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Over the past few decades, many communities in the United States have enjoyed adequate water supply and wastewater infrastructure. However, we can no longer rely on “business as usual.” This issue of IMPACT addresses current infrastructure needs ranging from no infrastructure to aging infrastructure – and the associated funding shortfalls. Today’s infrastructure challenges demand a new vision among water professionals, including a willingness to reexamine past presumptions about our infrastructure systems (such as presumptions about the adequacy of ground water supplies and storm water systems) and to develop creative, collaborative, broad-based solutions.

**FEATURE ARTICLES**

**5 Support for Indian Rural Water Systems Runs Dry** ... Christina Steinhoff
Both the U.S. Bureau of Reclamation and Congress have failed to support rural water projects benefiting Indian communities in need of water. The status of several such projects are described. It also observes that the ability to use tribal water rights is as important as obtaining the water rights in the first place.

**8 Science Drives Albuquerque’s Shift to Sustainable Supplies** ... John M. Stomp III and Michael J. Bitner
Describes how the Albuquerque Bernalillo County Water Utility Authority developed and is now implementing a new drinking water system for a metropolitan area. The project illustrates how surface and ground water resources can be conjunctively managed to allow better sustainability and environmental protections, while also assuring a reliable water supply.

**11 Envisioning Leadership: Articulating a Vision for the Water Industry** ... John (Woody) Wodraska
With increasing scarcity of and growing competition for sustainable supplies of water, water policy and decision makers must recognize that the paradigms for decision making in the allocation of water resources have changed. Discusses some of these changes, including issues one faces when dealing with diverse stakeholders.

**14 Supporting Water Supply and Distribution: Closing the “Needs Gap”** ... The Honorable Martin J. Chavéz
The Co-Chair of the U.S. Conference of Mayors (USCM) Urban Water Council addresses the nationwide concern among local leaders about the gap between available funding and infrastructure needs. Describes tools used by local governments to help narrow the gap, discusses the USCM’s policy on this issue, and calls for better cooperation from the federal government.

**17 The Green Infrastructure Action Strategy** ... Michelle Henrie
“Green Infrastructure” techniques aimed to better infiltrate storm water into the ground rather than channeling storm water into runoff. Describes the background of the green infrastructure action strategy that has been developed by the U.S. Environmental Protection Agency and others. Identifies seven key objectives and describes how to get involved in developing, enabling, and implementing green infrastructure techniques in new development and redevelopment.
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The last issue of IMPACT included a short article by AWRA Past President, Gerald E. Galloway, titled “Infrastructure Maintenance and Upgrade: Snakes in the Grass.” Mr. Galloway observed the magnitude of problems relating to water infrastructure, and observed: “It has always been tempting for those with responsibility for programming and budgeting the maintenance and upgrade of infrastructure to push such programs off for ‘just a year or two,’ and, if nothing goes wrong, to feel justified in delaying this work in favor of ‘higher priority needs.’ Those of us who must deal with infrastructure recognize that chickens do come home to roost. I can hear them clucking now.”

In this issue of IMPACT, we continue to hear the clucking. The clucking is undeniably upon us and growing louder and potentially messier every day.

We also take a look at some of those snakes in the grass. As a lifelong fan of snakes, I must say that I think we can tame and defang some of these slithery critters … but it will require us, as water professionals, to exercise creative, collaborative leadership. There are some snake charmers out there among us doing great things.

With this issue of IMPACT we hope to bring home the seriousness of our infrastructure situation. We also hope to applaud new ideas and encourage creative, collaborative solutions. Water professionals in the 21st Century will not be able to rely on and to replicate “business as usual.” But we will need to be a key part of every infrastructure solution. Do you hear the clucking, too?

February 2008 has been highly significant to me. Besides being the second month of my AWRA presidency, it has been just one year since the Co-Chairs of AWRA’s 3rd National Water Resources Policy Dialogue sent letters to President Bush, to Congressional Leaders, and the nation’s Governors. The letters provided our nation’s leaders with the results of the discussions and the recommendations of the attendees about what is needed to bring the nation’s water policies into the 21st Century. While we were disappointed by the lack of response from the Administration, we were encouraged by the responses from congressional leaders and from Governors who applauded AWRA’s efforts in the water policy arena, and from the continuing enthusiastic responses from AWRA members to this important effort. AWRA’s Board of Directors (BOD) is committed to making our leaders aware of our concerns regarding our nation’s water, and of our interest of being involved in finding solutions to these problems.

In January, I received a draft copy of a “Policy on Policies” from AWRA’s Policy Technical Committee (Committee). The purpose of the draft was to establish guidelines for the preparation of policy statements that describe the position of AWRA’s membership on pertinent water resources issues. At its meeting in late January, the AWRA BOD reviewed the draft and agreed to have the Committee prepare one policy statement on a pertinent water resources issue as a “test drive” before the “Policy on Policies” is finalized. As an outgrowth of the Policy Dialogue series and the work of the Committee, the AWRA BOD is interested ultimately in presenting to our elected officials and the public, AWRA’s positions on vital water resources issues by the use of policy statements. As I write this message, the Committee is making a determination of the issue that they will tackle for their first policy statement. I commend the Committee for its excellent work on establishing this important initiative. It is a wonderful follow-up to the Policy Dialogue series.

In February, the first “AWRA Water Blog” was launched. Check it out at http://awramedia.org/main-blog/. We intend the blog to be a means to communicate with the AWRA electronic community on a regular basis, and hope you will take the opportunity to review and comment on this new means for communicating with other members and friends.

Last but not least, we are beginning our annual search for people who are willing and able to assume leadership positions in AWRA. I have met many of you at conferences and through the technical committees and have been impressed with the level of technical capabilities and professionalism you have displayed. I urge you to support AWRA by considering a leadership position or by nominating other worthy candidates to ensure the continued significance of AWRA in the future. This is an effort well worth the payback in personal satisfaction and to the future of water resources in the U.S. and the world. If you are interested in leadership, or know someone who is, please visit AWRA’s website (www.awra.org) for information on nominations for AWRA’s elective offices. In addition you may contact Dave DeWalle, AWRA’s 2008 Nominations and Awards Committee Chair (drdewalle@ps.edu), for more info.

I hope to see many of you at AWRA’s 2008 Conferences. The list of upcoming conferences may be viewed on our website and also on pg. 19 in this issue. I will be attending these conferences in 2008. Please introduce yourself and let me know about your ideas and professional pursuits. I look forward to meeting you.
INTRODUCTION

Private entrepreneurs and public officials alike recognize the immediacy of America’s water infrastructure needs. Large multimillion-dollar pipeline projects are in the works throughout the West to bring water to urban areas. A growing number of these projects are drawing private investment.

The financial interest does not expand to the water needs of the remote reservations where water quality and availability are among the worst in the nation. The Indian Health Service reported in 2007 that 1 percent of the general United States population lacks safe water and sewerage systems. In comparison, 12 percent of Indian homes lack these systems.

Indian reservations are often poor with unemployment rates as high as 40 percent. Funding for rural reservation water systems is not available from tax revenue alone. The state can only fund a portion of the projects, and private investors have not shown an interest. The federal government is the remaining funding source and its reliability has been waning.

FEDERAL FUNDING FLUCTUATIONS

The U.S. Bureau of Reclamation (Reclamation) has become the primary federal funding source for tribal and rural water systems. Currently, Reclamation is supporting seven ongoing rural water systems, four of which directly help Indian tribes access their water resources.

The tribal programs range from the $472-million Mni Wiconi Project Rural Water Supply Project in South Dakota to the $193-million Fort Peck/Dry Prairie Rural Water System in northeastern Montana (see map below).

Congress approves each project for a 10-year period and allocates funding on an annual basis. Although state and local governments fund some of the costs, USBR, under the guidance of the Administration, is responsible for the tribal portion. However, despite public claims by the Administration, Reclamation has virtually cut off its allocations to many of the projects. Moreover, Congress has not been receptive to any new projects.

Approximately 20 tribes have reserved water right agreements with the federal government and many more, including the Navajo, are in the negotiating process ... The Navajo know from other tribes’ experience that the water rights cannot make the reservation prosperous without the water infrastructure

For Fort Peck, this means the rural water system the community designed for completion in 2013 may not even make significant progress by then. In general, Congress annually provides Fort Peck only about a quarter of the funding necessary to finish the project within the required 10-year period. At this rate, Fort Peck will need Congress to reauthorize its rural water supply project in 2013.
Support for Indian Rural Water Systems Runs Dry ... cont’d.

THE STATE OF WATER SYSTEMS
IN INDIAN COUNTRY

The funding crunch has created another challenge for tribes and their efforts to access their reserved water rights. The problem is most apparent with the Navajo Nation in the arid southwest. More than 12,000 Navajo households do not have access to safe drinking water, according to the U.S. Environmental Protection Agency’s (USEPA’s) 2005 Baseline Needs Assessment for Region Nine.

Many Navajos do not have running water. They haul water in buckets on truck beds from watering holes. Economic development is a challenge without a reliable water supply for industry or even for fire protection. The Navajo have settled with the State of New Mexico for water rights to the San Juan River. But without infrastructure to treat and move the water, the rights will not benefit many Navajo citizens.

The tribe is uniquely addressing the problem by including funding for a rural water system in a settlement agreement Congress must ratify. Historically, tribes have agreed to water right settlements without demanding funding for water development projects. The Navajo settlement agreement, which both the tribe and the State of New Mexico approved, includes an $875-million pipeline – the Navajo Gallup Water Supply Project. The project would bring water from the San Juan River to support as many as 250,000 people, including residents of the town of Gallup, the Navajo, and the Jicarilla Apache Indian Nation.

Local governments have agreed to pay approximately 25 percent of the cost. Now, the tribe is trying to get the remaining funds from Reclamation’s rural water supply program. The federal government is both concerned about the costs and the details of the settlement agreement. In a statement to Natural Resources Committee in July, Reclamation Commissioner Robert Johnson said the Navajo Nation’s settlement agreement is too expensive. The project is a lower priority to other settlements because it does not affect endangered species. He added that Reclamation is also concerned that withdrawing water from the San Juan River would affect Arizona water users. In the meantime, the Navajo Nation’s water supply situation remains below American standards.

NO WAY OUT OF THE FUNDING CRISIS

The Rocky Boy’s Chippewa Cree are trying to avoid a future similar to the Navajo’s current water situation. Like the Navajo, the Rocky Boy’s reservation is sustained by a limited supply of ground water. Wells in the aquifer have low yields, producing water at 10 gallons per minute or fewer, according to a 2002 report to the Natural Resources Committee by tribal representative Bruce Sunchild, Sr. Moreover, some wells are contaminated.

