

Crescenta Valley Water District

Weekly News Articles

January 1, 2023



CBS Sacramento

December 30, 2022

Getting Answers: Why are dams releasing water in a drought?

FOLSOM (CBS13) - Folsom Lake is letting the water flow while rains pick up across the valley. December has provided higher-than-average precipitation for the capital region giving way to cautious optimism about just how much longer the state will be in a drought.

But the rainfall also prompted questions about why, in a drought, dams and reservoirs are letting water out instead of holding it in.

"The operator has to draw it down to a certain level in the winter time and then hold it in that level until the spring snowmelt season starts," says Jeanine Jones of the California Department of Water Resources.

In short, the department has rules regarding how much water reservoirs can hold at a given time. If there's too much for that given time, they may have to drain some of their stores. That's based on the idea that seasonal precipitation will continue at a certain rate.

"The existing reservoirs largely have what you would call rule curves that don't provide flexibility," Jones explains.

But that creates a problem when in the middle of a drought and facing uncertain futures when it comes to precipitation.

"The reservoirs also have a storage deficit because of the drought conditions we've had," says Jones. "So we have a ways to go to fill up."

Folsom Lake, on the other hand, is different than most in California. Their flood control is handled by the Federal Bureau of Reclamation and Army Corps of Engineers.

The Bureau told CBS13 in a statement:

"The forecasted storm event is expected to bring significant precipitation as well as melt some of the existing snow at lower elevations, so the total inflow to the reservoir is expected to be quite large over a few days."

The statement went on to explain that the new flood control manual is designed to best balance between maximizing the water supply and flood control.

California is looking at different options for the reservoirs under state control, which includes Oroville Reservoir.

"The department is working with others to foster the idea of forecast-informed reservoir operations," says Jones. "[It] would allow more flexibility in managing water during the winter time just for the circumstances you described. "

"Most people tend to think about what's happening right now, or what happened last week or the week before and not thinking 'hey' we're just very early into the season."

<https://www.cbsnews.com/sacramento/news/getting-answers-why-are-dams-releasing-water-in-a-drought/>

NBC News

December 31, 2022

2022 was the year of drought



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Dec. 31, 2022, 6:00 AM PST

By [Denise Chow](#)

It was a year characterized by extreme drought.

From North America to Africa to Europe to Asia, huge swaths of the planet were parched in 2022. Lakes and rivers in several countries shrank to extreme lows and dry conditions threatened crops and fueled destructive wildfires across the globe.

As the world warms, climate change will exacerbate drought conditions on the planet. Research has shown that global warming worsens drought

by enhancing evaporation, depleting reservoirs and drying out soils and other vegetation.

Here's what drought this year looked like on four of the hardest-hit continents.

Asia

The world's largest continent provided a dire blueprint in 2022 of the consequences of drought and extreme heat in a warming world.

In March, an [early heat wave gripped India and Pakistan](#), causing at least 90 deaths as temperatures in some spots soared as high as 115 degrees Fahrenheit. The scorching conditions ignited forest fires in India and fueled the rapid melting of glaciers in northern Pakistan, which led to catastrophic flooding and even wiped out a bridge in the country's Hunza Valley. A [study released in May](#) by the World Weather Attribution group found that the punishing heat in India and Pakistan was 30 times more likely due to climate change.



Over the summer, prolonged heat waves in China created severe drought conditions for many parts of the country. Sections of the Yangtze River, the longest river in Asia, [reached record low levels in August](#), with some areas almost completely drying up. Some 400 million people in China depend on the Yangtze River for drinking water and to irrigate rice, wheat and other crops, according to the Nature Conservancy. The

waterway is also a major source of hydropower for the country and plays a key role in shipping and global supply chain management.

In the country's southwestern Sichuan province, the most extreme heat wave and drought in six decades caused water flow to the region's hydropower reservoirs to plummet in late August, prompting the provincial government to warn of "particularly severe" power outages, [the South China Morning Post reported](#).



The following month, September, officials in the central Chinese province of Jiangxi declared a water supply “red alert” for the first time as Poyang Lake’s water levels fell dramatically due to drought. The freshwater lake is the country’s largest and is normally a flood outlet for the Yangtze River.

Drought conditions gripped central China over the summer months, with the Jiangxi province experiencing 60% less precipitation from July to September compared to the same time last year, according to the Jiangxi Water Monitoring Center.

In Anhui province, which neighbors Jiangxi, water levels at 10 reservoirs fell below “dead pool” status, when the reservoir is so low that water cannot flow downstream from the dam.

Africa

The effects of extreme heat and drought were also dire for parts of Africa in 2022.

The Horn of Africa, which encompasses the easternmost part of the continent, experienced its longest drought in 40 years in 2022, [according to the World Meteorological Organization](#) (WMO). The region experienced drier than average conditions as it suffered through its fifth consecutive failed rainy season. Humanitarian organizations warned that the prolonged drought is exacerbating food insecurity issues for more than 50 million people in the region.



A woman waters goats from a shallow well dug into a dry riverbed at Eliye springs on the western shore of Lake Turkana in Kenya, on Sept. 28, 2022. Tony Karumba / AFP via Getty Images file

Parts of Kenya, Ethiopia and Somalia were among the hardest hit by drought this year. Guleid Artan, director of the WMO's climate center for East Africa [said in August](#) that the three countries are “on the brink of an unprecedented humanitarian catastrophe” because of rainfall deficits and ongoing drought.

The United Nations said severe drought and food shortages are likely to persist, which could lead to famine in parts of the Horn of Africa.



“Unfortunately, we have not yet seen the worst of this crisis,” Michael Dunford, the U.N. World Food Program’s regional director for eastern Africa, [said in a Nov. 28 statement](#). “If you think 2022 is bad, beware of what is coming in 2023.”

In a [report released in October](#), the United Nations and the Red Cross said certain regions of Africa and Asia will become uninhabitable within decades because of extreme heat.

“The impacts would include large-scale suffering and loss of life, population movements and further entrenched inequality. These impacts are already emerging,” the organizations jointly wrote.



The carcass of an adult elephant, which died during the drought, at the Namunyak Wildlife Conservancy in Samburu, Kenya, on Oct. 12, 2022Luis Tato / AFP via Getty Images file



In Italy, rivers and lakes dried up over the summer. Large sections of the country's longest river, the River Po, ran completely dry, forcing officials in July to declare a state of emergency in five northern regions.

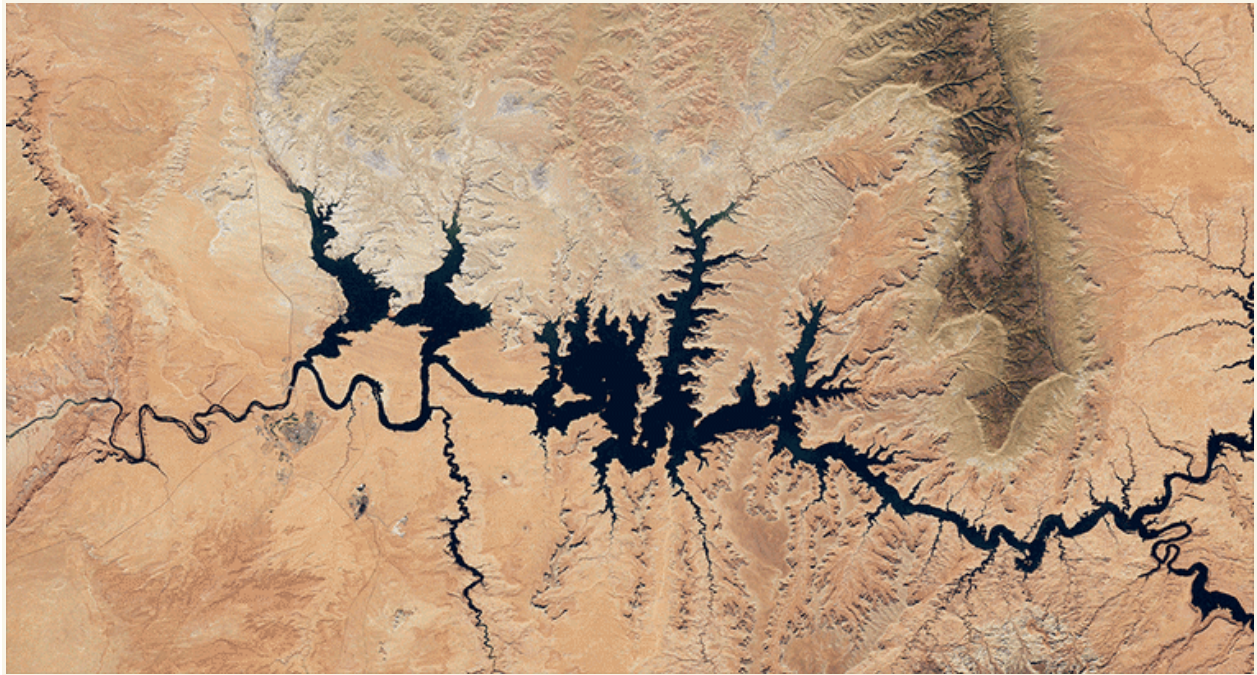
Lake Garda, Italy's largest lake, also shrank to near-historic lows over the summer. Water from the lake was diverted to local rivers to help farmers across the parched north of the country, leaving Lake Garda 12.6 inches above the water table, which approached the lowest levels recorded in 2003 and 2007.

Waterways elsewhere in Europe were similarly impacted by drought and extreme heat. In August, Serbia's Danube River shrank to one of its lowest levels in almost a century. The Loire River in France also fell to historically low levels over the summer amid record drought in the country.

North America

Parts of North America, such as the western United States, remained in the grips of severe drought this year. Dry conditions fueled dangerous wildfires in Arizona, Colorado, California, Oregon and Washington state.

A study published in February in the journal *Nature Climate Change* found that ongoing “megadrought” conditions in the southwestern U.S., which have persisted for the past 22 years, are the [worst since at least 800 A.D.](#)



Key reservoirs in the country shrank to alarming lows in 2022. In June, water levels at Lake Mead, which was created on the Colorado River on the Arizona-Nevada border, [dropped to the lowest levels since the lake was filled](#) in the 1930s. The historic low water levels carry enormous implications for water supply and the production of hydroelectric power for millions of people across Arizona, California, Nevada and parts of Mexico.

Lake Powell, the second-largest reservoir in the U.S., was similarly affected by intense drought, with its water dropping to the lowest levels since it was filled in the mid-1960s, [according to NASA's Earth Observatory](#).



