

Preparing for droughts is an essential part of managing California's water

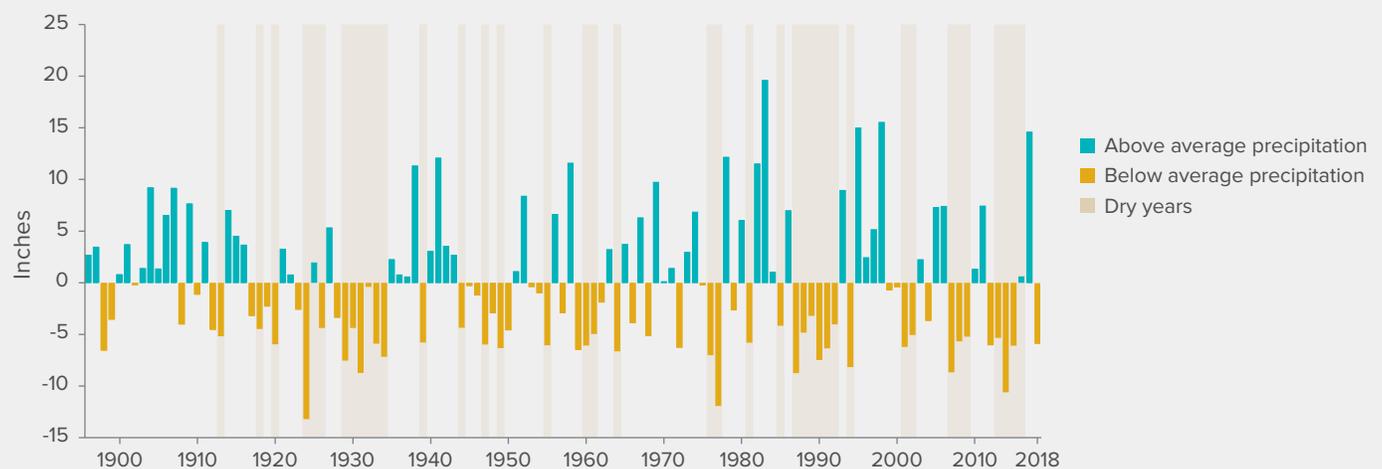
Droughts occur regularly in California. Laws governing water allocation and use were created in part to address water scarcity. The state's network of reservoirs, groundwater basins, and aqueducts is also used to manage drought.

California has weathered four droughts since the late 1970s. These ranged from a short, severe drought in 1976–77 to the recent drought of 2012–16, which included the driest four-year stretch in 120 years of record-keeping. 2014 and 2015 were also the two hottest years on record, which made coping with water shortages even more difficult. Although 2016 and 2017 winter storms provided substantial relief, 2018 started extremely dry and ended drier than average. One or two wet years can fall within a series of dry years. Recent research shows that extreme dry and wet years will become more common.

Linking any individual weather event to human-caused climate change is difficult. Nonetheless, models suggest that the recent drought may indicate a drier and warmer future. This poses major challenges for managing water for a growing population and economy while also sustaining a healthy environment.

Droughts test California's water management systems and expose their weaknesses. They also provide opportunities to improve the state's ability to weather future droughts. Lessons from the latest drought can help California begin preparing for the next one.

DRY YEARS ARE COMMON IN CALIFORNIA'S CLIMATE



SOURCE: Western Regional Climate Center.

NOTES: Bars show the number of inches above and below the long-term California statewide average precipitation level of 24.13 inches, based on water years (October–September) since 1896. The 2018 bar includes data through July and estimates for the remaining two months using 2017 values. Dry years are those classified as critical or dry in the Sacramento Valley based on the California Cooperative Snow Survey. Because this classification factors in the amount of water stored in reservoirs from the previous year, a single below-average year is often not classified as dry.