Congress ratified the Chippewa Cree’s water compact agreement in 1999. The agreement with the State of Montana provides the tribe 10,000 acre-feet of stored water rights from Tiber Reservoir, 50 miles from the reservation, and $15 million to begin development of a future water supply system. The funding is only a fraction of what the reservation needs for safe drinking water. As is common for most Indian reserved water right settlements, the settlement does not include funding for the infrastructure to distribute the water.

As a result, the tribe, along with its neighbors and the State of Montana, approached Congress for funding for a rural water system that would provide clean and reliable water through a water treatment plant and more than 400 miles of pipelines. By expanding the project to a larger region and including nontribal people, the tribe was able to gain more political, financial, and administrative support particularly from high-ranking Montana senators (Senator Max Baucus and former Senator Conrad Burns). In 2002, Congress authorized the Rocky Boy’s/North Central Montana Regional Water Authority pipeline project. The project will divert water from Tiber Reservoir, treat the water, and send it to communities and irrigators throughout north central Montana. A core pipeline will transport the treated water to the reservation.

The portion of the project that supports the tribe will cost $120 million. Congress authorized Reclamation to cover the tribe’s costs but did not provide a funding schedule. Instead, Congress approved the project through 2013 even if it does not appropriate adequate funds.

In 2008, the 3,500 residents of the Rocky Boy’s Reservation and their predominately white neighbors are still waiting on the federal government. Each year, the tribe, along with the consortium of local governments, approaches Reclamation for funding. The result has been sporadic. In 2005, Congress earmarked less than $1 million, according to the U.S. Department of the Interior budget reports. In 2006, the project received nearly $5.7 million. Figure 1 shows the congressional earmarks by rural water systems supporting reservations. Congress would have to allocate $30 million a year in order for the $228-million project to finish in 15 to 20 years, according to Project Coordinator Ammarie Robinson.

The Chippewa Cree do not want to wait any longer. Tribal leaders are proposing that Congress allow them to finance the project. But Reclamation’s response is to not commit Congress to future spending.

Other tribes have been able to find alternative sources of funding. States, including the State of Montana, have been willing to share a portion of the costs. Many Arizona tribes have received funds through the Central Arizona Project to develop water systems. The Utah Shivwits Band of Paiute Indian Tribe was able to get state and federal funding to bring a portion of their settlement water rights from the Gunlock Reservoir to the reservation, but the project, at $8 million, was comparatively small.

Tribes like the Chippewa Cree that need hundreds of millions of dollars have not been able to find a similar alternative to completely support their project. Nearly 40 percent of the Chippewa Cree are unemployed. A firm water supply on the reservation is essential to drawing new firms, Sunchild told Congress in 2002 ... “A safe and reliable water supply is a cornerstone of economic development.” “We would not have agreed to have this water
reserved for the tribe if there was not going to be a method of getting it to use."

SLOW SUCCESSES FOR SOUTH DAKOTA

The Oglala Sioux, Lower Brule Sioux, and Rosebud Sioux of South Dakota will be among the first tribes to benefit from the rural water system program. The program will replace the polluted well water with a regional water system. However, for the tribes, the process will have taken nearly 25 years.

In 1988, Congress authorized the Mni Wiconi Rural Water Supply Project to provide a safe and adequate water supply to both Indian and non-Indian residents in South Dakota using the Missouri River. More non-Indian related projects developed as the years went by through amendments to the original act.

By 1999, project coordinators projected the construction to end in 2008, but Reclamation delayed funding because of cost overruns. The Mni Wiconi Rural Water System Supply Extension Act extended the deadline through 2013 and prioritized the project among other rural water systems. The project, which should have a final cost of $472 million, includes a water treatment plant, 4,500 miles of pipeline, 60 booster pump stations, and 35 water storage reservoirs. The pipeline will serve more than 52,000 people, including more than 40,000 people on the three Indian reservations.

TRIBES LEFT OUT FOR NOW

The Montana and New Mexico tribes keep pressing for funding despite the difficulties. A water supply system would not only bring clean water but also provide an opportunity for economic development. A reliable, clean water source is important for fire protection and basic health and environmental standards to draw much needed economic development to reservations. In addition, many of the Montana tribal settlement agreements allow the tribes to lease their water. The Northern Cheyenne Tribe in southeastern Montana, for example, leases a portion of its settlement water to local irrigators. The ability to use tribal water rights either directly or indirectly is as important as obtaining the water rights in the first place.

Fort Peck’s Assiniboine and Sioux have rights to more than a million acre-feet of Missouri river water. The Rocky Boy’s Chippewa Cree have rights to 10,000 acre-feet. But neither of these tribes have reliable financial backing to make use of the water.

Approximately 20 tribes have reserved water right agreements with the federal government and many more, including the Navajo, are in the negotiating process. The Navajo know from other tribes’ experience that the water rights cannot make the reservation prosperous without the water infrastructure.

“In the Treaty of 1868, the Navajo leaders pledged their honor to keep peace with the United States and, in return, the United States pledged to assist the Navajo People in creating a permanent homeland on their reservation lands,” Joe Shirley, Jr., the President of the Navajo Nation, said in a June 2007 testimony to the Senate Committee on Energy and Natural Resources. “No lands can be a permanent homeland without an adequate supply of water, especially potable water.”

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Figure 1. U.S. Bureau of Reclamation Expenditures on Rural Water Systems Supporting Indian Reservations.
INTRODUCTION

During the 1950s and 1960s, rapid population growth in the Albuquerque, New Mexico, metropolitan area began to spur concerns about water management. Major studies, based on data gathered primarily from near the Rio Grande, led to a conceptual model of the aquifer in the Rio Grande Valley, a highly permeable aquifer that was recharged directly by the Rio Grande. Based upon this conceptual model, the City of Albuquerque’s water plan in the 1960s was simple: the aquifer supplied the City, the river resupplied the aquifer, and the San Juan-Chama Diversion Project resupplied the river.

The San Juan-Chama Diversion Project was built in the 1960s to transport New Mexico’s share of water under the Upper Colorado River Compact (up to 48,200 acre-feet per year) from the Upper Colorado River basin into New Mexico. Authorized by federal legislation, the project consists of 26 miles of diversions, conveyance channels, pipelines and tunnels, and a storage facility (Heron Reservoir). A key purpose of the San Juan-Chama Project is to provide water for users in the Middle Rio Grande Valley.

THE PROBLEM

By the 1980s, the Albuquerque metropolitan area had a population exceeding 500,000 and was experiencing fast growth. The City of Albuquerque provided water service to 400,000 customers, with the entire municipal water supply coming from ground water pumped from the Albuquerque ground water basin. At the same time, water managers in the Albuquerque metropolitan area noticed that water levels in some wells were dropping rapidly.

To investigate these observations, a ground water scientist, W.K. Summers, designed a deep well exploration program that involved drilling approximately 2,000 feet below the elevation of most of the area’s ground-water production. This program demonstrated that the highly productive sands and gravels of the aquifer (where most ground-water production occurs) are very limited in extent. In a separate effort, the U.S. Bureau of Reclamation conducted a water assessment of the Middle Rio Grande Valley, which showed that the amount of recharge from the Rio Grande to the aquifer was much less than previously believed.

These studies transformed the way water managers understood the aquifer. City water managers concluded that: (1) the aquifer was significantly smaller than was previously believed and (2) only about 50 percent of the water pumped from that aquifer was being recharged or replenished by the Rio Grande. In short, the ground water was being depleted faster than it was being renewed, which meant that the 1960s plan would not be sustainable. These revelations pointed out the critical need for a new plan to ensure continued economic vitality of the region.

NEW PLAN DEVELOPMENT

To address growing concerns over the long-term sustainability of the water supply, in 1994 the City of Albuquerque began the process of developing a new water plan. The plan incorporated the following steps: (1) formulating alternatives, (2) devising appropriate criteria, (3) devising performance measures, (4) evaluating the alternatives, and (5) considering and accounting for uncertainty.

The City began by developing a strategy table that facilitated formulation of the various alternatives for increasing the water supply. Altogether, 32 different alternatives were identified and evaluated. For each alternative, the City identified the supply source (conservation, Rio Grande, San Juan-Chama project), surface diversion facilities needed (dams, existing facilities, infiltration galleries, etc.), and the water use (drinking water, instream flows, recharge, etc.). To devise appropriate criteria for evaluating the alternatives, they looked at objectives that reflected community values and technical realities. These included quality of life, implementability, sustainability and reliability, environmental protection, and financial support.

Obviously, environmental protection was a key criterion in evaluating the alternatives. It was necessary to take into account the potential for and severity of impacts on sensitive wildlife species, the Rio Grande and surrounding bosque, and the aquifer. Impacts on water quality and historical, cultural, and aesthetic values were also examined.

With regard to sustainability and reliability of supply, the planning process evaluated the renewability of the water resource alternatives, their ability to reserve water for use during periods of drought, and their potential for regional cooperation that could lead to cost sharing and a broader base of support.

Financial performance of the proposed alternatives was, of course, an important factor to the City. Specific factors evaluated included capital and operation and maintenance costs over 20 years at net present value, potential additional project costs such as costs of water shortage, and need for treatment of ground water to meet the new U.S. Environmental Protection Agency arsenic standard. Use of San Juan-Chama and Rio Grande water...
Science Drives Albuquerque’s Shift to Sustainable Supplies . . . cont’d.

were also financial factors, since the City had already invested substantially in these assets.

The actual evaluation of the alternatives was based on technical judgments of experts as well as value judgments of stakeholders. The results of a ground-water flow model developed by the City’s consultants aided the technical evaluation by providing needed information on drought reserve retention, river effects, subsidence, arsenic treatment needs, and potential ground water pumping costs. Another study commissioned by the City had demonstrated that the aquifer had enormous value as a reserve for times of drought, so the computer model was used to calculate how much of the drought reserve would remain over time for each of the 32 alternatives. Scientists also calculated changes to flows in the surface water system for each of the different scenarios. The ground-water modeling results also were the basis for calculating the future costs of pumping ground water as water levels decline.

The planning effort relied heavily on an open public process. Many public meetings and workshops were held. A Customer Advisory Committee studied all 32 alternatives in detail and helped in the evaluation process. The National Environmental Policy Act (NEPA) process led to further public input.

IMPLEMENTATION STRATEGIES

The ultimate outcome of the planning effort was the selection of several key strategies. These included a shift from using the aquifer as the primary source of supply to using treated surface water diverted from the Rio Grande (the San Juan-Chama Drinking Water Project), aquifer storage and recovery to create and maintain drought reserves, and reclamation and reuse of nonpotable water for industrial and turf irrigation. The implementation of these strategies is heavily based on the scientific input into their selection and evaluation.

These strategies are currently being implemented by the Albuquerque Bernalillo County Water Utility Authority, formed by the New Mexico State Senate in 2003. The centerpiece of the Authority’s long-term sustainability goal is the San Juan-Chama Drinking Water Project. When operational in 2008, the Drinking Water Project will divert San Juan-Chama surface water from the Rio Grande and purify it for drinking. Water diverted from the river will be transported to a state-of-the-art treatment plant, from which purified water will be delivered to Albuquerque area homes and businesses (see below).

