Ending California's Water Crisis:

A Market Solution to the Politics of Water

Executive Summary

Although known as "the Golden State," water is undoubtedly California's most precious resource. Beginning with the gold rush during the mid-1800s, water has guided California's settlement and defined its landscape. At the turn of the century as settlers turned to farming and ranching, they depended on irrigation to transform arid California into the country's most productive agricultural region. Today, California's growing population has led to increased urban and industrial demands, not to mention the constant need for water to keep California's rich environment healthy.

As California's water needs increase, the rules that govern California water grow more complicated. The result is a myriad of laws and policies so complex that it defies understanding and makes reform seemingly impossible. One solution both policymakers and water users are discovering can help alleviate water shortages is water markets. Water markets balance supply with demand. Although water markets do not create new supplies, they reallocate water to make more efficient use of existing supplies, promote water conservation, and allow water users to get more out of their water supply than they otherwise could.

While policymakers and state resource agencies have acknowledged that water markets play a role in California water policy, they do not recognize the extent of that role. Nor do they address the fact that California's water problems do not stem from an inadequate water supply, but from poor management and allocation of existing supplies.

The clearest indication of this problem is the California Department of Water Resources' (DWR) latest update to the California Water Plan, Bulletin 160-98. DWR predicts that by 2020, California will experience water shortages of 2.4 million acre-feet (an acre-foot is about 326,000 gallons, a one-year supply for two typical families of four.) Such predictions are inaccurate, however, because they do not take water markets into account. DWR does not address the issue of water price, or its effect on usage. Moreover, Bulletin 160-98 takes a stagnant view of water use based on today's economic, demographic, and technological conditions. This situation is particularly troubling because the flaws inherent in Bulletin 160-98 are carried over into numerous water planning activities: primarily, the ongoing CALFED process.

CALFED, the federal-state task force created by the 1994 Bay Delta Accord, is currently attempting to develop a "long term water supply plan" for most of California, as well as to address environmental concerns over the Sacramento-San Joaquin Bay-Delta. To date, CALFED has proposed multi-billion dollar construction projects to create more water infrastructure, as well as additional regulations to govern California water. Rather than more dams, canals, and bureaucratic rules, however, CALFED should look to water markets.

Water markets can alleviate other perceived water crises in California as well, such as disputes over the allotment of the Colorado River. According to the 1922 Colorado River Compact, California is legally entitled to 4.4 million acre-feet of Colorado River water annually. Currently, California uses 5.2 million acre-feet. Until now, few problems have ensued because other states have not used their full water allotments. Yet demand for water in these states is rising, and thus states and water agencies fear a shortage in the near future. Interior Secretary Bruce Babbitt has given California until September 1999 to devise a workable "4.4 plan" to get within its legal allotment. Yet contrary to rhetoric, the

Colorado contains more than enough water to meet the needs of all parties involved.

This paper advocates water markets as the best solution to California's water problems. It takes a critical look at the state's existing water policies, as well as some of the new policies recommended by DWR and CALFED, and explains why water markets offer a better alternative. Finally, it makes policy recommendations that will allow water markets to further benefit California in the future. While California water policy is complicated, market solutions are not. Moreover, markets offer the best way to allocate and manage California's most scarce and valuable resource: water.

Introduction: A Primer on California Water

In order to understand California's current water policy, one first must know a little about the history of California water law. Generally, California water law has experienced three distinct periods of development. First was the initial settlement of California, spurred by the gold rush in the mid-1800s. Next came the era of massive irrigation projects in order to expand and promote agriculture throughout the state, even in arid regions with little rainfall. Finally, continued population growth and increasing concerns over environmental issues have led to the more recent era of California water law, which centers predominantly on the reallocation and management of the state's existing water supply. California's current water policy includes elements of all three periods.

The Forty-niners

On January 24, 1848, James Marshall struck gold at Sutter's Mill on the American River in Northern California. News of the discovery spread rapidly, and thousands of miners flocked to California. For most of the 1800s, mining camps formed the dominant government and societal units throughout the state. Predominantly male, full of bars and pool halls, and isolated by the surrounding rugged terrain, these early mining camps were somewhat chaotic, except when it came to the rules that governed their gold. As explained by natural resource law and policy scholar Dr. Charles F. Wilkinson,

> The resulting laws, the codes of the mining camps, were montages of Spanish rules transported north by Mexican miners, regulations from the Midwest, improvisation bred of common sense, and local custom. Everywhere, the idea of 'first in time, first in right' prevailed: a miner ought to have exclusive rights to a find that he had discovered, a principle also applied to the water necessary for mining.[1]

When applied to water, this concept of "first in time, first in right" is known as prior appropriation.

Prior Appropriation and Beneficial Use. Prior appropriation refers to the process by which water users acquire ownership of a water right simply by diverting it from a water source and putting it to a "beneficial use." During the 1800s, these included mining, ranching, farming, and manufacturing. Users could divert the water to any necessary location, and could switch uses of the water, as long as all uses remained beneficial.

Theoretically, if a water user diverted water for a use not considered beneficial, his claim would lose legitimacy, and he would lose his water right. Yet because such situations rarely arose, minimal conflicts ensued over forfeiture of a water right due to non-beneficial use.

This process differs significantly from water policy in the Eastern United States, which relies on riparian water rights. Riparian rights, adopted from English common law, mean that landowners have the right to use water that flows through their land. Because water is more abundant in the East, Easterners have little incentive to establish more formal property rights to water.

Prior appropriation also means that in times of drought or low stream flows, the oldest water right must be satisfied before junior rights' holders can divert their water. For example, if five water users are diverting water from a stream and a drought diminishes the available amount of water, all five individuals do not have to conserve. The individual with the most senior right can take his full amount, the individual with the second most senior right can do the same, and so on down the line. The individual with the most junior right is probably out of luck, as he can only divert water from what the first four users leave.

Finally, prior appropriation allows water users to trade and exchange their rights amongst one another. In 1859, the California Supreme Court made this transferability official: "The ownership of water as a substantive and valuable property, distinct, sometimes, from the land through which it flows....may be transferred like other property."[2]

In their 1997 book *Water Markets,* Dr. Terry Anderson and Pamela Snyder give the following summary of the evolution of western water law:

> The law that evolved in the West reflected the greater relative scarcity of water in the region. As the settlers devoted more efforts to defining and enforcing property rights, a system of water law evolved that
>
> > 1) granted to the first appropriator an exclusive right to the water and granted water rights to later appropriators on the condition that prior rights were met,
> >
> > 2) permitted the diversion of water from the stream so that it could be used on nonriparian lands,
> >
> > 3) forced the appropriator of water to forfeit his right if the water was not used, and
> >
> > 4) allowed for the transfer and exchange of rights in water between individuals.[3]

Thus, prior appropriation establishes the basic necessary elements for a successful water market: a scarce and valuable resource, a system of well-defined and transferable property rights for that resource, the ability to enforce property rights, and an agreed upon set of rules to govern, allocate, and exchange property rights. Even today, prior appropriation constitutes the basis of California's water rights system. Yet since the initial establishment of prior appropriation rights, social and political changes have occurred that have made those rights less secure, artificially altered the price of water, and otherwise politicized the management and allocation of California's water. Such changes not only drastically affected the physical landscape of the state, but they hinder the development of water markets in California.

From Mining to Agriculture: The Era of Reclamation

By the turn of the century, agriculture was becoming the predominant sector of California's growing economy. While most settlers had come for the gold, most failed to strike it rich and therefore turned to farming. Successful agriculture, however, depends on abundant water, and most areas of the state are quite arid, thus spurring new demand for irrigation.

