

Water Use in California

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► **Water in California is shared across three main sectors.**

Statewide, average water use is roughly 50% environmental, 40% agricultural, and 10% urban, although the percentage of water use by sector varies dramatically across regions and between wet and dry years. Some of the water used by each of these sectors returns to rivers and groundwater basins where it can be used again.

► **Environmental water provides multiple benefits.**

Environmental water use falls into four categories: water in rivers protected as “wild and scenic” under federal and state laws, water required for maintaining habitat within streams, water that supports wetlands within wildlife preserves, and water needed to maintain water quality for agricultural and urban use. Half of California’s environmental water use occurs in rivers along the state’s north coast. These waters are largely isolated from major agricultural and urban areas, and their wild and scenic status protects them from significant future development. In dry years, the share of water that goes to the environment decreases dramatically as flows diminish in rivers and streams. At the height of the 2012–16 drought, the state also reduced water allocations for the environment to reserve some supplies for farms and cities.

► **Agricultural water use is falling, while the economic value of farm production is growing.**

More than nine million acres of farmland in California are irrigated, representing roughly 80% of all water used for businesses and homes. Higher-revenue perennial crops—nuts, grapes, and other fruit—have increased as a share of irrigated acreage (from 16% in 1980 to 33% in 2015 statewide, and from 21% to 45% in the southern Central Valley). This shift, plus rising crop yields, has increased the economic return on water used for agriculture. Farm production generated 38% more gross state product in 2015 than in 1980, even though farm water use was about 14% lower. But even as the agricultural economy is growing, the rest of the economy is growing faster. Today, farm production and food processing generate about 2% of California’s gross state product, down from about 5% in the early 1960s.

► **Despite population growth, total urban water use has also fallen.**

The San Francisco Bay and South Coast regions account for most urban water use in California. Both rely heavily on water imported from other parts of the state. Total urban water use has been falling even as the population grows. Even before the latest drought, per capita water use had declined significantly—from 231 gallons per day in 1990 to 180 gallons per day in 2010—reflecting substantial efforts to reduce water use through pricing incentives and mandatory installation of water-saving technologies like low-flow toilets and shower heads. In 2015, per capita use fell to 146 gallons per day in response to drought-related conservation requirements. Much of the recent savings came from reducing landscape watering, which makes up roughly half of all urban water use. Per capita use has since rebounded slightly, but a new state law will require further long-term reductions.

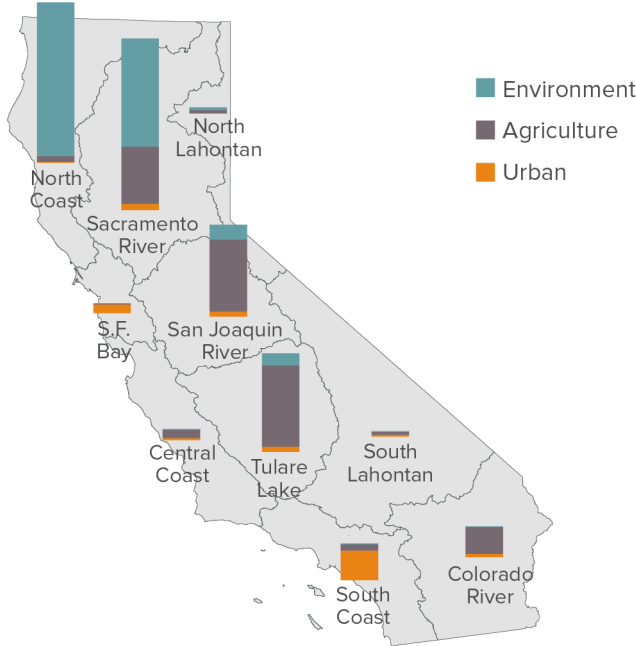
► **Drought will pose major water use challenges.**

