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Drought in the United States: Science, Policy, and Selected Federal Authorities

Updated February 8, 2022

Congressional Research Service
https://crsreports.congress.gov
R46911

CRS REPORT
Prepared for Members and
Committees of Congress

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Drought—a deficiency of moisture that results in adverse effects—occurs to some extent almost every year in areas of the United States. Droughts can simultaneously reduce available water supplies and increase demands for water. Drought has the potential to affect economic and environmental conditions on local, regional, and national scales, as well as to cause disruptions in water supplies for households and communities.

Droughts are a component of climate variability and may be seasonal, multiyear, or multi-decadal in duration. According to an August 2021 Intergovernmental Panel on Climate Change report on the physical science of climate change, variable precipitation and rising temperatures are intensifying droughts in some U.S. regions. According to the report, certain types of droughts, such as those causing agricultural impacts, are expected to be more likely in the western and central regions of the United States in the future.

The federal government generally defers to state primacy in surface and groundwater allocation, and states and local entities typically lead efforts to prepare for drought. Multiple federal agencies contribute to these efforts to predict, plan for, and respond to drought. The federal government, and in particular the National Oceanic and Atmospheric Administration, plays a key role in researching and monitoring drought through the National Integrated Drought Information System and the U.S. Drought Monitor. Other federal agencies, such as the U.S. Department of Agriculture (USDA) and the U.S. Geological Survey, also research and monitor drought factors and conditions. USDA provides the primary federal financial aid to lessen the impacts of drought and compensate for agricultural production loss after drought onset.

Congress has authorized federal assistance for other aspects of drought, but these programs generally are limited in scope. In localities or watersheds with major projects managed by the U.S. Bureau of Reclamation (Reclamation, which operates exclusively in the 17 arid western states) and the U.S. Army Corps of Engineers (USACE, which operates nationwide), the federal role in water management is more direct and can be especially controversial during times of drought, when multiple users compete for water. Congress has directed both Reclamation and USACE to plan for future droughts at federally authorized projects. Other federal programs, such as those supporting nonfederal efforts to develop water conservation, water reuse and recycling, rural water supplies, or other municipal and industrial water supplies, may prioritize projects that lessen the impacts of drought even when these programs do not focus exclusively on drought.

Severe drought in California from 2012 to 2016, as well as widespread drought in the western United States in 2021 and other recent events, has raised the profile of drought and led to increasing congressional and administrative proposals to prepare for and respond to its impacts. The 117th Congress enacted funding for drought activities in the Infrastructure Investment and Jobs Act (P.L. 117-58). Congressional interest in drought may include new and amended authorities for drought planning and response; emergency appropriations to alleviate drought impacts and enhance related activities; and oversight of ongoing federal drought science, preparedness, and management efforts.

SUMMARY

R46911

February 8, 2022

Charles V. Stern, Coordinator
Specialist in Natural Resources Policy

Eva Lipiec, Coordinator
Analyst in Natural Resources Policy

Lisa S. Benson
Analyst in Agricultural Policy

Nicole T. Carter
Specialist in Natural Resources Policy

Elena H. Humphreys
Analyst in Environmental Policy

Pervaze A. Sheikh
Specialist in Natural Resources Policy

Megan Stubbs
Specialist in Agricultural Conservation and Natural Resources Policy

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Introduction

Drought—a deficiency of moisture that results in adverse impacts—occurs to some extent almost every year in areas of the United States. Drought has the potential to create economic and environmental impacts on local, regional, and national scales, as well as disruptions in water supplies for households and communities. For example, the National Oceanic and Atmospheric Administration (NOAA) estimates the United States has experienced 29 billion-dollar drought events since 1980, at an estimated total cost of over $285.5 billion.[1] Although droughts are a component of climate variability and may be seasonal, multiyear, or multi-decadal in duration, variable precipitation and rising temperatures are intensifying droughts in some regions.[2] Severe droughts in California from 2012 to 2016, as well as widespread drought in the western United States in 2021, have raised the profile of drought and led to increasing congressional and administrative proposals to prepare for and respond to its impacts.

Multiple federal agencies contribute to efforts to predict, plan for, and respond to drought. NOAA plays a key role in monitoring drought through the National Integrated Drought Information System (NIDIS) and the U.S. Drought Monitor (through a partnership with the University of Nebraska–Lincoln and the U.S. Department of Agriculture [USDA]). USDA provides the primary federal financial aid to lessen drought's impacts and compensate for agricultural production loss after its onset. Federal water resource agencies such as the U.S. Bureau of Reclamation (Reclamation) and the U.S. Army Corps of Engineers (USACE) face difficult tradeoffs in operating federal water projects during drought; both agencies also have authorities and conduct activities to mitigate drought impacts. Various other federal agencies and emergency authorities also play a role in drought response and mitigation, including the U.S. Environmental Protection Agency (EPA).

This report provides an overview of drought in the United States, including information on drought science, monitoring, and forecasts and on drought types and intensity classifications. It also discusses federal authorities related to drought planning and response, with a focus on selected water-related agricultural, environmental, and natural resource-related authorities with explicit ties to drought. It does not discuss broader disaster-related authorities and their potential nexus to drought, such as the programs and authorities of the Federal Emergency Management Agency (FEMA) and interactions between drought and other hazards and concerns (e.g., wildfire, dust, and public health).

Overview of Drought in the United States[3]

The following sections provide information about drought in the United States, including a discussion of the different causes of drought, potential linkages between drought and climate change now and in the future, and how the impacts of drought are classified and forecasted in the United States.

[1] Costs represent the 2021 Consumer Price Index cost adjusted value if different from original value. National Oceanic and Atmospheric Administration (NOAA), National Centers for Environmental Information, "Billion-Dollar Weather and Climate Disasters: Events," at https://www.ncdc.noaa.gov/billions/events/US/1980-2021

[2] For more information, see "Drought and Climate Change."

[3] For more information, contact Eva Lipiec, Analyst in Natural Resources Policy, or Nicole Carter, Specialist in Natural Resources Policy.

What Is Drought?

Droughts are a component of climate variability and may be seasonal, multiyear, or multi-decadal (sometimes called *megadroughts*) in duration. Drought may be defined in various ways; NOAA, for instance, defines it as "a deficiency of moisture that results in adverse impacts on people, animals, or vegetation over a sizeable area."[4] Although a lack of precipitation is often central to drought, high temperatures, high winds, lack of clouds, and low humidity also can contribute.[5] Experts categorize definitions into four basic approaches to measuring drought: meteorological, hydrological, agricultural, and socioeconomic.[6] However, no one definition applies to all circumstances.

- *Meteorological drought* typically is defined based on the degree of dryness in comparison to some "normal" or average amount and the duration of a dry period. Meteorological drought is region-specific, because atmospheric conditions creating precipitation deficiencies vary from region to region.
- *Hydrological drought* is defined by the effects that periods of shortfalls in precipitation (including snowfall) have on surface and subsurface water supply, such as streamflows, reservoir and lake levels, and groundwater. The frequency and severity of this type of drought are measured on a watershed or river basin scale.
- *Agricultural drought* links characteristics of meteorological or hydrological drought to agricultural impacts, with a focus on precipitation shortfalls, evapotranspiration differences,[7] soil moisture deficits, reduced groundwater or reservoir levels, and other effects. The timing and severity of drought conditions and the types of plants involved may yield different agricultural impacts. Some experts use the term *agricultural and ecological drought* to capture not only the agricultural effects but also the ecological effects of drought, such as plant water stress that contributes to tree mortality.
- *Socioeconomic drought* associates the "supply and demand of some economic goods with elements of meteorological, hydrological, and agricultural drought."[8] A socioeconomic drought may occur when the demand for an economic good, such as water, food grains, fish, or hydroelectric power, exceeds supply due to a shortfall in water supply.

Scientists also have been studying a phenomenon referred to as *hot drought*. In contrast to precipitation-driven droughts, hot droughts are a result of high air temperatures, as warmer air absorbs more water than cooler air.[9]

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[4] Drought.gov, "Defining Drought," at https://www.drought.gov/what-is-drought/drought-basics#defining-drought.

[5] For more information, see U.S. Geological Survey (USGS), "Drought: Things to Know," at https://www.usgs.gov/special-topic/water-science-school/science/droughts-things-know?.

[6] National Drought Mitigation Center (NDMC), "Types of Drought," at https://drought.unl.edu/Education/DroughtIn-depth/TypesofDrought.aspx.

[7] *Evapotranspiration* may be defined as the loss of water from a land area through transpiration from plants and evaporation from the soil and surface water bodies such as lakes, ponds, and man-made reservoirs. For more about evapotranspiration, see USGS, "Evapotranspiration and the Water Cycle," at https://www.usgs.gov/special-topic/water-science-school/science/evapotranspiration-and-water-cycle?qt-science_center_objects=0.

[8] NDMC, "Types of Drought," at https://drought.unl.edu/Education/DroughtIn-depth/TypesofDrought.aspx.

[9] NOAA, Climate.gov, "Beyond 2016: Year in Review," January 4, 2017, at https://www.climate.gov/news-features/

Additionally, experts have begun to characterize drought by how quickly drought conditions begin, with some scientists using the term *flash drought* to identify rapid-onset drought conditions. Scientists at NOAA define a flash drought as "a drought event with greater than or equal to two categories degradation in a four-week period based on the U.S. Drought Monitor." (For more about the U.S. Drought Monitor and its categories, see "Drought Classification.")[10] Flash drought is usually caused by anomalously high temperatures, winds, and/or radiation from the sun rather than by precipitation deficits.[11]

Higher demand for water for human activities and vegetation in areas of limited water supply increases the severity of certain types of drought. For example, drought during the growing season likely is often considered more severe—in terms of impacts—than similar conditions when cropland lies dormant. For policy purposes, drought often becomes an issue when it results in a water supply deficiency. The effects of a water supply deficiency manifest in various ways, including the following:

- Decreased precipitation and/or soil moisture affecting runoff and water availability
- Low reservoir levels reducing allocations for multiple purposes (including irrigation, navigation, energy production, recreation, fish and wildlife needs, and other water supplies)
- Low stream flows limiting withdrawals for multiple purposes, including municipal and industrial supplies
- Decreased inflow into and evaporation off of lakes (less exchange of water in a lake can contribute to water quality problems and may hamper recreation)

Drought also can relate and contribute to other phenomena, such as wildfires and heat waves.[12]

Scientific advances, such as improved observation and understanding of atmospheric variability and of North American precipitation and temperature variations, have enhanced understanding of drought and the forces that contribute to it, although debates remain on those forces' relative importance. Drought likely never results from a single cause; rather, drought at a specific location may be influenced by a mix of various interacting atmospheric anomalies, land-atmosphere feedbacks, topographic features, and human activity, such as water use, among other forces and factors. Regarding the role of atmospheric patterns and conditions, prolonged droughts typically

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blogs/beyond-data/beyond-2016-year-review; and Bradley Udall and Jonathan Overpeck, "The Twenty-First Century Colorado River Hot Drought and Implications for the Future," *Water Resources Research*, vol. 53, no. 3 (February 17, 2017), pp. 2404-2416.

[10] L. Gwen Chen et al., "Flash Drought Characteristics Based on U.S. Drought Monitor," *Atmosphere, Special Issue: Meteorological and Hydrological Droughts*, vol. 10, no. 9 (2019), pp. 498-513. Hereinafter, Chen et al., "Flash Drought," 2019. However, a recent expert literature review noted the absence of a universally accepted definition or criteria for *flash drought*, with defined rates of onset for flash drought ranging between five days and eight weeks. See Joel Lisonbee et al., "Making Sense of Flash Drought Definitions, Indicators, and Where We Go from Here," *Journal of Applied and Service Climatology*, vol. 2021, no. 1 (2021), pp. 1-19. For a description of the evolution of a flash drought, see NOAA, "Flash Drought Engulfs the U.S. Southeast in September 2019," October 9, 2019, at https://www.climate.gov/news-features/event-tracker/flash-drought-engulfs-us-southeast-september-2019.

[11] Chen et al., "Flash Drought," 2019.

[12] For more on wildfire, see CRS In Focus IF10732, *Federal Assistance for Wildfire Response and Recovery*, by Katie Hoover, and CRS Report R43429, *Federal Lands and Related Resources: Overview and Selected Issues for the 117th Congress*, coordinated by Katie Hoover. For more information about the potential relationship between droughts and heat waves, see, for example, Linyin Cheng et al., "Physical Understanding of Human-Induced Changes in U.S. Hot Droughts Using Equilibrium Climate Simulations," *Journal of Climate*, vol. 32, no. 14 (July 15, 2019), pp. 4431-4443.

occur when certain spatially and temporally large-scale anomalies in atmospheric circulation patterns persist. These anomalies are referred to as *teleconnection patterns* and typically can last several weeks to several months or can be prominent for several consecutive years.[13] Ocean conditions contribute to some teleconnection patterns, including the El Niño-Southern Oscillation (ENSO) and the Pacific Decadal Oscillation (PDO).[14] A relationship between tropical Pacific Ocean conditions and drought in the United States is becoming better established. (For more on the role Pacific Ocean conditions play in droughts in the United States, see text box "Droughts and the El Niño-Southern Oscillation.") Other atmospheric conditions, such as blocking ridges, also may contribute to drought conditions.[15]

Droughts and the El Niño-Southern Oscillation

The El Niño-Southern Oscillation (ENSO) is an anomaly associated with central and eastern tropical Pacific Ocean conditions—particularly sea surface temperatures (SSTs) and air pressure—that can affect the path of the jet stream over mid-latitude North America and other regions globally, thereby influencing regional temperatures and precipitation. ENSO conditions often are described by phase: El Niño, neutral, or La Niña. The La Niña phase refers to the cooler-than-average SSTs in the central tropical Pacific region in the oscillating warming and cooling pattern of ENSO. Scientists have increasingly linked drought in portions of the United States to SST anomalies in the Pacific Ocean. La Niña's influence on drought varies across the continent and may vary seasonally.

- La Niña conditions can correlate with drier-than-normal winter conditions in California and the southwestern United States, while also contributing to wetter-than-normal conditions in other regions of the United States. ENSO's impact on southwestern summer weather and precipitation is less clear.
- In the southeastern United States, La Niña appears to be a contributor to some droughts (e.g., there seems to be a weak link between La Niña and dry winter conditions), with multiple other factors also corresponding or contributing to droughts in the region.
- The effects of El Niño and La Niña on drought conditions on Hawaii and the insular areas of the Pacific vary within the region.
- In many regions of the country, ENSO forces play an unclear role and combine with multiple other factors, such as topography, to determine conditions that could lead to drought (e.g., the effect of the Rocky Mountains in Colorado).
- Widespread flash droughts over the United States are often associated with La Niña conditions.

Sources: National Oceanic and Atmospheric Administration, National Ocean Service, "What Are El Niño and La Niña?," at https://oceanservice.noaa.gov/facts/ninonina.html; National Integrated Drought Information System, "Western Drought Webinar," July 20, 2021, PowerPoint presentation, at https://www.drought.gov/webinars/western-drought-webinar-july-20-2021; Climate Assessment for the Southwest, "How Does ENSO

[13] For more about teleconnection patterns, see NOAA, National Weather Service Climate Prediction Center, "Teleconnection Introduction," at https://www.cpc.ncep.noaa.gov/data/teledoc/teleintro.shtml. According to NOAA, a *teleconnection pattern* refers to a recurring and persistent large-scale pattern of pressure and circulation anomalies that spans vast geographical areas. Many teleconnection patterns are planetary-scale in nature spanning entire ocean basins and continents. Teleconnection patterns reflect large-scale changes in the atmospheric wave and jet stream patterns, and they influence temperature, rainfall, storm tracks, and jet stream location and intensity over vast areas.

[14] El Niño-Southern Oscillation (ENSO) is a periodic fluctuation in sea surface temperature (El Niño) and the air pressure of the overlying atmosphere (Southern Oscillation) across the equatorial Pacific Ocean (NOAA, "El Niño/Southern Oscillation (ENSO) Technical Discussion," at https://www.ncdc.noaa.gov/teleconnections/enso/enso-tech.php, and National Integrated Drought Information System (NIDIS), "Western Drought Webinar," July 20, 2021, PowerPoint presentation, at https://www.drought.gov/webinars/western-drought-webinar-july-20-2021). For more information about the Pacific Decadal Oscillation, see Climate.gov, "Going out for ice cream: a first date with the Pacific Decadal Oscillation," August 25, 2016, at https://www.climate.gov/news-features/blogs/enso/going-out-ice-cream-first-date-pacific-decadal-oscillation.