<https://www.nbcnews.com/science/environment/2022-was-year-drought-rcna62410>

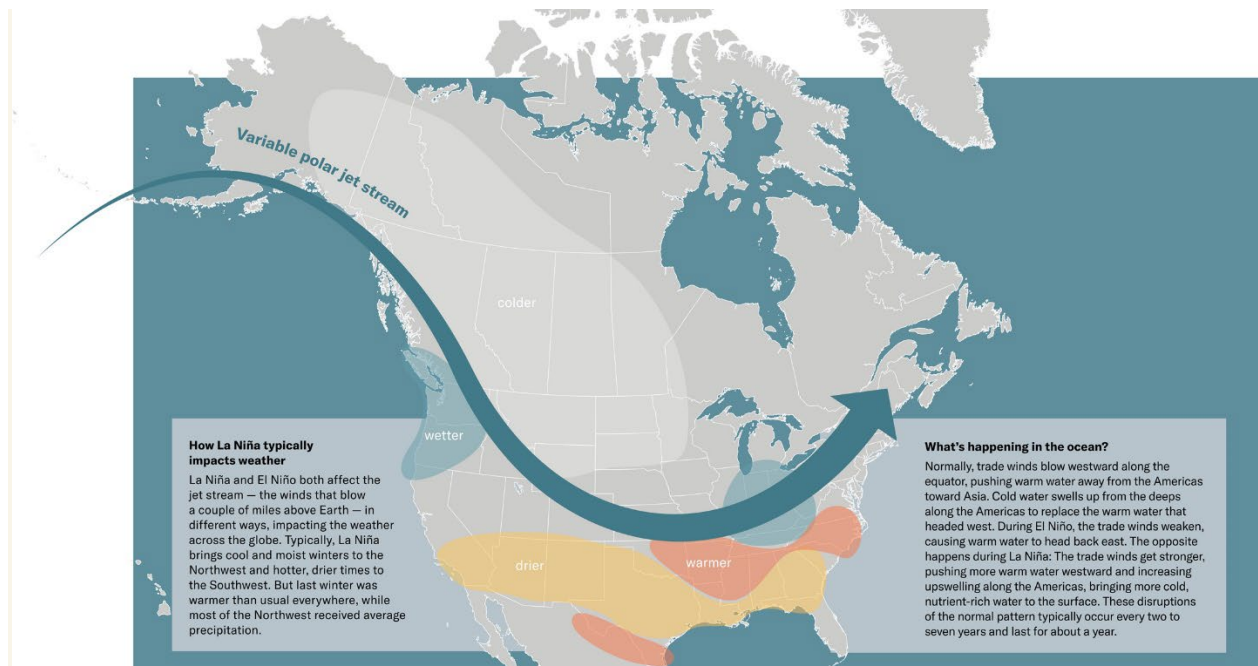
January 1, 2023

La Niña expected to serve up a hat trick

The weather pattern hits the West for a third consecutive winter.

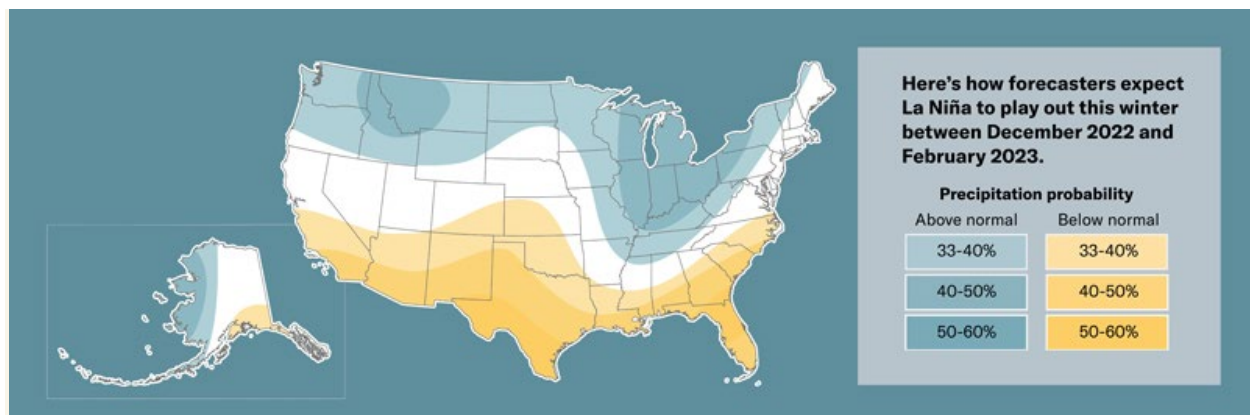
She's baaaack! For the past two years, La Niña, the cooling of ocean temperatures in the equatorial Pacific, has wreaked havoc on weather around the globe. Now the World Meteorological Organization expects the phenomenon to return for a third consecutive year, a rare occurrence that forecasters predict could bring wackier-than-usual winter weather to the West, once again.

La Niña is the yin to El Niño's yang. Normally, trade winds — the tropical winds near the Earth's surface — blow west along the equator, moving warm Pacific Ocean water from the Americas toward Asia. This cycle is disrupted every two to seven years by El Niño-Southern Oscillation, or ENSO, events, which typically last about a year. During El Niño, the winds weaken, and warm water is pushed back toward the Americas. La Niña, meanwhile, strengthens trade winds, bringing cool water to the surface of the Americas' West Coast.



A study published this summer by University of Washington researchers suggests global warming could be to blame for this year's La Niña encore. The two weather phenomena have different effects: El Niño tends to bring wetter conditions to the Southwestern U.S., while La Niña usually brings moist, cool weather to the Northwest and hot, drier conditions to the Southwest.

Still, you might not want to plan your winter around these predictions. Meteorologists have been tracking these phenomena and their impacts on Western weather for about seven decades, but it's hard to forecast exactly what they mean for any particular location. Pretty much the entire West was unusually moist during the La Niña winter of 2007-'08, for example, and all of it — including the northern regions — saw above-average temperatures last year. When it comes to weather, it's best to hedge your bets.



To get some sense of what we might expect this year, we look back on some of 2022's notable weather events and trends to see how they followed — and diverged from — the expected La Niña patterns.

71

Number of monthly high-temperature records tied or broken in the West in February 2022. This included a 93-degree Fahrenheit reading in Chula Vista, California, but also several readings in the 70s in Oregon. The Southwest was indeed warm, as is typical of La Niña, but the heat in Pacific Northwest was unusual. Chalk it up to climate change.

40

The high temperature in degrees Fahrenheit in Utqiagvik, Alaska's northernmost city, on Dec. 5, 2022. That shattered the previous high record of 34 degrees, set in December 1932, and also set a new record mark for the latest date the mercury hit 40 degrees F. It was also only the third December day on record that the temperature climbed above freezing. Much of Alaska is roasting — relatively speaking — under warmer-than-average temperatures so far this winter, even though the La Niña pattern would normally cause the state to be colder than usual.

13.4 inches

Snow water equivalent — a measure of snowpack — in the Upper Colorado River Basin at its 2022 peak on March 23. Normally, the peak is about 16 inches and occurs more than two weeks later. It was, in other words, a dry, warm winter, following the typical La Niña pattern. But by summer's end, precipitation for the entire water year had risen to the median level, thanks to heavy summer rains — unusual for La Niña.

900,000

Number of acres burned in wildfires in New Mexico by the start of summer 2022, thanks to tinder-dry forests following a meager winter.

113

Percent of median precipitation the Yellowstone River headwaters received during Water Year 2022 (Oct. 1, 2021, to Sept. 30, 2022), in line with the typical La Niña pattern.

50,000 cubic feet per second

Peak flow of the Yellowstone River at Corwin Springs, Montana, on June 13, 2022, about four times the median flow for the date. This 500-year flooding event was caused by abundant winter snowmelt, combined with an “atmospheric river” storm system that dumped record-breaking rainfall — as much as 3.6 inches in 24 hours — in and around Yellowstone National Park.

July 24

Date that the Rio Grande’s flow through Albuquerque, New Mexico, fell to zero cubic feet per second. While the river often dries up farther downstream, this was the first time since 1983 that it happened that far north.

1,810 cubic feet per second

Flow of the Rio Grande through Albuquerque on Aug. 7, less than two weeks after it had gone dry. An unusually bountiful monsoon dropped 2.48 inches of precipitation on Albuquerque that month, the second-highest monthly amount since 1995.

48

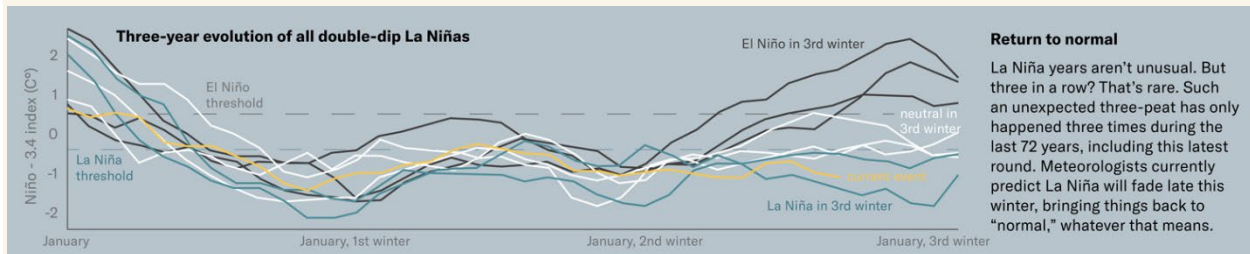
Number of all-time high temperature records tied or broken in the West during a September heat wave. The temperature exceeded 115 degrees in several cities in Northern California.

1,160 cubic feet per second

Flow of Mill Creek upstream from Moab, Utah, on Aug. 21 following a sudden deluge. The stream had been running at about 15 cfs just moments earlier, and the unexpected torrent flooded Moab streets and businesses. This does not jibe with typical La Niña patterns.

.76 inches

Amount of rainfall in the Phoenix, Arizona, area on Dec. 3, the wettest 24-hour period of the year — not what you'd expect for a La Niña year. Total precipitation in November was just .08 inches.



SOURCES: World Meteorological Organization; National Oceanic and Atmospheric Administration; National Weather Service; U.S. Geological Survey; National Resource Conservation Service; R.C.J. Wills, Y. Dong, C. Proistosescu, K.C. Armour and D. Battisti. S. (2022). "Systematic Climate Model Biases in the Large-Scale Patterns of Recent Sea-Surface Temperature and Sea-level Pressure Change," Geophysical Research Letters, 49, e2022GL100011. Climate schematics based on those by Emily Eng/NOAA.

Infographic design by Luna Anna Archey/High Country News

Jonathan Thompson is a contributing editor at High Country News. He is the author of [Sagebrush Empire: How a Remote Utah County Became the Battlefront of American Public Lands](#).

<https://www.hcn.org/issues/55.1/infographic-la-nina-expected-to-serve-up-a-hat-trick>

KTVU

January 3, 2023

California snowpack nearly 175% of average but state not out of drought yet

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After several years of drought, California's snowpack was well above normal on Tuesday, but still, water officials warned that the state is not out of the woods just yet. The good news is that statewide, the snowpack is 174 percent of average for this date and California is expected to see continued rain and snow over the next seven days. Snow surveyors at Phillips Station in El Dorado County recorded 55.5 inches of snow depth and a snow water equivalent of 17.5 inches.

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The good news is that statewide, the snowpack is 174 percent of average for this date and California is expected to see continued rain and snow over the next seven days. Snow surveyors at Phillips Station in El Dorado County recorded 55.5 inches of snow depth and a snow water equivalent of 17.5 inches.

"Our snow pack is off to one of its best starts in the past 40 years," Department of Water Resources Snow Survey Director Sean de Guzman said.

But still, parched Californians shouldn't rejoice too quickly.

"It's always great to be above average this early in the season, but we must be resilient and remember what happened last year," De Guzman added. We'll need consecutive storms; month after month after month of rain, snow and runoff to help really refill our reservoirs."

MORE: [Wildest weather videos from California's series of storms](#)

In 2022 and also in 2013, the Jan. 1 snowpacks were also at or above average conditions, but then dry weather set in, leading to drought conditions by the end of the water year in the fall.

On average, the Sierra snowpack supplies about 30 percent of California's water needs and is an important factor in determining how the department manages the state's water resources.

Its natural ability to store water is why the Sierra snowpack is often referred to as California's "frozen reservoir."

A below-average snowpack impacts water users across the state, putting further stress on the environment and critical groundwater supplies.

