

# Los Angeles County Climate Impacts and Costs

The climate crisis is accelerating in California, posing increased risks and burdening residents with the costs of adapting to a rapidly changing environment. Los Angeles County will experience an increase in severe storms, rising sea levels, hotter temperatures, and more extreme droughts in the coming years.<sup>1</sup> Even if fossil fuel emissions and atmospheric concentrations of greenhouse gases eventually stabilize through climate action, the severity of these events will continue to rise as we adjust to the new reality of the climate crisis. Below we outline the impacts of climate change Los Angeles County faces and some of the potential costs associated with these impacts. This list is not all-encompassing and other costs may be incurred as a result of additional climate change impacts.

## Severe Storms and Flooding

Los Angeles (LA) County is situated between both an area that will see increased precipitation due to climate change – the northern, midlatitude region – and an area that will see increased drought – the southern, subtropical region. While climate models predict that average rainfall conditions may not change,<sup>2</sup> studies show that climate change will increase the number of severe storms and extreme wet years,<sup>3</sup> creating significant flood risk in LA County.<sup>4</sup> One study shows that flood risk threatens 27% of buildings in the city of Los Angeles,<sup>5</sup> including hospitals and other critical infrastructure.<sup>6</sup> Increased flood risk is already being felt in LA County; flash flooding destroyed a portion of Interstate 10 in August 2022.<sup>7</sup> <sup>8</sup> According to NOAA, flooding costs an average of \$4.6 billion per event and severe storms

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- 1 Carmen Milanés et al., "Indicators of Climate Change in California," Office of Environmental Health Hazard Assessment, 2022. <https://oehha.ca.gov/media/downloads/climate-change/report/2018caindicatorsreportmay2018.pdf>
  - 2 Neil Berg, et al., "Twenty-First-Century Precipitation Changes over the Los Angeles Region," *Journal of Climate* 28, no. 2 (2015). <https://doi.org/10.1175/JCLI-D-14-00316.1>.
  - 3 Lu Dong et al., "Contributions of Extreme and Non-Extreme Precipitation to California Precipitation Seasonality Changes Under Warming," *Geophysical Research Letters* 46, no. 22 (2019): 13470–78. <https://doi.org/10.1029/2019GL084225>; Daniel Swain et al., "Increasing Precipitation Volatility in Twenty-First-Century California," *Nature Climate Change* 8, no. 5 (May 2018): 427–33. <https://doi.org/10.1038/s41558-018-0140-y>.
  - 4 Alex Hall et al., "Climate Change in the Los Angeles Region," UCLA Institute of the Environment & Sustainability, October 13, 2016. <https://www.ioes.ucla.edu/project/climate-change-in-the-los-angeles-region/>; Los Angeles, California Climate Change Risks and Hazards: Drought, Precipitation, Heat," 2022. <https://climatecheck.com/california/los-angeles>.
  - 5 Alex Hall et al., "Los Angeles, California Climate Change Risks and Hazards."
  - 6 Sabrina Adelaine et al., "An Assessment of Climate Change Impacts on Los Angeles (California USA) Hospitals, Wildfires Highest Priority," *Prehospital and Disaster Medicine* 32, no. 5 (October 2017): 556–62. <https://doi.org/10.1017/S1049023X17006586>.
  - 7 Alexandra Petri and Gregory Yee. "Flash Flooding Washes out Part of Interstate 10 in Riverside County as Wild Weather Continues," *Los Angeles Times*, August 25, 2022, sec. California. <https://www.latimes.com/california/story/2022-08-24/flash-flooding-washes-out-eastbound-interstate-10-near-california-arizona-border>.
  - 8 The Associated Press, "Surge in U.S. Thunderstorms Has Caused 'unprecedented' \$34B US in Insured Losses This Year," August 10, 2023. <https://www.cbc.ca/news/business/swiss-re-insurance-damage-1.6932920>.

cost an average of \$2.4 billion per event.<sup>9</sup> A recent analysis by Swiss Re, a reinsurance company, found that severe storms in the U.S. incurred \$34 billion in insured losses during the first half of 2023.<sup>10</sup>

Severe storms and flooding do not impact all LA County residents equally. A recent study published in Nature Sustainability found that in the city of Los Angeles, non-Hispanic Black and other disadvantaged populations are disproportionately exposed to flood risk that exceeds the federally defined floodplains, threatening more than 400,000 people and \$50 billion in property.<sup>11</sup> As such, the study highlights the need for the city of Los Angeles to update flood zones and flood prevention infrastructure.<sup>12</sup>