California needs to adapt to increasing drought intensity. Agriculture relies heavily on groundwater during droughts—particularly in the Central Valley—but more sustainable groundwater management is needed to maintain this key drought reserve. An increase in tree and vine crops—which need to be watered every year—is making farming more vulnerable to water shortages. State law now requires water users to bring their groundwater basins into long-term balance by the early 2040s. This will likely require farm water use to fall in regions that have been over-pumping, including the southern Central Valley and the Central Coast. In urban areas, the greatest potential for further water savings lies in long-term reductions in landscape irrigation—a shift requiring changes in plantings and watering habits. Finally, state and federal regulators will need new approaches to reduce harm to fish and wildlife during increasingly intense droughts. This will require better drought planning, investments in new habitat, and setting aside water during wet years for ecosystem uses in dry years.

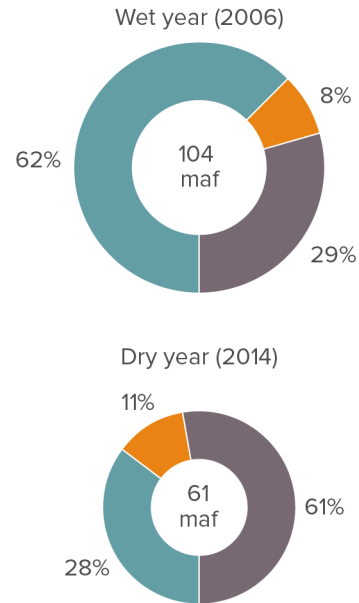


Water use varies dramatically across regions and between wet and dry years

Average annual applied water use (1998–2015)



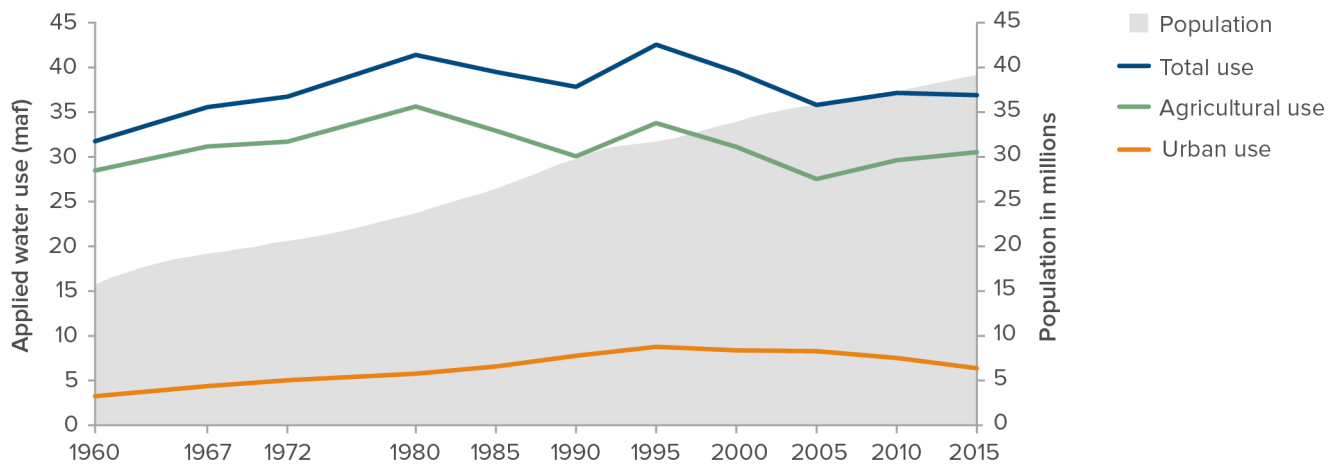
Statewide applied water use, millions of acre-feet (maf)



Source: Department of Water Resources, *California Water Plan Update 2018 (Public Review Draft)*.

