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

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

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 disrupt 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 a 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 and the U.S. Geological Survey, also research and monitor drought factors and conditions.

The U.S. Department of Agriculture provides the primary federal financial aid to lessen the impacts of drought and compensate for agricultural production loss after drought onset. Other federal programs may assist with drought in their support of other water investments. For example, Congress authorized programs supporting nonfederal and tribal efforts to develop water conservation, water reuse and recycling, rural water supplies, or other municipal and industrial water supplies. Some of these programs may prioritize projects that lessen the impacts of drought even if these programs do not focus exclusively on drought.

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 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.

Recent severe droughts, including widespread drought conditions in some areas of the western United States, have raised the profile of drought and led to 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) and in P.L. 117-169 (commonly referred to as the Inflation Reduction Act of 2022). Congressional interest in drought during the 118th Congress 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

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Contents

Figures

Contacts

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 30 billion-dollar drought events since 1980, at an estimated total cost of over $309.4 billion.[1] Although droughts are generally a common component of climate variability that 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 and 2022, 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) may face difficult tradeoffs in operating federal water projects during drought; both agencies also have the authority to and conduct activities to mitigate drought impacts. Various other federal agencies, including the U.S. Environmental Protection Agency (EPA), and emergency authorities also have a role in drought response and mitigation.

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 discusses federal authorities related to drought planning and response, with a focus on selected water-related agricultural, environmental, and natural resource 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.ncei.noaa.gov/access/billions/summary-stats.

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

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

What Is Drought?

Drought is a natural hazard with significant economic, social, and ecological consequences. *Drought* broadly refers to periods of substantially below-average moisture conditions. 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* is typically the degree of dryness, in comparison to a "normal" or average amount of dryness, and the duration of a dry period. Meteorological drought is region-specific, because precipitation deficiency varies regionally.
- *Hydrological drought* reflects reduced surface and subsurface water supplies, such as streamflows, reservoir and lake levels, snowpack, and groundwater. The frequency and severity of this type of drought are measured on a watershed or river basin scale.
- *Agricultural and ecological drought* links characteristics of meteorological or hydrological drought to agricultural and ecological effects (such as plant-water-stress contributions to tree mortality), often determined using precipitation shortfalls, evapotranspiration differences,[7] soil moisture deficits, reduced groundwater or reservoir levels, and other variables.
- *Socioeconomic drought* associates the "supply and demand of some economic goods with elements of meteorological, hydrological, and agricultural drought."[8]

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]

Additionally, experts have begun to characterize drought by how quickly drought conditions develop, with some scientists using the term *flash drought* to identify rapid-onset drought

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

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

[6] 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 U.S. Geological Survey (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/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.

conditions. Flash drought is usually set in motion by precipitation deficits, accompanied by anomalously high temperatures, winds, and/or solar radiation.[10]

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 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. Drought can lead to water restrictions affecting municipal and industrial supplies, decreased hydropower generation and power plant cooling efficiency, navigation limitations and disruptions, harm to drought-sensitive ecosystems and species, and increased fire and heat wave risk, among other effects.[11]

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 at a specific location often results from a mix of various interacting atmospheric anomalies, land-atmosphere feedbacks, topographic features, and human activity, such as water use, among other forces and factors. Prolonged droughts typically occur when certain spatially and temporally large-scale anomalies in atmospheric circulation patterns persist (such as multiyear La Niña conditions contributing to drier conditions in the U.S. Southwest). These anomalies are referred to as *teleconnection patterns* and typically last several weeks to several months but also can be prominent for several consecutive years.[12] Ocean conditions contribute to some teleconnection patterns, including the El Niño-Southern Oscillation (ENSO) and the Pacific Decadal Oscillation (PDO).[13] (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.[14]

[10] Drought.gov, "What is Drought: Flash Drought," at https://www.drought.gov/what-is-drought/flash-drought.

[11] 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 118th 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.

[12] 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.

[13] 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). 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.

[14] *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.

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 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 ocean and atmospheric phenomena (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 scientific understanding of the relationship between drought and climate change is evolving. Droughts are challenging to understand, because they are shaped by interactions between natural weather and climate variability, climate change, ecosystems, and human activities (e.g., land and water development and use). Multiple researchers are evaluating the contribution of human-induced warming to observed droughts and to droughts under a warmer climate. Some researchers are attempting to identify the role that human-induced warming may have on the severity of observed droughts in specific U.S. regions such as the southwestern United States, which has a history of droughts, including megadroughts.

The U.S. Global Change Research Program (USGCRP), an entity composed of representatives from U.S. federal agencies, released its special report on the state of climate science in 2017 and its periodic national climate assessment in 2018.[15] In these reports, 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.[16]
- 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.[17]
- 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.[18]
- 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.[19]

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,[20] such as ENSO, would respond to a warming climate and therefore how those changes might affect the frequency and severity of drought.[21] In 2021, 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 2021 IPCC physical science report, see text box "Overview of the IPCC 2021 Findings on Drought in the Continental United States."[22]

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

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

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

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

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

[20] For the drought information in IPCC reports, the term *low confidence* was used for various reasons, including if there is limited evidence, which may be due to a lack of data or studies, and if there is a lack of agreement on the type of change (e.g., mixed signals).

[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*, 2021, Table 11.21, pp. 11-229 to 11-231 (hereinafter, report cited as IPCC, *AR6 Physical Science Basis*). 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.

The 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" above.

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

Regarding observations of changes in drought for North America compared to a pre-industrial baseline (1850-1900), the 2021 Intergovernmental Panel on Climate Change (IPCC) report on the physical science of climate change indicated

- *low confidence* on the type of changes to dryness relative to normal—**meteorological drought**—for both western and eastern North America, and *medium confidence* in a decrease in the duration and frequency of meteorological droughts in central North America;
- *medium confidence* in an increase in **agricultural and ecological drought** in western North America, and *low confidence* on the type of changes for agricultural and ecological drought in central and eastern North America; and
- *low confidence* for identifying changes to **hydrologic drought** for western, central, and eastern North America.

Confidence in projected future drought changes for North America with a warming climate varied by region, type of drought, and assumed temperature increase.

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, 2021, Table 11.21, pp. 11-229 to 11-231; and IPCC, "Summary for Policymakers" 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, 2021, p. 10.

Notes: According to IPCC, author teams communicated the degree of certainty in key findings by expressing the qualitative confidence about the validity of a finding and degree of agreement (levels of confidence is expressed using five qualifiers: very low, low, medium, high, and very high) or quantified measure of uncertainty expressed probabilistically (e.g., exceptionally unlikely, likely, virtually certain, etc.). For instance, the term *low confidence* was used for various reasons, including if there is limited evidence, which may be due to a lack of data or studies, and if there is a lack of agreement on the type of change (e.g., mixed signals). (Mastrandrea, et al., *Guidance Note for Lead Authors of the IPCC Fifth Assessment Report on Consistent Treatment of Uncertainties,* IPCC, July 2010)

Some researchers have undertaken efforts to calculate the contribution of human-induced warming to specific U.S. droughts (known as *attribution science*).[24] Experience with trying to

[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).

