Securing Reliable Water Supplies for Southern California

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Gregory Freeman

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I. Introduction

Southern California is a semi-arid desert in the midst of an extended dry spell. Despite recent rain in California, water shortages may be a reality as soon as the summer of 2008. The area's four main sources of water – the Colorado River, the Sacramento-San Joaquin River Delta, local groundwater, and the Owens River Valley – are all under extreme stress. Southern California residents and policy makers, lulled into complacency by the ongoing successes of the region's water engineers and agencies, need to understand the looming water challenge. Most important, they need to understand the background, the stakes, and the potential solutions.

Challenges

Southern California is a home to an enormous population. Roughly 21 million people live in Los Angeles, Orange, San Diego, San Bernardino, Riverside and Ventura counties, more people than live in the entire state of New York. The area is growing, and will add 5.6 million new residents by 2030. This burgeoning population will depend on better management of local resources, increased conservation and imported water supplies, all of which are under pressure. (Local groundwater sources would be rapidly depleted if they were not replenished with imported water.)

Southern California's main water agency, the Metropolitan Water District (MWD), imports water from the Colorado River and the Sacramento-San Joaquin River Delta. The City of Los Angeles independently imports water from the Owens River Valley. All three sources are under strain from population growth, climate change, and the need for environmental restoration and preservation.

The entire Colorado River system is in the midst of an 8-year drought that has seen water levels at the two main storage facilities, Lake Mead and Lake Powell, fall below 50 percent capacity. Even in wet years, California will no longer be able to count on surplus water (above its 4.4 million-acre feet per year allotment) from the Colorado River since the other states with claims on Colorado River water have grown rapidly.

The Delta is in perilous condition, with Southern California's water supply threatened by possible levee collapse (after heavy rains or an earthquake); ecosystem deterioration (due to urban and agricultural runoff); environmental needs (to protect endangered fish); and climate change (increased salinity due to rising sea levels as well as predicted reduction in the annual snowpack).

Historically, the City of Los Angeles has relied principally on its Owens Valley resources and treated MWD as an insurance policy, but that could change now that it has had to reduce its take from the Owens River to settle environmental litigation. Even without invoking its preferential rights (which entitle it to much more of MWD's water than it has historically taken), L.A.'s increased reliance on MWD heightens the importance of securing sufficient Bay Delta and Colorado River water supplies for distribution by MWD throughout Southern California.

Urgency

Water remains the *sine qua non* of Southern California's existence. Economic development and job creation will be secondary considerations if Southern California cannot guarantee safe, reliable and competitively priced access to water. There are numerous strategies that will help secure water supplies, but there is no single 'silver bullet' solution. A diversified portfolio of strategies such as more aggressive conservation; development of alternative sources; and improved resource management is the best long-term approach. In the near term, however, there is a critical opportunity to improve the reliability of Southern California's water supplies by focusing on the sustainability of the Delta.

The Delta is in crisis. While a comprehensive solution to the myriad problems that ail the Delta is years away, there are some near-term opportunities for improvement. These include emergency preparedness to limit the potential losses that could follow a flood or earthquake; protection of endangered fish that force the periodic shutdown of the pumps that supply water for the state and federal water projects; and, critically for Southern California, the construction of an alternative conveyance system. For the first time since the Pat Brown era, there appears to be a potential alignment among the state's political leadership on the shape and urgency of a solution.

Opportunity

All of the key players are engaged on the water issue (a rarity in itself), creating what one industry expert describes as a "once-in-a-generation opportunity" to take positive action. When Governor Schwarzenegger addressed the SCLC in August, he spoke passionately about water and indicated he planned to make the issue a top priority for his administration. More recently, he proposed a series of physical improvements for water conveyance and environmental restoration in the Delta, along with additional surface storage. The State Senate and Assembly's Democratic majorities disagree with the governor on water storage, but there appears to be tentative agreement on the broad outlines of the physical improvements for the Bay Delta.

Water policy in general and the Bay Delta issues in particular, can be hugely contentious. The last proposal for a peripheral canal was rejected by state voters in 1982 after an acrimonious campaign. And competing interests – environmentalists, farmers, water districts, and state and federal agencies – have hamstrung attempted progress on the Bay Delta for more than 10 years since Governor Wilson brokered the Bay Delta Accord of 1994. Focused business leadership could help broker a deal to "fix" the broken Delta, thereby increasing the reliability of water supply and continuing environmental restoration. The deal should also improve water quality for both humans and the environment. However, it will be critical not to overreach. Thus, new conveyance must be appropriately sized (i.e. small enough) so that it would preclude a later political decision to drain the northern rivers for the benefit of Southern California (a lingering fear that contributed to the defeat of the peripheral canal in 1982).

II. Southern California's Diverse Water Supply

Local Sources

Despite Southern California's semi-arid climate, 40 percent of the region's water supply is taken from local aquifers. Local water agencies can maintain this surprising rate of withdrawal without risk of depletion because they actively recharge local groundwater supplies during periods of winter rain and supplement with imported water (particularly during wet years) and reclaimed wastewater. This allows the local aquifers to act as de facto reservoirs, augmenting (and vastly exceeding) the region's surface storage capacity.