Not only did Californians need water, they wanted it as cheaply as possible and turned to government for a subsidy. In 1887, the California legislature passed the Wright Act, which authorized the formation of public irrigation districts. Construction, maintenance, and operation of irrigation projects in these public districts were funded with tax dollars, and the districts were considered political subdivisions of the state. Thus, all property owners within the districts paid for the irrigation projects, whether or not their land was irrigable.[4]

While the Wright Act initiated the establishment of public systems, it is important to note that both before and after the passage of the Wright Act, private companies were successfully irrigating most of the West. For example, by 1910, private irrigation companies had irrigated more than 13 million acres of western land. Between 1900 and 1950, the number of irrigated acres grew 70 percent, and private irrigators accounted for 68 percent (more that 11 million acres) of this increase, despite the fact that private companies had to turn a profit while public companies received a subsidy.[5]

The most successful private organizations were mutual irrigation companies. Mutual companies were private cooperatives that either built their own irrigation projects or bought them from other companies. Because most mutual companies were incorporated, they could enter into contracts, hold property, and appear in court. As private companies, they would only build or purchase irrigation projects if they had enough stock shares to cover the construction, maintenance, and operation of the project. Moreover, water recipients paid for water according to how much water they used, which encouraged efficiency and discouraged water waste.[6]

Despite both the prevalence and effectiveness of private irrigation companies, the trend towards centralized, public control of water projects escalated. The growing popularity of both the Progressive and Populist movements at this time perpetuated the belief that careful planning by government, as well as expanded public control of services, was the best way to establish successful western societies. Moreover, Westerners wanted government to subsidize their water. Before long, the U.S. Congress passed a federal version of the Wright Act, the Newlands Reclamation Act of 1902.

The Newlands Reclamation Act. On July 17, 1902, Congress passed the Newlands Reclamation Act. Proponents of the Act claimed that government funded water projects would be repaid through the future sale of western public lands and through payments from the recipients of the projects' water. Nearly a century later, it is apparent that this was not to be the case. The initial Act granted farmers ten-year, interest-free loans for construction of water projects. Yet even with this subsidy, farmers found themselves unable to make payments. Congress expanded the loans to 20 years in 1914, and again to 40 years in 1926. In most cases, the loans were never repaid.

In a 1989 study entitled *Markets for Federal Water, Subsidies, Property Rights, and the Bureau of Reclamation,* economist Richard Wahl of Resources for the Future calculates that only 14 percent of public reclamation projects will ever be repaid to the federal treasury. In 1981, the U.S. General Accounting Office (GAO) examined six Bureau of Reclamation projects and found the construction subsidy to exceed 90 percent.[7]

Nonetheless, the Newlands Reclamation Act created the most expansive irrigation system ever built. In California alone, the Act had enormous impact—primarily, the expansive

Central Valley Project (CVP), which remains the single largest supplier of water in California. Built in the 1930s, the CVP includes 500 miles of waterways, 20 reservoirs, and 12 million acre-feet of storage capacity. The project irrigates about 3 million acres of California's prime farmland, and provides water for 2 million urban residents.[8]

On a state level, California has continued public irrigation projects into the latter part of this century. For example, in 1960, voters approved the State Water Project (SWP), run by DWR. The SWP provides water for agricultural and urban water users in the San Francisco Bay Area, Southern California, and those in the San Joaquin Valley who do not have access to the CVP.

In more recent years, however, a combination of population growth and rising environmental concerns have brought to light the inherent problems of subsidizing the state's water supply. Thus, California water policy is again entering a time of flux.

"The Era of Reallocation"

For the past generation, California water policy has focused not on developing new water supplies, but on reallocating existing supplies according to contemporary demands of society. Foremost, this reallocation has centered on a new concern for environmental protection. Professor Brian Gray of the University of California's Hastings College of Law explains,

> For the past two decades, the central issues of California water law and water policy have all focused on the reapportionment of already developed supplies from existing, and sometimes antiquated, uses to new demands by consumptive users and to the restoration of aquatic environments that were damaged during the era of development.[9]

Legislation, court decisions, and executive actions since the 1960s highlight this emphasis on environmental concerns. For example, the National Environmental Policy Act of 1969 and the California Environmental Policy Act of 1970 do not allow the construction of new water development projects unless proponents conduct a review of possible environmental consequences, alternatives, and mitigation measures of the proposed project. The federal Clean Water Act of 1972, California's Wild and Scenic Rivers Act of 1972, and the federal Endangered Species Act of 1973 have also limited water project activity and curbed the appropriation of water rights, due to environmental concerns.

In 1982, California voters rejected then Governor Jerry Brown's proposal to build a Peripheral Canal that would allow water suppliers to channel water from the Sacramento-San Joaquin Bay Delta to Southern California by way of the CVP and the SWP. Less than a year later, the California Supreme Court invoked the public trust doctrine as a means of environmental protection in its opinion in *National Audubon Society v. Superior Court.* The court claimed that Los Angeles could no longer appropriate water from Mono Lake (even though Los Angeles had legitimate water rights to do so) because continued withdrawals of the lake's water were adversely affecting the lake's environment. According to the Court, the lake's unique ecosystem constitutes a public value protected by the public trust doctrine—a value more important than the protection of property rights to water.

In 1992, then President Bush signed into law the Central Valley Project Improvement Act (CVPIA), which aims to restore and protect the Central Valley's fisheries, wetlands, and water quality by setting aside 800,000 acre-feet (one tenth of all CVP water) for environmental purposes. The Act also established a $50 million restoration fund in order to implement environmental mandates included in the Act, the money for which is expected to come from surcharges on water from other CVP water users.

Finally, in 1994, 15 state and federal agencies signed the Bay Delta Accord, which created CALFED. CALFED is a federal-state task force attempting to develop a long-term comprehensive plan that will restore ecological health and improve water management for beneficial uses of the Bay Delta System. The Delta is the nation's largest estuary system and provides two-thirds of the state's drinking water; irrigates most of the Central Valley; and supports more than 750 species of fish, animals, and birds, as well as 40,000 acres of wetlands.

Combined, these legislative actions, executive agreements, and court decisions illustrate that thus far, attempts to reallocate California's water have relied on political means. As the demands that California places on its water supply change, governments and courts attempt to recognize these changes by reallocating water from one use to another.

While well-intentioned, this political process will not allow California to get as much out of its water supply as would a greater reliance on markets. Moreover, it is in many ways contrary to the development of water markets, because it makes property rights less secure, and markets depend on secure property rights. Nevertheless, this trend towards greater public control of California water has not stopped water markets from springing up throughout the state.

California Water Markets

To date, California has experimented primarily with three types of water markets. First are local water markets, which exist in agricultural communities throughout the state. Second are agriculture-to-urban (ag-urban) transfers, which reallocate water from agricultural districts to cities in order to accommodate population growth. Finally, California enacted a water bank in the early 1990s in response to a drought beginning in the late 1980s. While not inclusive of all California water markets, the following examples illustrate how markets promote water conservation and make more efficient use of existing water supplies.

Local Water Markets. Numerous local water markets exist throughout California, in different forms according to regional supply and demand. While most are informal, some have become quite advanced. One of the most developed agricultural water markets exists in the Westlands Water District.

In March, 1996, Westlands established the first and largest electronic water marketing system called *WaterLink*. Representatives from the Natural Heritage Institute, researchers from the University of California at Berkeley and Davis, farmers, and water district administrators designed the system, which presently serves more than 600 farmers on nearly 600,000 acres of farmland. Through *WaterLink*, water users trade several different types of water, including CVP water, contract water, groundwater, and water imported by Westlands from neighboring water districts. Hundreds of thousands of acre-feet change hands in a given year, and the market may soon expand to include additional water districts.[10]

WaterLink is unique because it allows users to buy and sell water from their home computers. Users may post and read bids, and may access weekly and seasonal statistics on average prices and trading volumes. Buyers and sellers may then use *WaterLink* to negotiate deals and record trades with their water district.