[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; A.P. Williams, et al., "Rapid intensification of the emerging southwestern North American megadrought in 2020-2021," 2022, *Nature Climate Change*, vol. 12.; 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

understand the ongoing southwestern drought and the effects of climate change has led experts to identify some ways to improve understanding of future drought risk; these include better understanding of the following:

- Effects of climate change on atmospheric behavior leading to regional precipitation patterns
- The importance of the interrelated variables that influenced the current southwestern drought and other droughts
- The impact and influence of key ocean-atmosphere interactions that influence weather and climate variability over the United States (e.g., the influence of La Niña events)
- Changes to western snowpack and the implications of these changes
- Forecast errors that impact water management decisions[25]

Drought Classification

Certain measures, often referred to as *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. These measures may depend on a single indicator or on several indicators, often combined with expert opinions 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 opinions and stakeholder information to estimate the intensity and effects of ongoing drought conditions (**Figure 1**).[26] According to NOAA, roughly 40-50 unique indicators are used to create the U.S. Drought Monitor map, but not all geographic areas are represented equally by the indicators.[27] 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. For example, the regions depicted as red in **Figure 1** faced extreme drought conditions for the week preceding January 31, 2023, but they may have contained local areas and individual communities that experienced less or more severe drought. The estimated drought intensity can be a trigger for local, state, and federal responses to 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

meteorological drought (limited evidence) and hydrological drought (mixed signal) (pp. 11-229 to 11-230).

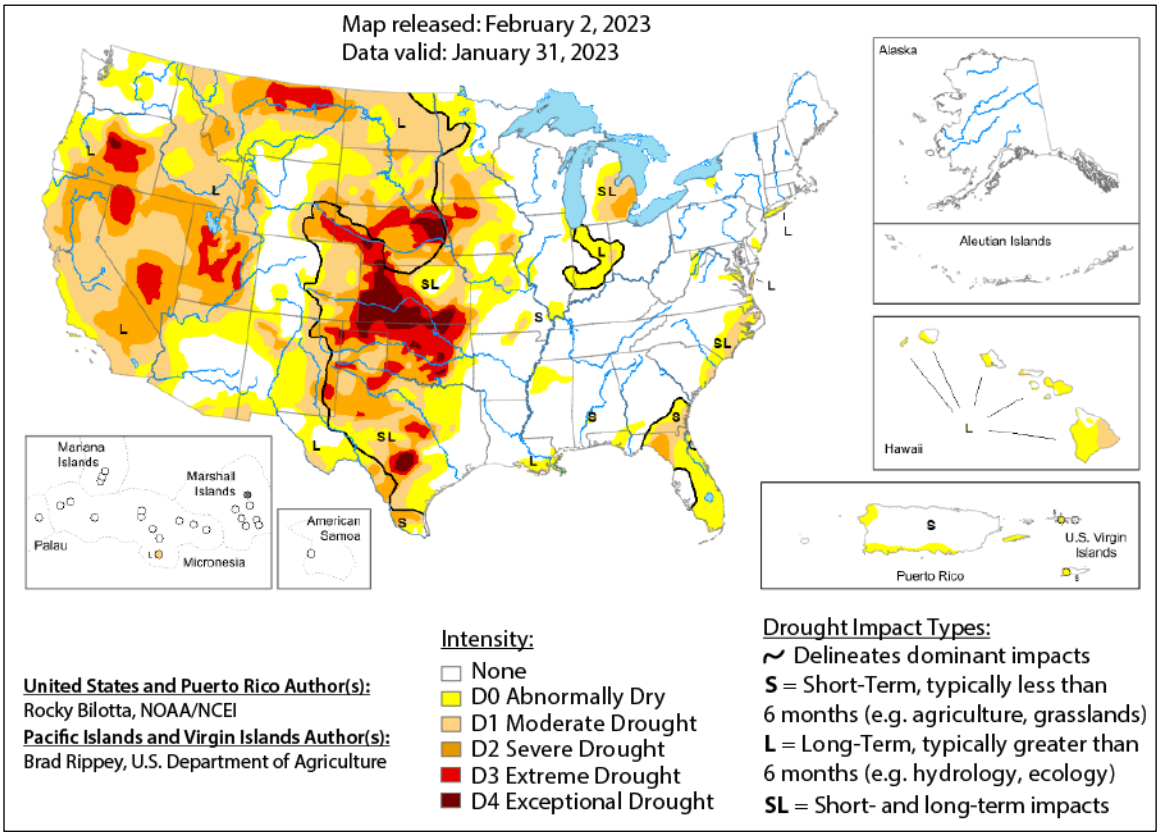
[25] NOAA Climate Program Office, *Assessment Report, 2020-2021 Southwestern U.S. Drought*, at https://cpo.noaa.gov/MAPP/DTF4SWReport#8405161-highlights.

[26] 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.

[27] 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.

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 January 2023, those regions experienced both short- and long-term impacts.

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.

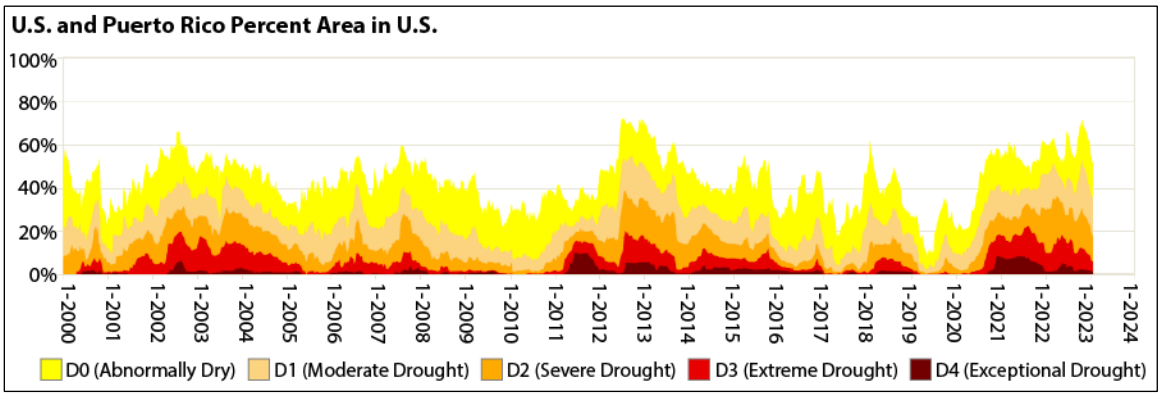
Since the U.S. Drought Monitor began in 2000, some portion of the land area of the United States has experienced drought of at least moderate intensity (D1) each year (**Figure 2**).[28] The land area affected by drought can vary widely by year and within a particular year. There is particular concern 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 every year since 2000 (**Figure 2**).[29]

[28] 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).

[29] 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 January 31, 2023)



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.

