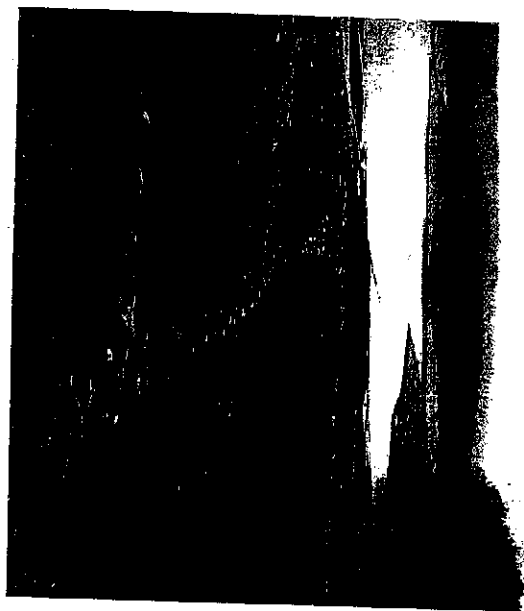


# WATER FOLLIES

Groundwater Pumping and the Fate of America's Fresh Waters



ROBERT GLENNON

3/10/03

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groundwater table that discharged groundwater to a gaining stream and that kept the floodplain moist after the spring floods receded. The moist soil provided enough water to sustain the beans and other crops until harvest. The Tohono O'odham learned this technique, one in harmony with nature, from their ancestors, the Hohokam, who may have learned it from even earlier inhabitants of the Santa Cruz River valley. The impact of groundwater pumping on the Santa Cruz River has had grievous consequences for the Tohono O'odham. The *ak chin* technique that endured for centuries, or even millennia, has been destroyed in mere decades by groundwater pumping. Recently, a Tohono O'odham elder was asked: "What happened to the Santa Cruz River?" He responded: "The city of Tucson took it."

## Chapter 4

### A River at Risk

#### *The Upper San Pedro River in Arizona*

"The well was dry beside the door,  
And so we went with pail and can  
Across the fields behind the house  
To seek the brook if still it ran. . . ."

—Robert Frost

The headwaters of the San Pedro River rise in Mexico approximately twenty miles south of the Arizona border. The river flows north into Arizona, past the Huachuca Mountains, the cities of Sierra Vista and Benson, and the town of Mammoth, and joins the Gila River near the town of Winkelman. Runoff from the Huachuca Mountains has created streams, fragile oases in a harsh environment, that flow down the mountain canyons into the San Pedro River.

During the past two centuries, substantial geomorphic changes have occurred in the San Pedro River valley as the river washed sand downstream. Cienegas, or marshlands, were common along the San Pedro in the nineteenth century. So were beavers. In 1879, there was so much standing water that the *Arizona Daily Star* described the San Pedro as "the valley of the shadow of death," due to frequent outbreaks of malaria, dengue and yellow fever. Although it would be another two decades before the experience of building the Panama Canal confirmed the link between mosquitoes and malaria, suspicion in the 1880s that swamps caused disease led to

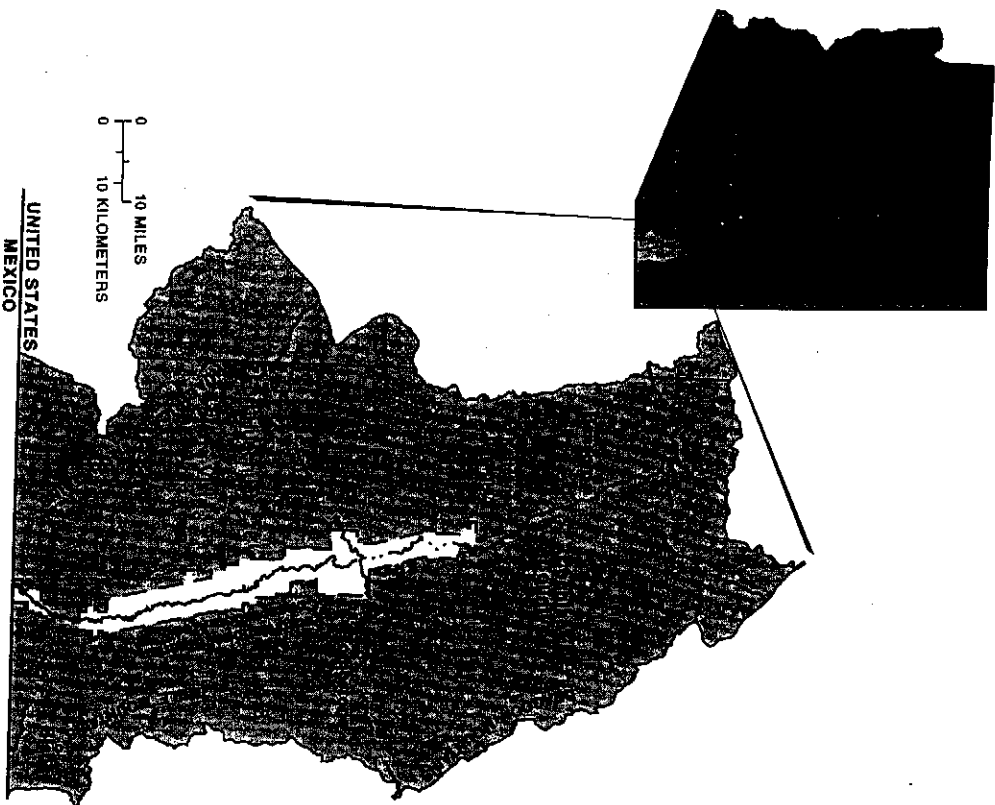


FIGURE 4.1. The upper San Pedro River in southern Arizona.

