied water management strategies will likely be implemented. Officials say having a broad recovery plan in place could help certain decisions withstand possible court challenges based on environmental concerns.

The agreement includes cost-sharing provisions. The Interior Department will pay half the \$625 million cost, with the Metropolitan Water District of Southern California paying \$150 million, and Arizona and Nevada paying roughly \$77.5 million each. Arizona's share will likely come from users of the Colorado River, increased water bills and added costs for fishing licenses or river trips. The Central Arizona Water Conservation District will make the initial Arizona payments, with later installments expected to be covered by other water providers and state agencies.

With the funding worked out, federal and state officials hope the conservation plan can be adopted by early January.

The plan is not to everyone's liking. Some environmentalists question whether the proposed fish and wildlife recovery plan will in fact restore populations decimated by dams and extensive water diversions along the Colorado River. They say, for example, that rather than preserving wild river runs the plan calls for releasing hatchery-produced fish into the river. Some also question whether healthy habitat will take root in the damaged environment.

U.S. Supreme Court Debates Right to Sue for Cleanup Costs

The U.S. Supreme Court recently considered a case with significant implications to communities with toxic sites from abandoned plants, landfills and mines. The issue at hand is whether a company that voluntarily undertakes cleanup of its polluted site can sue former owners of the land to help with the costs.

The usual course of action would be to wait for the Environmental Protection Agency to designate a highly polluted area as a Superfund site. Officials could then contact current and former owners of the site for funds to help pay clean-up costs.

The justices are being asked whether owners of properties that the government has not yet identified as a polluted site can look to the Superfund law to allow them to sue former owners to share clean-up costs. In effect, a landowner could take the initiative in contacting responsible parties without having to wait for EPA to act, an event that might be a long while in coming.

The case involves Aviall Services Inc. suing Cooper Industries, a former owner of land now owned by Aviall, for \$5 million for pollution clean-up costs. Aviall lawyers argue that a delay caused by waiting for government action could have serious consequences since the pollution is a threat to a nearby lake and groundwater.

Cooper's lawyers argue that government involvement is necessary to ensure proper and thorough cleanup of the site.

The Bush administration position is that companies can take the initiative to clean up sites but must consult with government officials in advance to ensure that the job is done properly.

The 5th U.S. Circuit Court of Appeals in New Orleans ruled that Aviall could sue. The court also stated, however, that "reasonable minds can differ over" the wording of the Superfund law.

The Supreme Court Justices also appeared to be troubled by the law's wording. Justice Sandra Day O'Connor said the section of the law at issue in the case did not seem to permit such lawsuits, although other sections of the Superfund law might be interpreted to allow the action. A Supreme Court decision in this case then may not resolve the issue.

Arizona is among the 23 states requesting the high court to uphold the lower court decision.

The case is Cooper Industries Inc. v. Aviall Services, Inc., 02-1192. ■



Publications & On-Line Resources

Braving the Currents: Evaluating Environmental Conflict Resolution in the River Basins of the American West

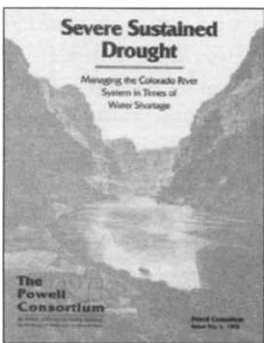
Tamra Pearson d'Estrée, Bonnie G. Colby, Kluwer Academic Publishers, 404 pp., \$125. (For ordering information check: <http://www.wkap.nl/>)

With various interests competing for what they believe is their fair share of limited water supplies, conflict is inevitable, and its occurrence has greatly increased during the last 25 years. Points of contention include surface and groundwater development, use, allocation and quality. Interests with a competing stake in these issues include agricultural and environmental interests, municipalities, industry, tribes and non-human species.