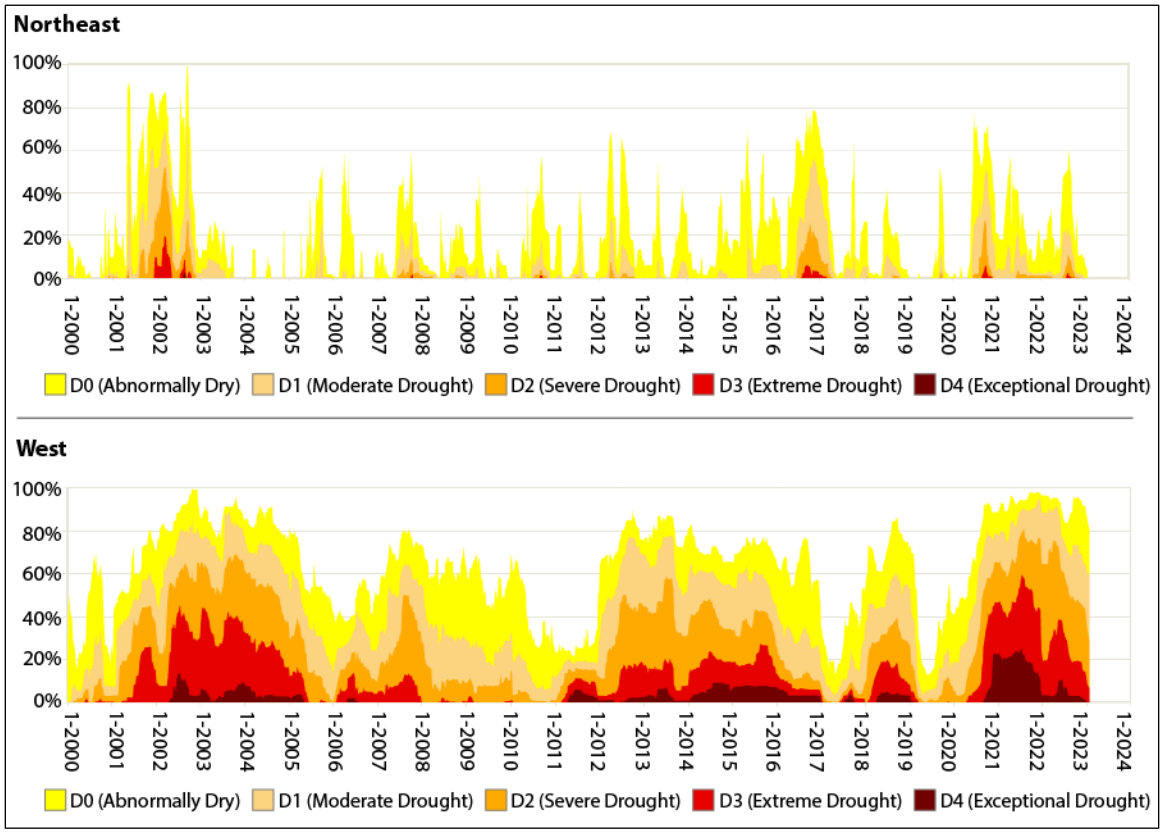
Drought may affect certain regions of the United States on a short-term or a longer-term basis, with varying intensity over time. For example, the Northeast region has rarely experienced extreme (D3) or exceptional drought (D4) since the U.S. Drought Monitor began issuing maps in 2000 (**Figure 3**).[30] In contrast, periods of extreme and exceptional drought have been relatively common since 2000 in the western region of the United States.[31]

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

[31] 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 January 31, 2023)



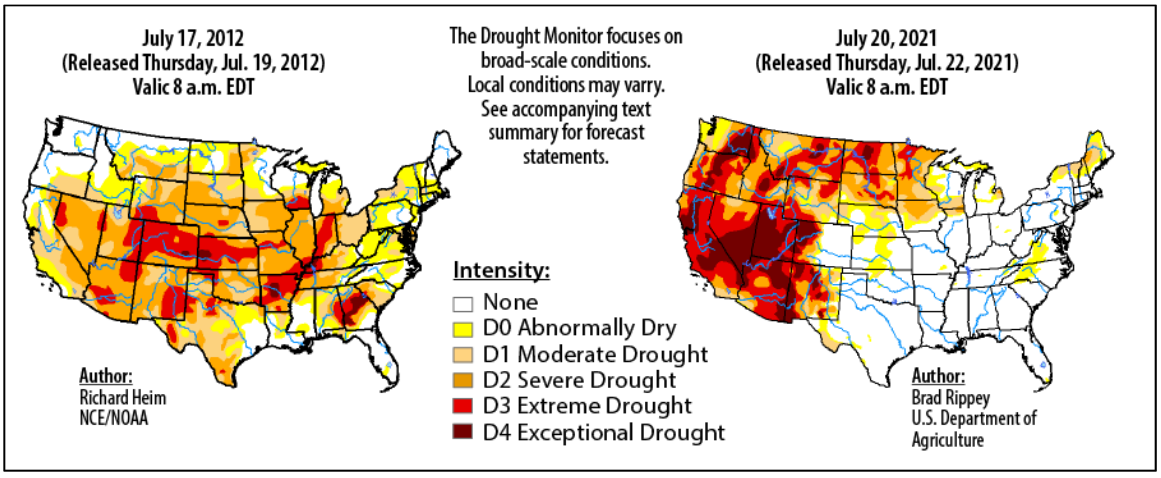
Source: U.S. Drought Monitor, "Time Series," at https://droughtmonitor.unl.edu/DmData/TimeSeries.aspx. Modified by CRS.

Notes: The Northeast region includes Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, and West Virginia. The West includes Arizona, California, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, and Washington.

Some drought conditions can stretch across the continental United States, whereas others affect only a comparatively small region. For example, **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).[32]

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

Drought Forecasts for the United States

Reliable drought forecasts depend on effectively integrating interactions of multiple variables, including surface temperature, precipitation, 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 in order to forecast drought onset, drought severity, and drought duration.

Among other issues, predicting the onset of drought remains difficult.[33] The drought onset forecasting challenge is due, in part, to limitations in accurately predicting precipitation beyond a two-week period.[34] 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.

Understanding potential changes in long-term drought 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 result in challenges for water managers and water users alike.[35]

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-range forecasts and models, and previous U.S. Drought Monitor maps.[36] The outlooks depict

[33] 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.

