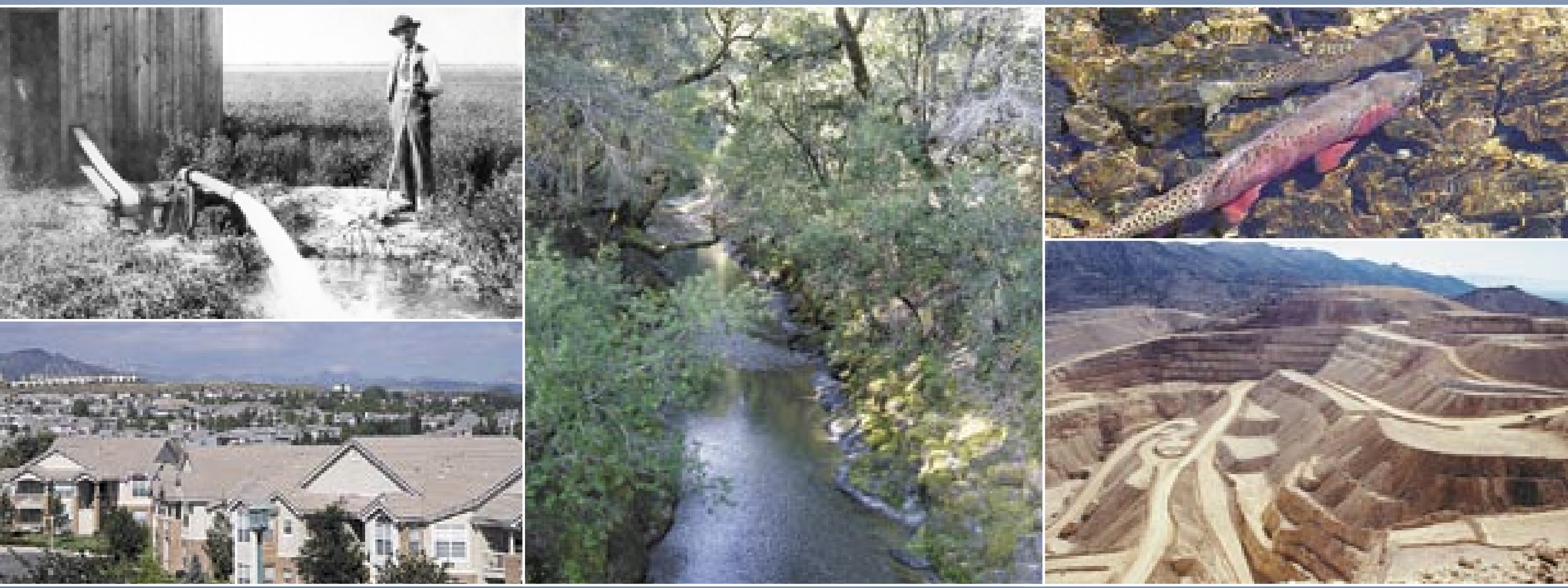
Gone to the Well Once Too Often



THE IMPORTANCE OF GROUND WATER TO RIVERS IN THE WEST

A Report by Trout Unlimited's
Western Water Project

April 2007
Second Printing

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Introduction

Many ask, "Why should people who care about healthy rivers also care about ground water management?" Our answer: ground and surface water are connected to each other and as a result, pumping ground water can adversely affect river flows. In too much of the West, new water users start using ground water because river flows are insufficient. Ground water is seen as a new source to solve their water needs, but ground and surface waters are not separate and will rise and fall together. Ultimately, rivers bear the burden.

Consider the Eastern Snake Plain Aquifer in southern Idaho. There is as much water in the upper 500 feet of this aquifer as there is in Lake Erie. At one time, there were thousands of springs flowing freely throughout the basin. In the early 1900's, farmers diverting water from the rivers and springs to flood their crops actually increased spring flows because so much of the irrigation water seeped back into the ground. After World War II with technology advances and cheap energy, farmers began to tap the aquifer, expanding their irrigated acreage and relying on powerful wells to pump ground water through sprinklers. By the end of the 20th century, producers were using more water each year than the system produced. Springs began drying up, causing harm both to the earlier settlers who still irrigated with surface water and to the area's fish and wildlife.

The area reached full-blown crisis during the drought of 2002. Charges and counter-charges flew between spring owners and pumpers. Idaho's water management strategies not only failed to keep the peace, they became the targets of litigation. The state legislature reacted by offering financial aid, authorizing studies, and demanding that state water officials solve the problems. Water officials tapped federal Farm Bill programs in an effort to encourage farmers to retire as many as 100,000 acres that had been irrigated with well water. Despite these efforts, the crisis has continued to build, exposing fundamental legal and policy problems along the way.

Such challenges exist throughout the west. This report provides basic information necessary for citizens, legislators and others to understand and address these challenges. It explains the relationship between ground and surface water and the adverse effects that ground water pumping can have on surface ecology. It describes the current regulatory management of ground water in a dozen western states. Finally, it makes a set of recommendations for wise ground water management. Interspersed throughout, there are stories of rivers in the region that have been adversely affected as a result of ground water pumping.

Left: Ranchers in the Upper Salmon Watershed are taking a pro-active stance to save the longest inland salmon runs in the world. Their actions will help restore the Lemhi River, shown, to its former status as prime salmon habitat.
Photo: Joel McNee, USDA Natural Resources Conservation Service

Opposite page: Tim Hawkes, TU.

Ground Water 101

Ground water is an essential piece in the *hydrologic cycle* that moves the earth's water from large water bodies to storm clouds, through rivers and streams and back again.

Precipitation that does not run off into rivers, nor is absorbed by plants or lost to evaporation, eventually percolates into the soil. Once underground, this water is stored in geologic formations called ground water *aquifers*. If people stop to consider ground water at all, they often picture large underground lakes or rivers.

It is a common misconception that ground water has no relation to surface water. In fact, ground water provides much of the water that flows in streams.

An aquifer, however, is more like a sponge holding water in the cracks and spaces between soil, sand, and rock. Like a stream, ground water moves through the aquifer, but where we measure stream flows in cubic feet per second, ground water flow is usually measured in inches per day.

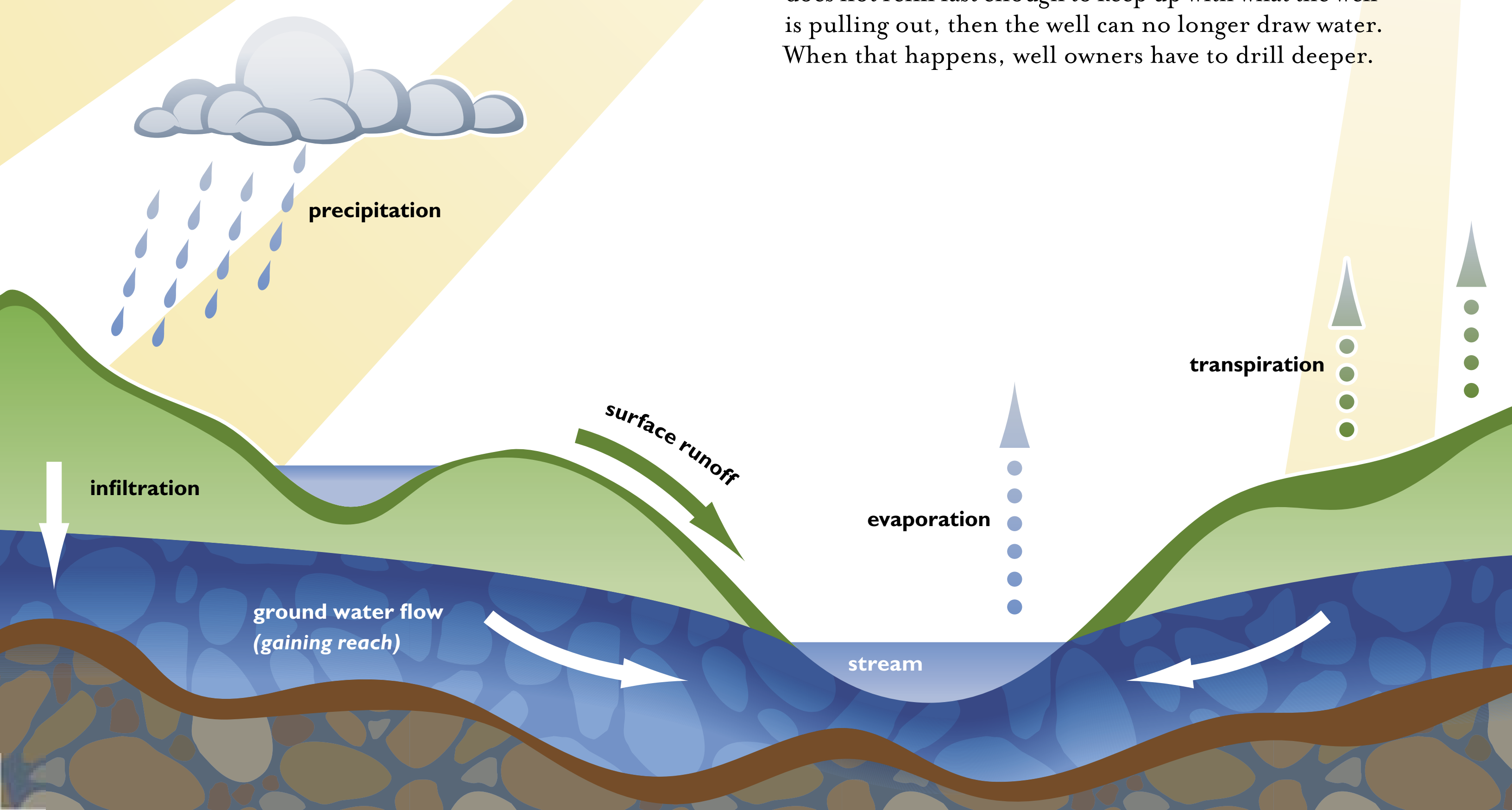
As water *percolates* down from the surface through the soil, it reaches a depth where the soil is completely saturated. The top of this saturated zone is the *water table*. The depth of the water table does not remain constant, but fluctuates almost continuously in response to several factors, including:

- the **rate of recharge** (how much new water there is);
- **flows in neighboring streams**, which can either contribute to or take water away from the aquifer;
- **well-pumping rates**, which deplete the aquifer; and
- the **rate of water absorbed** by plants' root systems.

Wells dry up when the recharge rate can no longer match the rate of water withdrawn from the aquifer. Initially well owners always dig or drill their wells to a depth comfortably below the water line. But if the well continues to pump and the aquifer does not refill, or does not refill fast enough to keep up with what the well is pulling out, then the well can no longer draw water. When that happens, well owners have to drill deeper.

