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PPIC Water Policy Center

PRIORITIES FOR CALIFORNIA'S WATER

Responding to the Changing Climate

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INTRODUCTION

Water is central to how California adapts to a changing climate. To those of us steeped in the complexities of managing the state’s water resources, the current fast-moving drought—coming on the heels of the record-breaking 2012–16 drought—is a stark reminder that we must accelerate preparation for the disruptive changes underway.

Californians have taken steps to address major threats to our water resources. But a recent IPCC report underscored that the climate is changing faster than anticipated, and that many of these changes are already locked in. Rising temperatures are making our winters shorter and our droughts more intense, outpacing our ability to manage water supplies and the natural environment. We need to act with urgency to adapt to these changes. And we need to rethink how we store water.

This brief examines how the current drought and a changing climate are affecting California’s ability to manage water and lays out priority actions to address major challenges—including some urgent short-term actions should the drought continue into next year. It’s time to:

- **Hasten the shift to groundwater sustainability, and remove roadblocks to underground storage.** Groundwater is the state’s best drought reserve and is essential for supporting its vibrant agricultural industry. We are moving in the right direction with sustainability plans for stressed basins, as required by the Sustainable Groundwater Management Act (SGMA). But another severe drought so early in SGMA’s 20-year implementation timeline is causing a surge in unsustainable pumping, with many undesirable results. We must speed efforts to reduce demand, increase groundwater recharge, and manage surface water infrastructure to make better use of both surface and underground storage.

Sources for this document are available at <https://www.ppic.org/wp-content/uploads/priorities-for-californias-water-sources-2021.pdf>.

- **Ensure safe and affordable water.** Three main drinking water challenges have fueled a water equity crisis—water quality, reliability of supplies, and water affordability. Major investments will be needed to maintain climate resilience for local water supply, wastewater, flood, and stormwater systems. Solutions must ensure service for low-income residents, while maintaining the financial health—and safety—of these systems.
- **Improve the health of freshwater ecosystems at the watershed scale.** The warming climate is compounding difficulties in managing rivers and wildlife refuges. To protect against drought impacts, we need new approaches for how we store water for the environment and how we manage it once it’s released. And to get the most benefit from environmental water, releases should reconnect water to physical habitat, such as floodplains. Prioritizing these efforts at the watershed scale will make water and dollars go further.
- **Catalyze a major expansion of headwater forest management.** California’s headwater forests—a key part of the state’s natural water supply infrastructure—are in poor health and prone to severe wildfires. The state has expanded funding to improve forest health, but we need a massive increase in the pace and scale of forest treatments. Water agencies are well-positioned to take a leading role in this effort.

The events of this past year make it clear that we must act with urgency to meet the challenge of increasingly severe, warmer droughts. Now is the time to “seize the drought” and muster all the forces we can to tackle climate change head-on. Our social, economic, and natural well-being depend on it.



Ellen Hanak

SHIFTING CURRENTS

In the volatile realm of California’s water, the following changes are causing immediate challenges:

Increasing Drought Intensity: Droughts are getting hotter, which makes them more intense, with impacts lasting long after the rains return. This is [part of a decades-long shift in conditions](#) and an indication of a rapidly changing climate. “[Snow droughts](#)” are throwing a wrench into our water management systems, which were designed for the slow melting of mountain snow, and runoff is changing as rising temperatures dry out our landscapes. The [past two years saw poor snowpack](#), and this year it [melted early and yielded little runoff](#). These changes go beyond historical precedents.

A Growing Need to Update Infrastructure: Increasing drought severity highlights the importance of dealing with aging infrastructure. Failures and safety issues are rendering crucial water infrastructure less dependable, just when we need it most. For instance, Santa Clara County [declared a water shortage emergency](#) this summer after it was forced to drain the reservoir behind Anderson Dam to make urgently needed seismic upgrades.

Securing Groundwater Sustainability: Successful implementation of the Sustainable Groundwater Management Act (SGMA) represents the most important step California agriculture can take toward drought security. This law was adopted in 2014, in the midst of the last major drought. With yet another intense drought coming so soon in its wake, groundwater levels haven’t had time to recover, making implementation that much harder. The first sustainability plans have [some serious gaps](#)—too much emphasis on new supply, not enough on reducing demand, and insufficient attention to problems like impacts on shallow wells and land subsidence. The process [has not adequately included](#) small communities threatened by drying wells.