In addition, *WaterLink* allows users to schedule their water deliveries electronically, and

soon users will be able to acquire account balances in the same way one obtains a bank account balance from an ATM. This feature will authorize water users to manage their water supplies more effectively, as well as streamline water district operations. Furthermore, water districts can use *WaterLink* to provide public information such as rainfall summaries, water storage levels, and access to online irrigation advice from the state resource departments in a cost-effective manner. Janice Olmstead of the Natural Heritage Institute explains,

> The value of *WaterLink* lies in its potential to lower transaction costs by providing market information, reducing negotiation costs and expediting communication between water users and water districts. As with other network technologies, the worth of *WaterLink* will increase as the number of users increases. *WaterLink's* adoption rates have been promising. There are currently about 50 users on the system. Expansion of *WaterLink* to over 20 additional Central Valley Project water districts in the San Joaquin Valley is being discussed. *WaterLink* can be adapted to meet the specific needs of each water district in multiple intra-district markets, or in one large inter-district market network.[11]

Local markets such as *WaterLink* allow agricultural districts to improve efficiency within specific regions and over short periods of time. Yet long distance transfers among different users, such as agriculture-to-urban transfers, also offer a promising way both to promote conservation and to secure long-term water supplies.

Ag-Urban Transfers. Presently, agriculture uses 80 percent of the state's water supply, while cities use about 20 percent. Yet as California's population continues to grow, demand for urban water is increasing. This trend is particularly true in Southern California, where the population is expected to increase by 43 percent by 2020, for a total of 22.3 million people. Thus, urban water wholesalers have begun looking to agricultural irrigation districts to purchase water for urban use.

Southern California's two largest water suppliers are the Imperial Irrigation District (IID) and the Metropolitan Water District (MWD). IID is an irrigation company that delivers 3.2 million acre-feet annually, all of which come from the Colorado River and 98 percent of which go to agriculture. MWD is a consortium of 27 cities and water agencies that provides water for more than 16 million people in six Southern California counties. In 1997, MWD sold 1.8 million acre-feet, which it received from the Colorado River and from Northern California sources via SWP aqueducts.

Each year, MWD spends $12.5 million on water conservation programs, such as water recycling, desalination, and storage programs. These high costs are reflected in the price of MWD's water: MWD currently sells water for $431 per acre-foot. Meanwhile, agricultural water is cheap: IID sells water to farmers at a cost of $14.06 per acre-foot. It therefore makes sense for IID and MWD to engage in trade.

MWD's first major transfer was the 1989 Water Conservation Agreement with IID, a deal in which MWD paid IID for conservation improvements in exchange for 106,100 acre-feet of salvaged water over 35 years. MWD has since completed other transfer agreements with different Southern California agencies as well, as illustrated by Table 1.

Table 1
Recently Completed Long-Term Water Marketing Agreements

Participants	Region(s)
Westside Water District, Colusa County Water District	Sacramento River
Semitropic Water Storage District, Santa Clara Valley Water District	Tulare Lake, San Francisco Bay
Semitropic Water Storage District, Alameda County Water District	Tulare Lake, San Francisco Bay
Semitropic Water Storage District, Zone 7 Water Agency	Tulare Lake, San Francisco Bay
Semitropic Water Storage District, Metropolitan Water District of Southern California	Tulare Lake, South Coast
Kern County Water Agency, Mojave Water Agency	Tulare Lake, South Lahontan
Arvin-Edison Water Storage District, Metropolitan Water District of Southern California	Tulare Lake, South Coast
Mojave Water Agency, Solano County Water Agency	South Lahontan, San Francisco Bay
Imperial Irrigation District, Metropolitan Water District of Southern California	Colorado River, South Coast

Source: The California Water Plan Update: Bulletin 160-98

More recently, IID has agreed to sell the San Diego County Water Authority 200,000 acre-feet annually and, after much debate, MWD agreed to transport the water through the Colorado River Aqueduct for a negotiated transportation, or "wheeling," fee. All three organizations expect the transfer to provide an adequate water supply for San Diego County over the next 45 years, as well as to benefit agriculture through a new revenue stream, new incentives for increased water conservation, and more secure water rights.

Ag-urban transfers allow California as a whole to use water more efficiently. Because they are voluntary, such transfers constitute positive sum, or "win-win," situations in which both parties come out ahead. Overall, these transactions continually increase the net benefit that California receives from its water supply. They also promote efficient water use because water users realize the opportunity costs of their water, and therefore have reason to conserve.

In addition to local markets and large-scale transfers, California has experimented with a third type of water marketing: water banking.

The 1991 California Drought Bank. In February 1991, after four years of drought, DWR announced that the SWP would not make agricultural water deliveries that year, and other contractors would receive only a percentage of their water. At the same time, the CVP made a similar announcement. The situation prompted Governor Wilson to sign Executive Order W-3-91, which instructed DWR to "develop a clearinghouse for facilitating water marketing transactions between willing sellers and willing buyers of water, consistent with the need to protect fish and wildlife resources."[12]

On April 17, 1991, the California Legislature passed enabling legislation, and the bank began operation. DWR began offering $125 per acre-foot of water, which they in turn would sell to willing buyers. In 1991 alone, the bank acquired more than 800,000 acre-feet of water, most of which was bought for urban use (47 percent). Agriculture purchased about 13 percent, and the SWP purchased 40 percent to store for use in 1992.

The California Department of Fish and Game (DFG) participated in the market as well, although they did not make any direct purchases from the bank. Rather, they facilitated the transfer of water to Central Valley wildlife refugees outside of formal bank transactions. For example, in one instance, they helped the New Bullards Bar Reservoir acquire 28,000 acre-feet at a reduced cost of $50 per acre-foot to protect fish and wildlife.[13]

Even the Drought Bank was not a true market, however, because DWR was the only buyer, and the agency set the price of water at $125 per acre-foot. Yet the bank does demonstrate that once the right incentives are in place, abundant water can be found even during a drought. The bank also provides California with valuable water marketing experience that can guide and direct future markets.

International Water Markets

Chili | Mexico | Australia

Because they are an efficient and equitable way to allocate scarce water, water markets have developed outside of the United States as well. The most developed water market is found in Chile, although Mexico and Australia use water markets as well.

Chile. In 1980, Chile transferred water from state ownership to a system of private property rights. According to Chile's Constitution, "The rights to private individuals, or enterprises, over water recognized or established by law, grant their holders the property over them."[14] Water rights are separate from property rights to land, and except for a few restrictions, owners may sell or lease them to anyone else for any purpose at a negotiated price. According to the World Bank, Chile's water market has given farmers greater flexibility to shift crops according to demand, and has allowed cities to meet their urban demands without having to buy land or expropriate water.[15]

Prior to the enactment of the market, Chile's federal government owned all of the nation's water. Once the law was changed, however, any interested party could petition the government for water rights. Petitioners receive most unappropriated water rights free of charge, unless competition exists for the same rights. In such cases, those rights are auctioned off to the highest bidder. Chile grants private rights to both surface and groundwater, and in most cases, petitioners do in fact receive unappropriated rights for free.