the extermination of the beaver and the removal of their dams, which significantly impacted the river. The river has also suffered from the introduction of cattle. Grazing, by destroying grassland and shrubs, has produced quicker runoff and even greater erosion.

Nonetheless, the upper San Pedro still has an extraordinarily rich and diverse riparian habitat, the largest surviving broadleaf riparian forest in the

Southwest. A ribbon of Fremont cottonwood/Gooding willow gallery forests, marshlands, and native Sacaton grasslands extends one-quarter-mile on each side of the river. This riparian habitat supports an estimated 390 species of birds (almost two-thirds of all species seen in North America), eighty-three species of mammals (second in diversity only to rain forests in Costa Rica), and forty-seven species of amphibians and reptiles. The upper San Pedro is also home to at least three endangered species—the southwestern willow flycatcher, the Huachuca water-umbel, and the jaguar.

The enormous number of bird species comes from flyway patterns that make the area the southern limit for many northern species, and the northern limit for many Central and South American species, including fifteen varieties of hummingbirds. Approximately 220 species breed along the river, including the rare gray hawk and twenty other kinds of raptors. As many as 4 million migrating songbirds, including warblers and vireos, use the river on their annual trek between wintering grounds in Mexico and Central America and their breeding grounds in the United States and Canada. Many species, including the green kingfisher, occur in the United States only in the upper San Pedro River basin. The area is so special that *Birders' Digest* named it *the* premier bird watching site in the United States. The Nature Conservancy placed the San Pedro River Basin on its list of "Last Great Places" in the western hemisphere. In 1995, the American Bird Conservancy, together with Partners in Flight and the National Audubon Society, designated the San Pedro a Globally Important Bird Area, the first such designation in the western hemisphere.

In 1999, the prospect of harm to the river from groundwater pumping prompted American Rivers, a national environmental group, to declare the San Pedro one of the ten most endangered rivers in the United States. The San Pedro plays an especially crucial role for the migrating birds. Paul Hardy, The Nature Conservancy's program manager for the San Pedro, has explained: "If you take the San Pedro out, you are jeopardizing a hemisphere's bird populations. It would be like trying to drive cross country if you took out all the gas stations and restaurants." The novelist Barbara Kingsolver, writing in *National Geographic* in April 2000, described the San Pedro as "a sparkling anomaly for sun struck eyes, a thread of blue-green relief."

On the other hand, not everyone appreciates the attention the river is receiving. The population of the city of Sierra Vista and Cochise County is exploding, and local politicians and developers fear that environmental

issues may retard growth. One of them has been Harold Vangilder, a member of the Sierra Vista City Council, who has strong prodevelopment views. His priorities are clear: "If the San Pedro River is a national treasure, we are an impoverished nation. You can't drown a fish in it." The meaning of his odd assertion is elusive, but he is clearly unhappy with the attention the river is receiving.

The river is so special that Congress, in 1988, created the San Pedro Riparian Natural Conservation Area (Conservation Area), an area of 47,688 acres, which includes perennial reaches of the river. The legislation created a federal water right for the Conservation Area. Most water rights are creations of state law. When Congress sets aside (reserves) land for a particular purpose, say, an Indian reservation, military base, or national park, it may reserve water for the reservation. The Conservation Area legislation expressly reserved sufficient water to protect the riparian area and the aquatic and wildlife resources. As Senator Dale Bumpers, chair of the Senate Subcommittee on Public Lands, National Parks and Forests, put it: "[T]here is no point in having this legislation unless we are going to protect . . . the free flow of water year-round." Despite congressional intent to protect the flows in one of the last perennial, dam-free streams in the Southwest, the river is in jeopardy.

Thomas Maddock III, a professor of hydrology and water resources at The University of Arizona, is not the sort of individual to become involved in an environmental controversy. After attending the University of Houston on a baseball scholarship, he earned a Ph.D. in mathematics at Harvard and began teaching at The University of Arizona. He specializes in groundwater hydrology, which involves "building" elaborate computer models of how groundwater moves under various conditions. To understand this stuff, you need a Ph.D. in math because most models consist of an elaborate series of partial differential equations. Maddock is a scientist whose enthusiasm for his work is evident. Hydrology poses difficult puzzles, the type that mathematicians love to wrestle with. In 1988, when Cochise County asked him to examine the impact of groundwater pumping on the San Pedro River, Maddock jumped at the chance. The study allowed him to construct a hydrologic model to analyze "the relationship between the groundwater pumping and the surface water system, and how the cone of depression might be advancing or declining [in the area]." When I asked

him whether he had ever hiked along the San Pedro River or was a bird watcher, he replied: "No, and I don't know a sparrow from a hawk." The scientific questions piqued his curiosity.

