

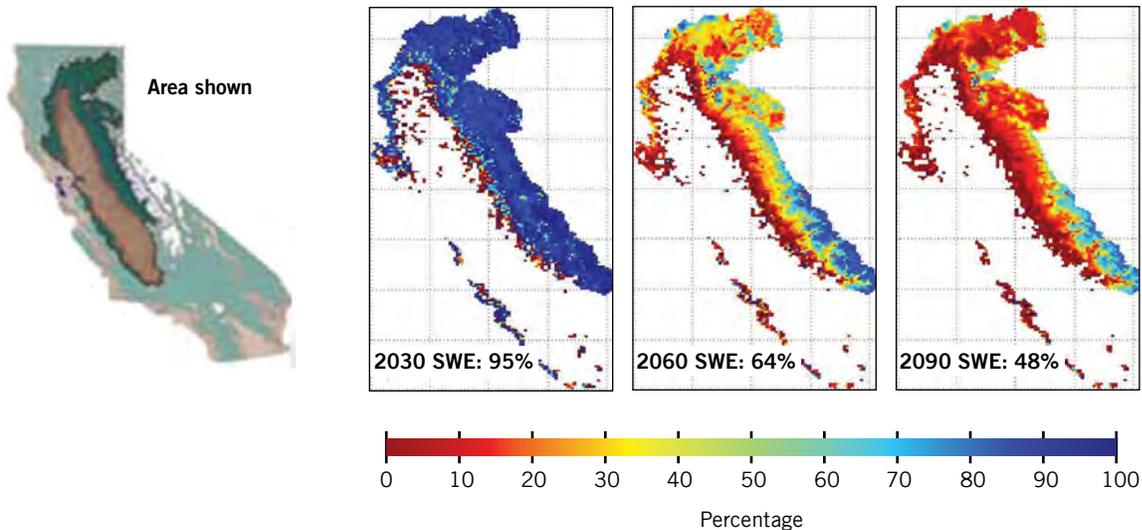
CALIFORNIA FACES GROWING WATER MANAGEMENT CHALLENGES

Water management in California has always been difficult. The state's variable climate is marked by long droughts and severe floods, with stark regional differences in water availability and demand. A vast network of storage and conveyance facilities delivers water from the wetter parts of the state to population and farming centers in the Bay Area, Southern California, and the San Joaquin Valley. This network is now threatened by the physical and biological fragility of the Sacramento–San Joaquin Delta, hub of the state's water system.

Other challenges are on the horizon: Although per capita water use is decreasing, population growth is likely to increase urban water demand in some regions. At the same time, conflicts are growing between human water use and water needed to support fish and other wildlife. In addition, California faces serious and growing threats to life and property from flooding.

Climate change will play an important, if uncertain, role. California's natural variability is likely to increase, accentuating droughts and floods. Rising air temperatures are expected to significantly reduce the Sierra Nevada snowpack, affecting water storage as well as winter and spring flood flows. Higher water temperatures may make it harder to maintain aquatic habitats for native fish species. Over time, all of these challenges are likely to intensify. Potential solutions will involve difficult and sometimes costly trade-offs, as well as inconvenient legal and political changes.

RISING TEMPERATURES WILL DIMINISH THE SIERRA NEVADA SNOWPACK



SOURCE: N. Knowles and D. R. Cayan, "Potential Effects of Global Warming on the Sacramento/San Joaquin Watershed and the San Francisco Estuary," *Geophysical Research Letters* 29, no. 18 (2002).

NOTES: SWE is snow water equivalent. These scenarios are based on projected temperature increases: 0.6°C (2020–2039), 1.6°C (2050–2069), and 2.1°C (2080–2099), expressed as a percentage of estimated present conditions (1995–2005). These are modest increases relative to some model projections. With higher temperature increases, the snowpack would be commensurately smaller.

CALIFORNIA'S BIGGEST WATER CHALLENGE: INSTABILITY IN THE DELTA

As the fragile hub of California's water supply, the Delta now poses serious risks to the economies of the Bay Area, Southern California, and the San Joaquin Valley. Sea level rise and earthquakes threaten the weak Delta levees. The collapse of native fish species has led to cutbacks in pumping from the southern Delta. The Delta's physical deterioration will not be delayed by political indecision: the state faces inevitable, fundamental change in this region.