THE HYDROLOGIC CYCLE

This illustration shows how water moves between the atmosphere and underground aquifers.



Many aquifers, especially those not directly connected to surface waters, flow and recharge quite slowly. Geologists estimate that if the aquifer that underlies the High Plains of New Mexico were drained completely, it would take thousands of years to replenish.

It is a common misconception that ground water has no relation to surface water. In fact, ground water provides much of the water that flows in streams, especially during periods of scarce rainfall and in cold climates when air temperatures prevent snow from melting. Along any river or stream, ground water flows into surface water in some areas, while in others, surface water flows into ground water. When the water table sits higher than the streambed, water flows from the aquifer into the stream. This is called a *gaining reach* and the ground water is contributing base flow to the stream. By contrast, in a *losing reach*, water will move from within the stream to a water table that sits below the streambed. A stream can have both gaining and losing reaches along its course, all depending on the location of the streambed as it flows through a varying water table. Thus ground water withdrawals can deplete not only an aquifer, but also the rivers and streams near it.

Over-reliance on ground water to meet human demands can have important environmental consequences. Ground water withdrawals that exceed recharge will lower the water table, eventually causing gaining stream reaches to become losing stream reaches.

Geologists estimate that if the aquifer that underlies the High Plains of New Mexico were drained completely, it would take thousands of years to replenish.

Reduced stream flows harm both the stream and its *riparian* ecosystem, the flora and fauna along its banks. Further, consistent reduction of aquifers can decrease well yields, increase pumping costs, impair water quality, and cause overlying land to crack or subside.

Healthy watersheds slow surface water flows from precipitation, snowmelt, and other events; this allows water to penetrate soils, where it then enters the ground water. Over time, the ground water flows downhill, often back to a surface river or lake where it can provide important, positive water quality benefits. Typically, ground water maintains a cool temperature and high percentage of dissolved oxygen, both of which are critical to healthy fisheries.

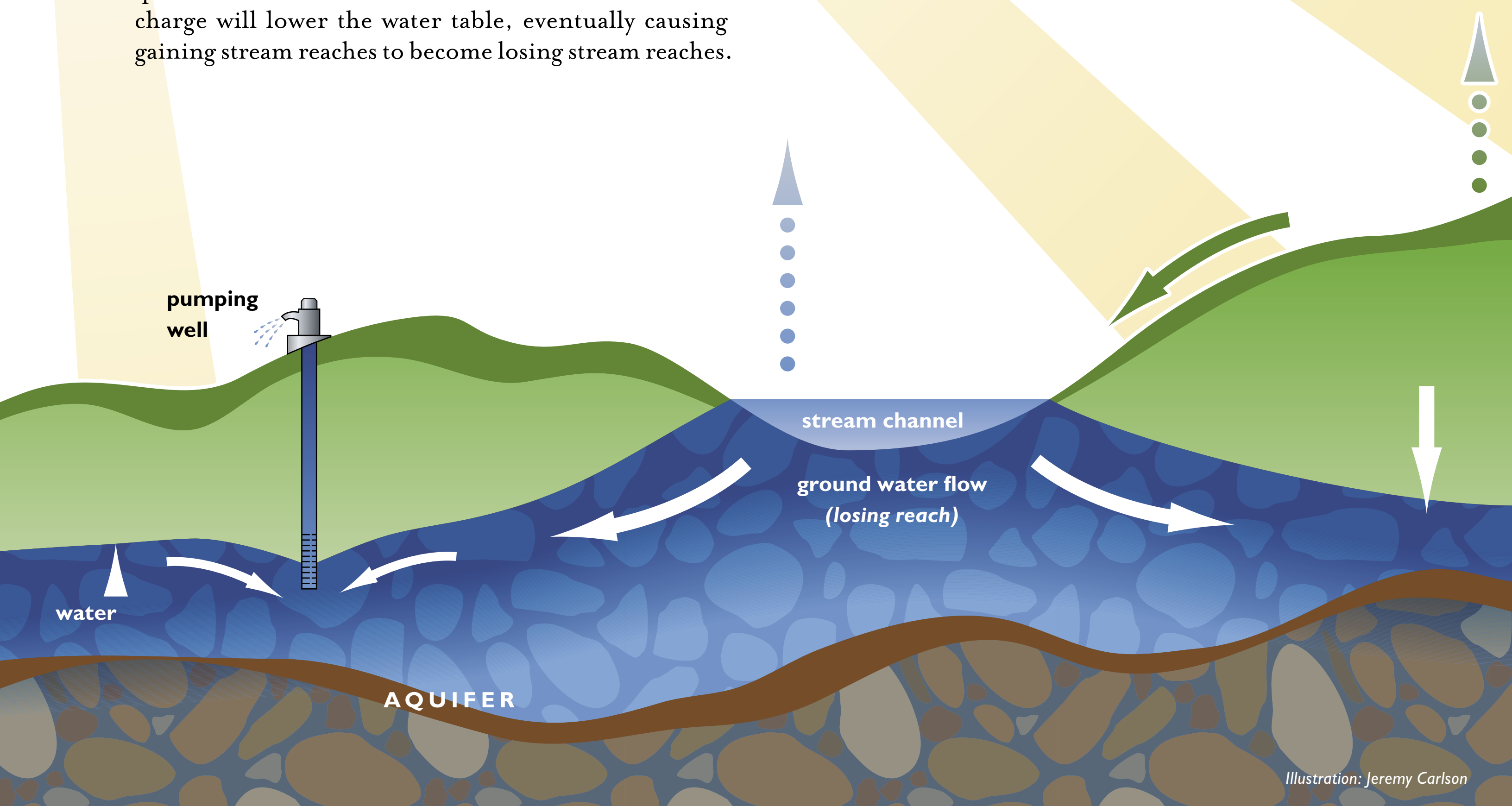


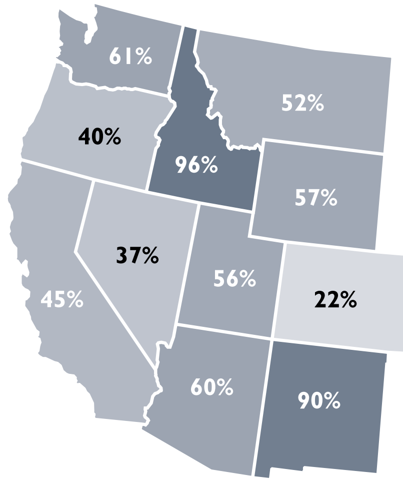
Illustration: Jeremy Carlson

Ground Water Use and Development

From small, hand-dug wells for 19th century homesteads to today's massive wells that feed irrigation sprinklers and cities, the West has long relied on ground water to slake its thirst for water. However, the twin forces of deep, extended drought and rapid suburban growth in recent years have created an unprecedented regional demand for ground water.

Irrigation uses the most ground water in the West, ranging from 79 percent of Arizona's withdrawals to 90 percent of Colorado's. Like many western states, California agriculture pumps and consumes more water than all municipal and industrial uses combined. In Idaho, the Eastern Snake River Plain Aquifer covers more than 10,000 square miles in area and contains up to 500 million acre feet of water, supporting an agricultural economy in a region that usually receives less than 10 inches of precipitation a year. The dry and agriculturally dependent eastern part of Washington has over-drafted ground water for irrigation until some locations report a 200 foot drop in the water table over the past 20 years. Ground water over-appropriation and the resulting problems of subsidence, low stream flows, and poor water quality are now common throughout the western states.

Today, other uses of ground water are also on the rise. While historically it was mostly rural homeowners



Colorado	22%
Nevada	37%
Oregon	40%
California	45%
Montana	52%
Utah	56%
Wyoming	57%
Arizona	60%
Washington	61%
New Mexico	90%
Idaho	96%

Percentage of state population dependent on ground water for domestic water needs.
From U.S. Geological Survey.

MEASURING WATER

An acre foot of water is 325,850 gallons, the amount of water it would take to flood a football field one foot deep. Depending on where someone lives in the West, a family of four uses on average, between one quarter and one half an acre-foot per year.

POWDER RIVER BASIN, WYOMING

Coal bed methane (CBM) development in Wyoming's Powder River Basin is rapidly transforming a prairie landscape into industrial terrain, presenting enormous challenges for ranchers, farmers, and municipalities. Roads, wells, power lines, pipelines, wastewater discharge pits, and compressor stations supplant sagebrush and native grasses that are home to pronghorn antelope, mule deer, and sage grouse.

Coal beds provide a relatively cheap source of methane, or natural gas, because the beds often lie close to the surface, making extraction easier. However, before capturing the methane, an operator must pump out large volumes of ground water to depressurize the coal bed and allow the gas to escape. For up to two years after drilling a well, an operator must pump water from the coal seam at rates of up to 100 gallons per minute. This produced water averages 20 tons of salt per year. In 2003, CBM operations produced over 74,000 acre feet of water across Wyoming.

The produced water not only depletes the aquifer at a rate far exceeding its recharge, but also poses a disposal challenge. An operator has three options. First, an operator can re-inject the water back underground. This option is costly, and local geology may preclude it. Second, operators can build large waste pits from which the water will either evaporate or percolate back into the ground. When the pit finally empties, a shallow depression remains, often filled with a residue of concentrated mineral salts and other pollutants. The seeped water can move into local dry streambeds, where it is not always welcome. Third, operators may simply discharge the water on to the surface, where again it typically runs down what would otherwise

who drew ground water to drink, population growth is forcing thirsty cities to look for water wherever and however they can find it. Less than half of the water New Mexico uses comes from wells, but ground water supplies 90 percent of the State's drinking water. The Rio Grande Aquifer provides drinking water to 500,000 people and is the primary public supply for Albuquerque, Las Cruces, and Santa Fe. In Oregon, wells supply public drinking water systems for 3,000,000 city dwellers, as well as drinking water for the State's 400,000 rural residents.

The U.S. Geological Survey has noted that increased ground water mining is a significant issue in almost every state. Development of ground water for industrial purposes has led to declining water levels. In several areas, ground water levels have declined 300 feet or more in the past 10 years. Large gold mines in northern Nevada pump millions of gallons of fresh water a day out of their mines and into terminal rivers or reservoirs, where it evaporates in the desert sun. Since 1989, Wyoming oil and gas production, especially those operations associated with the production of coal bed methane, now account for significant amounts of ground water withdrawals. Large amounts of water must be pumped from the coal bed area to depressurize the bed and allow the gas to escape.