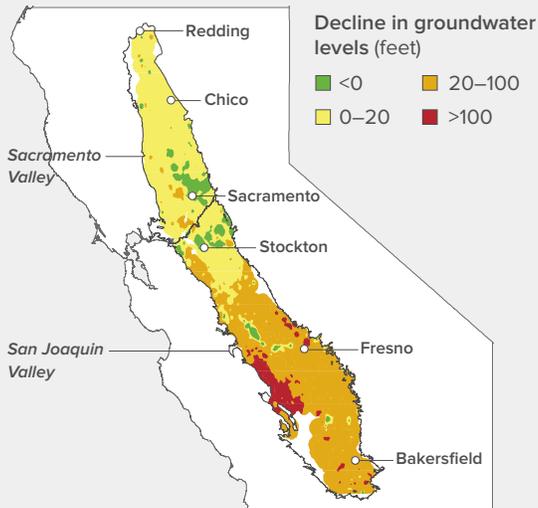
Not all sectors and regions are prepared for future droughts

The 2012–16 drought showed that urban and rural areas experience drought in different ways.

- **Large urban areas are reasonably well prepared.**

Most large urban utilities were better prepared to handle the most recent drought than past ones, despite population increases. After the 1987–92 drought, they made major investments to diversify water supplies and reduce demands. They built interconnections with neighboring systems that draw on different supply sources, reduced per capita water use, stored conserved water in new reservoirs and groundwater banks, and purchased water from farmers.

PUMPING DIMINISHED CENTRAL VALLEY GROUNDWATER RESERVES DURING THE 2012–16 DROUGHT



SOURCE: Author calculations using data from California Department of Water Resources groundwater level data reports.

NOTE: The figure shows estimated groundwater level changes during the 2012–16 drought.

From 2013 to 2015, urban residents further reduced water use by nearly 25 percent in response to voluntary local programs and a statewide conservation mandate, with saved water largely kept in storage in case the drought continued. However, lower water sales reduced revenues, causing financial problems for some utilities and frustration among customers who used less water and then saw water rates rise.

- **Some communities remain vulnerable to future shortages.** Some communities faced extreme shortages during the latest drought, reflecting their high dependence on a single source and their lack of connection to other water utilities. This included some Central Coast and Sacramento Valley cities, as well as poor, rural communities across the state. More than 150 communities faced shortages, and more than 2,500 domestic wells went dry—particularly in the San Joaquin Valley and the Sierra Nevada foothills. The state provided emergency aid for replacement water in rural areas, but it needs a long-term plan to avoid a similar crisis in the future.

- **Agriculture faces hurdles in managing water demand during droughts.**

Surface water deliveries to Central Valley farms are often cut during droughts—in 2015 to just 52 percent of average. Farmers with the oldest and highest priority water rights are better served, but many receive little or no water. Farmers seek to offset

lost surface water by pumping additional groundwater; some purchase water from other farmers to keep tree crops alive. Some must also fallow land. Extra groundwater pumping increases costs. Land fallowing creates lost revenues and jobs. During the latest drought, strong commodity prices partially offset production losses, but the state still needed to provide financial and food assistance to hard-hit farmworker communities.

- **Groundwater basins provide the largest drought storage.**

Although farmers in most areas can pump extra groundwater during droughts, decades of unsustainable pumping have lowered groundwater levels. This depletion has increased pumping costs, dried out some wells, degraded water quality, and caused land to sink—damaging aqueducts and other infrastructure. The Sustainable Groundwater Management Act (SGMA) of 2014 requires local agencies to adopt groundwater sustainability plans by the early 2020s and achieve balance by the early 2040s. Implementing these plans can improve drought preparation over the long term but will reduce farm water supplies in some regions, particularly in the southern San Joaquin Valley.

Droughts hit ecosystems hard

Water and habitat management during droughts can have lasting impacts on fish, migratory birds, and other species.

- **Wetland and river ecosystems suffer from low flows and impaired water quality.**

Many coastal and mountain streams dry up during droughts, harming salmon, steelhead, and other native fishes. Conditions deteriorate for fish in rivers below dams, and some hatcheries lack adequate cold water, particularly during longer droughts when cold water storage behind dams is depleted. Water supplies in wildlife refuges in the Central Valley and Klamath Basin can fall dramatically. This forces birds to gather in smaller areas, increasing their vulnerability to disease and predation.

- **Lacking advance planning, managers make trade-offs on the fly.**

Fish and wildlife managers usually have minimal plans and few resources to manage the risks of severe droughts. During the latest drought, regulators had to make difficult decisions based on limited knowledge and little scientific or public review. In some cases, agencies had to choose how to use water—for salmon versus Delta smelt, or for fish versus waterbirds—with little information about the consequences. Flows to protect fish in Central Valley rivers were reduced to save water for cities and farms. Most eggs of endangered winter-run Chinook salmon died because

of poor management of cold water releases from Shasta Reservoir. Fish and wildlife agencies carried out many fish rescue efforts.