A contribution to the field of dispute resolution evaluation, this volume will assist those working to understand and resolve water disputes in their search for the most effective approach for their particular situation. Along with a theoretical framework, the authors present various case studies that demonstrate how conflicts emerge and tensions build. Also, the role of mediators is shown as they design and implement processes to bring conflicts to some sort of resolution.

What has long been needed is a means to evaluate the viability, success rate and costs of various approaches. The authors examine 28 "success" criteria from various angles and offer a method for systematically considering all the elements necessary for successful environmental conflict resolution. This analytic framework then is applied to eight specific western U.S. water conflicts.

"Appendix A" is a guidebook that provides detailed instructions for case documentation and analysis.



Severe Sustained Drought: Managing the Colorado River System in Times of Water Shortage

Powell Consortium, Arizona Water Resources Research Center. It can be purchased for \$15 from the Water Resources Research Center, The University of Arizona, 350 N. Campbell, Tucson, AZ 85721, or by calling 520-792-3124.

With the continuation of drought, some items from the past are getting increased exposure. Two examples: the subsiding waters of Lake Mead have exposed the foundations of the old Mormon town of St. Thomas, and a 1995 publication, "Severe Sustained Drought: Managing the Colorado River System in Times of Water Shortage," is attracting renewed attention because it raises issues relevant to the ongoing drought.

Written during flush times with reservoirs brimming, the publication includes the results of a multi-and interdisciplinary research project begun in the early 1980s and completed in 1994. The work of a cadre of western water scholars, the study creates a scenario of severe and sustained drought. The scenario then provides the means to assess what the hydrologic, social and economic impacts of such a drought would be under the current law of the river.

Further, the researchers have explored combinations of changes in institutional arrangements affecting the operation of the river that might reduce or mitigate the impacts of a severe, sustained drought. For example, a research finding indicates that the law of the river limits the flexibility of states to deal with a water crisis.

The Colorado River Water Conservation District recently reprinted the 1995 bulletin containing the study to distribute to Colorado's chief water-decision makers.

The Powell Consortium is an alliance of seven water resources research institutes and centers from the states of Arizona, California, Colorado, Nevada, New Mexico, Utah and Wyoming.

Confronting the Nation's Water Problems: The Role of Research

Committee on Assessment of Water Resources, The National Academies Press, \$47 paperback, \$42.30 if purchased online at <http://books.nap.edu/catalog/11031.html>. Also it can be read free online.

This congressionally mandated report calls for a new U.S. commitment to water resource research to confront the nation's increasingly severe water problems. An identified priority is for a new strategy to coordinate water research currently fragmented among nearly 20 federal agencies. According to the committee, various developments — competition for water among farmers, communities, aquatic ecosystems and other users, climate change and the threat of waterborne diseases — justify that an additional \$70 million in federal funding be annually allocated to water research. Areas identified in special need of research include water demand and use and water supply augmentation. The report notes that overall real-term federal funding for water research has been stagnant for the past 30 years, with the portion dedicated to research on water use and social science topics actually having declined considerably.

Web Site Offers Forecast, Climate Info

Stakeholders in the Southwest may have difficulty finding and interpreting forecasts and climate information issued by various agencies. To assist those seeking such information, the University of Arizona's Climate Assessment for the Southwest Project (CLIMAS) gathers and publishes this information, along with interpretive summaries written by the CLIMAS team, in the "Southwest Climate Outlook." Each month the outlook, available in PDF and HTML formats, includes summaries of recent conditions and forecasts for temperature, precipitation, drought, fire, streamflow, reservoir levels and El Niño. In addition, the outlook provides feature articles and special "focus pages" on relevant topics. Recent feature articles have detailed the North American Monsoon Experiment and an experimental East Pacific hurricane forecast, while recent focus pages have spotlighted internet resources for drought and local forecast information. The latest Southwest Climate Outlook in html format is available at: <http://www.ispe.arizona.edu/climas/forecasts/swoutlook.html> An archived list of past outlooks can be accessed at: <http://www.ispe.arizona.edu/climas/forecasts/archive.html>