Despite the increased development of ground water for agriculture, domestic, and industrial usage, the importance of ground water to the hydrologic cycle and stream flows is often overlooked or ignored. For example, though coastal Oregon receives 80 inches of rainfall annually, eastern Oregon is high desert and ground water supplies 90 percent of the base flows for many rivers, including parts of the Deschutes and Willamette. Similarly, much of Washington sits above ground water resources that yield over 50 gallons per minute and provide the base flow to 70,000 miles of rivers and streams. As human use and development of ground water exceeds the recharge rate of aquifers, water tables lower, and our rivers and the wildlife that depend on them begin to suffer.

AN IMPORTANT RESOURCE

Nationally, ground water accounts for:

22%
of all fresh water withdrawals

37%
of agricultural use

37%
of public water supply withdrawals

51%
of all drinking water for the total population

99%
of drinking water for rural populations

By 2015, there may be 40,000 new CBM wells pumping more than a trillion gallons of water out of the region's meager aquifer, drawing down the water table and drying up domestic and stock water wells throughout the Powder River Basin.

be a dry wash. While many people find such drainages ugly, these *ephemeral* streams, which naturally flow only in response to rainfall or snowmelt, have ecological value that constant or poor quality CBM water will harm or destroy. Moreover, surface discharge to pits or washes can contaminate shallow aquifers as well as ranchland so that they are no longer useable because of irreversible soil damage from the produced water's high salinity. Plus, in places where the quality would allow use—or could be treated to do so—these discharges essentially waste significant ground water reserves.

By 2015, as many as 40,000 new CBM wells may pump more than a trillion gallons of water out of the region's meager aquifer, drawing down the water table and potentially drying up domestic and stock water wells throughout the Powder River Basin. Federal and state regulators must come to terms with how Wyoming can contribute to the nation's energy supplies without wreaking havoc on the State's environment and way of life.

Coal bed methane impoundment in Wyoming.
Photo: Northern Plains Research Council.

Ground Water Impacts on Fisheries and Wildlife

Ground water plays a crucial role in maintaining wildlife habitat by contributing water for river base flows, playas, and wetlands. These ecosystems provide habitat not only for fish, but also for sage grouse, antelope, mule deer, bats, amphibians, and other small mammals. Where over-pumping of ground water diminishes surface flows, native and wild local fisheries suffer, as do the plants and animals that depend on those flows. Over-pumping can also dry up riparian vegetation and wetlands, which provide rearing habitat for young fish and critical stops along the flyways of migratory birds. Examples of these problems can be found across the West.

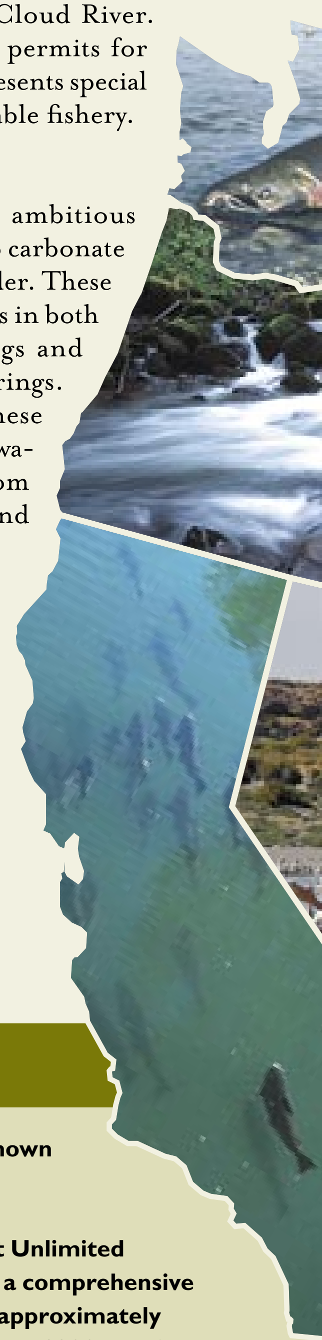
Where over-pumping of ground water diminishes surface flows, native and wild local fisheries suffer, as do the plants and animals that depend on those flows.

In the shadow of Mt. Shasta, a proposed Nestlé water bottling plant threatens a key spring-fed spawning tributary to the hallowed McCloud River. **California's** failure to require state permits for ground water as for surface water presents special challenges for protecting this valuable fishery.

As initially proposed, Las Vegas' ambitious pipeline project could deplete deep carbonate aquifers along the **Utah-Nevada** border. These aquifers feed surface water resources in both states, including countless springs and major wildlife refuges like Fish Springs. Pumping too much water from these aquifers could even reverse ground water flows and pull saline water from the Great Salt Lake into these ground water formations.

PHOTOS ON THIS SPREAD

Washington: Dave Menke, U.S. Fish & Wildlife Service
Oregon: Ron Nichols, USDA Natural Resources Conservation Service
California: Gary Kramer, USDA Natural Resources Conservation Service
Idaho: U.S. Geological Survey
Montana: Jesse Achtenberg, U.S. Fish & Wildlife Service
Wyoming: Harvey Doerksen, U.S. Fish & Wildlife Service
Nevada: Harry Thomas, iStockphoto.com
Utah: Tim Hawkes, TU
Colorado: U.S. Fish and Wildlife Service
Arizona: Arizona Department of Water Resources
New Mexico: Gary M. Stolz, U.S. Fish & Wildlife Service



NORTH COAST, CALIFORNIA

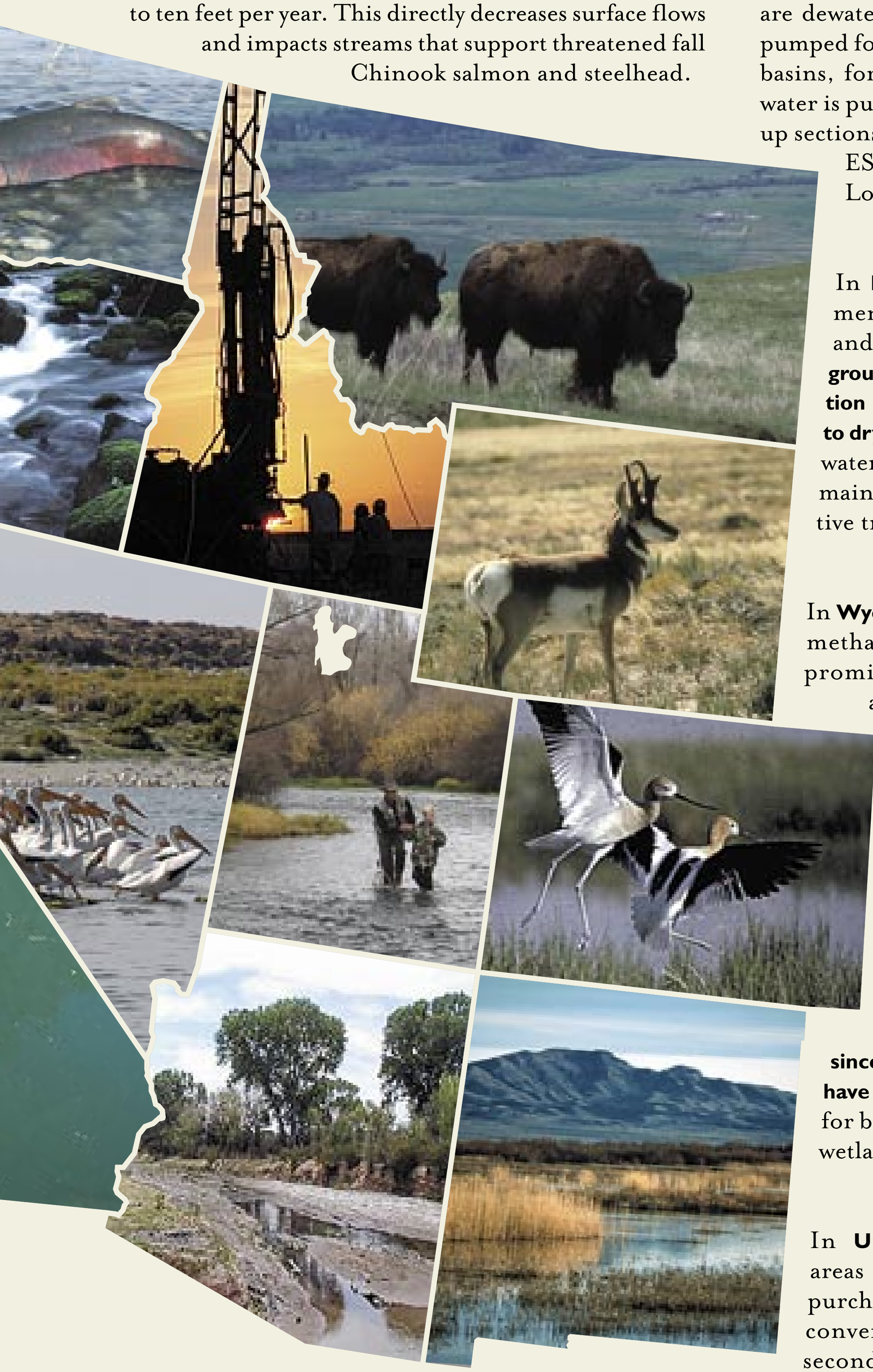
California's scenic North Coast is home to redwood forests, world-class wineries, and some of the nation's most endangered salmon populations. Coho salmon numbers between San Francisco and Oregon declined from 400,000 in 1940 to 10,000 today, and local steelhead and Chinook salmon have not fared much better. One of the culprits is clear: many streams simply lack enough water.

State water law commits California to managing water in a way that protects public trust values such as fish and wildlife. But while the conservation of salmon and trout stands shoulder to shoulder with traditional beneficial uses like irrigation and water supply in theory, the reality is much messier.

The State Water Board, charged with administering permits for surface water rights, has had no clear policy in place to protect instream flows. Worse, hundreds of surface water diversions—upwards of 75 percent in some watersheds—have been constructed illegally, without a state permit. Hundreds of wells in the same area make matters worse, and California requires no state permit at all to pump ground water unless the water is drawn from a "subterranean stream flowing through known and definite channels."

Fortunately, some things are about to change. Legislation championed by Trout Unlimited requires the State Water Board to adopt a comprehensive system to maintain instream flows along approximately 5,900 North Coast stream miles by the end of 2007. This policy should address at least some ground water diversions, because numerous wells in the area draw from subterranean streams. To spur far-reaching change, Trout Unlimited and the Mendocino County chapter of the National Audubon Society also filed a formal petition with the State Water Board and other agencies demanding top-to-bottom reforms to the water right system, including compliance, monitoring, and enforcement. To work through the issues of the petition, Trout Unlimited convened a stakeholder group of grapegrowers and other agricultural interests; urban water users; conservation groups; and local, state and federal agencies. This group is now working to develop cooperative programs to reconcile water supply needs—from whatever the source—and the conservation of salmon and steelhead.