<https://www.ktvu.com/news/california-snowpack-nearly-175-of-average-but-state-not-out-of-drought-yet>

LA Times

January 3, 2023

California ‘storm train’ may rival notorious El Niño winter of 1997–98



Nurse Katie Leonard hands a cup of hot tea to Patsy Costello, 88, as she awaits rescue from her stalled car Saturday in Pleasant Hill, Calif.

(Jose Carlos Fajardo / Bay Area News Group)

SAN FRANCISCO —

The [parade of severe storms slamming](#) into Northern California could lead to one of the strongest seasons since the wild El Niño-fueled winter of 1997–98, given the relentless pace of weather systems marching in with little relief.

And this isn't even an El Niño year.

Already, Northern California and the Central Valley have been hit by a number of history-making storms, pouring floodwaters into homes, cars, restaurants, a [nursing home](#), freeways and [underpasses](#). At least four deaths have been reported: a 72-year-old struck by a [falling tree](#) in Santa Cruz on New Year's Eve, two people found near where the Cosumnes River flooded in Sacramento County, inundating Highway 99; and another person west of Galt.

Relief from the pounding storms is not in sight. More storms are expected through mid-January, even after Wednesday's powerful event, expected to hit hard in the afternoon through the night. The National Weather Service for the San Francisco Bay Area issued a rare warning that the storm Wednesday and Thursday would bring "extreme" risk, the worst category — colored purple — on a five-level scale. The Sacramento region's valleys and foothills are forecast to endure "extreme" risk on Wednesday.



[California](#)

String of brutal atmospheric rivers imperils a California already weakened by drought

The atmospheric river due to hit California in the coming hours is likely to compound the damage wrought by a deadly storm on New Year's Eve.

Jan. 4, 2023

The Los Angeles area, meanwhile, is expected to see “major” risks from the storm on Wednesday and Thursday, the second-highest risk level.

“We’ve already gotten quite a burden of precipitation over the last week and a half. So the grounds are saturated,” said Warren Blier, science officer with the National Weather Service office for the San Francisco Bay Area. “Essentially, none of that is going to percolate into the soils and all of it’s going to run off,” raising the flood risk.

Wind gusts of up to 60 miles per hour could hit some locations in the Bay Area and the Sacramento area, and up to 80 miles per hour in the coastal hills. Power lines are expected to be blown down, and could cause widespread blackouts.

“In addition, this storm looks like it’s going to be accompanied by quite strong winds, and potentially even stronger than with the last storm. And that combination of saturated soils and strong winds can result in quite a few trees blowing down,” Blier said. “It’s hard to imagine a scenario that’s potentially more impactful — and also something that could realistically occur — than what we’re looking at with this incoming system.”

Many trees’ root systems have been weakened because of the recent rainfall. On New Year’s Eve, there was a two-hour period where gusts of about 60 miles per hour downed many trees, leading to power outages, said Craig Shoemaker, meteorologist with the National Weather Service office in Sacramento.



California

Toddler killed, cities evacuated as massive storm lashes Northern California

The intense downpours — coming after an earlier deluge days ago — pushed some rivers toward flood stage, prompting a string of evacuations from towns along the Russian River to communities in Santa Cruz County and beyond.

Jan. 5, 2023

In this storm, “winds will be just as strong but a longer duration,” Shoemaker said. “And so we’re expecting quite a few number of [downed] trees and power outages.”

Landslides and mudflows are expected, and officials issued a coastal flood advisory. “Flooding of lots, parks and roads is expected,” the weather service said.

Wednesday's event won't be a "one-and-done" storm. Forecasters said "a storm train of systems looks to march across the Pacific and impact much of NorCal through at least next week, and possibly through [the Martin Luther King Jr. holiday] weekend."

Another storm is expected this weekend, followed by a moderate-to-strong atmospheric river Monday into Tuesday, and another storm at the end of next week heading into the three-day weekend.

"The cumulative effects of these storms could be quite debilitating," the weather service said.

The current pattern of storms is shaping to be quite unlike anything Northern California has seen in years. By the time it ends, downtown San Francisco may have recorded among the highest three-to-four week precipitation totals in the modern record, Blier said. One such memorable train of storms occurred during the historic 1997-98 El Niño winter, a season that ended with 17 deaths and more than half a billion dollars in damage in California.

There is no El Niño this year, and there's instead a weak La Niña, which involves waters off the Pacific coast that are cooler than normal. La Niña tends to result in drier conditions in California, but — as is plausible for this winter — the correlation between the two doesn't always happen.

The most dangerous part of the storm was expected for Wednesday afternoon and the overnight hours into Thursday, with "heavy rain rates that will lead to urban and small stream flooding, with basins getting overloaded," the weather service said.

Karla Nemeth, director of the California Department of Water Resources, called the latest series of storms the most powerful set since 2017, the same robust season that nearly caused the failure of a retaining wall in California's second largest reservoir, Lake Oroville.

"The most vulnerable places in California right now are rural levees — they are not required to meet the same standards as the levees that protect our more urban communities," Nemeth said.

“Please stay home,” pleaded San Francisco Fire Chief Jeanine Nicholson at a news briefing. Government officials across the region reported shortages of sandbags as residents rushed to prepare for flooding.

The city of [San Jose](#) and [San Mateo County](#) declared a state of emergency and [Santa Cruz County](#) declared a local disaster in advance of Wednesday’s storm. San Jose officials [ordered](#) homeless people living along several creeks — Coyote, Guadalupe and Penetencia — to be evacuated. San Jose neighborhoods along Coyote Creek suffered significant [flooding](#) in 2017.

San Mateo County officials said the New Year’s Eve storm has already put sewer treatment plants at risk of failure, forced firefighters to move fire engines away from floodwaters, and caused the evacuation of a trailer park and a farmworker housing community. An evacuation advisory is in effect for the rural southern coastal areas of San Mateo County, particularly the area that burned in the CZU Lightning Complex fire of 2020, one of the most [destructive fires](#) in state history.

A [flood warning](#) has been issued for the Russian River near [Guerneville](#) in Sonoma County. Officials forecast the river will see moderate flooding Thursday. The city of [Watsonville](#) in Santa Cruz County has issued a mandatory evacuation order for areas close to the Pajaro River and Salsipuedes Creek. Santa Cruz County has already suffered \$10 million in damage from the preceding storms.

The San Francisco Bay Ferry [suspended](#) service Wednesday on lines serving South San Francisco and Harbor Bay in Alameda, citing the forecast of big winds from the south threatening terminals. Ferry service to Angel Island was also canceled.

The prior storms have already been impressive. For the 36-hour period that ended 4 a.m. on New Year’s Day, the weather service had expected 1½ to 2 inches of rain for San Francisco. In fact, 5.46 inches of rain fell on downtown San Francisco on New Year’s Eve — the second-wettest day in the historical record, which dates back to 1849.

Downtown Sacramento recorded one of its wettest Decembers on record — 9.5 inches. That’s about half the rainfall the city gets on average in

an [entire year](#), 18.2 inches. Stockton and Modesto set [all-time records](#) for December rainfall, Shoemaker said.

And the flooded Cosumnes River — which flows for 53 miles from the Sierra Nevada to the Central Valley — posted its second-highest river flow on record. By the afternoon of New Year's Eve, a section of the Cosumnes River about 25 miles southeast of downtown Sacramento was flowing at 65,143 cubic feet per second.

“We had a tremendous amount of rain with with that system — we’re talking about two-day totals that were in the seven- to 10-inch range across a lot of our Sierra foothills areas,” Shoemaker said.

That easily topped the previous second-highest flow record, of 49,700 cubic feet per second, set on Feb. 10, 2017 — which came the same week that heavy storm runoff threatened the stability of a [retaining wall](#) at Lake Oroville, California’s second largest reservoir, 75 miles away, forcing large evacuations.

The record for the highest river flow on the Cosumnes River came a year before the 1997–98 El Niño winter. The winter of 1996–97 brought deadly New Year’s [floods](#) and billions of dollars in damage, and on Jan. 2, 1997, the Cosumnes River reached a peak flow of 93,000 cubic feet per second.

Luckily, Wednesday’s storm is not expected to flood the areas around the Cosumnes River. For the Central Valley, the heavier rains are aimed farther north, Shoemaker said.

One potential complication is a higher risk of thunderstorms in Wednesday’s storm “that could cause a quicker burst of heavy rainfall,” Shoemaker said.

The main concern for the Sacramento area, like for the Bay Area, is the line of storms prepared to march through mid-January.

“We’re very concerned about continuation of the threat of flooding and strong winds going into the future. And that could begin to affect some of the larger rivers, as this rain piles up,” Shoemaker said.

While the back-to-back nature of these storms is impressive, the cumulative precipitation recorded so far in the northern Sierra — a key indicator of the health of California’s reservoirs — is nowhere near enough to suggest the end of the drought is in sight.

Water levels in many California reservoirs remain significantly **below** their historical averages.



Climate & Environment

California snowpack is far above average amid January storms, but a lot more is needed

California snowpack is 174% of average for this time of year, but state officials caution that the drought isn’t over.

Jan. 3, 2023

<https://www.latimes.com/california/story/2023-01-04/storm-train-aimed-at-northern-california-could-rival-el-nino-winter-of-97-98>

Department of Water Resources

January 3, 2023

THIS JUST IN ... Snow Survey Shows December Storms Provided Big Snow Totals with More Systems, Flooding in Forecast



**Despite Heavy Rain and Snow, Relief from Drought Conditions
Still Depends on Coming Months**

From the Department of Water Resources:

The Department of Water Resources (DWR) today conducted the first snow survey of the season at Phillips Station. The manual survey

recorded 55.5 inches of snow depth and a snow water equivalent of 17.5 inches, which is 177 percent of average for this location. The snow water equivalent measures the amount of water contained in the snowpack and is a key component of DWR's water supply forecast. Statewide the snowpack is 174 percent of average for this date.

California is expected to see continued rain and snow over the next seven days, with the threat of flooding in parts of California. Conditions so far this season have proven to be strikingly similar to last year when California saw some early rainstorms and strong December snow totals only to have the driest January through March on record.

"The significant Sierra snowpack is good news but unfortunately these same storms are bringing flooding to parts of California," said DWR Director Karla Nemeth. "This is a prime example of the threat of extreme flooding during a prolonged drought as California experiences more swings between wet and dry periods brought on by our changing climate."

One year ago, the Phillips survey showed the seventh highest January measurements on record for that location. However, those results were followed by three months of extremely dry conditions and by April 1 of last year, the Phillips survey measurements were the third lowest on record.

More telling than a survey at a single location are DWR's electronic readings from 130 stations placed throughout the state. Measurements indicate that statewide, the snowpack's snow water equivalent is 17.1 inches, or 174 percent of average for this date. This January's results are similar to results in 2013 and 2022 when the January 1 snowpack was at or above average conditions, only for dry weather to set in and lead to drought conditions by the end of the water year (September 30). In 2013, the first snow survey of the season also provided promising results after a wet December similar to today's results. However, the following January and February were exceptionally dry, and the water year ended as the driest on record, contributing to a record-breaking drought. In 2022, record-breaking December snowfall was again followed by the driest January through March period on record.

“Big snow totals are always welcome, but we still have a long way to go before the critical April 1 total,” said DWR’s Snow Surveys and Water Supply Forecasting Unit Manager Sean de Guzman. “It’s always great to be above average this early in the season, but we must be resilient and remember what happened last year. If January through March of 2023 turn out to be similar to last year, we would still end the water year in severe drought with only half of an average year’s snowpack.”

On average, the Sierra snowpack supplies about 30 percent of California’s water needs and is an important factor in determining how DWR manages the state’s water resources. Its natural ability to store water is why the Sierra snowpack is often referred to as California’s “frozen reservoir.” A below-average snowpack impacts water users across the state, putting further stress on the environment and critical groundwater supplies.