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

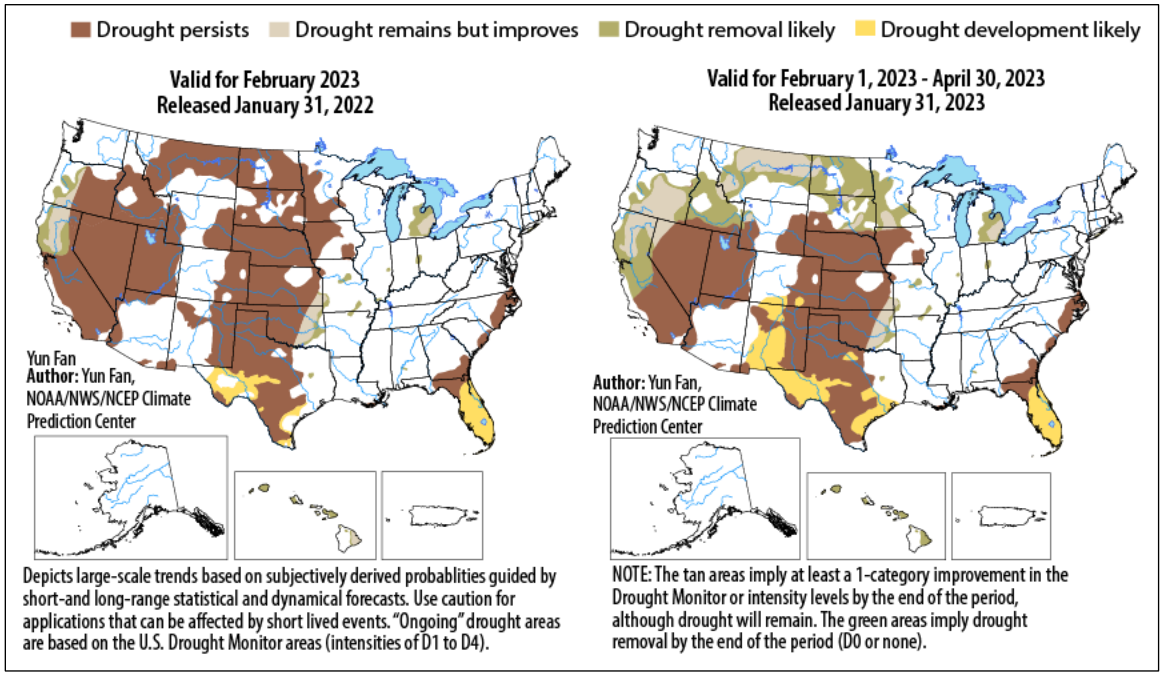
[35] P. C. D. Milly et al., February 2008, "Stationarity Is Dead: Whither Water Management?," *Science*, vol. 319, no. 5863 (February 2008), p. 574.

[36] 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

areas of the United States where drought is likely to persist, improve, or develop in the next month to several months (**Figure 5**).[37]

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

(February 2023 and February 1, 2023-April 30, 2023, respectively)



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

Federal Drought Policy and Coordination

States have primary authority to allocate surface and groundwater, with the federal government generally deferring to state primacy. As a result, 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.[38] 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 transfers. Community-level drought plans are less widespread than state plans, except in states that require or support this planning.

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.

[37] In addition, to inform stakeholders of the potential for a flash drought, NOAA had issued an experimental forecast depicting where potential flash drought could develop in the next 30 days. NOAA discontinued the forecast, but expects to release new tools and products as they become available. (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.)

[38] 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.

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.

Federal agency actions are coordinated under a variety of mechanisms, including multi-agency partnerships such as the National Integrated Drought Information System (NIDIS), the National Drought Resilience Partnership (NDRP), and the Drought Relief Interagency Working Group. 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 on 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).[39] The group collaborates with additional regional and state partners, as well.[40]

In 2013, President Obama created NDRP as a "complement" to NIDIS.[41] 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.[42] In October 2020, President Trump issued Executive Order 13956, "Modernizing America's Water Resource Management and Water Infrastructure," which tasked NDRP with implementing the "Priority Actions Supporting Long-Term Drought Resilience" document, released on July 31, 2019.[43] The document set out specific actions (for

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

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

[41] 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).

[42] "Building National Capabilities for Long-Term Drought Resilience," Section 5, 81 *Federal Register* 16053, March 25, 2016.

[43] 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

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 that may be available for impacted irrigators and tribes, undertake other activities to address drought conditions in the West, and support farmers, tribes, and communities impacted by water shortages.[44] Long-term goals include the development of measures to "respond to climate change and build more resilient communities and protect the natural environment," and a "recommitment to strengthening" NDRP.[45] The group released a one-year summary report in June 2022, which highlighted the agencies' activities in implementing drought-related provisions of the Infrastructure Investment and Jobs Act (IIJA; P.L. 117-58) and other existing authorities.[46]

In 2022, Congress established the Interagency Committee on Water Management and Infrastructure to include the Administrators of NOAA and EPA and the Secretaries of the Interior, Agriculture, Commerce, Energy, and the Army, and others, as appropriate. [47] The committee's purpose is to "ensure" the federal government engages in water-related matters, including water storage and supplies, water infrastructure, and water forecasting, among other topics, where agencies have joint or overlapping responsibilities.

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, nonfederal water supply projects that increase drought resilience or provide new water supplies, and 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).

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.).

[44] 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/.

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

[46] White House Drought Resilience Interagency Working Group, *Drought Resilience Interagency Working Group 1-Year Summary Report*, June 2022, at https://www.whitehouse.gov/wp-content/uploads/2022/05/DroughtIWGReport_Final_Embargoed-Until-June-1-at-6AM-ET.pdf. Hereinafter Drought Resilience IWG, *1-Year Summary*, 2022. For more about the Infrastructure Investment and Jobs Act, see "Infrastructure Investment and Jobs Act."

[47] Section 13 of the FLOODS Act, P.L. 117-316.

Selected federal drought response authorities regarding monitoring and research, support programs for farmers and ranchers, operations at federal facilities, and nonfederal planning and projects 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]

Monitoring and Research

Congress has directed multiple federal agencies to support drought monitoring, forecasting, warning, and related research activities. NIDIS has identified such activities at federal agencies including the Centers for Disease Control and Prevention, the Department of Energy, the Department of Transportation, the Federal Emergency Management Agency, NASA, National Science Foundation, USACE, EPA, and multiple agencies in the USDA (e.g., Farm Service Agency, U.S. Forest Service, National Resources Conservation Service [NRCS]), the Department of Commerce (e.g., NOAA, National Institute for Standards and Technology), and the Department of the Interior (e.g., U.S. Geological Survey [USGS], Reclamation, Bureau of Indian Affairs, BLM, National Park Service, and U.S. Fish and Wildlife Service).[50] These and other agencies also have roles in research to address drought through nature-based or natural infrastructure features—an area of active scientific and policy interest—among other ways.[51]

Many of the monitoring and research responsibilities lie with NOAA, USDA, and USGS. NOAA's drought-related monitoring and research responsibilities fall under several authorities.[52] 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

[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."

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

[51] White House Council on Environmental Quality, White House Office of Science and Technology Policy, and White House Office of Domestic Climate Policy, *Opportunities to Accelerate Nature-Based Solutions: A Roadmap for Climate Progress, Thriving Nature, Equity, and Prosperity*, November 2022, at https://www.whitehouse.gov/wp-content/uploads/2022/11/Nature-Based-Solutions-Roadmap.pdf. The report also identified fewer federal resources, such as tools, guidance, and technical assistance, available to stakeholders interested in addressing drought, among other hazards, through nature-based infrastructure (p. 16). See also White House Council on Environmental Quality, White House Office of Science and Technology Policy, and White House Office of Domestic Climate Policy, *Nature-Based Solutions Resource Guide: Compendium of Federal Examples, Guidance, Resource Documents, Tools, and Technical Assistance*, November 2022, at https://www.whitehouse.gov/wp-content/uploads/2022/11/Nature-Based-Solutions-Resource-Guide-2022.pdf.