Maddock and a graduate student, Letitia Vionnet, prepared a groundwater flow model that varied from prior models by focusing on the interaction between the river and the floodplain aquifer. Earlier models had remarkably assumed that the river could never go dry! While this assumption might make hydrologic sense with respect to a river like the Mississippi, which in fact will never go dry because it contains such a huge volume of water, it made no sense with respect to a small river like the San Pedro. The assumption foreclosed any examination of whether groundwater pumping could dry up the river. Maddock's model at least allowed for the possibility that the river might go dry. When Maddock and Vionnet ran the model, they found that the river is fed, at least partly, by discharge from the aquifer. But they also found that nearly 40 percent of the groundwater pumped in 1988 was capture, water that would have discharged to the river. Even as of 1988, groundwater pumping significantly reduced the river's flow.

Maddock's model caused a problem for officials at Fort Huachuca, an army base just north of Sierra Vista, who were considering an expansion of the fort's activities. The fort's principal source of water is groundwater. Fort Huachuca, originally commissioned to protect white settlers from the Apaches after the Indian wars in 1877, has long been an economic engine for the town of Sierra Vista. In early 1993, the U.S. Base Realignment and Closure Commission (Closure Commission) proposed moving the Monterey, California, Defense Language Institute to Fort Huachuca, which would have increased the fort's population by approximately 5,000 and increased water use by approximately 2,500 acre-feet per year (af/yr). In discussions with the city of Sierra Vista, the Department of Defense raised the issue of water availability, but city officials assured them that the groundwater system contained enough water for "a thousand years." The city of Monterey naturally opposed the transfer, as did local environmental groups in Sierra Vista, who wished to protect the San Pedro River. Some opponents of the move characterized Sierra Vista as "a dusty cowboy town with inadequate water, insufficient housing, and scarce intellectual resources."

After the Closure Commission learned of the Maddock model, they asked Maddock and Bill Lord, an economics professor at The University of

Arizona, to comment on the proposed move. By letter, Maddock and Lord explained that the increased growth would exacerbate the adverse environmental impact on the San Pedro River and the Conservation Area. The letter set off a furor that has yet to subside. Sierra Vista officials blasted the letter, saying it was filled with "distortions and misstatements," and that Maddock and Lord were environmental extremists. An Arizona Department of Water Resources hydrologist criticized the letter as containing "erroneous and unsupported statements." The Closure Commission faxed the letter to Arizona Senator Dennis DeConcini, who relayed it to Manuel Pacheco, president of The University of Arizona. The University of Arizona administration, in the midst of negotiating a lucrative contract with the Army to supply instructors to the Defense Language Institute, was caught off guard. Dean of Engineering Ernie Smerdon, Maddock's boss, summoned Maddock into his office and told him "the president was pissed." Harold Vangilder and Bill Noyes, a University of Arizona vice president, took a different approach and offered Maddock space in Sierra Vista for an "Institute." People didn't want water problems to stand in the way of growth. But Maddock refused to recant.

The city of Sierra Vista decided to attack Maddock's model. In July 1994, the city requested proposals to evaluate it. In the world of consulting firms, requests to submit a bid on a particular contract are highly competitive. A successful proposal must convince the awarding agency that the bidding firm will produce what the agency needs. In most instances, it's fairly cut-and-dried: a municipality needs a certain study, and the consulting firm will generate it. In this case, the city sent an unambiguous message that it wanted the model trashed. The request for proposals claimed that "most people reviewing the [model], including some of those involved in producing it, do not have much confidence in its results."

The city awarded the contract to an engineering team that included R. Alan Freeze, a world-renowned groundwater hydrologist. After exhaustive study, however, the team found "inherent conflicts between groundwater pumping that accompanies economic development" and the survival of the riparian system in the San Pedro River valley. When the team released its evaluation of the model, an environmental newspaper, *High Country News*, observed that "it reads as if Maddock had written it."

In 1994, U.S. Secretary of the Interior and former governor of Arizona Bruce Babbitt entered the fray and declared that all parties involved in the San Pedro River controversy should enter into negotiation. Bab-

bitt's emergence sparked an angry response from then-Arizona Governor Fife Symington, who grumbled, "Babbitt's problem is that he thinks he's still governor." A flurry of activity, with the appointment of committees and subcommittees, continued for several months, but all for naught. The issues were too complex, nobody was authorized to implement anything, and some water users weren't even at the table. Ultimately, the settlement group faded away. Through the settlement process, however, the hydrologists unanimously agreed on one thing: pumping was harming the river.