The other 60 percent of Southern California's water supply is imported from far-flung sources.

Los Angeles Aqueduct

The City of Los Angeles, lacking adequate local water resources, pioneered large scale water transfers in the Western United States by importing water from the mountains in Central California. The Los Angeles Aqueduct, represented by the red line running north-south on Figure 1, is actually two aqueducts. The Los Angeles Owens River Aqueduct was designed by William Mulholland and opened in 1913. It carries water 233 miles from the Owens River (at a point of diversion north of Bishop, California) to the City of Los Angeles. The Second L.A. Aqueduct, built in 1970, parallels the Owens River Aqueduct for 137 miles starting at the Haiwee Reservoir south of Owens Lake. Both aqueducts are operated by the Los Angeles Department of Water and Power.

Colorado River Aqueduct

The Colorado River Aqueduct transports water from the Parker Dam on the Colorado River (at the southern end of Lake Havasu on the border between California and Arizona) to to coastal Southern California. The 242-mile long aqueduct was completed in 1941, and is represented in Figure 1 by the red line running east-west, just north of the Salton Sea. The aqueduct was built and is operated by the Metropolitan Water Department of Southern California in order to deliver its allotment of Colorado River water to its coastal service area. These transfers depend on storage in Lake Mead (behind the Hoover Dam in Nevada) and Lake Powell (behind the Glen Canyon Dam on the Arizona-Utah border). Both lakes have receded to barely half of their capacity as the Colorado River Basin entered its eighth year of drought.

State Water Project

Most of the precipitation in California (75%) falls north of Sacramento, yet most of the demand (75%) is south of the state capital. The State Water Project (SWP) is a massive water conveyance system designed to redress this imbalance by moving surplus water from the north to deficit areas in the south. Designed and operated by the California Department

of Water Resources (DWR), the project's main components are the Oroville Dam, the San Luis Reservoir, and the 444-mile long California Aqueduct.

The California Aqueduct (the bright green line in Figure 1) runs from the Delta to the southern end of the San Joaquin Valley, where it is lifted almost 2,000 feet over the Tehachapi Mountains. From there, it splits into two branches, one feeding into Lake Perris

(the easternmost green dot on the yellow region of the map); the other supplying Pyramid Lake and Castaic Lake (the green dot on the northern end of the yellow area).

The SWP project accounts for about 25% of Southern California's imported water. The pumps that lift the water over the Tehachapi Mountains are the single largest consumer of electric power in the state, which increases the cost of water imported into Southern California.

III. Southern California Water Challenges

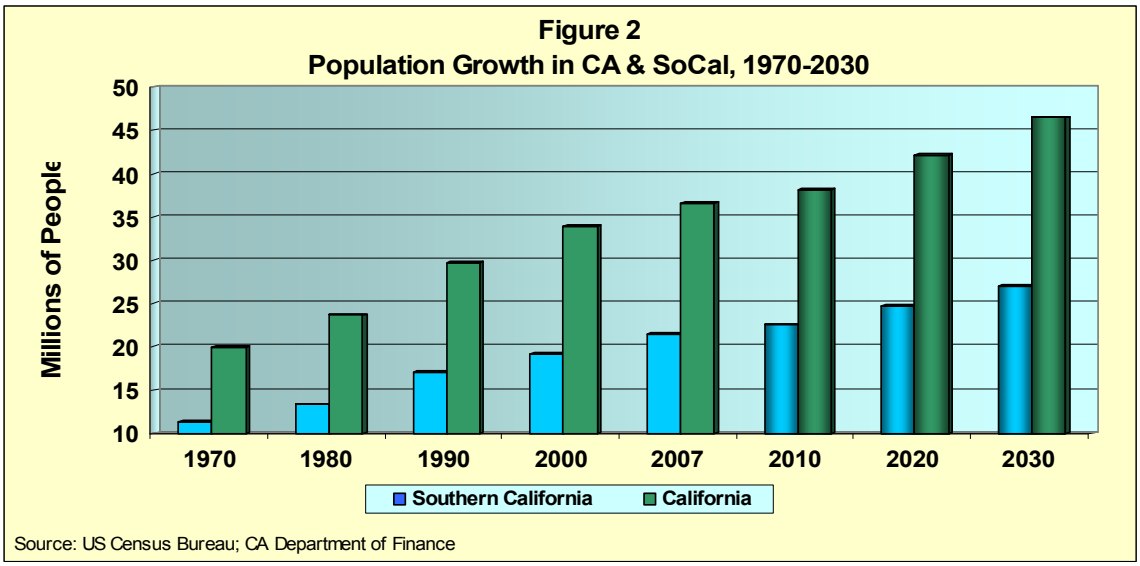
The region's water agencies have done a superb job providing reliable water for decades, and that success has bred complacency among the region's business and political leadership. Southern Californians live in a semi-arid desert with limited local supplies, yet most area residents regard water issues with casual indifference. Their attitude seems to be that water is not worth getting worked up about, at least not when it can be procured with ease from a tap or a plastic bottle. Given the increasing stress on resources, however, water issues have slipped back to the forefront of the policy arena, with rival water bonds proposed by Governor Schwarzenegger and State Senator Perata during the recent special session. The renewed interest is warranted, particularly in Southern California, where water supplies for the decades ahead face substantial risks and challenges.