- The diversion dam to divert water from the Rio Grande to the treatment facility is a high-tech, 620-foot-long adjustable-height bladder dam that extends the full width of the river. The dam allows free river flow of up to 4.5 feet of water held by the dam and incorporates a “fish screen” whereby fish, including the endangered silvery minnow, are directed away from the water system intake through a canal that connects to a bypass channel leading back to the river.

- The water treatment plant, currently under construction, will purify water by removing particulate matter, including turbidity (cloudiness), sediment, and bacterial and microbial contaminants such as giardia, cryptosporidium, and E-coli. The purified water will then be sent throughout the system and will be blended with ground water to supplement drinking water supplies.

During droughts, the Authority will stop releasing San Juan-Chama water from its upstream storage reservoir and will use ground water. When flows in the Rio Grande return to normal, the stored San Juan-Chama water will be treated and placed back into the aquifer through an innovative aquifer storage and recovery program. A pilot demonstration project currently being conducted by the Authority and its consulting hydrology firm is land-applying San Juan-Chama water to the surface of an unlined arroyo to allow for infiltration of the water into the aquifer. This pilot project will both demonstrate the effectiveness of this technique and allow the Authority to prepare for the necessary permits required for a large scale project.

The Authority is also committed to increasingly use reclaimed wastewater to facilitate conjunctive use of available water resources and enhance water conservation and recycling efforts. Water from the Southside Water Reclamation Plant is cleaned and disinfected and is currently used for cleaning and irrigation at the Plant, with the remainder put into the Rio Grande to supplement river flow and be available for use downstream; this program is being expanded to include irrigation of parks and other turf areas. Methane gas produced by the wastewater treatment process generates about half the electricity and heat needed to operate the Southside Plant. A separate recycled water system in the North I-25 area captures industrial wastewater, treats it, and delivers it for industrial use and turf area irrigation. This recycled wastewater is also being supplemented with nonpotable surface water and used for turf irrigation in parts of the City.

CONCLUSIONS

These innovations are designed to ensure Albuquerque water users a safe and sustainable water supply to at least 2060. The strategy was the culmination of a multiyear effort of extensive scientific research and analysis by the City, its technical consultants, and governmental and state agencies involved in water resources management and engineering. This strong scientific
Science Drives Albuquerque’s Shift to Sustainable Supplies . . . cont’d.

basis has provided both the impetus for shifting the area toward a more sustainable water resources management approach and the knowledge required to effectively implement the policies and infrastructure that will ensure a permanent, adequate water supply for the urban area’s needs.

John M. Stomp III, PE, holds B.S. and M.S. degrees in Civil Engineering from the University of New Mexico, and is currently the Water Resources Manager for the City of Albuquerque, working as an agent to the Albuquerque Bernalillo County Water Utility Authority. His co-author, Michael J. Bitner, PG, is President and CEO of Daniel B. Stephens & Associates, Inc., having received degrees in Geology from Penn State (B.S.) and Hydrology and Water Resources Management from the University of Arizona (M.S.). Combined, Mr. Stomp and Mr. Bitner have approximately 45 years of water resources experience.

Douglas S. Kenney et al., studied factors influencing residential water demand in Aurora, Colorado, during a turbulent drought period (2000-2005). Monthly billing records keyed by a customer number and customer location allowed tracking individual behavior while still preserving the anonymity of specific customers. Among their findings are that pricing and outdoor water restriction policies interact with each other ensuring that total water savings are not additive of each program operating independently.

Catherine Allan et al., draw on their work as social scientists, and on a guided panel discussion at a recent AWRA conference, to suggest that watershed-scale adaptive management must be recognized as a radical departure from established ways of managing natural resources if it is to achieve its promise. Successful implementation will require new ways of thinking about management, new organizational structures, and new implementation processes and tools.

R. Edward Beighley et al., explore the impact of watershed characteristics, transient weather regimes, and land conversion on the frequency distributions of event runoff from coastal watersheds in southern California. Combining frequency distributions of event runoff with regional nutrient export relationships, they show that in El Niño years, one in five events produced runoff ≥2.5 cm and temporary near-shore nitrate and phosphate concentrations approximately 5-10 times above ambient conditions.

Sarah Newman and Sherman Swanson report on stream survey, riparian proper functioning condition (PFC) assessment, repeat photographic analysis, and stream and ecological classification used to study 10 streams within the Marys River watershed of northeast Nevada during all or parts of 20 years. They found, for most effective riparian management, a broad scale qualitative assessment, such as PFC could be used to identify areas with the capacity to respond favorably to changes in management.

Gary S. Johnson et al., examine the challenges confronting effective and efficient transfers of ground-water rights and possible approaches for dealing with those challenges. They conclude that a more holistic approach to ground-water right transfers, such as a ground-water accounting or banking scheme, may adequately control transfer third-party effects while reducing mitigation requirements on individual transfers.

Lindsay M. Cross and L. Donald Duke have developed a methodology to assess facilities using intensity of industrial activities exposed to stormwater, a rational measure that could regularize municipal agencies’ requirements and prioritize implementation toward facilities with the potential to impact receiving water quality. Their results in Pinellas County, Florida, documented that a large proportion of facilities conduct few or no activities likely to produce stormwater pollutants, indicating that the regulations’ equal treatment of all facilities may constitute overregulation.

Lynn A. Mandarano et al., evaluate alternative approaches to management of interstate water resources in the United States, including interstate compacts, interstate associations, federal-state partnerships, and federal-interstate compacts. They highlight several attributes of institutional arrangements that have contributed to effective conflict resolution and to overcoming limitations of fragmented governance.

A full Table of Contents may be viewed at http://www.blackwell-synergy.com/doi/jawr/44/1.

JAWRA ~ Journal of the American Water Resources Association
ENVISIONING LEADERSHIP: ARTICULATING A VISION FOR THE WATER INDUSTRY

John (Woody) Wodraska

INTRODUCTION

Long known for its stability, the United States (U.S.) water industry is undergoing a dramatic transition, the result of such ongoing changes as growing demand for water and water infrastructure, the deteriorating state of existing infrastructure, the decline in federal funding for water projects, rising operational costs, and climate change. To succeed in this dynamic environment, water industry leaders must have the necessary skills and the vision to overcome the disparate challenges. Future leaders also must be well versed in the latest technologies to integrate multiple, and sometimes competing, demands from different constituencies.

Historically, the water industry has been a risk-averse profession, attracting engineers, scientists, managers, and lawyers who traditionally have emphasized their reliability as much as their creativity. This approach worked well when water supplies far exceeded demand. However, future leaders will not be hired on the basis of reliability alone. Rather, they will need to be “change agents” capable of leading water agencies in whatever new directions are required.

It is now widely recognized that leadership is a set of learned competencies, rather than some nebulous innate personal characteristic. Our solutions must marry promising new technologies with appreciative, collaborative attitudes that move critical water projects past infighting and stalemates. If water industry professionals fail to provide the required vision and leadership, we can expect to see others from outside the industry assume this role instead.

RESPONDING TO SHORTAGES

The current multi-year drought in the Colorado River basin and the more recent drought in the southwestern U.S. have highlighted the precarious state of water supplies on which millions of people in this country rely. Shrinking reservoirs underscore this truth: As stored supplies are tapped, a region’s safety net disappears. In such situations, unappealing alternatives such as water rationing move from the position of last resort to an option for serious consideration. Of course, rationing, along with routine conservation and investments in alternative water sources, can stretch water supplies. Yet only rain or increased storage can ease the pain caused by a sustained drought.

For this reason, any serious approach to improving water reliability will, invariably, include provisions to build new water storage infrastructure. Also any serious discussion about leadership in the water industry will, by necessity, include ideas on how to get this done.

Obviously, the days of unilaterally building major infrastructure projects are long past. New infrastructure will no longer come about by engineering alone. Engineering skill and vision were the cornerstones of great projects such as the Owens Valley Aqueduct in California. Today, however, solving engineering challenges is only one part of the solution.

I should point out that a call for new water storage infrastructure does not necessarily mean building huge above-ground tanks. Many other viable options exist for increasing storage, such as enlarging existing reservoirs, utilizing ground water aquifers, and developing new lakes to provide water supplies and recreation. Whichever storage options are selected, they play a critical goal in meeting the public’s water needs.

In many areas throughout the United States, in arid as well as temperate climates, the public’s relationship with water itself and the agencies that provide it will change, perhaps dramatically.

Just as we have inherited a vibrant water infrastructure network from previous generations, we owe an adequate and secure infrastructure to future generations. With a growing population, we must improve aging infrastructure or build new facilities to meet our needs. Water utilities, of course, understand that their facilities must be brought into the 21st Century in terms of improved capacity. Such facilities also require new, more sophisticated controls and provisions to minimize environmental impacts that had not been considered when water storage facilities and treatment plants were constructed in the mid-20th Century.

CONSIDERING PERSPECTIVES AND HERDING CATS

The key challenge facing water industry leaders in the 21st Century involves embracing conservation and building new and improved infrastructure while addressing the values of today’s citizens: fair wages, a clean and healthy environment, multiple uses for infrastructure, and responsible government spending. Looking ahead, we must also deal with the potential long-term consequences of any building project, something not always considered in the past.

To meet the public’s water needs while addressing the disparate demands for how infrastructure should be developed today, leaders in the water industry must have excellent communication skills. Along with listening and learning, leaders must be able to corral and count hundreds of concepts that may be unrelated or in direct conflict. In short, they must have a skill set much like that required for herding cats.

Because today’s water resources challenges are so complex and far-reaching, garnering many different perspectives on a problem is essential. Even though
Envisioning Leadership: Articulating a Vision for the Water Industry . . . cont’d.

Successful implementation of new water resources solutions depends on effectively managing a complex landscape of stakeholders and their positions.

First and foremost, suspicion and fear must be replaced with trust between utilities and stakeholders. Projects simply cannot move forward without first establishing trust. And the foundations for establishing trust must start at a water agency’s top leadership positions.

But how to establish this trust? This can prove especially arduous if various stakeholders have lost their faith in your agency as a result of what they thought were one-sided actions. Although difficult, restoring trust is possible. If you’re an honest broker in the process, if you get back to people when you say you will get back to them, and if you are really committed to the process of trying to find common ground, you will gain trust. Furthermore, once stakeholders believe that an agency will respond as agreed on a debated issue, they will trust the agency’s judgment on future issues.

SEEKING AGREEMENT, NOT CONSENSUS

Admittedly, getting multiple stakeholders with different objectives to agree on a single outcome is not easy. But it is possible. In fact, an approach known as “Appreciative Inquiry” offers perhaps the best way to build working relations with the public and stakeholder groups and create successful projects to secure future water supplies. Planners applying the principles of Appreciative Inquiry approach interested parties with the following message: “Our project could affect you, and we value what you have to say. You’ll be included, and we’ll honor our relationship with you. However, you will not be an equal decision maker.”