In eastern **Washington**, ground water pumping for irrigation is dropping water levels in the Odessa Aquifer up to ten feet per year. This directly decreases surface flows and impacts streams that support threatened fall Chinook salmon and steelhead.



Arizona's forty year history of over-pumping ground water has taken its toll on most of its rivers. Wildlife that also rely on Arizona's rivers struggle, as ground water withdrawals have caused areas of native plant cover to shrink. On the San Pedro River, where ground water pumping reduces the river's flow by two thirds, only two of thirteen native fishes remain. In fact, **the river went dry for the first time on record on July 5, 2005, and remained dry for 8 days.**

Too many of **Idaho's** streams that rely on mid- to late-year ground water inflow to create spawning habitat are dewatered at critical times when ground water is pumped for other uses. In the Big and Little Lost River basins, for example, more than half of all irrigation water is pumped from ground water wells, which dries up sections of river that provide important habitat for ESA-listed bull trout and ESA- petitioned Big Lost River mountain whitefish.

In **Montana**, current ground water management results in many streams running lower and warmer than ever before. In one example, **ground water pumping during the height of irrigation has caused the South Fork of the Smith River to dry up completely during drought years.** Ground water development threatens the State's effort to maintain and recover its stocks of wild and native trout.

In **Wyoming's** Powder River Basin, where coal bed methane natural gas development has become prominent during the last decade, the prairie aquatic ecosystems are at risk because of the deep-aquifer dewatering that occurs to release the methane and the discharges of those waters both to the surrounding landscape and surface streams.

The San Luis Valley in south-central **Colorado** contains numerous large wetland complexes, supporting large concentrations of resident and migratory water birds. **As ground water use has risen in the valley since the 1960s, however, many acres of wetlands have disappeared**, limiting the available habitat for birds and other wildlife that depend on these wetland areas.

In **Utah's** rapidly developing recreational areas like Park City and Kamas, the practice of purchasing seasonal irrigation water rights and converting them to year-round well water for second homes threatens headwater streams that provide important habitat for wild and native trout as well as other species.

Over-pumping in the Ogallala Aquifer has resulted in the dry up of the playa lakes along **New Mexico's** eastern border. The playas provide critical flyway habitat for north-south migratory birds.

Regulation of Ground Water Around the West

Most state efforts to regulate and manage ground water began in the middle of the 20th century, as pumping increased and the adverse effects of ground water extraction, including land subsidence and less surface water, became clear. Despite these efforts, however, no western state has adopted a system that would completely protect surface lands and rivers against the adverse effects of over-pumping. Recently, almost every state has seen litigation to force meaningful changes to existing legal systems. The proponents of change in these cases typically look to protect existing surface water rights holders and keep springs and rivers flowing.

States are responsible for regulating how water, including ground water, is allocated among those who want to use it. This means that every state has a unique approach, although broadly they fall into two camps: those states that conceive of ground and surface water together as a single resource and practice joint management, and those states that regulate the two separately. Layered upon this broad understanding of the two camps are additional legal systems and mechanisms, including the prior appropriation system, exemptions, bans, and interstate law.

JOINT MANAGEMENT WITHIN THE PRIOR APPROPRIATION SYSTEM

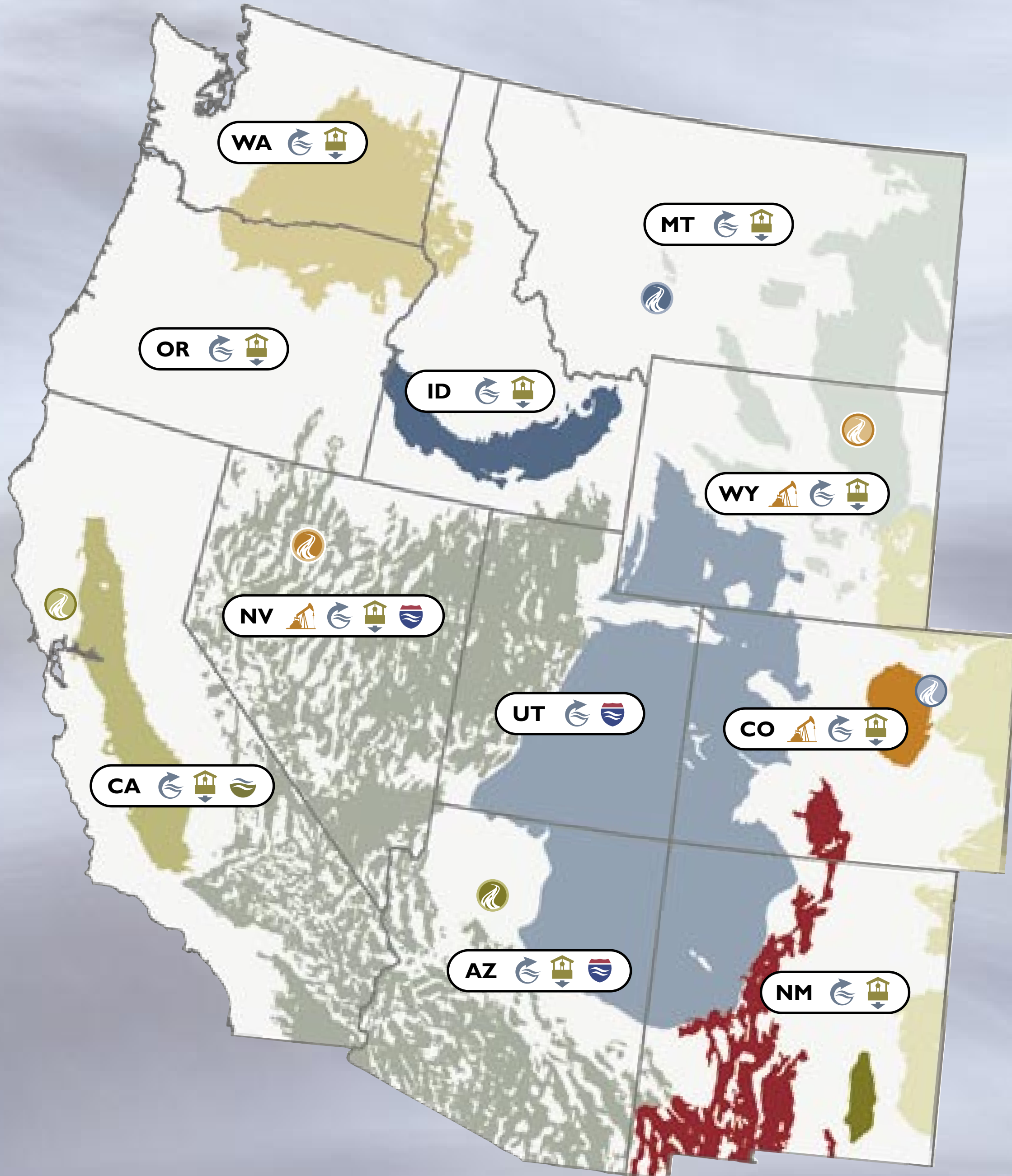
Since settlement began in the mid 19th century, most western states follow the system of prior appropriation to allocate surface water. Under the *prior appropriation system*, the first person to divert water and place that water to beneficial use has the best, or most senior, right. Later diverters have more junior rights. In times of shortage, diverters do not share the shortage; rather, the most senior diverter is entitled to his/her entire right before junior users get any water. Because most states didn't begin to consider protecting the water remaining in rivers until the 1970s and stream flow protection remains something of an afterthought in many states, the prior appropriation system can allow diverters to own water rights for more water than is in the stream. The result: streams can run dry for periods of time in some reaches.

Colorado has a relatively pure form of the prior appropriation system, but it did not regulate ground water until 1957, when it faced increased pumping east of the Continental Divide. First, the State required permits for new wells and registration of existing wells. Then in 1969, Colorado folded ground and surface water diversions into a single system for the purposes of seniority and administration. Those who propose new wells must demonstrate that their pumping will not injure either other pumpers or surface water users. If there is demonstrated injury, new pumping may not occur unless the water user provides *augmentation*, or replacement water, to maintain existing water rights.

There are two exceptions. Ground water in the deep Ogallala aquifer on Colorado's eastern plains is organized into basins where pumpers can get permits for new withdrawals even if they lower the water table to the detriment of others. Such new withdrawals can be permitted only if there is unappropriated water available and the new use neither creates unreasonable waste nor unreasonably impairs others' rights. Second, water in the deep Denver Basin aquifer belongs to the overlying landowner who can pump the underlying water out at a rate of one percent per year, effectively allowing communities to mine this resource to extinction.

On paper, these systems look protective at least for all senior water rights holders. However, in practice, Colorado surface water users in at least three river basins argue that increased ground water pumping has injured them. In each case, the state legislature has had to step in within the last five years to restructure ground water management. To halt injury to senior water users, state actions will result directly or indirectly in the retirement of tens of thousands of acres of land previously served by ground water pumping.

While **New Mexico** has separate legal codes for surface and ground water, it manages the resources together. If ground water pumping adversely affects surface flows for senior water users, the State can limit well withdrawals or require an applicant to purchase and retire a surface water right to "keep the river whole." However, because so many of the State's water rights have yet to be quantified, the system is really quite fragile. The lack of certainty has driven growing cities to allow whole new areas to rely on domestic wells that, until last year, remain largely unregulated. One of the twists in New Mexico is that many of the unquantified rights belong to pueblos and tribes who have special status. For example, while the United States has negotiated a settlement to satisfy the Navaho Tribe's water



MAJOR WESTERN AQUIFERS

- Basin and Range
- Central Valley
- Colorado Plateau
- Columbia Plateau
- Denver Basin
- High Plains
- Lower Tertiary
- Rio Grande
- Roswell Basin
- Eastern Snake Plain

MAJOR GROUND WATER ISSUES

- Closing Exempt Wells
- Stream Flow Protection
- Regulation of Produced Water
- Need for Integrated Management
- Interstate Regulation

Powder River Basin, Wyoming. . . . . *see page 4*
North Coast, California. . . . . *see page 6*
South Platte River Basin, Colorado. . . . . *see page 10*
Verde River, Arizona . . . . *see page 12*
Gallatin Valley, Montana . . . . *see page 14*
Humboldt River Basin, Nevada . . . . *see page 17*

Aquifer map data derived from federal GIS dataset.
Map authored by Andrew Todd, TU.
Illustration: Jeremy Carlson

rights, Congress has been reluctant to provide the funds necessary to implement the agreement.

Nevada began regulating ground water development in 1939 with passage of the Nevada Underground Water Act. Today, the State regulates ground water much like any other water resource, subject to the requirements of prior appropriation and non-interference with other preexisting surface or ground water rights. The prior appropriation doctrine is not sacrosanct as applied to ground water, however, as the State Engineer may designate "preferred uses" for ground water appropriations. While Nevada generally adheres to the principle of *safe yield*, where ground water withdrawals cannot exceed the annual recharge rate, the State Engineer may issue a "temporary revocable permit," which allows withdrawals that exceed the safe yield subject to revocation if water does not become available later from an outside source, such as the Colorado River.