The first challenge is population growth, and the accompanying increase in demand. The population is growing in Southern California and in neighboring areas with whom we share water sources, both in-state and out-of-state. Next, there is the uncertainty inherent in a system that depends on the weather. Episodes of intense drought are normal in the western United States, and reduce the amount of water available. Moreover, our understanding of what constitutes 'normal' will likely need to be revised as climate change alters weather patterns and their predictability. The third challenge relates to human interaction with the environment. Habitat restoration and endangered species protection place competing and often priority claims on water that has long been diverted to Southern California users, casting doubt on the reliability of these supplies, particularly in times of scarcity. A similar risk revolves around damage to existing supplies. Chemical pollutants from agricultural, industrial, and urban sources can contaminate groundwater supplies, making them unusable until expensive cleanup has been completed. In this section we briefly survey these risks and what they mean for Southern California.

Population growth

Southern California's population has grown rapidly for decades, backed by secure but extraterritorial supplies of water imported by the Metropolitan Water District and the Los Angeles Department of Water and Power. These agencies have handled the growth with spectacular aplomb, meeting the needs of a regional population that has swelled to rival that of the largest states. The state has made real progress on water conservation (Southern California uses roughly the same amount of water today as it did 15 years ago, despite the population growth in the interim) and the pace of growth is expected to slow compared to most recent decades. Nonetheless, each additional household represents additional pressure on water supplies in Southern California.

Figure 2 (on the next page) shows population trends for the state and the region over seven decades, with historical data covering the period 1970 to 2007, and estimates for 2010, 2020 and 2030. California's population has grown by 83 percent, 1970-2007, rising from 20.0 million to 36.6 million people. During the same period, the population of the six counties of Southern California (Los Angeles, Orange, Riverside, San Bernardino, San Diego and Ventura counties) increased 89 percent, from 11.3 million to 21.4 million people.



Going forward, California is expected to add nearly 9.9 million additional residents by 2030, a 27 percent increase to 46.4 million residents. Southern California will be home to 5.6 million of these new residents, bringing the regional population to 27.0 million and accounting for 58 percent of the statewide increase, 2006-2030. This forecast suggests that more people will live in Southern California in 2030 than lived in the entire state of Texas in 2006!

Thus, in 60 years, California's population will have grown by 133 percent, from 20.0 million to 46.4 million residents: 26.4 million more people will call the Golden State home in 2030 than in 1970. To put this growth in context, consider that it is numerically equivalent to *everyone* living in New York and New Jersey in 2006 (except the residents of the Bronx) moving to California!

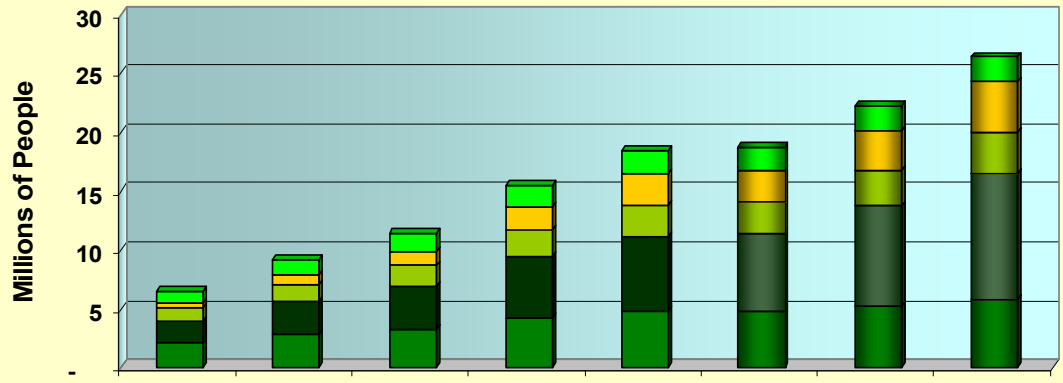
The growth in the rest of the state will also create subtle pressures on water supplies in Southern California. One potential strategy for securing additional water is to buy it from predominantly agricultural areas in other parts of the state. Yet, some of the fastest growth in coming decades is forecast for the San Joaquin Valley and the Sacramento Valley. These areas are expected to supplant the Bay Area as the second most populous region of the state. Increased urbanization in traditional rural areas may increase the demand to reserve local supplies exclusively for future (local) use. Even if California does move towards the increased use of water markets, a growing population statewide will ensure plenty of competition from rival buyers and higher prices for whatever water is available.