- **Moving water beneath the Delta could reduce both ecosystem and economic risks.**

The current system relies on pulling water directly through Delta channels to the pumps. A new management plan, known as the Bay Delta Conservation Plan, is now being formulated by local, state, and federal water agencies. They are considering the construction of two tunnels to tap some water upstream on the Sacramento River and move it underneath the Delta to the pumps. This change could be good for the environment: fewer native fish would be trapped in the pumps and it would be easier to restore more natural flows within the Delta. The state's economy could also benefit from improved water quality and water supply reliability.

- **Governance and finance solutions are needed and so is attention to the Delta economy.**

To ensure that the tunnels are managed for environmental benefits, the project should include performance-based limits on water diversions from the Delta. Water users have said they will pay for the new conveyance infrastructure, but the plan assumes state and federal taxpayers will pay for large ecosystem investments. Although this is appropriate, given the broad public responsibility for water and land management practices that have contributed to the Delta's ecosystem decline, it will be challenging to raise these funds. Funds will also be needed to support the Delta economy, because many of the region's islands are at high risk of inundation.

CALIFORNIA HAS MANY TOOLS TO COPE WITH WATER SCARCITY

There has been little expansion of the state's major water infrastructure since the early 1970s, but California's economy has still prospered. From 1967 to 2005, per capita water use declined by half, real per capita state GDP doubled, and the economic value of each unit of water increased four-fold. These trends—which were temporarily slowed by the recent recession—reflect the increased efficiency of water use in all sectors as well as a decline in the relative importance of agriculture, which accounts for more than three-quarters of water use but only 1 to 2 percent of state GDP.

- **California is fortunate to have many options for meeting new demands.**

Expanding traditional supply sources—particularly surface reservoirs and native groundwater supplies—is more difficult today than in the past. But there is considerable scope for cost-effective expansion of nontraditional supplies, such as recycled wastewater, and for improving water use efficiency. Water marketing—the sale or leasing of water—plays an important role in increasing efficiency; it allows water to be transferred to growing urban areas and from lower- to higher-value farming. It also creates broad incentives to conserve.

- **Much progress has been made since the drought of the early 1990s.**

Water markets have been effective in supplying water to cities and high-value agriculture during droughts and for long-term growth. Urban water use efficiency has risen in most areas thanks to new plumbing codes, better technology, and better pricing incentives. Regional cooperation is helping local utilities cope with supply emergencies.

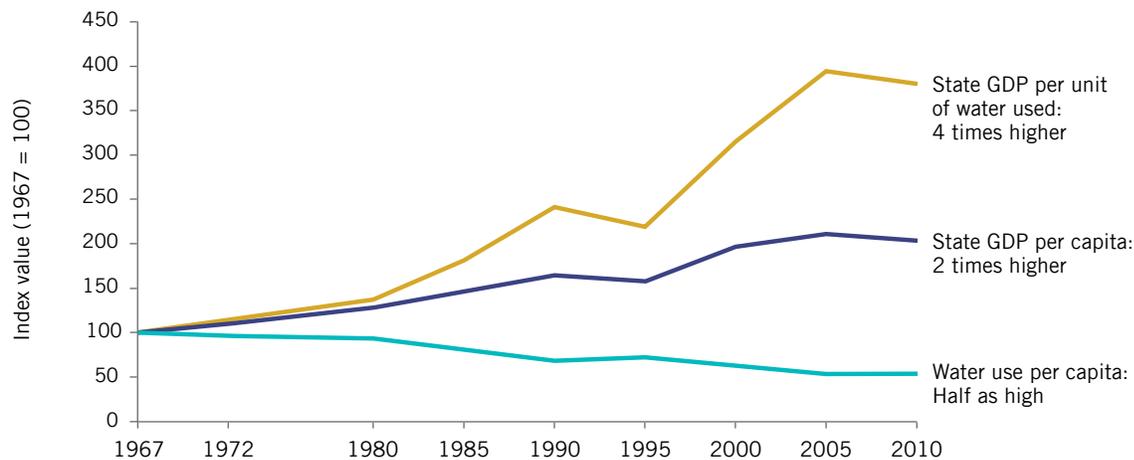
- **Underground storage still has great untapped potential.**