Due to these increasing swings from dramatically wet to dry conditions, Governor Newsom’s recently released “[California’s Water Supply Strategy, Adapting to a Hotter, Drier Future](#)” calls for investing in new projects and technologies that will modernize how the state manages water. In alignment with the Administration’s strategy, the recently adopted [2022 Update to the Central Valley Flood Protection Plan](#) identifies actions needed to adapt much of California’s flood infrastructure to a rapidly changing climate. Current climate research indicates the state will see bigger swings from extreme heat and dry conditions to larger and more powerful storms that deliver temporary large boosts to the state snowpack as well as flood risk.

DWR encourages Californians to visit [SaveOurWater.com](https://www.saveourwater.com) for water saving tips and information, and to continue to conserve California’s most precious resource, rain or shine.

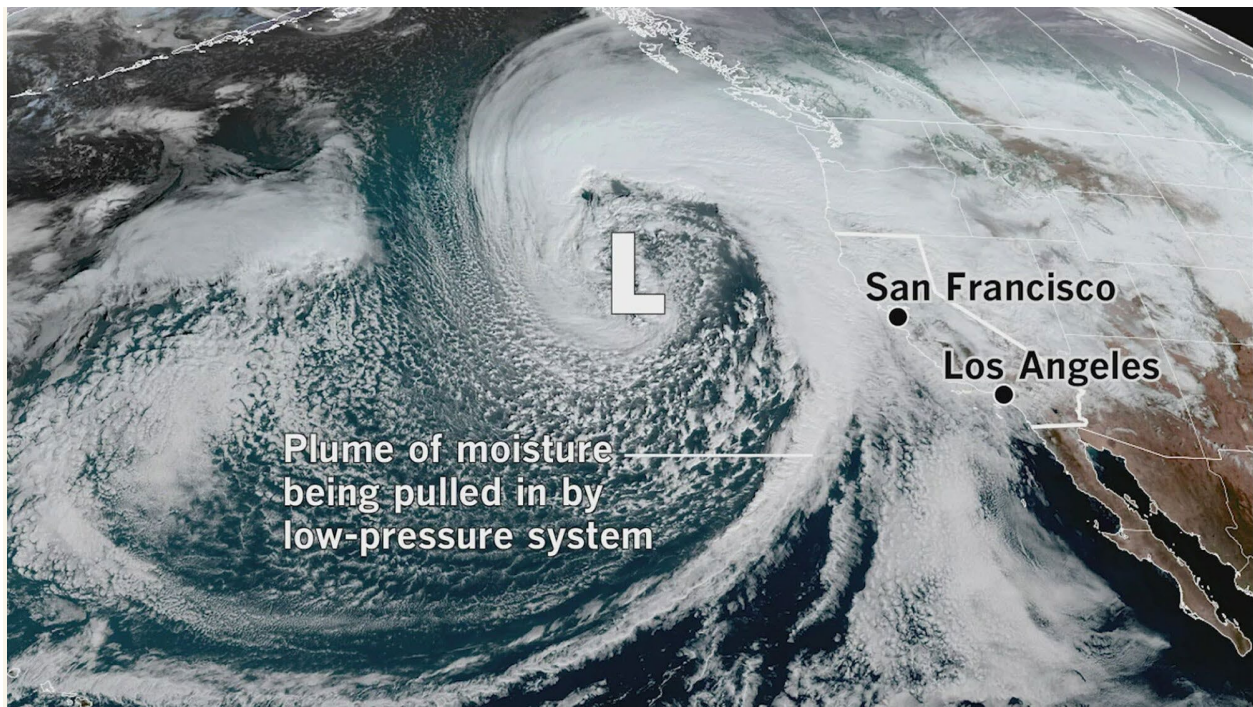
DWR conducts five media-oriented snow surveys at Phillips Station each winter near the first of each month, January through April and, if necessary, May. The next survey is tentatively scheduled for February 1.

<https://mavensnotebook.com/2023/01/03/this-just-in-snow-survey-shows-december-storms-provided-big-snow-totals-with-more-systems-flooding-in-forecast>

LA Times

January 4, 2023

The atmospheric river hitting California as seen from space: How to interpret it



Satellite imagery from midday on Wednesday shows an intense low-pressure system spinning counterclockwise off the Northern California coast. As it spins, it draws in a robust plume of moisture, called an atmospheric river, from the Pacific Ocean.

Atmospheric rivers are concentrated streams of water vapor about 100 to 250 miles wide in the middle and lower levels of the atmosphere. They can transport water at a rate per second equivalent to 25 Mississippi Rivers or 2.5 Amazon Rivers, according to Marty Ralph, an expert at the Scripps Institution of Oceanography in San Diego.

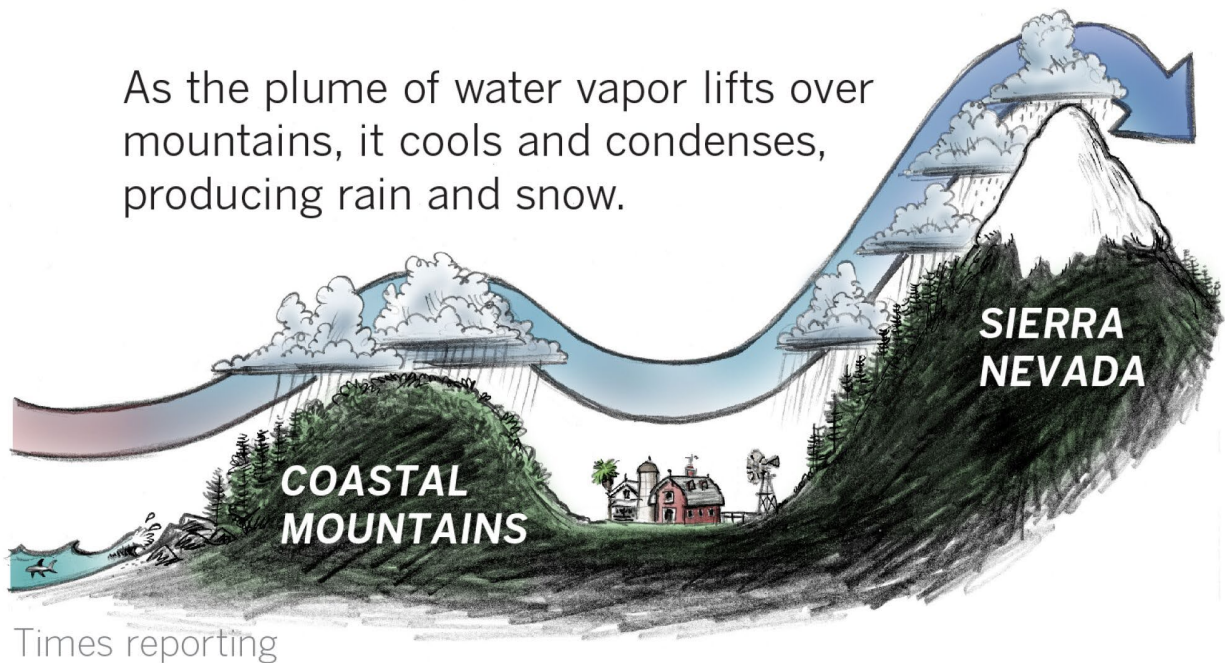
They're like a continuous channel of moisture streaming across the ocean without interruption. When this atmospheric stream, bloated with

moisture, meets California's mountainous coastal topography, it is forced up and over the higher terrain. This is called orographic lift.

Atmospheric river

A long, narrow corridor of concentrated water vapor.

As the plume of water vapor lifts over mountains, it cools and condenses, producing rain and snow.



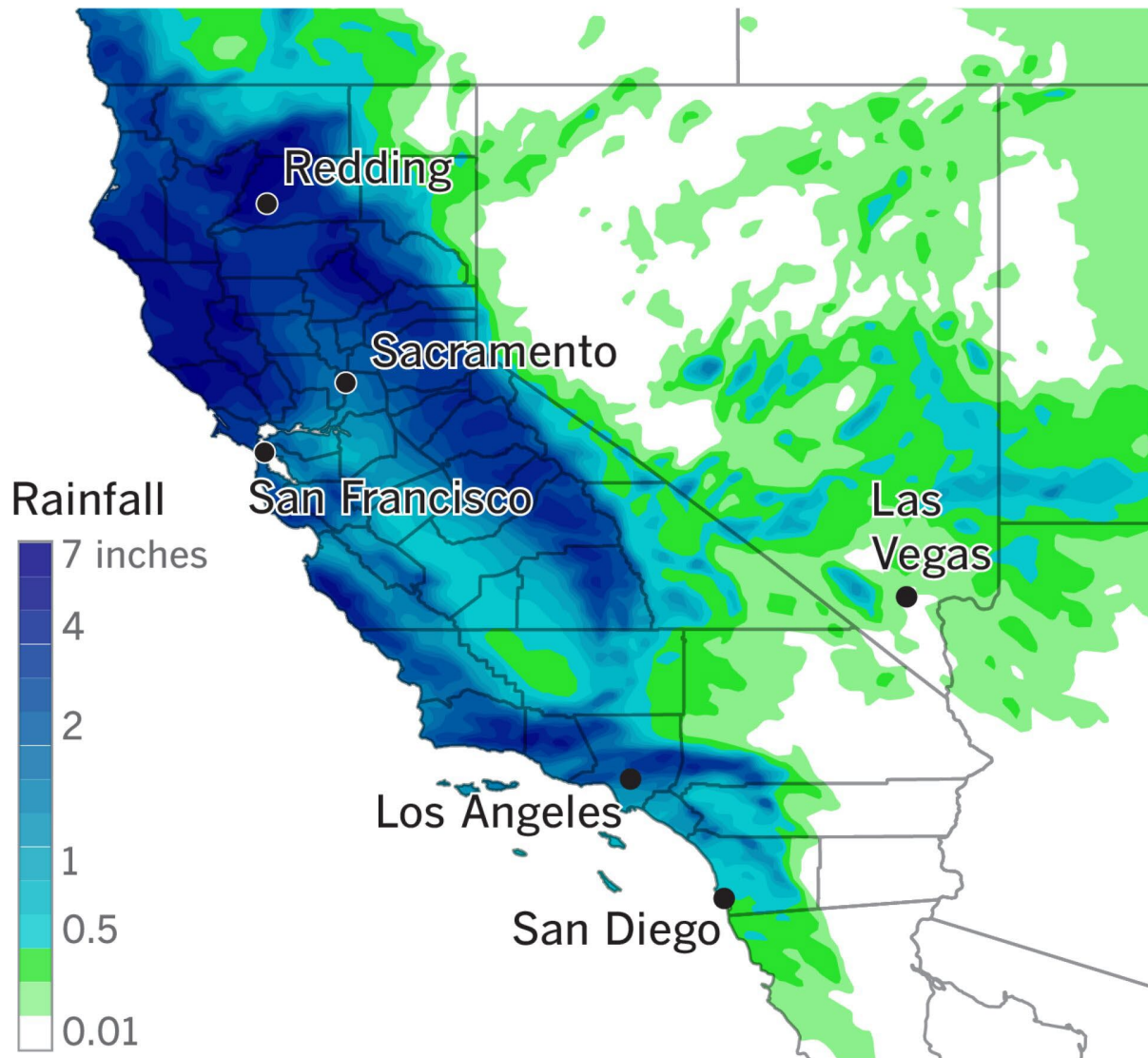
(Paul Duginski / Los Angeles Times)

The moist air plume cools as it gains altitude, and the moisture condenses, falling as precipitation. The atmospheric river in this satellite image will sag southward toward the Los Angeles area on Thursday.