Managing Headwater Forests to Protect Water Supply: Drought, disease, and a lack of forest management have primed our mountainous forests for extreme wildfires. This year continued the trend of [ever-larger and more damaging wildfires](#). These fires increase water supply risks throughout the state. Plans to improve forest health are advancing and more money has been allocated, but [progress is not keeping pace with increasing threats](#).

Funding Unmet Needs: One piece of good news is that the state government has allocated significantly more money for meeting these challenges over the next few years—a welcome down payment. A boost in federal water infrastructure spending is also under consideration. But building climate resilience into our water systems will require a commitment to secure long-term, reliable funding to upgrade the [water grid](#) for a warmer, more volatile climate; ensure safe, affordable local water services; prevent further decline in our native freshwater species and ecosystems; and sustain efforts to bring headwater forests back to health.

LEARN MORE

“California’s Latest Drought in 4 Charts.”
Alvar Escriva-Bou and Jeffrey Mount, *PPIC Blog*, 2021.

“Droughts Aren’t Just About Water Anymore.” Lori Pottinger, *PPIC Blog*, 2020.

“How Water Justice Groups View Groundwater Sustainability Planning.”
Caitrin Chappelle, *PPIC Blog*, 2020.



MANAGING GROUNDWATER

Underground basins provide [nearly 40 percent](#) of the water used by California’s farms and cities, but that portion rises significantly in dry years, when farmers pump more to make up for shortages in surface water. With California in the midst of another drought, concerns are growing that high levels of groundwater pumping could result in a host of problems, including declining water tables, sinking lands, saltwater intrusion, harm to ecosystems, and drying wells.

Sustainable groundwater management is an essential hedge against our increasingly drought-prone climate, and SGMA requires groundwater to be managed in ways that avoid or mitigate significant undesirable impacts. Yet SGMA takes a long-term view. To reduce economic hardship, the law gives water users 20 years to attain sustainability, as long as they address undesirable impacts along the way. Unfortunately, increasingly intense droughts make negative impacts from pumping even more likely. Most urgently, this [could cause water shortages](#) for some communities and [harm groundwater-dependent freshwater ecosystems](#) already reeling from drought. [Land subsidence](#) from falling water tables is also likely to increase, which could further damage critical water infrastructure.

Current sustainability plans may not be able to adequately address this escalating challenge. Local agencies submitted sustainability plans for the most stressed basins in early 2020; plans for the remaining basins are due in early 2022. All must be updated every five years. Most plans recognize the need to reduce water use to bring basins into balance. [Few include details](#) for how they will get there or how they will address the negative impacts of increased pumping during the 20-year SGMA transition period. Furthermore, most plans are overly optimistic about their ability to increase supplies. And the current drought highlights the need to revisit their projections in light of the changing climate.

If this drought continues another year or more, we’ll face one main near-term challenge: avoiding problems from increased pumping while also supporting a healthy agricultural economy. And even if this drought ends soon, the changing character of recent droughts sends a stark message about preparing for the next one: to protect groundwater reserves, groundwater agencies need to pick up the pace on managing demand in flexible, cost-effective ways. California must also speed up steps that

“To protect domestic wells, we’d like plans to have trigger points, so that a groundwater sustainability agency isn’t waiting until the last minute to intervene if people’s drinking water is at risk.”

—AMANDA MONACO,
LEADERSHIP COUNCIL FOR JUSTICE
AND ACCOUNTABILITY

enable more water storage. Expanding underground storage will be especially important to help adapt to the declining snowpack and heightened risk of flashier floods brought on by climate change. But barriers to making the most of recharge potential persist.

PRIORITIES

Minimize the negative impacts of increased pumping.

Surface water deliveries could be even lower if next year is dry, increasing the pressure on groundwater reserves and the likelihood of undesirable results. A combination of local pumping restrictions and mitigation plans is likely to yield the best outcomes. For instance, incentivizing farmers to avoid pumping in sensitive areas might be an effective tactic in some cases. In others, paying for alternative solutions, such as lowering or replacing at-risk wells before they go dry, might be better for the local economy than requiring farmers to reduce their groundwater use or fallow farmland. In these early days of SGMA implementation, it is important to explore creative solutions. *This step is especially urgent if the drought continues.*

Pick up the pace of demand management.