In other words, the goal is not to seek consensus on every detail. If 100-percent agreement is a manager’s goal, then nothing will ever get done. Rather, a water agency must make it clear that it seeks input from all interested parties, input that it will soundly consider as part of the planning process.

When developing integrated resource plans or other forward-looking measures, the heads of water agencies must be able to assimilate many more variables and perspectives than were required in the past. For example, concerns related to the environment, socio-economic considerations, and stormwater management have assumed much greater significance in recent years. Where-as past efforts to develop integrated resource plans focused on identifying a preferred resource mix, the planning process of the future will incorporate multi-criteria decision-analysis techniques that will provide interactive choices.

DEVELOPING BETTER DECISIONS

Fortunately, water industry leaders today have at their disposal new technologies that enable detailed analyses of multiple components. For example, a decision support system (DSS) is a computerized system for helping make decisions. Such systems can incorporate data related to hydrology, hydraulics, water demand, capital improvements, environmental risk, and other critical items.

For utilities that have invested in supervisory control and data acquisition (SCADA) systems and geographic information system (GIS) technology, a DSS offers a particularly useful means of integrating data from both technologies to support critical decision-making processes. For example, by relating water-level readings collected via a SCADA system to reservoir’s dimensions, as captured in a GIS, the DSS creates a meaningful picture at any given time of the available alternatives regarding water storage capacity. The geospatial time series created – in this case reservoir levels over time – becomes a reliable decision-making tool for the manager who must decide how much floodwater to release from the reservoir during a rain event.

As they gain acceptance, DSSs will be a great help to water agencies, municipalities, and even international interests seeking to maximize existing, safe water resources. A DSS’s refined abilities will help water managers better assess water budgets for a given area or predict short- and long-term water storage requirements.

For a utility providing various services – including treatment of drinking water, wastewater and recycled water, hydro-electric power generation, and recreation – integrated data quickly reveal problem areas or potential conflicts between priorities. Using real time, location-specific information, managers can determine where to borrow staff, equipment, or other resources to address a short-term need in one area without creating future problems in another area.

It has frequently been said that in the 21st Century “water will be the new oil.” The growing demand for water will be the central challenge facing water providers in the future, a demand that will have to be addressed in myriad ways.

TRANSFORMING THE INDUSTRY

Given the series of major challenges facing the water industry, we must redefine what it means to be a water manager. Like it or not, the world of water management in the not-too-distant future is going to be fundamentally different than it is today. In many areas throughout the U.S., in arid as well as temperate climates, the public’s relationship with water itself and the agencies that provide it will change, perhaps dramatically.

In some cases, such changes will occur for economic reasons, as the cost to upgrade and expand water infrastructure continues to soar. Rising energy prices also will play a role. In the face of these trends, such common
practices as irrigating landscapes with water that has been treated to drinking water standards may become a thing of the past. In turn, dual-plumbing systems – one for drinking water, one for water to be used for other purposes – will become more common, as will different sources of water, including desalination and reclaimed water.

Conservation, however, must become the critical foundation of water resources management. For too long, conservation has been an afterthought, something to be performed during times of water scarcity but discarded the moment a drought begins to wane. To meet the many demands facing the water industry, its leaders must make conservation the industry’s standard ethic. Instead of focusing mainly on finding new sources of water and simply making noises about conservation, we must make conservation a basic practice before seeking to augment supplies.

Increasingly, members of the public want to see sustainable approaches that help to ensure a healthier environment. They want more green space. They want water to be allocated for environmental purposes, and not just drinking water and agriculture. They want to see their utilities decrease their “carbon footprint” to offset the effects of global warming. In other words, they do not want business as usual.

Water industry leaders cannot remain on the sidelines as these issues are debated. Instead, they must play an active role in helping to shape public opinion regarding what can and should be done to ensure adequate water supplies in the most sustainable manner possible. In the past, water industry representatives have viewed themselves solely as service providers, judging their success mainly in terms of their reliability. Yet water leaders must transform the industry beyond this concept of simply providing a service.

Instead, we must meet the growing demand for a more unified, holistic approach to water resources. As modern society struggles to find sustainable approaches for satisfying its demands for resources, the water industry has an opportunity to rise to the occasion and showcase what can be done when leadership and vision unite to address a common goal.

It has frequently been said that in the 21st Century “water will be the new oil.” The growing demand for water will be the central challenge facing water providers in the future, a demand that will have to be addressed in myriad ways. Water industry leaders must possess a far-ranging vision and the requisite technological know-how to meet the public’s need for water while balancing a host of competing interests.

John (Woody) Wodraska is a nationally known water resource expert and the national director of water resources for the consulting firm PBS&J. During his 30 years in the water industry, Wodraska has worked with sensitive water management issues as both executive director of the South Florida Water Management District and the general manager and chief executive officer of the Metropolitan Water District of Southern California.
INTRODUCTION

The future challenges local government will face in providing safe, affordable, and adequate water and wastewater services are likely to be greater than those faced in the past.

The U.S. Conference of Mayors Urban Water Council (UWC) provides a national forum for mayors to address municipal water resource issues such as water and wastewater services and security, watershed management, conservation, and finance. The goal of the UWC is to promote effective, economical, and environmentally sound solutions. Through meetings, articles, and networking, the UWC provides mayors with opportunities to learn one another’s experiences and best practices.

One key issue shared by many mayors across the country is the “needs gap” (i.e. the gap between available funding and the moneys needed to replace or rehabilitate aging infrastructure and to address new infrastructure needs due to climate change).

HOW WIDE IS THE GAP?

The Scope of Municipal Services

Most people do not think about what it takes to provide municipal water and wastewater services until a water main breaks and disrupts the evening rush hour. Indeed, many people do not realize the full scope of municipal water and wastewater services. These services are consumed by multiple forms of industry (agriculture, energy production, and manufacturing) that provide value-added in taxes and employment in our cities and metropolitan economies. Municipal water supply also is the primary tool used for fire suppression. It saves lives and property, and has effectively contained insurance costs. When the public benefit multipliers in energy, agriculture, fire suppression, conservation and elsewhere are factored into the equation, the return on water utility investment is greatly positive. Yet municipal water and wastewater services are greatly undervalued in America, despite the fact that full public benefits are far greater than every dollar invested.

While providing water and wastewater is undervalued, its impact on municipal coffers cannot be underestimated. Local government spent $82 billion in Fiscal Year 2005 on municipal water and wastewater services and infrastructure, and more than $841 billion from 1992 through 2005. The U.S. Conference of Mayors estimates that local government spending is increasing by an average of 5 percent annually and likely to exceed $110 billion annually by 2010. This remarkable price tag reflects replacement costs for aging infrastructure and new capital costs relating to growth. According to the U.S. Environmental Protection Agency, there is a gap of over $500 billion in spending that is necessary to comply with current law in the 20-year period from 2000 to 2019. These price tags do not include additional spending that will be needed to adapt to climate change impacts that threaten treatment plants as well as pipes and water supplies.

Climate Change

Ignoring the causes of climate change for the moment, the impacts are nonetheless becoming recognizable: more intense and widespread droughts; areas of greater intensity and frequency of storms and hurricanes; subsequent flooding and pollutant loadings in water bodies; increased treatment costs; rising temperatures; loss of snowpack resulting in diminished water supplies; rising sea levels; and threats of saltwater intrusion into coastal aquifers.

While the weather we have long been accustomed to is changing, our built public infrastructure is already in place. For example, drinking water reservoir systems have been sized and managed based on anticipated snow melt. Similarly, storm sewer systems were sized and built for a particular storm event capacity. As our weather changes, our water and wastewater infrastructure may prove to be inadequate. Keep in mind that world-wide estimates suggest that 80 percent of infectious diseases are waterborne and are substantially responsible for infant and childhood morbidity and mortality. The United States has all but eliminated this threat, and in the process has significantly lowered the cost of health care response in this arena. Will climate change threaten this stability?

TIGHTENING OUR BELTS

Where will municipalities find the money to address aging infrastructure, growth, and climate change?

Conservation and Source Water Protection

As everybody knows from their own household economics, the most practical way to grow available funds is often to cut costs. In terms of water and wastewater services, this principle is best illustrated by conservation. For example, in the Albuquerque metro area, water users have responded to our conservation initiatives and reduced their water use from 250 gallons per capita per day (gpcd) in 1995 to 174 gpcd by the end of 2005. So...
Supporting Water Supply and Distribution: Closing the “Needs Gap” . . . cont’d.

while we have still had to spend enormous sums to improve our infrastructure, we are nonetheless substantially postponing the day when we will have to spend even more.

A second way to grow funds is to protect existing resources. Source water protection efforts by local government help protect ecosystems and improve the sustainability of watersheds and cities. Indeed, the new lexicon of “eco-services” suggests that protecting watersheds has multiple benefits of protecting population centers from floods and tsunamis, enhancing the aesthetic quality of our environments and supporting biodiversity. Here too Albuquerque’s initiatives have enabled a fundamental shift in sourcing that will enable us to recharge our aquifer for future generations and for contingencies such as future drought conditions.

Asset Management

Another tool used by municipalities is known as “asset management.” Asset management can be described as a group of practices to help water and wastewater system managers minimize the overall cost of acquiring, operating, maintaining, and rehabilitating capital water and wastewater assets through their lifecycle while simultaneously maintaining the desired public service levels. For example, through asset management, utility managers have better information on the age and condition of existing assets, so they can adjust the level of maintenance needed to optimize asset performance and useful life. Asset management thus allows better planning and prioritization for maintenance as well as capital replacement. Because public infrastructure investment decisions are made for the long-term, and it is costly to go back later and change them, asset management allows better decisions to be made up front.

A 2007 city survey conducted by the Conference of Mayors indicates that more than 70 percent of cities employ full or partial asset management programs for both their drinking water and wastewater plants and pipes. Survey findings suggest that 22 to 38 percent of cities are achieving capital cost and operating cost savings from implementation of asset management programs now, while 50 to 60 percent expect to achieve savings in the future. On the other hand, roughly 16 to 17 percent of cities do not currently expect to achieve savings with their programs.

While asset management programs are gaining in popularity, they should be viewed as works-in-progress. Some aspects of an asset management program may be well advanced, but other aspects may take a number of years before they yield efficiencies. For example, it is the experience that local managers gain in the practice of applying the techniques of asset management that leads to creativity, cost-efficiencies, and better service in the long term.