Rainfall rates are expected to peak between 0.5 and 1.0 inches per hour in most areas. There is a chance, however, those rates could reach up to 1.25 inches per hour — which would heighten the risk for mud and debris flows in recent burn areas.

“This is a dangerous weather system, a very significant flood situation developing later tonight and Thursday morning,” said Eric Boldt, a National Weather Service meteorologist in Oxnard.

Total forecasted rainfall through Saturday



National Weather Service Weather Prediction Center

LOS ANGELES TIMES

There will also be a slight chance of thunderstorms once the heaviest rains have passed.

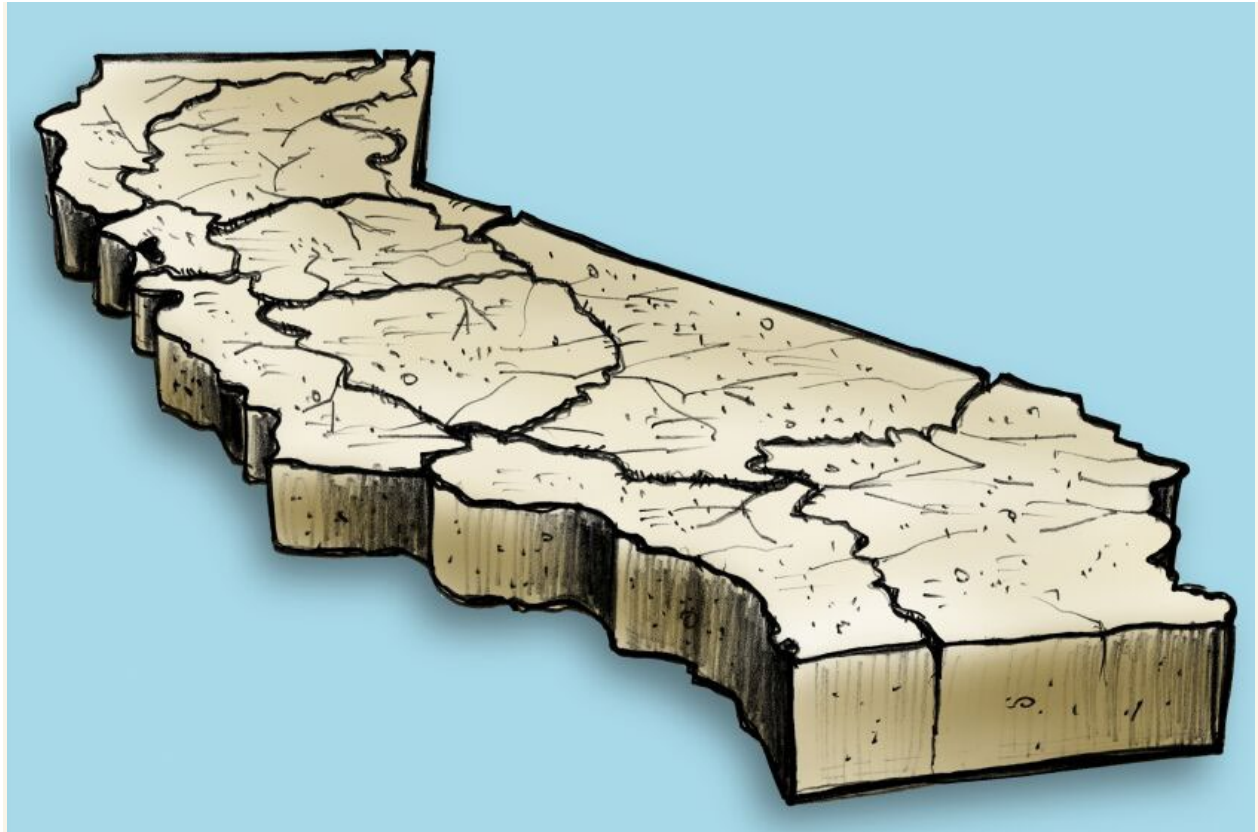
“Those could create their own very brief heavy downpours, but those cells will be fast-moving, kind of short-duration,” Boldt said. “So the threat of flooding is still there, but we will be monitoring those closely for both potential heavy rain and gusty winds.”

Although potent atmospheric rivers can cause extreme rainfall with catastrophic flooding and mudslides, many are weak and provide beneficial rain to [drought-stricken California](#).

On average, about 30% to 50% of annual precipitation on the West Coast comes from just a handful of atmospheric rivers, according to the National Weather Service.

Mountain slopes facing the ocean and positioned as obstacles to oncoming atmospheric rivers tend to receive the heaviest rain, while some areas such as San Jose and parts of the Salinas Valley, for example, will be in the rain shadow of these mountains, and will receive less precipitation as a result.

An atmospheric river hitting the Central Coast will continue across the Central Valley and climb the western slope of the Sierra Nevada. These peaks are so high and give the atmospheric river such a workout that almost all the rest of the moisture is wrung out of it, leaving the mountains smothered in a blanket of snow because of the cold at high altitudes. But the Great Basin of Nevada beyond the Sierra to the east is largely left in a gigantic rain shadow.



Climate & Environment

Tracking the California drought

The latest maps and charts on the California drought, including water usage, conservation and reservoir levels.

July 8, 2022

A look at the map shows that California's deserts are a product of mountain ranges, including the Transverse Ranges in the south. They starve inland areas of moist flow off the ocean.

The mountain snowpacks serve as the state's water bank under good conditions, and the snow gradually melts through the warm months, replenishing streams and reservoirs.

Sometimes the moisture is tropical, originating near the Hawaiian Islands. As a result of its origin, such systems will be warmer, causing snow levels to be higher.

An atmospheric river such as this is popularly known as a “Pineapple Express.”

“All Pineapple Expresses are atmospheric rivers, but not all atmospheric rivers are Pineapple Expresses,” said Drew Peterson, a National Weather Service meteorologist in Monterey.

Times staff writer Luke Money contributed to this report.

<https://www.latimes.com/california/story/2023-01-04/a-satellite-view-of-the-atmospheric-river-hitting-california>

January 4, 2023

With all this rain, is California still in a drought?

'Rain in California will certainly help, but it won't alleviate the drought overall in the western United States'



After years of drought, here's a look at how this winter's storms help the state's water supply.

LOS ANGELES (KABC) -- After the driest start to any year on record, California ended 2022 with snow-capped mountains, soaked roadways and flood warnings.

The soggy weather continues into 2023, with this week's bomb cyclone storm dumping several inches of rain.

So what difference does that make in California's extended drought?

Experts say the wet winter makes a dent, but there's still a long way to go for the state's water supplies to be built back up to sufficient levels.

"Rain in California will certainly help, but it won't alleviate the drought overall in the western United States," said Lowell Stott, professor of earth sciences at the University of Southern California.

Stott says our water resources rely on a consistent seasonal accumulation of snow and ice at high elevations in the Sierra Nevada Mountains.

"In California we are dependent upon the accumulation of snow and ice at high elevations because we get so little precipitation during the spring and summer seasons. And so during the winter, we accumulate snow and ice hopefully at high elevations. And during the spring months, that precipitation that was in the form of snow begins to melt and the runoff from that melt flows into reservoirs," Stott said.

Stott says it'll take many years of consistent rain to see a difference in the drought, which is why water conservation efforts are still so important.

A map of conditions in California produced by the U.S. Drought Monitor [can be found here](#). The latest map update as of Dec. 29, before the most recent storms, showed large swaths of inland California - more than a third of the state from Kern County north to the Oregon border - in the two most extreme states of "exceptional" and "extreme" drought.

In Los Angeles, water supplies come from several sources, including snowfall in the High Sierra - but also direct capture of rainfall. So big storms do help that aspect.

Steven Frasher, public information officer with Los Angeles County Public Works, says about one-third of L.A. County's water supply is from stormwater capture.

"Big priority for a storm event is to capture as much of the rainfall as we can," Frasher said.

"You can almost call it stormwater harvest. Even in this last storm over New Year's weekend, the county was able to capture almost 2 billion gallons of stormwater for use in groundwater recharge."

https://www.google.com/url?rct=j&sa=t&url=https://abc7.com/rain-california-drought-socal-storm-water-supply/12653281/&ct=ga&cd=CAEYBCoUMTY4Mzc0Nzc0NzUzMjA4NzkzOTgyHDkyNjBjODk2NzcxMzJjM2U6Y29tOmVuOIVTOII&usg=AOvVaw30PxrCCmc0ag-KT_GgnS3N

E & E News

January 5, 2023

Lethal storms challenge California's levees



People fill sandbags Tuesday in preparation for the next storms outside a public works station in South San Francisco, Calif. Northern California residents are dealing with powerful storms that have already exposed vulnerabilities in a rural levee system. Haven Daley/AP Photo

A run of atmospheric rivers that have swollen California streams to record levels and breached some of the state's crucial levees shows no sign of easing up, leaving farms and residences vulnerable for what could be another week or more.

Multiple deaths have already been linked to the series of storms, including that of a young Sonoma County child whose family's doublewide trailer home was crushed Wednesday night by a falling tree.

An estimated 190,000 California residents had lost power Thursday morning, some heavily trafficked highway stretches have been closed and evacuation orders have been issued for several towns. California Gov. Gavin Newsom (D) has declared a state of emergency.

"We anticipate that this may be one of the most challenging and impactful series of storms to touch down in California in the last five years," Nancy Ward, who was appointed Dec. 31 as director of the California Governor's Office of Emergency Services, said at a [news briefing](#).

Ward added that the storms "may continue for the next seven to 10 days" and that if this happens as anticipated "we could see widespread flooding, mudslides and power outages in many communities."

Streamflow measurements in Northern California between Dec. 31 and Jan. 2 recorded 13 preliminary record-high levels, according to the U.S. Geological Survey. Near Sacramento, water tumbled by at a stunning 63,700 cubic feet per second along a stretch of the Cosumnes River.

The high waters breached levees at multiple locations along the river near the town of Wilton, with several of the breaks that started last weekend spanning at least 2,000 feet.

On Wednesday afternoon, Sacramento County officials reported finding a body in a submerged vehicle west of the town of Galt. It was at least the third person found dead in a flooded part of south Sacramento County, according to *The Sacramento Bee*. The death of the child in Sonoma County was reported by Santa Rosa's *Press Democrat*.

"Heavy rains and hazardous weather conditions continue in Northern California this week," said Mark Dickman, associate director of data for the USGS Water Science Center. "Streamflows have been very high, and we expect more over parts of the region the next several days."

Atmospheric rivers are long columns of water vapor that produce heavy rain during winters in California. They are ranked on a scale of 1 to 5 based on the amount of water vapor they carry and their duration.

The most recent atmospheric rivers hitting California have been characterized as Category 3, but they have also come one after another.

“This is an extreme weather event, and we’re moving from extreme drought to extreme flood,” Karla Nemeth, director of the California Department of Water Resources, told reporters at a briefing Wednesday.

Nemeth added that this double-whammy means that “after three years of intensive drought, the ground is saturated and there is significant chance of downed trees that will create significant problems.”

On Tuesday, the state agency activated the State-Federal Flood Operations Center that monitors conditions and keep local and partner agencies informed of elevated river levels.

While atmospheric rivers deliver a big share of California’s water supply, they also wreak most of the state’s flood damage. Roughly 80 percent of levee breaches in California’s Central Valley are linked to atmospheric rivers.

In the crucial Sacramento-San Joaquin River Delta, notably, a somewhat ad hoc network of over 1,100 miles of levees, many of them more than a century old, seek to contain flows where the two rivers meet.