As difficult as it is, reducing farm water use sooner rather than later is one of the best ways to increase drought resilience in overtapped basins. Doing this in ways that protect regional economies requires important up-front work. First up is establishing groundwater allocations—caps on how much each water user may pump—which enables users to plan ahead. Second is establishing transparent local groundwater markets, which can help users apply groundwater to the most productive activities. Expanding surface water trading—already an important tool for managing drought—can also significantly reduce the economic impacts of using less water. Finally, it’s necessary to develop a coordinated game plan for managing formerly irrigated lands, to reduce the risk of pests, weeds, and dust—and to get the most economic and environmental benefits from these lands. Although local stakeholders will need to lead all of this work, state and federal agencies can provide critical technical and financial support—including funding incentive programs for strategic fallowing and creative land repurposing that brings multiple benefits.

Accelerate actions to improve water storage.

Groundwater users are already focused on recharging basins with water from large storms as a way to reduce overdraft. Getting more water into the ground can also help the system adapt to changing conditions by freeing up room in surface reservoirs. Robust groundwater allocation and monitoring systems will facilitate the expansion of groundwater banks—recharge projects that store water on behalf of specific parties. Crediting water users for recharge will help incentivize investments in storage, while helping water users manage supply risk. But current storage and conveyance infrastructure—as well as operational and regulatory practices—are **not primed to take advantage** of water available for recharge. Regional plans that identify how to make local systems work together and identify opportunities for joint investments in infrastructure will be key. **Coordinating investments across regions** can also maximize benefits and reduce costs.



“More supply is critical. The biggest opportunity is to figure out how to capture water in big flood events, which are expected to become more common with climate change.”

—EMMY CATTANI,
KERN COUNTY FARMER

LEARN MORE

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SAFE AND AFFORDABLE WATER

Nearly 3,000 water systems deliver drinking water to all corners of the state and across a wide range of conditions—from single-well systems in small rural communities to large urban districts serving millions of people. In addition, tens of thousands of Californians rely on domestic wells. While the vast majority of Californians have reliable drinking water, some systems have been unable to meet drinking water quality standards over many years, and water in some domestic wells is tainted. Supply disruptions are another concern, and the ongoing drought puts more residents at risk of shortages. [Small, groundwater-dependent systems](#) in low-income communities—disproportionately communities of color—are at particular risk of both quality and supply shortfalls.

In recent years, the state has taken big strides to address drinking water quality issues. A new [needs assessment](#) provides a comprehensive look at systems already out of compliance with—or at risk of violating—water quality standards, and reviews a host of solutions. The assessment enables better tracking and support for at-risk systems, which can prevent problems in the early stages and save money. The state has also begun outreach to better support [tribal water systems](#). And it has provided significant new funding: this year’s budget includes an additional \$1.3 billion for investments in water and wastewater systems in small and low-income communities.

California has also expanded its understanding of [drought vulnerabilities in small communities](#) since the last drought. But many still face issues, particularly if they rely on shallow wells. By late September, nearly [700 domestic-well users had reported lost access to water](#), and [hundreds more are at risk](#) if the drought continues. Some urban areas could also see shortages, including communities in Marin County and the North Coast that depend on local rivers, now running exceptionally low. Many urban systems are calling for added conservation to help weather the drought. But savings may be harder to achieve this time, as per-capita water use has remained much lower than it was before the last drought. The state has allocated \$200 million for drinking water [drought emergencies in small communities](#), and [\\$100 million for urban systems](#).

Finally, water affordability became an urgent concern during the pandemic. Racial and ethnic disparities in income and unemployment meant that [people of color were more likely to be affected](#). Shutoff moratoriums protected public health, but they

“Tackling drinking water problems before they get out of control brings health benefits, prevents governance crises, and is cheaper in the long run than emergency responses.”

—GREG PIERCE, UCLA LUSKIN CENTER FOR INNOVATION

reduced revenues and added to a ballooning water debt problem. The state has allocated **nearly \$1 billion** in federal pandemic relief to cover water utility bill arrears. These dollars will provide an essential reboot to protect Californians and their water systems. But without policy changes, the affordability problem is likely to grow—as are the impacts to the fiscal health of water providers. And water services **aren't getting cheaper**. Investments to improve systems' resilience to a changing climate and other growing needs will continue to raise costs.