Utah folded ground water regulation into its existing surface water system of prior appropriation in 1935. Improved technologies subsequently brought extensive ground water development, but while development proceeded, the science of understanding ground water and its relationship to surface water lagged behind. As a result, well users over-drafted ground water basins in a number of areas around Utah. This led to a range of problems, including land subsidence in some rural areas, reduced base flows for streams, and the expansion of pollution plumes in ground water basins along the Wasatch Front. In an effort to bring those basins back to a safe yield, the State Engineer began working with local water users to develop ground water management plans. Legislation passed in 2006 formally commits the State to the principle of safe yield, confirms the authority of the State Engineer to limit ground water withdrawals and to create ground water management plans, and clarifies the process the State Engineer can use to return over-appropriated basins to a condition of safe yield.

In 1945, **Washington** adopted the Ground Water Code and began regulating the use of ground water together with surface water in the same system. The Ground Water Code applied the same permitting process and order of priority to ground water that already applied to surface water. Thus before issuing ground water permits, the State must determine if water is really available, if the water will be put to a beneficial use, whether the beneficial use will impair existing senior water rights, and if the water use will harm the public interest. However, as in most western states, it took litigation before the Washington Supreme Court would make the legal connection between ground water pumping and surface flows. Since 1997, not only is there a presumption of hydrologic connection, but new ground water pumping cannot adversely affect surface rights, including minimum stream flows.

Wyoming first adopted a comprehensive ground water statute in 1947. Major amendments were passed in 1958 and again in 1969. Since that time, potential ground water users have been required to use the same general procedures as those used to acquire surface water rights, adhering to the State Engineer's Office

SOUTH PLATTE RIVER BASIN, COLORADO

In April 2006 the Colorado State Engineer, Hal Simpson, making what he called "the toughest decision" of his career, shut down 440 ground water wells irrigating 200 farms across 30,000 acres along the South Platte River. The ground water irrigation well owners had failed to produce adequate *augmentation plans*, plans that protect senior surface water rights holders from pumping by junior wells. In this case the senior surface right holders were the Cities of Boulder, Highlands Ranch and Sterling, as well as several of Colorado's oldest irrigation ditches. The seniors contended that the wells reduced both surface water flows and the riparian ground water on which they rely. The well owners' failure violated a Colorado Supreme Court opinion demanding protection for the senior water users whose fields had burned up during the devastating 2002 drought, even as the well owners kept irrigating. So, when the spring of 2006 again turned extremely dry, given that the well owners still did not have augmentation plans in place, the State Engineer was forced to act. The well-dependent farms and families had expected to be allowed to pump 15 percent of their water during the 2006 season, and planted accordingly. With precipitation nearly 3 inches below average, their wells shut off and the seniors unwilling to relent, farmers were forced to watch their crops wither and face hundreds of thousands of dollars in losses. Tragically, for some, this will mean bankruptcy. While Colorado's system, on paper, should have prevented this catastrophic event, it did not. Many see this catastrophe as an example of the increasing tension between ground and surface water users throughout Colorado.

Drilling on the eastern plains.
Photo: Colorado Division of Water Resources.

application and information requirements. The State Engineer considers a number of factors when contemplating a specific application, including if ground water use in a particular area is approaching the rate of recharge, whether ground water levels are declining or have declined excessively, if water is being wasted, and any conditions that require regulation to protect the public interest.

These circles are due to a revolutionary development in farming called center-pivot irrigation. Center-pivot irrigation has made it possible to farm land that otherwise could not be farmed, but has also dramatically increased the pressure on aquifers.

Right: Doug Wilson, U.S. Department of Agriculture. Far Right: Gene Alexander, USDA Natural Resources Conservation Service.

JOINT MANAGEMENT OUTSIDE THE PRIOR APPROPRIATION SYSTEM

Several states attempt to manage their ground and surface water resources together, but not formally within the prior appropriation system. This approach, taken by Oregon, Montana, and Idaho, faces legal challenges from those who operate within and benefit from the existing prior appropriation system. Challengers generally argue that joint management outside the prior appropriation system does not protect senior surface water rights holders, including state-held instream flows.

Only in 1963 did **Idaho** begin requiring a permit to pump ground water. In 1986, the legislature gave the Idaho Department of Water Resources (IDWR) the authority to shut down unauthorized wells, and the Idaho Legislature approved a full moratorium on new water developments in the Eastern Snake Plain Aquifer in 1994. At that time, IDWR developed what it called "conjunctive management" rules to support joint administration of surface and ground water rights, but not strictly according to the prior appropriation system. These rules allowed junior ground water pumpers to buy or lease surface water rights as mitigation. In the spring of 2006, an Idaho court threw these rules out as unconstitutional, because they did not adequately protect senior surface rights under the prior appropriation system. IDWR appealed to the Idaho Supreme Court and won the appeal in March 2007.

Under **Montana** law, ground water and surface water must be managed as a single resource. While Montana law does not specify how to do this, Montana water planning documents are rife with expressions of the need to assure that development of ground water will not adversely affect surface water. Yet historically, unless a neighboring water user raised the potential effects of ground water development on surface waters by formal objection, the Montana Department of Resources and Conservation (DNRC) has been reluctant to impose requirements that new ground water development mitigate its impacts on stream and river flows. This is true despite that fact that ground water withdrawals can reduce stream flows, harm the environment, and leave less water available for surface water diverters. In 2006, the Montana Supreme Court ruled that, at least in over-appropriated river basins closed to additional surface water development, the State may not allow new ground water pumping that adversely affects senior surface water rights holders and instream flow water rights.

Where ground water overdrafting occurs, **Oregon** has the authority to designate management areas either to limit permits for new withdrawals or to restrict existing withdrawals in "critical" areas. In 2005, environmentalists challenged the State's regulations implementing this authority for the Deschutes River. A state court threw the regulations out as inconsistent with Oregon's instream flow protection statutes, but the next year, the state legislature reinstated the regulations. To address the adverse effects of ground water depletions on several highly depleted rivers, the State has also approved provisions for both permanent mitigation and mitigation water banks. A mitigation bank accepts "deposits" of water rights that a water user voluntarily gives up the right to use for a period of time, in exchange for payment. The deposited water is then available for "withdrawal" to mitigate injury from new, increased pumping either by providing augmentation water to surface rights owners or by maintaining instream flows.

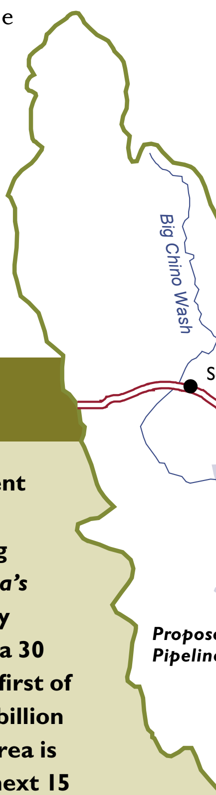
REGULATING GROUND WATER SEPARATELY FROM SURFACE WATER

From the Rocky Mountains to the West Coast, only California and Arizona separate their regulation of ground water from their surface water allocation systems.

Beyond the common law of "reasonable use," **Arizona** did not regulate ground water at all until overdraft conditions during the 1970s forced the State to pass the Ground Water Management Act of 1980. This Act set three goals: control the overdraft, allocate ground water resources to meet state needs, and augment Arizona's ground water through development of surface water supplies. Under the Act, the State established five Active Management Areas (AMAs), primarily in its most urban areas. In AMAs, new development must prove it has an assured sustainable water supply, and cities must develop renewable (i.e. surface) water supplies that guarantee safe yield by 2025. Unfortunately, in the three central state AMAs, a specially created district established to buy surface water supplies is vastly over-extended. It will only meet the 2025 standard if it buys surface water supplies from beyond the AMA boundaries. In addition, the 1980 Act did not fold ground water regulation into Arizona's preexisting system for allocating surface water. Thus, overdrafting in some other parts of the state has worsened because outside the AMAs (80 percent of the state area, with 20 percent of its population), new developers do not need to demonstrate a long-term, sustainable water supply. Instead, they simply drill new wells or pipe ground water from other watersheds, essentially unconstrained.

California's system is unusual for two reasons. First, its system combines aspects of the prior appropriation system with aspects of the riparian water right system used in the East, which allows landowners adjacent to rivers to divert water to satisfy their reasonable needs. Second, the State has applied the public trust doctrine to stream flows, thereby ensuring (legally, if not always practically) that rivers cannot be diverted until they are dry, but rather must maintain instream flows to protect fisheries, navigation, and other public trust values. Yet California regulates almost all ground water separately from surface water, and excluding specific cases (19 adjudicated ground water basins and ground water in "subterranean streams flowing through known and definite channels" that is regulated as if it were surface water), a property owner may simply withdraw ground water underneath the land for use without a state permit. In times of shortage, the State expects property owners to share.

Without a statewide system, local agencies have stepped into the breach. State legislation has authorized 13 special districts to manage ground water. In addition, in areas of critical ground water overdrafting, the State gave local water agencies the power to develop ground



VERDE RIVER, ARIZONA

South of the Grand Canyon runs the 150-mile Verde River. Eighty percent of its base flows come from ground water in the Big Chino aquifer. Like many of Arizona's rivers, it is running out of water and in danger of being drained away by wells. American Rivers named the Verde one of *America's Most Endangered Rivers of 2006*. Thousands of unmonitored wells already withdraw ground water, and the booming city of Prescott plans to build a 30 mile pipeline to move ground water to supply new growth. In 2009, the first of eight wells will begin pumping; at full capacity the project will move 2.8 billion gallons a year out of the Big Chino. Population growth in the Prescott area is expected to raise demand for water by as much as 50 percent over the next 15 years. Prescott Valley estimates its population will more than double by 2020 and that, by 2050, its water needs will have increased fivefold. Hydrologists and conservation groups believe that if Prescott continues its pipeline project, 24 miles of the Verde's headwaters will be dry by 2100.

Population growth in the Prescott area is expected to raise demand for water by as much as 50 percent over the next 15 years. Prescott Valley estimates that by 2050, its water needs will have increased fivefold.

Headwaters of the Verde.
Photo: Arizona Department of Water Resources.

water management plans that can include extraction limits and replenishment requirements. Seven have done so. In other areas, water agencies may adopt ground water management plans; these plans can include fees to support ground water replenishment. As of 2005, about 200 local agencies have adopted plans, although none with fees. Finally, a number of counties have adopted ground water ordinances, mainly to limit exports.