Special Projects

Water Treatment Process Has Broad Application, From Industry to Use in Third World Nations

Called "Dewvaporation," the technique relies on complementary processes: dew formation and evaporation

An Arizona company is bringing to market a water treatment process able to convert seawater and contaminated water, including wastewater, to distillation quality water. Operating with less energy and at lower operating costs than conventional distillation or reverse osmosis techniques, the process has the potential to be broadly used, from industrial applications to use by individuals, farms or Third World countries.

James Beckman, Chief Technology Officer of L'Eau LLC says the treatment process has been trademarked as "Dewvaporation." The name is derived from two complementary processes, dew formation and evaporation; Beckman's process essentially relies on a humidification/dehumidification cycle.

The physical component consists of a honeycombed layered structure. It includes a heat transfer wall, with an evaporation side and a dew-formation side. The water to be treated flows down the evaporation side of the wall while air is pumped into the bottom of the tower and circulates upward over the water in the heat transfer wall. The air moving up the tower over the water constantly picks up moisture because the air is heated as it moves up the heat transfer wall. As the temperature of air increases, its capacity to hold moisture also increases. By the time the air reaches the top of the tower its temperature is 93.3 °C and it contains as much water vapor as air by weight.

The air is then recirculated downward after steam or heat is added to the air stream further heating the air. The air or gas flows downward on the dew formation side of the heat transfer wall. The heated gas stream is warmer on the dew formation side than the gas stream on the evaporation side. This imbalance results in a continuous flow of heat from the dew formation side to the evaporation side, with the result that the gas stream on the dew formation side cools. This cooling diminishes its capacity to hold water vapor picked up coming up the evaporation side, and the water condenses out and is carried away by a gas stream which passes down the dew formation side. Since salts and contaminants do not vaporize, the water that condenses is pure distilled water. The final product is purified water condensing on one side of the structure and contaminants on the other side.

The amount of steam or heat needed to establish temperature differences across the wall is minimal and can vary in intensity, from low temperature solar (55°C) to higher temperatures from waste heat or combustible fuels (99°C). If servicing power plants and certain types of industry, the thermal needs of the process might be met by waste atmospheric steam. In certain locations of the world, including Yuma and areas of California, ambient dry desert air could be used as heat source.

The unit or module is rather small scale, measuring 4 ft. by 4 ft.

by 8 ft. high, with a capacity of 1,000 gallons per day. Four modules would be installed for an application requiring 4,000 gallons per day

Beckman says L'Eau may develop a unit with a greater capacity. He expects, however, the module will remain the basis of a larger unit. He compares the concept to a reverse osmosis operation with a capacity of a million gallons per day. He says, "They have a module of something in the order of 5,000 gallons a day that is simply repetitive. ... Our notion is very similar to that kind of approach. We would probably develop a module that was best-sized and then duplicate it." He figures a Dewvaporation module of 5,000 gallons a day would be about right.

Units have been tested at several electric generating plants. At one plant, discharge from cooling towers was one percent saline. The unit more effectively treated the discharge so that the final brine was almost 20 percent. Increases in salt concentration mean more water recovered. Treating 213 gallons per day yielded 200 gallons of pure water and 13 gallons of concentrated saline water.


At another power plant the unit treated very concentrated brine, removing water and producing crystals for disposal.

A New Mexico carwash will be using Dewvaporation technology with a 16,000 gallons per day application as part of its Green approach to doing business. Grimy soapy water that would normally be discharged will be treated, with over 98 percent recovered. The recovered water will be pure distillate to be reused for washing the cars. Plans also call for the carwash to harvest rain and stormwater runoff to uses in the operation.

Beckman intends that the treated water will eventually be certified as potable drinking water. He says, "So far we have been taking salt out of water for purposes other than consumption. We want to move to the certified, consumable arena."