Since its inception, Chile's market has adapted and developed according to circumstances and demand for water. It has also successfully encouraged new methods of water conservation without raising water charges. For example, when the Chilean government denied a request from Santiago's municipal water company, EMOS, for more water rights without charge, EMOS initially looked to purchase more rights from potential private sellers. Yet rather than pay the sellers' high prices, EMOS opted to rehabilitate its old pipe structure to reduce water leakages and thereby increase the amount of water available for use.[16]

Farmers, likewise, who must pay for water rights to expand production, have an incentive to install efficient irrigation, use better soil management techniques, and grow less water intensive crops. In addition, Chilean farmers have used options contracts as a way to avoid buying water they may not need. An options contract allows a farmer to pay a neighboring farmer, growing an annual crop, for the option of buying water at a prenegotiated price in case of a drought.[17]

By almost all counts, the water market has brought Chile significant benefits. Particularly in

regions with the scarcest water, trading is active and transactions costs are low. A 1997 study by researchers Robert Hearne and William Easter concludes that the greatest societal gain brought by Chile's water market is the ability to meet the demands of all its urban water users.[18] The city of Serena, for example, purchased 28 percent of its water from neighboring farmers, allowing the city to postpone the construction of a newly proposed dam. Similarly, the northern city of Arica meets the needs of its urban residents by leasing groundwater from farmers.

Because water markets have postponed the need to build new water infrastructure, they have allowed Chile to avoid potential environmental degradation as well.[19]

Mexico. Initially the Mexican government subsidized both the construction and operation of the nation's water infrastructure. Before long, however, government expenditures on water constituted five percent of Mexico's gross domestic product. Mexico, therefore began charging full recovery of service costs, and began holding users responsible for operation of infrastructure. Thus, the price of water increased, and tradable water rights were introduced.[20]

Under Mexico's 1992 water law, water users can exchange nontradable water rights for tradable, sellable "concessions," which are essentially allowances to use an allotted share of water. The concessions have a maturity of 30 years, and can be bought or sold freely as long as transactions do not negatively impact the water rights of others.

In both Chile and Mexico, secure and tradable water rights have aided in the reduction of poverty in numerous ways. First, when farmers sell their water rights to more productive farmers or to cities, scarce resources are reallocated for more productive uses, leading to increased overall production. Second, tradable water rights encourage new investment and generate additional employment in activities that require a secure water supply. For example, Mexican investors built a water-bottling plant only after negotiating for the water rights from a local farmer.[21]

Third, secure and tradable water rights increase the value of the rights because of opportunity costs. Farmers are now able to sell or lease their water rights, which are often their most valuable assets. For example, many small Mexican farmers were able to sell some of their water in order to remain on their land. In addition, because poor urban residents are the most likely to lack piped water service, markets benefit Mexico's urban poor by making it easier for cities to obtain water.

Finally, studies indicate that although poorly quantified, economic growth has occurred in Mexico due to gains from trading water rights. Farmers have been able to increase both farming efficiency and output through the selling and purchasing of water rights. Moreover, when the peso dropped in 1994, a decline in domestic demand followed. Without the opportunity to sell water rights, farmers undoubtedly would have had more difficulty adjusting to the nation's economic changes.[22]

Australia. Like California, Australia has an arid climate with scarce water. In response to this scarcity, informal water markets began evolving throughout Australia well before the government passed legislation codifying water trading in the 1980s. By 1983, however, South Australia made water trading official by allowing permanent transfers of water entitlements. New South Wales followed suit in 1989, as did Victoria in 1991.

Australia's agricultural sector has reaped the greatest benefits from its established water market. In a 1993 report entitled "Water Rights in New South Wales: The Evolution of a Property Rights System," researchers Gary Sturgess and Michael Wright quantify the increase in farm income from water transfers along the Murray-Darling River Basin in South

Australia. The basin covers 1,058,800 square kilometers; incorporates half of Australia's cropland, sheep population, and orchards; provides water for a quarter of the nation's cattle; and irrigates three-quarters of Australia's irrigated crops and pastures. They conclude that

> In 1990/91 the addition to rural income as a consequence of water transfers had nearly doubled to some $10 million. This compromised some 437 transfers for a total of some 120,000 megalitres. These transfers lifted rural income for that year by an incredible $17 million. If benefits of this scale can be obtained by a system of water transfers circumscribed by regional barriers, the benefits that would flow from the redefinition of water property rights to allow the free transfer of water between regions ...would be greater still.[23]

Australia also engages in interbasin transfers. In 1992, the first interbasin transfer occurred when a property along the Murrumbidgee River in New South Wales leased 7,982 acre-feet of water to a cotton farm on the Lower Darling River. Because they feared it would harm the local economy, farmers opposed a permanent transfer of the water. They did approve a temporary five-year lease, however, which increased the Murray River's flow between the two locations, thereby increasing its net wealth by $2 million. Between July 1, 1994 and June 30, 1995, water users traded a net 87,000 acre-feet out of the Murrumbidgee, 15,904 acre-feet to the Lower Darling, 75,829 acre-feet to the Murray, and 4,789 acre-feet back into the Murrumbidgee from the Murray.[24]

In order to accommodate such transfers, the role of water institutions is changing in Australia as well. For example, the Murray-Darling River Basin Commission was originally founded in 1917 to build dams and other physical infrastructure, as well as to regulate river traffic. Today, however, they also manage water transfers and work as a regional federation of states in the basin. In addition, the commission works to define water rights more clearly, establish environmental water rights, and translate different types of water rights into a common currency tradable within the region.[25]

Support for Water Markets

The success of these existing markets has led to widespread support for water marketing. Legal scholars and economists concerned about water law and policy have promoted water markets for decades. In 1973, water markets became a topic of national discourse when the National Water Commission (NWC) recommended transferring water from marginal uses in agriculture to industrial and urban uses. In 1986, the Western Governors' Association (WGA) also began promoting water markets as an effective way to meet the rising demand for existing water supplies.[26]

Throughout the 1990s, this support has grown. Environmental groups such as The Nature Conservancy (TNC) and the Environmental Defense Fund (EDF) have voiced strong support for water markets. According to senior EDF attorney Tom Graff, "Not only does a [water] market reduce the need for new, environmentally destructive infrastructure, it also provides a way for ecosystems that have been short-changed to obtain more water from a willing seller."[27] Research organizations including Resources for the Future (RFF), the Reason Public Policy Institute (RPPI), and the Political Economy Research Center (PERC) promote water markets as well.

Despite this support, however, resource agencies and policymakers in charge of managing and allocating California's water are not recognizing or embracing water markets as the

basis for a sound water policy in California. The clearest indication of this fact is DWR's most recent update to the California Water Plan: Bulletin 160-98.

The California Water Plan: Bulletin 160-98

In 1957, DWR released Bulletin 3, the first California Water Plan. Since then, DWR has updated that plan as part of the Bulletin 160 series. Bulletin 160-98, released in 1998, is the latest update. According to DWR, the Bulletin 160 series "assesses California's water needs and evaluates water supplies, to quantify the gap between future water demands and water supplies. The series presents a statewide overview of current water management activities and provides water managers with a framework for making decisions."[28]

Bulletin 160-98 concludes that by 2020, California will experience water shortages of 2.4 million acre-feet (see Table 2). This conclusion, however, is inaccurate because it takes a stagnant view of water use by making future predictions based on today's conditions. DWR itself states that the predictions in Bulletin 160-98 "forecast the future based on today's data, economic conditions, and public policies."[29]

This process is inherently flawed. By basing future forecasts on current conditions and policies, DWR misses the boat on numerous counts. First, it fails to acknowledge that throughout all sectors in California, water use grows more efficient each year, and will continue to do so to 2020. Second, it does not address the issue of water price, or its effect on water use. Third, it does not take water markets into account. While it does pay water markets lip service as a " a possible water supply augmentation option," this characterization only highlights their misunderstanding of the potential of markets. Water markets are not a source of water supply, but rather, they are a way of matching supply and demand.

The first problem stems from DWR's stagnant view of water use. Currently, California is making vast improvements in water use efficiency. For example, despite population growth, per capita water use is declining and, in some cities, overall water use is declining. San Diego County uses 13 percent less water than it did a decade ago, despite a 10 percent increase in population growth. Between 1970 and 1998, Los Angeles' water use only increased minimally, from 593,000 acre-feet to 594,000 acre-feet. During that same time, however, population increased 32 percent: from 2.8 million to 3.75 million.[30]

Industrial water use shows similar efficiency improvements. Between 1980 and 1990, the state's economic production rose 30 percent, while industrial water use fell 30 percent. The trend has continued into this decade.