CASH NEEDS

Cities cannot satisfy the financial demands of closing the needs gap alone, and they should not have to. Spending for drinking water is 99 percent local, and the local share for wastewater is 95 percent. The local share is supported by rate-payers or taxpayers, and in some cases both. Historically, local government has relied on “pay-as-you-go” financing, which means setting user charges that generate cash reserves that are dedicated to reinvestment in the water system. Other financing tools historically used by municipalities are municipal bonds, federal grants, or federal loan programs through the Clean Water Act and Safe Drinking Water Act State Revolving Fund.

For all the discussion in Congress about federal financial assistance, one might think that the federal government was paying for it all. In fact, the federal share is relatively small and continues to shrink. Under the Clean Water Act, the federal government funded over 75% of clean water infrastructure at its peak in the 1970s. By 1981, this had declined to 55%. Today, the federal government’s share is under 5%. Nevertheless, cities want every penny of federal financial aid they can lay their hands on for water and wastewater funding because utility expenditures compete for resources with other necessary municipal expenditures like schools, roads, parks, police and hospitals.

As an alternative to deferred capital costs or maintenance, local governments may want to consider partnering with the private sector ... such partnerships can be structured to ensure ultimate control continues to remain in the public's hands while the public also benefits from investment of private capital, economies of scale, decades of experience, and innovation that the private sector brings to the challenge

In order to close the needs gap, the U.S. Conference of Mayors has adopted policy positions that call for:

- Recapitalization of the clean water and drinking water State Revolving Fund loan programs by Congress, with a particular emphasis on 30-year no-interest loans.
- A federal grant program to help cities pay for costly fixes to combined sewer overflows (CSO) and sanitary sewer overflows (SSO). This program is particularly needed for cities experiencing severe economic or environmental hardships.
- Changes to the federal tax code to allow greater use of private equity and technical/operating expertise for public water and wastewater infrastructure and services. Removing the state volume caps on private activity bonds for public-purpose water and wastewater has the potential to increase aggregate spending to meet the challenges faced by cities.
federal financial assistance. Many local governments have historical concerns associated with inflexible and overly prescriptive requirements and one-size-fits-all approaches.

TURNING TO PUBLIC-PRIVATE PARTNERSHIPS

As an alternative to deferred capital costs or maintenance, local governments may also want to consider partnering with the private sector. As noted by Mayor David G. Wallace, City of Sugar Land, Texas, these partnerships can help control water and wastewater user rates by keeping both operating and capital costs down, while still replacing infrastructure in a timely way. As Mayor Wallace has pointed out, such partnerships can be structured to ensure ultimate control continues to remain in the public’s hands while the public also benefits from investment of private capital, economies of scale, decades of experience, and innovation that the private sector brings to the challenge.

CONCLUSION

The Conference of Mayors’ Urban Water Council has stepped forward to propose how to create some level of certainty in an uncertain environment. Municipal water and wastewater services are critical to public health and safety. They help drive our local and metropolitan economies and they protect our ecosystems and our ability to achieve sustainable cities.

Given the rising cost to provide the services and infrastructure, and the growing impacts of climate change on water resources and public infrastructure, it is clear that local government needs more and better cooperation from the federal government and greater access to private equity and expertise.

Martin J. Chávez
Office of the Mayor
Albuquerque, NM
mayor@cabq.gov

The Honorable Martin J. Chávez is now serving his third term as Mayor of Albuquerque. Mayor Chávez, a former member of the New Mexico State Senate, is a graduate of both the University of New Mexico and Georgetown. Under his leadership, Albuquerque has received numerous recognitions, including those from American Style, Forbes, and Inc. magazines; USA Today; and the Milken Institute’s Best Performing Cities Index. Mayor Chávez is the Co-Chair of the Mayor’s Water Council, a task force of the U.S. Conference of Mayors.

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THE GREEN INFRASTRUCTURE ACTION STRATEGY
Michelle Henrie

INTRODUCTION

The Partners for Green Infrastructure recently released a “green infrastructure” action strategy aimed at reducing stormwater runoff, combined sewer overflows, and nonpoint source pollution, which are among key projected impacts of climate change. The “Partners” (also called “core partners”) are the entities primarily responsible for coordinating the development of this first iteration of the action strategy. They are American Rivers, the Association of State and Interstate Water Pollution Control Administrators, the Low Impact Development Center, the National Association of Clean Water Agencies, the Natural Resources Defense Council, and the U.S. Environmental Protection Agency. The action strategy is interesting both in how it is being developed as well as its content.

ORIGINS AND PARTICIPANTS

The concept of green infrastructure has been discussed for several years. Green infrastructure is the open spaces and natural areas such as greenways, wetland parks, forest preserves, and native vegetation that naturally manages stormwater, reduces flooding risk, and improves water quality. Gray infrastructure refers to non-porous areas and includes buildings and parking lots. A key stimulus for mobilizing this discussion was a 2006 report published by the Natural Resource Defense Council titled “Rooftops to Rivers.” This report recognized the use of green infrastructure techniques to restore watersheds. In April 2007, most of the core partners listed above signed a Statement of Intent (SOI). The SOI has been described as a public-private partnership with a goal of helping states, cities, and local governments implement innovative and effective green infrastructure solutions.

In addition to the core partners, there is a broad growing base of supporters who have signed a companion document to the SOI called the Stakeholder Statement of Support for Green Infrastructure (SSGI). Already, dozens of organizations have signed or endorsed the SSGI, including industry organizations such as the American Society of Landscape Architects and the American Institute of Architects, advocacy groups such as the Sierra Club and Amigos Bravos, and government agency umbrella organizations such as the Environmental Council of the States and the Bay Area Clean Water Agencies. These stakeholders are also referred to as “partners” in the action strategy. Thus, the action strategy is a product of collaboration among many agencies, organizations, and individuals.

PROCESS

The federal government has been criticized in the past for developing policy and programming without stakeholder input, and then expecting stakeholders to simply agree with the result. By contrast, the action strategy describes itself as a “living document” that will be regularly updated as activities and priorities evolve. It includes, in some cases, specific project plans. In other cases, it has only general ideas about tasks and activities, not any plans.

Interestingly, the action strategy states that the core partners “preferred this approach, as it made it possible to begin work immediately on efforts with widespread support, rather than waiting for development and finalization of this action strategy document.” Also interesting is that the action strategy invites input: “In all areas, but especially in areas where action is not well defined, we welcome input from anyone or any organization with ideas, energy, or resources to develop specific tasks. This is truly a collaborative effort, and new partners willing to take leadership in specific areas can only strengthen the outcomes.”

THE NEED FOR GREEN INFRASTRUCTURE

Wastewater collection systems collect domestic sewage and other wastewater and convey it to sewage treatment plants for proper treatment and disposal. “Separate sanitary sewers” are designed to carry only sanitary sewage to a wastewater treatment plant. Stormwater is collected separately via storm sewers and directed to a nearby river, lake, or stream. Separate sanitary sewer overflows (SSOs) are unintended discharges of raw or inadequately treated sewage from separate sanitary sewer systems. SSOs may be caused by (1) too much water entering into a sanitary sewer system (e.g., inflow and infiltration of stormwater or an undersized system); (2) blockages such as tree roots; or (3) power outages, emergency conditions, and equipment or mechanical failures.

Combined sewer systems are designed to convey both sewage and storm water in one pipe to a waste water treatment plant under dry conditions. During intense wet periods, however, the wastewater volume in a combined sewer system can exceed the capacity of the sewer system or treatment plant. Combined sewer systems typically are designed to overflow occasionally, and to discharge excess wastewater directly to nearby streams, rivers, or other water bodies. For some combined sewer systems, overflow basins (also called reten-
The Green Infrastructure Action Strategy . . . cont’d.

tion/treatment basins) capture the overflow long enough to provide initial treatment and disinfection before the discharge is released.

As stated in the SOI, combined sewer overflows (CSOs) and SSOs contain pathogens and other pollutants that may be harmful to the environment and to human health. CSOs and SSOs can cause or contribute to water quality impairments, beach closures, shellfish bed closures, and contamination of drinking water supplies. Even when CSOs or SSOs do not reach streams, overflows may release raw sewage to areas where they present high risks of human exposure, such as streets, residential areas, and basements.

Impervious surfaces such as roads, driveways, and buildings channel water offsite instead of allowing it to infiltrate into the ground. This channeling may contribute excess water to SSOs and CSOs during wet weather events.

WHAT IS GREEN INFRASTRUCTURE?

“Green infrastructure” was described by Benjamin H. Grumbles, the Assistant Administrator for Water for the U.S. Environmental Protection Agency, as a “new approach to stormwater, CSO and SSO management that is cost-effective, sustainable, and environmentally friendly. Green infrastructure techniques utilize natural systems, or engineered systems that mimic natural landscapes, to capture, cleanse, and reduce stormwater runoff using plants, soils, and microbes.” Mr. Grumbles described the goal of the green infrastructure action strategy as “reducing[ing] runoff volumes and sewer overflow events through the widespread use of green infrastructure management practices.” This goal has been expanded in the action plan to include maintaining or restoring natural hydrologies.

The action strategy consists of seven different categories, with objectives and tasks developed (or being developed) relating to each category. The seven categories are as follows.

(1) Research. Recognizing that many green infrastructure management practices are relatively new, there is little quantitative data on performance and effectiveness. Objectives in this category are aimed at ensuring that potential adopters of green infrastructure approaches have the necessary information to make the transitions. Objectives include developing a standard for assessing benefits from green infrastructure practices, filling in research gaps, and establishing a web-based resource center with case studies, performance data, etc.

(2) Outreach and Communication. Objectives include not only the web-based resource center mentioned above, but also periodical newsletters and partnering with national and regional organizations to include various aspects of green infrastructure on conference agendas.

(3) Tools. The action strategy notes that engineers and others use well-established standard models and design paradigms in their work. These tools need to be updated with standard sets of assumptions and other information relating to green infrastructure practices. Objectives and tasks in this category are numerous, including:

- Establishing modeling protocols that quantify discharge volume and pollutant reductions of green infrastructure practices (in combination with each other and with gray infrastructure practices) at not only the site scale but also at sewer-shed and system-wide scales
- Developing a guidebook for municipalities. Planned features of the guidebook include master planning considerations, site planning and design review specifications, operation and maintenance needs, model codes and ordinances (including removing obstacles in current codes and ordinances), incentives and funding, tracking and evaluation protocols, marketing, case studies, as well as lessons learned about barriers, implementation, partnerships and incentives.
- Developing design standards and drawings for homeowners and property owners that can be shared with designers, contractors and builders.
- Developing bid specification language for green infrastructure practices to articulate specific provisions, outcomes, etc.

(4) Clean Water Act Regulatory Support. Objectives in this category are aimed at clarifying for regulators and the regulated community how Clean Water Act provisions can facilitate implementation of green infrastructure approaches. Objectives include providing direction to promote utilization of green infrastructure approaches in lieu of, or in combination with, gray infrastructure approaches, such as developing model permit language for municipal separate storm sewer system (MS4) permits, incorporating green infrastructure approaches in long-term control plans (LTCP) and settlements (Supplemental Environmental Programs [SEPs] and injunctive relief), and providing training programs.