[15] *Blocking ridges* are regions of high atmospheric pressure that disrupt typical wind patterns in the atmosphere. Scientists identified a persistent ridge pattern, often referred to as the *Ridiculously Resilient Ridge*, contributing to California's 2012-2016 drought by diverting winter storms northward, thereby preventing them from reaching California. For more information see, for example, Haiyan Teng and Grant Branstator, "Causes of Extreme Ridges That Induce California Droughts," *Journal of Climate*, vol. 30, no. 4 (February 15, 2017), pp. 1477-1492.

Affect SW Weather Patterns?," at https://climas.arizona.edu/content/how-does-enso-affect-sw-weather-patterns; Richard Seager et al., "Drought in the Southeastern United States: The Recent Drought in the Context of a Millennium of Climate Variability, Physical Causes and Future Hydroclimate Change," July 2008, at http://ocp.ldeo.columbia.edu/res/div/ocp/drought/SE.shtml; A. Park Williams et al., "The 2016 Southeastern U.S. Drought: An Extreme Departure from Centennial Wetting and Cooling," *Journal of Geophysical Research: Atmospheres*, vol. 122, no. 20 (2017), pp. 10888-10905; Colorado State University, Colorado Climate Center, "ENSO and Colorado," at https://climate.colostate.edu/co_enso.html; and L. Gwen Chen et al., "Flash Drought Characteristics Based on U.S. Drought Monitor," *Atmosphere, Special Issue: Meteorological and Hydrological Droughts*, vol. 10, no. 9 (2019), pp. 498-513.

Notes: Some researchers associated the 2019 southeastern drought to a waning El Niño and other phenomena, specifically the Indian Ocean dipole and Rossby waves (see Siegfried D. Schubert et al., "On the Development and Demise of the Fall 2019 Southeast U.S. Flash Drought: Links to an Extreme Positive IOD," *Journal of Climate*, vol. 34, no. 5 (March 1, 2021), pp. 1701-1723).

For more on the ENSO effects on Hawaii and Pacific insular islands, see U.S. Global Change Research Program (USGCRP), "Hawai'i and U.S.-Affiliated Pacific Islands" in *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment,* vol. II, 2018, p. 1251; or Benjamin I. Cook et al., "Pan-Continental Droughts in North America over the Last Millennium," *Journal of Climate*, vol. 27, no. 1 (January 1, 2014), pp. 383-397.

Drought and Climate Change

The relationship between climate change and drought is complex, and the scientific understanding of this relationship is evolving. The U.S. Global Change Research Program (USGCRP), an entity composed of U.S. federal agencies, released its special report on the state of climate science in 2017 and its periodic national climate assessment in 2018.[16] In these reports, the USGCRP made various observations related to drought, including the following:

- Variable precipitation and rising temperature were intensifying droughts, with groundwater depletion (from withdrawal for human uses exceeding aquifer recharge) further exacerbating drought risk.[17]
- Annual trends toward earlier spring snowmelt and reduced snowpack were affecting water resources in the western United States, and those trends were expected to continue.[18]
- Future droughts in most regions of the United States likely would be more intense and could last longer due to projected decreases in soil moisture, with trends likely strongest in the Southwest and the southern Great Plains.[19]
- The then-recent droughts and heat waves (as of 2017) had reached record intensity in some U.S. regions but had not reached the geographical scale and duration of the Dust Bowl era of the 1930s.[20]

[16] USGCRP expects to release the next iteration of its reports in 2023.

[17] USGCRP, "Water," in *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment,* vol. II, 2018, p. 2.

[18] USGCRP, "Executive Summary," in *Climate Science Special Report: Fourth National Climate Assessment,* vol. I, 2017, p. 11.

[19] USGCRP, "Our Changing Climate," in *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment,* vol. II, 2018, p. 91.

[20] USGCRP, "Executive Summary," in *Climate Science Special Report: Fourth National Climate Assessment,* vol. I, 2017, p. 21.

Regarding teleconnections patterns that may contribute to drought, a 2019 Intergovernmental Panel on Climate Change (IPCC) report on climate change and land had *low confidence* in how large-scale systems, such as ENSO, would respond to a warming climate and therefore how those changes might affect the frequency and severity of drought.[21] In August 2021, the IPCC released its sixth assessment on the underlying physical science of climate change. The report provided observations by drought type and region, and it synthesized projections regarding future drought risk. For more on the drought discussion in the August 2021 IPCC physical science report, see text box "Overview of the IPCC August 2021 Findings on Drought in the Continental United States"[22]

The August 2021 IPCC report identified research that projected an intensified rainfall response over the equatorial Pacific Ocean as a result of ENSO-related sea surface temperature changes under a warming climate, with resulting impacts over land.[23] For a discussion of how ENSO's La Niña conditions may contribute to drier conditions and droughts in the continental United States, see text box "Droughts and the El Niño-Southern Oscillation."

Overview of the IPCC August 2021 Findings on Drought in the Continental United States

The August 2021 Intergovernmental Panel on Climate Change (IPCC) physical science report provided the following observations by drought type and U.S. region:

- **Meteorological Drought**. For observed meteorological droughts, the report identified inconsistent trends or mixed signals for both western and eastern North America (low confidence) and a decrease in the duration and frequency of meteorological droughts in central North America (medium confidence).
- **Hydrologic Drought**. For observed hydrologic droughts, the report identified mixed signals for trends for western and central North America and limited evidence available for eastern North America.
- **Agricultural and Ecological Drought**. The report identified an observed increase in agricultural and ecological drought for western North America (medium confidence), inconsistent trends for central North America, and inconsistent trends depending on metrics used and geographic areas for eastern North America.

Among the changes in projected future droughts, the August 2021 IPCC physical science report identified the following:

- For western North America, limited evidence or inconsistent trends at +1.5 °C for all drought types and increased hydrologic drought as well as agricultural and ecological drought at +2 °C warming (medium

[21] Intergovernmental Panel on Climate Change (IPCC), "Land-Climate Interactions," in *Special Report on Climate Change and Land*, 2019, p. 146. According to IPCC, author teams evaluated their confidence about the validity of a finding, providing a synthesis of the evaluation of evidence and agreement (levels of confidence include five qualifiers: very low, low, medium, high, and very high; Virginia R. Burkett et al., "Point of Departure," in *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contributions of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, 2014, p. 9).

[22] IPCC, "Chapter 11: Weather and Climate Extreme Events in a Changing Climate," in *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* (in press), version date August 2021, Table 11.21, pp. 11-229 to 11-231 (hereinafter, report cited as IPCC, *AR6 Physical Science Basis*; the August 2021 chapters in this report remain subject to revision). For a depiction of the areas included in the western, central, and eastern North America designations, see IPCC, "Chapter 1: Framing, Context, and Methods," in *AR6 Physical Science Basis*, p. 1-197.

[23] IPCC, "Chapter 11: Weather and Climate Extreme Events in a Changing Climate," in *AR6 Physical Science Basis*, pp. 11-17 and 11-110. The report did not identify a robust consensus in the research literature regarding changes in amplitude of ENSO-related sea surface temperature variability (e.g., an intensification of how much warmer or cooler than normal the surface ocean is along the equator in the central-to-eastern Pacific for El Niño and La Niña, respectively).

confidence), with limited evidence and inconsistent trends for meteorological drought at those projected temperature increases.

- For central North America, increased agricultural and ecological drought severity or frequency at both +1.5 °C and +2 °C warming (medium confidence).
- For eastern North America, limited evidence or inconsistent trends at both +1.5 °C and +2 °C warming for the various drought types (low confidence).

Source: IPCC, "Chapter 11: Weather and Climate Extreme Events in a Changing Climate," in Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (in press), version date August 2021, Table 11.21, pp. 11-229 to 11-231.

Some researchers have undertaken efforts to measure the contribution of human-induced warming to specific U.S. droughts (known as *attribution science*).[24] Efforts to link observed droughts to human contributions to climate change, as well as to identify drought *nonstationarity*,[25] are complicated by the multiple factors that can influence the severity, frequency, and duration or timing of a drought; by limitations on data availability, given there are often fewer drought events to compare over time relative to other types of weather events; and by challenges in identifying drought onset and termination.[26]

Drought Classification

Certain measures, or drought indicators, are typically used to assess and classify the intensity and type of drought. Local, state, and federal entities may have different ways to classify drought, which may depend on a single indicator or on several indicators, often combined with expert opinion from the academic, public, and private sectors.

The U.S. Drought Monitor, a partnership between federal and nonfederal entities, uses multiple indicators and indexes, together with expert opinion and stakeholder information, to estimate the intensity and effects of ongoing drought conditions (**Figure 1**).[27] According to NOAA, roughly 40-50 unique indicators are used to create the U.S. Drought Monitor map but not all geographic

[24] For example, see A. Park Williams et al., "Large Contribution from Anthropogenic Warming to an Emerging North American Megadrought," *Science*, vol. 368, no. 6488 (April 17, 2020), pp. 341-318 and Andrew Hoell et al., *Drought Assessment Report: The Causes, Predictability, and Historical Context of the 2017 U.S. Northern Great Plains Drought*, February 2019, NOAA, Earth System Research Laboratory, and University of Colorado, Cooperative Institute for Research in Environmental Sciences, at https://www.drought.gov/sites/default/files/2020-09/2017-NGP-drought-assessment.pdf. Using research like the former articles, the IPCC *AR6 Physical Science Basis* indicated medium confidence in western North America's observed agricultural and ecological drought having a human contribution (IPCC, "Chapter 11: Weather and Climate Extreme Events in a Changing Climate," in *AR6 Physical Science Basis*, Table 11.21). The report identified low confidence in the attribution to human-induced climate change of observed changes for meteorological drought (limited evidence) and hydrological drought (inconsistent trends in observations in central North America and limited evidence in and eastern North America) (pp. 11-230 to 11-232). The report identified low confidence in attribution for western North America for meteorological drought (limited evidence) and hydrological drought (mixed signal) (pp. 11-229 to 11-230).

[25] The *nonstationarity* of a process such as drought consists of an exhibited shift in the process's mean, variance, or shape. Climate variability, climate change, land use changes, and water management changes are possible contributors to nonstationarities in hydrological extremes such as droughts and floods.

[26] Louise J. Slater et al., "Nonstationary Weather and Water Extremes: A Review of Methods for Their Detection, Attribution, and Management," *Hydrology and Earth System Sciences*, vol. 25, no. 7 (2021), pp. 3897-3935.

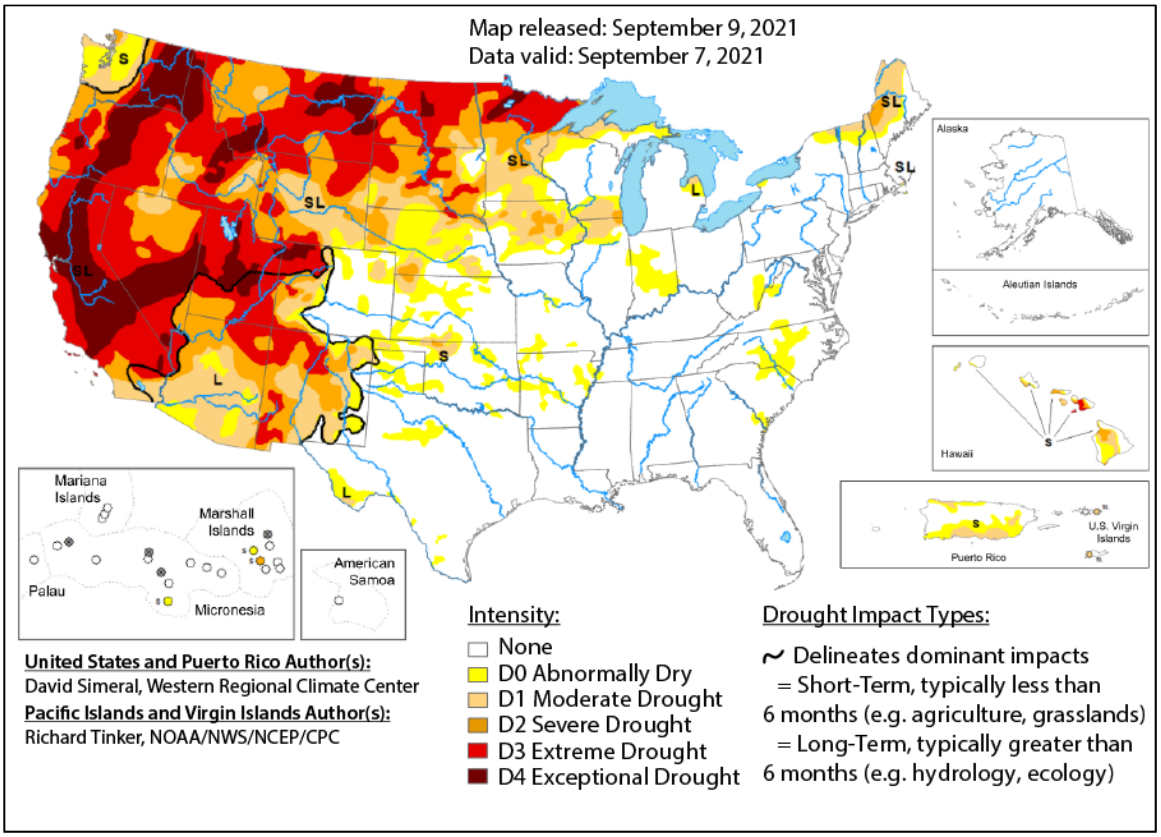
[27] The U.S. Drought Monitor represents a consensus view between academic and federal scientists of ongoing drought conditions. The U.S. Drought Monitor is produced jointly by the NDMC at the University of Nebraska–Lincoln, NOAA, and the U.S. Department of Agriculture (USDA). For more information, see U.S. Drought Monitor, "What Is the USDM," at https://droughtmonitor.unl.edu/About/WhatistheUSDM.aspx.

areas are represented equally by the indicators.[28] The U.S. Drought Monitor intensity scheme—D0 (abnormally dry), D1 (moderate), D2 (severe), D3 (extreme), and D4 (exceptional)—depicts broad-scale conditions but not necessarily drought circumstances at the local scale. The estimated drought intensity can be a trigger for local, state, and federal responses to drought. For example, the regions depicted as red in **Figure 1** faced extreme drought conditions for the week preceding September 7, 2021, but they may have contained local areas and individual communities that experienced less or more severe drought.

In addition to the color-coded D0-D4 designations, U.S. Drought Monitor maps often include "S" and "L" designations to provide additional information about the nature of drought (**Figure 1**). The "S" designation indicates the existence of short-term effects: a combination of different drought indexes that approximates responses to precipitation over days up to a few months. These effects would include impacts to agriculture, topsoil moisture, unregulated streamflows, and aspects of wildfire danger. The "L" designation indicates the existence of long-term effects; it approximates responses to precipitation over several months up to a few years. These effects include reservoir levels, groundwater, and lake levels. As **Figure 1** shows, some regions of the United States include both an "S" and an "L" designation, indicating that in September 2021, those regions experienced both short- and long-term impacts.

[28] NOAA, "NOAA Drought: Science, Observations, and Services," July 15, 2021, PowerPoint presentation. Key indicators and indexes include the Palmer Drought Index, the Climate Prediction Center soil moisture model, USGS weekly streamflow data, the Standardized Precipitation Index, and short- and long-term drought indicator blends. For a discussion of drought indicators, see NOAA, National Centers for Environmental Information, "Drought: The Importance of Drought Indicators," at https://www.ncdc.noaa.gov/news/drought-importance-drought-indicators.

Figure 1. Example of a U.S. Drought Monitor Map



Source: U.S. Drought Monitor at https://droughtmonitor.unl.edu/.

Note: U.S. Drought Monitor national maps are updated weekly.