California's agricultural sector is also producing more with less water. California farmers are planting more high-value crops, which require less water, in place of lower valued crops that require more water. In other cases, new technologies are allowing farmers to use less water to grow the same crops. Total farm productivity in California has increased from $600 per acre-foot in 1960 to more than $800 per acre-foot in 1997.[31] DWR does not incorporate these efficiency improvements in its projections for California's future water use, nor does it take into account the fact that such efficiency improvements are likely to continue.

Moreover, Bulletin 160-98 fails to address the issue of water price, or its effect on water use. Currently, most water in California is delivered by publicly owned and operated water systems. For example, public agencies provide 78 percent of urban water and almost all agricultural water. The CVP and SWP alone provide more than 10 million acre-feet annually. Because public water delivery systems are funded with federal, state, and local

tax dollars, the water they deliver is heavily subsidized. Cheap water gives the illusion of abundance and, therefore, farmers presently are insulated from the reality that water in California is scarce.

Price studies show, however, that agricultural water use is fairly elastic. In other words, farmers are relatively sensitive to changes in water price. For example, increasing the price of agricultural water by 10 percent decreases demand by 20 percent. Thus, decreasing subsidies for agricultural water even slightly would affect agricultural water use. A 10-percent decrease in DWR's projected agricultural demand for 2020 would more than make up for DWR's predicted shortage of 2.4 million acre-feet.

Not only would reducing subsidies decrease demand, it would also give farmers further incentive to increase the efficiency of their water use. This may entail switching methods of irrigation, or improving existing irrigation infrastructure to increase water conservation. For example, drip irrigation is a precise method that uses considerably less water than other types of irrigation, such as surface irrigation. Surveys show that already, statewide use of drip irrigation is increasing, while use of surface irrigation is declining. Between 1972 and 1990, overall use of drip irrigation increased .45 percent each year, and 2 percent each year for vineyards. Over that same time, overall use of surface irrigation decreased .73 percent each year, and more than 1 percent for orchards and vineyards.[32] Because more than 50 percent of all vineyards and 80 percent of orchards presently do not use drip irrigation, the potential for increased efficiency does exist.

Another possibility for increasing agricultural efficiency is through crop shifting. While the distinction is not completely clear-cut, most California crops fall into two categories: low-value and high-value. Low-value crops generally yield low profit margins, and include such field crops as cotton, alfalfa, and rice. High-value crops yield high profit margins, and include orchard crops (i.e. nuts and fruit) as well as many vegetables.[33] Because most low-value crops require large amounts of water, farmers may opt to switch to higher value crops in addition to adjusting irrigation methods.

Finally, DWR does not take water markets into account. As demand for water increases, it becomes more valuable. In the absence of subsidies, prices increase to reflect scarcity and match supply with demand. While existing water subsidies, particularly for agriculture, presently skew the link between price and cost, limited water markets are, nevertheless, developing around California, and as water grows more scarce, DWR should expect that water markets will develop further.

For example, the price of urban water is continually rising. As ag-urban transfers become more popular and streamlined, more agricultural water districts will want to sell water as the opportunity costs of that water rise along with urban districts' purchasing prices. Stated another way, as the potential gains from trade grow, so will the number of market transactions.

Moreover, DWR should promote markets as the best way to match water supply and water demand, and thereby minimize water "shortages." The predicted shortage in Bulletin 160-98 is not a real shortage—rather, it is a "paper" shortage derived from a flawed political process. This fact is particularly troubling because numerous reports, studies, and water planning activities rely on Bulletin 160-98 data. Foremost is the ongoing CALFED process, which uses Bulletin 160-98's numbers for expected water demand levels in 2020. As explained by Dr. Peter Gleik, President of the Pacific Institute for Studies in Development, Environment, and Security, "The flaws found in [Bulletin 160-98] are explicitly carried over into the CALFED process, and if not corrected, could lead to huge public expense for unnecessary public works projects with high economic and environmental costs."[34]

CALFED

In 1994, Governor Pete Wilson and Interior Secretary Bruce Babbitt signed the Bay Delta Accord. The Accord authorized the creation of CALFED, a federal state task force assigned to develop a long-term water supply plan for California, as well as to address environmental problems in the Sacramento-San Joaquin Bay Delta. The Delta is the nation's largest estuary system, and it provides two-thirds of the state's drinking water; irrigates most of the Central Valley; and supports more than 750 species of fish, animals, and birds, as well as 40,000 acres of wetlands.

To date, CALFED has come up with three alternative proposals, which are presently undergoing a public review and comment period. The first proposal authorizes construction projects for existing pumps, channels, and dams throughout the Delta. The second authorizes additional projects and increases storage facilities. The third includes the projects of the second, and authorizes a new "facility" much like the proposed Peripheral Canal that was defeated in 1982, connecting the Sacramento River to export facilities of the SWP and the CVP.

These proposals are seriously misguided. They rely heavily on Bulletin 160-98, and, therefore, are based on inaccurate assumptions. Like DWR, CALFED assumes that California is facing a water crisis and thus prescribes more construction projects, storage facilities, dams, and bureaucratic rules and regulations.

While CALFED does include a Water Transfer Program as part of its overall plan for the state, the program does not recognize water markets' potential, nor does it address the issues that impede effective water markets. The purpose of the program is to "provide a framework of actions, policies, and processes to facilitate, encourage, and streamline a properly regulated and protective water market which will allow water to move between users, including environmental uses, on a voluntary and compensated basis."[35] Yet CALFED ignores both water subsidies and water price. Instead, it suggests the enactment of new rules and regulations to govern transfers, the construction of more physical infrastructure, and the expansion of existing regulatory water agencies.

CALFED's Water Use Efficiency Program, which it calls "one of the cornerstones of [their] management strategy," fails to even mention water markets as a way to promote efficiency. In fact, CALFED promotes a series of actions, which it refers to as "agricultural and urban conservation incentive programs that will provide technical assistance and financing to aid adoption of locally cost-effective measures, and grants to foster implementation of measures that are cost effective from a state-wide perspective."[36] Rather than end existing water subsidies, therefore, CALFED promotes enacting new subsidies for programs it believes lead to efficient water use.

For example, to promote agricultural water conservation, CALFED relies on the expertise of the Agricultural Water Management Council (AWMC), an advisory committee first created under 1990 state legislation that aims to prepare and implement water management plans. CALFED calls on AWMC to review water management plans from local water suppliers, and either endorse them or withhold endorsement. If endorsed, CALFED will grant loans and provide technical assistance to implement the approved plans.

For urban water conservation, CALFED does not outline a specific process for certification, but rather suggests that either DWR or the SWRCB develop a certification process for approving efficient urban water conservation programs, which CALFED will in turn assist.

CALFED also promotes water recycling, and plans to subsidize local water recycling programs. "CALFED also will make funding available for planning and implementing local water recycling projects."[37]

Like DWR's Bulletin 160-98, these approaches take a myopic view of water use. Rather than create incentives to develop the most efficient methods of water use, CALFED's proposed processes create incentives to adopt management plans likely to be approved by state boards and committees. For example, CALFED promotes water recycling, yet recycled water costs an estimated $500 per acre-foot. These high costs indicate that recycling water is not efficient, driving the push for new subsidies. Reducing existing subsidies, on the other hand, would promote efficient water use.

For example, many southern California farmers receive CVP or SWP water at one-tenth the price of recycled water. By allowing the price of water to more closely reflect its true cost, farmers will determine the best way to increase efficient water use and thereby free up water for transfers.