Notes: The figure shows applied water use. The statewide average for 1998–2015 was 77.2 maf. Environment (38.3 maf average) includes water for “wild and scenic” rivers, required Delta outflow, instream flows, and managed wetlands. Urban (7.9 maf) includes residential, commercial, and industrial uses; and large landscapes. Agriculture (31 maf) includes water for crop production. Net water use—i.e., the volume consumed by people or plants, embodied in manufactured goods, evaporated, or discharged to saline waters—is lower. The figure excludes water used to actively recharge groundwater basins (3% for urban and 1% for agriculture on average), conveyance losses (3% for urban and 8% for agriculture), and water used for energy production (less than 2% of urban use).

Both agricultural and urban water use have fallen over the past two decades



Sources: Water use: *California Water Plan Updates* (Department of Water Resources, various years). Population: Department of Finance.

Notes: Except for 2015 (a severe drought year), the figure reports estimates for normal rainfall years. Pre-2000 estimates are adjusted to levels that would have been used in a year of normal rainfall. Estimates are for water years (October to September).

Sources: Department of Water Resources (water use and population for 1998–2015), State Water Resources Control Board (post-2015 urban water use), US Bureau of Economic Analysis (gross state product), and National Agricultural Statistics Service (crop acreage).

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California's Water Market

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➤ **Water marketing is an important tool for managing scarce supplies.**

In California's water market, buyers and sellers trade water through short- and long-term leases and permanent sales of their water rights. Trading adds flexibility to the state's water allocation process. Short-term transfers lessen the economic impact of shortages during droughts by shifting water to activities and places where the lack of water will be more costly. Long-term and permanent transfers accommodate geographic shifts in water demand as the economy changes and the population grows. Today, most trading involves surface water. Establishing local groundwater markets could significantly reduce the costs of bringing groundwater basins into balance under the Sustainable Groundwater Management Act (SGMA).

➤ **Water sales grew significantly during the 1990s, but trading has since been flat.**

Statewide, almost 1.5 million acre-feet of water are traded annually—about 4% of all water used by cities and farms. Most trading occurs within the same county (44%) or region (33%). The state began fostering market growth in the early 1980s, when annual trades averaged just over 100,000 acre-feet. A major uptick in market activity occurred during the 1987–92 drought. In 1991, direct state purchases and a state-run Drought Water Bank resulted in trades of more than one million acre-feet. Market expansion continued when the rains returned, partly driven by increased purchases of water for the environment. Trading has been fairly flat since the early 2000s.

➤ **Most water sales are from the farm sector.**

Both farms and cities buy water, but most sellers are in the farm sector—reflecting the fact that farms hold many more water rights (roughly four times as much as cities). The 2000s saw a shift toward more long-term leasing and permanent sales. Growing cities in the San Joaquin Valley and Southern California were major buyers. Southern California cities now receive nearly 15% of their supplies from such trades. The market has also supported productive farming areas lacking reliable supplies and has helped keep orchards alive during droughts.

➤ **Water sales also support the environment.**

Environmental water purchases have been used to support wildlife refuges, increase flows for fish, and until recently, reduce salt build-up in the Salton Sea. Such trades can help reduce conflicts among water users over the allocation of scarce supplies. In all, nearly six million acre-feet were acquired for environmental purposes from 1982–2017, or 17% of total market flows. Funds have come from state and federal taxpayers and some water users. Recent funding declines have reduced volumes of environmental water purchases.