There have been at least 162 Delta levee failures during the past century, according to the state Department of Water Resources. Most of these levee failures have led to the flooding of islands within the delta.

In recent days, California officials have deployed equipment to 49 locations statewide, along with levee inspectors and flood-fighting specialists.

The heavy precipitation has not been all grim, as the state’s first snow survey of the season on Jan. 3 found 55.5 inches of snow depth at one Sierra Nevada location, which is 177 percent of average for the site.

Statewide, the snowpack is 174 percent of average for this date.

<https://www.eenews.net/articles/lethal-storms-challenge-californias-levees>

LA Times

January 5, 2023

Editorial: The drought is over now, right? (Spoiler alert: No)



Patsy Costello, 88, sits trapped in her car in Pleasant Hill in Contra Costa County on New Year's Eve. A nurse who lives down the block used her kayak to bring Costello hot tea, blankets, food and a phone to call a friend.

(Jose Carlos Fajardo / Bay Area News Group via Associated Press)

The storms keep coming, one after another after another, like a series of fire-hose blasts so relentless that meteorologists use terms like “[atmospheric river](#),” “bomb cyclone” and “[bombogenesis](#).” What happened to our formerly gentle old winter visitor, the “[pineapple express](#)”? Cities and highways have flooded in Northern California, and

the Sierra Nevada [snowpack measured](#) at 174% of the historical average for this point in the year. And that was even before the current storm.

And still, the experts insist that we remain in the midst of a record-breaking four-year drought. Are they just mean?

Unfortunately, the experts have data on their side. Living in California in the 21st century means simultaneously dealing with downpours and severe water shortages.



[California](#)

[Toddler killed, cities evacuated as massive storm lashes Northern California](#)

The intense downpours — coming after an earlier deluge days ago — pushed some rivers toward flood stage, prompting a string of evacuations from towns along the Russian River to communities in Santa Cruz County and beyond.

Jan. 5, 2023

Just a year ago, [December storms](#) appeared to have [heralded a wet 2022](#), but [by January the rain and snow had stopped](#) and never picked up again. Flooding was followed just a few weeks later with emergency drought orders that sharply limited water use, first in the northern part of the state and ultimately [in Los Angeles as well](#).

This winter's precipitation, currently running above average, could shut off again. We'll need additional storms (with or without bombogenesis) in February and March in order to meet annual precipitation averages.

So if we get those, then can we say the drought is over?

Alas, no. We've been running a water deficit for so long, due to a succession of extremely dry years, that average rainfall and snowfall won't cut it. Even double the normal rain and snow won't be enough to lift us out of drought. We need to recoup a portion of what we didn't get each year since the [wet winter of 2017](#), when Californians last exulted that the dry times were done.



Opinion

Editorial: There is no drought

If 'drought' means a period of dry years followed by a return to the norm, California is not in drought. The current climate is the norm.

May 6, 2021

And what if we do get a 2017-type winter, a season so wet that the reservoirs all fill to the brim as they did then? Can we then rest easy?

No, because the amount of moisture that falls from the sky is only part of the formula. We need cold mountain temperatures, too, persisting at least through March, to maintain the Sierra snowpack that accounts for at least a third of the state's water storage capacity. A couple of winter heat waves, like the one that's [currently baking Europeans](#) and leaving the Alps nearly bare of new snow, could quickly deplete an entire winter's worth of stored snowfall.

Instead of melting at a steady pace and flowing into rivers and aqueducts through the summer, when farmers and city dwellers need it most, warm temperatures could liquefy the snowpack and send it downstream in the winter, all at once, when the reservoirs are already full and the fields and streets are already flooded. Or worse, it could just evaporate off the mountainsides into an oven-like sky, leaving the ground beneath it as dry as if the snow had never been there. That's what [California's last several winters](#) have been like.



Opinion

Editorial: What we should do with all that rainwater

Southern California needs to capture and reuse more of its rainfall while Northern California needs to keep more of it flowing to the sea.

Dec. 19, 2021

But let's suppose everything goes our way, that the precipitation keeps coming through January and February, in above-average but manageable doses, to minimize the landslides and flooding while filling the reservoirs and restoring the groundwater. And suppose Sierra temperatures stay cold so that much of that water falls as snow and stays that way until springtime.

We might then be able to say that the drought that followed the [wet winter of 2017](#) is truly over.

Remember, though, that [2017 also followed an extended drought](#). That year — and this year, and the wet winter of 2011 — may simply be wet breaks in an extended era of aridity.

In fact, what we're experiencing may not be a drought at all, in the sense that the amount of water that falls on California in any given decade really hasn't changed much. What has changed is that rain and snow now come on a less predictable schedule, leaving living patterns, industries, infrastructure and laws we created during the 20th century less suited for the realities of the 21st. We emerge from drought when we restore floodplains, so that excess runoff can seep down to restore depleted aquifers, improve our technology to limit waste, update our laws to apportion our most precious resource more wisely and take other steps to reorient ourselves and society to fit the new way Mother Nature sends us water.

<https://www.latimes.com/opinion/story/2023-01-05/droughts-not-over>

The Conservation

January 6, 2023

How California could save up its rain to ease future droughts – instead of watching epic atmospheric river rainfall drain into the Pacific

[Andrew Fisher](#), *University of California, Santa Cruz*

Author



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Disclosure statement

Funding: U.S. National Science Foundation, U.S. Department of Agriculture, National Aeronautics and Space Administration, Gordon and Betty Moore Foundation, Santa Clara Valley Water District, U.S. Geologic Survey Affiliation: Research Network with the Public Policy Institute of California

California has seen [so much rain](#) over the past few weeks that farm fields are inundated and normally dry creeks and drainage ditches have become

torrents of water racing toward the ocean. Yet, most of the state remains in [severe drought](#).

All that runoff in the middle of a drought begs the question — why can't more rainwater be collected and stored for the long, dry spring and summer when it's needed?

As a [hydrogeologist](#) at the University of California at Santa Cruz, I'm interested in what can be done to collect runoff from storms like this on a large scale. There are two primary sources of large-scale water storage that could help make a dent in the drought: holding that water behind dams and putting it in the ground.

Why isn't California capturing more runoff now?

When California gets storms like the [atmospheric rivers](#) that hit in December 2022 and January 2023, water managers around the state probably shake their heads and ask why they can't hold on to more of that water. The reality is, it's a complicated issue.

California has [big dams and reservoirs](#) that can store large volumes of water, but they tend to be in the mountains. And once they're near capacity, water has to be released to be ready for the next storm. Unless there's another reservoir downstream, a lot of that water is going out to the ocean.

In more populated areas, one of the reasons storm water runoff isn't automatically collected for use on a large scale is because the first runoff from roads is [often contaminated](#). Flooding can also cause [septic system overflows](#). So, that water would have to be treated.

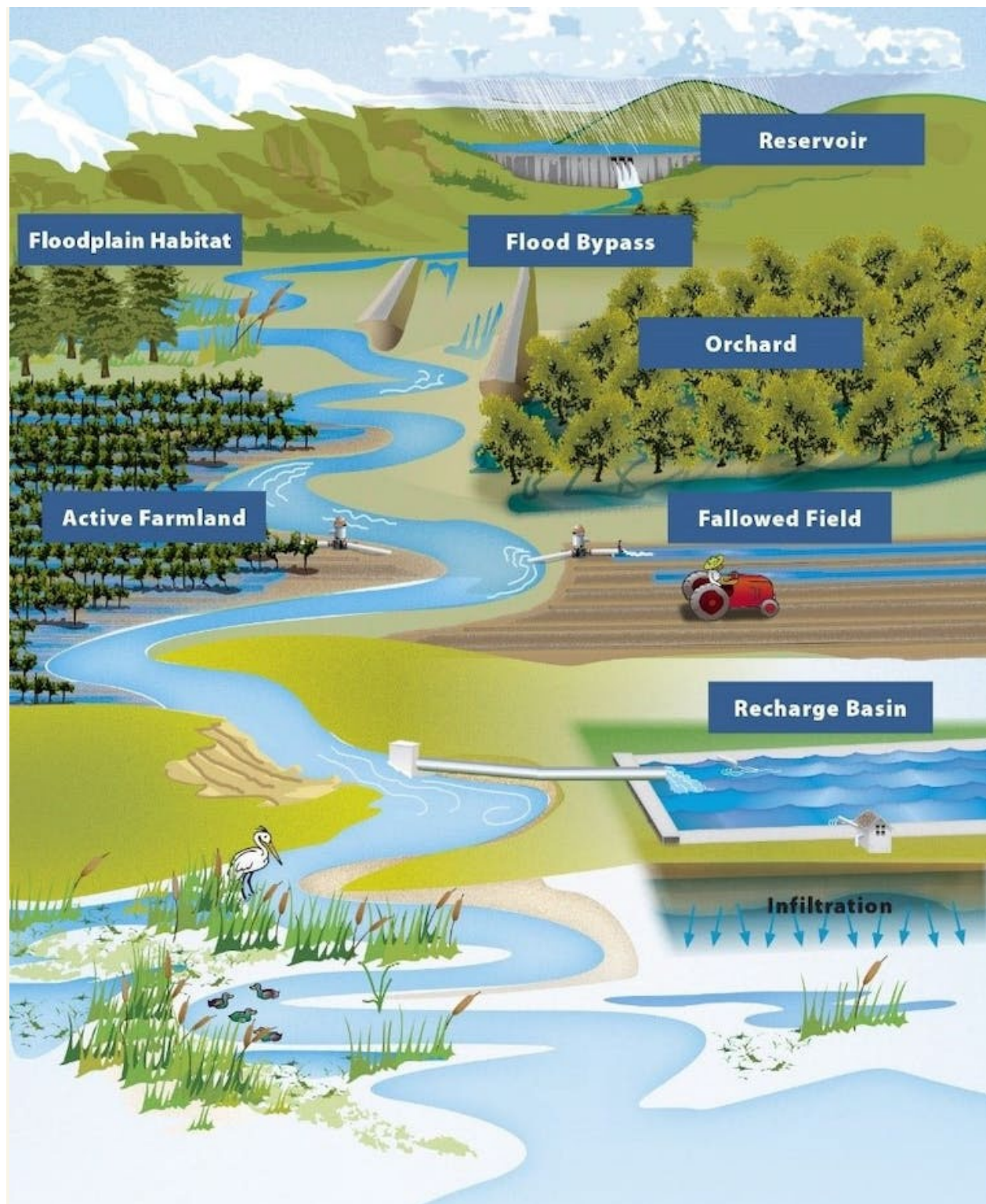
You might say, well, the captured water doesn't have to be drinking water, we could just use it on golf courses. But then you would need a place to store the water, and you would need a way to distribute it, with separate pipes and pumps, because you can't put it in the same pipes as drinking water.

Putting water in the ground

There's another option, and that's to put it in the ground, where it could help to replenish groundwater supplies.

Managed recharge has been used for decades in [many areas](#) to actively replenish groundwater supplies. But the techniques have been gaining more attention lately as wells run dry amid the long-running drought. Local agencies have proposed more than [340 recharge projects](#) in California, and the state estimates those could recharge an additional 500,000 [acre-feet](#) of water a year on average if all were built.

One method being discussed by the state Department of Water Resources and others is [Flood-MAR, or flood-managed aquifer recharge](#). During big flows in rivers, water managers could potentially divert some of that flow onto large parts of the landscape and inundate thousands of acres to recharge the aquifers below. The concept is to flood the land in winter and then farm in summer.