PRIORITIES

Identify systems at risk of shortages and take rapid action.

Small communities that rely on shallow wells are especially vulnerable. During the last drought, state help mainly came in the form of water deliveries after wells went dry. To cope with the current drought, the state should help counties, groundwater agencies, and other local partners anticipate shortages and implement rapid solutions, including refurbishing or drilling deeper wells and preparing tanks for water deliveries before wells go dry. Now is also the time to build momentum on permanent fixes, such as connecting these communities to larger, more robust water suppliers. Larger systems facing severe drought emergencies will need rapid solutions—including fast-tracking of approvals for water transfers, new wells, and emergency pipelines. *This step is especially urgent if the drought continues.*

Expand water rate assistance programs.

Rate assistance programs will be more important than ever as water costs grow. Many utilities offer “lifeline” rates that can subsidize the bills of low-income customers, and private water utilities have been able to expand these programs as rates have risen. But public agencies are constrained by Proposition 218, which **requires a tight connection between water rates and cost of service**. Relaxing restrictions on using water rates to fund lifeline programs would give utilities more flexibility to tailor these programs to local needs. Other actions may also be necessary, such as state- or federally run rate assistance. A **temporary federal assistance program** for water and wastewater bills, launched during the pandemic, may be a useful model for more durable support.

Find state and federal funding to speed up climate resilience upgrades.

Building resilience in local water systems will require significant upgrades in water storage, treatment, and distribution systems. Local wastewater, flood protection, and stormwater collection systems will also need improvements. In the past, **communities funded most water system upgrades** through water and wastewater bills and local taxes. Today, state and federal support may be needed to help them pay for essential climate resilience upgrades. Many small, low-income communities already face greater risks from water system failures and are unable to fund solutions locally. Likewise, Proposition 218's cost-of-service requirements constrain local flood investments in flood-prone neighborhoods, which tend to have higher needs but lower capacity to pay. In the face of rising costs and affordability challenges, some larger communities likely also will need state and federal assistance for water system upgrades.



“These very small systems often don't have an office, the books are done on someone's kitchen table, they may be run by a part-time manager who is managing the system in their spare time to support their community. It's almost impossible for most urban folks to conceive of what these systems face.”

—DARRIN POLHEMUS,
STATE WATER BOARD

LEARN MORE

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Paying for California's Water System. Chappelle et al., PPIC, 2021.



FRESHWATER ECOSYSTEMS

California’s ecosystems underpin the state’s economy: they nurture and protect the state’s water supply, shorelines, agriculture, fisheries, and wildlife. But droughts—and the ways we manage water—have taken an increasingly heavy toll. This spring, for example, state and federal agencies overestimated [how much water would be available](#) in summer for the Central Valley and failed to reserve enough water to protect river ecosystems and salmon in particular. Changes made decades ago to the freshwater landscape—such as draining wetlands, placing levees close to rivers, and building dams—have eliminated or blocked access to habitat that fish and wildlife need to survive and recover from drought.

California lacks a coherent strategy for recovering the health of ecosystems devastated by drought and the warming climate. Moreover, we rely on a century-old water rights system and 50-year-old environmental laws to manage our ecosystems. As administered, these institutions are not keeping up with the challenge of rapidly changing conditions. State and federal regulators have been unable to strike an effective balance between protecting the environment and providing water for business and domestic uses. This fuels water conflict and results in the long-term decline of native species. Many of our most iconic fishes—including salmon and steelhead—are in dire condition, with near-term [extinctions likely](#) if the drought continues.

Current approaches are simply not working. We need to focus on ecosystem health, rather than setting minimum flows to protect individual endangered species. The state urgently needs to adopt a more forward-looking approach to ecosystem management—one that increases flexibility, changes how water is stored, and focuses on restoring key natural processes—to sustain this vital natural infrastructure in a warming world.

PRIORITIES

Manage reservoirs more conservatively.

The state will need transparent contingency plans by the beginning of the 2021–22 winter to cope with the impacts of extreme drought on the environment and native species. Given how little water is currently available, this requires the difficult task of

“Getting more restoration projects done is really important to help recover at-risk species, protect water quality, and improve habitat. Restoration projects also benefit the economy, creating jobs that can reduce flood risk . . . and help the state prepare for the effects of climate change.”