➤ **The transfer approval process is complicated.**

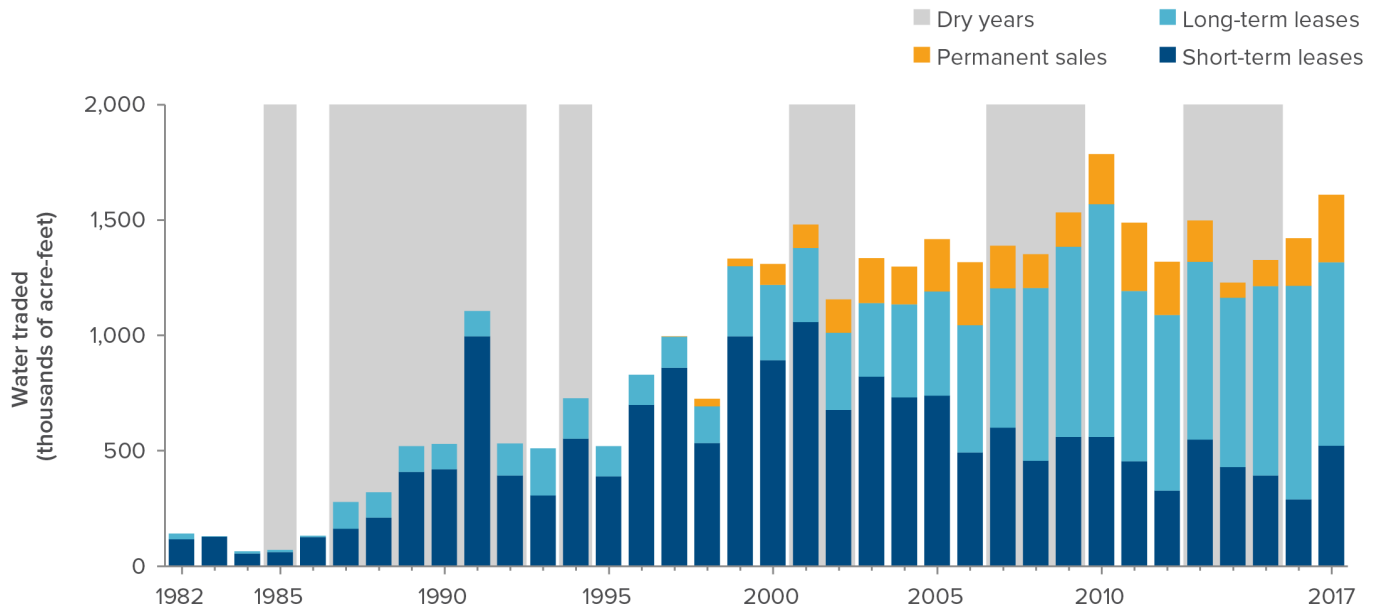
Trading is subject to regulatory oversight because moving water from one place to another can affect the environment and other water users. However, the transfer approval process is fragmented and inconsistent, with different rules for different types of water rights and agencies. State and federal administrative reviews can be lengthy—often taking months, even years. Many irrigation districts restrict trading of surface water with outside parties and many rural counties restrict transfers of groundwater. As part of their plans for implementing SGMA, many of the new groundwater sustainability agencies will also establish their own groundwater trading policies.

➤ **Reforms could help strengthen the market.**

Several changes could help California's water market function more smoothly. A top priority is improving information about water availability and how much can be safely traded without harming the environment or other legal water users. Establishing groundwater markets will require strong basin accounting systems, as well as caps on how much each water user may pump. Building a central repository of information on volumes and prices of trades can also improve transparency and market access. Clarifying and streamlining the review process for transfers is another priority. Addressing infrastructure weaknesses that restrict moving water between buyers and sellers can also improve trading in some areas.