[52] For example, the 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), and Weather Research and Forecasting Innovation Act of 2017 (P.L. 115-25, as amended).

records and reconstructions, and direct on-the-ground field observations.[53] 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.[54] 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.[55]

In 2022, Congress directed NOAA to collect and disseminate data and information regarding certain drought factors through several laws. One law directed NOAA to establish, in partnership with groups such as NIDIS and USGS, 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.[56] It also instructed the agency to improve precipitation frequency estimates; 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; and conduct a gap analysis in the availability of snow-related data, in consultation with USDA, DOI, and USACE.[57] Another law directed NOAA to improve maximum precipitation estimates, including through a report conducted by the National Academies of Sciences, Engineering, and Medicine.[58]

USDA also carries out monitoring and research activities related to drought, in addition to its role of providing direct support. USDA conducts research and collects data related to drought and water supply on topics such as drought-tolerant crop varieties, evapotranspiration modeling, drought-resilient management techniques and practices, and soil moisture capacity and retention. 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 NRCS administers the program, using over 900 automated data collection sites in NRCS's Snow Telemetry (SNOTEL) network.[59] The data collected at both SSWSF and SNOTEL sites are used to make water supply forecasts. Another USDA monitoring network, the Soil Climate Analysis Network, takes hourly readings of soil moisture content at over 200 stations.

USGS also supports a wide range of research and monitoring activities. The agency maintains a network of streamgages across the United States, which provides key information for the development of the weekly U.S. Drought Monitor maps and classifications.[60] In the Colorado

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

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

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

[56] P.L. 117-316, §3.

[57] P.L. 117-316, §§12, 15, and 16.

[58] 15 U.S.C. §§8561 et seq.

[59] 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 Survey and Water Supply Forecasting," at https://www.nrcs.usda.gov/resources/data-and-reports/snow-survey-and-water-supply-forecasting.

[60] 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*

River Basin, USGS is also piloting new monitoring tools through its Next Generation Water Observing System and developing machine learning approaches to improve drought prediction.[61] Another ongoing effort is the USGS Climate Adaptation Science Center's effort to synthesize the "state of the science" on transformational drought (i.e., drought events that can permanently and irreversibly alter ecosystems).[62] NASA, USGS, and a number of stakeholders launched OpenET that employs several methods to generate monthly and annual satellite-based evapotranspiration estimates at the field scale.[63]

Multiple federal agencies also work on aspects of drought-related research and monitoring individually as well as together under NIDIS, NDRP, and other partnerships, depending on the issue area. The 2019 NDRP report identified multiple individual agency leads for ongoing and planned data collection and integration actions, among other activities.[64] In terms of multi-agency efforts, 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.[65] 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.[66]

USDA Drought Support Programs for Farmers and Ranchers[67]

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.[68] 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

Survey (USGS) Streamgaging Network: Overview and Issues for Congress, by Anna E. Normand.

[61] USGS, "Next Generation Water Observing System: Upper Colorado River Basin," at https://www.usgs.gov/mission-areas/water-resources/science/next-generation-water-observing-system-upper-colorado-river?qt-science_center_objects=0#qt-science_center_objects. USGS, Addressing Stakeholder Science Needs for Integrated Drought Science in the Colorado River Basin, at https://pubs.usgs.gov/fs/2022/3010/fs20223010.pdf. Personal communication from USACE staff to CRS staff, November 7, 2022.

[62] Climate Adaptation Science Centers Project Explorer, "State of the Science Synthesis on Transformational Drought: Understanding Drought's Potential to Transform Ecosystems Across the Country," at https://cascprojects.org/#/project/4f8c64d2e4b0546c0c397b46/5d40ac2fe4b01d82ce8d9db0.

[63] The primary inputs include data from Landsat, Sentinel-2, GOES, and other satellites; weather station networks and models; and field boundary and crop type datasets. The initiative is working toward daily evapotranspiration estimates. For more information, see "OPENET," at https://openetdata.org/.

[64] National Drought Resilience Partnership (NDRP), *Priority Actions Supporting Long-Term Drought Resilience*, 2019, at https://www.usda.gov/sites/default/files/documents/ndrp-priority-actions.pdf (hereinafter NDRP, *Priority Actions*, 2019).

[65] See Drought.gov, *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.

[66] Drought.gov, "The National Coordinated Soil Moisture Monitoring Network," at https://www.drought.gov/drought-in-action/national-coordinated-soil-moisture-monitoring-network#goals.

[67] 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.

[68] 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."

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.[69] 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 to request assistance. The loan programs require a disaster declaration or designation for eligibility (discussed further in "Loans," below).[70] The "Other Drought Authorities: Support for Nonfederal Drought Planning and Projects" section below includes discussion of some additional types of USDA programs. Supplemental funding for drought-related agricultural loss is discussed in the "Enacted Supplemental Funding for Drought Activities" section.

Direct Payments

Some USDA programs provide direct 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."[71] USDA's Farm Service Agency (FSA) administers the following direct payment programs, for which producers may file applications through local FSA offices.[72]

- **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).[73] A county's U.S. Drought Monitor intensity level and the drought's 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 only an eligible adverse weather

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

[70] 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.

[71] 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.

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

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

event when associated with anthrax, a disease that may occur because of drought and directly results in the death of eligible livestock.[74]

- **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 and feed but not the cost of water and feed. ELAP also may cover the cost of hauling livestock to forage or other grazing acres during periods of drought.
- **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. 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 its drought classifications. 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 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.
- The Extending Government Funding and Delivering Emergency Assistance Act (P.L. 117-43, Division B) included $10 billion for agricultural producers impacted by natural disasters, including drought. Congress required that drought-related losses must have occurred in counties with a D2 classification for eight consecutive weeks, or D3 or higher classification in calendar years 2020 and 2021. The same requirement was added to $3.74 billion appropriated in the Disaster Relief Supplemental Appropriations Act, 2023 (passed

[74] 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.

as Division N of the Consolidated Appropriations Act, 2023 (P.L. 117-328) for drought-related losses occurring in calendar year 2022.

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).[75] 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, including certain adverse growing and market conditions.[76] 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.[77]
- **Noninsured Crop Disaster Assistance Program (NAP).** NAP provides coverage for crops and in locations where FCIP insurance is unavailable.[78] 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-

[75] 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.

[76] 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.

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

[78] 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.

share programs, for which producers may file applications through local FSA offices. These programs are permanently authorized but subject to appropriations.[79]

- **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 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 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.[80]

- **Emergency Farm Loans.** Loans may help producers recover from production and physical losses.[81] 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.[82] The payment

[79] 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.

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

[81] 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.