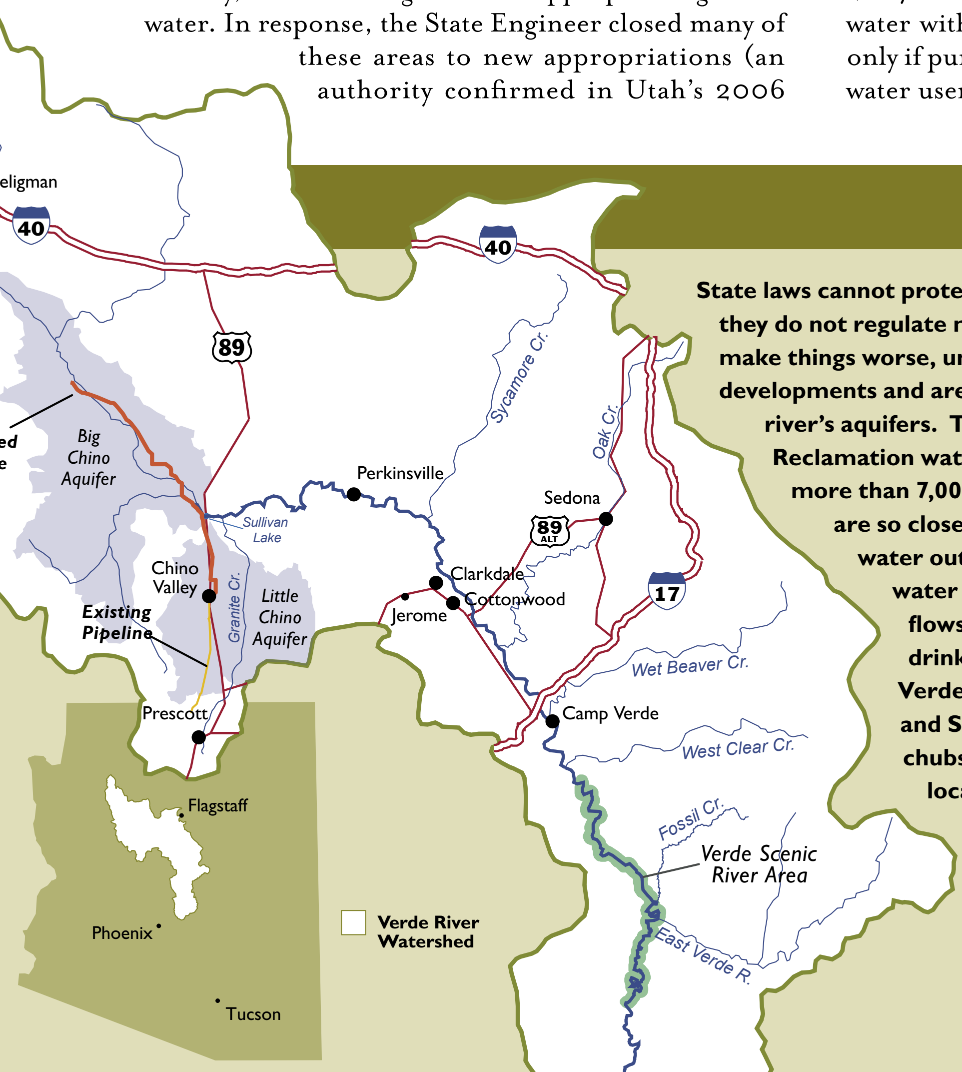
DIRECT BANS ON WITHDRAWALS THROUGH BASIN CLOSURES

Regardless of the overarching regulatory systems, some states have adopted additional protections. For example, at least three states have recognized that the adverse effects of historical ground water pumping have become so severe that the only solution is to ban any additional ground water withdrawals in certain areas. In some cases, the states have laws to allow closures of ground water basins; in other situations, the ground water ban is included in the closure of a surface watershed.

In its 1980 Ground Water Management Act, **Arizona** carved out three rural, agricultural areas that were heavily reliant on ground water into Irrigation Non-Expansion Areas (INAs). These INAs are treated differently from the primarily urban areas that were put in Active Management Areas. In INAs, no new land may be irrigated with ground water.

As described above, in the second half of the 20th century, some **Utah** regions over-appropriated ground water. In response, the State Engineer closed many of these areas to new appropriations (an authority confirmed in Utah's 2006 ground water legislation). In other parts of Utah, however, the State Engineer allows new ground water uses as long as the users provide augmentation sufficient to avoid injury to other water rights holders.

In **Montana**, several large river basins have been declared over-appropriated and closed to additional surface water diversions. Even in these basins, an applicant for a new ground water permit could obtain a permit if the ground water to be withdrawn was not "immediately or directly connected to surface water," a criterion the State read as narrowly as possible, effectively allowing most new ground water withdrawals. Thus, when the Montana Supreme Court ruled in 2006 that the state agency's interpretation was too narrow, and that in most instances ground water is connected to surface waters, the agency did not know how to treat new ground water applications. All parties expect the legislature to provide direction during its 2007 session. New laws may allow additional ground water withdrawals in closed basins in the future, but only if pumpers augment the supplies of senior surface water users.



State laws cannot protect the Verde from the withdrawals since they do not regulate most diversions of ground water. To make things worse, unregulated subdivisions outnumber zoned developments and are withdrawing unknown amounts from the river's aquifers. The Salt River Project, the oldest Bureau of Reclamation water project in Arizona, estimates there are more than 7,000 wells in the Verde Valley alone. Some wells are so close to the river that they must either be drawing water out of the River itself or intercepting the ground water that moves toward it and supplies its base flows. The Verde provides crucial irrigation and drinking water to communities and farms in the Verde Valley and Phoenix. As Arizona's only Wild and Scenic River, it supports bald eagles, roundtail chubs, javelinas, and Arizona toads. Lawmakers, local leaders, and the community must act to deal with rapid urban growth and lack of comprehensive water use planning to protect the Verde River and its resources for the generations to come.

Original Map: Center for Biological Diversity.

Exempt Wells

All western states except Utah exempt household wells from regulation. Each household well is small, but the increase in the sheer number of household wells in the region has resulted in measurable depletions to the ground water resource. As a result, depending on how much rural and suburban growth occurs, the combined well withdrawals can lower surface water flows. For example, in **Idaho**, where there is little available water to buy in the marketplace, fast-growing cities without firm water supplies are tempted to over-utilize that State's domestic well exemption as a way to allow current growth, even though this strategy will not be sustainable in the long-term.

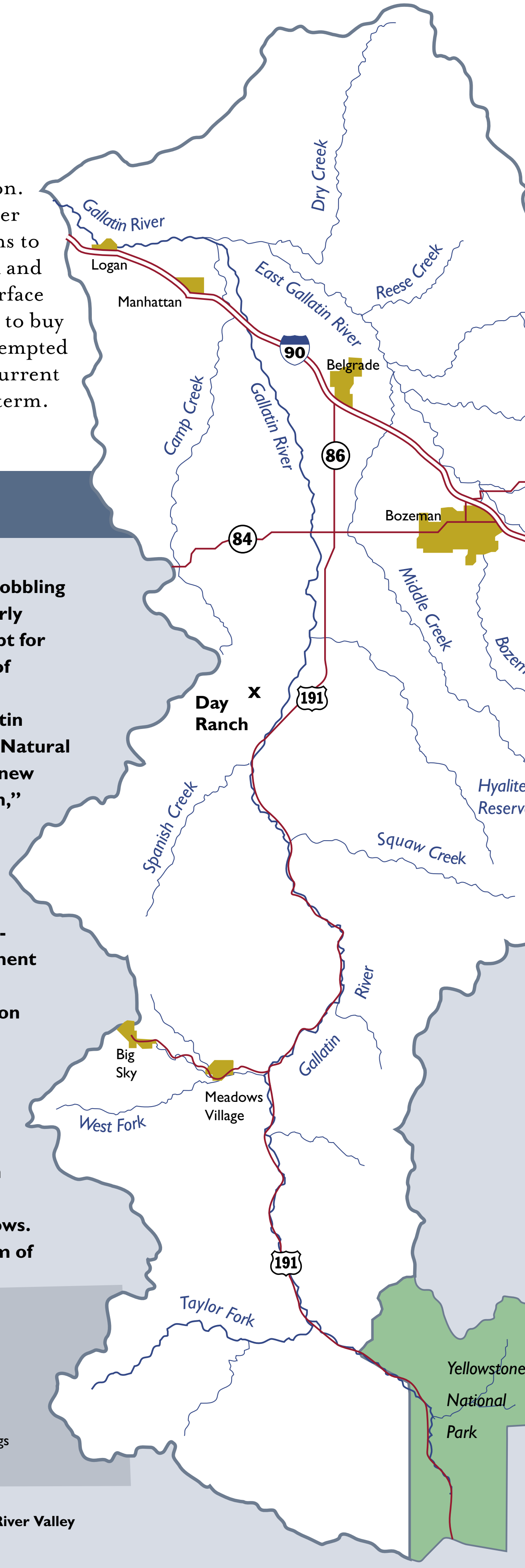
GALLATIN VALLEY, MONTANA

In the Gallatin Valley, just north of Yellowstone National Park, subdivisions are gobbling up ranch lands at an alarming rate. From 1964 to 2002, Gallatin County lost nearly a third of its agricultural land to residential and commercial development. Except for the town of Bozeman, Gallatin residents rely on ground water, and the number of ground water appropriations has tripled in the last 20 years.

Concern over ground water development and its impact on flows in the Gallatin River and tributaries came to a head in 2003, when the Montana Department of Natural Resources and Conservation (DNRC) considered a developer's application for a new ground water pumping permit. The permit was to provide water for "Day Ranch," a proposed golf course and resort. Concern about the impact to surface flows in this valley, where the river provides water for both irrigation and a recreational fishery, led Trout Unlimited and ranchers to object. After a two day hearing, DNRC denied the application based on evidence that the pumping would result in less water in the river. The Day Ranch case was the "canary-in-the-coal-mine" for Gallatin County, placing the issue of how rapid ground water development along the river corridor was depleting the river firmly in the public eye.