(5) Economic Viability and Funding. This category seeks to establish that green infrastructure approaches are economically viable and to compile a list of grant and loan programs that local governments and other entities can use to help fund green infrastructure projects.

(6) Demonstrations and Recognition. The goal of this category is to develop pilot projects that can be used to document costs, quantify benefits, develop models, gather performance data, etc. Objectives include developing a catalog of green infrastructure case studies and recognizing innovative green infrastructure through awards or recognition programs.

(7) Partnerships. The action strategy seeks to expand the broad base of support for green infrastructure and expand the number of partners who sign the SSGI. Objectives include promoting “green” practices with large (“big box”) retailers, promoting training and certification programs for qualified installers of green infrastructure.
techniques and products, and targeting key organizations – both private sector and government – in pivotal areas of implementation for partnership (e.g., the U.S. Department of Transportation).

CHALLENGES

The enthusiasm for green infrastructure is exciting. However, local regulations have contributed to the need for green infrastructure, and the challenge will be to reverse the societal preferences that created the local regulations in the first place. For example, a church, event center, or retail center may have an oversized, barren parking area for multiple reasons. Local regulations probably require the parking lot to be sized to accommodate a once-a-year crowd because neighboring residents do not want their neighborhood streets to serve as overflow parking. Some customers prefer knowing that they will be able to find a parking spot in a lighted, level, parking area. Property managers worry about maintaining landscape islands, and risk managers may view landscape islands as simply an opportunity for distracted customers to break ankles or blow out tires. The action strategy recognizes and addresses symptoms (e.g., restrictive local regulations). The greater challenge lies underneath and is much more subtle ... changing public preferences. In that light, the green infrastructure action strategy might consider adding features or programs aimed at youth, schools, the education system, and possibly the media and entertainment industry.

CONCLUDING REMARKS

Climate change is expected to increase rain intensity (“bursts”) and thus flood events. Because of the potential for SSOs and CSOs during flood events, as well as the added problem of nonpoint source pollution via surface contaminants picked up in flood waters, flooding is not simply the problem of having too much water in one location at one time ... it is also a problem of being inundated with polluted water. Thus the green infrastructure action strategy is an important project for maximizing water infiltration. If your organization is interested in signing the SSGI, go to http://cfpub.epa.gov/npdes/gisupport.cfm#org for more info.

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On the most northwest point of the continental United States is a small reservation where four major rivers drain and flow into Washington’s Puget Sound. On the Sound, the Makah people have for centuries fished the ocean waters. Their livelihood has been sustained by the ocean. Today, many of the 1,550 residents of the Makah Indian reservation live in subsistence. More than 70 percent of their income comes from fisheries, according to the Neah Bay Downtown Revitalization Master Plan. The ocean is the Tribe’s food and income source. In a few years, the ocean may also become its source of energy production and potable water supply.

AquaEnergy Group Ltd., an Irish renewable energy company and a division of Ireland’s Finavera Renewables Limited, is proposing an innovative commercial wave energy power plant in Neah Bay. Meanwhile, the U.S. Bureau of Reclamation (Reclamation) is proposing a publically funded desalination plant to serve the rural Indian community.

**WAVE ENERGY**

AquaEnergy Group Ltd., along with a consortium of American organizations and businesses, are proposing a small wave energy plant three miles off the coast of Neah Bay. AquaEnergy is in the final stages of approval for a license to construct the Makah Bay Offshore Energy Pilot Project. The project would place wave energy buoys three miles offshore at depths of 150 to 250 feet. The seawater would be directed into a conversion system consisting of a turbine driving an electrical generator. The buoys would convert the energy through an undersea transmission line for electrical use onshore.

The demonstration plant is expected to supply 1,500 MWh or enough energy to support 150 homes in Neah Bay. Construction could begin within the year. The pilot project is supported by the tribe as a way to promote the benefits of renewable energy and contribute to the energy mix in the region. Meanwhile, AquaEnergy is attempting to establish a private business base in the United States (U.S.) for larger scale projects.

**SEA WATER DESALINATION**

The tribe may also be drinking water from the sea through a process of desalting ocean water for potable use. Seawater desalination is rare in the U.S. because of the high costs. The price of desalinated water is on average three times more than the cost of traditional sources of water because of the difference in energy costs. Normally, plans for desalination projects are reserved for large-scale, long-range urban water plans involving private investment or public-private partnerships.

For the Makah Indian Reservation, desalination may be the only solution to provide the region clean, reliable water necessary for community-wide economic development. The reservation usually obtains its water supply from Educkett Reservoir, which stores 47 acre-feet of water when it is filled. During the summer months the water contains high organic concentrations and the tribe is forced to switch to river water, according to Reclamation’s 2006 Makah Community Water Source Project Feasibility Study. When the reservoir water quality is poor, the tribe will use an infiltration gallery on the Wa’atch River. During dry years the river flow is too low and the tribe turns to its last resort – ground water, which is often contaminated by iron and manganese.

The problem caught the Indian Health Services’ attention in the late 1990s when it requested Reclamation to review water supply options for the Makah people. Reclamation determined that underlying ground water could not provide an adequate water supply to this support growth. Instead, the agency is recommending desalinated ocean water. The reverse osmosis desalination plant would collect seawater through an underground system. The water would be purified by the desalination plant and piped to the Neah Bay drinking water treatment plant. The remaining nonpotable water would be sent to the wastewater treatment plant, blended with wastewater effluent and discharged into the ocean. The (continued on pg. 22)
"Esau took his wives, his sons and daughters, all the members of his household, his livestock, all his cattle and all the goods he had acquired in Canaan and left for Seir, away from his brother Jacob. For they had acquired too much to live together. The land in which they were at that time could not support them both because of their livestock" Genesis 36:6-7

Two thousand and eight is a presidential election year in the United States (U.S.). The previous statement is apparent to everyone not living under a rock or off the grid. What may not be apparent is how little candidates discuss agriculture anymore. Yes, in Iowa, they talk about the Farm Bill and ethanol/biodiesel supports, but none seem to talk about the looming crises in American agriculture. Like three blindfolded men trying to describe an elephant, they only touch upon the issues that are right before them and not the big picture. It was not always this way. Some of our greatest political orators/writers understood agriculture and held nuanced policy positions about it. William Jennings Bryan’s “Cross of Gold” is one of the greatest speeches in American history. What is often overlooked is the prairie populist message was aimed at a major electoral constituency: farmers going broke on that “cross of gold.” “The Nation that destroys its soil destroys itself,” wrote Franklin Roosevelt in a letter to governors supporting soil conservation. “We travel together, passengers on a little spaceship, dependent on its vulnerable supplies of air and soil; preserved from annihilation only by the care, the work, and I will say, the love we give our fragile craft” was penned by Adlai Stevenson. From Jefferson through to Teddy Roosevelt to Nixon, agriculture was a major policy arena. What has happened to remove this status, and what does this have to do with water resources?

The transition of campaign rhetoric away from agriculture and related topics is simply a matter of demographics. As America industrialized and urbanized, those farming and ranching dwindled in numbers. There aren’t enough votes for presidential candidates to chase on farms and ranches, and the electorate has lost touch with how food and fiber are produced. Meanwhile, radical changes are taking place in farm country.

Resources necessary for maintaining agricultural productivity are diminishing in relation to demand for its products. Over a third of fresh water withdrawals in the U.S. are for agriculture. Most goes to make areas having good soil like California’s Imperial Valley farmable. These waters are constantly being targeted for distribution elsewhere to meet burgeoning domestic and industrial needs. Soil loss continues due to land use practices that promote wind and water erosion, sprawl, salination, and a variety of other negative impacts. Bottom line, the number of people in the U.S. and around the world is growing, while arable land is shrinking. Add the long-term impacts of climate change (including shifting available water away from areas with prime soils, and changes in precipitation patterns, mean temperature and seasonality), and the long-term impacts on food supplies cannot be understated.

Using current methods, it takes ~1.2 acres per person in the U.S. to provide a diverse diet. Currently, the U.S. has ~470 million acres of arable land in cultivation with a population of ~303 million. There is today ~1.6 acres per person of arable land: a surplus that will soon be lost. An acre of natural or agricultural land is lost to development, including transportation, for each person added to the population: a net loss of 1 million acres annually. Add to this a loss of 2 million acres of prime cropland to erosion, salination, and water logging. With projected population growth, by 2050 we will have only 0.6 acres of arable land per person. So looking at the big picture, if more people = more demand, then does its follow that less arable land per capita and in total = less productivity? Have we reached to soil and water equivalents of “Hubbert’s Peak,” and if not, when do the curves meet?

Are there solutions to this crisis? None without problems. (1) Open substantial new lands - not an option anymore (unless someone comes up with a cheap, practical interstellar mode of transportation). (2) Irrigate undeveloped lands - not a realistic option. Society has been systematically reducing water for farm use and irrigating undeveloped places with arable soils is cost and energy prohibitive. (3) Supplement soils with agchemicals (the current modality) - this is becoming prohibitively expensive as petroleum and natural gas prices rise, with diminishing returns to productivity and hazardous consequences to aquatic life. (4) Move everyone to a vegetarian diet - unlikely even for personal and planetary health. (5) Bioengineer plants to need less water and fewer nutrients (and maybe produce fuel as well) - unlikely without producing unintended negative side effects. (6) Engage in sustainable agriculture practices nationally - necessary, but not sufficient to meet growing human needs.

Are these problems new? No (see the opening quote from the Book of Genesis), the problems are as old as agriculture. Why then is no one during the campaigns asking basic questions like: What does it take to feed the nation? ... What are the prospects for sustaining agricultural production without degrading the natural environment? ... What needs to be done to promote water and soil conservation?

The consequences of ignoring these issues are more serious then ever, deserving not only public debate, but policies revitalizing integrated stewardship of soil and water.

E-MAIL CONNECTION
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In previous columns we have discussed several themes on how a water resource professional can become an informed consumer of legal services. Several issues ago we reviewed the way in which lawyers see their own role and their specialized areas of practice in the field of water resources. We have also discussed the use of legal terminology and “terms of art.” In our last column we explored why it is inherently difficult for an attorney to provide a definitive answer to a question … interpretation of rules and regulations, the narrow scope or split nature of some judicial decisions, and the uncertainty associated with courts of different jurisdictions ruling on slightly different fact patterns. In this column we will discuss the process and role of lawyers in creating change to the laws and regulations that affect water resource projects.

The work of most water resource professionals, whether you are advancing a utility project, watershed issue, or intergovernmental agreement, will be governed by a hierarchy of local, state, and federal laws and regulations. Those laws and regulations are a result of the legislative process, implemented by the executive branch of the pertinent government and interpreted by the judicial branch having jurisdiction over the topic or geographic area. One way to create change in this regulatory structure is to bring a lawsuit and ask a judge to interpret the language and intent of a law in light of specific circumstances or in consideration of various facts. Another way is to lobby for adoption of a legislative or administrative change to the rule or regulation.