This process is preferable to CALFED promoting one specific method of water conservation because in different circumstances, different techniques will work best. Even DWR admits, "There is a perception that only drip irrigation is an efficient agricultural water use technology. High efficiencies are possible with a variety of irrigation techniques. Considerations such as soil type, field configuration, and crop type influence the choice of irrigation technique."[38] It is, therefore, better to get the right incentives in place and allow farmers to determine the most efficient use of their water according to local conditions.

The same principles apply to urban water use. CALFED should not subsidize one form of water conservation over another. Rather, it should rely on market forces to allow price to reflect water's true cost, and thereby guide water users to choose the most efficient form of water conservation.

The Colorado River

A third perceived water crisis in California stems from the escalating debates over the allocation of the water in the Colorado River. Various treaties and agreements have divided the river between tribes, states, agencies within states, and between the United States and Mexico. As demand for water grows throughout the West, policymakers and water agencies are beginning to panic at the idea of a shortage.

Contrary to rhetoric, however, the Colorado does contain enough water to meet the needs of the states and agencies involved. If states and agencies within states engaged in water trading, anticipated shortages would end.

At the heart of the debate is the 1922 Colorado River Compact, which divides allotments of the Colorado River for use among seven states and Mexico. According to this agreement, California, Nevada, and Arizona share 7.5 million acre-feet that make up the lower basin portion of the river. In a normal year (a year without drought), California is entitled to 4.4 million acre-feet, Nevada receives 300,000 acre-feet, and Arizona receives 2.8 million acre-feet—1.5 million of which the state diverts to Phoenix and Tucson through the Central Arizona Project (CAP)..

The upper basin river water also contains 7.5 million acre-feet, which is divided between four states. In a normal year, Colorado is entitled to 3.8 million acre-feet, Utah receives 1.7

million acre-feet, Wyoming receives 1 million acre-feet, and New Mexico receives 838,000 acre-feet.

Disputes over the terms of the 1922 agreement are causing numerous political problems. The first problem stems from the fact that for years, California has taken more than its allocated 4.4 million acre-feet. Presently, California takes about 5.2 million acre-feet of Colorado River water annually. Until now, few problems have ensued because Arizona, Colorado, and Nevada have used less than their allocated amounts. Yet as demand for water increases in these states, they are growing increasingly frustrated with California, and are preparing to take legal action to halt California's excess consumption. Interior Secretary Bruce Babbitt has given California until September, 1999 to devise a workable "4.4 plan" to eliminate the extra 800,000 acre-feet it presently uses.

In addition, Arizona and other states want the U.S. Department of the Interior to renegotiate the rules governing surpluses and shortages. According to the agreement, California is entitled to any surplus water during wet years, and in dry years, California is entitled to its full allotment before Arizona may divert any water into the CAP. Because Arizona currently diverts over half its water into the CAP, Arizona believes that this part of the agreement should be renegotiated.

Within California, the situation is complicated as well. Farmers are legally entitled to all but 550,000 acre-feet of California's allotment. The two biggest California recipients of Colorado water are IID and MWD: IID is entitled to 70 percent of California's allotment (2.8 million acre-feet), and MWD is entitled to 12.5 percent (500,000 acre-feet).

Yet as population grows, so does the price of MWD water (currently $431 per acre-foot). Already MWD has spent approximately $2 billion over the past decade to increase efficient water use, in an attempt to meet rising demand. Meanwhile IID's water use is increasing by about 400,000 acre-feet each year, and IID continues to sell water cheaply ($14 per acre-foot). Historically, the two agencies have had an antagonistic relationship, as evidenced by the bitter nature of the debates over the recent transfer between IID and San Diego. As price differentials grow, however, so do the potential gains from trade, indicating that more transfers will likely occur.

Interstate trades offer great potential as well. Currently, Arizona receives much of its water at highly subsidized prices through the CAP. The CAP contains 336 miles of aqueducts capable of carrying Colorado River water all the way to Tucson, which is located 3,000 miles from the river itself. Moreover, Arizona farmers receive CAP water well below cost, at prices of $17, $27, or $41 per acre-foot. Not only does the CAP cost taxpayers more than $24 million per year to operate, but even at these subsidized prices, Arizona does not use all of its allotted water. In 1994, the CAP delivered only 809,117 acre-feet (55 percent) of the 1.5 million acre-feet it is entitled to under the Colorado River Compact.[39]

A similar situation exists in Utah. The Central Utah Project (CUT) currently delivers water to Utah farmers at the subsidized price of $8 per acre-foot. The farmers in turn produce crops that yield $30 per acre-foot, yet the water costs taxpayers about $300 per acre-foot.[40] Nonetheless, Utah does not use its full allotment of Colorado River water.

Meanwhile, Nevada and California are paying enormous amounts to conserve water, particularly in urban areas such as Las Vegas and Southern California. For example, in 1991, Santa Barbara built a desalination plant that provides water for $1,600 per acre-foot. The costs are so high that the plant is currently closed. Other California cities have begun purifying salty groundwater, which they sell for an average of $300 to $400 per acre-foot.

In Nevada, the city of Las Vegas has recently instituted a "cash for grass" program in which

they offer residents $400 to replace their lawns with alternative landscapes such as rocks and desert plants. They also offer free seminars on how to make the change. Other residents receive $50 to replace unreliable hand-timed sprinklers in their yards with new, automated sprinklers that use less water.

Rather than pay such outrageous prices to conserve urban water, it makes far more sense for states such as Arizona and Utah to sell their unused portions of Colorado River water to states such as Nevada and California. If Arizona charged $140 per acre-foot for CAP water, the multi-million dollar losses that the project currently suffers would cease. Moreover, $140 per acre-foot is far less than water users in Nevada or California currently pay for water, which indicates that Arizona could likely find willing buyers. Even some irrigation districts in California and Nevada sell water for upwards of $150 per acre-foot.[41]

Already the concept of interstate water markets is catching on. Interior Secretary Bruce Babbitt has voiced support for interstate transfers, as have individual states. In 1996, Arizona expressed interest in selling California and Nevada a portion of its Colorado River water when Arizona's DWR released a report addressing the concept of short-term, interstate leases. Arizona and Nevada have also considered interstate water banking.

Utah has expressed interest in interstate trading as well. In 1994, Utah Governor Mike Leavitt suggested selling 500,000 acre-feet of Utah's Colorado River water to downstream users in order to develop more economic water resources within the state.

Within California, markets offer the best solution to solving disputes over Colorado River water as well. Yet particularly for large-scale transfers of water to users in different geographic regions, water users must take third party impacts into consideration.

Third Party Impacts

When any market exchange occurs, it usually affects more than simply the two parties engaging in trade. This fact is true of water markets as well. Sometimes, transfers can adversely and unjustly affect the water rights of others. In such cases, transfers should not occur, or third parties should receive compensation for their losses.

The basis for governing third party impacts in California is the "no injury" rule of the California Water Code, which states that water transfers may not injure other legal users of water or the environment. California has also enacted other laws governing transfers. While third party impacts are real problems that must be addressed, creating restrictions on transfers that are too prohibitive will prevent markets from flowing. In economic terms, they create high transaction costs, and when transaction costs are too high, markets cannot function.

Already, California has placed a number of restrictions on water transfers, particularly large scale, long-term transfers. For example, the 1992 Central Valley Project Improvement Act (CVPIA) allows the long-term transfer of CVP water to users both within and outside the project's service area. According to the Act, water users may "transfer all or a portion of the water [delivered by the project]...to any other California water user or water agency, State or Federal agency, Indian tribe, or private nonprofit organization under applicable State law."[42]

Yet the Act also includes 13 restrictions on transfers, allocates a large amount of water to environmental purposes, and empowers state and federal agencies to maintain a

'reasonable balance' among competing demands for CVP water.[43] These restrictions impede an effective water market because they favor certain uses over others and make the transfers complicated, time consuming, and difficult to get approved.