A similar phenomenon is occurring in the Colorado River Basin.[1] Of the seven states in the Colorado River Basin, all are growing rapidly in population except for tiny Wyoming. Figure

[1] There are seven states in the Colorado River Basin: Colorado, New Mexico, Utah, Wyoming, Arizona, California, and Nevada. The Upper Basin includes CO, NM, UT, WY, and a small portion of AZ, all of which are tributary to the Colorado River above Lees Ferry. The Lower Basin (tributary below Lees Ferry) consists of most of AZ, CA, NV, and small portions of NM and UT.

3, focuses on the population of the five fast-growing states in the basin besides California, 1970-2007 and forecast to 2030.

Figure 3
Colorado River Basin Population Growth, 1970-2030



Source: US Census Bureau

The combined population of CO, AZ, UT, NV and NM increased by 181 percent during 1970-2007 period, growing from 6.6 million to 18.4 million people. Nevada and Arizona were the fastest growing states among them, rising by an astonishing 425% and 257% respectively during the same period.

Following them were Utah (150%) and Colorado (120%). Even the comparative laggard of the group, New Mexico, almost doubled its population. Going forward, the growth is expected to continue, albeit at a less torrid pace. NV and AZ will again lead the pack, followed by UT, CO and NM. Overall, the 5-state population is expected to add 8 million people and reach 26.4 million people in 2030, a 43% increase.

Therefore, the seven decades, 1970 to 2030, will see the population of these five Colorado River Basin states rise fourfold from 6.6 million people in 1970 to 26.4 million people in 2030. This matters for Southern California because it will create additional competition for water from the Colorado River.

Until the adoption of the 4.4 Plan, California routinely took more than its allotted 4.4 million acre-feet (MAF) per year under declarations of surplus. Since agreeing to the 4.4 Plan, however, the state has surprised many observers, notably the other members of the Colorado River Compact, by living within its allotment. The possibility that California could take additional water under future declarations of surplus has been rendered moot for the foreseeable future by the ongoing 8-year drought on the Colorado River. At this point, refilling the water storage on the river would likely require 20 years or more of average precipitation in the basin. By the time the next surplus is declared (if ever), there will be millions of additional people with rival claims to any 'excess' water.

Weather pattern variability

Southern California's seemingly permanent sunshine disguises considerable variation in annual precipitation. For most people, the only noticeable affect of the variation is in how many winter days they carry an umbrella, which even in wet years, is still not often. For water agencies, on the other hand, a wet year versus a dry year can make a difference of a million acre-feet of water or more, and determines whether storage facilities will end the year with more water or less than when it started. Since periodic droughts are a fact of life in the West, water agencies prepare for consecutive dry years with sufficient stored water to tide their customers through. They have done so with such success that low water levels come to the public's attention only in the severest of droughts and fade from memory as soon as the rains return. The water agencies' successful mitigation of the risks associated with variable weather patterns has been impressive, and may be tested by rare events.

Water planners stress-test their forecast models based on the observed hydrology of the past eight decades, a reasonable and sensible precaution, particularly for routine planning. Yet, looking at a circumscribed time period, even one lasting almost one hundred years, may present an incomplete picture of the possible or even likely hydrology. This point is illustrated by the 1922 Colorado River Compact. The compact allocated water among the states of the Colorado River Basin based on roughly two decades (1905-1922) of observed flows at Lees Ferry. The first two decades of the 20th Century turned out to have been unusually wet, with flows at Lees Ferry averaging about 16 MAF/year, compared to the long-term average that has been closer to 14 MAF/year. The compact allocated 7.5 million acre-feet per year each to the Upper Basin and the Lower Basin, so the river is oversubscribed, even before taking into account the treaty grant of 1.5 MAF/year to Mexico.

Paleoclimatologists – scientists who use evidence from tree rings and pollen in core samples taken from lakebeds and glaciers as well as other methods to estimate historical precipitation patterns – have been working to place the comparatively recent 80+ years of history in a much longer context. Reconstructed estimates going back hundreds of years suggest the early and late years of the 20th Century were exceptionally wet ones; the mid-century drought was fairly typical (with one or two similar events per hundred years); and the dustbowl years of the 1930s were possibly the driest in the past 300 years. Look back even further, however, and there is evidence that the entire West suffered *decades* of drought beginning in the late 1500s.

Another group of scientists has been studying the oceans and the atmosphere for clues to mechanisms underpinning the long-term variations in precipitation. They have identified three regular oscillations in sea-level atmospheric pressure and ocean temperatures that influence rainfall patterns in the southwestern United States: the El Niño-Southern Oscillation (ENSO), the Pacific Decadal Oscillation (PDO), and the Atlantic Multidecadal Oscillation (AMO).

The ENSO describes water temperature shifts in equatorial region of the Eastern Central Pacific Ocean produced by surface air-pressure changes lead to strong or slack trade winds. The latter let warm water flow south creating the familiar wet-weather pattern known as El Niño; the former pull cold water north and leads to the drier conditions associated with La Niña.