The first step in effecting a legislative change is to identify with specificity the sections of law or regulation that are at issue, and any related provisions in law or regulation that may be impacted. For example, if a state statute prohibits an activity (like a long term lease of property or water rights, rate increases for certain types of expenses, or the use of a chemical) then the role of a lawyer is to determine the source of authority for the rule, the way that rule is tied into the local and federal regulatory system, and the most efficient process for amending or removing that rule. For this example of changing a state statute, it is essential that you determine what other entities are impacted by the rule and discuss with them how your proposed change will impact other similarly situated clients. You will also need to identify an elected official who will sponsor the proposed change, who will give you access to legislative drafters and who will make sure that the item is placed on an agenda for consideration. This type of project underscores the interdisciplinary nature of water resource issues since technical or financial issues may be identified in the process and amendments to a proposed change will need to be reviewed for their legal effect.

The analogous process of effecting an administrative change is to identify and propose changes to an agency rule or regulation. This is often managed by a request, analysis, notice, and hearing process that can differ greatly depending on the agency and regulation that you are trying to change. The hearing process is usually where all the legal and technical issues come together, and where it is critical that all the members of an interdisciplinary team must work together closely … it can be the last chance to enter evidence and objections to a rule change that will be important in a subsequent lawsuit.

With the increasing concern over ethics reform and the oversight of the legislative and administrative process in local, state, and national government it is imperative that someone review the applicable communication, contact, and lobbying rules that may apply. Many states require lobbyists to register their client representation and report expenditures (like campaign donations or certain purchases of gifts or meals), and some regulations prohibit certain activities while a state legislature is in session. Contact with agency staff can be less formal, but legal ethics rules can influence the type and nature of contact a lawyer advocate can have with nonlegal agency staff. These regulations must be considered at the local and federal level … dealing with an alleged ethics or lobbying violation will hamper your best laid plans and bring unwanted attention to you or your client.

Advocating for administrative and legislative changes in the water resource field will be primarily driven by the staff that understand the substantive issues. However an ounce of lawyering at the beginning of the process can save a pound of heartache later in the process.

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**E-MAIL CONNECTION**

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**The New Economy of Water . . . cont’d.**

... cont’d. The wave energy plant would produce 157 gallons per minute. If approved, the project would be among the first in the country to use desalination to solve small-scale water quality problems.

A WATER-BASED COMMUNITY

The two projects would make the Makah people even more intertwined with the ocean for economic development. Water has historically been important to the economy. Neah Bay is a prime destination for tourists. The town has as many as 2,000 visitors a day during fishing season. The wave energy plant would provide an additional economic base. Moreover, the clean potable water from desalination would provide the capacity for more business development.
WATER RESOURCES PUZZLER (answers on pg. 25)

ACROSS
1. ERA and RBIs
6. part of AWRA
11. silica rich rocks
15. Wyoming range
16. escapees
18. bifurcation _____
19. apathy
20. calculator maker
21. chemical compound
23. not locked
25. each
26. fan
28. wily
29. carols
31. radio controls
33. ooze
35. help a crook
37. mean to
39. followed by bread or grass
40. _____ Turner
41. lawsuit
42. an ending for goat or boot
43. former foe of the U.S.
44. concerns
46. ladder rung
48. compass dir.
49. cousin’s parent
51. Post-It ____
53. Linkletter or Carney
54. map abbreviation
55. a sphere
57. an assault
59. more slippery
61. Red or Black
62. fuzz
63. a shot of liquor (Brit.)
64. loc. of Gila R.
66. sci-fi role
68. clear
71. long cigar (var.)
74. summer cooler
75. bring to birth
76. abstruse
77. Hopalong’s prop
78. TV room
79. blockhead
80. earplugs?

DOWN
1. prisoner’s uniform
2. pester
3. lawyers
4. labor
5. nap
7. get into trouble with
8. gate
9. discharge
10. to tease harshly
11. imitates
12. ER task
13. allot
14. stage talk
17. alarm bells
20. popular dessert
24. 1974 Nobel physicist
27. fireproofing material
30. manage
31. the lower of 120/80
32. mocks
34. Gaelic language
35. help a crook
36. Ames and McMahon
38. followed by charge or perception
41. company exec.
43. unfastened
45. unlock
47. degree of tenseness
50. not PG or X
52. anagram of dine
54. filet ____
56. edit
58. ER person
60. halt
65. _____ Mostel
67. vow
69. soften
70. lope
72. 0.01 of a Laotian kip
73. Diamond ____
75. followed by blood or Lands
77. the sixth tone

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We typically think of water “infrastructure” as the collection of dams, levees, canals, pipelines, treatment plants and other engineering works that help provide water services to society. As Gerry Galloway pointed out in the last issue of IMPACT, this infrastructure is sorely in need of maintenance and upgrading. However, another class of infrastructure needs urgent attention as well: the aquatic ecosystems that provide so many valuable, but typically unpriced, goods and services to society.

Healthy rivers, floodplains, wetlands, and forested watersheds supply much more than water and fish. When functioning well, this “eco-infrastructure” stores seasonal floodwaters, helping to lessen flood damages. It recharges ground water, filters pollutants, purifies drinking water, and delivers nutrients to coastal fisheries. Most importantly, it provides the myriad habitats that support the diversity of plants and animals that perform so much of this work and keep the planet humming. It is difficult to place a dollar value on any one piece of this eco-infrastructure, but in 2005, scientists participating in the Millennium Ecosystem Assessment estimated that wetlands alone provide services worth $200-940 billion per year.

The water strategies of the 20th Century worked largely against nature, rather than in concert with it. As a result, ecological infrastructure has been dismantled and degraded at a rapid rate. An estimated 25-55% of the world’s wetlands have been drained, 35% of global river flows are now intercepted by large dams and reservoirs, and more than 100 billion tons of nutrient-rich sediment that would otherwise have replenished deltas and coastal zones sits trapped in reservoirs. River flows are turned on and off like plumbing works, eliminating the natural flow patterns and habitats upon which myriad life forms depend.

Fortunately, forward-thinking planners, resource managers, and engineers from around the world are demonstrating that clean drinking water, flood control, and other human needs can be met in ways that use eco-infrastructure rather than destroy it – and that such approaches often save money. For example, through watershed protection and aggressive conservation measures, cities as different as Bogotá, Colombia, and Boston, Massachusetts, have postponed construction of expensive water supply capital projects, saving their residents money while protecting critical ecosystems.

More typically, however, the benefits of capitalizing on nature’s services continue to go uncaptured. To cite just one example, following the Great Midwest Flood of 1993, U.S. researchers estimated that restoration of 13 million acres of wetlands in the upper portion of the Mississippi-Missouri watershed, at a cost of $2-3 billion, would have absorbed enough floodwater to have substantially reduced the $16 billion in flood damages. Unfortunately, instead of calling floodplains and wetlands back into active duty, officials in the region permitted even more floodplain development. According to Nicholas Pinter of Southern Illinois University in Carbondale, 28,000 new homes and 6,630 acres of commercial and industrial development have since been added on land that was under water in 1993.

Global warming and its anticipated effects on the hydrological cycle – including increased flooding, droughts, and storm intensity – will only add to the value of ecological infrastructure that helps mitigate these effects. For the same reason people buy home insurance and life insurance – to avoid catastrophic losses – societies need to buy more disaster insurance by investing in the protection and restoration of watersheds, floodplains, and wetlands.
New guidance to determine federal jurisdiction of some “waters of the United States” may lead to a more holistic view of the watershed and justify a National Water Policy.

On June 5, 2007, the Assistant Secretary of the Army and the Assistant Administrator for Water, U.S. Environmental Protection Agency (EPA), signed into effect a Memorandum for the Corps of Engineers Director of Civil Works (Corps) and EPA Regional Administrators to coordinate on Jurisdictional Determinations (JDs) under Clean Water Act (CWA) Section 404. This charge to collaboratively document JDs is a result of the Supreme Court decisions made under Solid Waste Agency of Northern Cook County vs. The US Army Corps of Engineers S 531 U.S. 159 (2001) (“SWANCC”) and the 2006 Supreme Court consolidated cases Rapanos v. U.S. and Carabell v. U.S. (known as the “Rapanos” decision).

In 2003 SWANCC challenged Corps’ findings of jurisdiction in intrastate, nonnavigable, isolated waters based on interstate commerce. The rational for the claim was formalized in the Migratory Bird Rule (MBR) and connected isolated wetlands to interstate commerce through migratory waterfowl use. The Court ruled that the MBR was not legal. Millions of acres of isolated wetlands, including bogs, playa lakes, and prairie potholes, fell from Corps jurisdiction. This tragic decision left essential habitats for many species unregulated. New guidance addresses jurisdiction of isolated waters without the MBR.

The new procedures also implement Rapanos, apparently clarifying how much of the watershed Congress intended for Federal regulation. The new Corps/EPA procedures include determining a “significant nexus” with Traditional Navigable Waters (TNW) for seasonal, nonnavigable tributaries (Relatively Permanent Waters-RPW), RPW abutting wetlands and wetlands adjacent but not abutting RPWs. The defined cut-off for regulation of RPWs is 90 days. If flowing less than 90 days, the Corps and EPA must agree whether the tributaries, or wetlands abutting or adjacent to them have a significant nexus to TNWs.

Previously, Corps Districts determined jurisdiction based on “blue lines” on U.S. Geological Survey maps, scour, water-carried sediments/drift, and other less defensible methods. The new guidance potentially determines jurisdiction more consistently, although the process could be long and arduous when applied to large areas with multiple wetlands and streams. It is not clear whether the difficulty in applying the guidance will result in future Supreme Court litigation or tax already overburdened Corps District personnel with little payback in actual protection of the resource. Corps and EPA headquarters will soon assess application of the guidance by the 38 U.S. Corps Districts. Honest evaluation of District response is essential.

Although the new guidance is more definitive in the attributes of a connected “water,” the arbitrary 90-day flow duration used to define extent of the RPW may not adequately protect important systems. Hydrologic and ecologic considerations raise the question, should a channel with only 89-days of flow or less be excluded from jurisdiction. The February 2007 issue of the Journal of the American Water Resources Association contains a collection of papers documenting the significance of low flow, seasonal streams.

If challenges to the new guidance result in the reversion to original TNW limits, even more valuable waters, including millions of acres of wetlands, will be threatened. Alternatively, regulating sheet flow could send regulation of water resources into litigation limbo. Corps water policies must address the broad values of water resources, since they cascade to related federal and state water policies. If application of Corps’ jurisdiction limits the protection applied by associated programs, far-reaching effects will result.