Erosion related to flooding is also predicted to cause an increase in landslides,<sup>13</sup> which further compounds risk to people, homes, roads, and other infrastructure. Southern California has a history of precipitation induced landslides,<sup>14</sup> like the landslide that led to the collapse of 12 homes in Rolling Hills Estate located in LA County in July 2023.<sup>15</sup> Though experts are still testing to determine if the landslide was triggered by a leaky pipe or the uncharacteristically heavy rainfall experienced during the beginning of the year, these events are almost always caused by water weakening the bedrock.<sup>16</sup> As such, they will become more frequent and costly as severe storms increase.

## Potential Costs Related to Severe Storms and Flooding

### Structure and Infrastructure Projects

- Remove, relocate, acquire, or demolish structures to minimize future flood losses.
- Install, reroute, increase capacity, or implement a routine cleaning plan of the storm drainage system.
- Add extra culverts, increase dimensions of existing culverts, or implement routine cleaning and repairing.
- Install detention or retention basins, relief drains, spillways, drain widening/dredging or rerouting, etc.
- Inspect and maintain drainage systems and flood control structures (dams, levees, etc.).

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<sup>9</sup> National Atmospheric and Oceanic Administration (NOAA), "NOAA National Centers for Environmental Information (NCEI) U.S. Billion-Dollar Weather and Climate Disasters," 2023. <https://doi.org/10.25921/stkw-7w73>.

<sup>10</sup> The Associated Press, "Surge in U.S. Thunderstorms"

<sup>11</sup> Brett Sanders, "Opinion: Disasters like the Rolling Hills Landslide Are Foreseeable. The Warnings Are All around Us," Los Angeles Times, July 11, 2023. <https://www.latimes.com/opinion/story/2023-07-11/rolling-hills-landslide-climate-change-geology>.

<sup>12</sup> Ibid.

<sup>13</sup> Chloe Fleming et al., "Assessing the Geographic Variability in Vulnerability to Climate Change and Coastal Hazards In Los Angeles County, California," 2020. <https://doi.org/10.25923/MGCA-HC06>.

<sup>14</sup> United States Geological Survey, "Rainfall and Landslides in Southern California," Landslide Hazards Program, 2015. <https://www.usgs.gov/programs/landslide-hazards/science/rainfall-and-landslides-southern-california>.

<sup>15</sup> Brett Sanders, "Disasters like the Rolling Hills Landslide" <https://www.latimes.com/opinion/story/2023-07-11/rolling-hills-landslide-climate-change-geology>.

<sup>16</sup> Jason Henry, Jason and Lisa Jacobs, "Whether Rain or a Leaky Pipe, Water Is the Likely Culprit in Rolling Hills Estates Landslide," Daily Breeze (blog), July 16, 2023. <https://www.dailybreeze.com/2023/07/16/whether-rain-or-a-leaky-pipe-water-is-the-likely-culprit-in-rolling-hills-estates-landslide/>.

- Inspect bridges in order to identify and/or implement repairs or retrofits or clean under low bridges.
- Resurface roads with more permeable pavement and concrete.
- Elevate roads and bridges above the base flood elevation (BFE)<sup>17</sup> to maintain dry access.
- Elevate structures above the BFE, or relocate utilities, water heaters, etc. above BFE.
- Floodproof inside of municipal buildings, for example by installing check valves, sump pumps, or backflow prevention devices.
- Floodproof wastewater treatment facilities located in flood hazard areas.
- Floodproof water treatment facilities located in flood hazard areas.
- Protect emergency operations by requiring or moving all emergency operations centers, police stations, and fire department facilities outside of flood-prone areas.
- Protect critical and emergency facilities by requiring all critical facilities be built one foot above the 500-year flood elevation (to meet requirements of FEMA Executive Order 11988).<sup>18</sup>
- Protect critical and emergency facilities from floods using any other technique, for example, raising components above BFE, installing pumping systems or back-up generators for pumping, building dikes or stabilizing banks.
- Construct floodwalls, small berms, revetments, bioengineered bank stabilization, or other small structural mitigants.

### **Natural Flood Mitigation**

- Protect and enhance natural floodplain mitigation features (such as wetlands, dunes, and vegetative buffers) to help prevent flooding in other areas.