[82] 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.

set-aside is not forgiven and must be repaid prior to final maturity of the note. Any principal set-aside continues 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.[83] 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.[84]

- **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.[85] Haying and grazing may occur on CRP acres under emergency and certain 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).[86] Outside of the primary nesting season, up to 90 days of grazing or one cutting of hay is allowed.[87] 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.[88] In the past, USDA has announced special EQIP

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

[84] 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.

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

[86] 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.

[87] 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.

[88] 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,

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.

NOAA Drought Support Programs

Congress has furnished the Secretary of Commerce, through NOAA, with the authority to provide disaster assistance to the fishing industry when fish populations decline or other disruptions cause economic loss.[89] Once a review is initiated and necessary information is obtained and reviewed, the Secretary determines whether a fishery failure or fishery disaster has occurred. In most cases, Congress has appropriated funds to support the fishing industry following the Secretary's determination. NMFS, states, regional commissions, and industry representatives often work together to plan how to distribute assistance to the fishing industry and allocate assistance among potential projects. The Secretary has declared fishery disasters related to drought in several cases, most recently for Florida oysters in 2012.[90] In 2022, Congress amended the Secretary's authority, explicitly listing drought, among other phenomena, as a natural cause that may be considered under a fishery disaster determination.[91]

Drought and Federal Facilities and Projects[92]

The federal government owns and operates thousands of dams and other infrastructure that 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-feet (AF) that have water supply or irrigation among their operational purposes.[93] Federal reservoirs are distributed across the conterminous United States; in some watersheds and states,

NRCS, "Environmental Quality Incentives Program," at https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/eqip/.

[89] Prior to 2022, Congress provided multiple authorities to the Secretary of Commerce to respond to fishery disasters. For more information about these provisions, see CRS Report RL34209, *Fishery Disaster Assistance*, by Anthony R. Marshak. Congress amended or repealed these authorities in the Fishery Resource Disasters Improvement Act, Division S, Title II of P.L. 117-328.

[90] NOAA, "Fishery Disaster Determinations," at https://www.fisheries.noaa.gov/national/funding-and-financial-services/fishery-disaster-determinations.

[91] Fishery Resource Disasters Improvement Act, Division S, Title II of P.L. 117-328.

[92] 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.

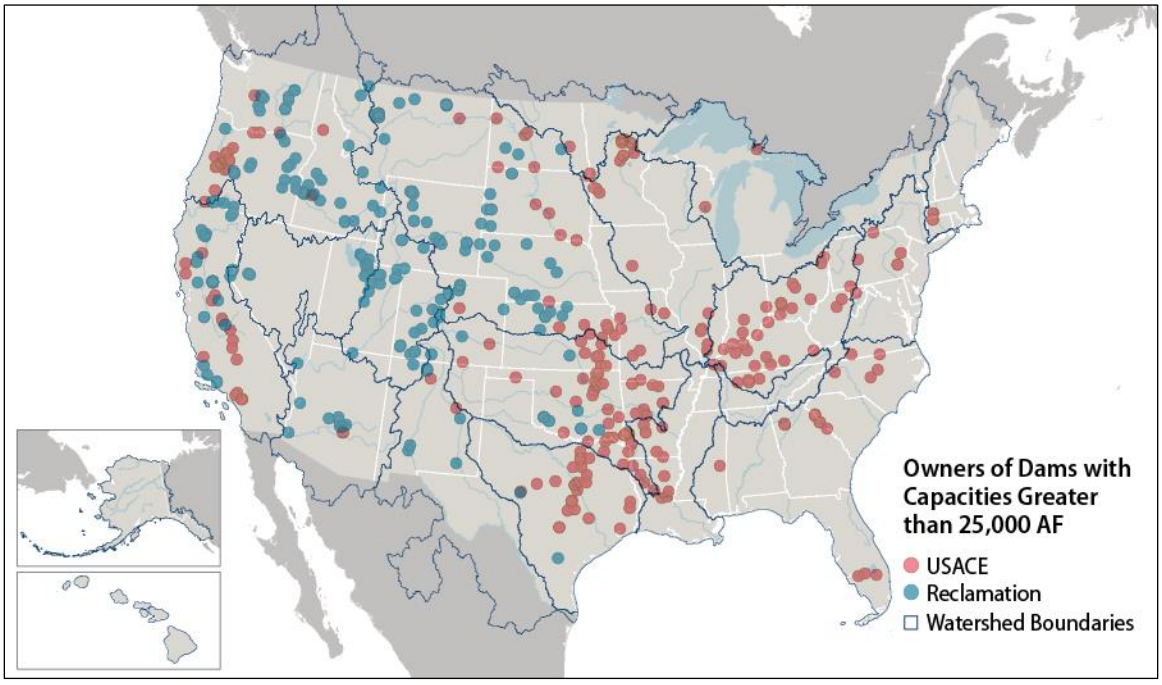
[93] An acre-foot of water is equal to the volume of a sheet of water 1 acre in area and 1 foot in depth, equivalent to 43,560 cubic feet of water.

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.[94] 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, data accessed in August 2021.

Notes: AF = Acre-feet (1 AF 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); USACE = U.S. Army Corps of Engineers; Reclamation = U.S. Bureau of Reclamation. As discussed in the report, municipal and industrial water supply and irrigation water storage generally are not primary purposes of USACE projects and instead are associated with multipurpose

[94] 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.

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. The role of USACE in water storage nonetheless can be regionally or locally significant. USACE has agreements to provide municipal and industrial water supply storage totaling 10.2 million AF at 132 projects, benefitting hundreds of communities.[95] In addition, 15 USACE projects have an estimated 0.4 million AF of authorized M&I water storage not yet allocated under an agreement.[96]

Sustained hydrological drought has other operational effects on 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 by 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 activities discussed in more detail below:

- 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. In 2015, Congress created a new authority for Reclamation to build water storage: Section 4007 of the Water Infrastructure Improvements for the Nation Act (WIIN Act; P.L. 114-322). The authority provided federal support for the construction of new and augmented surface and groundwater storage projects in the 17 reclamation states.

Funding for water storage projects under Section 4007 is available for two primary project types. This section allows that 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 receive up to 50% of project costs as federal funding (project sponsors must fund the remainder of costs). State-led storage projects (surface

[95] Assistant Secretary of the Army (Civil Works), Memorandum, "Army Civil Works Supporting Drought Resilience in America's Communities," July 28, 2022. Hereinafter referred to as Assistant Secretary of the Army July 2022 Drought Memorandum.

[96] Ibid.

water or groundwater storage projects constructed, operated, and maintained by states or political subdivisions) may receive up to 25% of their costs as federal funding. 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:

- 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.
- The Secretary of the Interior must transmit a list of recommended projects and funding levels to Congress, and Congress must designate those projects by name in an enacted appropriations act.