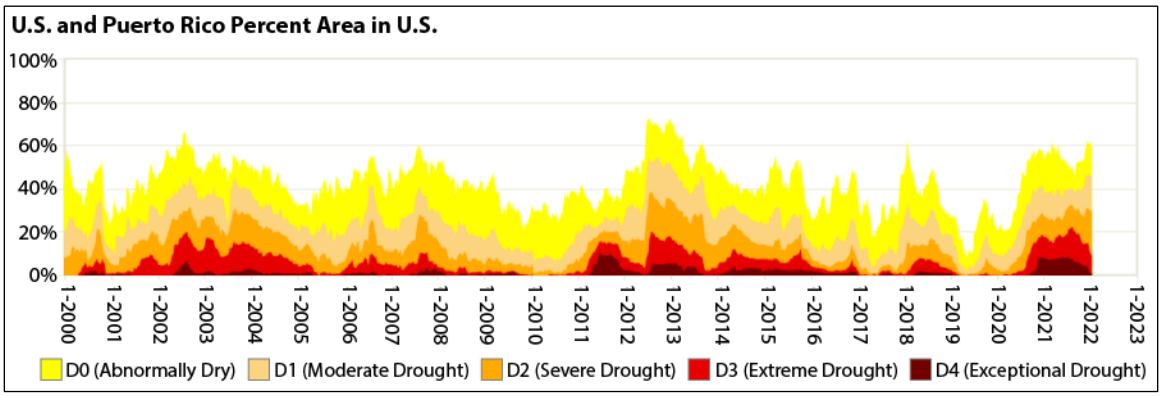
Since the U.S. Drought Monitor began in 2000, some portion of the land area of the United States has experienced drought of at least moderate intensity (D1) each year (**Figure 2**).[29] The land area affected by drought can vary widely by year and within a particular year. There is particular concern about locations experiencing the most intense drought conditions: *extreme* and *exceptional* drought (D3 and D4, respectively). Some portion of the country has experienced extreme (D3) or exceptional (D4) drought in nearly every year since 2000 (**Figure 2**).[30]

[29] U.S. Drought Monitor, "Time Series," at https://droughtmonitor.unl.edu/DmData/TimeSeries.aspx. A 2013 article stated that, based on a monthly precipitation and mean temperature drought indicator, each decade from 1900 through 2012 had experienced drought episodes that covered 30% or more (by area) of the contiguous United States (Thomas C. Peterson et al., "Monitoring and Understanding Changes in Heat Waves, Cold Waves, Floods, and Droughts in the United States: State of Knowledge," *Bulletin of the American Meteorological Society*, vol. 94, no. 6 [June 2013], p. 827).

[30] There have been some periods since 2000 where extreme (D3) or exceptional (D4) drought did not affect any portion of the country. For example, from January 2000 through early April 2000 and more recently, from late March 2019 through mid-March 2020.

Figure 2. Percentage of United States in U.S. Drought Monitor Categories

(January 4, 2000, through December 31, 2021)



Source: U.S. Drought Monitor, "Time Series," at https://droughtmonitor.unl.edu/DmData/TimeSeries.aspx. Modified by CRS.

Note: Includes the continental United States and Puerto Rico.

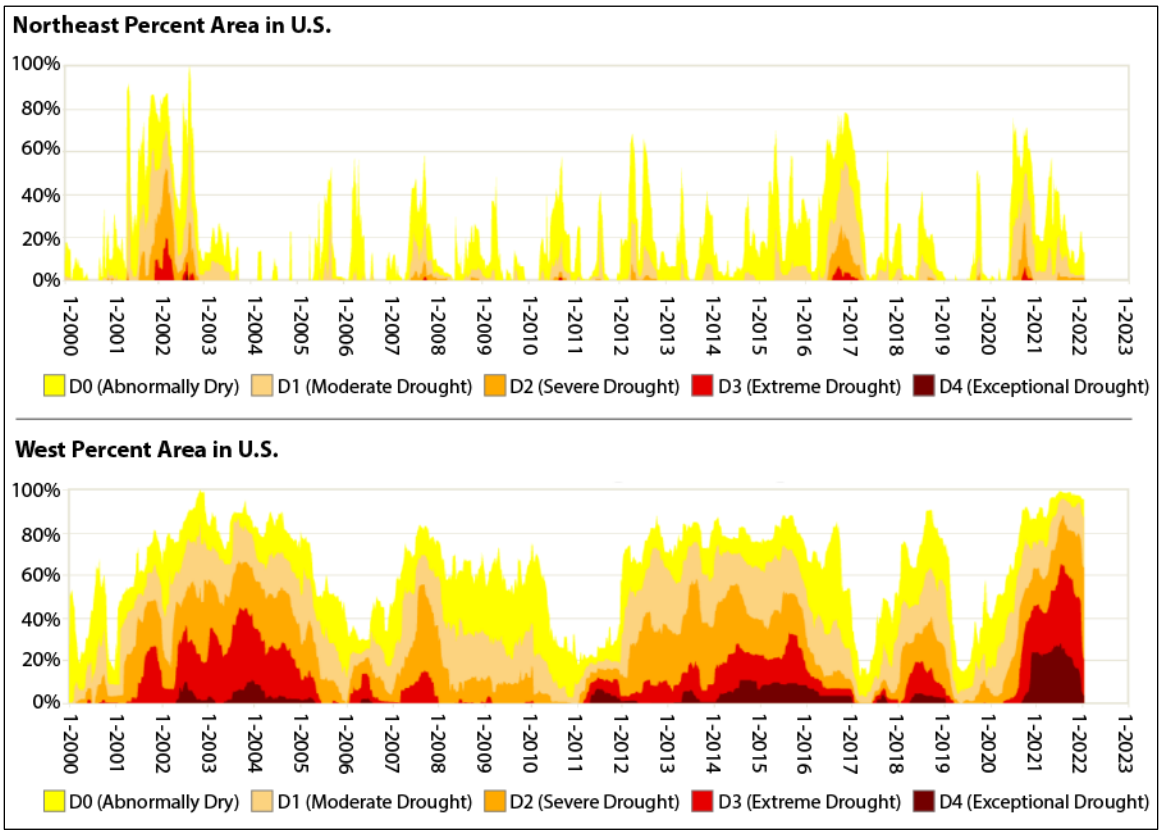
Drought may affect certain regions of the United States on a short-term or a longer-term basis, with varying intensity over time. For example, the Northeast region has rarely experienced extreme (D3) or exceptional drought (D4) since the U.S. Drought Monitor began issuing maps in 2000 (**Figure 3**).[31] In contrast, periods of extreme and exceptional drought have been relatively common since 2000 in the western region of the United States.[32]

[31] The Northeast region includes Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, and West Virginia.

[32] The western region includes Arizona, California, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, and Washington, also referred to as the West.

Figure 3. Percentage of the Northeast and the West in U.S. Drought Monitor Categories

(January 4, 2000, through December 31, 2021)

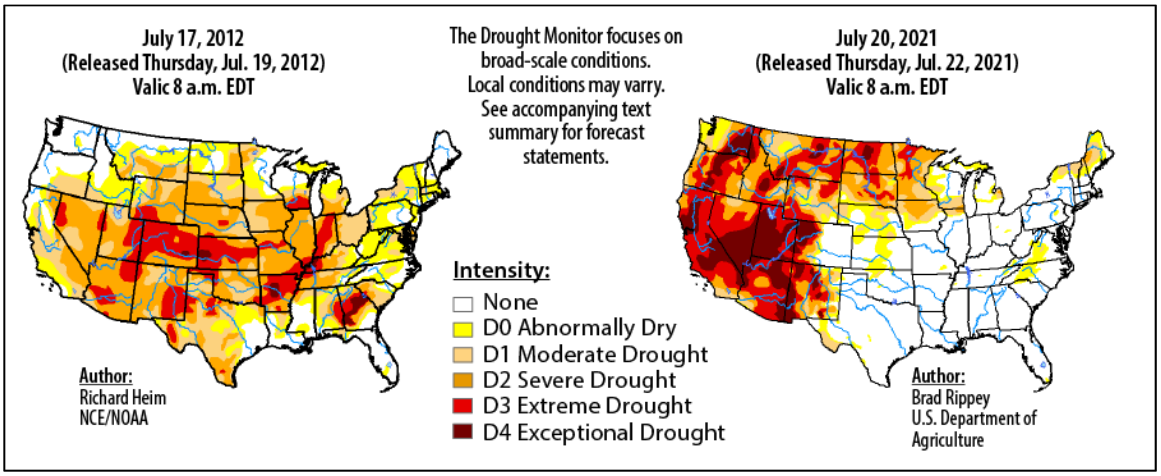


Source: U.S. Drought Monitor, "Time Series," at https://droughtmonitor.unl.edu/DmData/TimeSeries.aspx. Modified by CRS.

Some regions may experience extreme and exceptional drought more often than other areas. **Figure 4** illustrates how drought can stretch across the continental United States or can affect only a comparatively small region. On July 17, 2012, abnormally dry or drought conditions (D1-D4) covered roughly 81% of the continental United States, with about 42% of the nation experiencing severe drought or worse (D2-D4). In contrast, on July 20, 2021, about 54% of the continental United States faced abnormally dry or drought conditions (D1-D4), with 38% experiencing severe drought or worse (D2-D4).[33]

[33] U.S. Drought Monitor, "Compare Two Weeks," at https://droughtmonitor.unl.edu/Maps/CompareTwoWeeks.aspx.

Figure 4. Example Comparing Widespread and Regional Drought in the Continental United States



Source: U.S. Drought Monitor, "Compare Two Weeks," at https://droughtmonitor.unl.edu/Maps/CompareTwoWeeks.aspx. Modified by CRS.

Drought Forecasts for the United States

Predicting drought is difficult, because the ability to forecast surface temperature and precipitation depends on a number of key variables, such as air-sea interactions, topography, soil moisture, land surface processes, and weather systems at the global scale (e.g., ENSO). Scientists seek to understand how these variables interact; however, it may not be possible to reliably forecast temperate regions a season or more in advance.[34]

Similarly, predicting the onset of drought remains difficult.[35] The drought onset forecasting challenge is due, in part, to limitations in accurately predicting precipitation beyond a two-week period.[36] Other factors, such as land cover changes, dam operation, irrigation works, groundwater extraction, and other engineered changes, also confound understanding of hydrologic extremes such as drought.

Although forecasting drought at the regional scale is difficult, understanding potential changes in long-term trends is important for water managers at all levels—federal, state, local, and tribal. Water project operations and state water allocations typically are based on past long-term hydrological trends; significant deviations from such trends may result in challenges for water managers and water users alike.[37]

In spite of these challenges, NOAA periodically releases monthly and seasonal U.S. drought outlooks. According to the agency, the outlooks are based on temperature and precipitation outlooks, including seasonal and multiyear patterns of precipitation, various short- and medium-

[34] Drought.gov, "Challenges with Predicting Drought," at https://www.drought.gov/forecasts#challenges.

[35] NIDIS and National Drought Resilience Partnership (NDRP), *Second National Drought Forum, July 30-31, 2019*, Washington, DC, December 2020, p. 13, at https://www.drought.gov/sites/default/files/2020-12/SecondNationalDroughtForumReport.pdf. Hereinafter, NIDIS and NDRP, *Second National Drought Forum*, 2020.

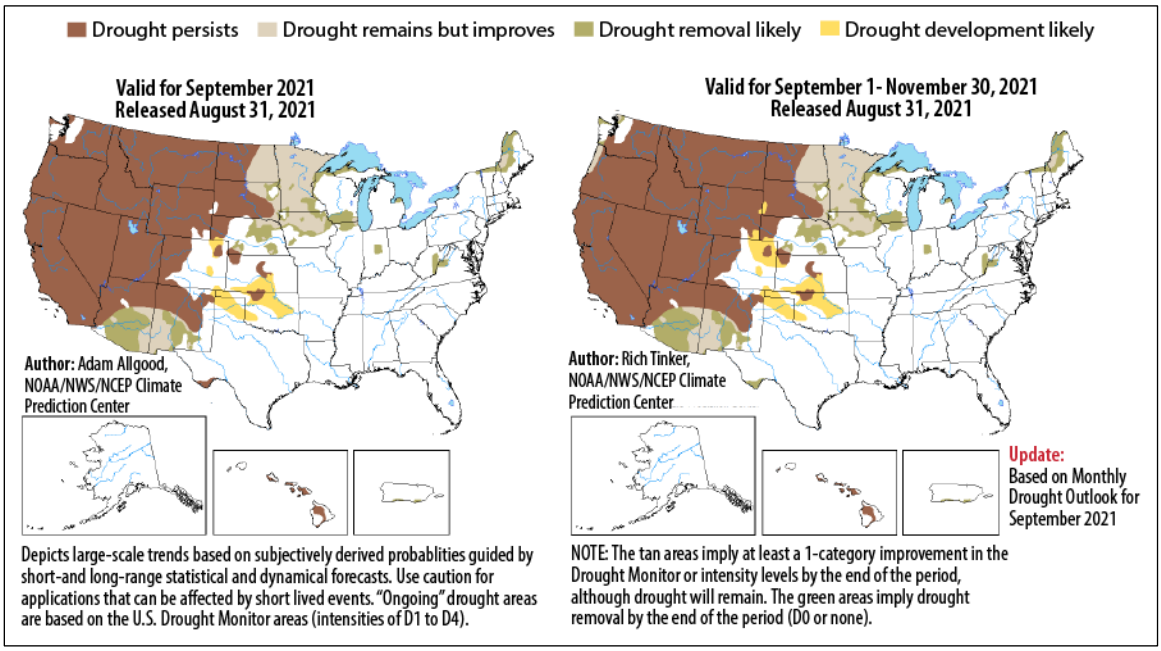
[36] NIDIS and NDRP, *Second National Drought Forum*, 2020, p. 13.

[37] P. C. D. Milly et al., February 2008, "Stationarity Is Dead: Whither Water Management?," *Science*, vol. 319, no. 5863 (February 2008), p. 574.

range forecasts and models, and previous U.S. Drought Monitor maps.[38] The outlooks depict areas of the United States where drought is likely to persist, improve, or develop in the next month to several months (**Figure 5**). In addition, to inform stakeholders of the potential for a flash drought, NOAA has begun to issue an experimental forecast depicting where potential flash drought may develop in the next 30 days.[39]

Figure 5. Examples of U.S Monthly and Seasonal Drought Outlooks in the Continental United States

(September 2021 and September 1-November 30, 2021, respectively)



Source: U.S. Drought Monitor, "Outlooks," at https://droughtmonitor.unl.edu/ConditionsOutlooks/Outlooks.aspx. Modified by CRS.

Federal Drought Policy and Coordination

The federal government generally defers to state primacy in surface and groundwater allocation, and states and local entities typically lead efforts to prepare for drought. Most states have drought plans in some form, and some of these plans incorporate efforts to reduce drought vulnerabilities.[40] Some states and communities have invested in reducing water demand and expanding drought-resilient supplies (e.g., wastewater reuse and recycling, desalination, and groundwater recharge and management) or have facilitated water banks and markets for water

[38] NOAA National Weather Service, Climate Prediction Center, "Discussion for the Monthly Drought Outlook," at https://www.cpc.ncep.noaa.gov/products/expert_assessment/mdo_discussion.php; "Discussion for the Seasonal Drought Outlook," at https://www.cpc.ncep.noaa.gov/products/expert_assessment/sdo_discussion.php; and NOAA, Climate.gov, "Data Snapshot Details: Monthly Drought Outlook," at https://www.climate.gov/maps-data/data-snapshots/data-source-drought-outlook.

[39] NOAA, "NOAA Drought: Science, Observations, and Services," July 15, 2021, PowerPoint presentation; and NOAA National Weather Service, Climate Prediction Center, "Flash Drought," at https://www.cpc.ncep.noaa.gov/products/Drought/Flash_Drought/tendency_forecast.php.

[40] NDMC collects information on state drought plans; for more information on state plans, see NDMC, "State Drought Plans," at https://drought.unl.edu/Planning/DroughtPlans/StatePlans.aspx.

transfers. Community-level drought plans are less widespread than state plans, except in states that require or support this planning.

Multiple federal agencies contribute to efforts to predict, plan for, and respond to drought. Federal financial aid to lessen the impacts of drought, after its onset, occurs mostly in the form of financial aid for agricultural production loss. Some federal authorities provide financial assistance for other aspects of drought (e.g., drought-related planning or projects), but these programs are limited in scope and authority. In localities or watersheds with major projects managed by USACE or the Bureau of Reclamation, the federal role in water management is more direct and can be especially controversial during times of drought, when multiple users are competing for water.

Federal agency actions are primarily coordinated under two mechanisms, the National Integrated Drought Information System (NIDIS) and the National Drought Resiliency Partnership (NDRP). In 2006, Congress directed the Under Secretary of Commerce for Oceans and Atmosphere, also known as the *NOAA Administrator*, to create NIDIS (P.L. 109-430). Congress modified the NIDIS authorization in 2014 and 2019 (P.L. 113-86 and P.L. 115-423, respectively). NIDIS is primarily focused on drought-related research and communication and is tasked with the following:

- Providing a drought early warning system on a national and regional scale.
- Communicating drought forecasts, conditions, and impacts on an ongoing basis to federal and nonfederal entities.
- Providing "timely" data, information, and products at the local, regional, watershed, and state scales.
- Coordinating and integrating federal research and monitoring in support of the early warning system.
- Using existing forecasting and assessment programs and partnerships.
- Continuing ongoing research and monitoring activities related to drought.

NIDIS is composed of representatives from federal agencies and nonfederal entities (e.g., nongovernmental organizations and local governments).[41] The group collaborates with additional regional and state partners, as well.[42]

In 2013, President Obama created NDRP as a "complement" to NIDIS.[43] NDRP aims to coordinate federal drought policies, facilitate access to drought assistance, and improve information sharing to help with drought preparedness. NDRP has representatives from multiple federal departments and agencies.[44] In October 2020, the Trump Administration's Executive Order 13956, "Modernizing America's Water Resource Management and Water Infrastructure," tasked NDRP with implementing the "Priority Actions Supporting Long-Term Drought

[41] NIDIS, Drought.gov, "Who We Are," at https://www.drought.gov/about/who-we-are.