Where space is available in aquifers, storing water underground can be a cost-effective way to save it for dry years. This “groundwater banking” will become increasingly important as the snowpack declines. The current lack of state regulation makes success dependent on agreements among local parties. Groundwater banking provided significant relief during the drought in the late 2000s, but much more could be done, particularly in the Central Valley.

- **Surface storage expansion has been very contentious.**

Increased surface storage could make up for some loss of storage in the snowpack and could also provide more flexibility in managing floodwaters and environmental flows. However, new storage has not been proven to provide large new supplies of water, and it will be less valuable if climate change reduces overall precipitation. Large financial and environmental costs also raise concerns. Public opinion appears split: 49 percent of all adults feel that California should focus on improving water use efficiency, while 45 percent prefer building new storage (PPIC Statewide Survey, September 2013).

THE ECONOMIC EFFICIENCY OF WATER USE CONTINUES TO RISE



SOURCE: Ellen Hanak et al., *Water and the California Economy* (PPIC, 2012), updated to 2010 with data from the Department of Water Resources, the Department of Finance, and the U.S. Bureau of Economic Analysis.

NOTE: State GDP (gross domestic product) is adjusted for inflation. Water use estimates are for applied use in the agricultural and urban sectors.

CALIFORNIA HAS ONLY JUST BEGUN TO ADDRESS EXTREME FLOOD RISKS

Sacramento has the highest flood risk of any major U.S. city, and many other areas in the Central Valley and the Bay Area are at extreme risk of flooding. These risks are expected to grow with climate change. Although the state has recently increased investments in flood control infrastructure, more work is needed to keep new development out of harm's way.

- **Flood management faces major funding challenges.**

This sector has traditionally relied on large (65%) federal cost shares for new investments, but federal contributions have been lagging and are likely to decline in the future. State investments in flood prevention increased considerably after Hurricane Katrina, thanks to voter approval of \$5 billion in state general obligation bonds. However, the remaining funds fall far short of estimated needs (\$13 to \$17 billion in the Central Valley alone).

- **Local governments have few incentives to limit flood risk exposure.**

A 2003 court decision made the state liable for damage from failure of many Central Valley levees, even those maintained by local agencies. A legislative package passed in 2007 requires that locals make land-use decisions that will reduce flood risk to new homes in the Central Valley, but it is unclear whether climate change—expected to increase flood risk—will be taken into account in these decisions.

- **Residents also have few incentives to limit flood risk exposure.**

As long as buildings are located behind levees deemed to provide protection against a “100-year flood,” there is no requirement to disclose flood risks to residents at the time of sale, even though many areas would face serious flooding if levees were breached. Within the Central Valley, the state recently began to send annual flood risk notices to landowners in these zones—a positive step. Few Californians hold flood insurance, which is required only in areas with extreme flood risk.