The WIIN Act set a deadline of January 1, 2021, for projects to be found feasible by Reclamation and be eligible to receive additional construction funding. Congress approved Reclamation study funding prior to that date for 13 projects in three states (California, Idaho, and Washington). Eight of these projects were found feasible prior to the deadline and thus are eligible for ongoing funding.[97]

In Section 40902 of the IIJA, Congress built on the WIIN Act water storage authority and authorized a total of $1.15 billion for western water storage projects over five years (FY2022-FY2026). The authority approved additional funding for WIIN Act projects and projects meeting other criteria specified in the IIJA, as well as a new grant program for small water storage projects impounding less than 30,000 acre-feet of water.[98]

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,[99] 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 with 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.[100] Congress, in Section 8106 of Water Resources Development Act of 2022 (WRDA 2022, enacted as Division H, Title LXXXI of P.L. 117-263), provided USACE with additional authorities to study water supply and water conservation activities as part of its feasibility studies for new or modified water resources projects. Section 8108 of WRDA 2022 authorized the Secretary of the Army to conduct a national

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

[98] Congress also appropriated this funding in the bill (see below section, "Infrastructure Investment and Jobs Act"). For additional information on these authorities, see CRS Report R47032, *Bureau of Reclamation Provisions in the Infrastructure Investment and Jobs Act (P.L. 117-58)*, by Charles V. Stern and Anna E. Normand.

[99] 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 cost is 35% nonfederal.

[100] WRDA 2020, Section 221.

assessment of using managed aquifer recharge projects at authorized water resource development projects to address drought, reduce aquifer depletion and enhance water resilience, and to assess and identify opportunities to support nonfederal interests in carrying out managed recharge projects; it further directed the establishment of a USACE-nonfederal aquifer recharge working group. Section 8108 also authorized USACE to perform up to 10 feasibility studies (at 90% federal cost and 10% nonfederal cost) on managed aquifer recharge projects in drought-prone or water-scarce areas. Actions on these USACE authorities are subject to the availability of appropriations.

Drought Operations Manuals and Planning

Reclamation

Reclamation projects typically are governed by operating plans.[101] Reclamation also has authority to enter into drought contingency plans—guidance on how the project is to be operated during droughts; in Section 202 of the Reclamation States Emergency Drought Relief Act of 1991 (P.L. 102-250), Congress authorized Reclamation to prepare or participate in the preparation of cooperative drought contingency plans, for the prevention or mitigation of adverse effects of drought conditions.[102] There is no requirement for Reclamation to formally revise its operating plans with drought contingency plans (DCPs). In practice, Reclamation generally has supported contingency plans developed by nonfederal interests through its Drought Response Program. 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.[103]

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.[104] Reclamation published reports pursuant to the SECURE Water Act in 2011, 2016, and 2021.[105] 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 of 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 for this purpose, including ones related to (1) modifying reservoir storage or operating guidelines; (2) developing 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.[106] 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

[101] 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.

[102] 43 U.S.C. §2222.

[103] 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.

[104] 42 U.S.C. §10363.

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

[106] 42 U.S.C. §10363.

seek to identify operational improvements to respond to variable water supplies, including droughts. Beginning in 2015, Reclamation conducted five pilot studies.[107] In June 2021, Reclamation announced another six pilot studies in five western states.[108] Initial studies employed a variety of approaches, including the increased use of pre-historic hydrology, advanced monitoring, and forecast-informed operations, among others (for more information on forecast-informed 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).[109]

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*.[110] 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.[111] 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 undertake to incorporate climate change considerations into DCP development, including the consideration of regional variables.

Congress has provided USACE with authorities related to reservoir management for drought and water conservation activities in the last decade.[112] According to USACE, limited to no action had

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

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

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

[110] 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.

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

[112] 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

occurred by 2021 under these authorities due to a lack of funding or interest from nonfederal partners.[113] 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.[114] Section 8107 of WRDA 2022 further expanded this authority. Separately, Section 8208 of WRDA 2022 directed the Secretary of the Army to conduct a study of the effectiveness of carrying out additional measures at USACE reservoirs in the South Pacific Division to increase water supply and mitigate drought and flood, among other purposes.[115] WRDA 2022 also addressed western states' concerns related to how USACE reservoirs operate vis-à-vis state water rights. In contrast to Reclamation facilities that often have state water rights associated with them, USACE typically does not have water rights associated with its reservoirs. WRDA 2022 directed the Secretary of the Army to establish a Western Water Cooperative Committee to work on identifying opportunities to avoid or minimize conflicts between USACE flood control projects and water rights and water laws in western states. Actions on these WRDA 2022 and other USACE authorities are subject to appropriations.

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, in 2012 and in 2022, 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.

Forecast-Informed Reservoir Operations

Federal dam operators have often used runoff measurements and other observations (e.g., snowpack or soil moisture) to estimate inflow and 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 detecting and forecasting atmospheric rivers,[116] have increased decisionmakers' interest in identifying opportunities to use forecasts for

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. Section 8107 of WRDA 2022 also authorized updating of water control manuals for states with a statewide disaster declaration in 2021.

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

[114] Personal communication from USACE staff to CRS staff, July 8, 2021. According to the Assistant Secretary of the Army, the Prado Dam FIRO pilot found "that an average of 7000 acre-feet (af) per year of stormwater could be released in a modified manner to allow the Orange County Water District to use the water in its groundwater recharge system and provide additional supply for its customers." (Assistant Secretary of the Army July 2022 Drought Memorandum.)

[115] For a map of the South Pacific Division, see USACE, "Around the South Pacific Division," at https://www.spd.usace.army.mil/. The division covers the Southwest states of Arizona, California, and New Mexico; most of Colorado, Nevada, and Utah; and portions of Texas, Idaho, Oregon, and Wyoming.

[116] *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,

more dynamic dam operations, and in improving precipitation forecasts beyond two-weeks.[117] That is, operations would shift 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 (FIRO), uses data from watershed monitoring and from weather and water forecasting to inform water management decisions to retain or release water from reservoirs. A July 2022 memorandum by the Assistant Secretary of the Army for Civil Works states "FIRO and related initiatives are among the most cost-effective ways to increase water availability in drought-impacted regions. In some cases, water availability may be significantly increased on an annual basis for less than 5% of the cost of new infrastructure investments on a dollar per [acre foot] basis."[118]

Researchers and agencies have applied early FIRO efforts to reservoirs in California, a state that is not only pursuing additional water supplies due to being drought-prone but also receives a significant portion of its annual precipitation from atmospheric rivers. An atmospheric river (AR) consists of a long band of water vapor moving through the atmosphere, typically resulting in heavy precipitation over land (**Figure 7**).[119] Reservoir managers are trying to store water supplies to meet demands during dry periods while considering the consequences for how quickly reservoir storage space can be made available to capture floodwaters during wet periods. Managers using FIRO are making these operational decisions based in part on forecasts, rather than following fixed operational rules for how to operate reservoirs during different seasons.