Flood-managed aquifer recharge methods. [California Department of Water Resources](https://www.water.ca.gov/flood-managed-aquifer-recharge/)

Flood-MAR is promising, provided we can find people who are willing to inundate their land and can secure water rights. In addition, not every part of the landscape is prepared to take that water.

You could inundate 1,000 acres on a ranch, and a lot of it might stay flooded for days or weeks. Depending on how quickly that water soaks in, some crops will be OK, but other crops could be harmed. There are also concerns about creating habitat that encourages pests or risks food safety.

Another challenge is that most of the big river flows are in the northern part of the state, and many of the areas experiencing the [worst groundwater deficits](#) are in central and southern California. To get that excess water to the places that need it requires transport and distribution, which can be complex and expensive.

Encouraging landowners to get involved

In the Pajaro Valley, an important agricultural region at the edge of Monterey Bay, regional colleagues and I are trying [a different type of groundwater recharge project](#) where there is a lot of runoff from hill slopes during big storms.

The idea is to siphon off some of that runoff and divert it to infiltration basins, occupying a few acres, where the water can pool and percolate into the ground. That might be on agricultural land or open space with the right soil conditions. We look for coarse soils that make it easier for water to percolate through gaps between grains. But much of the landscape is covered or underlain by finer soils that don't allow rapid infiltration, so careful site selection is important.

One program in the Pajaro Valley encourages landowners to participate in recharge projects by giving them a rebate on the fee they pay for water use through a “[recharge net metering](#)” mechanism.

How recharge net metering works.

We did a cost-benefit analysis of this approach and found that even when you add in all the capital costs for construction and hauling away some

soil, the costs are competitive with finding alternative supplies of water, and it is cheaper than desalination or water recycling.

Is the rain enough to end the drought?

It's going to take many methods and several wet years to make up for the region's long period of low rainfall. One storm certainly doesn't do it, and even one wet year doesn't do it.

For basins that are dependent on groundwater, the recharge process takes years. If this is the last rainstorm of this season, a month from now we could be in trouble again.

<https://theconversation.com/how-california-could-save-up-its-rain-to-ease-future-droughts-instead-of-watching-epic-atmospheric-river-rainfall-drain-into-the-pacific-197168>

LA Times

January 6, 2023

L.A. lets rain flow into the Pacific Ocean, wasting a vital resource. Can we do better?



High surf brought spectators to Manhattan Beach on Friday.
(Carolyn Cole/Los Angeles Times)

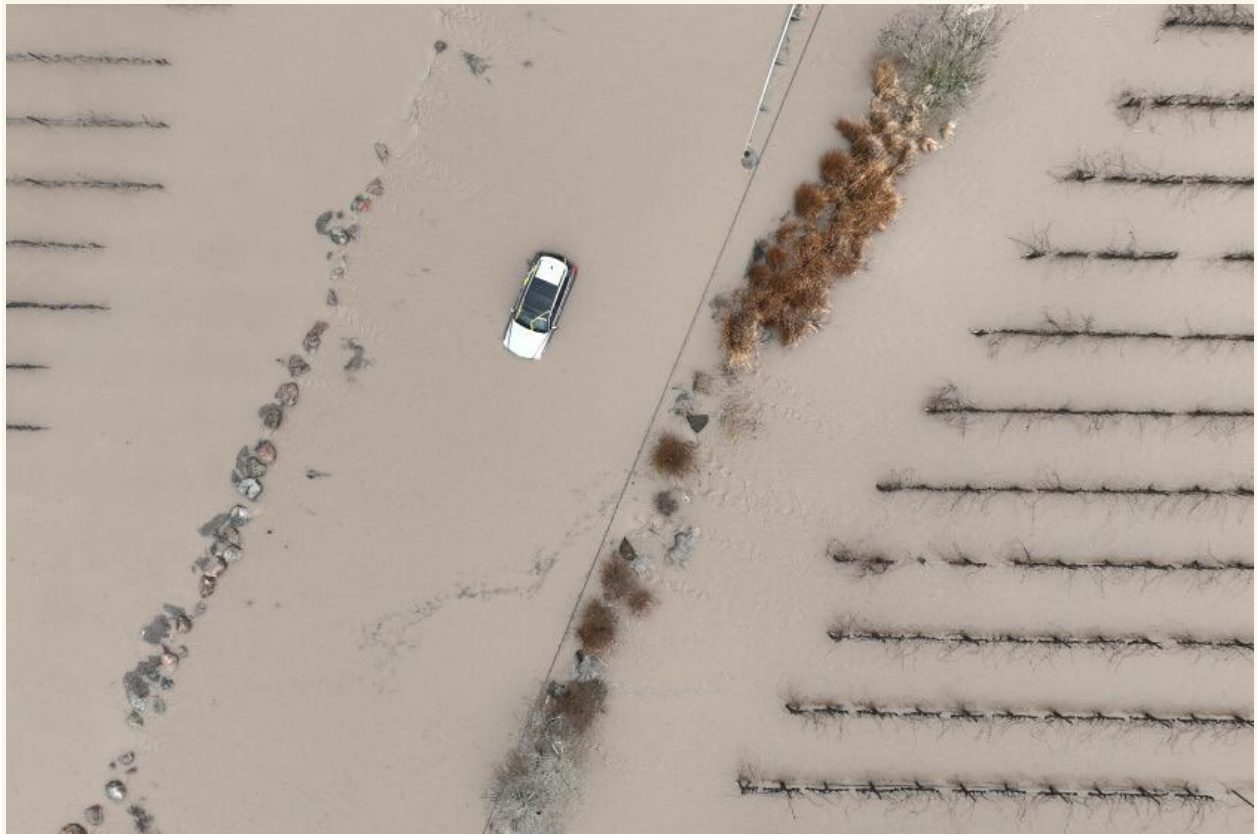
The Los Angeles River roared to life this week as a series of powerful storms [moved through the Southland](#). In Long Beach, 3 feet of water shut down the 710 Freeway in both directions, while flooding in the San Fernando Valley forced the closure of the Sepulveda Basin.

It was by all accounts a washout, but despite heaps of water pouring into the area, drought-weary Los Angeles won't be able to save even half of it. The region's system of engineered waterways is designed to whisk L.A.'s

stormwater out to sea — a strategy intended to reduce flooding that nonetheless sacrifices countless precious gallons.

Voters in 2018 approved [Measure W](#), which is aimed at improving L.A.'s aging stormwater capture system. Officials are making progress, but experts say there's a long way to go. Of an estimated 5 billion to 10 billion gallons pouring into the Los Angeles Basin from current storms, only about 20% will be captured by the county.

“In a region that imports 60% of our water, it's just a huge untapped potential for a local water supply,” said Bruce Reznik, executive director of L.A. Waterkeeper. “We passed the Safe Clean Water Program to get us there, but we're just not there yet. It's going to take us some years.”\\



California

Photos: ‘Life-threatening’ flooding feared in Northern California as storms cause rivers to swell

The powerful storm that knocked out power, toppled trees — including one that killed a toddler — and flooded homes along the coast in Santa Cruz continued its march through the region.

2 hours ago

Many years, in fact. County officials have said [it will take three to five decades](#) to build its stormwater capture system to full capacity, with the ultimate goal of capturing 300,000 acre-feet, or roughly 98 billion gallons, of water annually.

Part of the challenge is that the current system was built about 100 years ago, in an era when Angelenos were more concerned about saving lives and property from flooding than they were about drought. Their solution was to lay millions of barrels of concrete to get rid of that water faster — channelizing the L.A. River, Ballona Creek and nearly every other waterway in the area.

Though a few regional watersheds, such as the Upper San Gabriel River, have good soils and systems for capturing stormwater, they are few and far between, with the vast majority of water that comes to the region “on a superhighway to get out,” said Reznik.

“Water is the most precious resource we have, something that we cannot live without, and yet we do everything we can, when it comes to rain, to get rid of it as soon as possible,” he said.



California

Southern California storm front brings rains, strong winds and helicopter rescues

The most recent storm pounded the Southland, closing piers and eroding beaches, and spurring water rescues and some evacuation orders.

Jan. 5, 2023

Los Angeles County Department of Public Works spokesman Kerjon Lee said Measure W is working, however. Since its approval in 2018, the agency has awarded \$400 million to more than [100 regional infrastructure projects](#), such as the Rory M. Shaw Wetlands Park Project to convert a 46-acre landfill into a wetlands park that can collect stormwater runoff.

But he also said much of the rain is ending up in the Pacific, with L.A. River outflows measuring about 28,500 cubic feet per second Thursday.

“The conditions were ripe for capturing more, but when it comes all at once — which is kind of how we get our water here — we’ve got to move that water away from city streets and away from properties to save life and property,” Lee said. “We have that dual mission: flood protection and supporting local water supply.”

City officials said similarly that stormwater capture capability is improving, including about 20 projects from the Los Angeles Department of Water and Power in the last decade. Updates to the [Tujunga Spreading Grounds facility](#) in the San Fernando Valley, for example, doubled its ability to capture stormwater from 8,000 acre-feet per year to 16,000.

But managing the influx of water in a drought is a delicate dance, according to Marouane Temimi, an associate professor in the Department of Civil, Environmental, and Ocean Engineering at the Stevens Institute of Technology.

During normal rain events, green infrastructure projects such as parks and gardens can help capture and store more water. But during extreme events, such as the [atmospheric rivers hitting California this week](#), larger infrastructure investments are needed.

“Each city has to balance between the major and the minor infrastructure projects to control runoff from extreme events, as well as frequent events, to cover the whole spectrum of rainfall, because throughout the years, we receive different rainfall events with different magnitudes,” he said.

Rain can also bring pollution as the stormwaters sweep up debris, dirt, litter and even chemicals from roadways. While managing water quality is important, Temimi said it falls second to managing quantity during major flood events. At least [three people were killed](#) by floodwaters in Northern California this week.



California

L.A. has \$556 million and a plan to capture more storm water. But will they ever do it?

In 2018, L.A. County voters approved Measure W, a massive tax aimed at protecting beaches and improving water supply through storm water capture. Yet only \$95.5 million has been disbursed for projects out of \$556 million collected.

March 4, 2022

The problem is not unique to Los Angeles. California Natural Resources Secretary Wade Crowfoot said the whole state is dealing with aging infrastructure that need improvement.

“In order to be resilient to floods and drought, which are kind of two sides of the same coin of extreme weather, we need to be able to adapt our infrastructure to the new normal,” he said. “And that means

significantly expanding water recycling, capturing stormwater, modernizing conveyance and recharging groundwater basins, and so we're in a race."

Crowfoot called Measure W a "world-leading policy," that can also help [reduce pollution from reaching oceans and bays](#).

"We are missing an opportunity to actually take that water that's falling in greater L.A. and actually putting it into the groundwater basins for future use," he said. "L.A., as a result of Measure W passing four years ago, has more resources than almost any other place in the country to do that. But the implementation is very much a work in progress."

There are other hurdles, said Anne Lynch, integrated water management lead with engineering and consulting firm GHD. She noted that while droughts and floods are "not mutually exclusive," it can be hard to garner public and political will for storm projects in dry times.

The state's last big funding bill allotted far more to sectors such as transportation than to water, she said, which "tells you how, as a society, we view water — it's out of sight, out of mind until there's a catastrophe."



California

Storm is an 'extreme test' of waste capture system protecting the Pacific from L.A. runoff

The atmospheric river storm hitting California this week presents a test for an experimental waste-capturing system that's intended to keep plastic bottles, diapers and other trash from flowing into the Pacific.

Jan. 4, 2023

Water managers also have to work around the existing environment — including the hundred-year-old system designed for a different climate — which can create challenges for planning new projects.