### **Local Planning and Regulation**

- Update flood risk maps and flood zones.<sup>19</sup>
- Develop a floodplain management plan.
- Adopt a stormwater management or drainage plan.
- Adopt, apply and enforce building codes to ensure buildings can withstand flooding.
- Obtain easements to use privately-owned land for temporary water retention and drainage.

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<sup>17</sup> Base flood elevation (BFE), as defined by FEMA, is “the elevation of surface water resulting from a flood that has a 1% chance of equaling or exceeding that level in any given year.”

<sup>18</sup> Federal Emergency Management Agency, “Executive Order 11988: Floodplain Management,” [www.fema.gov/executive-order-11988-floodplain-management](https://www.fema.gov/executive-order-11988-floodplain-management).

<sup>19</sup> Brett Sanders et al., “Large and Inequitable Flood Risks in Los Angeles, California,” *Nature Sustainability* 6, no. 1 (2023): 47–57. <https://doi.org/10.1038/s41893-022-00977-7>.

- Join or improve compliance with the National Flood Insurance Program (NFIP).<sup>20</sup>
- Apply for Floodplain Management, Protection, and Risk Awareness Grants through California Department of Water Resources.<sup>21</sup>
- Preserve floodplains as open space using any of several land use planning tools: develop a plan that targets hazard areas for acquisition, reuse, and preservation, a land banking program, use of transfer of development rights to keep floodplains vacant, easements to prevent development, or acquiring properties in the floodplain and turning them into open space.

### Education and Awareness Programs

- Increase public outreach to encourage flood insurance purchase; educate residents in flood safety, flood mitigation, technical assistance availability, funding sources, and best practices.
- Locate new utilities and critical facilities outside of susceptible areas.
- Identify, map, or track erosion hazard areas.

### Summary of Costs from Increased Precipitation and Severe Storms

Floodproof buildings, relocate infrastructure in especially flood prone areas, improve drainage systems and flood control structures, elevate infrastructure (buildings, roads, and bridges) where needed, restore natural flood protection, develop and implement comprehensive flood management plans, preserve floodplains, and increase public awareness of flooding.

## Rising Sea Levels – Coastal Flooding and Erosion

According to a report from the National Atmospheric and Oceanic Administration (NOAA), sea levels are projected to rise about one foot in LA County by 2050,<sup>22</sup> leading to increased coastal flooding and erosion.<sup>23</sup> These changes will occur even if rising temperatures and greenhouse gas emissions are mitigated.<sup>24</sup> According to a Los Angeles Times article about NOAA's report, Patrick Barnard, a co-author, said “it will definitely be more costly to defend the coast, and more costly to keep beaches around,” though he doesn’t picture the city of Los Angeles retreating entirely.<sup>25</sup>

<sup>20</sup> U.S. Federal Emergency Management Agency (FEMA), The National Flood Insurance Program (NFIP), at [www.fema.gov/national-flood-insurance-program](http://www.fema.gov/national-flood-insurance-program) Policy Information by State (<https://nfipservices.floodsmart.gov/reports-flood-insurance-data>), accessed August 10, 2023; Los Angeles County only has one active NFIP policy in place, which covers \$212,000. For comparison, Kern County has over 1,755 active policies covering over \$390 million.

<sup>21</sup> California Department of Water Resources, “Floodplain Management, Protection, and Risk Awareness Grant Program,” Accessed August 11, 2023. <https://water.ca.gov/Work-With-Us/Grants-And-Loans/Flood-Management-Protection-Risk-Awareness-Program>.

<sup>22</sup> William Sweet et al., “Global and Regional Sea Level Rise Scenarios for the United States: Updated Mean Projections and Extreme Water Level Probabilities Along U.S. Coastlines,” National Ocean Service, Silver Spring, MD: National Atmospheric and Oceanic Administration, 2022. <https://oceanservice.noaa.gov/hazards/sealevelrise/sealevelrise-tech-report-sections.html>.

<sup>23</sup> Ibid.

<sup>24</sup> Ibid.

<sup>25</sup> Hayley Smith, “Sea Levels to Rise by as Much as One Foot by 2050,” Los Angeles Times, February 16, 2022. <https://www.latimes.com/california/story/2022-02-16/rising-sea-levels-pose-perilous-threat-to-california-coast-study-raises-new-alarms#>.