The political situation heated up again, in 1995, when the Center for Biological Diversity (then called the Southwest Center for Biological Diversity) initiated a lawsuit alleging violations of the Endangered Species Act and the National Environmental Policy Act. Under the leadership of Robin Silver, a Phoenix physician, the center had become known for its take-no-prisoners approach to environmental litigation. The lawsuit raised the hackles of Sierra Vista officials. In true Wild West fashion, the mayor declared: "We've been silent too long. Them days are gone." A headline in the local newspaper blared: "City officials declare war on enviro 'enemy.'" City councilman Harold Vangilder, in a particularly well-informed reaction, responded: "All right, there may be 500 species of wildlife found along the San Pedro. My response is, so what? What benefit do these animals have for humans? We are the ones who rule supreme, and if a plant or animal can't adapt to our needs, then it's too bad."

The feared growth in the fort's population never materialized. Instead, the fort's military and family member population, including those living off base, declined from 19,427 in 1994 to 16,393 in 1997. The fort's recent efforts to reduce its water use and to protect the river have been nothing short of remarkable. An aggressive water conservation program includes the reuse of treated effluent to irrigate the fort's parade field, golf course, and sports complex. The fort is replacing older, high-use plumbing fixtures with the aquifer. The fort reduced its on-post water consumption by almost 50 percent, from 3,207 af/yr in 1989 to 1,655 af/yr in 2001. Its successful conservation program is partly due to the fact that it is a military facility. As Major General John D. Thomas, Jr., wryly observed: "If we tell people not to water their grass, they probably will not water their grass." Although the fort's population has declined, military personnel and their families, civilian employees, and military retirees made up 28 percent of Cochise

County's 1997 population. Fort Huachuca remains the driving force of the local economy with expenditures of \$525 million in 1997. Yet the fort is no longer the principal threat to the San Pedro River.

For generations, Arizonans have been selling desert lots that lack water to folks from Illinois and other points back East. In Arizona, this is an honorable way to make a living. In 1973, after some particularly well-publicized scandals when the rubes showed up and discovered what they had purchased sight unseen, the state legislature began to require developers to obtain from the Arizona Department of Water Resources a determination regarding the availability of water for the development. If the supply of water is "inadequate," then the developer must disclose this fact in the promotional materials and sales documents. Although this red flag has put a real crimp in fraudulent land sales, marketing efforts now are directed toward selling land that is not subject to this subdivision development restriction. Though passing legal muster, land with inadequate water continues to be sold.

The most critical problem in Cochise County is to find water supplies for the expected increases in nonmilitary population. Between 1980 and 2000, the city of Sierra Vista's population increased 64 percent from 25,000 to 41,000. State of Arizona demographers predict that by 2025 the city's population will grow to nearly 70,000. Population growth in surrounding areas in Cochise County increased even faster, at an annual rate of 3.4 percent in recent years, rising from 108,225 to 123,750 over four years. Water demand to serve this projected population growth is likely to increase from 17,900 af/yr currently to 25,000 af/yr in 2025. Sierra Vista's historical dependence on Fort Huachuca for its economic growth is changing; to sustain growth, the city is relying on housing developments that target "snowbirds," a euphemism for winter visitors and retirees who flee northern climates for Arizona and other warm states.

One development, with the green-sounding name "Cottonwoods of the San Pedro," would have created a 90-lot subdivision immediately adjacent to the Conservation Area and served by groundwater. This development, perversely, would have contributed to killing the very trees after which it would be named. The same developer also proposed to build an additional 5,000 homes next to the "Cottonwoods" development. Fortunately for the San Pedro River, these projects got derailed when the devel-

oper was sent to prison in Nevada for fraud relating to his ownership of a water company in that state. But the "Cottonwoods" land is still being developed into four-acre parcels that are exempt from state regulation, a significant loophole in efforts to regulate development. Judy Anderson of the Cochise County Planning and Zoning Department believes that more growth is occurring through this unregulated splitting of properties than through platting of subdivisions, but no one knows the exact number of lots that are being split. There is another associated problem: water for platted subdivisions usually comes from a central supply, which makes it quite simple to monitor water use. However, when property is split, each parcel will have its own well. Arizona law, like that of almost all states, does not regulate these wells, known as "exempt wells," because they are deemed so small as not to be worth the trouble to regulate. Domestic wells present an enormous loophole in every state's water management system. Most states have tens of thousands, or even hundreds of thousands, of exempt wells. Making matters worse, most domestic wells are relatively shallow and usually located near rivers, streams, or wetlands; their cumulative impact on surface flows can be substantial.

The "Cottonwoods" development is not the only indicator of growth in the San Pedro River Basin. Another developer envisions a 7,500-home master-planned community within six miles of the Conservation Area. In 1999, a 400,000-square-foot, \$60 million regional shopping mall opened, the first of its kind in the area. The mall created approximately 400 jobs. A new state park, Karchner Caverns State Park, located just north of Sierra Vista, also opened in 1999. It may be the most remarkable cave in the country, with magnificent stalactites, stalagmites, helictites, soda straws, and especially "Kubla Khan," a massive 58-foot-tall column. Between 250,000 and 350,000 cave enthusiasts visit the park each year. A proposed industrial air park will encourage more in-migration. Richard Archer, mayor of Sierra Vista, welcomed this economic growth. "These [projects] will bring in new people, new growth. We should not be afraid of that."