—ERIKA LOVEJOY,
SUSTAINABLE CONSERVATION

setting priorities—a kind of environmental triage. Where possible, it is important to conserve winter and spring inflows to better meet the needs of rivers and wildlife refuges next summer and fall (something we failed to do well in 2021). The state must also do everything possible to protect flows for drought refugia—areas where vulnerable species can survive severe drought conditions. This will require aggressively enforcing restrictions on diversions in some locations. To reduce conflicts, the state should experiment with compensating farmers and other water users who help conserve and manage flows during extreme drought conditions. State drought funds should prioritize all these actions. *This step is especially urgent if the drought continues.*

Rethink how water is stored and released long-term to build ecosystem resilience.

When the drought emergency ends, California must begin managing water in ways that improve overall ecosystem conditions. We must use surface and groundwater storage to help **restore key ecosystem functions**. This can involve releasing water from reservoirs to mimic key flow patterns or switching some surface water users to groundwater during severe drought to protect river flows—as is now done on the Yuba River. These “**functional flows**” will be most effective if paired with investments in physical habitat—particularly floodplains—to reestablish the interactions between land and flowing water that are essential to ecosystem health. This approach brings a greater environmental return on investment, creating opportunities for multi-benefit projects that meet the needs of people and the environment. Ecosystems can also be managed more flexibly for drought if they are allocated a block of water—an **ecosystem water budget**—that can be stored, released, or traded as conditions allow.

Focus on key watersheds.

Shifting toward **ecosystem-based management** would improve watershed health by using locally developed plans to achieve agreed-upon goals. Prioritizing key watersheds will be necessary: there simply aren’t enough resources to improve everything everywhere. Investments should focus on watersheds that are critical for maintaining native species (for example, Battle Creek, with its reliable cold water, is critical to the survival of winter- and spring-run Chinook salmon). This approach should be used to expand **nature-based solutions to meet climate change and biodiversity goals**; it is integral to the governor’s **executive order** requiring conservation of 30 percent of California’s land and coastal waterways by 2030.

Improve permitting to enable ecosystem restoration to scale up faster.

Given the pace of change, California urgently needs to scale up efforts to restore physical habitat. Besides lacking reliable funding, environmental projects face challenges from the myriad federal, state, and local permits required. These permit requirements were originally designed to prevent environmental harm, but they now often prevent restoration. The state’s **Cutting the Green Tape** initiative is a good start—as is the recent passage of a budget trailer bill that **exempts restoration projects** from the California Environmental Quality Act (CEQA)—but much more needs to be done.

Reforms are needed to shorten permitting timelines, lower costs, increase the size of restoration projects, and focus on improving ecological outcomes. This will require greater coordination across multiple projects, better collaboration between permitting agencies, and efforts to restore key ecosystem functions across watersheds.



“We need environmental water allocations that can be managed flexibly ... This could enable more proactive water management during droughts for ecosystems, and better integration with urban and agricultural water uses.”

—SARAH NULL, PPIC CALTROUT ECOSYSTEM FELLOW

LEARN MORE

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HEADWATER FORESTS AND FIRES

Two decades of increasingly dry and warm conditions have hastened a major decline in the health of California’s headwater forests, the source of most of the state’s water. [Decades of poor management](#) created a dangerous build-up of fuel in these forests, priming them for more extreme wildfires, which can have devastating consequences for water supply systems downstream. The record-breaking 2020 and 2021 fire seasons burned a vast area in the headwaters and beyond, caused thousands to flee their homes, unleashed widespread air pollution, and harmed water quality.

The good news is that California greatly increased state funding for forest management in the past year. [New state funding](#) is spread across many programs, reflecting the complexity of addressing the growing wildfire problem. There is more money now to improve forest health and boost community resilience to fires. Importantly, a rule change allows funds to be spent more quickly, in advance of peak wildfire season.

In addition, a new statewide plan for improving forest health is a major step forward. The governor’s forest management task force developed the [Wildfire and Forest Resilience Action Plan](#) in cooperation with the US Forest Service—the primary landowner of California’s headwater forests. It provides direction on priorities over the next decade to improve forest health and reduce wildfire risk.