The PDO and AMO are similar patterns of shifting ocean surface temperatures, though as their respective names suggest, their oscillations may last a decade or more, compared to the 6-month to 18-month oscillations of the ENSO. The PDO seems to have a strong influence on precipitation patterns in the Western U.S.; the effect of the AMO is still under investigation. The effects of these three oscillations are believed to interact in complex ways that influence precipitation in the West and thus California's water supply.

Understanding their interaction better may hold the key to more reliable long-term forecasts of wet and dry year patterns in the West, which could be an asset in planning and delivering a secure water supply for Southern California. The predictive value of this knowledge could be diminished if climate change forces us to throw out our expectations of what constitutes normal.

Climate change

A warming climate could have serious consequences for Southern California's long-term water supply. The gradual rising of the lowest altitude at which precipitation falls as snow in California mountain ranges, particularly the Sierra Nevadas, is the single most important climate-change-related threat to water supplies in Southern California. Snow levels earn this distinction for two reasons. First, scientists expect it to happen. Uncertainty is the handmaiden of climate change forecasting, but rising snow levels is one of the least uncertain of the possible outcomes.

Second, a snow pack 30% to 70% smaller than the current average could force a radical overhaul of portions of the state's water infrastructure. Mountain snowpack acts as a vast reservoir that conveniently stores water in the winter when it is abundant and releases it in the summer when it is needed most. If more precipitation falls as rain instead of snow, the storage capacity of this natural reservoir will be diminished. Moreover, the peak runoff period would shift to earlier in the year, making it harder to capture and store water.

California uses dams for flood control and storage. In the winter, the reservoirs behind the dams are deliberately left low in order to maintain the capacity to capture (and thus moderate) the runoff from major winter storms. As the danger of flooding recedes late in the season, the reservoirs are refilled, storing water for use in the summer and fall. An earlier peak runoff would pose a dilemma for dam operators: refill the reservoir too soon and risk a devastating flood; or keep the reservoir low too long and miss the opportunity to capture water.

Southern California's water supply could also be threatened by the need to further curtail water diversions from the Bay Delta in order to combat the adverse effects of climate change. As we'll see in section four below, the Bay Delta is a fragile ecosystem poised on the edge of disaster. With a smaller snowpack, there may not be sufficient summer runoff to sustain a viable habitat *and* water deliveries to Southern California. This problem would be exacerbated by rising sea levels, which would push saltwater further into the Delta.

Climate change could also have interesting effects on water supply and demand, depending on the responses to specific, localized changes (that climate models predict only with great uncertainty). The increased uncertainty and heightened risks faced by farmers could encourage their appetite for water transfers (sales) to urban areas, or it could intensify their opposition if they decide that retaining as much water as possible is their best course of action.

Over the next several decades, regulations aimed at lowering the state's contribution to climate change could have a larger impact on water supply than climate change itself. Meeting the AB 32 targets – a return to 1990 levels of greenhouse gas emissions by 2020, and a further reduction to 80% below the 1990 levels by 2050 – will impose changes on the California economy that could have a profound effect on future water options. Desalination of seawater, for example is an appealing prospect because of its reliability. Yet, the reverse osmosis process is energy intensive and still more energy will be required to lift the freshwater it produces uphill from sea level to the point where it enters the region's predominant gravity-flow water system. Tackling climate change will require full consideration of the greenhouse gas emissions from the power used in desalination, and weighing it against the emissions that would be generated by tapping alternative water sources.

Habitat restoration and endangered species protection

When California's vast water transfer infrastructure was being built, environmental concerns were not part of the equation. Moving water from distant sources to where it was needed was simply an engineering challenge to be overcome. The intervening years have seen the passage of legislation such as the Endangered Species Act. The rise of an energetic and vocal environmental lobby has produced greater public awareness of some of the unintended consequences of water diversion. There is considerable support for the general goals of habitat restoration and species protection. And an aggressive legal strategy has produced some stunning victories for environmental causes. Thus, environmental concerns must be given considerable weight when evaluating the future reliability of water supplies in Southern California.

The City of Los Angeles, for example, lost some of the water it had previously imported from the Mono Basin and Owens River Valley. A series of court decisions required the city to mitigate environmental damage by restoring a portion of the Owens Lake (which had dried up after the transfers) and returning flows to the lower portion of the river. Since it will not be able to independently import as much water as in previous years, the decisions increase the city's dependence upon MWD, which it had previously treated as an expensive insurance policy. The loss may be felt in future dry years, when the growing population has increased overall water demand. Certainly it would be an advantage for everyone in Southern California if there were more water rather than less, and if LA did not need to draw on Metropolitan's supplies because it was importing enough water on its own.

Transfers from the State Water Project have also been affected by the needs of environmental protection and habitat restoration in the Bay Delta. The courts have previously ordered reductions in transfers at certain times of year to protect spawning fish. Most recently, decisions related to the endangered smelt will require cutbacks in water

deliveries that will impose a court-ordered drought on Southern California (on which more later). The Bay Delta ecosystem remains in a fragile state and urgently requires mitigation that will continue to cast doubt on the reliability of Southern California supplies.