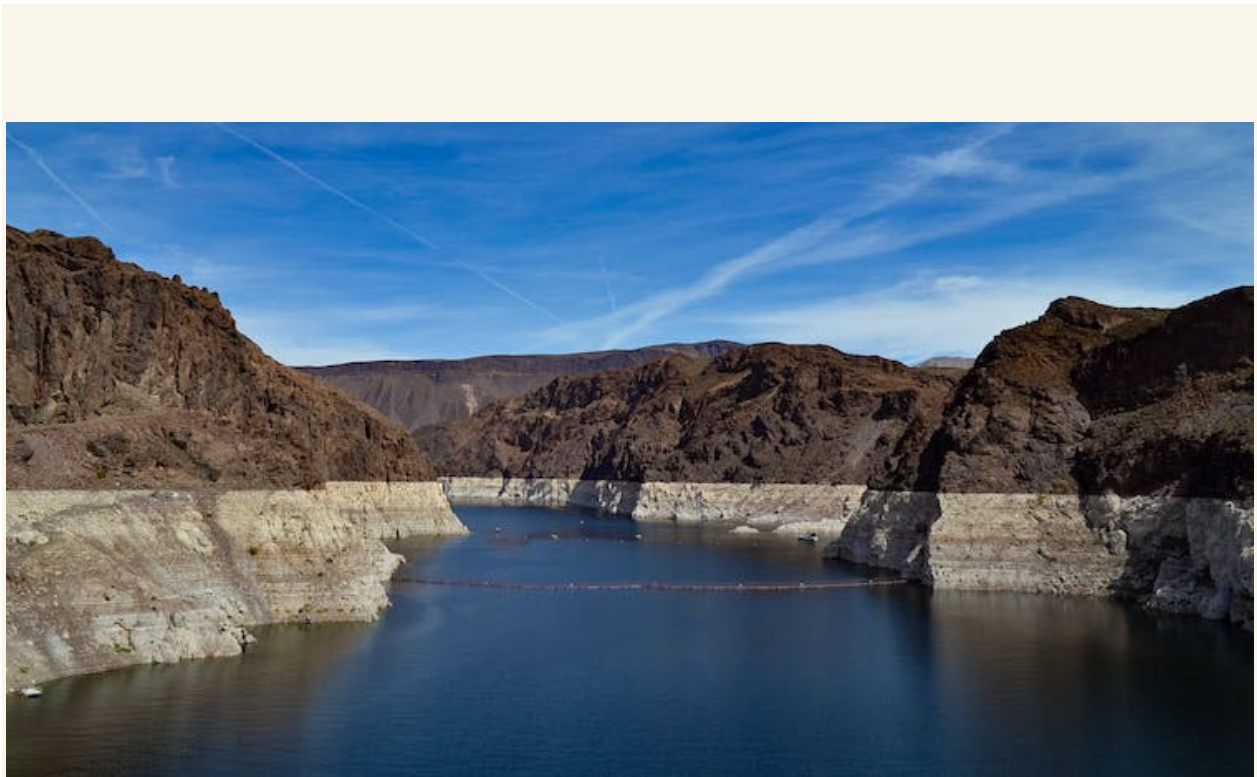
“Not only are we dealing with the built environment but this ever increasing flow that's coming into the system,” she said. “So we're like, behind the eight ball.”

<https://www.latimes.com/california/story/2023-01-06/why-cant-we-capture-all-this-storm-water>

Lake County News

January 9, 2023

Scientists dig deep and find a way to accurately predict snowmelt after droughts



Following historic drought in 2021, reservoir levels dropped down in the Hoover Dam on the Colorado River, which gets its waters from the melting snowpack from the Rocky Mountains of Colorado and Wyoming. (pxhere.com), CC BY-SA

Where does your water supply come from?

If you live near mountains, for instance in British Columbia, a lot of your water probably comes from mountain snowpack. Over [1.9 billion](#)

people globally rely on the snow melting and running off from these mountain snowpacks for their water supply.

Accurate predictions of this annual trend is critical for water supply planning. And forecasting models often rely on the [historical relationship between mountain snowpack and the subsequent water supply](#).

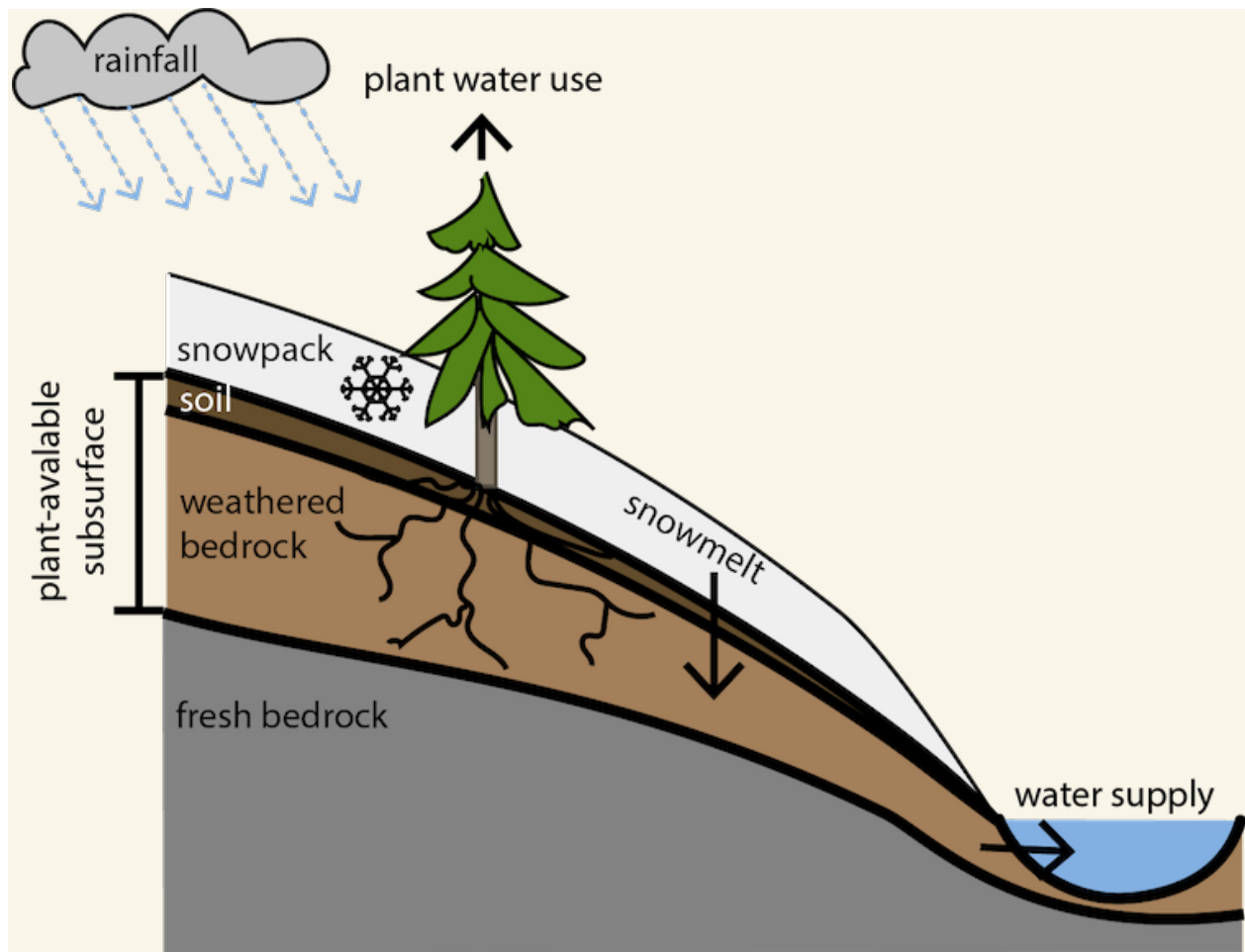
However, in times of unprecedented drought and a changing climate, these forecasting models seem to no longer be reliable. Following an intense drought in California in 2021, [snowmelt from mountain snowpack delivered significantly less water than historical models predicted](#), meaning that reservoirs remained drier than anticipated. For the first time in 100 years, water supply models were wrong.

In an attempt to address the gaps in the traditional model, we recently [developed an updated water supply forecasting model](#) that considers additional factors, like water storage deficits in the soil and bedrock. This new model significantly improves the accuracy of water supply forecasts following drought.

What are existing water supply models missing?

[Models used for forecasting snowmelt](#) typically consider winter rain and snowpack. But it turns out that water absorbed by the ground matters too. The amount of water absorbed into the soil and bedrock varies from year to year and is especially impacted by drought.

When snow melts or rain falls, almost all of it goes underground first before [heading downstream to water supply systems](#) . The water storage processes below the surface of the ground are key to understanding the ultimate fate of rain and snow in the mountains.



A diagram showing how water gets from snowpack or rain to water supply systems. Rain and snowmelt seep into the ground. Plants draw water from this region. Once the subsurface is wet, the water flows downstream to water supply systems. (Dana Lapidés), Author provided

The below ground environment is made up of complex layers of soil, fractures and weathered bedrock that can [store, detain and transport water](#). The details of these processes are complicated, but the overall effect can be likened to a giant sponge.

Over the summer, the ground dries out and it gets wet again with the arrival of rain and snowmelt in winter and spring. Once the ground is wet enough, it starts to drip. This dripping water enters the groundwater and streams and eventually goes into the water supply systems.

How much water drips depends on how much snowmelt and rain is received, which is included in forecasting models. It also depends on how dry the subsurface was to begin with, which is not traditionally included in forecasting models.

Plants use a lot of water

How dry the subsurface is this year can depend on how much water the plants used last year (or even over the last few years). In hotter, drier years, plants can use more water from underground, causing the subsurface to dry out more.

Recent studies show us that [trees routinely dry up not just soils but also weathered bedrock metres below the surface](#).

Scientists are still struggling to identify how dry these mountain environments can get and how far below the surface they dry. With a drier subsurface at the start of the year, more snowmelt is needed before water starts to flow downstream to water supply systems.

As droughts become more frequent and intense with climate change, this process could become more important even in regions that historically haven't faced much drought.

Measuring the moisture underground

Directly observing the moisture levels of the ground's subsurface is difficult, especially when it's stored in weathered bedrock, which can extend many metres below the ground surface and be challenging to observe.

In our research, we found the most accurate measurements by lowering geophysical instruments down boreholes and taking water content readings at different depths. By comparing these readings over time, we observe how [the subsurface dries out and gets wet again](#).



A USDA Forest Service employee uses an instrument to measure the moisture conditions deep underground. (Jamie Hinrichs/USDA Forest Service), Author provided

However, this intensive monitoring is nearly impossible to do over large areas.

While we can't look directly underground everywhere, [we can track how much water enters \(rain and snowmelt\) and leaves \(plant water use\) the ground using satellite-derived data.](#)

By taking a running account of water going in and out of the ground, we can estimate how dry the subsurface is — a metric we call the water storage deficit.

Water supply models must dig deeper

Our [newly-developed water supply forecasting model](#) accounts for water storage deficits in both soil and bedrock. This has improved post-drought

forecast accuracy substantially, taking the probability of error in the calculation of predictions from 60 per cent to about 20 per cent.

Since we can calculate deficits before spring snowmelts, they serve as an early warning sign and can aid water management strategies.

As the climate changes, the water supply challenges in California foreshadow issues that will become increasingly prevalent in British Columbia and other regions reliant on mountain snowpack. Using updated forecasting models in the future can help these regions better prepare for [continued water shortages even when snowpack seems normal](#).

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