Because of the growing demands on groundwater, a fight is brewing. The city's wells have cones of depression that have intersected those of Fort Huachuca, causing a drawdown of the water table. Under Arizona law, however, a landowner is not liable if his or her well interferes with the operation of another well. The reasonable use doctrine permits exactly such a result. As a consequence, both the fort and the municipal providers

will need to drill deeper wells. The city's and the fort's wells significantly affect the river, because the cones of depression are intercepting water that is flowing underground from the Huachuca Mountains to the river. The cones of depression have reached the San Pedro River and are directly reducing the flow in the Conservation Area.

Frustrated by the failure of its litigation to produce effective reform, the Center for Biological Diversity used the river's international status to petition the Commission for Environmental Cooperation (CEC), set up as part of the North American Free Trade Agreement, to study the San Pedro River Basin. In 1999, the commission concluded that groundwater pumping has caused a steady decline in surface flows. Agricultural pumping near the river has "contributed significantly" to the reduction, and groundwater pumping by the city of Sierra Vista and Fort Huachuca has reduced groundwater discharge to the river by 70 percent. But the major long-term threat is "the creeping incremental demands on the groundwater that sustains [the river]."

What will happen if groundwater pumping continues to reduce flows in the river and to lower the water table? The riparian plant community will change. Aquatic plants require perennial flows; marsh plants require shallow groundwater. As the groundwater level drops, wetland plant species decline and upland species increase. Loss of perennial flow would collapse the aquatic ecosystem, killing fish, frogs, aquatic invertebrates, and terrestrial insects. The cottonwood-willow forest might initially survive, though it will undergo stress. The trees will die if the water table drops below nine to fifteen feet beneath the surface of the ground, which for trees on a bank next to the river leaves little margin for error. These changes will profoundly impact birds. Marshland species like the western yellow-billed cuckoo, green kingfisher, gray hawk, summer tanager, and Swainson's thrush will virtually disappear. Native, but exotic, bird species such as the vermilion flycatcher will sharply decline in numbers. Migrating songbirds would no longer stop there. Eventually, salt cedar trees will replace the cottonwoods and willows. They, in turn, will yield to mesquite woodlands, but even the mesquites will decline as the water table drops further.

Some local politicians, such as Harold Vangilder, expressed contempt for the CEC: "Our experience is that these guys are little more than new-age, feel-good thugs." Nothing will likely come from the CEC report, which is only a report of an advisory committee; it carries no force of law, nor is it the product of a politically powerful congressional committee. Nor

does the CEC have any important local constituency to put political muscle into the report's findings. Instead, even before the release of the report, Sierra Vista interests persuaded the Arizona legislature to pass a resolution urging President Clinton not to declare any Arizona river an "American Heritage River," nor to allow international meddling in the affairs of local U.S. interests. According to the legislature, "The CEC study and report represent an unnecessary intrusion of an international environmental entity into state matters that excessively limits the use of both private and public lands in this state." The Arizona legislature managed to reach this conclusion *before* the CEC had released its report! Moreover, given that the San Pedro River crosses an international border as it flows from Mexico into the United States, it is difficult to understand how river issues are solely "local" or "state" matters.

Other heavy hitters soon weighed in to rail against the threat that the CEC represented to U.S. sovereignty. Lieutenant Colonel Oliver North (Ret.) circulated a petition claiming that the San Pedro River and the city of Sierra Vista "have come under attack from a new left-wing international commission. . . ." Sierra Vista officials were probably not happy with Mr. North's claim that the CEC was "trying to bully the town of Sierra Vista into cutting back on *water drawn from the San Pedro River*." To combat this challenge to U.S. sovereignty, Mr. North asked recipients to sign the petition and to send him a check so he could continue his vigilant efforts to protect us from foreign threats.

In another attempt to resolve the issue, the CEC convened a thirteen-member Upper San Pedro Advisory Panel to consider public reactions to its report and to formulate recommendations for the future. Members of the advisory panel represented a spectrum of local interests, including environmental groups, civic organizations, and the ranching community, as well as regional and international perspectives. But the advisory panel achieved consensus by producing a report timid enough to secure the votes of its members from Cochise County and Sierra Vista who favored unrestrained growth.

Relations between local elected officials and University of Arizona hydrologists took a turn for the worse in 1999 when hydrologist Robert MacNish, at a meeting in Cochise County, proclaimed that the river was going to die due to elected officials whom he described as being members of a species called the "Cochise County ostrich, a noisy and flightless bird which does not see any problem because it buries its head in the sand."

MacNish thought that the ostrich should be put on the threatened or endangered species list "where it belongs." His comments were amusing to be sure, but they further annoyed local officials.