This is significant progress, but the problem is vast, and management [is not scaling fast enough](#). Improving forest health requires reducing the density of small trees and fuels on a massive scale. While more is being done to manage many mountain watersheds—including by [water utilities](#) who benefit from headwater supplies—the pace of treatment is not sufficient. This problem is especially acute on federal lands, which make up roughly half of California’s headwater forests. [Fire scientists have pushed back](#) on a [recent policy change](#) by the US Forest Service to halt controlled burns and managed wildfires, as it removes a key tool for treating overly dense forests.

Climate change makes this an even more urgent problem. California needs to increase the pace and scale of forest management, encourage management partnerships, and commit to long-term streams of revenue to ensure that managed forests stay healthy after initial treatment.

“Our forests are just too dense, making them susceptible to disease, drought, and extreme wildfire. A restoration strategy can get forests in a condition that reduces tree mortality during droughts.”

—SCOTT STEPHENS,
UC BERKELEY

PRIORITIES

Improve preparedness of at-risk communities.

Increasing drought resilience in headwater forests will take decades to implement. But California can take immediate actions that will help in the near term, especially if drought continues into a third year. At the top of the list should be urgent efforts to help headwater communities reduce their fire risk. If and when this year's wildfires finally give way to winter rains, California, in cooperation with the US Forest Service, should embark on an all-hands-on-deck strategy of reducing fuels within and around communities. Prevention now will protect lives and save money in coming fire seasons. *This step is especially urgent if the drought continues.*

Find new ways to pay for long-term forest stewardship.

State funding has played a major role in catalyzing forest health efforts in recent years, but much of it is one-time General Fund money. Restoring and maintaining the health of headwater forests is a multi-decade task that takes sustained investment. **New funding mechanisms** are needed to more reliably support on-the-ground projects as well as efforts to **build technical capabilities and personnel**. And given the scope, cost, and complexity of the problem, the state will need to promote ways to **generate revenue from forest management**. This entails developing the infrastructure (sawmills and biomass energy facilities) and workforce to produce wood products from small-diameter trees harvested from overly dense forests. California must also continue to find ways to link the many different benefits that healthy forests provide—such as clean water, recreation, biodiversity, and carbon storage—to diverse funding sources.

Promote partnerships to increase the pace of forest treatment.

The state should go beyond its current Wildfire and Forest Resilience Action Plan and invest in the development of **regional plans** to organize and coordinate actions on federal and private land, preferably at the watershed scale. Expanding federal, state, and **local partnerships** is key to getting the work done. Local entities that work with landowners to maintain forests—such as fire safe councils, resource conservation districts, nonprofits, local governments, and **tribes**—need financial and technical support to scale up this work. It will also be key to build partnerships with those who depend upon the forest, such as water districts who derive much of their water supply from headwater forests. Water districts' technical and organizational capacity makes them **ideal partners in cooperative forest management**. They need to push for action and take a leadership role where they can.

Document forest management progress and gaps.

California **lacks a comprehensive accounting** of how private, state, and federal entities are managing their forests. A clearer picture of forest management accomplishments and gaps can help set priorities for allocating scarce management resources. Improving the accuracy, completeness, and comparability of data collected on forest management across the headwater region will be critical for evaluating progress toward meeting goals for forest health. It is also an effective way to provide assurances that public resources are being spent wisely.



“Working at the regional scale allows us to create efficiencies, and really think about a forest restoration economy.”

—ANGELA AVERY,
SIERRA NEVADA CONSERVANCY

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THINKING DIFFERENTLY ABOUT MANAGING RISK

California has made advances in addressing the risks of its highly variable climate. The state’s [water resilience portfolio](#) lays out numerous additional ways to prepare the water system for greater climate volatility over the long term. And agencies at all levels—local, state, and federal—are paying greater attention to disparities in water service that climate change is expected to worsen.

But it is clear that we’ve passed a climate inflection point. Now is the time to move from planning for climate change to taking action to protect our society, economy, and natural environment.

WHAT WILL IT TAKE TO BECOME CLIMATE-READY?