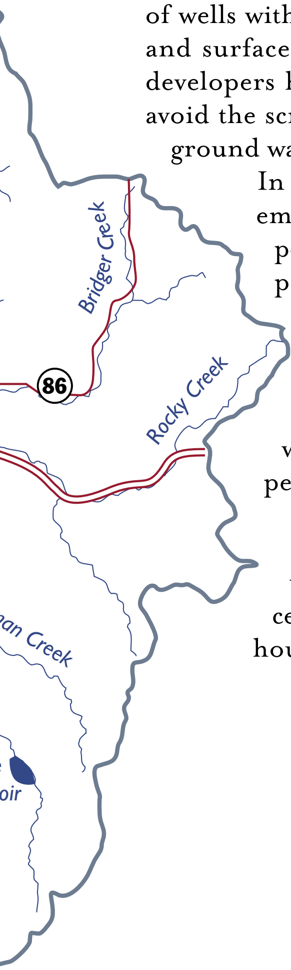
Gallatin valley ranchers formed an association to defend their surface irrigation rights; the Gallatin County Commission convened an independent task force to address the issue; and a local watershed group formed. Between the Day Ranch precedent and increased awareness and involvement in the community, Gallatin Valley developers must now demonstrate responsible water development, including mitigation for the adverse impacts of new ground water pumping on river flows. Meanwhile, Trout Unlimited also teamed with ranchers in the Smith River basin to win a ruling from Montana's Supreme Court barring new ground water pumping that adversely affected existing surface water users or stream flows.

The Day Ranch and Smith River cases have set the stage for state-wide reform of Montana's ground water laws. In 2007, the state legislature will consider whether to require mitigation of new ground water pumping impacts on stream and river flows. The legislature will also consider new subdivision permitting and ways to encourage new tools, such as water banking and aquifer storage and recovery, to address increased ground water pumping.



Original Map: USDA Natural Resources Conservation Service

The household well exemption in **Montana** provides a typical example. Although the statute requires that multiple, small wells are subject to DNRC review when the wells exceed the 35 gallons per minute (gpm) and ten acre feet per-year limitation, DNRC has narrowly defined this language to apply only if the wells have been piped together. This interpretation has allowed the unreviewed development of literally tens of thousands of wells without any review of their effect on ground and surface water sources. Large-scale subdivision developers have relied heavily on this exemption to avoid the scrutiny of their developments' impacts on ground water and surface water.



In **Washington**, the Ground Water Code exempts wells that draw 5,000 gallons or less per day for domestic use from the permitting process. The Washington Supreme Court has limited the scope of this exempt well provision by determining that a developer building a subdivision cannot rely on multiple, domestic well exemptions when they pump more than 5,000 gallons per day collectively.

In **Arizona**, where urban Active Management Areas need to reach sustainable water use by 2025, the Prescott AMA recently acknowledged that it has 9400 exempt household wells. When totaled, these wells constitute the third largest water use in the AMA. The only way that the AMA is going to be able to reach its safe yield mandate will be by importing surface water from elsewhere.

Montana's existing statute has allowed the unreviewed development of literally tens of thousands of wells without any review of their effect on ground and surface water sources.

New Mexico exempts small, domestic wells from regulation within the prior appropriation system, but does require permits for these wells. There are as many as 6000 to 8000 new such permits a year and their combined withdrawals affect river flows. In 2006, the State Engineer adopted rules that tighten annual withdrawal limits for new domestic wells, from three to one acre foot generally, and to 0.25 acre feet in designated management areas where the high concentration of such wells are severely affecting nearby surface flows. **Nevada** and **Colorado** also both exempt domestic use wells from the need to obtain a permit or water right.

Interstate Regulation of Ground Water Withdrawals

Most western states try to restrict the export of their water to a neighboring state, even though the US Supreme Court found an extreme version of this export ban unconstitutional. And while existing statutes and case law focus on surface water, there is no reason that the same principles would not also govern ground water withdrawals. A recent proposal illustrates the issues.

The Nevada State Engineer is considering whether to permit the Southern Nevada Water Authority's ambitious pipeline project that would bring water pumped from a deep carbonate aquifer along the Utah-Nevada border to Las Vegas. Although these basins have not been studied in depth, available information suggests that all the aquifers in this region are interconnected, raising the risk that mining deep ground water on the Nevada side will affect surface and ground water resources in both Nevada and Utah. The resources at issue include wildlife refuges like Fish Springs and the ground water basins west of the Great Salt Lake, which risk becoming saline if the existing water is withdrawn. More immediate impacts could include dewatering important low-elevation ponds and springs like Spring Creek, Nelm's Pond, and Fifteen Mile Pond on the Goshute Indian Reservation south of Ibapah, Nevada. These resources have proved critical in a 30-year effort to restore native Bonneville cutthroat trout to streams that flow off the Deep Creek Mountains along the Utah-Nevada border. The project also potentially threatens springs and native trout streams farther south in the Mount Moriah Wilderness Area and Great Basin National Park. Congress passed legislation in 2004 directing the two states to "reach an agreement" regarding the division of the shared ground water resource.

Right: The Coeur Rochester Mine, Humboldt River Basin, NV. Photo: Alan R. Wallace, U.S. Geological Survey.

Below: Hot sulphur water near Thermopolis, Wyoming, used for irrigation. 1921. Photo: U.S. Geological Survey.

Unregulated Ground Water Pumping Associated with Resource Extraction

Some ground water pumping falls outside a state's water allocation system. This is pumping associated with resource extraction, historically both oil and gas operations in the Rockies and hard rock mining in Nevada. Today this practice also occurs with booming coal bed methane (CBM) production. In Wyoming, a single CBM well can produce 17,280 gallons per day and 6,307,200 gallons per year. In the future, this pattern may extend to cover ground water extracted for oil shale development in Colorado and Utah. These operations require the removal of large quantities of ground water to extract oil, gas, gold, or other resources. In most situations, operations produce so much water that most, if not all, of it cannot be put to beneficial use on the surface, either for lack of any immediate need for the water or because the water is of poor quality. In some cases, local residents can use small quantities for things like watering stock. In the vast majority of cases, however, the resource operation considers the water a byproduct and discharges it to a local waterway or re-injects it into the ground.

While a state regulatory agency may have authority over well construction, spacing, and reclamation, these agencies typically do not consider water rights issues.

While a state regulatory agency (such as the Oil and Gas Commissions in Wyoming and Colorado) may have authority over well construction, spacing, and reclamation, these agencies typically do not consider water rights issues, such as whether pumping the ground water will adversely affect senior water rights holders or stream flows. Similarly, the state water quality agencies appear to have the authority to regulate the water quality of any byproduct water discharge to surface streams under the Clean Water Act. Unfortunately, these regulations do not address the harms caused by the discharge of byproduct water over a landowner's fields or into the delicate environment of *ephemeral* (which run in response to precipitation) or *intermittent* (which run seasonally) streams.

Wyoming designed its original ground water statute to handle traditional consumptive uses of water, but in 1973 the legislature granted the State Engineer's Office (SEO) authority to administer ground water permits associated with byproduct water. Specifically, the SEO has authority to issue beneficial use permits at the point which water is actually withdrawn from the ground. It can also issue permits for on-channel and off-channel storage of CBM produced water if the waters will be stored for uses such as stock water or irrigation. However, as noted above, the State Engineer exercises no authority over unused byproduct water, discharged or otherwise. The situation is similar in Colorado, although most Colorado operations re-inject it or store it in non-discharging containment ponds. In Wyoming, most operations discharge byproduct water on the surface.

In Nevada, the State determined in the 1980s that it would treat all mining operations as a "temporary" use of water not subject to general rules or regulations that prohibit permanent impairment of a water resource. This ruling freed mining companies to pump and then discharge massive quantities of ground water into surface streams. As explained in the sidebar on the Humboldt River, while this water has provided a temporary benefit to surface streams, once the mines cease operations, there will be devastating consequences both for river flows and from the likely creation of highly contaminated lakes in the mine pits.

HUMBOLDT RIVER BASIN, NEVADA

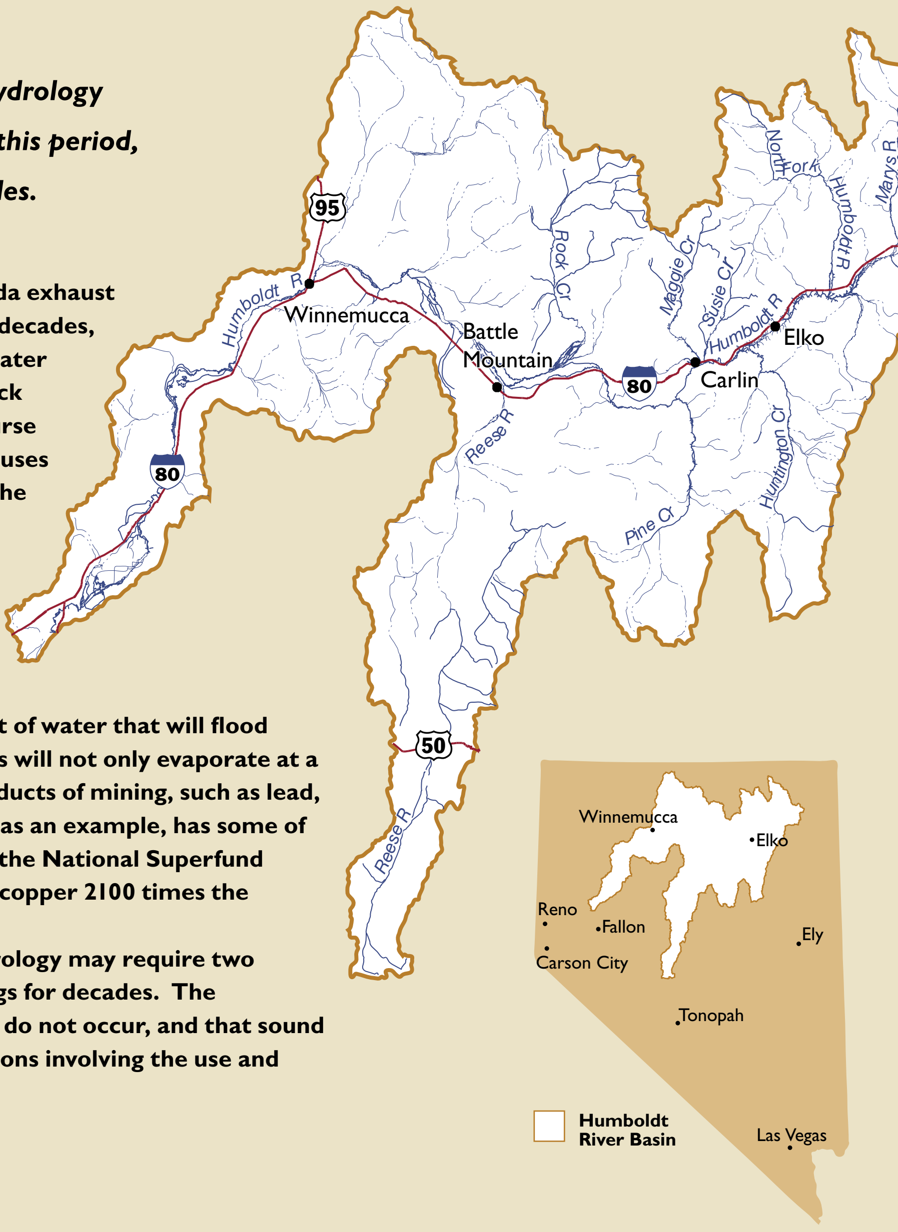
Nevada holds the distinction of being the driest and one of the fastest growing states in the nation. On the Vegas strip, in a desert that averages barely four inches of rain a year, tourists ride Venetian gondolas down "the Grand Canal," and pirate ships sail an artificial sea. Meanwhile, large gold mines in northern Nevada pump millions of gallons of ground water a day out of their open pits as waste. Much of the water ends up in waste ponds where it evaporates in the sun, although the miners also pipe some to nearby rivers, where it augments stream flows. Throughout the Humboldt River Basin, by the time the mines close, the mining industry will have created a 5,000,000 acre feet deficit in the aquifer.