[42] NIDIS, Drought.gov, "Partners," at https://www.drought.gov/about/partners. For more information on NIDIS, contact Eva Lipiec, Analyst in Natural Resources Policy.

[43] NOAA, Climate Program Office, "President Signs NIDIS Reauthorization Act," March 7, 2014, at https://cpo.noaa.gov/News/News-Article/ArtMID/6226/ArticleID/1275/President-signs-NIDIS-Reauthorization-Act. NDRP was "institutionalized" by President Obama in a presidential memorandum in 2016 (Executive Office of the President, "Building National Capabilities for Long-Term Drought Resilience," 81 *Federal Register* 16053, March 25, 2016).

[44] NIDIS, Drought.gov, "Partners," at https://www.drought.gov/about/partners.

Resilience" document, issued on July 31, 2019.[45] The document set out specific actions (for which it assigned specific lead agencies) related to accomplishing various policy goals identified in the NDRP charter regarding drought information, preparedness approaches, and technologies.

In April 2021, the Biden Administration announced the creation of the Drought Relief Interagency Working Group, which is cochaired by the Department of the Interior (DOI) and USDA, with representatives from multiple federal entities. The group aims to identify immediate financial and technical assistance for impacted irrigators and tribes and undertake other activities to address drought conditions in the West and support farmers, tribes, and communities impacted by water shortages.[46] Long-term goals include the development of measures to "respond to climate change and build more resilient communities and protect the natural environment," through President Biden's proposed American Jobs Plan and a "recommitment to strengthening" NDRP.[47]

Selected Federal Response Authorities

Congress has enacted a range of authorities related to drought. Some of these authorities deal with drought-related monitoring and research, including early warning and tracking of various drought metrics and conditions. Other authorities involve response to the onset of drought and its effects (e.g., agriculture-related disaster authorities and emergency drinking water supply assistance). Still others focus on longer-term drought response and mitigation. These authorities can take multiple forms, including federal assistance for local and state drought planning and for nonfederal water supply projects that increase drought resilience or provide new water supplies, as well as the construction of new or expanded federal water storage projects and the reoperation of existing projects to yield additional water supplies. In some cases, the federal government, at Congress's direction, also has provided targeted regulatory relief for drought-stricken areas (e.g., relaxation of environmental requirements on pumping water).

Selected federal drought response authorities are discussed below. The discussion focuses on agricultural, natural resources, and environmental authorities that directly relate to drought and does not include broader disaster authorities that might be applicable to drought under specific circumstances,[48] or available to help mitigate future drought-related damage.[49]

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[45] Executive Order 13956 directed the Water Subcabinet (composed of the Secretary-level representatives from the Departments of Agriculture, the Army, Commerce, Energy, and the Interior, as well as the U.S. Environmental Protection Agency) to implement the priority actions identified in the report (Executive Order 13956, "Modernizing America's Water Resource Management and Water Infrastructure," 85 *Federal Register* 65647, October 13, 2020.).

[46] Department of the Interior (DOI), "White House Launches Drought Relief Working Group to Address Urgency of Western Water Crisis," press release, April 21, 2021, at https://www.doi.gov/pressreleases/white-house-launches-drought-relief-working-group-address-urgency-western-water-crisis. Hereinafter, DOI, "Drought Relief Working Group" and White House, "Readout of the Third National Climate Task Force Meeting," press release, April 21, 2021, at https://www.whitehouse.gov/briefing-room/statements-releases/2021/04/21/readout-of-the-third-national-climate-task-force-meeting/.

[47] DOI, "Drought Relief Working Group."

[48] For an introduction to these authorities, see CRS Insight IN11696, *Climate Change, Slow-Onset Disasters, and the Federal Emergency Management Agency*, by Diane P. Horn, Erica A. Lee, and Elizabeth M. Webster.

[49] FEMA Hazard Mitigation Assistance programs, such as the Hazard Mitigation Grant Program and the Building Resilient Infrastructure and Communities (BRIC) program, can potentially provide funding for mitigation of drought-related damage. See CRS Insight IN11515, *FEMA Pre-Disaster Mitigation: The Building Resilient Infrastructure and Communities (BRIC) Program*, by Diane P. Horn and CRS Insight IN11733, *Recent Funding Increases for FEMA Hazard Mitigation Assistance*, by Diane P. Horn. Note that FEMA uses the term *mitigation* rather than adaptation, defining mitigation as "any sustained action to reduce or eliminate long-term risk to people and property from natural hazards and their effects".

Monitoring and Research

Congress has directed federal agencies to support forecasting, warning, monitoring, and related research activities. The primary federal agency with such responsibilities is NOAA. According to the agency, NOAA's drought-related monitoring responsibilities primarily fall under several authorities, including the following:

- National Climate Program Act (P.L. 95-367, as amended)
- Global Change Research Act of 1990 (P.L. 101-606)
- Weather Service Modernization Act of 1992 (P.L. 102-567)
- National Integrated Drought Information System Act of 2006 (P.L. 109-430, as amended)
- Weather Research and Forecasting Innovation Act of 2017 (P.L. 115-25, as amended)

Under these authorities, NOAA supports drought-related observations, data, forecasts, modeling, research, products, and services for use across the agency, as well as by other federal agencies, tribal, state, and local governments, and individuals. NOAA's observations and data come from several sources, including geostationary and polar-orbiting weather satellites, historical climate records and reconstructions, and direct on-the-ground field observations.[50] Resulting products and services contribute to global, national, and regional drought-related indexes, the U.S. Drought Monitor, Drought.gov, and large-scale reports (e.g., National Climate Assessment and IPCC reports), among others.[51] As discussed above, NOAA's NIDIS program is the federal government's primary drought-related research and communication hub and serves as a coordinating mechanism for federal drought-related monitoring and research.[52]

USDA also carries out monitoring and research activities related to drought. In addition to its role providing direct support, USDA conducts research and data collection related to drought and water supply, such as drought-tolerant crop varieties, evapotranspiration modeling, drought-resilient management techniques and practices, and soil moisture capacity and retention.[53] Many of these research projects and programs are collaborative efforts with other federal and state agencies and with universities. For example, USDA's Snow Survey and Water Supply Forecasting Program (SSWSF) conducts snow surveys and develops water supply forecasts for western states. USDA's Natural Resources Conservation Service administers the program, using over 900 automated data collection sites in NRCS's Snow Telemetry (SNOTEL) network.[54] Another USDA monitoring network, the Soil Climate Analysis Network, takes hourly readings of soil moisture content at over 200 stations. The data collected at both SSWSF and SNOTEL sites are used to make water supply forecasts.

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[50] NOAA, "NOAA Drought: Science, Observations, and Services," July 15, 2021, PowerPoint presentation.

[51] NOAA, "NOAA Drought: Science, Observations, and Services," July 15, 2021, PowerPoint presentation.

[52] For more information on NOAA monitoring and research activities, contact Eva Lipiec, Analyst in Natural Resources Policy.

[53] For more information on USDA research activities, see CRS Report R40819, *Agricultural Research: Background and Issues*, by Genevieve K. Croft, or contact Genevieve Croft, Specialist in Agricultural Policy.

[54] The Snow Survey and Water Supply Forecasting Program is authorized under 26 Stat. 653, as amended, and Reorganization Plan No. IV, as a provision of the Reorganization Act of 1939, as amended (54 Stat. 1234). For more information on this program and the Natural Resources Conservation Service (NRCS's) Snow Telemetry network, see USDA, NRCS, "Snow Program Overview," at https://www.nrcs.usda.gov/wps/portal/wcc/home/aboutUs/snowProgramOverview/.

Other federal agencies with authorities related to drought monitoring and research include the U.S. Geological Survey (USGS), National Aeronautics and Space Administration, and the Bureau of Reclamation.[55] For example, USGS maintains a network of streamgages across the United States. Streamgage information is a key component of the weekly U.S. Drought Monitor maps and classifications.[56] Multiple federal agencies also work together to support research and monitoring under NIDIS, NDRP, and other partnerships, depending on the issue area. For example, the 2019 NIDIS Reauthorization Act (P.L. 115-423) directed the NOAA Administrator to develop a strategy for a national coordinated soil moisture monitoring network. The strategy was released in June 2021.[57] As part of the strategy, NIDIS, NOAA, USGS, and USDA have supported a joint research effort to develop and share near-real-time soil moisture information.[58]

USDA Drought Support Programs for Farmers and Ranchers[59]

Although many factors (e.g., pest infestation, flooding, hail) can pose major production challenges to farmers, drought is the most significant agricultural risk in the United States in terms of production and income loss.[60] Due to the complex way in which plants and livestock respond to heat and water availability, the effect of drought on crops and livestock can be highly variable depending on what is being produced, how, and where. For example, dryland farms with shallow soils may experience a significant loss in production during a moderate drought, whereas irrigated production with ample groundwater may experience negative impacts only during an extreme drought.[61] Soil structure and soil moisture retention, as well as access to ground or surface water, also can heavily influence the level of agricultural production loss from drought.

Congress has authorized support for farmers and ranchers to manage drought risk, pay for losses caused by drought, and incentivize adaptive measures. USDA administers these federal assistance programs, which include direct payments for loss, subsidized insurance, cost sharing to rehabilitate damaged lands, loans, and financial and technical assistance to implement conservation practices. Most programs have permanent authorization and aim to assist producers recovering from production, financial, and physical loss related to or caused by natural disasters, such as drought. Each program has a different administrative process for producers requesting assistance. Only the loan programs require a disaster declaration or designation for eligibility

[55] For more information about ongoing and planned drought-related data collection and integration activities at these agencies, see NDRP, *Priority Actions Supporting Long-Term Drought Resilience*, 2019, pp. 3-7, at https://www.hsdl.org/?view&did=829959 and Drought.gov, "Partners," at https://www.drought.gov/about/partners.

[56] See U.S. Drought Monitor, "Drought Classification," at https://droughtmonitor.unl.edu/About/AbouttheData/DroughtClassification.aspx. For more information about USGS streamgages, see CRS Report R45695, *U.S. Geological Survey (USGS) Streamgaging Network: Overview and Issues for Congress*, by Anna E. Normand, or contact Anna Normand, Analyst in Natural Resources Policy.

[57] See *A Strategy for the National Coordinated Soil Moisture Monitoring Network*, June 2021, at https://www.drought.gov/documents/strategy-national-coordinated-soil-moisture-monitoring-network.

[58] Drought.gov, "NationalSoilMoisture.com," at https://www.drought.gov/data-maps-tools/nationalsoilmoisturecom.

[59] For additional information on the USDA disaster assistance programs, see CRS Report RS21212, *Agricultural Disaster Assistance*, by Megan Stubbs; and CRS Report R42854, *Emergency Assistance for Agricultural Land Rehabilitation*, by Megan Stubbs.

[60] Steven Wallander, Elizabeth Marshall, and Marcel Aillery, "Farms Employ Strategies to Reduce Risk of Drought Damages," USDA, Economic Research Service, *Amber Waves*, June 5, 2017, at https://www.ers.usda.gov/amber-waves/2017/june/farmers-employ-strategies-to-reduce-risk-of-drought-damages/. Hereinafter, Wallander, Marshall, and Aillery, "Drought Damages."

[61] Wallander, Marshall, and Aillery, "Drought Damages."

(discussed further in "Loans," below).[62] USDA programs that do not provide direct financial support for agricultural producers are discussed in "Other Drought Authorities: Support for Nonfederal Drought Planning and Projects," below.

Direct Payments

Some USDA programs provide payments to cover production losses above normal mortality. Advance sign-up and fees are not required to participate; however, application deadlines exist following a qualified loss. These programs are permanently authorized and receive mandatory funding amounts of "such sums as necessary."[63] USDA's Farm Service Agency (FSA) administers the following direct payment programs, for which producers may file applications through local FSA offices.[64]

- **Livestock Forage Disaster Program (LFP).** LFP provides payments to eligible livestock producers who suffered a loss of grazing forage for covered livestock due to drought on privately owned or cash-leased pastureland (including cropland planted specifically for grazing).[65] A county's U.S. Drought Monitor intensity level and the drought severity and duration trigger payment. LFP payments for drought are equal to 60% of the monthly feed cost for all covered livestock for up to five months, depending on the drought's severity. For producers who sold livestock because of drought conditions, the payment rate is equal to 80% of the estimated monthly feed cost.
- **Livestock Indemnity Program (LIP).** LIP provides payments to eligible livestock owners and contract growers for livestock deaths in excess of normal mortality caused by adverse weather. Drought is not an eligible adverse weather event, except when associated with anthrax, a disease that may occur because of drought and directly results in the death of eligible livestock.[66]
- **Emergency Assistance for Livestock, Honey Bees, and Farm-Raised Fish Program (ELAP).** ELAP provides payments to producers of livestock, honeybees, and farm-raised fish as compensation for losses due to disease, adverse weather, feed or water shortages, or other conditions not covered under LIP or LFP. ELAP may cover the cost of transporting water but not the cost of water.
- **Tree Assistance Program (TAP).** TAP makes payments to qualifying orchardists and nursery tree growers to replant or rehabilitate trees, bushes, and vines damaged by natural disasters, including excessive wind and qualifying drought.

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[62] For additional information on the USDA disaster assistance programs, see CRS Report RS21212, *Agricultural Disaster Assistance*, by Megan Stubbs; and CRS Report R42854, *Emergency Assistance for Agricultural Land Rehabilitation*, by Megan Stubbs.

[63] The four direct-payment programs are authorized under Section 1501 of the Agricultural Act of 2014, as amended (P.L. 113-79; 7 U.S.C. §9081). For additional information on the four programs, see CRS Report RS21212, *Agricultural Disaster Assistance*, by Megan Stubbs.

[64] To find a local Farm Service Agency (FSA) office, see https://offices.sc.egov.usda.gov/locator/app.

[65] Fire is also an eligible cause of loss on rangeland managed by a federal agency.

[66] Anthrax is caused by *Bacillus anthracis*, a spore-forming bacterium that can survive in the soil for decades. Hoofed animals (e.g., cattle, goats, sheep) are the main animals affected by this disease. Outbreaks usually occur after periods of drought followed by heavy rains. Spores can become concentrated on the soil surface and on vegetation, where foraging animals can become exposed to the disease. For additional information, see American Veterinary Medical Association, "Anthrax Facts," December 4, 2001, at https://www.avma.org/anthrax-facts.

Insurance programs generally cover losses in crop production (see "Insurance," below).

U.S. Drought Monitor and USDA Programs

The U.S. Drought Monitor is a map that identifies areas of drought and drought intensity using four levels of drought intensity (see "Drought Classification"). Congressional interest in the U.S. Drought Monitor has grown in recent years, as additional U.S. Department of Agriculture (USDA) program benefits have become tied to it. Below are examples of how both Congress and USDA have increasingly relied on the U.S. Drought Monitor as a mechanism for triggering drought assistance in USDA programs.

- Beginning in 2003, USDA used the U.S. Drought Monitor to determine state and county eligibility to distribute nonfat dry milk surplus stocks for livestock feed in areas experiencing extreme or exceptional drought (D3 or D4 classifications).
- In the Food, Conservation, and Energy Act of 2008 (2008 farm bill; P.L. 110-246), Congress required that specific drought intensity classifications published in the U.S. Drought Monitor be used as triggers for payments under the Livestock Forage Disaster Program (LFP). Subsequent reauthorizations of LFP have retained this funding mechanism and reliance on the U.S. Drought Monitor.
- In 2012, USDA amended the secretarial disaster designation process used to trigger emergency farm loans (see "Loans") by creating an expedited process—referred to as a *fast-track designation*—for severe drought situations. This fast-track process is based on drought intensity levels from the U.S. Drought Monitor. The process has allowed USDA to issue secretarial disaster designations very quickly during periods of severe drought (D2 or higher), expediting access to aid and reducing reporting requirements at the Farm Service Agency (FSA) office level.
- The Agriculture Improvement Act of 2018 (2018 farm bill; P.L. 115-334) amended the Conservation Reserve Program (CRP; see "Conservation") to allow emergency haying and grazing on selected CRP acres when a county is experiencing drought classified as severe (D2) or greater.
- In the FY2020 Further Consolidated Appropriations Act (P.L. 116-94), Congress repurposed funding for the Wildfires and Hurricanes Indemnity Program to cover losses related to drought, among other loss types. Drought-related losses must have occurred in counties with a D3 (extreme) or D4 (exceptional) classification in calendar years 2018 and 2019.