- **Improve water storage and conveyance.** California needs to rethink how we manage our [water grid](#)—the network of above- and below-ground storage and conveyance systems we use to capture and move water around. To buffer against drought, we’ll need new investments in underground storage—such as groundwater banks—and, where feasible, new surface storage. We also need to take a more cautious approach to managing reservoirs and aquifers, saving more water in reserve as a hedge against reduced snowpack and more intense droughts. Finally, the state needs to make a strategic decision about a way forward for the Sacramento–San Joaquin Delta—the weakest link in the water supply grid and one of the state’s most enduring ecological challenges.
- **Promote technological innovation.** We need to accelerate the development and adoption of new technology. Recent advances in using [advanced storm forecasting](#) to maximize water capture need to become part of operations throughout the state. Improved [accounting, modeling, and monitoring](#) will allow us to better understand how much water is used and where. [Advanced imaging](#) can help identify the best places for recharging aquifers. And there have been significant innovations in water recycling and stormwater capture that can help urban areas meet supply needs.
- **Upgrade aging infrastructure.** The 2017 failure of the Oroville Dam spillways highlighted the need to upgrade existing infrastructure to better manage droughts and floods. Priorities include addressing dam safety; repairing existing conveyance systems (key for expanding groundwater recharge); dealing with the flood risks from deteriorating levees and sea level rise; and upgrading water treatment systems

“We have to prepare for these changes and figure out how to use the state’s amazing water system to our advantage.”

—MARTY RALPH,
SCRIPPS INSTITUTION OF
OCEANOGRAPHY

to handle new contaminants and changing storm runoff. **Multipronged solutions**—including water system consolidation, local infrastructure upgrades, and on-site treatment in homes—will be needed to provide safe drinking water for the many Californians who currently lack it.

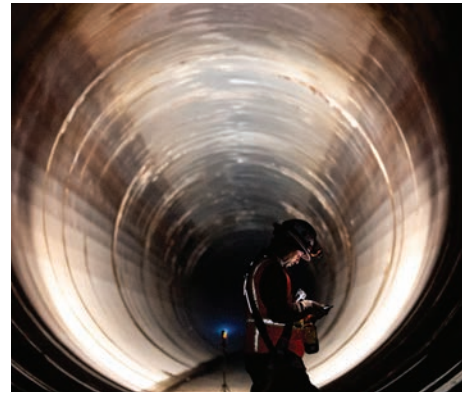
- **Manage demand.** We cannot simply build our way out of water scarcity, particularly as droughts become more intense. Reducing demand for water in ways that minimize economic and social costs will also be essential. This will require ramping up programs that incentivize both conservation and water trading. Additional savings can help cities continue to adapt. For farms, net reductions in water use will be hard, as this will inevitably involve fallowing land. But robust **water trading** programs—along with **groundwater banks** that enable farmers to manage their year-to-year water risks—can greatly reduce the economic and social impacts of land fallowing.
- **Find the money.** The changes needed to prepare water systems for a warming climate are going to be expensive—but much less so than the social, environmental, and economic costs of postponing action. California’s water system has recently benefited from favorable state budgets, and there is renewed federal interest. But this is just a down payment. Significant additional funds will be required to make the needed investments, and our current funding system is not up to the task. Rigid **constitutional rules on local funding** make it hard to provide access to safe and affordable water services. If these rules are not reformed, California may need to rely more heavily on state and federal funds to pay for key water resilience investments. While there may be scope to expand **water bond funding**, new fees or taxes may also be necessary.

CHANGING MINDSETS: TAKE RISKS TO REDUCE RISKS

To make all of this happen, we will also need to change the way we approach climate risks. In a nutshell, reducing risks will require a change in mindsets: we need to be more willing to take risks and change the way we do business.

Cooperation and innovation—essential for progress, but often viewed as risky by agencies and stakeholders—are slowed by outdated, overly complex rules and practices. Permitting—historically designed to reduce risk—needs an overhaul if we are going to tackle the big water challenges. Environmental regulations—also intended to reduce risk—are too inflexible to manage ecosystems in today’s climate. And the state’s ability to manage water rights during drought and respond to rapidly changing conditions is severely constrained.

Making needed changes will require a willingness to try new approaches and take a gamble on uncharted waters, giving local, state, and federal water managers the tools to be nimble. This won’t be easy. But the alternative—sticking to the old rules and practices, including litigating every dispute—puts us at even greater risk. California needs leadership at all levels to build a culture of trust, partnership, and innovation to respond to perhaps the greatest challenge water management has ever faced—our rapidly changing climate.



“Today, a reality check greets each season: we can’t make more water or control the forces of nature.”

—MAS MASUMOTO,
FRESNO COUNTY FARMER

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