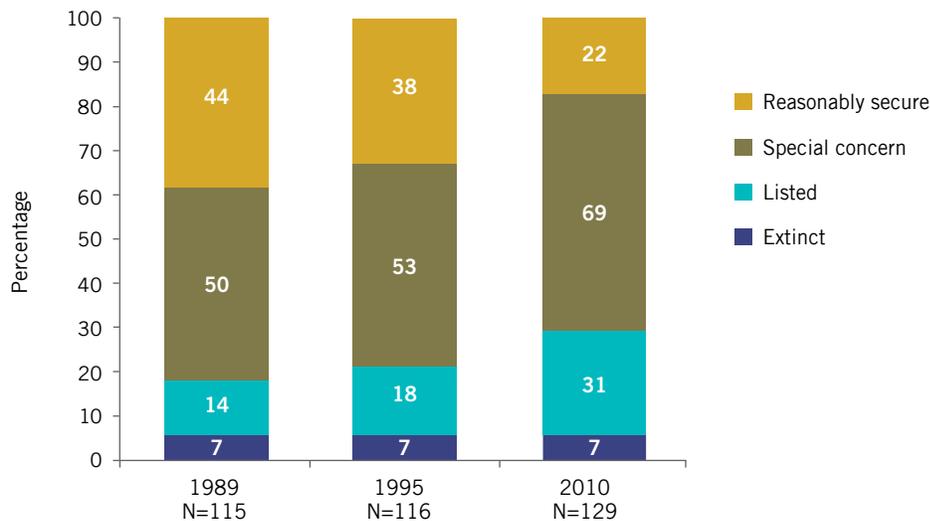
CALIFORNIA MUST IMPROVE MANAGEMENT OF AQUATIC ECOSYSTEMS

The demand for environmental water, healthy watersheds, and clean beaches has been increasing and is likely to grow. However, the state faces major challenges in meeting some environmental goals.

- **Native fish species are in decline.**

Populations of native fish species—an important indicator of overall ecosystem health—are declining across the state, despite several decades of well-intentioned efforts and expense. These declines heighten conflicts with other water management goals because they lead to increasingly tight and costly restrictions on water supply, wastewater, and flood protection projects.

CALIFORNIA'S NATIVE FISHES ARE IN TROUBLE



SOURCE: P. B. Moyle, J. Katz, and R. M. Quinones, "Rapid Decline of California's Native Inland Fishes: A Status Assessment," *Biological Conservation* 144: 2414–23 (2011).

NOTES: "Extinct" = extirpated from California; "listed" = threatened or endangered under state or federal Endangered Species Acts; "special concern" = in decline and could qualify for listing in the future; "reasonably secure" = widespread and abundant according to current knowledge. N = number of known species.

- **Ecosystem-based approaches can help.**

At present, environmental management is often "siloeed," with each agency and each project addressing particular issues in particular locations—water quality, wetlands, flows, habitat—and no integrated vision of how to contribute to overall improvement of ecological conditions. Coordinated approaches that seek to improve environmental performance for entire watersheds would be much more effective in protecting native species and would enable California to allocate its dollars (and environmental water) more wisely.

CALIFORNIANS MUST DECIDE HOW TO FILL FUNDING GAPS

Although Californians pay for most water system expenditures through their monthly water and wastewater bills, the state has been relying more heavily on state general obligation bonds (funded by tax dollars) over the past decade.

- **State bonds have provided valuable support ...**

These bonds have helped local water agencies fund some innovative projects, such as water recycling and groundwater banking, and they have been essential for flood protection and ecosystem management, which do not have adequate alternative funding sources.

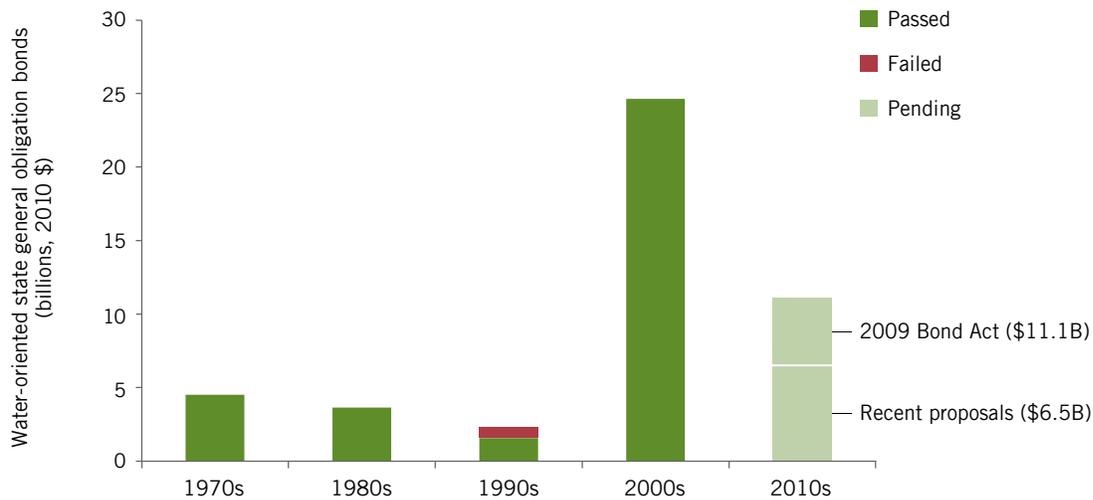
- **... but public appetite for more bonds may be waning.**