According to the Center for Climate Integrity, California will face \$523.5 million for seawalls by 2040.<sup>26</sup> The report also states that “roads, rails, and other public infrastructure will be hit with unavoidable rising tides, unless state officials invest in mitigating infrastructure, such as sea walls.” Sea level rise will also compound the effects of severe storms, so all flood mitigation strategies are doubly important in LA County coastal areas.

## Potential Costs Related to Rising Sea Level

### Structure and Infrastructure Projects

- Stabilize susceptible coastal slopes and cliffs and shorelines using grading techniques, planting vegetation, riprap or geotextile fabric, or bioengineering.
- Refer to “Structure and infrastructure projects” from “Potential costs related to severe storms and flooding,” as they also apply here.

### Coastal Protection

- Protect critical infrastructure using techniques like beach nourishment, jetties, and seawalls.
- Restore natural wetland areas.

### Local Planning and Regulation

- Identify, map, and track coastal erosion and flood hazards.
- Develop and enforce a coastal zone management plan.
- Develop site and building standards.
- Other local planning and regulation as suggested by the Legislative Analyst’s Office.<sup>27</sup>

### Education and Awareness Programs

- Increase awareness by disclosing location of high-risk areas to current and future property owners; offer mitigation technique information.
- Locate new utilities and critical facilities outside of susceptible areas.
- Identify, map, or track erosion hazard areas.
- Other education and awareness programs as suggested by the Legislative Analyst’s Office.<sup>28</sup>

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<sup>26</sup> Center for Climate Integrity, “Climate Costs in 2040: California,” 2019. <https://climatecosts2040.org/files/state/CA.pdf>.

<sup>27</sup> Gabriel Petek, “Preparing for Rising Seas: How the State Can Help Support Local Coastal Adaptation Efforts,” Legislative Analyst’s Office, 2019. <https://lao.ca.gov/reports/2019/4121/coastal-adaptation-121019.pdf>.

<sup>28</sup> Ibid.

**Summary of Costs from Sea Level Rise:**

Implement flood management infrastructure and structure projects in coastal areas, install coastal protection, restore natural flood protection, develop and implement a comprehensive coastal zone management plan, and increase public awareness of sea level rise risks.

**Temperature Extremes**

Climate change will cause more extreme temperatures in LA County. Specifically, by 2050 LA County will experience hotter and longer heat waves, regardless of whether mitigation occurs. This means significant impacts from increased temperatures, despite taking swift action. Coastal areas and central LA will experience 3 times the number of days with temperatures over 95°F.<sup>29</sup> San Fernando and San Gabriel Valley — areas of the county with the most population growth — will face even more extreme temperatures.<sup>30</sup> One study suggests that population growth in the LA County valleys should be discouraged because of increasingly dangerous temperatures.<sup>31</sup> Increased temperature will also cause snow to fall as rain, reducing the amount of snowpack<sup>32</sup> and threatening water availability. A lack of green space, especially in socially vulnerable areas,<sup>33</sup> further compound impacts from rising temperatures. An increase in temperature will increase electricity demand by 2060, which means LA County needs to update infrastructure to avoid outages<sup>34</sup> and increase the number of trees and high light-reflecting surfaces to prevent heat-related illness and death.<sup>35</sup> According to the Center for Climate Integrity, California will face \$1 billion in school cooling costs by 2025.<sup>36</sup>

**Potential Costs Related to Temperature Extremes****Structure and Infrastructure Projects**

- Energy efficiency retrofits in public and private buildings and housing, including costs for the design and development of standards.
- Increased cooling costs for all public buildings, including green roofs or cool roofing systems on public buildings and new AC installation or upgrade costs for schools.

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<sup>29</sup> Fengpeng Sun, "A Hybrid Dynamical-Statistical Downscaling Technique. Part II: End-of-Century Warming Projections Predict a New Climate State in the Los Angeles Region," *Journal of Climate* 28, no. 12 (June 15, 2015): 4618–36. <https://doi.org/10.1175/JCLI-D-14-00197.1>.

<sup>30</sup> Ibid.

<sup>31</sup> Sungyop Kim, Fengpeng Sun, and Clara Irazábal, "Planning for Climate Change," *Journal of the American Planning Association* 87, no. 1 (January 2, 2021): 34–44. <https://doi.org/10.1080/01944363.2020.1788415>.

<sup>32</sup> Fengpeng Sun et al., "Twenty-First-Century Snowfall and Snowpack Changes over the Southern California Mountains," *Journal of Climate* 29, no. 1 (January 1, 2016): 91–110. <https://doi.org/10.1175/JCLI-D-15-0199.1>.