The San Pedro River reached the nation's radar screen in 1999 with the publication of a long piece in the *New York Times* that portrayed a bird oasis in peril. Once again, local officials responded defensively, insisting that the *Times* reporter did not comprehend the environmental efforts undertaken by Fort Huachuca and the city of Sierra Vista.

The U.S. Bureau of Land Management (BLM), which Congress entrusted with management of the Conservation Area, may hold a trump card. The federal water right that Congress created in 1988 when it reserved water for the Conservation Area supersedes subsequent state water rights. Those who initiated their water use *before* the creation of the Conservation Area may continue their activities. But newcomers stand in different shoes. Federal law protects the Conservation Area's water rights against interference by subsequent water users, whether these users rely on surface or groundwater.

Unfortunately, the Conservation Area's water rights are only theoretical at this point in time. Lawyers for BLM have asserted these water rights in the Gila River General Adjudication, a hideously complicated process that is attempting to quantify *all* water rights in two-thirds of the state of Arizona, including the San Pedro River. The special master, assigned by the Arizona Supreme Court to take a first crack at resolving the claims, is working watershed by watershed as he attempts to bring some semblance of sanity to this bizarre legal process. As of March 2002, there were no scheduled hearings concerning water rights for the Conservation Area. It will be years before BLM obtains a decision from the special master, and that decision would be subject to the normal process of appellate review.

The river cannot wait that long; incremental additional demands for water will have long since sealed its fate. BLM has another option. The special master has authority to issue a preliminary injunction in order to preserve the status quo for the duration of the judicial proceedings. In March 1999, Tom Maddock and I urged BLM to ask the special master to enjoin irrigation pumping that commenced after 1988. However, Michael Ferguson, deputy state director of the BLM office in Arizona, feared that such a request would undermine BLM's efforts to work with other agencies and landowners to achieve "community collaboration and cooperation" concerning the problems in the San Pedro River Basin. Consensus

building is a wonderful process, but sometimes it just does not work. The most recent effort to achieve consensus is the Upper San Pedro Partnership, made up of federal, state, county and city agencies and The Nature Conservancy, all of which own land, make land use policy, or have resource expertise in the upper San Pedro River Basin. Prior to the partnership came the Water Issues Group, the County Comprehensive Plan, and a federally sponsored water rights negotiation. Each failed to achieve consensus. The question is whether BLM's current effort will yield greater success.

The partnership began rather timidly by advocating for the preparation of additional studies and a new hydrologic model. The San Pedro River may give literal meaning to the phrase "studied to death." A September 1999 report by BLM and the Sonoran Institute identified various groups involved in conservation and research efforts concerning the San Pedro River. The results are staggering. They include four state of Arizona agencies; nine United States government agencies; seven universities, colleges, and foundations; eleven environmental organizations; two international organizations; one consulting firm; one unit of local government; and five coordinating committees and task forces. These are only the participants on the United States side of the border! There are also twenty-nine organizations and government agencies in Mexico. Despite the efforts of so many people and the expenditure of enormous sums of money, very little has occurred to halt the impact of groundwater pumping on the river. Every credible hydrologist understands this impact on the San Pedro River. A new hydrologic model might slightly improve the understanding of groundwater-surface water interactions, but the enhanced knowledge would come with a considerable delay and at a huge cost to the river.

In July 1999, Dale Pontius, associate solicitor in the Department of the Interior, along with Department of Justice lawyers and BLM officials, met with state, county and city representatives in Sierra Vista. The meeting was cordial, but produced no concrete results. As soon as the federal officials left town, the Sierra Vista City Council approved a plan by California-based developer Castle & Cooke to build 7,000 new homes for 15,000-20,000 new residents on 2,000 acres near the San Pedro River. The mayor of Sierra Vista responded to criticism by arguing that the partnership would address water issues through a \$6 million project to recharge treated sewage effluent in order to offset the effects of groundwater pumping on the river, and through conducting feasibility studies to capture and recharge flood-



water from streams in the Huachuca Mountains. City councilman Harold Vangilder insisted that the only problem was outsiders who were stirring up trouble. He asked the city council to require citizens who might testify at future council meetings to indicate where they live.

The city council's action gave pause to BLM's hope of achieving consensus through "community collaboration and cooperation." When Secretary of the Interior Bruce Babbitt visited Sierra Vista in November 1999, he no longer offered an olive branch. Babbitt threatened to take management of the river away from city, county, and state officials unless they acted to curb growth. Babbitt asserted that it was his responsibility, as Interior Secretary, to "protect this extraordinary piece of God's creation." He placed special blame on the state, which, he stated, "has abdicated its responsibility to lead in the management of this resource." Babbitt deplored recent agricultural expansion as "an unimaginable abuse of the resource."