Sources: USDA, FSA, "Sale of Surplus Non-fat Dry Milk," fact sheet, April 2003, at https://www.fsa.usda.gov/Internet/FSA_File/nfdm03.pdf; USDA, FSA, "Disaster Designation Process," 77 *Federal Register* 41248, July 13, 2012; and CRS In Focus IF11539, *Wildfires and Hurricanes Indemnity Program (WHIP)*, by Megan Stubbs.

Insurance

USDA administers two insurance programs that offer subsidized or federally supported insurance coverage for yield, revenue, or other financial losses associated with production of eligible crops and livestock. Coverage is available for adverse weather conditions, including natural disasters, and, in some cases, market declines. Most policies consider drought and related conditions, such as extreme heat and irrigation water supply failure, eligible causes of losses. Coverage is available for *catastrophic* losses—losses in excess of 50% of normal yield. Higher coverage levels may be purchased for less severe losses (referred to as *buy-up* coverage).[67] Policies must be purchased prior to a disaster event, and producers must purchase or renew coverage on an annual basis. These programs are permanently authorized and have mandatory funding authority.

- **Federal Crop Insurance Program (FCIP).** FCIP offers farmers the opportunity to purchase insurance coverage against financial losses caused by various perils,

[67] Buy-up coverage is available in increments of 5% through the Federal Crop Insurance Program (FCIP) to cover between 50% and 85% of a crop and through the Noninsured Crop Disaster Assistance Program (NAP) to cover between 50% and 65% of a crop. For example, a NAP policy with buy-up coverage of 60% would insure losses greater than 40% of the expected yield and provide no coverage for losses amounting to less than 40% of expected yield.

including certain adverse growing and market conditions.[68] Crop insurance is available for most major crops, many specialty crops (e.g., fruit, tree nut, vegetable, and nursery crops), forage and pastureland for livestock producers, and revenues from dairy and livestock production. USDA's Risk Management Agency administers the program, and approved private insurance companies sell and service federal crop insurance policies. Producers must contact their crop insurance agents to file a claim following a loss.[69]

- **Noninsured Crop Disaster Assistance Program (NAP).** NAP provides coverage for crops and in locations where FCIP insurance is unavailable.[70] NAP applicants must pay an administrative fee at the time of application, plus any additional cost for buy-up coverage. FSA administers NAP, and producers must notify their local FSA office following a loss.

Cost-Share Assistance

Some USDA programs pay a percentage of the cost to reinstall conservation infrastructure or rehabilitate damaged land. Advance sign-up generally is not required. However, the programs will not pay for impairments existing before the disaster event. FSA administers the following cost-share programs, for which producers may file applications through local FSA offices. These programs are permanently authorized but subject to appropriations.[71]

- **Emergency Conservation Program (ECP).** ECP assists landowners in restoring land used in agricultural production damaged by a natural disaster and in implementing emergency water-conservation measures in severe drought periods. Eligible activities may include providing emergency water for livestock and existing permanently installed irrigation systems for orchards and vineyards.
- **Emergency Forest Restoration Program (EFRP).** EFRP provides cost-share assistance to private forestland owners to repair and rehabilitate damage caused by natural disasters, including drought, on nonindustrial private forestland. Eligible practices may include removing debris and replanting to restore forest-related damage from drought.

Loans

USDA can provide low-interest loans to help producers recover from production or physical losses due to drought and other natural disasters, or it can provide temporary loan relief for existing FSA farm loans. These loan options are triggered when a county is designated as a disaster area under a presidential major disaster declaration, a presidential emergency declaration pursuant to the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act; 42

[68] FCIP is authorized by the Federal Crop Insurance Act, as amended (P.L. 96-365; 7 U.S.C. §§1501 et seq.). For more information on FCIP, contact Stephanie Rosch, Analyst in Agriculture Policy, or see CRS Report R46686, *Federal Crop Insurance: A Primer*, by Stephanie Rosch.

[69] To locate an approved insurance provider, visit https://prodwebnlb.rma.usda.gov/apps/AgentLocator/#/.

[70] NAP is authorized under Section 196 of the Federal Agriculture Improvement and Reform Act of 1996, as amended (P.L. 104-127; 7 U.S.C. §7333). For additional information on NAP, see CRS Report RS21212, *Agricultural Disaster Assistance*, by Megan Stubbs.

[71] The cost-share assistance programs are authorized under Title IV of the Agricultural Credit Act of 1978 (P.L. 95-334; 16 U.S.C. §§2201-2206). For additional information on the programs, see CRS Report R42854, *Emergency Assistance for Agricultural Land Rehabilitation*, by Megan Stubbs.

U.S.C. §§5121 et seq.), or a USDA secretarial disaster designation. Although Stafford Act declarations related to drought are uncommon, USDA issues a secretarial disaster designation very quickly during periods of severe drought under a fast-track process in accordance with U.S. Drought Monitor intensity (see text box on "U.S. Drought Monitor and USDA Programs," above). FSA administers the loan programs, and local FSA offices accept applications. USDA loan programs are subject to appropriations.[72]

- **Emergency Farm Loans.** Loans may help producers recover from production and physical losses.[73] A qualified applicant can borrow up to 100% of actual production (e.g., loss of a crop) or physical losses (e.g., repairing or replacing damaged or destroyed structures or replanting permanent crops, such as orchards). Loan totals may not exceed $500,000. A producer must operate in a county declared eligible or in a contiguous county and must meet the loan requirements.
- **Disaster Set-Aside.** A producer with an existing FSA farm ownership or operating loan located in a designated disaster area or contiguous county may apply to set aside one payment to allow the operation to continue.[74] The payment set-aside is not forgiven and must be repaid prior to final maturity of the note. Any principal set-aside will continue to accrue interest until repaid.

Conservation

Certain USDA conservation programs that are not emergency programs may provide assistance during drought periods to help alleviate drought's impacts on agricultural production.[75] In many cases, this assistance comes through the use of waivers and flexibility provided to the Secretary of Agriculture. Other assistance is offered through adaptive measures that reduce drought risk through various management decisions and practices, which are not discussed in detail in this report.[76]

- **Conservation Reserve Program (CRP).** CRP uses mandatory funding to provide annual payments to agricultural producers to take highly erodible and environmentally sensitive land out of production and install resource-conserving practices for 10 or more years.[77] Haying and grazing may occur on CRP acres

[72] For more information on USDA loan programs, see CRS Report R46768, *Agricultural Credit: Institutions and Issues*, by Jim Monke.

[73] Emergency farm loans are authorized under Title III of the Consolidated Farm and Rural Development Act, as amended (7 U.S.C. §§1961 et seq.) For more information, see USDA, FSA, "Emergency Farm Loans," at https://www.fsa.usda.gov/programs-and-services/farm-loan-programs/emergency-farm-loans/index.

[74] The Disaster Set-Aside Program is authorized under Section 331A of the Consolidated Farm and Rural Development Act, as amended (7 U.S.C. §1981a). For more information see, USDA, FSA, "Disaster Set-Aside Program," fact sheet, August 2019, at https://www.fsa.usda.gov/Assets/USDA-FSA-Public/usdafiles/FactSheets/2019/disaster-set-aside-program-factsheet-19.pdf.

[75] For additional information on USDA conservation programs generally, see CRS Report R40763, *Agricultural Conservation: A Guide to Programs*, by Megan Stubbs.

[76] Examples of *adaptive measures* include soil health practices—such as no till or reduced tillage, cover crop adoption, and conservation crop rotations—that can increase soil organic matter over time and reduce soil moisture loss. Adoption of irrigation efficiency practices—such as variable-rate irrigation, flow meters, land leveling, and soil moisture sensors—generally reduces evaporation and runoff loss but also may impact ground water infiltration and downstream water availability. For additional information on USDA adaptation activities, see CRS Report R46454, *Climate Change Adaptation: U.S. Department of Agriculture*, coordinated by Genevieve K. Croft.

[77] The Conservation Reserve Program (CRP) is authorized under Title XII of the Food Security Act of 1985, as

under emergency and nonemergency conditions. Emergency haying and grazing of CRP acres is generally authorized during periods of severe drought (D2 or higher, according to the U.S. Drought Monitor) or similar natural disaster (e.g., wildfire).[78] Outside of the primary nesting season, up to 90 days of grazing or one cutting of hay is allowed.[79] During the primary nesting season, emergency grazing is allowed in approved counties, but at half the normal carrying capacity and only if LFP payments also have been triggered for the county. Emergency haying is not allowed on CRP acres during the primary nesting season. Not all CRP practices are eligible for haying and grazing; a request must be filed with the local FSA office before any activity begins.

- **Environmental Quality Incentives Program (EQIP).** EQIP is a voluntary program that uses mandatory funding to provide financial and technical assistance to agricultural producers to address natural resource concerns on agricultural and forestland.[80] In the past, USDA has announced special EQIP sign-ups for farmers and ranchers in hurricane-, flood-, or drought-affected areas. EQIP also may be used to proactively mitigate potential damage from natural disasters through conservation practices (e.g., residue management to improve the soil's capacity to be more drought resilient). NRCS administers EQIP, and applications may be filed at any local NRCS office.

Drought and Federal Facilities[81]

The federal government owns and operates thousands of dams as well as other infrastructure; some of this infrastructure supports water supplies. These facilities' operations, particularly the water stored in reservoirs at federal dams, can both assist in meeting water supply needs during droughts and be vulnerable to droughts. Federal dams, particularly in the West, were constructed in part to provide multiyear storage to help with variations in seasonal and annual precipitation.

The majority of large-scale federal water resource projects are owned and managed by the two principal federal water resource agencies: Reclamation and USACE. The discussion herein focuses on the federal dams that form storage reservoirs operated by these two federal agencies. **Figure 6** shows the Reclamation and USACE reservoirs with capacities greater than 25,000 acre-

amended (P.L. 99-198; 16 U.S.C. §§3831-3835). For additional information on CRP emergency haying and grazing, see USDA, FSA, "CRP Haying and Grazing: Emergency and Non-Emergency Use," fact sheet, May 2021, at https://www.fsa.usda.gov/Assets/USDA-FSA-Public/usdafiles/FactSheets/crp_haying_grazing_factsheet.pdf.

[78] Emergency haying and grazing status is reviewed every Thursday using the U.S. Drought Monitor. Approved counties are listed on the FSA "Emergency Haying and Grazing" website, at https://www.fsa.usda.gov/programs-and-services/conservation-programs/conservation-reserve-program/emergency-haying-and-grazing/index.

[79] The *primary nesting season* is established in each state as the nesting season for birds in the local area that are economically significant, in significant decline, or conserved in accordance with federal or state law (7 C.F.R. §1410.2). For a list of primary nesting dates and durations, see USDA, FSA, "Primary Nesting Season Dates and Duration," June 16, 2020, at https://www.fsa.usda.gov/Assets/USDA-FSA-Public/usdafiles/Conservation/PDF/Primary%20Nesting%20Season_June_16_2020.pdf.

[80] The Environmental Quality Incentives Program (EQIP) is authorized under Title XII of the Food Security Act of 1985, as amended (P.L. 99-198; 16 U.S.C. §§3839aa-3839aa-7). For additional information on EQIP, see USDA, NRCS, "Environmental Quality Incentives Program," at https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/eqip/.

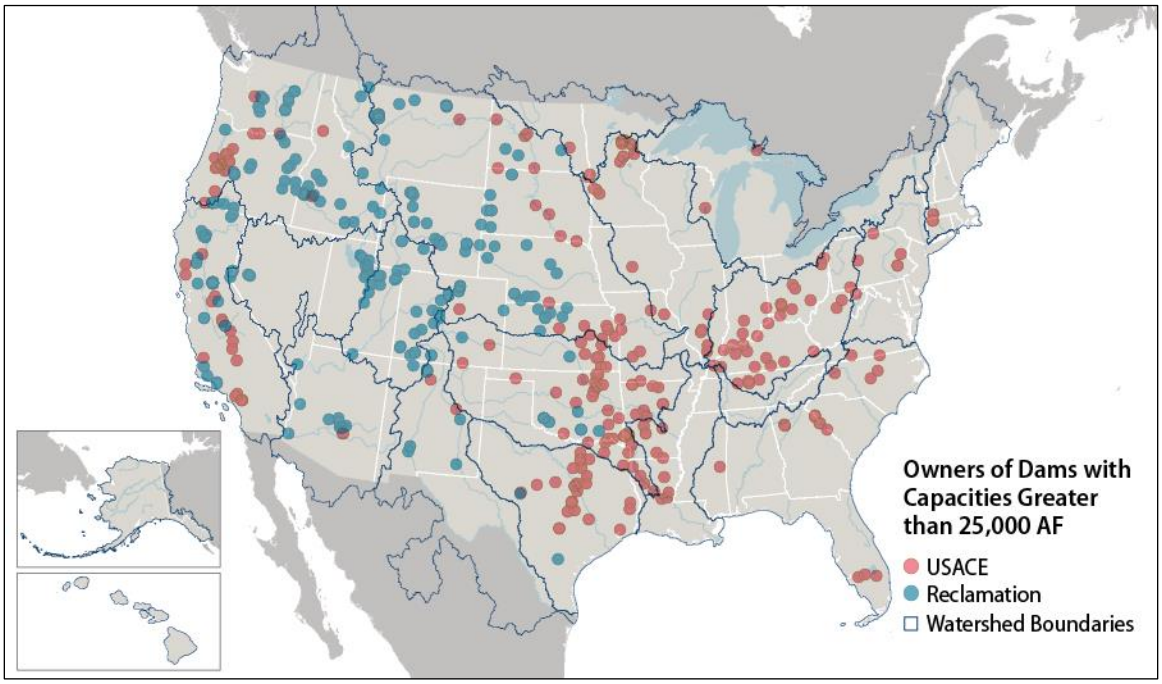
[81] For more information on the Bureau of Reclamation, contact Charles V. Stern, Specialist in Natural Resources Policy. For more information on USACE, contact Nicole T. Carter, Specialist in Natural Resources Policy. For more information on the Endangered Species Act, contact Pervaze A. Sheikh, Specialist in Natural Resources Policy.

feet (AF) that are identified as having water supply or irrigation among their operational purposes.[82] Federal reservoirs are distributed across the conterminous United States; in some watersheds and states, particularly in the West, federal reservoirs and related infrastructure are prevalent and play a significant role in storing and delivering water supplies.

Reclamation is a central player in water resource management in the West. It maintains 491 dams and other water supply infrastructure in the 17 arid and semi-arid western states (known as *reclamation states*), as defined in statute.[83] Reclamation's facilities serve over 31 million people in the West and deliver a total of nearly 30 million AF of water annually. During droughts, these facilities face operational challenges and particular scrutiny, in part due to conflicting priorities among users of the water that Reclamation facilities supply.

Figure 6. Selected Bureau of Reclamation and U.S. Army Corps of Engineers Dams with Water Supply and/or Irrigation Purposes

(dams with storage capacities greater than 25,000 acre-feet)



Source: CRS, using data from the National Inventory of Dams (NID) and U.S. Geological Survey watershed boundaries.

Notes: AF = Acre-Feet (see footnote 82 for more information); USACE = U.S. Army Corps of Engineers; Reclamation = U.S. Bureau of Reclamation. As discussed in the report, municipal and industrial water supply and

[82] An acre-foot of water is equal to the volume of a sheet of water 1 acre in area and 1 foot in depth, equivalent to 43,560 cubic feet of water.

[83] An 1890-1896 drought coincided with a period in U.S. history of federal encouragement of large-scale efforts to irrigate the relatively arid western states. At that time, Congress debated a larger federal role in western states' irrigation. This debate led to the Reclamation Act of 1902, which was enacted largely to "reclaim the arid West." The federal government constructed hundreds of dams, reservoirs, and related facilities to provide water to local farmers to reclaim the arid West through irrigation of arid lands. Today, Reclamation is responsible for managing and developing many of the large federal dams and water diversion structures in the 17 coterminous states west of the Mississippi River (referred to as *reclamation states*): Arizona, California, Colorado, Idaho, Kansas, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Oregon, South Dakota, Texas, Utah, Washington, and Wyoming. For more information, see CRS Report R46303, *Bureau of Reclamation: History, Authorities, and Issues for Congress*, by Charles V. Stern and Anna E. Normand.

irrigation water storage generally are not primary purposes of USACE projects and instead are associated with multipurpose USACE projects. This figure refers to Reclamation and USACE as the dam owners for consistency with NID classifications, although Reclamation and USACE dams are ultimately owned by the federal government.

In contrast, USACE facilities operate throughout the United States and typically have not focused on water supply storage as a principal project purpose; instead, water supply storage is often a secondary purpose of multipurpose USACE facilities. Sustained hydrological drought nonetheless affects operations of USACE-managed reservoirs, dams, locks, hydroelectric facilities, and other components of the nation's water infrastructure. For example, numerous USACE reservoirs have drought management plans that result in the curtailing of some benefits (e.g., navigation, hydropower) to maintain other benefits (e.g., in-stream flows to support water quality, aquatic species, and river withdrawals for electric power cooling and municipal and industrial water supplies).