<sup>33</sup> Chloe Fleming et al., "Assessing the Geographic Variability" <https://repository.library.noaa.gov/view/noaa/26469>

<sup>34</sup> Daniel Burillo et al., "Electricity Infrastructure Vulnerabilities Due to Long-Term Growth and Extreme Heat from Climate Change in Los Angeles County," *Energy Policy* 128 (May 1, 2019): 943–53. <https://doi.org/10.1016/j.enpol.2018.12.053>.

<sup>35</sup> Laurence Kalkstein et al., "Increasing Trees and High-Albedo Surfaces Decreases Heat Impacts and Mortality in Los Angeles, CA," *International Journal of Biometeorology* 66, no. 5 (May 1, 2022): 911–25. <https://doi.org/10.1007/s00484-022-02248-8>.

<sup>36</sup> Center for Climate Integrity, "Hotter Days, Higher Costs: The Cooling Crisis in America's Classrooms." Center for Climate Integrity, 2021. <https://coolingcrisis.org>.

- Increased road damage due to more frequent extreme heat events.
- Plan for and increase capacity for increased energy demands due to both increased daytime and nighttime temperature.
- Increase high-albedo surfaces on buildings, roads, or where feasible.

### **Public Health Projects**

- Build and manage more cooling centers, including staffing and tracking of high-risk individuals.
- Increased demand for publicly financed air conditioning targeted to low income families and public housing.
- Control the increase of vector borne illness – education and physical and chemical controls for ticks and mosquitos.
- Treat victims of vector borne illness.
- Increase in asthma attacks requiring hospitalization (resulting from increased heat and ground level ozone, and the increase in airborne allergens).
- Reduce the urban heat island effect by planting trees.
- Protect drinking water supplies from hazardous algae blooms.

### **Summary of Costs from Increased Temperatures:**

Public health costs (e.g., medicare/medicaid), AC installation and improvement where needed, establishing new cooling centers, planting trees to reduce urban heat islands, and protecting drinking water supplies.

## **Extreme Drought**

According to NOAA's National Centers for Environmental Information, drought was the second most expensive natural disaster – costing at least \$249 billion – in the U.S. over the last three decades.<sup>37</sup> Extreme drought due to climate change poses a significant threat to LA County. LA County has experienced 726 weeks of drought conditions and 237 weeks of extreme drought since 2000, meaning that the county has spent 64% of the last 23 years in drought and 21% in extreme drought.<sup>38</sup>

Drought increases the risk of forest fires and occurrences of wildfires have increased dramatically over the last 20 years due to climate change,<sup>39</sup> impacting human health and air quality. There is even evidence that the recent increase in wildfires has reversed previous progress in slowing greenhouse

<sup>37</sup> Adam Smith, "2010-2019: A landmark decade of U.S. billion-dollar weather and climate disasters," 2020. <http://www.climate.gov/news-features/blogs/beyond-data/2010-2019-landmark-decade-us-billion-dollar-weather-and-climate>.

<sup>38</sup> Alex Hall et al., "Los Angeles, California Climate Change Risks and Hazards."

<sup>39</sup> A. Park Williams et al., "Observed Impacts of Anthropogenic Climate Change on Wildfire in California," *Earth's Future* 7, no. 8 (2019): 892–910. <https://doi.org/10.1029/2019EF001210>.

gas emissions in California.<sup>40</sup> The Environmental Protection Agency estimates the cost to treat long-term exposures to wildfire is \$450 billion, while short-term exposure (2008-2012) leads to premature death and hospitalizations totaling \$63 billion.<sup>41</sup>

Forest fires also put 30% of buildings – including hospitals – in LA County at risk.<sup>42</sup> As such, building resilience should be a focus of climate change adaptation and mitigation in the city of LA.<sup>43</sup> Relatedly, wildfires and climate stress have caused immense forest dieback in California;<sup>44</sup> 170 million trees died in the state between 2010 and 2021.<sup>45</sup> Fire suppression — which includes expenditure on aviation, vehicles, and fire crew — cost the U.S. \$3.7 billion in 2022.<sup>46</sup> In fact, wildfires have become so severe in California that some major insurance companies have pulled out of the home insurance market.<sup>47</sup> NOAA estimates that wildfires cost an average of \$6.5 billion per event.<sup>48</sup>