Rita Pearson, director of the Arizona Department of Water Resources, rose to defend her state and agency. Pointing to state funding for additional studies, the recharge project, and the Upper San Pedro Partnership, Pearson asserted that the state had a deep commitment to the San Pedro River ecosystem. She also claimed that no agricultural expansion was taking place. On this point, one wonders who advised her. Since 1988, her own agency had granted permits for four new large-capacity agricultural irrigation wells near the San Pedro. Director Pearson also claimed that hydrologic studies had concluded that the San Pedro River could withstand a 5,000-af/yr increase in groundwater pumping. The river would face a more promising future were she correct. In fact, every hydrologic model prepared by her own department since 1974 has concluded that the current level of pumping negatively affects the river. In the late 1990s, Ms. Pearson resisted pleas that she use her authority to bring about state regulation of pumping in the San Pedro River Basin. She apparently did not want to offend local officials by imposing state management on water use.

The efforts of the Center for Biological Diversity to use the Endangered Species Act (ESA) to restrict growth in Sierra Vista and Cochise County suddenly appeared to have merit in 1999, when a federal judge ordered the Fish and Wildlife Service (FWS) to designate critical habitat for the spikedeuce and loach minnow, both threatened species under the ESA. In April 2000, FWS designated hundreds of miles of streams and rivers in Arizona and New Mexico as critical habitat, including the San Pedro River. That same month, David J. Harlow, FWS field director in

Phoenix, expressed concern about development near the river. Under section 404 of the Clean Water Act, a developer must obtain a permit from the U.S. Army Corps of Engineers for the discharge of dredged or fill material into navigable waters, which include "intermittent streams," i.e., dry washes. Harlow argues that development on the floodplain of the San Pedro River requires a section 404 permit because the new construction, once operational, would rely on groundwater to the detriment of the San Pedro, the listed species, and their critical habitat. Section 7 of the ESA requires the Corps to consult with FWS in order to ensure that the final permit does not jeopardize a listed species or adversely modify or destroy its habitat. Under section 7, FWS must suggest "reasonable and prudent alternatives" that the Corps could take to avoid jeopardy to the listed species or its habitat. Because the threat comes from the impact of groundwater pumping on the San Pedro River, any alternative presumably must propose that the development *not* rely on groundwater. Unless there are other sources of water (and none come to mind), developers may be denied the necessary permits.

The ESA may also force the fort to reduce its water use even further. In April 2002, a federal judge found merit in the Center for Biological Diversity's attack on FWS and the fort's conclusion that the its pumping would not jeopardize endangered species. He ruled that the biological opinion, required by section 7 of the ESA, did not contain adequate measures to mitigate the long-term impacts of the fort's pumping. FWS and the fort must prepare a new biological opinion.

The Endangered Species Act and the Clean Water Act have served as hammers to encourage the stakeholders to work with the Upper San Pedro Partnership. Indeed, Andy Laurenzi, The Nature Conservancy's Southern Arizona conservation manager, who has worked on San Pedro issues for twelve years, is "fairly optimistic" about the partnership. The process has created "a much more receptive environment" for discussing "amazing things like growth restrictions."

The fort, which is a partnership member, has committed substantial funds toward protecting the river. The fort spent \$6 million on its effluent recharge project. It has also entered a partnership with The Nature Conservancy to spend \$2.5 million over five years to purchase conservation easements from willing landowners to reduce agricultural water use. The jury is out on whether Sierra Vista and Cochise County will make the same commitment. Although the city and county historically looked to the

fort for growth, city officials now admit—albeit not for attribution—that “we’ve already unhitched our wagon from the fort and are promoting Sierra Vista as a great place to come and live.”

Can the situation be reversed? Options are limited. Reducing water consumption below current levels is a political nonstarter. Importing water from other basins would involve enormous costs and legal and environmental challenges. If new growth relies on groundwater, the impact on the river will become more severe. To protect the river, the city of Sierra Vista and Fort Hachuca have initiated an intriguing groundwater recharge project. Begun in 2000, this \$7.5 million effort will construct a fifty-acre wetlands complex and thirty acres of groundwater recharge basins. Treated municipal wastewater will recharge the aquifer through these basins. The idea is to create a mound of water underground between the city’s wells and the river, so that the city’s pumping draws on this water rather than expanding the existing cone of depression. City officials initially hope to recharge between 800 million and one billion gallons per year, an amount that will increase as growth occurs and new development connects to the city’s sewer system. This system will potentially reduce the impact of the city’s pumping. However, by itself, it is not an adequate solution because recharge returns only a percentage of the total water used, and because significant pumping currently occurs throughout Cochise County at places other than the city’s existing wells. The recharge project, according to a federal judge, “will mask and delay the effects of the groundwater pumping.” It only postpones the inevitable if the quantity of pumping continues to increase.