Federal facilities' ability to deliver water supplies can be curtailed during the low inflow and storage conditions accompanying droughts. In the past, Congress has conducted oversight of federal facilities' ongoing operations and has been active in several other areas related to federal reservoirs and drought, including the following:

- Providing authorities and funding to expand western water storage.
- Enacting authorities related to updating operating plans for reservoirs during drought.
- Supporting developments in the area of forecast-informed reservoir operations (FIRO) and other efforts to enhance the data used to inform operations decisions.
- Allowing for regulatory relief, in some instances, for federal water resource project operations during drought.

Expanding Western Water Storage

Reclamation

Some long-term federal drought response authorities support the construction of new or expanded water storage projects in drought-prone areas. During the 2012-2016 California drought, Congress created a new authority for Reclamation to build water storage in Section 4007 of the Water Infrastructure Improvements for the Nation Act (WIIN Act; P.L. 114-322).[84] The authority provided federal support for the construction of new and augmented surface water storage projects in the 17 reclamation states.

Funding for water storage projects under Section 4007 is available for two primary project types. Federally owned storage projects (surface water or groundwater storage projects to which the United States holds title and which were authorized to be constructed pursuant to reclamation law and regulations) may be no more than 50% federally funded. State-led storage projects (surface water or groundwater storage projects constructed, operated, and maintained by states or political subdivisions) may be no more than 25% federally funded. Prior to the WIIN Act, Congress had not authorized Reclamation to fund state-led water storage projects.

Before the federal government can spend or contribute funding for the construction of new water projects under this authority, several criteria must be met:

[84] For more information on these projects, see CRS In Focus IF10626, *Reclamation Water Storage Projects: Section 4007 of the Water Infrastructure Improvements for the Nation Act*, by Charles V. Stern.

- The Secretary of the Interior must find that the project is feasible and provides benefits proportionate to the federal government's cost share, and project sponsors must agree to pay their portions of project costs up front.
- Appropriations under the Section 4007 authority are available only after (1) the Secretary of the Interior transmits a list of recommended projects and funding levels to Congress and (2) Congress designates those projects by name in an enacted appropriations act.

Congress has approved Reclamation's project-level allocations of this funding for 13 projects in three states (California, Idaho, and Washington). Most of this funding was for studies, and Reclamation also recommended six projects for construction under this authority. Apart from advocating for additional appropriations, some support extension and/or changes to Section 4007.[85]

USACE

Water supply storage typically is not a principal project purpose of USACE-constructed facilities in the United States. In December 2020, Congress authorized USACE to carry out certain water storage projects,[86] including for water supply and water conservation. The authority allowed USACE to undertake construction of (1) new water storage projects with capacities between 2,000 AF and 30,000 AF or (2) enlargements between 1,000 AF and 30,000 AF of existing storage; the authority established cost-sharing requirements based on the purpose of storage. This authority has not been funded, and USACE has not released implementation guidance for how the agency would act on this authority if funded. In the same 2020 legislation, Congress directed USACE to provide the congressional authorizing committees, within 18 months of enactment, a report that analyzes the benefits and consequences of including water supply and water conservation as a primary mission of USACE in carrying out water resources development projects.[87]

Drought Operations Manuals and Planning

Reclamation

Reclamation projects typically are governed by operating plans.[88] There is no formal requirement for Reclamation to formally revise these plans with drought contingency plans (DCPs)—guidance on how the project is to be operated during droughts. Most Reclamation contracts with water users include provisions that allow Reclamation to restrict deliveries due to water shortages and other drought-related factors, which allows for some level of operational flexibility during drought.[89] Reclamation has authority to enter into drought contingency plans; in Section 202 of the Reclamation States Emergency Drought Relief Act of 1991 (P.L. 102-250), Congress

[85] For additional information on congressional proposals related to this authority, see below section, "Drought Legislation in the 117th Congress."

[86] Section 155 of WRDA 2020 (Division AA of P.L. 116-260). The provision limits federal project costs to $65 million and specifies that municipal and industrial costs are 100% nonfederal and agricultural water supply is 35% nonfederal.

[87] WRDA 2020, Section 221.

[88] In accordance with Section 7 of the Flood Control Act of 1944 (33 U.S.C. §709), USACE has formal responsibility for preparing water control manuals for reclamation projects with storage space allocated for flood control purposes.

[89] See Bureau of Reclamation, "Water-Related Contracts and Charges – General Principles and Requirements," Reclamation Manual PEC P05, July 24, 2013, at https://www.usbr.gov/recman/pec/pec-p05.pdf.

authorized the bureau to prepare or participate in the preparation of cooperative drought contingency plans, for the prevention or mitigation of adverse effects of drought conditions,[90] but Congress did not specify the level of these projects. In practice, the bureau has supported contingency plans developed by nonfederal interests (for more information, see below section, "Bureau of Reclamation WaterSMART Program: Drought Response and Other Authorities"). In part to facilitate Reclamation's ability to adapt its operations to changes in water supplies and demand, in 2009 Congress enacted Section 9503(c) of the SECURE Water Act (P.L. 111-11). This directed Reclamation to identify and assess potential water-related risks of climate change in major reclamation river basins and to report on these efforts at five-year intervals.[91] Reclamation published reports pursuant to the SECURE Water Act in 2011, 2016, and 2021.[92] These reports, coupled with complementary reporting in the form of West-wide climate and hydrology assessments and individual river basin reports, highlight Reclamation's analysis and expectations for altered water supply and demand at a variety of geographical levels.

The SECURE Water Act also authorized Reclamation to undertake actions to address climate change risks. The act authorized Reclamation to use specific strategies, including those related to (1) modification of reservoir storage or operating guidelines; (2) development of new water management, operating, or habitat restoration plans; (3) water conservation; (4) improved hydrologic models and other decision support systems; and (5) groundwater and surface water storage needs.[93] One way Reclamation has used these authorities is by conducting a number of reservoir operations pilot studies at specific locations in the 17 reclamation states; these studies seek to identify operational improvements in response to variable water supplies, including droughts. Beginning in 2015, Reclamation conducted five pilot studies.[94] In June 2021, Reclamation announced another six pilot studies in five western states.[95] Initial studies employed various approaches, including the increased use of paleohydrology, advanced monitoring, and forecast-informed operations, among others (for more information on forecast-based operations, see "Forecast-Informed Reservoir Operations" below).

USACE

USACE maintains water-control manuals that detail how reservoirs are to be operated given their congressionally authorized purposes. Since the late 1970s, USACE regulations have required USACE projects that maintain controlled reservoir storage to have a DCP. The DCP informs water management decisions and responses to drought-related water shortages in a basin. Because of uncertainties such as when a drought will end, DCPs generally specify a minimum suite of actions related to water control and allow for additional actions as the specific situation warrants (e.g., approval of deviations from operating plans).[96]

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[90] 43 U.S.C. §2222.

[91] 42 U.S.C. §10363.

[92] For more information and individual reports, see https://www.usbr.gov/climate/secure/2021secure.html.

[93] 42 U.S.C. §10363.

[94] For more information, see Reclamation, "Reservoir Operations Pilots," at https://www.usbr.gov/watersmart/pilots/index.html.

[95] For more information, see Reclamation, "FY2021 Reservoir Operations Pilots—Round 1 Selections," at https://www.usbr.gov/watersmart/pilots/docs/FY21-ResOps-R1ProjectDescriptions.pdf.

[96] A *deviation* is the operation of a USACE project in a manner other than specified in the approved water control manual or its associated drought contingency plan (DCP). A detailed assessment is required prior to the execution of a deviation. Since 2015, USACE has maintained a drought portal for its staff, which has expanded to include a collection of DCPs, more than 300 approved deviations, and other drought-relevant materials. Due to portal access limitations,

In 2015, after an internal assessment of the state of USACE drought contingency planning and an effort to develop methods to update DCPs to account for a changing climate, USACE released a report titled *USACE Drought Contingency Planning in the Context of Climate Change*.[97] The report reviewed the 142 existing DCPs for USACE projects, the majority of which were developed prior to 1993, and noted that "none of the DCPs reviewed include information about drought projections under future climate change. Consequently, it is unlikely that these reports provide an adequate guide for preparing for future droughts that may be longer and more intense than recognized by these DCPs."

In 2018, USACE updated the 1981 regulation that guided the development and updating of DCPs.[98] The 1981 regulation used the standard engineering practice of preparing DCPs based on observed periods of record for temperature, precipitation, and drought. The 2018 regulation identified actions that "at a minimum" its planners and engineers should do for purposes of incorporating climate change considerations into DCP development, including the consideration of regional variables. It remains unclear how much recent DCP efforts have accomplished toward enhancing drought preparedness at USACE projects nationally.

Congress provided USACE with authorities related to reservoir management for drought and water conservation activities in the last decade.[99] According to USACE, limited to no action has occurred under these authorities due to a lack of funding or interest from nonfederal partners.[100] One exception is activity under the authority of Section 1116 of the WIIN Act, which authorized USACE to study and perform water conservation measures at USACE reservoirs in certain states that had declared droughts. USACE used this authority to evaluate and approve conservation measures at Prado Dam, Riverside County, CA, for the purpose of downstream nonfederal groundwater recharge efforts.[101]

Water supplies for communities and agriculture receive much attention during droughts, but USACE also makes drought-related adjustments to meet its navigation mission at times. For example, during the 2012 drought, USACE maintained navigation on the Mississippi River and its tributaries (albeit in a narrower and shallower channel than is available in a normal water year) using a combination of measures: dredging of critical areas, removal of rock pinnacles, and releases of reservoir water within authorized purposes.

CRS was unable to assess the location or frequency of drought-related deviations for different USACE projects or for specific watersheds.

[97] USACE, *USACE Drought Contingency Planning in the Context of Climate Change*, CWTS Report 15-15, September 2015, at https://usace.contentdm.oclc.org/digital/collection/p266001coll1/id/6727. The report team identified and assessed 142 DCPs covering 301 projects.

[98] USACE, *Drought Contingency Plans*, ER 1110-2-1941, February 2, 2018.

[99] These authorities include provisions in the Water Resources Reform and Development Act of 2014 (WRRDA 2014; P.L. 113-121) and the Water Infrastructure Improvements for the Nation Act (WIIN Act; P.L. 114-322). In WRRDA 2014, Section 1045, Congress authorized a USACE assessment of the effects of drought conditions on lakes managed by the Secretary of the Army that are affected by Federal Energy Regulatory Commission-licensed reservoirs. In Section 1046, Congress authorized a USACE assessment of the management practices, priorities, and authorized purposes at USACE reservoirs in arid regions to determine the effects on water supply of periods of drought, among other things. In WIIN Section 1117, Congress authorized USACE, at the request of a governor, to prioritize updating the water control manuals for USACE operated and maintained water control structures in certain states with declared droughts and to incorporate into the updates seasonal operations for water conservation and water supply.

[100] Personal communication from USACE staff to CRS staff, July 8, 2021.

[101] Personal communication from USACE staff to CRS staff, July 8, 2021.

Forecast-Informed Reservoir Operations

Federal dam operators have often used runoff measurements and other observations (e.g., snowpack or soil moisture) to inform decisions related to storing or releasing water. In some cases, operators are considering also using forecasts to inform inflow estimates. Advancements in weather forecasting, in particular in detection and forecasting of atmospheric rivers,[102] have increased decisionmakers' interest in identifying opportunities to use forecasts for more dynamic dam operations.[103] That is, operations would move from rules that use a single estimate of runoff to rules for making operational decisions based on ensembles of runoff (or streamflow) forecasts and statistical techniques to simulate conditions and operations. This reservoir management approach, referred to as forecast-informed reservoir operations, or FIRO, uses data from watershed monitoring and from weather and water forecasting to inform water management decisions to retain or release water from reservoirs.

Researchers and agencies have applied early FIRO efforts to reservoirs in California and the Pacific Northwest, where atmospheric rivers often are significant contributors to precipitation. A challenge of using FIRO to adjust reservoir operations is that although atmospheric rivers may alleviate drought, they also can cause floods. Reservoir managers must balance maintaining reservoir storage space to capture floodwaters during wet periods with storing water supplies to meet demands during dry periods. Multiple factors can affect how forecasts translate into reservoir inflows. Various federal agencies have worked together on a limited number of pilot projects, including one applying FIRO at USACE's Lake Mendocino in California's Russian River Basin.[104] The facility is a USACE dam that provides flood control and stores water for municipal and agricultural water supplies. The pilot project's researchers documented the viability of FIRO operations using 15-day ensemble streamflow forecasts to enhance water supply while not significantly hampering flood risk reduction.[105] USACE has temporarily approved the use of FIRO for Lake Mendocino and is pursuing a permanent change to the reservoir's operations manual. The temporary deviation allows additional water to be stored in Lake Mendocino during the winter rainy season, with the goal of improving drier-season water supply reliability and environmental conditions in the Russian River without harming the reservoir's flood management function.

Reclamation and USACE also incorporated forecasts into a 2018 update to their joint *Folsom Dam Water Control Manual*.[106] Pursuant to the manual, the federal water managers use

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[102] *Atmospheric rivers* are a flowing corridor of concentrated water vapor in the atmosphere that can contribute to significant rainfall or snow upon landfall. According to NOAA, atmospheric rivers on average contribute between 30% and 50% of annual precipitation on the along the West Coast of the continental United States. For more information, see NOAA, *What Are Atmospheric Rivers?*," at https://www.noaa.gov/stories/what-are-atmospheric-rivers.

[103] In addition to expressing interest in using forecasts, Congress has supported the expansion of the collection and use of observed data in informing reservoir operations and other flood and drought risk preparedness activities in some basins. For example, in 2014 and 2020, Congress authorized actions to improve soil moisture and snowpack monitoring in the Upper Missouri River Basin (P.L. 113-121, §4003(a); WRDA 2020 §511).

[104] Ongoing FIRO research efforts are underway for Prado Dam, CA; the Yuba-Feather River System, CA; and Howard Hanson Dam, WA. The Lake Mendocino FIRO research effort featured involvement by NOAA, Reclamation, USACE, state and local agencies, and academics.

[105] Jay Jasperse et al., *Lake Mendocino: Forecast Informed Reservoir Operations Final Viability Assessment*, December 2020, at https://escholarship.org/uc/item/3b63q04n. The report states, "Because each watershed and location is unique, the analysis, results, and conclusions of the [final viability assessment] are only applicable to Lake Mendocino."

[106] Although the updated *Folsom Dam Water Control Manual* has some FIRO characteristics, USACE indicates that FIRO research was not explicitly used in the revision to the manual (personal communication from USACE staff to

continuous five-day forecasts available for that region of California to identify plausible flows into the reservoir to assess operational release requirements.

How widely and how quickly benefits of forecast-informed operations may assist in drought preparedness remains an area of active interest and ongoing research. Current federal research efforts focus on understanding the influence of site characteristics and other factors on the forecasting of atmospheric rivers, which may help in identifying opportunities and limitations of applying FIRO to other reservoir sites. Enhanced soil moisture and snowpack monitoring also may inform adjustments in reservoir operations and other drought responses, especially for regions with water regimes less influenced by atmospheric rivers.[107] In late 2020, Congress directed the Secretary of the Army to produce a report identifying additional opportunities for applying forecast-informed reservoir operations across the United States.[108]

Drought Flexibilities and the Endangered Species Act

Some federal and nonfederal water infrastructure projects in the United States operate under requirements of the Endangered Species Act (ESA; 16 U.S.C. §§1531-1544).[109] Operational plans and ESA regulations often result in water projects maintaining a certain level of water in the ecosystem, such as in-stream flows below a dam, for species listed as threatened or endangered under the ESA. Under drought conditions, this practice can lead to disagreements among stakeholders vying for scarce water supplies. Water projects that might affect listed species or their habitat undergo consultation under Section 7 of the ESA. The consultation results in a *biological opinion* (BiOp), issued by either the U.S. Fish and Wildlife Service (FWS) or the National Marine Fisheries Service (NMFS), that governs project operations. Some project BiOps include policy mechanisms to maximize water supplies for users during drought while continuing to conserve listed species. These mechanisms include the use of adaptive management (AM), real-time management of water supplies, artificial propagation of listed species (e.g., hatcheries), and habitat restoration.

Projects use AM to provide flexibility during drought conditions. AM is the process of incorporating new scientific and programmatic information into the implementation of a project or plan to ensure the activity's goals are reached efficiently. AM promotes adaptable decisionmaking that modifies existing activities and/or creates new activities if new circumstances arise (e.g., new scientific information) or projects are not meeting their goals. Under drought conditions, AM provisions in a project's BiOp might allow federal agencies to address the conservation needs of a listed species while still accomplishing project purposes. In some cases, the operations of water infrastructure have used AM to account for changes in environmental conditions that were not contemplated in a BiOp. In these cases, the agency may

CRS staff, July 8, 2021).