Water contamination

Enforcement of the Clean Water Act; heightened public awareness; and better scientific understanding of the effects of certain chemicals and their ability to linger in the environment have contributed to fewer pollutants entering groundwater in California. We no longer believe, for example, that filtration through sediment will remove every contaminant from water. New landfills are now lined and stricter rules govern which materials can be disposed in them, all to prevent containments from leaching into the groundwater. And some pollutants, such as the gasoline additive Methyl tertiary butyl ether (MTBE), have simply been banned. [MTBE does not degrade on its own and tends to migrate.] These are welcome improvements, yet there is still much to do.

Pollution enters the water system from urban runoff, particularly the chemicals washed off the roads by storms; farm runoff contaminated by fertilizers, pesticides and naturally occurring arsenic and other minerals; mining operations (including some that have been closed for decades); leaks and spills from commercial and industrial operations; landfills; and faulty or broken sewers and septic tank systems.

These contaminants do not affect current water deliveries. Indeed, Southern California water agencies deliver top quality water that meets all state and federal standards. But perchlorate contamination (from improper disposal of materials used in the aerospace industry), PERC (a chemical used in dry cleaning), MTBE and assorted volatile organic compounds (VOC) has forced the isolated closure of wells in locations throughout the region. Many of the wells will be usable again after remediation, but in the meantime the closure eliminates a potential source of water. Aquifers play an important role in Southern California, both as a source of groundwater and as an alternative to large-scale above-ground storage. (Aquifers can be replenished with imported water as well as native runoff.) The region will need to be vigilant in curtailing groundwater pollution to prevent damage to this valuable resource.

IV. Focus on the Delta

Introduction

The Bay Delta covers 738,000 acres northeast of Oakland. The area is about the size of Rhode Island, expanding inward from the upper reach of San Francisco Bay to the edge of the Central Valley. Two rivers flow into the Delta from their eponymous valleys: the Sacramento from the north and the San Joaquin from the south. The freshwater from the Delta mixes with saltwater from the Pacific Ocean in San Francisco Bay to form the largest estuary on the West Coast of North America. The entire region is referred to as the Bay-Delta.

The Delta is characterized by a latticework of natural and man-made channels and sloughs surrounding low-lying wetlands and islands. Many of the islands are protected by an extensive network of earthen levees built mostly during the late 19th and early 20th centuries. Since many of the islands are below sea level, land subsidence and seismic activity are constant concerns.

Farmland in the Delta is richly productive, but this predominantly agricultural area is gradually transitioning to a more urban environment. Sources variously describe the population of the Delta as being "more than 400,000 people" and "in excess of 500,000", but agree that the population is growing quickly.

The Delta is the principal hub in the California's water supply system and a key source of Southern California's water. The area is a vital ecosystem, yet is fundamentally broken.

Delta as water source

The Delta is probably the most important piece in the state's water infrastructure. The average annual flow of freshwater into San Francisco Bay from the Delta is about 24 MAF, though in recent decades it has ranged from a low of 6 MAF (1977) to a high of 69 MAF (1983).

The southern end of the Delta is the main diversion point for both the Central Valley Project (CVP) and the State Water Project (SWP). The CVP began exports from a protected diversion near Tracy in 1942. The CVP has a physical diversion capacity of about 1.3 MAF/year.[2] The SWP began larger scale exports from the Banks Pumping Plant in 1972. The Banks pumping plant was supposed to be a short-term physical and financial expedient pending the construction of a peripheral canal to carry water around the Delta. The SWP has diversion capacity of roughly 2.5 MAF/year and downstream capacity of 4 MAF/year. The water projects support more than 25 million people and 2.5 million acres of farmland.

Southern Californians are the most numerous beneficiaries of water exported from the Delta, which represents roughly 25% of Southern California imports. Other beneficiaries of

[2] The *Layperson's Guide to San Francisco Bay* prepared by the Water Education Foundation describes the annual diversion as 2.6 MAF/year.

water exported by the CVP include Contra Costa County and Santa Clara County (notably the City of San Jose). The SWP project sends water from the Delta to Napa, Solano, Alameda and Santa Clara Counties as well as coastal communities like Santa Barbara. Both projects also sustain residents of the Central Valley.

Delta as ecosystem

The Delta is a vital estuary teeming with life. The interaction of fresh and salt water produces a rich, varied and unique habitat. The Delta is home to 400 plant species, including 51 on the endangered list; 130 fish species (the area is transited by endangered salmon and home to the endangered Delta smelt); and 200 bird species. The prolific nature of life in the Delta is illustrated by a recent incident following a levy breech that flooded a low-lying island. The crew conducting repairs filled in the gaps in the levy and then began pumping out the water to drain the island, expecting to find a few unfortunate fish. They were surprised (and created a small furor) when the rapidly disappearing water revealed *thousands* of stranded fish.