After Congress created the Conservation Area in 1988, the BLM purchased and retired almost 20,000 ac/yr of agricultural water rights. Since then, The Nature Conservancy (TNC) has purchased additional water rights, some in Ramsey Canyon, a tributary of the San Pedro River and a famous hummingbird observation site. However, irrigation outside the TNC-owned land and the Conservation Area presents a significant threat to the river. In the mid-1990s, BLM and TNC paid a nearby farmer to cease pumping on 500 acres. However, the farmer turned around and began to irrigate another 500-acre parcel. This irrigation unquestionably affected the river, yet the farmer’s actions were perfectly legal under Arizona law. Some way must be found to prevent new large-scale pumping for low-value agriculture in areas near the river. Otherwise, the resolve of the city and fort may dissipate if a single landowner can undermine their

efforts to conserve. A successful retirement program needs assurances that new irrigators will not undo the program. This raises the possibility of holding out for ransom; as water rights are purchased and retired, the value of the remaining private lands, and water rights, increases. Another option is to designate the region an active management area under Arizona law and inaugurate state regulation and control. This avenue requires state involvement, which is not likely to be forthcoming in the absence of support from the local stakeholders. The Cochise County board of supervisors has voted unanimously to oppose such a designation.

Water conservation is another option, but measures such as low-water-use landscaping requirements involve only modest amounts of water. Furthermore, it does not make sense to conserve a few gallons of water per household while increasing threefold the number of households.

One Rube Goldberg proposal is to pump more groundwater during periods of extreme drought and dump it into the river to offset lower surface flows. This is a kind of hydrologic Ponzi scheme. Increasing pumping would capture more water from the river. The whole process would produce an ever increasing cycle: more pumping, more capture, hence even more pumping, hence even more capture. This process would have to continue indefinitely.

The San Pedro River today has only a narrow ribbon of cottonwood and willow along its banks, so when rains come, the water flows quickly downstream through the Conservation Area. That may change if a 1999 program to reestablish beavers along the San Pedro River is successful. Beavers are truly remarkable environmental engineers who perform critical functions in maintaining healthy riparian ecosystems. Beaver dams slow the movement of water, encourage lateral percolation of water into the surrounding soil, and foster more diverse plant and animal species. As the water spreads out behind their dams, it saturates a wider band of soil, forming marshy backwaters favored by catfish, spiky bulrushes, and leafy vegetation. During dry periods of the summer, the water stored in the riverbanks and marshes discharges into the river, assuring a continuous flow over a longer period of the year. Beaver dams also discourage flooding. During significant storms, rainwater fills the beaver ponds rather than flooding the river, which would scour out the channel and cause further erosion. Beavers contribute to a healthier river because the water, as it tumbles over the top of the beaver dams, gets aerated and provides more favorable habitat for native fishes, such as the longfin dace. Riffles that form below the

dams also attract a wider variety of insects which, in turn, attract a wider variety of bird species, such as the endangered willow flycatcher.

Early reports from BLM and the Arizona Game and Fish Department suggest a successful restoration program. Officials hope a self-sustaining population of twenty to thirty beaver colonies will eventually inhabit the Conservation Area. A robust beaver population would produce, in the long term, marshy areas next to the river, with a swath of willows and other shrubs behind the marshes. The cottonwood gallery would be farther back from the river because cottonwood seeds would land on moist soil behind the marsh and willow areas. The net effect would be a larger riparian habitat with a greater variety and number of plants, animals, insects, and birds.

If the San Pedro River is not to suffer the same fate as the Santa Cruz, dramatic changes must occur. Even if all the good ideas are implemented—rethiring agricultural irrigation, recharging effluent, installing low-flow fixtures, mandating water conservation, and repopulating beavers—they will not bring the present rate of overdraft to zero. Saving the San Pedro demands the *will* to save the river, and the local community may lack the necessary resolve. The river does not play an important part in the life and culture of Sierra Vista. Lying eight or ten miles east of the city, off a road traveled mostly by tourists on their way to Bisbee, the San Pedro River is a small river of interest mostly to bird watchers. One suspects that many people in Sierra Vista are puzzled by the claim that the city's water supply affects a river ten miles away. It takes a rather sophisticated understanding of hydrology to grasp how the pumping is intercepting water that would otherwise reach the river. A 1994 poll revealed that approximately one-half of Sierra Vistans did not know there was a problem with the river.

The saga of the San Pedro River offers a number of lessons, each of them useful for those trying to protect other rivers and streams. First, population growth is driving the increased demand for groundwater. Real estate developers and local politicians are unreceptive to claims that controls on growth are necessary to protect rivers and streams. It is often said that the "engine of the American economy" is growth, and challengers to this mantra may expect a hostile audience. Second, the complicated nature of hydrology and of capture processes creates a serious information problem. It takes considerable time and resources to document the hydrologic connection between pumping and surface flows. It takes little effort to obfuscate the issue by claiming that the science is uncertain. Truth will

eventually win out, as declines in river flows confirm that pumping has caused a reduction in flows. Third, time passes to the disadvantage of the resource. Capture processes may occur over decades and be hidden from view. Each new subdivision and irrigation well places additional stresses on the system and enlists new advocates for permissive pumping rules. As time goes by, it becomes increasingly difficult to reverse direction.

All streams flow into the sea;  
yet the sea is not full.  
To the place the streams come from,  
there they return again.  
—Ecclesiastes 1:7

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