[107] For an example, see footnote 104.

[108] WRDA 2020, Section 157. Also in Section 157 of WRDA 2020, Congress directed that the report include an assessment of the viability of FIRO in two basins—Upper Missouri River and North Platte River. Congress authorized the Secretary to implement FIRO at reservoirs in the two basins. Congress required that if these operations are found to be viable, the Secretary, subject to the availability of appropriations, shall implement FIRO for at least one reservoir in each of basin. The report, which was due in December 2021, had not been delivered to Congress as of publication of this report.

[109] For more information on the Endangered Species Act (ESA; 16 U.S.C. §§1531-1544), see CRS Report R46677, *The Endangered Species Act: Overview and Implementation*, by Pervaze A. Sheikh, Erin H. Ward, and R. Eliot Crafton; and CRS Report R46867, *Endangered Species Act (ESA) Section 7 Consultation and Infrastructure Projects*, by Erin H. Ward, R. Eliot Crafton, and Pervaze A. Sheikh.

seek concurrence from either FWS or NMFS to perform temporary modifications to the BiOp's implementation.

Some BiOps allow for "real-time" management (i.e., management based on changing conditions) of water projects under certain circumstances, including drought, to maximize water supplies for users or address immediate threats to species. This approach allows managers to alter project operations in real time to respond to changing conditions. For example, pursuant to the 2019 BiOp for the coordinated operations of the Central Valley Project (CVP) and the State Water Project in California, project pumping operations may adhere to certain preestablished levels, unless findings from real-time monitoring of threatened Delta smelt trigger changes that aim to conserve the species. Congress authorized this approach for CVP operations under Section 4001 of the WIIN Act. At the time, supporters generally endorsed the provisions as short-term measures to alleviate the effects of the ongoing drought in California on users.[110]

Other Drought Authorities: Support for Nonfederal Drought Planning and Projects

In addition to the aforementioned federal activities and programs, multiple federal agencies have programmatic authorities to support non-federally led projects related to drought. Some of these authorities are discussed below.

Bureau of Reclamation WaterSMART Program: Drought Response and Other Authorities[111]

In recent years, Congress has enacted multiple new authorities for Reclamation to support nonfederal efforts to conserve water. In contrast to Reclamation's traditional activities, there is typically no federal ownership role associated with projects supported by these authorities. As with Reclamation's other authorities, the new authorities mostly limit activities to the 17 reclamation states defined in statute.[112] Reclamation combines funding for its programs promoting water conservation into a single program—the WaterSMART (Sustain and Manage American Resources for Tomorrow) program. Programs under WaterSMART with direct ties to drought are discussed below.

The Drought Response Program (DRP) is Reclamation's only program specifically dedicated to addressing drought. The DRP assists water managers develop and implement comprehensive drought plans and related projects that build long-term drought resiliency. Specific sub-program areas of the DRP include Contingency Planning, Resiliency Projects, and Emergency Response Actions. In an effort to incentivize advanced planning and mitigation, Reclamation directs the majority of DRP funding to the first two sub-program areas. According to Reclamation, the bureau funds DRP planning and resiliency projects sequentially, when possible. First, it funds planning for communities to learn how droughts will affect them, as well as to scope potential projects to reduce the impacts of the next drought. Subsequently, it prioritizes grant funding for resiliency projects identified through the planning process. Generally, Reclamation supports resiliency projects that attempt to either (1) increase the reliability of water supplies by providing additional alternatives during drought (e.g., constructing new infrastructure, such as intakes or

[110] For additional information about these provisions, see CRS Report R44986, *Water Infrastructure Improvements for the Nation (WIIN) Act: Bureau of Reclamation and California Water Provisions*, by Charles V. Stern, Pervaze A. Sheikh, and Nicole T. Carter.

[111] For more information on these programs, contact Charles Stern, Specialist in Natural Resources Policy.

[112] 43 U.S.C. §391.

groundwater banking facilities) or (2) improve water management by providing entities with tools and decision support (e.g., improved modeling, access to water markets). Both contingency planning and resiliency efforts include a 50/50 cost share with local sponsors.

Reclamation reserves a small amount of DRP funding for emergency response actions, as authorized in the Reclamation States Drought Relief Act of 1991 (P.L. 102-250). Eligible projects include temporary construction activities (e.g., temporary pipes and pumps) and other actions authorized under Title I of the act (e.g., water purchases, use of Reclamation facilities to convey and store water) that can be completed within a year. Reclamation conducts emergency response actions through contracts rather than through the provision of financial assistance, and approval of these actions is subject to a number of other requirements, such as a state or tribal drought declaration.[113]

Other WaterSMART programs also have the potential to lessen drought impacts, including by supporting some means of alternative water supplies, increased efficiency, and/or water resources conservation. For example, the Title XVI Program provides cost-shared financial assistance for authorized nonfederal studies and construction projects that provide supplemental water supplies by recycling or reusing agricultural drainage water, wastewater, brackish surface and groundwater, and other sources of contaminated water. Similarly, Reclamation's Desalination Program provides federal financial support for selected nonfederal desalination projects that Congress has approved. Although project selection processes for both programs prioritize drought resiliency (among other criteria), they do not formally prioritize funding for drought-stricken areas. Generally, projects under the Title XVI Program and the Desalination Program take years to construct.

Several WaterSMART programs promote water conservation and related efforts and therefore provide benefits that may increase drought resiliency. For instance, WaterSMART Grants provide cost-shared federal funding for projects in multiple categories, including water and energy efficiency grants, small-scale water efficiency grants, and water marketing strategy grants. Separately, Reclamation's Basin Study Program supports efforts to address imbalances between water supply and demand in western river basins through applied science tools, guidance, and information to support water management planning. Reclamation's Cooperative Watershed Management Program provides funding to watershed groups to encourage stakeholders to find local solutions to water management needs. Most of these programs require some form of cost sharing from nonfederal sponsors to leverage federal funding, and most include caps on the amount of federal assistance.[114]

Congress also has authorized targeted grant programs to combat drought and add *system water* through conservation efforts in drought-stricken river basins.[115] For example, in the Lower Colorado River Basin,[116] the Pilot System Conservation Program (part of the Lower Basin's Drought Contingency Plan) provides funding for voluntary conservation projects and reductions of water use; water conserved from these projects is applied toward storage in Lake Mead, one of

[113] This requirement applies only to entities without an approved DCP. For more information on emergency drought assistance requirements, see Reclamation, "Request for Emergency Drought Assistance Checklist," WTR 10-01, Appendix C, at https://www.usbr.gov/recman/wtr/wtr10-01-AppC.pdf.

[114] For more information on these and other Reclamation programs supporting nonfederal water supplies and planning, see Reclamation, "WaterSMART," at https://www.usbr.gov/watersmart/.

[115] *System water* refers to water that is provided to increase water supplies as a whole, without being directed toward additional consumptive use for specific contractors or water users.

[116] For more information about ongoing drought in the Colorado River Basin and federal response efforts, see CRS Report R45546, *Management of the Colorado River: Water Allocations, Drought, and the Federal Role*, by Charles V. Stern and Pervaze A. Sheikh.

the basin's two large storage reservoirs. Congress authorized this funding in the Energy and Water Development and Related Agencies Appropriations Act, 2015 (P.L. 113-235) and has since stipulated that this authorization is a subset of the aforementioned WaterSMART Grants authorization under Section 9504(e) of the SECURE Water Act.

USDA Programs and Authorities

Rural Utilities Service[117]

USDA's Rural Utilities Service (RUS) provides grants and loans for rural community and household water systems. Some of these programs are tailored for emergency situations, whereas others may prioritize loans and grants for rural communities and households facing drought-related declines in water quantity or quality. For RUS programs, *rural communities* are often defined as those with populations of fewer than 10,000 residents. The RUS programs that may assist in addressing drought-related rural water issues include the following:

- **Water and Waste Disposal Grants and Loans**.[118] The Rural Water and Waste Disposal Program supports construction and improvements to rural community water systems (i.e., drinking water, sanitary sewage, solid waste disposal, and storm drainage facilities). Although most of these funds are provided to assist with rural community water and waste systems broadly, systems affected by drought may receive a priority.
- **Emergency and Imminent Community Water Assistance Grants**.[119] This program provides grants specifically to rural water systems experiencing an emergency resulting from a significant decline in the quantity or quality of drinking water. A federal disaster declaration is not required to participate in this program.
- **Rural Decentralized Water Systems Grant Program**.[120] This program provides grants to nonprofit organizations, which provide loans or grants to eligible individuals for refurbishing household water-well systems in rural areas. Eligible rural areas include rural areas or towns with populations of less than 50,000 residents. Sub-loans or sub-grants are to be made to individuals with low or moderate incomes. Some of this program's funds may be used to assist drought-affected households.

Natural Resources Conservation Service[121]

USDA's Natural Resources Conservation Service (NRCS) provides assistance for watershed activities under four closely related authorities. Most of these programs pay a percentage of the cost to install infrastructure or correct impairments, and they require a local project sponsor. The

[117] For more information about the Rural Utilities Service, contact Lisa Benson, Analyst in Agricultural Policy.

[118] For additional information, see USDA, Rural Development, "Water and Waste Disposal Loan and Grant Program," at https://www.rd.usda.gov/programs-services/water-waste-disposal-loan-grant-program.

[119] For additional information, see USDA, Rural Development, "Emergency Community Water Assistance Grants," at https://www.rd.usda.gov/programs-services/emergency-community-water-assistance-grants.

[120] For additional information, see USDA, Rural Development, "Rural Decentralized Water Systems Grant Program," at https://www.rd.usda.gov/programs-services/rural-decentralized-water-systems-grant.

[121] For more information on NRCS programs, contact Megan Stubbs, Specialist in Agricultural Conservation and Natural Resources Policy.

programs are permanently authorized but subject to appropriations. Applications may be filed at any local or state NRCS office.[122]

- **Watershed and Flood Prevention Operations (WFPO) Program.** The WFPO program consists of two authorities—the Watershed Protection and Flood Prevention Act of 1954 (P.L. 83-566) and the Flood Control Act of 1944 (P.L. 78-534). These acts authorize NRCS to provide technical and financial assistance to state and local organizations to plan and install measures to prevent erosion, sedimentation, and flood damage and to conserve, develop, and use land and water resources.[123]
- **Watershed Rehabilitation Program.** The Watershed Rehabilitation Program provides technical and financial assistance for planning, design, and implementation to rehabilitate aging watershed dam projects (including upgrading or removing dams) in communities to address health and safety concerns. Only dams constructed under the WFPO program are eligible.[124]
- **Emergency Watershed Protection (EWP) Program.** The EWP program assists local project sponsors in implementing emergency recovery measures for runoff retardation and erosion prevention to relieve imminent hazards to life and property created by natural disasters, including drought. For example, the program can be used to reseed drought-stricken areas that would be prone to erosion and could pose a threat to life or property.[125]

USACE Emergency Water Supplies[126]

In 1974, Congress provided USACE with authority (33 U.S.C. 701n) to assist with emergency water supplies (e.g., bulk or bottled water) and their transport when state resources are exceeded and a public health threat is imminent.[127] USACE provides assistance only to meet any minimum public health and welfare requirements that cannot be met in the immediate future by state or local actions or through reasonable conservation measures. USACE assistance may include various activities, some of which must be reimbursed (i.e., 100% nonfederal expenses) and some at full federal expense (i.e., 100% federal), as follows:

- Purchase or acquisition of the water and the storage facility at the terminal point and permanent water facilities are reimbursable expenses (i.e., 100% nonfederal)
- USACE well construction costs are reimbursable expenses (i.e., 100% nonfederal)

[122] To find a local NRCS office, see https://offices.sc.egov.usda.gov/locator/app.

[123] For additional information on the Watershed and Flood Prevention Operations Program, see CRS Report R46471, *Federally Supported Projects and Programs for Wastewater, Drinking Water, and Water Supply Infrastructure*, coordinated by Jonathan L. Ramseur.

[124] The Watershed Rehabilitation Program is authorized under Section 313 of the Grain Standards and Warehouse Improvement Act of 2000 (P.L. 106-472) and Section 14 of the Watershed Protection and Flood Prevention Act, as amended (16 U.S.C. §1012). For more information, see CRS Report R46471, *Federally Supported Projects and Programs for Wastewater, Drinking Water, and Water Supply Infrastructure*, coordinated by Jonathan L. Ramseur.

[125] The Emergency Watershed Protection Program is authorized under Title IV of the Agricultural Credit Act of 1978 (P.L. 95-334; 16 U.S.C. §2203) and 33 U.S.C. §701b-1. For additional information on the program, see CRS Report R42854, *Emergency Assistance for Agricultural Land Rehabilitation*, by Megan Stubbs.

[126] For more information on these authorities, contact Nicole Carter, Specialist in Natural Resources Policy.

[127] This authority cannot be used for the provision of water for livestock, irrigation, recreation, or commercial/industrial use. Eligible entities are limited to drought-distressed political subdivisions, farmers, and ranchers.

- Water transport costs are nonreimbursable expenses (i.e., 100% federal)

A governor, a governor's representative, or the governing body of a tribe must make a written request for assistance to USACE. The USACE Director of Civil Works or the Assistant Secretary of the Army (Civil Works) makes the determination that an area has an inadequate water supply that is causing, or is likely to cause, a substantial threat to the health and welfare of the area's inhabitants. Funding for actions pursuant to this authority is provided through the USACE Flood Control and Coastal Emergencies Account. In most years, USACE does not receive requests to use this authority; it has used the authority most often to assist tribes with emergency drinking water issues. USACE also has the authority to contract for limited quantities of water (if available) from its reservoirs for municipal and industrial purposes.

U.S. Environmental Protection Agency Programs[128]

Improving public water system resilience to droughts and other events that may disrupt the provision of a safe and reliable water supply has been a focus of congressional attention. Congress has established programs administered by EPA that provide financial assistance to public water systems for projects that help ensure the provision of a safe and reliable water supply. Further, several provisions of the Safe Drinking Water Act (SDWA; 42 U.S.C. §300j-12) promote water systems' preparedness for, and resilience to, events that may disrupt water service (e.g., natural hazards, malevolent acts).[129]

Drinking Water State Revolving Fund[130]

In 1996, Congress established the Drinking Water State Revolving Fund (DWSRF) program to provide financial assistance to public water systems for infrastructure projects needed to comply with federal drinking water regulations and protect public health.[131] Projects that aim to increase water system drought resilience through the development of a new or alternative drinking water source(s) and through the construction or rehabilitation of water storage are eligible for DWSRF financial assistance.[132]

Congress annually appropriates DWSRF program funding, which EPA uses to make annual grants to states to capitalize their drinking water state revolving loan funds. Every year, each state must match 20% of its annual capitalization grant and develop an intended-use plan for the allotted funds. The SDWA requires states to give funding priority to projects that address the most serious human health risks; are necessary to ensure regulatory compliance; and assist systems most in

[128] For more information on these programs, contact Elena Humphreys, Analyst in Environmental Policy.

[129] 42 U.S.C. §§300f et seq. For a discussion of Safe Drinking Water Act (SDWA; 42 U.S.C. §300j-12) risk and resilience assessments and emergency response planning requirements, see CRS In Focus IF11777, *Safe Drinking Water Act (SDWA): Water System Security and Resilience Provisions*, by Elena H. Humphreys.

[130] For more information about the Drinking Water State Revolving Fund (DWSRF), see CRS Report R45304, *Drinking Water State Revolving Fund (DWSRF): Overview, Issues, and Legislation*, by Mary Tiemann.

[131] The Safe Drinking Water Act Amendments of 1996 (P.L. 104-182 P.L. 104-182), Section 130, added the DWSRF provisions (§1452) to the SDWA. The Clean Water Act (CWA) authorized complementary financial assistance programs to help publicly owned treatment works achieve CWA compliance and other statutory purposes. The Clean Water State Revolving Fund (CWSRF) provides financial assistance for infrastructure projects to publicly owned treatment works and other eligible recipients (33 U.S.C. §§1381-1387). Water recycling and/or reuse projects and other projects eligible for CWSRF financial assistance may reduce the use of potable water for irrigation or other activities and may increase drinking water supplies. The key purpose of DWSRF financial assistance is to support projects that the Environmental Protection Agency (EPA) has determined through guidance will facilitate compliance with SDWA.