- **Headwater forests are in poor health and at greater risk of severe fires.**
Hot, dry conditions during the most recent drought led to widespread tree mortality, creating hazardous fuels for future fires.
- **Species declines from droughts have lasting consequences.**
Failure to protect native biodiversity during droughts increases extinction risk for California’s vulnerable aquatic species—including most salmon runs. Actions that move some species into threatened or endangered status can also increase future regulatory costs and lead to water supply reductions for cities and farms.

California’s drought water allocation policies need strengthening

Water is scarce in California, even in normal years. The state government oversees water rights and must be prepared to manage cutbacks during droughts to balance competing needs fairly. From 2014 to 2016, California’s interagency drought task force managed many aspects of the emergency in an effective and coordinated manner. But the drought also exposed weaknesses in the water allocation system.

- **California’s fragmented water rights system creates unnecessary problems.**
The State Water Board’s efforts to allocate scarce water supplies were made more difficult by an archaic, fragmented water rights system. Some senior water-right holders successfully challenged the board’s authority to curtail their supplies.
- **The state lacks a comprehensive policy on water allocation priorities.**
In addition to overseeing urban and agricultural users’ water rights, the state must consider the water needed to protect public health and freshwater ecosystems. It lacked clear policies on how to prioritize these vital interests during the latest drought.
- **Drought water allocations have not fully followed two legal mandates.**
The state constitutional “reasonable use” requirement mandates that all water uses must be reasonable under current hydrologic conditions. The “public trust” doctrine requires the state to consider the effects of its decisions on freshwater ecosystems, water quality, and fisheries, and to protect such uses to the extent feasible under the circumstances. It has not followed these doctrines sufficiently, instead relying principally on the priority of water rights.
- **The state’s information systems are inadequate.**
Water use reporting is advancing, but state agencies still lack enough coherent information on water rights, surface water flows, and water use to manage droughts more effectively. Decisions to curtail some water rights during the latest drought were based on rough estimates—an approach that could unfairly harm some water users and the environment. Better monitoring and reporting of ecosystem conditions would also make management easier.

Looking ahead

Now is the time to prepare for the next drought, while lessons from the latest one remain fresh. Better preparation will also help California adapt to a warming climate and increasingly variable precipitation.

Build on progress in urban drought management. Some cities still need to diversify water supply sources and reach sharing agreements with neighboring communities. Many utilities must improve their drought pricing policies to give customers incentives to conserve while generating adequate revenue to remain financially healthy when water sales decline. Urban drought plans should go beyond current state requirements and include “climate stress tests” that evaluate supply reliability with longer droughts and warmer temperatures.

Plan ahead for drought emergencies in disadvantaged rural communities. Small rural communities do not have the financial capacity for drought planning and mitigation. Yet drinking water vulnerabilities occur in every major drought, and they could worsen as the climate warms. State and local partners should use the experience from the recent drought to identify communities at highest risk, connect them to larger systems where feasible, and devise drought response programs for the others.

Develop an environmental stewardship strategy. Reducing the impacts of future droughts requires ecosystem drought plans at the watershed level. Plans should identify actions to be taken in advance—such as water acquisitions or strategic investments in environmental strongholds to protect at-risk species—and actions to help post-drought recovery. Ecosystem water budgets, which allocate a portion of water to the ecosystem within watersheds, could also enable more flexible and effective environmental management.

Implement sustainable groundwater management. Successful implementation of SGMA is the most important step toward drought security for California agriculture. Sustainability plans should prepare for groundwater drawdowns during severe droughts and pursue regional approaches—including coordinated supply and land-fallowing efforts. Conveyance investments are critical to support groundwater recharge and water trading.

Modernize management of cutbacks. Water sources and uses should be tracked better, and the State Water Board’s direct regulatory authority should be extended to cover all surface water rights. The reasonable use and public trust doctrines should be applied in allocation decisions, and priorities for protecting environmental flows and public health should be clearly defined and implemented.

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