The Delta is a fragile habitat beset with problems. The Delta faces a severe challenge from invasive (non-native) species, some of which are out-competing indigenous species. There are more than 200 invasive species of plants and animals in the larger Bay Delta region. Other current challenges include farm runoff, endangered species, and competition for water among agricultural users, environmental uses, and water agencies, including those dependent on water exports. The Delta's troubles are not limited to these immediate issues. Climate change and rising ocean levels both loom as long-term challenges. The former may alter the timing and volume of freshwater flows into the Delta; the later could flood the Delta, submersing islands and upsetting the balance between fresh and salt water.

Finally, the twin dangers of a major flood or earthquake are always lurking in the background. A severe earthquake in or near the Delta could destroy the levees, alter salinity levels, and completely disrupt water exports for 12 to 18 months.

Delta as disaster

There is widespread agreement that the Bay Delta ecosystem has been devastated. The levees that protect the low-lying islands, farmland, three state highways, a railroad, and several utility lines are weak and widely expected to fail in the event of an earthquake. Hundreds of thousands of Delta residents were reminded just how vulnerable they are by the images of the aftermath of Hurricane Katrina. Invasive species, urban development, polluted runoff (urban and agricultural), and water transfers have pushed many native species onto state and federal list of threatened and endangered species.

The peripheral canal rejected in a statewide vote in 1982 was supposed to help secure water supplies and help protect the fish, notably by eliminating flow reversals in the Delta. (At times of low inflows, the CVP/SWP pumps occasionally reverse the water flow in the Delta, confusing fish and drawing some of them into the pumps.) Instead, it brought to a boil a fierce policy debate that has continued to simmer ever since.

The Bay Delta Accord, brokered in 1994, has underpinned a temporary truce that lasted from 1994 to 2007. From a vantage point in Southern California, the most important development ushered in by the Bay Delta Accord was the supposedly temporary assignment of responsibility for Delta water quality to the CVP and SWP. This change matters. Previously, allocation disputes among the various users of Delta water were settled by giving environmental uses (such as maintaining freshwater flows in order to restore and/or protect habitat) short shrift. The assignment of responsibility for water quality to the CVP and SWP means that exporters now bear any shortfall in battles among the various users of Delta water.

The CALFED process, inaugurated in 1995 by the federal and state agencies with management and regulatory responsibility related to the Bay Delta, was another attempt to fix once and for all the problems of the Delta. The process was a small success in as much as it managed the heretofore impossible task of bringing together all of the diverse water interests in the Delta – regulators, farmers, water exporters (recipients), and environmentalists – to pursue solutions. Ultimately, however, CALFED failed, ushering in a new era that has seen a shift from negotiation to litigation and legislation. This has produced court-ordered limits on water transfers, and a status quo that is quite simply unsustainable.

The Gathering Storm

The CVP and SWP need Endangered Species Act (ESA) "take permits" in order to operate in the Delta because their pumping operations kill some fish on the endangered species list, notably the Delta smelt. In 2007, a federal court declared the export projects' ESA take permits invalid and ordered a new biological opinion (scientific review). Further, the court ordered Delta exports interrupted for 10 days in June to protect the smelt. At the end of August, a federal judge imposed interim operating guidelines, pending revised biological opinion. The interim guidelines significantly curtail CVP and SWP exports in 2008.

Southern California will therefore face court-mandated cutbacks in 2008. The impact on the CVP and SWP are uncertain but significant: Delta exports will be reduced by 8% to 35%, depending on hydrology (whether it is a particularly wet or dry year). These cuts are a serious blow and follow a series of reductions in Southern California water deliveries. The Colorado River 4.4 Plan restricted California to its annual allotment of 4.4 MAF of water from the river (where prior to the agreement the state routinely exceeded its allotment). Court-ordered mitigation reduced deliveries in Los Angeles from the Owens Valley.

The pain from the cuts will almost certainly be shared between the CVP and SWP, but there is still considerable uncertainty surrounding the allocation of water during shortage between SWP and CVP (metropolitan and industrial users versus agriculture users); water shortage and drought management plans; preferential rights; and local supply reliability programs. There is also uncertainty regarding banking, storage and transfers. Resolving these issues will be a top priority now that 21 million people – the world's 12th largest economy – will face water shortages. The issue is unlikely to fade once the new permits have been issued because the biological opinion is expected to recommend that curtailment continue.

Short-term responses

The surest short-term response to water shortage is to use less water. Conservation will be a top priority. Some local water agencies are already adopting more aggressive local conservation measures and most are seeking voluntary cuts. If it is a particularly dry year, mandatory conservation (in the form of rationing) might be necessary. Such a drastic move seems unlikely for now, not the least because MWD and some local agencies can continue to draw down storage. Relying on stored water, however, is a short-term solution since it presumes the mandated cuts will eventually end with the restoration of higher water import levels.

Transfers from agriculture are always a possibility, since most of the water in the state is consumed by agricultural users whose use is often subsidized through old contractual arrangements and who often grow low-value crops. Mutual aid arrangements between water agencies can also help bridge the gap – a solution that once again presumes a favorable resolution and the resumption of imports. In sum, there are several short-term responses that will allow Southern California water agencies to cope with the court-order reductions in deliveries, but all of them are at best band-aid measures.