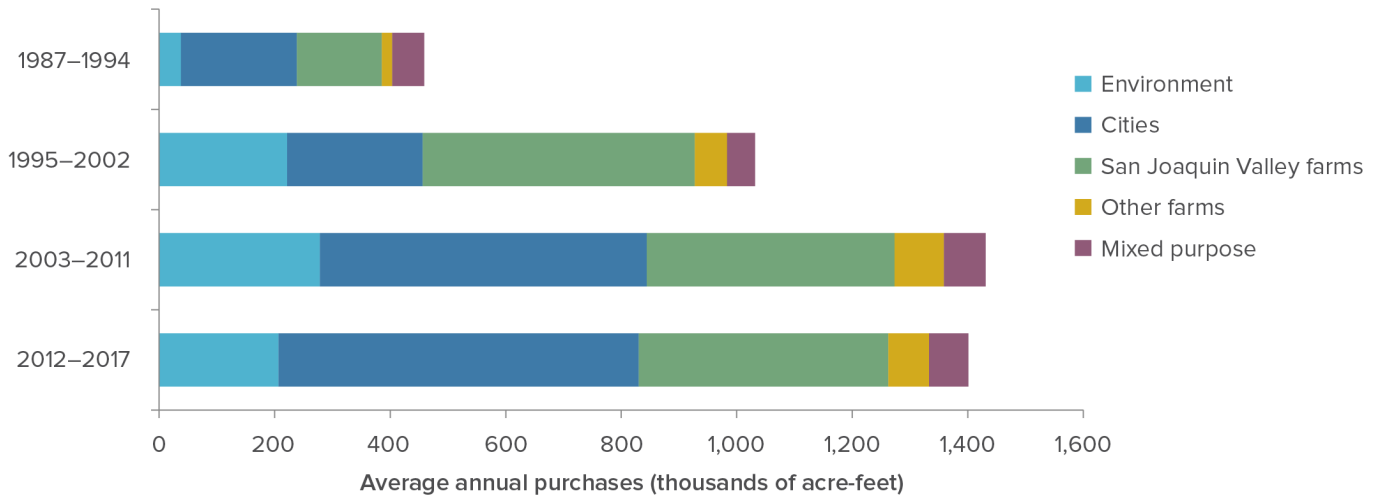
California's water trades have been fairly flat since the early 2000s



Source: Updated from E. Hanak and E. Stryjewski. *California's Water Market, By the Numbers: Update 2012* (PPIC 2012).

Notes: The figure shows surface water traded between entities that are not members of the same water district or wholesale agency. It excludes volumes committed under long-term lease and permanent-sale contracts that were not physically transferred because of hydrologic conditions or other factors (in 2017, roughly 500,000 acre-feet). Dry years are those classified as critical or dry for the Sacramento Valley. Volumes are in thousands of acre-feet (taf).

Cities, farms, and the environment acquire water through the market



Source: Updated from E. Hanak and E. Stryjewski. *California's Water Market, By the Numbers: Update 2012* (PPIC 2012).

Notes: The figure shows actual volumes purchased by different sectors. "Mixed purpose" denotes purchases by agencies with significant urban and agricultural uses, such as the Coachella Valley Water District and the San Luis & Delta-Mendota Water Authority.

Sources: Water trading: compiled from the authors from various sources. Water use: Department of Water Resources. Water trading benefits under SGMA: E. Hanak et al. *Water and the Future of the San Joaquin Valley* (PPIC 2019).

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Managing Drought in a Changing Climate: Four Essential Reforms

Climate change is bringing pressures that will seriously impact California's water system: warming temperatures, shrinking snowpack, shorter and more intense wet seasons, more volatile precipitation, and rising seas. The unusually warm drought of 2012–16 provided a crucial test of California's ability to manage severe water scarcity, along with lessons on adapting to conditions that are expected to become more common. The following four reforms can help reduce the social, economic, and environmental costs of future droughts.

Climate Pressures

Warming temperatures

Shrinking snowpack

Shorter wet seasons

More volatile precipitation

Rising seas

Reform 1: Plan Ahead

Successful adaptation requires advance planning at both local and regional scales. Top priorities:

- **Strengthen urban water management plans.** Plans should incorporate stress tests of supplies to account for longer droughts and the impacts of increased warming. The state should provide oversight, incentives, and guidance on incorporating climate projections into these tests.
- **Ensure effective groundwater sustainability plans.** Successfully implementing the Sustainable Groundwater Management Act is the most important step toward drought security for California agriculture. Sustainability plans should prepare for groundwater drawdowns during severe droughts and pursue coordinated, regional approaches on recharge and land fallowing.
- **Develop drinking water plans for rural communities.** Drinking water vulnerabilities in disadvantaged rural communities will worsen with climate change. State and local partners should identify communities at highest risk, connect them to larger systems where feasible, and devise drought resilience programs for the rest.
- **Prepare ecosystem drought plans.** Reducing the impact of future droughts requires watershed-level drought plans for freshwater ecosystems. These plans should identify actions to prepare for drought and to help with post-drought recovery. Strategic investments in water acquisitions and climate-resilient habitat—such as streams fed by cold water springs—can help protect at-risk species during drought.

Reform 2: Upgrade the Water Grid

Climate pressures will make it harder to simultaneously store water for droughts, manage flood risk, and protect freshwater ecosystems. Modernizing California's "water grid"—the linked network of above- and below-ground storage and conveyance systems that connects most water use in the state—can help reduce costs of future droughts. Investments should favor projects that provide multiple benefits and increase resilience. Top priorities:



- **Improve conveyance and storage capacity.** California’s aging water infrastructure needs an overhaul to improve its ability to adapt to a changing climate. Priorities include repairing dams and expanding conveyance to support groundwater storage and water trading and sharing programs.
- **Modernize and integrate operations.** Adapting to a warmer, more volatile climate will require introducing more flexibility into the operation of storage and conveyance facilities and ensuring they work together as an integrated water supply and flood management system. One key opportunity for better integration is to merge the federal Central Valley Project and the State Water Project into a single entity that functions as a regulated, independent wholesale water utility. Regionally, there are also many opportunities to integrate the operation of local water systems.

Reform 3: Update Water Allocation Rules

California should undertake a comprehensive update of water allocation rules. The goals should be to find equitable and efficient ways to allocate supplies among competing demands during dry times while promoting efforts to capture and store water during wet times. Top priorities:

- **Promote groundwater recharge.** The rules governing diversion of water from rivers for groundwater storage are unclear, and permitting needs to be more expeditious to take advantage of high flows. The State Water Board should update rules governing capture and recharge during high flows.
- **Streamline trading and banking.** Limitations in conveyance infrastructure are compounded by difficulties in securing permits for trades and groundwater banking partnerships, where parties work together to store water. Simplified environmental reviews and pre-approved transfers are needed.
- **Give the environment a water budget.** Current practices do not provide enough flexibility to manage flows in support of freshwater ecosystems. Granting ecosystems water budgets that can be flexibly managed like a water right—including storing and trading—would allow managers to prepare for and manage drought. It would also reduce conflict over scarce supplies.
- **Improve water rights administration.** The State Water Board should have more comprehensive jurisdiction over water rights—including permitting authority over all surface water rights, and groundwater pumping that has a significant effect on surface water resources.

Reform 4: Find the Money

The state’s water system has numerous areas where available funding is far below ongoing needs. Reliable sources of funding are crucial for adapting to climate change. Top priorities:

- **Use general obligation bonds for public benefit.** State bonds should be used for projects that address environmental or social justice concerns, or provide other demonstrable public benefits such as flood protection or restoration of groundwater basins.
- **Fill the gap for fiscal orphans.** Underfunded areas—including safe drinking water, ecosystems, flood and stormwater management—face a gap of \$2–\$3 billion per year. Closing it will require a broader, more reliable mix of state and local funding sources, including new fees and taxes.
- **Reform water pricing law.** Proposition 218 limits the ability of publicly owned water utilities to charge higher prices during drought. In addition, utilities need more flexibility to implement “lifeline rates” to maintain affordability for poor residents. The legislature and state voters should address the obstacles to efficient, equitable water pricing created by Proposition 218.

Excerpted from *Managing Drought in a Changing Climate: Four Essential Reforms* by Jeffrey Mount, Ellen Hanak, et al. Public Policy Institute of California, 2018.

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