That the device is constructed mostly of plastic has various advantages. Plastic resists corrosion and is relatively inexpensive and lightweight.

The unit's simplicity of design, low maintenance and reliability, as well as the low cost of its materials and its low operating costs enhances its suitability for use in Third World countries. The core processing towers are entirely passive elements, and operate at atmospheric pressure. Because there are no moving parts in the core process, low pressure, and low air and liquid flow rates, little to no stresses are placed on the equipment. The only moving parts are the external blower and pump, and they are off-the-shelf components, both highly reliable and simple to replace.

The U.S. Bureau of Reclamation has supported Beckman's research since 1998. State organizations also contributed to the project. 



Announcements

Ground Water Expo Scheduled

The National Ground Water Expo will be held Dec. 12-15 in Las Vegas. The event will provide an opportunity to check out new equipment (about 280 exhibitors) and participate in educational opportunities including lectures and presentations from industry experts. Session topics will include scientific, regulatory, technical and social aspects of groundwater. The event is billed as an opportunity "to experience cutting-edge technology, interact with current industry peers, make new important contacts, or meet your certification requirements." For more information, go to the NGWA website at <http://ngwa.org/>

Conference on Restoring, Managing Arid Watercourses

The Arid Regions Biennial Conference — Restoration and Management of Arid Watercourses — will be conducted Nov. 16-19 in Mesa. The focus of this year's conference will be on river management and restoration techniques for arid watercourses, and on technical, administrative and political floodplain management issues. The biennial event attracts a broad audience, including local, state and federal government officials, engineers, consultants, planners, non-profit organizations, researchers, educators and involved citizens. For additional information and to register check the Arizona Floodplain Management Association website: <http://azfma.org/>

AWPCA Issues Call for Papers

The Arizona Water and Pollution Control Association is issuing a call for papers for its 78th annual conference, May, 2005. Interested presenters should prepare a one-page abstract describing the subject matter in sufficient detail to allow evaluation of the proposed topic and submit it by Dec. 1. Presentations will be limited to 30 minutes including time for questions; longer presentations, however, will be considered. For additional information check AWPCA's web site: <http://awpca.org/>

Water History Assoc. Call for Papers

A call for papers has been issued for the International Water History Association's conference devoted to topics relating to water and history, to be held in Paris, Dec. 1-4, 2005. Participants are invited to submit an abstract (maximum 600 words) no later than March 1, 2005 via the web site: <http://iwha.polaire.net/cgi-bin/2005/submit.cgi> For additional information check: <http://www.iwha.net/>



WRRC Invites Research Proposals

The University of Arizona's Water Resources Research Center is accepting proposals for research grants under the Water Resources Research Act, Section 104B. Funded by the U.S. Geological Survey, Section 104B provides support for small research projects on water-related issues of state and regional importance. WRRC expects to distribute about \$50,000 to fund projects, although the federal budget has not yet been approved, and exact figures are not available.

Only faculty members at the three Arizona state universities can submit proposals. Researchers in the social, biological, physical, and engineering sciences and fields such as water management, water law, economics and public health are invited to apply. The start date for funded projects is March 1, 2005.

Proposals must be submitted via the National Institutes for Water Resources web site. Also, an electronic copy and ten hard copies must be submitted to WRRC. Guidelines are available on the WRRC web site: <http://cals.arizona.edu/azwater/> Deadline for submitting complete proposals is 5:00 p.m., Nov. 22, 2004.

The WRRC will convene an external review committee to review all proposals. In addition, each proposal will be reviewed by persons experienced in the field of the proposal. The WRRC will make final award decisions on the basis of input from both groups and available funding.

Water Research...continued from page 5

pal investigator who came up with the idea. ... They want to deal with the PI." Further, researchers may find their services needed even after negotiations are finalized, to work with a company as the product is commercialized.