Solutions for the Bay-Delta

Securing deliveries of water from the Delta to Southern California will require embracing four strategies. First, Southern Californians and their water agencies will have to get truly aggressive about conservation. The region has made important strides, particularly with respect to measures that curtail indoor water use, such as requirements for low-flow showers and toilets. The next step will be to curtail outdoor uses. Here, the Southern Nevada Water Authority (SNWA) offers an extreme example.

SNWA in the mid-1990s adopted a goal of 25 percent conservation by 2010. Southern Nevada made consistent progress through the 1990s, but conservation levels peaked in 1999 and then began declining. By 2002 it became apparent the drought on the Colorado River was worsening and in early 2003 SNWA launched a Drought Plan that reinvigorated conservation and pushed the region to the 2010 target in 2004. SNWA determined the biggest potential for water savings come from outdoor uses such as landscape irrigation. To reduce demand, they employed tiered water pricing, and a slew of incentives such as an irrigation clock rebate program, water efficient technologies rebate program for businesses and a pool cover rebate program. One of their most successful programs offered smart water landscapes rebates that paid residents $1/sq ft to replace turf with water-efficient landscaping. This one program element alone is estimated to have saved 3.5 billion gallons of water annually.

Getting more aggressive about conservation in Southern California is a sensible long-term strategy because it will make it easier to deal with future shortages and lessen the pressures from population growth. Moreover, Northerners seem particularly incensed that water should be transferred to what some perceive as profligate uses of water in a naturally arid region. The aggressive conservation strategy therefore could make Northern California more receptive (or less hostile) towards Delta solutions that permit more reliability of exports to Southern California.

The second long-term strategy is improved resource management. As we enter an era in which all of the region's imported water supplies are likely to be stressed, it is going to become increasingly important to use *all* of our resources more effectively. The region needs to take advantage of the benefits that can be realized by employing more flexible approaches to water management. In particular, the region needs to work at breaking down the political and institutational barriers to common-sense, physical-engineering-type solutions. If it makes sense to move off of imported water in one place by backing it with surplus water from another, then institutional barriers shouldn't prevent it. One of the critical barriers to efficient resource sharing is the lack of institutional mechanisms for inter-agency sharing and cooperation. Put more bluntly, individual water agencies act as if they are running fiefdoms where the primary goal is to horde available supplies, even though cooperation with neighboring agencies might produce better outcomes and more reliable supplies for everyone.

Third, the entire state needs to get serious about environmental restoration in the Delta. The status quo in the Delta is not physically or legally sustainable. Physically, the miles of dilapidated earthen levees barely protect sea-level or sub-sea-level parcels from inundation, and from a legal perspective, water export activities are hurting the environment (and killing fish) in a manner that the law will not permit.

Fourth, alternative conveyance facilities (along the lines illustrated in Figure 4) need to be built. Conveyance capacity should be limited to the minimum required to meet export needs on a flexible basis. A canal much smaller than the one proposed in 1982 would reassure

Figure 4
Alternative Conveyance Facilities for the Delta

Northern California voters by making the political decision to drain the river for the benefit of Southern California physically impossible to carry out. Similarly, investing in through-Delta conveyance would reassure environmentalists that Delta habitat protection and restoration will remain a state-wide priority.

V. SCLC Opportunities (Next Steps)

Fixing the Bay-Delta is a necessary *first step* in securing water supplies for Southern California. A Delta fix is not a "silver bullet" to solve the state's water/environmental problems, but it makes those problems more manageable and more susceptible to solution. With all of the key players engaged on the water issue and proposing competing visions for a major water bond to be sent to the voters in 2008, there is a "once-in-a-generation opportunity" to end more than twenty years of inaction in the Bay-Delta.

The next steps for the Leadership Council on water should be to:

1) *Support the solution in the Delta*
   The Governor, the legislature, environmentalists, the blue ribbon task force, and the academics at UC Davis – everyone – agree on the minimum fixes required for the Delta. The solution doesn't require money from the state general fund or from a bond issue, since it can be paid for by the water users. Nonetheless, the basic solution risks being held up as competing interest groups attempt to tie their special projects to the Delta solution. The SCLC can help keep the focus on a minimum necessary solution by emphasizing that the status quo needlessly places the entire state economy at risk should a major flood or earthquake strike the Delta.

2) *Support efforts to break down barriers to cooperation among water agencies in Southern California*
   One of the critical barriers to efficient resource sharing is the lack of institutional mechanisms for inter-agency sharing and cooperation. Put more bluntly, individual water agencies act as if they are running fiefdoms where the primary goal is to horde available supplies, even though financially equitable cooperation with neighboring agencies would produce better outcomes and more reliable supplies for everyone.

3) *Fix the Delta to address the Khuel and Costa requirements for proven water resources before new development can proceed.*
   Fixing the mess in the Delta won't automatically resolve the limits on growth created by the requirements of Khuel's and Costa's respective bills, but addressing them without a long-term solution in the Delta is probably impossible. Southern California needs reliable water (not more water), and reliability is something the Delta cannot provide in its current state.