Drought also leads to subsidence, or the sinking of the land surface, causing structural damage to roads, bridges, and other infrastructure.<sup>49</sup> Rainfall after a drought can also lead to increased soil erosion, placing further strain on structures. An example is the millions of dollars in damage to the Oroville Dam spillway in California in 2017,<sup>50</sup> which has been attributed to climate change.<sup>51</sup> Plans and improvements to structures should be made to decrease risk.<sup>52</sup>

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- 40** Hayley Smith, “A Single, Devastating California Fire Season Wiped out Years of Efforts to Cut Emissions,” Los Angeles Times, October 20, 2022, sec. California. <https://www.latimes.com/california/story/2022-10-20/california-wildfires-offset-greenhouse-gas-reductions>.
- 41** Jesse Roman, Angelo Verzone, and Scott Sutherland, “The Wildfire Crisis: Greetings from the 2020 Wildfire Season,” National Fire Protection Association Journal, 2020. <http://www.nfpa.org/News-and-Research/Publications-and-media/NFPA-Journal/2020/November-December-2020/Features/Wildfire>.
- 42** Sabrina Adelaine et al., “An Assessment of Climate Change Impacts on Los Angeles” Adelaine et al., “An Assessment of Climate Change Impacts on Los Angeles (California USA) Hospitals, Wildfires Highest Priority.” <https://www.cambridge.org/core/journals/prehospital-and-disaster-medicine/article/abs/an-assessment-of-climate-change-impacts-on-los-angeles-california-usa-hospitals-wildfires-highest-priority/6E9ABCCC7A7A36170B6724E65A510C14>
- 43** Ibid.
- 44** Jonathan Wang, et al., “Losses of Tree Cover in California Driven by Increasing Fire Disturbance and Climate Stress,” AGU Advances 3, no. 4 (2022): e2021AV000654. <https://doi.org/10.1029/2021AV000654>.
- 45** James Thorne, and Tadashi Moody, “Indicators of Climate Change in California: Forest Tree Mortality,” Office of Environmental Health Hazard Assessment, 2022. <https://oehha.ca.gov/media/epic/downloads/04treemortality.pdf>.
- 46** Jennifer L, “Wildfires Cost Over \$148B and 30% of Emissions,” Carbon Credits, January 30, 2023. <https://carboncredits.com/wildfires-cost-emissions/>; Western Fire Chiefs Association, “What Is the Financial Cost of a Wildfire?,” December 7, 2022. <https://wfca.com/articles/cost-of-wildfires/>.
- 47** The Associated Press, “Surge in U.S. Thunderstorms”
- 48** NOAA, “U.S. Billion-Dollar Weather and Climate Disasters”
- 49** National Integrated Drought Information System, “Navigation and Transportation,” Accessed August 7, 2023. <https://www.drought.gov/sectors/navigation-and-transportation>.
- 50** Matt Hamilton and Shelby Grad, “Too Much Water: How Oroville Dam Problems Became a Crisis,” Los Angeles Times, February 13, 2017, sec. California. <https://www.latimes.com/local/lanow/la-me-oroville-dam-spillway-explainer-20170212-story.html>.
- 51** Allison Michaelis et al., “Atmospheric River Precipitation Enhanced by Climate Change: A Case Study of the Storm That Contributed to California’s Oroville Dam Crisis,” Earth’s Future 10, no. 3 (2022): e2021EF002537. <https://doi.org/10.1029/2021EF002537>.
- 52** Cybersecurity & Infrastructure Security Agency (CISA), “Drought and Infrastructure - A Planning Guide,” Cybersecurity and Infrastructure Security Agency with the National Drought Resilience Partnership, 2021. [https://www.cisa.gov/sites/default/files/publications/Drought\\_and\\_Infrastructure\\_A\\_Planning\\_Guide\\_508c.pdf](https://www.cisa.gov/sites/default/files/publications/Drought_and_Infrastructure_A_Planning_Guide_508c.pdf).



Drought causes water security issues, which will impact a majority of water resources, both local and imported.<sup>53</sup> Already, California has more than 1,300 dry wells.<sup>54</sup> Drought also impacts water quality. Nearly 1 million Californians are already exposed to unsafe drinking water,<sup>55</sup> meaning increased water treatment costs may be incurred as water quality and quantity continues to decline.<sup>56</sup> According to the NOAA, drought costs an average of \$11.2 billion per event.<sup>57</sup>

## Potential Costs Related to Extreme Drought

### Water Management

- Individual purchase of water during water scarce times.<sup>58</sup>
- Public health costs related to increased exposure to water-borne illnesses.<sup>59</sup>
- Replace old pipelines that have water leak issues.<sup>60</sup>
- Use climate science to update water treatment, wastewater treatment, and other energy infrastructure.<sup>61</sup>
- Reinforce roads, bridges, and buildings to withstand prolonged drought.