While some transfers are occurring (water users transferred nearly 288,000 acre-feet of CVP water in 1997), the potential for a far more fluid water market exists. Indeed, water users claim that complicated approval processes—both for CVP and non-CVP water—deter them from potential market exchanges. This problem is magnified because capacity limitations of conveyance and pumping facilities mean that, often, parties engaging in transfers have only a narrow time window in which the transfer can be physically accomplished.

As markets further develop, new and innovative ways to address third party impacts will develop as well. Yet in the midst of this process, policymakers must ensure that government approval processes, if appropriate and necessary, are kept short and transaction costs are kept low.

Conclusions and Recommendations

Policymakers enthusiastic about the potential of water markets should keep the following conclusions in mind before making any reforms to California's water policy. As indicated by DWR's Bulletin 160-98 and the ongoing CALFED process, it is easy to recognize that water markets should play a role in California water policy without really understanding what water markets are, or how they operate. Policy recommendations that claim to promote water markets sometimes do not, and can even impede the development of efficient and effective markets. These conclusions summarize the findings of this paper and provide policymakers with a foundation of knowledge about water markets on which to base reform.

- Secure, tradable, and enforceable property rights are the key to good water policy for California.
- Water markets are not a source of water supply, but are a way of balancing supply and demand.
- Because of gains from trade, markets allow water users to get more out of their water supply than they otherwise could.
- Water markets promote water conservation.
- Water markets depend on low transaction costs.
- Third party impacts of water transfers can constitute problems that need to be addressed. Yet efforts to curb third party impacts should not be so prohibitive that they prevent water markets from functioning.
- Water subsidies lead to water waste.
- DWR's latest update to the California Water Plan, Bulletin 160-98, uses an inherently flawed process to make predictions about California's water future. Bulletin 160-98's predicted

water "shortage" is not a real shortage, but rather is a "paper" shortage that can be eliminated through the use of water markets.

- CALFED's recommendations to "develop a long-term water supply plan" for California are based on inaccurate assumptions made in Bulletin 160-98, and are, therefore, misguided. Rather than promoting more construction projects for water infrastructure and more bureaucratic rules and regulations, CALFED should promote water markets.

- The Colorado River contains more than enough water to meet the current and future needs of the states for whom it supplies water. If states and agencies within states engaged in water marketing, the perceived crisis over a shortage of Colorado River water would end.

Policy Recommendations

Based on these conclusions, there are a number of specific reforms that policymakers can enact in order to facilitate the development of an efficient and effective water market in California. Such reforms include:

Privatize Irrigation Projects Whenever Possible. State and federal water projects, left over from the reclamation era, continue to provide a large amount of California's water supply. Indeed, the federally owned CVP remains California's single largest supplier of water and currently delivers about 7 million acre-feet of water each year. The state-run SWP delivers 2.3 million acre-feet each year.

Because these projects are funded by tax dollars and operated by public agencies, they create a significant subsidy to recipients of project water—primarily, agricultural water districts. Rather than use variable prices for water that reflect its true cost, governments used fixed prices that undervalue water. Even after reform such as CVPIA, which introduced tiered pricing for agriculture, agricultural water remains subsidized. For example, in some areas of Southern California, cities pay 10 to 100 times more for an acre-foot of water than do neighboring agricultural irrigation districts. As long as these subsidies are in place, an efficient and effective water market cannot develop.

If private irrigation companies, however, operated these water projects, subsidies would end. The price of water would reflect its true cost, including the costs of delivering the water and maintaining the delivery and storage infrastructure. Water bills would vary along with water use, giving users incentive to conserve.

Moreover, the success and prevalence of private irrigation companies throughout the West prior to the establishment of public irrigation districts (see page 9 of this paper) demonstrate that the private sector is both able and willing to manage and deliver California's water. In 1996, the Reason Public Policy Institute released a study comparing existing investor-owned and government-owned water delivery systems in California. The study,

entitled *Restructuring America's Water Industry,* concludes that private companies provide comparable water services to consumers at the same price as public companies, despite the fact that private companies pay taxes and public companies receive subsidies. The study also found that private companies are more efficient in their operation of water services and that, most likely, public companies have higher capital expenditures than their private counterparts.[44]

Finally, private operation of water projects would mean that any additional construction or improvements to existing water delivery or storage systems would be based on their financial feasibility (unlike the proposals put forth by CALFED). Furthermore, they would be paid for by those who benefit from them, and not with tax dollars.

Public reclamation projects were authorized and constructed at a time when Californians wanted to irrigate as quickly and cheaply as possible. This goal no longer constitutes the objective of California water policy. Because the subsidies provided by public irrigation projects promote water waste, California should look to private companies to better manage and deliver its water.

Ensure That Property Rights to Water Remain Secure. For the most part, California water rights are secure property rights based on the doctrine of prior appropriation. Yet over the past century, those rights have become less secure. As early as 1914, California water users could not obtain appropriative rights unless they applied to the state for approval. Moreover, Section 102 of the 1943 California Water Code states, "All water within the State is the property of the people of the State, but the right to the use of water may be acquired by appropriation in the manner provided by law." Thus, while California water rights are considered property rights, they are rights to use water, but not to own it. This type of right is called a usufruct right.

Usufruct rights are not as secure as true property rights because, legally, the state still owns the water. Nevertheless, they are still property rights and any reform to California water policy must respect those rights. In some cases, property rights should be made more secure. For example, in the case of the environment, private groups dedicated to environmental protection—or even the California Department of Fish and Game—should be given title to the water presently mandated for environmental purposes.

Secure property rights are the key to any good market. If water users do not have secure property rights to water, they cannot buy, sell, or trade that water to others. Thus, water markets depend entirely on secure water rights.

Allow Water Right Holders to Trade Their Rights More Freely. Water right holders must have greater autonomy to trade those rights to different users. This reform would entail altering California's current water transfer laws, which require an extensive review and approval process before any water is traded in California. In some cases, particularly long-term transfers that channel water to distant locations, some sort of approval process is appropriate. Yet in

others, decision making should be left to water users themselves.

Dr. Brian Gray of the University of California's Hastings College of Law explains,

> [T]he law renders these "user-initiated" transfers impossible without the approval of the agency that holds the underlying water rights (or contract rights in the case of CVP and SWP contractors). This presents a fundamental contradiction. On the one hand, the transfer statutes are premised on the theory that the price initiatives offered by potential buyers will motivate existing water users to engage in more efficient use and to transfer water in situations when the net revenues from conservation and transfer are likely to exceed those generated by the users' current practices. On the other hand, the law vests the ultimate power to decide whether to enter into transfers in the boards of directors of the local agencies that deliver water to the users, rather than in the users themselves. The current law is flawed because it separates the financial incentives that are intended to induce water users to conserve and transfer from the authority to decide whether the transfers may in fact occur.[45]

Water right holders, therefore, should be allowed to trade water more freely, but they must also be held accountable if their transfers adversely affect third parties. Theoretically, third parties adversely affected by a water transfer could seek redress through the courts, and water traders would have to pay third parties for damages. Yet in effect, a system of accountability would prevent third party impacts because if water traders know they will be held accountable for their actions, they have incentive to minimize third party impacts before they occur. In other circumstances, water users can work out arrangements with third parties to compensate them for any losses. By devolving decision-making to water users themselves, innovative solutions based on local conditions and variables will result.

Contract Out to a Private Group to Create and Operate a Statewide Water Transfer Clearinghouse. In order for a water market to really flow, water users must have a place where they can interact with other willing buyers and sellers. A statewide water clearinghouse would serve this purpose. Any water users who wished to sell or lease water rights would post their rights at the clearinghouse, and potential buyers would look to the clearinghouse to find rights for sale or lease.