Scientists estimate that the Humboldt River hydrology may require two centuries to recover. During this period, some streams and springs will be dry for decades.

As many of these large gold mines in northern Nevada exhaust their claims and cease operations over the next two decades, the abandoned mines will act like sponges, sucking water back into their open pits. As ground water floods back into these voids, effectively reversing the natural course of ground water flow, it is siphoned away from other uses such as base flows to local desert rivers. Rivers like the Humboldt will suffer a two-fisted blow. Not only will they lose their ground water base flows, but also the artificially high flows that the mines have pumped into the river. This one-two punch will likely wreak havoc on downstream users, including the river's fish and wildlife.

Meanwhile, the approximately 1,500,000 acre feet of water that will flood the open mine pits once ground water pumping stops will not only evaporate at a high rate, but likely will be contaminated with byproducts of mining, such as lead, mercury or arsenic. The Battle Mountain Complex, as an example, has some of the most polluted ground water in Nevada and is on the National Superfund List. Seepage from its tailings has concentrations of copper 2100 times the Nevada state drinking water standard.

Scientists estimate that the Humboldt River hydrology may require two centuries to recover, drying some streams and springs for decades. The challenge for Nevada is to ensure that these impacts do not occur, and that sound science rather than political expedience drives decisions involving the use and management of ground water.



Original Map: U.S. Geological Survey

Solutions

Ground water pumping poses a serious threat to existing senior surface water right holders and important western fish and wildlife, but it will continue to occur and even expand in the future. Prompted by successful lawsuits from irrigators holding senior rights and conservationists concerned about river flows, western states have experimented with a variety of strategies to minimize the adverse effects of ground water pumping and maintain a sustainable level of withdrawals. Discussed below are a number of strategies that may work to allow ground water pumping without harming the environment or local economies. All will require careful monitoring, and some involve increased regulation.

Denver Xeriscape.
Photo: David Winger, Denver Water.

CONSERVATION FIRST. As with surface water resources, wise water use through efficiency, conservation, and reuse represents the single best strategy for achieving a sustainable ground water supply. Until westerners incorporate these common sense strategies into our way of life, we will continue to see the problems associated with unsustainable ground and surface water use.

SUSTAINABLE CONJUNCTIVE MANAGEMENT means managing ground and surface water resources together in a way that not only shares shortages, but protects river base flows. For example, citizens in Pocatello, Idaho just voted to issue bonds to buy surface water rights from the Portneuf River. The City will use these rights to enhance stream flows through town and to provide dilution for its wastewater treatment plant. In the future, Pocatello also plans to treat and inject water back into the Portneuf Valley Aquifer as a potential additional drinking water supply. In another example, in California, Trout Unlimited has partnered with the Yuba County Water Agency and 15 other parties in the "Yuba River Accord." This accord will put in place minimum stream flows, establish a comprehensive conjunctive use program to integrate surface and ground water supplies with irrigation districts and mutual water companies, result in a major long-term water acquisition for the State's environmental water account, and improve flood control.

Sweetwater Recharge Facility, City of Tucson.
Photo: Bruce Prior, Tucson Water.

AQUIFER RECHARGE. In some cases, it is possible to replenish ground water supplies. Obviously, for this to be an environmentally acceptable solution, the water used to do so cannot cause significant adverse effect to a surface water stream. Typically, this means either buying water from existing users or injecting water back into the ground only during extremely wet years when a system has large quantities of unused and unappropriated water. A number of western states are experimenting with programs to recharge aquifers or otherwise store water underground.

Arizona created a state agency whose mission is to store available surface water in underground cisterns. Idaho has determined that recharging ground water constitutes a beneficial use of surface water, and water interests will present an Eastern Snake Plain Aquifer Comprehensive Management Plan to the legislature in 2007. In Washington, where the Walla Walla River valley faces rapid growth, declining well levels, dry river beds, and uncertainty after steelhead and bull trout were added to the Endangered Species list, water users have implemented two aquifer recharge projects. In one project, they divert high spring surface flows into the region's wetlands and shallow aquifer for use during the dry season. Developed, funded, and implemented under the authority of Washington's Watershed Planning Act, this project has brought back springs that had dried up. In the second, the Walla Walla Basin Watershed Council implemented an aquifer recharge project that contributed almost 2,000 acre feet of water to the region's shallow aquifer in 2004-05.

UNDERGROUND WATER BANKS. As explained above, a water mitigation bank accepts "deposits" of water that can be withdrawn for later uses or used to mitigate adverse impacts of current uses. Oregon has begun to use water banks on two highly over-appropriated rivers, including the Deschutes, where ground water pumping is one of the major reasons for over-appropriation. There, the local water interests created a non-profit corporation to develop a water bank as well as to support permanent reallocations of water rights for the benefit of senior surface water irrigators, cities, and stream flows. In Arizona, in what is essentially a form of aquifer storage and recovery, the State injects the unused portions of its share of Colorado River water into ground water aquifers for withdrawal in later years when it is needed. In Idaho, researchers are developing a ground water banking model that will account for the impacts of ground water pumping to surface flows, as well as the impacts of irrigation run-off on ground water recharge. The bank will use the model in an effort to prevent ground water pumping from exceeding recharge, and it will retain a cumulative record for individual pumpers who both withdraw from and recharge the aquifer.

EFFECTIVE ADMINISTRATION. States must take several important actions if they want to integrate ground and surface water regulation with their existing systems of prior appropriation. First, states need good data regarding ground water distribution and models that accurately predict how ground water pumping affects surface water flows. Most western states do not have such models everywhere that ground water pumping occurs. States range from Oregon, Washington, and Montana, where the State has modeled some, but not all, basins, to California, which has virtually no data on surface and ground water interaction for much of the state. In Idaho, the Idaho Water Resources Research Institute has just designed a new, comprehensive model for the Eastern Snake Plain Aquifer, which the basin's water users hope will provide timely and accurate information.

Monitoring ground water.
Photo: Northern Illinois University.

Second, states must have enforceable rules or plans that integrate ground and surface water withdrawals to ensure that neither senior water users nor base flows suffer injury as a result of ground water pumping. These rules or plans must not simply defer problems with over-allocation into the future. While several states have adopted rules (Colorado, Idaho) or plans (Utah, New Mexico) that apply at least in some regions, in all cases these rules and plans are relatively new, so the question remains whether they will hold up over time.

MEANINGFUL AUGMENTATION. Where ground water pumping adversely affects surface water, states must protect senior water users, including state-established instream flow water rights or set-asides. Colorado's experience with augmentation requirements over the last 35 years has shown that real augmentation requires adequate data, on-going monitoring, and the ability to adjust plans over time as facts on the ground reveal themselves.

SENSIBLE REGULATION OF EXEMPT WELLS. To staunch the overdrafting currently caused by thousands of exempt household wells, states need to reconsider their exemptions and restrict this loophole. For example, developers building multiple residences should not be able to avoid regulation. While it will almost certainly be necessary to grandfather existing exempt wells, states should consider new statutes or regulations to ensure that these wells are (1) not used for outside watering, (2) limited to one half an acre foot or less of water per year, and (3) appropriately spaced so that they are not available to multi-residence developments and adequately protect the underlying resource. For example, New Mexico is considering a proposal to space wells at least 1/4 mile apart, while Montana is considering a rule that would continue to exempt all wells on lots of 20 acres or more. In addition, states need to have either self-reporting requirements or enough inspectors to ensure that users abide by these restrictions after the wells are drilled and operating.

REGULATION OF PRODUCED WATER. Poor quality produced water must not be introduced into the fragile, arid ecosystems of the West, where salinity already poses a problem in many drainages. States must continue to require companies to re-inject poor quality produced water. Where treatment is not too expensive, producers may treat the water and then make it available for beneficial use. However, the beneficial use must be purposeful, rather than simply a discharge of such water across other people's property. Regardless of how operators dispose of produced water, states must model the impacts of large scale ground water pumping (even from deep aquifers) on surface flows. Like all other ground water pumpers, those who pump to recover minerals must not be allowed to harm senior water rights holders or the base flows of rivers and streams. Finally, states must recognize that, while resource production is by nature temporary, it makes no sense to grant temporary use permits for activities that will last for decades and have impacts that last for centuries. Rather, regulators must assess these activities in terms of injury to both vested rights and river base flows, and then they must impose conditions on these activities to avoid injury.

Conclusion

As more and more people populate the western states, more and more water providers consider tapping ground water to supply new cities and developments. The same urban water conservation measures that Trout Unlimited and others have advocated for more than a decade offer important ways to help address increasing municipal demand. Unfortunately, the systems of ground water management in many western states suggest that using ground water to supply these demands offers a no-lose proposition. However, states must go further and address the unsustainable use of ground water head-on, with new regulatory programs and management strategies, such as those listed in the Recommendations described above. While many of the stories in this report suggest that the situation is dire, as Wallace Stegner wrote, "The west is the native land of hope." Conservationists, communities, local governments, and traditional water users all have a vital stake in finding sustainable water supplies. Now, more than ever, we need to adopt common sense ground water reforms, conservation measures, and other strategies that will allow the West to grow while protecting our rivers, our springs, and the fish, wildlife, and people—all of us—that depend on them.

Photo: Rob Dickerson, TU

ACKNOWLEDGEMENTS

Trout Unlimited's Western Water Project produced this report to further its mission to work primarily at the state level in decisions affecting water allocations and quality, so as to restore and maintain stream flows for healthy coldwater fisheries and to increase meaningful public participation in these decisions.

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Special thanks to our outside reviewers: Bruce Aylward – OR, Consuelo Bokum – NM, Boyd Clayton – UT, Robert J. Glennon – AZ, Anne MacKinnon – WY, Joseph L. Sax – CA, and Jack Williams – OR.

This report was made possible by a grant from the William C. Kenney Foundation.

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