### Wildfires

- Increase fire suppression, including staffing and aviation.
- Rebuild or relocate damaged properties and public infrastructure, such as homes and utility lines.
- Relocate public infrastructure where necessary.
- Update power lines to withstand dust from wildfires.
- Implement fire mitigation strategies for the future like burying utility lines underground.
- Plan for and disburse community aid after wildfires.
- Implement fire detection strategies, like solar-powered sensors.<sup>62</sup>

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**53** Negin Ashoori, David Dzombak, and Mitchell Small, "Sustainability Review of Water-Supply Options in the Los Angeles Region," *Journal of Water Resources Planning and Management* 141, no. 12 (December 1, 2015): A4015005. [https://doi.org/10.1061/\(ASCE\)WR.1943-5452.0000541](https://doi.org/10.1061/(ASCE)WR.1943-5452.0000541).

**54** Hayley Smith, "Dirty Water, Drying Wells: Central Californians Shoulder Drought's Inequities," *Los Angeles Times*, September 1, 2022, sec. Climate & Environment. <https://www.latimes.com/environment/story/2022-09-01/central-california-shoulders-drought-inequities>.

**55** Ibid.

**56** Abdul Tariq et al., "A Climate Stress Test of Los Angeles' Water Quality Plans," *Climatic Change* 144, no. 4 (October 1, 2017): 625–39. <https://doi.org/10.1007/s10584-017-2062-5>.

**57** NOAA, "U.S. Billion-Dollar Weather and Climate Disasters"

**58** Zoë Roller et al., "Closing the Water Access Gap in the United States: A National Action Plan," Dig Deep and US Water Alliance, 2022. [https://static1.squarespace.com/static/5e80f1a64ed7dc3408525fb9/t/6092ddcc499e1b6a6a07ba3a/1620237782228/Dig-Deep\\_Closing-the-Water-Access-Gap-in-the-United-States\\_DIGITAL\\_compressed.pdf](https://static1.squarespace.com/static/5e80f1a64ed7dc3408525fb9/t/6092ddcc499e1b6a6a07ba3a/1620237782228/Dig-Deep_Closing-the-Water-Access-Gap-in-the-United-States_DIGITAL_compressed.pdf).

**59** Ibid.

**60** CISA, "Drought and Infrastructure - A Planning Guide"

**61** Ibid.

**62** Jennifer L., "Wildfires Cost Over \$148B"

- Rehabilitate the landscape post-fire to reduce the risk of erosion and invasive species and mitigate future fire risk.
- Increased hospitalization costs for asthma attacks and other chronic health conditions (resulting from decreased air quality due to wildfire smoke).

### **Local Planning and Regulation**

- Organize meetings to create water scarcity management plans.<sup>63</sup>
- Develop tools for monitoring ground and surface water resources for public use.<sup>64</sup>

### **Education and Awareness Programs**

- Public education, outreach, and awareness campaigns about water conservation.<sup>65</sup>
- Increase public outreach to encourage wildfire risk management; educate residents in wildfire safety, technical assistance availability, funding sources, and best practices.

### **Summary of Costs from Extreme Drought:**

Fire prevention and recovery, water security and water treatment, infrastructure damages, public health, and education and awareness.

## **Other Extreme Weather**

Other extreme weather includes: tsunamis, earthquakes, winter storms, firestorms, and more.

### **Potential Costs Related to other Extreme Weather**

#### **Structure and Infrastructure Projects**

- Increased costs of storm recovery and clean-up.
- Protect power lines through pruning trees.
- Bury overhead power lines or install systems that allow small sections of power lines to fail rather than the complete system.

#### **Other Public Health Costs**

Other plausible impacts from climate change that would incur public health costs are increased allergen levels, food- and waterborne infections, and zoonotic diseases.<sup>66</sup>

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<sup>63</sup> CISA, "Drought and Infrastructure - A Planning Guide"

<sup>64</sup> Ibid.

<sup>65</sup> Ibid.

<sup>66</sup> Carmen Milanes et al., "Indicators of Climate Change"