University researchers are not always comfortable dealing with the private sector. Some believe the effort required to work out successful negotiation takes time and resources from their true interests — research and teaching. Others feel they are not temperamentally suited for the task.

UA microbiologist Chuck Gerba felt out-of-place in the entrepreneurial role. He says, "You need to be a real promoter to knock on doors until someone bites. ... I think that is difficult for

a university professor. We are used to writing grants, and I think (salesmanship) is a role we are not really trained for."

Some believe university researchers will readily learn to cope as private sector funding becomes more available. W. Scott Stornetta, a technology transfer consultant working in higher education, views it as part of a historical process. He says that before WW II universities funded their researchers' work. Outside government funding then became available after the war, and the faculty learned to tap into this new source of research funds.

Stornetta says the emerging movement is for researchers to approach the private sector for support. He says some researchers may be uncomfortable at first but believes they will adapt as

Continued on page 12



Public Policy Review

by Sharon Megdal

State Drought Plan on Right Road Despite Some Concerns



After about 18 months of work, the Governor's Drought Task Force sent its recommended Arizona Drought Preparedness Plan to Governor Napolitano. A key part of the Plan is the document, Operational Drought Plan. Also part of the Drought Preparedness Plan is a lengthy document, Background and Impact Assessment Section. A companion report is the Arizona Statewide Water Conservation Strategy. The reports can be found at <http://water.az.gov/gdtf/>

A key question during the latter stages of the Task Force process was to what extent water conservation should be required as a drought response. The plan initially released for public comment included a Conservation Strategy Document and a requirement that locally developed Drought Contingency Plans include a water conservation component. The separate Conservation Strategy focused on developing a water conservation ethic over the long-term, beyond the immediate drought context. But there was no real guidance on what that conservation component of the drought plans should look like. The media and others questioned Arizona's consideration of a drought plan lacking mandatory conservation requirements as drought conditions worsen. The adopted plan included much more in the way of conservation requirements and guidance.

Included in the final document is a five-page table that ties the declared drought stage, which ranges from Normal to Extreme, with actions state government, communities and utilities, and individuals would take. Required and recommended conservation practices become more strict with the severity of the drought. Developed late in the process, the table was not subject to much public comment. It represents a good start, but refinement is needed. For example, under Extreme drought conditions, communities and utilities must prohibit "all public water uses not required for health or safety and publicize enforcement activities to customer[s]." Winter overseeding is to be prohibited, except for golf course greens. Individuals are to "use covers to reduce evaporation from pools."

As I read it, in Extreme drought conditions, water is not to be used for community or public pools but could be used for golf course greens and private pools. Does it make sense for the city pool to close while people can continue to keep their backyard pools full and golf course greens are kept green? A further look is required, and affected parties should have an opportunity to comment.

The Operational Drought Plan includes general recommendations to the Governor. The first recommendation is to seek resources to fund two half-time ADWR positions and funding for a university partner to work on "implementation, assessment and improvements to the Arizona Drought Preparedness Plan." It is important to recognize that proper implementation of the plan will

take resources, and this recommendation should be implemented as quickly as possible. ADWR has had its resources cut considerably over the past few years. To maintain momentum, finding the needed resources for ADWR should not have to wait until finalization of next year's budget.

The second recommendation is that ADWR should continue to facilitate coordinated water planning of counties, cities and water providers, with the task assigned to the agency's Rural Watershed Program and Local Area Impact Assessment Groups. (The Plan recommends the formation of the latter group.) This recommendation is recognition that additional work is needed in Arizona's rural communities to enable locally tailored drought plans to be developed.