Our nation must think creatively about implementing a water policy where all governmental agencies – federal, state, and local – apply similar methods to adequately value water resources to wisely manage their use.

Solution to Puzzle on pg. 23

![Solution to Puzzle](image)
I am in a unique position because I straddle the worlds of science and policy. I have worked as an environmental planner focusing mainly on water issues for the past 20 years. I work for a private consulting firm that employs scientists and planners but have interfaced with elected officials for many years before being elected to office at the state level. I know first hand that policy makers are often faced with having to make decisions faced with “dueling” science or no science to back up their decisions. Many policy makers are not comfortable with interpreting science or do not have the tools to do that.

SCIENCE WITHOUT POLICY

In a perfect world, science should be used to support public policy decisions but today differences between the scientific and policy-making processes make it difficult for scientists to fully inform decision making. A 2000 National Science Board study found that fewer than 25% of Americans understand the true nature of science as a mode of inquiry and fail to recognize that public policy relies heavily on science, but that policy makers often do not have reliable information. Failure to understand the limitations or role of science can threaten credibility.

Science without the support of policy makers means that programs might not get recognition, funding, or support. Not all science needs political buy-in but it is important to keep decision makers informed about actions involving the government, especially if funding will be needed for research or program implementation.

Some examples of where the science has been clear but where policy makers have been hesitant to act because of political pressures include problems relating to acid rain and climate change, issuing water rights in overappropriated basins, and the failure to fully recognize the connection between ground water and surface water.

POLICY WITHOUT SCIENCE

Environmental problems today are complex and perfect knowledge is an unrealistic expectation. This incomplete knowledge often leads to uncertainty in decision making or not basing decisions on proven scientific principles. Policy makers need to understand the limits of scientific knowledge but not to ignore or discount them.

The American people depend upon federal agencies to promote scientific research and to develop science-based policies that protect the nation’s health and welfare. Historically, these agencies – such as the National Institutes of Health, the Food and Drug Administration, the Centers for Disease Control and Prevention, and the Environmental Protection Agency – have had global reputations for scientific excellence.

Mixing politics with science produces bad science and casts a shadow over government’s efforts to fund scientific research and protect public health.

TIPS FOR WORKING WITH POLICY MAKERS

Scientists working with policy makers can be effective if they focus on a few simple rules in their efforts to communicate… be clear and succinct; tell a story, talk about people; do not use acronyms; limit use of numbers and technical terms; use charts, graphs, and pictures; and focus on outcomes.

TRANSLATING RESEARCH INTO POLICY

To facilitate translating research into policy start developing the answer years before being asked the question. When testifying or answering questions assume legislators are pretty smart – they frequently are. Use simple terms that demonstrate your message, and do not show off, do not be the smartest person in the room (even if you are). Scientists need to be clear if the information they offer has been peer reviewed and is widely accepted in the scientific community. Develop trust.

Remember the difference between being an advocate and being a policy expert. Certainly on their own time, scientists can be advocates but they need to be clear about their role. A major challenge is for scientists to minimize bias and to refrain from an advocacy role that will jeopardize their credibility but still find meaningful ways to contribute to and inform the decision making process.

Communication is key. In my observation, scientists need to do a better job of communicating in simple terms not only the results of their research but what those results mean to every day lives. Environmental problems are generally complex and there are no simple answers. However, while we shouldn’t ask scientists to simplify the results of their research, we need to work on better ways to present scientific findings in a less complex way.

If this occurs, important scientific findings can gain popular support which in turn will fuel political support. What’s happening today with climate change is a very good example where there finally was a convergence of scientific, political, and popular support.

THE NORTHWEST AS AN EXAMPLE OF THE CHALLENGES FOR WATER

As we consider the need to bring science effectively to policy making, we have a huge challenge when it comes
to water in the Pacific Northwest. Unless there is a drought, people in the Northwest assume we have an abundant and perpetual supply of water. Without sounding alarmist, we need to come up with a strategy to educate Northwest residents about the realities of our limited water resources and the possible impacts of climate change on our water supplies.

This year is the 100th anniversary of the Oregon Water Code – a law steeped in tradition, not based on scientific principles.

Funding for research and studies has been cut back both at the state (at least in Oregon) and the federal level (USGS). These are not popular issues. Over 100 people turned out to testify against requiring water measurement for water rights in Oregon. This opposition was not based on science but fear of change.

If we are going to properly manage our limited water resources in the Northwest, we need the proper tools and funding. That is where effective communication with political leadership becomes important; not only in the Northwest, but throughout the United States.

American Water Resources Association

2008-2009 RICHARD A HERBERT MEMORIAL SCHOLARSHIP OPPORTUNITIES

BACKGROUND – In 1980, AWRA established the Endowment-Memorial Fund to be used for the enhancement of education in water resources. The fund has since been renamed the Richard A. Herbert Memorial Educational Fund to honor Richard A. Herbert – a champion for water resources education – who passed away in 1994. In order to carry out his vision, AWRA is proud to announce the availability of $4,000 in scholarships derived from the proceeds of this fund.

ELIGIBILITY – Each applicant must be a National AWRA member. One $2,000 scholarship will be awarded to a full-time undergraduate student working toward his/her first undergraduate degree and who is enrolled in a program related to water resources for the 2008-2009 academic year. One $2,000 scholarship will also be awarded to a full-time graduate student enrolled in a program related to water resources for the 2008-2009 academic year.

SELECTION CRITERIA – The undergraduate scholarship will be awarded to the student most qualified by academic performance. Measures of academic performance include the cumulative grade point average, relevance of the student’s curriculum to water resources, and leadership in extracurricular activities related to water resources. The graduate scholarship will be awarded to the student most qualified by academic and/or research performance. The measures of academic performance are identical to those of the undergraduate scholarship with the addition of the quality of the student’s research and its relevance to water resources. Recipients will be selected by the AWRA Student Activities Committee and announced during the summer 2008.

APPLICATION PROCESS – Applicants should prepare a title page and a two-page summary of their academic interests and achievements, extracurricular interests, and career goals as they relate to the above selection criteria. Summaries must be limited to two pages. The application must also include three letters of reference (preferably from professors and/or advisors), a transcript of all college courses (undergraduate and graduate), and the applicant's full name, permanent mailing address, email address, and a phone number at which she or he may be easily reached. ALL REQUIRED INFORMATION MUST BE SENT IN ONE PACKAGE!!

DEADLINE – All applications and supportive materials must be received at the AWRA Headquarters by APRIL 23, 2008.

QUESTIONS? – Call AWRA (540.687-8390) or send an email to info@awra.org.

HYDROLOGY RESEARCH ASSISTANTSHIPS AT THE UNIVERSITY OF MEMPHIS, GROUND WATER INSTITUTE

Applications are being accepted for research assistantships for Fall 2008 enrollment in the MSc or PhD programs with the Ground Water Institute at the University of Memphis. The degree program may be pursued through the Departments of Civil Engineering or Earth Sciences, depending on academic background and interests. Areas of research interest include ground water-surface water interactions, mechanisms and measurement of recharge, hydrologic boundary analysis, land-based and remote-based methods of evapotranspiration estimation, and development and application of environmental tracers. An annual stipend from $15,500 to $27,000 plus tuition will be provided depending on chosen degree program and experience. Applicants must be highly motivated with strong backgrounds in one or more of the following areas: numerical methods, field hydrology, GIS, and geochemistry. Applications material must include: (1) a detailed letter discussing research interests and academic goals, (2) copies of college transcripts, and (3) a curriculum vitae to include the names and contact information of at least three references and may be sent electronically to gwimail@memphis.edu. Or application materials may be sent to: Graduate Research Application Program, University of Memphis, Ground Water Institute, RM 300 Engineering Administration Building, Memphis, TN 38152-3170.

The University of Memphis is an equal opportunity/affirmative action employer.
**NEWS FROM AWRA’S NEW MEXICO STATE SECTION**

In conjunction with the Student Paper Competition held at AWRA’s Annual Water Resources Conference, the New Mexico Section of AWRA decided to give an award to the top student from New Mexico and they used the national evaluation form scores to identify their winner. They have announced that **Craig Broadbent** from the UNM Economics Department received the AWRA-NM award for the highest scoring talk or poster given at the conference by a New Mexico student. His presentation was entitled *A Water Leasing Framework for the Middle Rio Grande with a focus on the Farmers Decision Making Process.* Congratulations Craig!

All of the topics listed above are subject to change. For information concerning submitting an article to be included in the above issues, contact the designated Associate Editor or the Editor-In-Chief N. Earl Spangenberg at espangen@uwsp.edu.

**SCHEDULED TOPICS FOR FUTURE ISSUES OF WATER RESOURCES IMPACT**

**MAY 2008**

RIPARIAN ECOSYSTEMS & BUFFERS: AT THE WATER’S EDGE

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Laurel Phoenix (Associate Editor)
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**JULY 2008**

LAND USE AND WATER SHORTFALLS

Eric J. Fitch (Associate Editor)
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**SEPTEMBER 2008**

WETLAND PROBLEMS AND POTENTIALS

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**NOVEMBER 2008**

DATA MANAGEMENT IN WATER RESOURCES

Trevor Campbell (Guest Editor)
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Jonathan E. Jones (Associate Editor)
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2007 AWRA STUDENT PRESENTER COMPETITION WINNER ANNOUNCED

We are pleased to announce that the winner of the 2007 AWRA Annual Water Resources Student Presenter Competition is **Dan Holz**, from Southern Illinois University, whose presentation was entitled *Factors Controlling Erosion and Sediment Delivery on an Appalachian Gas Pipeline.* Dan’s co-authors were Pamela Edwards, Karl Williard, and Jon Schoonover.

Dan is in his second year as a master’s student in the Dept. of Forestry at SIU in Carbondale with Dr. Karl Williard as his primary advisor. His current scientific interests include water quality issues, especially erosion and sedimentation of rivers and streams due to anthropogenic disturbance. His thesis research is underway near the town of Parsons, West Virginia, in the Monongahela National Forest. He is studying the effects of pipeline development on erosion rates and the factors driving erosion. His research is one of the first studies in the Forest looking at erosion from gas pipelines.

Dan earned his B.S. in Reclamation and Environmental Conservation in 2004 from the University of Wisconsin-Platteville under the advisement of Dr. Thomas Hunt. During his undergraduate career Dan developed a comprehensive Greenway Management Plan for a parcel of land bordering a trout stream on campus. His plan was accepted by the university to guide future conservation and development decisions within the Campus Greenway.

After earning his undergraduate degree, and before he started his master’s work, Dan worked on the Crab Orchard National Wildlife Refuge in southern Illinois for a private contractor. Dan helped manage the decontamination and sampling of the land surrounding a decommissioned wastewater treatment plant. Raised on his family’s farm near Fort Atkinson, Wisconsin, Dan wants to pursue a career in environmental consultation and restoration.

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