The clearinghouse could also act as an information center about water transfers in California, including how much trading is occurring, the effects of those trades throughout California, and information on surface water supplies, groundwater levels, and other water conditions. Over time, the clearinghouse would develop according to water owners' needs, and it would become an even more sophisticated and valuable resource.

Such a clearinghouse would greatly facilitate water trading in California. It would reduce transaction costs by providing market information, while also reducing negotiation costs by putting willing sellers in touch with willing buyers. It would also allow water owners to track California's water market and keep an eye on market activity.

A water clearinghouse could also help address third party impacts. If water traders post potential transfers for a specified brief time prior to the actual transporting of the water, other rights holders who anticipate that it will adversely affect them could protest the transfer, or possibly negotiate a deal to avoid, minimize, or receive compensation for any detrimental impacts. While the third party would not necessarily have the authority to prevent the transfer from happening, keeping water owners informed of potential transfers allows them the opportunity to negotiate and compromise ahead of time in order to prevent conflict later.

For example, *WaterLink*, the online water market used by farmers in California's Westlands Water District provides another model for a statewide clearinghouse, on a larger scale. *WaterLink* enables water users to buy and sell water from their home computers. They can post and read bids and asks, access weekly and seasonal statistics on average prices and trading volumes, negotiate deals, and record trades.[46]

Numerous proposals already have been made for the creation of such a clearinghouse, although proposals thus far recommend a state-run clearinghouse. In the February 1999 update of its Revised Phase II Report, CALFED recommends that the SWRCB create and operate a nonregulatory California Water Transfers Information Clearinghouse.

The 1991 California Drought Water Bank began as a state-run clearinghouse as well. Because the ongoing drought created an emergency situation, and because California had little experience with large-scale water banking, a state-run bank at that time was arguably appropriate. However, as economist Richard Wahl explains,

> If the bank is to operate in the future, the bank should consider encouraging private brokerage arrangements, particularly as experience with water transfers increases. . . [T]he long term transfers in the state will almost certainly be privately negotiated. Such transactions are likely to be more diverse than the transactions facilitated by the bank (they may differ in duration, price, and other conditions), and the state has shown no indication of trying to organize them through a state-sponsored water bank.[47]

Initial public funds may be required in order to contract with a private group to run the clearinghouse, but with such numerous network technology companies in existence, and for the reasons explained by Professor Wahl above, the state should not run the system.

Create Property Rights for Groundwater as well as Surface Water. While the majority of this report has focused on surface water, about 40 percent of the state's water supply comes from groundwater. Overdraft of groundwater basins has occurred in California for most of this century, due largely to irrigation for agriculture. The reason for this fact is obvious: when people have open access to free groundwater, they attempt to pump as much as possible. This situation is known as a "tragedy of the commons." Property rights, however, can rectify this situation because water users cannot pump groundwater that belongs to someone else.

Like surface water, the rules that govern California's groundwater supply are complicated. Unlike surface water, no comprehensive statute for managing groundwater exists. Rather, local public authorities, and sometimes court-appointed "watermasters," manage groundwater basins. As a result, basins are managed differently, but most rely on the correlative rights doctrine.

The correlative rights doctrine allows landowners overlying an aquifer to share groundwater, within the scope of reasonable use. Landowners from non-overlying areas may obtain rights to use surplus groundwater according to the prior appropriation doctrine. In times of shortage, rights to surplus water are not fulfilled, and overlying users must reduce their use as well. Courts, however, have interpreted and enforced this doctrine differently, resulting in uncertainty over California groundwater rights.[48]

Secure groundwater rights are necessary, however, because they protect against groundwater overdraft. If a market for surface water rights develops, but water users still have free access to groundwater, landowners will begin over-pumping groundwater, knowing that they can in turn sell that water in the market.

Some basins already use a property rights approach to groundwater allocation: primarily, the Tehachapi Basin in Kern County and the Mojave Basin, located 100 miles east of Tehachapi. In both cases, courts divided the basins into rights, allocated the rights among users, and enabled users to trade those rights with other users within the basin. The result has been better allocation of the basins' groundwater, as well as proof that groundwater rights can be defined and enforced.[49]

For groundwater basins that courts have not adjudicated, the initial allocation of rights will face political controversy. True market allocation would entail holding an open auction, with water rights going to the highest bidder. Yet because dramatic reallocation could potentially throw a number of California communities into chaos, this is not the most equitable option. Rather, allocation of groundwater rights should be based on use patterns over an extended period of time.

Reform or Abolish the California Water Plan's Bulletin 160 Process. As explained in this paper, the Bulletin 160 Series constitutes an inherently flawed process that leads to inaccurate

conclusions and misguided policy recommendations. It takes a stagnant view of water use based on current economic, demographic, and technological conditions. It does not incorporate many of the ongoing changes that already are altering the way California uses water. Nor does it address the issue of water price, or take water markets into account. Finally, it incorrectly concludes that California faces a water crisis and will experience severe water shortages in the near future.

The problems are intrinsic to the Bulletin 160-98 process itself and, therefore, they cannot be remedied with simple reforms. Policymakers should instead look to create a new "planning" process for California water use—one that incorporates technological improvements, economic and demographic changes, the effect of water price on water use, and one that promotes water markets as the best way to match California's water supply and demand.

Advise CALFED to Promote Water Markets, Rather Than More Water Projects. To date, CALFED's policy recommendations rely on old fashioned, costly approaches that postpone, rather than solve, California's water problems. Environmental Defense Fund economist David Yardas explains, "Despite the fact that similar market-based strategies have proven effective elsewhere, CALFED appears to be favoring traditional water development and old-style water management under the guise of ecosystem restoration—and then asking taxpayers to foot the bill. That's a long way from the durable solution that CALFED was chartered to develop."[50]

CALFED does recommend the creation of a Water Transfer Information Clearinghouse, which they suggest be operated by SWRCB. They do not, however, make other policy recommendations that promote water marketing. In fact, many of their recommendations would impede effective markets. Rather than prescribe that California taxpayers foot the multi-billion dollar bill for more construction projects and more regulation, CALFED should look to water markets.

Promote Interstate Water Markets as the Basis for California's "4.4 Plan." California's "4.4 plan" is an ongoing effort to bring California back within its legal entitlement to 4.4 million acre-feet of Colorado River water annually. California presently takes 5.2 million acre-feet annually. While it is reasonable for other states to expect California to stop "taking" 800,000 extra acre-feet each year, it is also reasonable for California to purchase or lease Colorado River water from other states.

California policymakers should petition the U.S. Department of the Interior to allow for interstate water transfers. California cities are used to paying high prices for water, and they easily could present irrigation districts in other states—or even other water wholesalers in other states—with attractive water transfer deals that could benefit both parties involved. If agencies in other states do not want to sell or lease water to California, they do not have to. But states and agencies should have the legal option to do so.

Conclusion

As California looks ahead to the future of water policy, markets should and will dominate the structure of that policy, replacing the subsidies and political management of the past. Already the foundations for successful water markets exist. Water rights in California are fairly secure, and California has a vast infrastructure through which water rights can be bought, sold, leased, and traded. Water is a scarce and valuable resource, and experience in California and around the world demonstrates that when structured correctly, water markets work well and can benefit all parties involved.

Unfortunately, CALFED and DWR are not making policy recommendations that will lead to effective or efficient water markets. They rely on outdated approaches and inherently flawed planning processes that effectively turn back the clock on water policy. Policymakers and resource agencies aiming to make the most of California's limited water supply (and interstate water supplies coming from the Colorado River) will take markets seriously and base reforms on the conclusions and recommendations outlined in this paper. While California water policy is complicated, market solutions are not. Moreover, they offer the best way to allocate and manage California's most scarce and precious resource: water.

End Notes

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