The third recommendation is very significant. It requires every potable water system (public and private) to develop a Drought Contingency Plan to be submitted to ADWR by January 1, 2006. If implemented, this recommendation would result in hundreds of such plans being due in about a year. The recommendation states: "The Drought Plan must include both mitigation strategies, including a water conservation plan to reduce vulnerability to drought, and response actions." Since implementing this recommendation requires legislative action, the January 1, 2006 due date for the plans may be somewhat optimistic. Some small utilities may not have the staff needed to develop a plan. Also, there are likely unresolved questions regarding the ability or willingness of a private utility to enforce drought plan requirements. There will clearly be further discourse on this recommendation.

The fourth recommendation may be more significant than it appears. It recommends legislation to enable ADWR to require all water systems to provide to the agency consistent and coordinated water supply information. The information is expected to be "used at the state and local level to identify water uses within the system, determine conservation potential, and ensure reductions during times of critical need." Not only does the recommendation not specify exactly what is a water system that would be required to provide this information, the recommendation could be interpreted as suggesting that ADWR may determine water conservation potential rather than the local entities. A major effort would be required to carry out this task. It is not entirely clear to what extent this recommendation relates to drought planning, rather than water supply planning in general, although it is generally agreed that better data are needed outside the Active Management Areas. Further clarification may be needed before local communities not now required to report water use support this.

The fifth recommendation is to assess the merits of an Assured Water Supply program in non-AMAs. The need for economic analysis of the impacts of such a program along with public involvement is acknowledged. With the recent release of a white paper on this

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subject by the Arizona Policy Forum, this recommendation has strong support in certain quarters and strong opposition in others. A thorough and perhaps heated debate is likely to ensue. But I hope people approach the debate with open minds. Requiring some demonstration of an adequate water supply does not have to be coupled with utilization of renewable water supplies, as in the AMAs in Central Arizona.

The final recommendation is that ADWR immediately initiate Local Area Impacts Assessment Groups. Their task will be "to identify a structure and contacts and to facilitate the implementation of the Arizona Drought Preparedness Plan." The report suggests that the county emergency manager and a county Cooperative Extension agent co-chair these impact assessment groups and that they include representation from local, state and federal agencies and other interested entities. This effort, too, will require much work but is essential if drought plans tailored to local conditions are to be adopted.

There is much, much more to the plan. It proposes to institutionalize the excellent work done by climate experts and resource managers on the Monitoring Technical Committee by making that group permanent. Again, it is important that momentum not be lost and that this important work continues.

It is a long plan that was a long time coming. Its recommendations are significant and are likely to be debated. What should not be debated, however, is that Arizona needs to approach drought response in a deliberate and thorough manner. The work of the Governor's Drought Task Force provides a framework and process for reducing vulnerability to drought throughout the state. ■■

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researchers did after World War II to a new situation.

Pepper raises another concern, that university researchers at times have lacked the right attitude for working with the private sector. He says, "There has been a little bit of arrogance from certain sectors of academia, whereas basic research is pure and good and anything funded by the private sector is dirty money. That's ludicrous. Clearly the way of the future is going to be the integration of academics with the private sector and government and non-government organizations."

Promoting Technology Transfer

Recent developments in the state demonstrate an official interest and commitment to further promote the marketing of university inventions, a process also known as technology transfer. In 2000, voters approved Proposition 301 which increased the state sales tax to provide educational funding. Proposition 301 revenues going to the universities established the Technology and Research Initiative Fund. The University of Arizona used its TRIF funds to support and expand various research areas including water. (See newsletter supplement for description of TRIF-supported water research.)

The research areas selected for TRIF funding needed to show that the additional support would build on existing university high-priority strengths and that the work promoted collaboration with, and support of active southern Arizona industry clusters. Along with specific research areas, TRIF funding also is designated to support technology transfer activities at both the UA and ASU. Available until 2006, TRIF funding is expected to result in moving new discoveries from the laboratory to the marketplace.

A recent UA budget request also adds to the water research and technology transfer momentum. The UA is seeking \$10 million for a water studies program that would be a collaborative effort with ASU and Northern Arizona University. The program would address state water problems and promote technology transfer. ■■



Arizona Water
Resource

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

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