[132] EPA, *Drinking Water State Revolving Fund Eligibility Handbook*, EPA 816-B-17-001, June 2017.

need on a per household basis, according to state affordability criteria. Depending on the applicants' project types and the state's individual circumstances, a state may prioritize DWSRF assistance for drought resilience projects, such as alternative water projects to replace diminished or contaminated water sources. The primary type of DWSRF financial assistance are low-interest-rate loans. SDWA Section 1452 authorizes states to provide additional subsidization (including forgiveness of principal) to disadvantaged communities.[133] The federal capitalization grants, together with state funds (e.g., state match, loan repayments, leveraged bonds, and other state sources), are intended to build a sustainable source of drinking water infrastructure funding.

Water Infrastructure Finance and Innovation Act[134]

The Water Resources Reform and Development Act of 2014 (P.L. 113-121) authorized the Water Infrastructure Finance and Innovation Act (WIFIA) program to promote development of and private investment in water infrastructure projects.[135] WIFIA authorized EPA and USACE to provide credit assistance in the form of secured or direct loans for a range of water infrastructure projects.

The range of eligible projects for the EPA-administered WIFIA program is broader than for the DWSRF program or for the analogous Clean Water State Revolving Fund program, which provides financial assistance for publicly owned treatment works. WIFIA-eligible drinking water projects include those projects eligible for DWSRF financial assistance and other projects that may support drought resilience, such as through the following activities:

- Desalination.
- Aquifer recharge or development of alternative water supplies to reduce aquifer depletion.
- Water recycling and/or reuse.
- Mitigation, prevention, or reduction of the effects of drought.

Entities eligible for WIFIA assistance include (1) state infrastructure financing authorities; (2) corporations; (3) partnerships; (4) joint ventures; (5) trusts; and (6) federal, state, local, or tribal governments or instrumentalities. WIFIA establishes broad selection criteria that EPA uses to rank projects, including a project's national or regional significance with respect to economic and public benefits, creditworthiness, and readiness.

Each year that Congress appropriates funds to cover subsidies for WIFIA loans, EPA publishes a Notice of Funding Availability (NOFA) to provide interested entities with WIFIA application information. In each NOFA, EPA identifies considerations for project prioritization (e.g., repairing aging infrastructure). For FY2021, the WIFIA selection criteria included projects that "protect the nation's water infrastructure from the impacts of climate change" and new and innovative projects such as "the development of alternative sources of drinking water through, for example, desalination, aquifer recharge or water recycling, and resource recovery."[136]

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[133] SDWA §1452(d); 42 U.S.C. §300j-12(d) authorized states to provide additional subsidization to disadvantaged communities. *Disadvantaged community* is defined as the service area of a public water system that meets affordability criteria developed by the state.

[134] For more information about the Water Infrastructure Finance and Innovation Act (WIFIA) program, see CRS Report R43315, *Water Infrastructure Financing: The Water Infrastructure Finance and Innovation Act (WIFIA) Program*, by Jonathan L. Ramseur, Mary Tiemann, and Elena H. Humphreys.

[135] 33 U.S.C. §§3901-3914.

[136] EPA, "Notification of Funding for Credit Assistance Under the Water Infrastructure Finance and Innovation Act

WaterSense

Programs that identify and promote the use of water-efficient products and/or services aim to lessen the effects of drought, though not by providing financial assistance. WaterSense is a voluntary labeling program that EPA created to encourage the development and use of water-efficient products and services.[137] Through WaterSense, EPA develops water-efficiency specifications for products, certain services, and homes; licenses third-party certification bodies; and maintains a registry of WaterSense-labeled products and certified services. The 115th Congress authorized and expanded WaterSense in Section 4306 of America's Water Infrastructure Act of 2018 (P.L. 115-270).[138]

EPA has issued WaterSense specifications for categories of services and a variety of products, including residential toilets, showerheads, bathroom faucets, commercial toilets, urinals, irrigation controllers, and spray sprinkler bodies. To obtain certification to use a WaterSense label, manufacturers must develop products that meet EPA specifications. EPA states that a water-efficient product should generally (1) reduce water use by at least 20% from federally mandated water-use conservation standards and (2) function at least as well as regular models. For products without federal standards, such as irrigation equipment, WaterSense certifications are based on calculations of average efficiency. The use of water-efficient products may reduce demand for water, helping communities improve drought resilience. EPA estimates the program saved 5.3 trillion gallons of water from 2006 to 2020.[139]

Drought Legislation in the 117th Congress

Recent drought events have increased the profile of drought and have led to congressional and administrative proposals to prepare for and respond to drought's effects. Congressional interest in drought may include new and amended authorities for drought planning and response, emergency appropriations and reprogramming that could enhance existing drought-related activities, and oversight of ongoing federal efforts to address the impacts of drought. Congress also may consider additional funding and direction for existing authorities. Some legislative proposals in the 117th Congress are discussed below.

New and Amended Drought Authorities

Monitoring and Research

Some legislation introduced in the 117th Congress would direct agencies to work together on aspects of water management that could affect drought preparedness and response. For instance, provisions in H.R. 1438/S. 558 would establish an interagency coordinating committee on water management, with members from NOAA, USACE, USDA, DOI, FEMA, the National Science Foundation, the Department of Energy, EPA, the Office of Science and Technology Policy, the Council on Environmental Quality, and others, as appropriate. The committee's purpose would be to "ensure" the federal government engages in water-related matters, including water storage and

(WIFIA) Program," 86 *Federal Register* 22616, April 29, 2021.

[137] EPA established WaterSense in 2006.

[138] 42 U.S.C. §6294b.

[139] EPA, *WaterSense 2020 Accomplishments Report*, EPA-832-F-21-024, June 2021.

supplies, water infrastructure, and water forecasting, among other topics, where agencies have joint or overlapping responsibilities.

Provisions under H.R. 1438/S. 558 would also direct NOAA to collect and disseminate data and information regarding certain drought factors. For instance, one provision would direct NOAA to establish a national integrated flood information system with data on streamflow, reservoir release and diversion, precipitation, soil moisture, snow-water equivalent, land cover, and evaporative demand. The provision would require NOAA to leverage the efforts of other groups, such as NIDIS and USGS. Other provisions would direct the agency to improve precipitation frequency estimates (similar to provisions in H.R. 1437/S. 3053) and to conduct a gap analysis in the availability of snow-related data, in consultation with USDA, DOI, and USACE. These bills (as well as H.R. 2760/S. 1282) would direct NOAA to identify and support research to establish a "consistent federal set of forward-looking, long-term meteorological information that models future extreme weather events," including drought, for use by other federal and nonfederal entities in their planning efforts. Several bills would direct NOAA to support the collection of data and observations of related phenomena, such as wildfire (H.R. 5781), or of climate change and weather conditions in insular areas (H.R. 2780/S. 2613).

Other proposed legislation would direct agencies to study the effects of drought in certain geographic areas or on specific entities. For example, H.R. 3764 would direct NOAA to report to Congress on the impacts of drought, among other phenomena, on ocean, coastal, and Great Lakes ecosystems. H.R. 5477/S. 3156 would direct the Department of Commerce to develop a plan to identify and adapt to the impacts of drought, among other phenomena, on the agency's mission and to serve on an interagency council on climate-related planning and preparedness

NOAA Drought Support Programs

Several congressional proposals would amend the Secretary of Commerce's existing fisheries disaster relief authorities to explicitly include the impacts of drought. For example, provisions within H.R. 4690 and H.R. 5453/S. 2923 would direct the Secretary to determine the existence, extent, and timeframe of a fishery resource disaster due to natural causes, such as drought, in certain ways and to allocate financial assistance, among other things. The Secretary has approved disaster assistance requests related to droughts several times in the past, mostly recently in 2012 for specific oyster fisheries in the Southeast.[140]

Under other proposals (H.R. 2013/S. 873), the Secretary of Commerce would provide funds to eligible entities to support infrastructure, disaster response, and ecosystem "protection" by reducing the risks of or "enhancing resilience" to drought, among other activities. Other bills (H.R. 2872/S. 1420) also would authorize the Secretary to approve and provide funding for the implementation of state plans to maintain or enhance the ability of fish, wildlife, and plant to adapt to droughts, among other phenomena.

Federal Facilities: Western Water Supplies and Reclamation Programs

Several legislative proposals would reauthorize and/or amend existing authorities related to Reclamation and drought in the West. Several proposals have focused on extending or amending Reclamation drought provisions in the WIIN Act to address drought. Some bills (e.g., H.R. 737 and H.R. 1563) would extend the WIIN Act's California water provisions, which aimed to provide operational flexibility during drought for the nation's largest water project, the CVP (see

[140] For more information on previous fishery disaster determinations, see NOAA, "Fishery Disaster Determinations," at https://www.fisheries.noaa.gov/national/funding-and-financial-services/fishery-disaster-determinations.

"Drought Flexibilities and the Endangered Species Act, above"). Other legislation, such as H.R. 4018, also would renew the WIIN Act CVP operational provisions and would explicitly direct the Secretary of the Interior to maximize the CVP's operations by approving any projects that would provide additional water supplies and requiring operations pursuant to the 2019 CVP BiOps,[141] among other requirements. Some of these bills would also extend WIIN Act authorities to study and fund new water storage projects in the West. In addition to extensions of the aforementioned operational proposals in the WIIN Act, H.R. 737 and H.R. 1563 would extend WIIN Act provisions authorizing additional storage projects throughout the West through 2031 and 2028, respectively.

Some legislation would address multiple western water priorities, including water storage and water conservation. For example, H.R. 3404 would authorize funding in several different areas with the goal of increasing drought resiliency, including new funding for storage, water reuse and recycling, and desalination, as well as investments in improved technology and data, ecosystem restoration and protection, water job training, and other areas. S. 953 would authorize new funding for infrastructure development for water reuse and recycling and desalination projects and for ecosystem restoration and protection to support biodiversity in droughts and drought preparation for fisheries, among other priorities.

Funding for Drought Activities

Enacted Funding

In the past, supplemental appropriations legislation has provided additional funding to address drought concerns. Additional funding was enacted for these purposes in 2021. In Division J of P.L. 117-58, the Infrastructure Investment and Jobs Act (IIJA), Congress enacted funding for a number of nationwide and regional drought-related provisions. IIJA provided emergency appropriations for a number of drought-related provisions, including

- $300 million over five years to Reclamation for Colorado River Basin DCP funding.
- $80 million over five years to NOAA for high-performance computing to improve climate and weather modeling capabilities, related to drought, flood and wildfire prediction, detection, and forecasting, and $492 million over five years to NOAA for coastal and inland flood and inundation mapping and forecasting and for next-generation water modeling activities, including modernized precipitation frequency and maximum studies.
- $25 million over three years to NOAA for data acquisition and $1 million over four years for the study of a soil moisture and snowpack monitoring pilot program in the Upper Missouri River Basin.
- $40 million to USACE for Upper Missouri River Basin soil moisture and snowpack monitoring.
- $918 million over five years for NRCS watershed programs, including the WFPO, Watershed Rehabilitation, and EWP Programs.[142]

[141] For more information, see CRS Report R45342, *Central Valley Project: Issues and Legislation*, by Charles V. Stern and Pervaze A. Sheikh.

[142] For additional information, see CRS In Focus IF11990, *Infrastructure Investment and Jobs Act (IIJA): Funding for USDA Broadband, Watershed, and Bioproduct Programs*, by Lisa S. Benson, Megan Stubbs, and Kelsi Bracmort.

- $1 billion over five years for Reclamation's Title XVI water reuse and recycling program.
- $250 million over five years for Reclamation contributions to eligible desalination projects.,
- $400 million for Reclamation WaterSMART water and energy efficiency grants.

Recent congressional actions for agricultural loss assistance have centered on continuing or expanding ad hoc assistance provided through supplemental appropriations. Over the past 20 years, Congress has authorized permanent disaster assistance programs and expanded federal crop insurance and NAP policies to reduce the need for ad hoc disaster assistance (see "USDA Drought Support Programs for Farmers and Ranchers" above). In 2018, Congress funded ad hoc assistance for agricultural losses for the first time in over a decade.[143] Most of this funding was made available through the creation of the Wildfires and Hurricanes Indemnity Program (WHIP) and block grants to states.[144] Subsequent appropriations expanded WHIP to include losses from other natural disaster events, including drought in counties with a U.S. Drought Monitor classification of D3 (extreme) or D4 (exceptional) in calendar years 2018 and 2019.[145] Division B of P.L. 117-43 extended WHIP to cover losses in 2020 and 2021, added qualifying disaster events (including extreme heat), and appropriated $10 billion to remain available through 2023. Under the 2022 supplemental appropriation, qualifying losses related to drought were expanded to include counties with D2 (severe)classification for eight consecutive weeks or D3 or higher classification according to the U.S. Drought Monitor. Of the $10 billion, $750 million is to compensate livestock owners for losses in 2021 due to drought and wildfires.

P.L. 117-43 also included drought-related funding for Reclamation. The act provided Reclamation with $200 million for drought-related programs and projects (i.e., funding in addition to regular appropriations). Reclamation allocated these funds to various projects and programs in December 2021. These project-level allocations included funding for drought resiliency activities in the California Central Valley Project ($61.8 million) and the Colorado River Basin ($45.4 million), as well as $20 million for the Drought Response Program, among other things.[146]

Proposed Funding

The Build Back Better Act (BBBA; H.R. 5376) includes several provisions that would provide appropriations for drought-related activities. For example, the bill would provide NOAA in FY2022

- $50.0 million to improve weather data collection and to provide data and decision support services to reduce drought, as well as other extreme event, impacts in insular areas (§70506);
- $1.24 billion to increase the agency's understanding and predictive and forecasting capabilities of weather and climate phenomena, such as drought;

[143] The Bipartisan Budget Act of 2018 (P.L. 115-123) authorized $2.36 billion for agricultural losses in 2017.

[144] For more information on WHIP+, see CRS In Focus IF11539, *Wildfires and Hurricanes Indemnity Program (WHIP)*, by Megan Stubbs.

[145] The Additional Supplemental Appropriations for Disaster Relief Act of 2019 (P.L. 116-20) added $3 billion in funding for losses in 2018 and 2019. Section 791 of Division B of the FY2020 Further Consolidated Appropriations Act (P.L. 116-94) further amended the program by repurposing unobligated expiring WHIP+ funding, expanding eligibility, and adding program requirements.

[146] For a complete list of allocations, see Bureau of Reclamation, FY2022 - Distribution of Additional Funding in P.L. 117-43, at https://www.usbr.gov/budget/2022/FY-2022-Extending-Government-Funding-and-Delivering-Emergency-Assistance-Act-Funding-Allocation-Distribution-List.pdf.

enhance weather and other environmental observations, research, data, data assimilation, and modeling; facilitate the transition of research to operations and operations to research; acquire high-performance computing, data management, and storage assets; and develop, leverage, and use new capabilities, technologies, and instruments, among other tasks (§90014); and

- $765.0 million to support end users, such as states and territories, to make decisions and recruit, educate, and train a "climate-ready workforce" in response to climate impacts and extreme events, such as drought (§90015).

Additional provisions would provide funding for activities that could be indirectly related to drought, such as research and development infrastructure and scientific equipment.

Congress is also considering additional drought funding for Reclamation in BBBA. For example, the bill would provide Reclamation with $25 million in FY2022 for drought support for tribes (§70104); $550 million in FY2022 for water supply projects in disadvantaged communities and $50 million per year in FY2032 and subsequent years for these purposes (§70801); $100 million for large-scale water reuse projects (§70802); $100 million to mitigate the impact of reduced inflows into inland waterbodies (§70803);[147] and $25 million each for canal repair and conveyance projects and solar panel integration into these same projects (§70804).

Reprogrammed Funding

Some agencies also have reprogrammed previous appropriations and/or transferred funding internally to address drought-related priorities. For example, in February 2021, Reclamation announced $15 million in funding for drought relief at the federal Klamath Project in Oregon; this funding came from a combination of base spending, internal transfers, and the allocation of additional funding from Congress. In July 2021, Reclamation notified Congress of its intent to reprogram $100 million in prior-year appropriations toward various drought-related projects in the western United States.[148]

[147] An example of such a water body is the Salton Sea in Southern California. For additional information, see CRS Report R46625, *Salton Sea Restoration*, by Pervaze A. Sheikh and Charles V. Stern.

[148] Letter from Rachel S. Taylor, Assistant Secretary of the Interior for Policy, Management, and Budget, to Honorable Marcy Kaptur, Chairwoman, Subcommittee on Energy and Water Development, July 23, 2021.

Author Information

Charles V. Stern, Coordinator
Specialist in Natural Resources Policy

Eva Lipiec, Coordinator
Analyst in Natural Resources Policy

Lisa S. Benson
Analyst in Agricultural Policy

Nicole T. Carter
Specialist in Natural Resources Policy

Elena H. Humphreys
Analyst in Environmental Policy

Pervaze A. Sheikh
Specialist in Natural Resources Policy

Megan Stubbs
Specialist in Agricultural Conservation and Natural Resources Policy

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