Existing bonds are nearly depleted, and concerns about weak voter support have led the legislature to twice delay putting a new \$11 billion bond on the ballot (originally scheduled for November 2010, now delayed until November 2014). Even a smaller bond—such as the \$6.5 billion measure now being considered by the legislature as a replacement for the larger one—would probably face an uphill battle; in recent polling, only 50 percent of likely voters said they would approve a bond of this amount (PPIC Statewide Survey, September 2013). When investments lead to true public benefits, such as ecosystem restoration, relying on tax dollars makes sense. But these investments also take general revenue funds away from education and other state budget priorities.

- **Will the public get behind more locally based funding?**

Given these tradeoffs, California may need to rely more heavily on the “user pays” principle to fund ecosystem programs (through higher monthly water bills and property assessments). Gaining public backing for more ecosystem funding may prove challenging: 61 percent of Californians say they support increasing state spending to improve conditions for native fish, but support falls to 39 percent if it means an increase in residents’ water bills (PPIC Statewide Survey, December 2012). Increasing local contributions is also likely necessary for flood protection, but this requires making a case to local voters.

THE 2000S SAW UNPRECEDENTED GROWTH IN STATE WATER BONDS



SOURCE: Ellen Hanak et al., *Water and the California Economy* (PPIC, 2012).

NOTES: Values are converted to 2010 dollars using the construction cost index from the *Engineering News-Record*. Past bonds have supported water supply, water quality, flood infrastructure, and ecosystem and open space improvements. In 1960, voters approved a \$1.75 billion bond (\$18.7 billion in 2010 dollars) for the construction of the State Water Project, but this bond has been paid for by water users, not general fund tax dollars.

LOOKING AHEAD

California has the tools to help secure a safe and reliable water supply, improve conditions for aquatic species, and reduce flood risks. In recent years, water managers have made significant progress toward these goals. But the challenges are increasing with population growth and climate change. Increased momentum toward policy reform—coupled with new investments—is essential to the state’s future. Some changes will be politically difficult. The following issues require sustained attention.

The Delta. The proposed new tunnels have the potential to safeguard the Delta’s environment while maintaining water supply reliability. But this solution requires solid policies on governance, finance, and mitigation for Delta landowners and residents, and a well-organized and well-funded science program to adapt and refine ecosystem management under changing conditions.

Ecosystem protection. Beyond the Delta, a more comprehensive, coordinated, and proactive approach is needed to support California's aquatic ecosystems and the species that depend on them.

Water efficiency. Better pricing policies—such as tiered water rates with higher prices for greater use—can heighten incentives to conserve while allowing local water suppliers to balance their budgets.

Groundwater management. Better basin management is a prerequisite to realizing the significant potential of groundwater banking. Many groundwater basins have effective local management protocols, especially in Southern California and Santa Clara County. But improvement is needed elsewhere.

Flood risk exposure. To reduce risks to new development, floodplain mapping should account for climate change and increasing flood risks. To boost homeowner awareness, the risks of living behind levees should be disclosed statewide, building on the new policy in the Central Valley, and flood insurance requirements should perhaps be strengthened.

Funding. The state will need to find ways to pay for rising water infrastructure costs and for critical improvements in aquatic habitat. Even if voters ultimately approve new state bond funding, local funding by ratepayers (and property owners in flood zones) will need to increase.

Climate change. Higher water temperatures and sea level rise will alter aquatic habitat in significant but largely unexplored ways. Environmental laws will require that water users respond to these changes with potentially costly management actions (e.g., altering reservoir operations). Anticipating the likely changes would allow the design of more cost-effective responses.

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