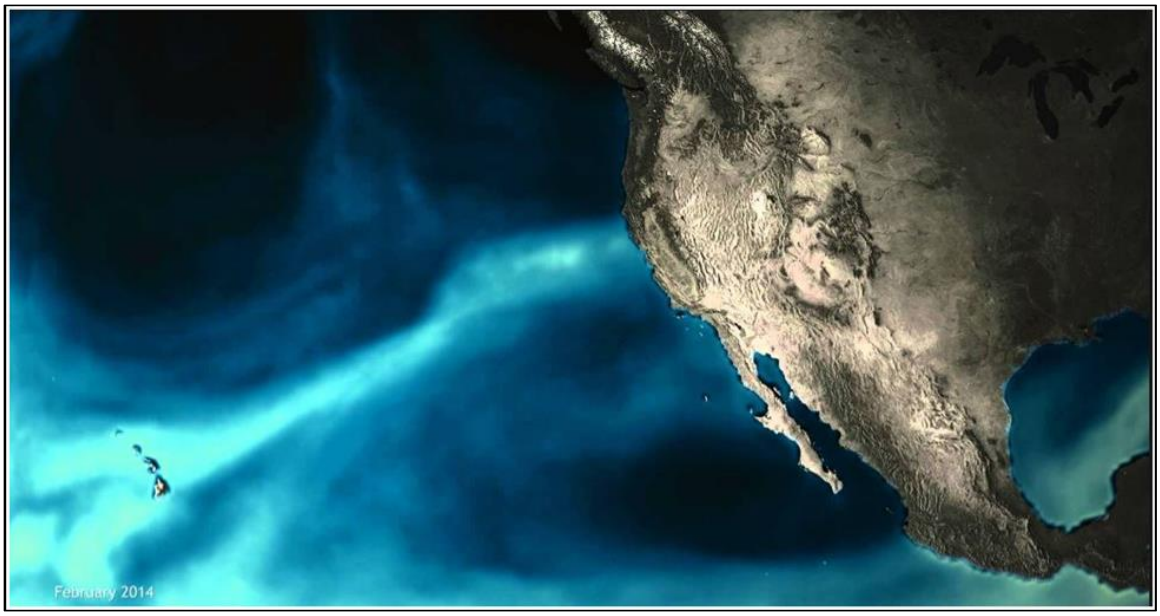
see NOAA, "What Are Atmospheric Rivers?," at https://www.noaa.gov/stories/what-are-atmospheric-rivers.

[117] 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).

[118] Assistant Secretary of the Army July 2022 Drought Memorandum.

[119] For more on atmospheric rivers, see CRS Insight IN12094, *Atmospheric Rivers: Background and Forecasting*, by Eva Lipiec and Nicole T. Carter.

Figure 7. Atmospheric River Originating Near Hawaii and Extending to the U.S. West Coast



Source: NOAA, "Atmospheric Rivers," at https://noaa.maps.arcgis.com/apps/Cascade/index.html?appid=2871beb71aae4542a63b31157c4dce3b

Notes: In this image from February 2014, the light blue area denotes a plume of water vapor. Atmospheric rivers typically form in tropical regions when winds over the ocean draw water vapor into narrow bands. The atmospheric river's interactions with land features, such as mountain ranges, or certain atmospheric conditions cause the water vapor to move upward in the atmosphere and fall as heavy rain or snowfall.

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.[120] 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.[121] 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.

[120] Ongoing FIRO research efforts also 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.

[121] 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." According to the Assistant Secretary of the Army, the FIRO pilot "at California's Lake Mendocino yielded a 19% increase in water supply in 2020, the third driest year on record." (Assistant Secretary of the Army July 2022 Drought Memorandum.)

Reclamation and USACE also incorporated forecasts into a 2018 update to their joint *Folsom Dam Water Control Manual*.[122] Pursuant to the manual, the federal water managers use continuous five-day forecasts available for that region of California to identify plausible flows into the reservoir to assess operational release requirements.

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. In late 2020, Congress directed the Secretary of the Army to produce a report identifying additional opportunities for applying FIRO across the United States.[123] The FIRO report has not been published as of the date of this report. Congress has continued to support FIRO through direction related to FY2023 appropriations and additional authorizations for studying FIRO and performing pilot projects in Section 8304 of WRDA 2022.

Drought Flexibilities and the Endangered Species Act

Some federal and nonfederal water infrastructure projects in the United States must ensure that their operations are consistent with the requirements of the Endangered Species Act (ESA; 16 U.S.C. §§1531-1544) due to their potential to jeopardize threatened or endangered species (listed species) or adversely modify designated critical habitat.[124] Operational plans and ESA regulations often result in water projects being required to maintain a certain level of water in an ecosystem or river for listed species to comply with terms of an ESA permit. Under drought conditions, these requirements can lead to disagreements among stakeholders vying for scarce water supplies.

Water projects or operation thereof that may affect listed species or their habitat may be required to undergo consultation with FWS or the National Marine Fisheries Service (NMFS) (collectively referred to as the Services) under Section 7 of the ESA. The consultation concludes with a *biological opinion* (BiOp) issued by the one of the Services that imposes terms and conditions on project operations. Some BiOps for water project operations include policy mechanisms to maximize water supplies for users during drought while continuing to conserve listed species. These mechanisms often include the use of adaptive management (AM), real-time management of water supplies, artificial propagation of listed species (e.g., hatcheries), and habitat restoration.

Project operators use AM to fine-tune operations during drought conditions. AM is the process of incorporating new scientific and programmatic information into the implementation of a project or plan to adapt to present and changing conditions that may be difficult to predict and to help 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

[122] 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 CRS staff, July 8, 2021).

[123] 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. Section 8303 of WRDA 2022 added a third basin—Apalachicola Chattahoochee Flint River Basin. Congress authorized the Secretary to implement FIRO at reservoirs in the three basins if the assessment finds FIRO viable for the reservoirs. 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 basin.

[124] 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.

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 seek concurrence from either FWS or NMFS to temporarily modify 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.[125]

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[126]

Congress has enacted multiple 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.[127] 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 with developing and implementing 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 may 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,

[125] 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.

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

[127] 43 U.S.C. §391.

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 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 nonfederal 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 by providing financial assistance, and approval of these actions is subject to a number of other requirements, such as a state or tribal drought declaration.[128]

Other WaterSMART programs also have the potential to lessen drought impacts, such as 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.[129] Similarly, Reclamation's Desalination Program provides federal financial support for selected nonfederal desalination projects that Congress has approved.[130] 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 support for projects that benefit ecological values or promote watershed health. 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.[131]

Congress also has authorized targeted grant programs to combat drought and add *system water (*i.e.*,* water that is provided to increase water supplies as a whole, without being directed toward additional consumptive use for specific contractors or water user) through conservation efforts in

[128] 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.

[129] For more information about this program, see Reclamation, "Title XVI – Water Reclamation and Reuse," at https://www.usbr.gov/watersmart/title/index.html.

[130] For more information about this program, see Reclamation, "Desalination," at https://www.usbr.gov/watersmart/desalination/index.html.

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

drought-stricken river basins. For example, in the Lower Colorado River Basin,[132] 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 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[133]

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**.[134] 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**.[135] 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**.[136] 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.

[132] 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.

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

[134] 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.

[135] 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.

[136] 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.

Natural Resources Conservation Service[137]

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 programs are permanently authorized but subject to appropriations. Applications may be filed at any local or state NRCS office.[138]

- **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.[139]
- **Watershed Rehabilitation Program.** The Watershed Rehabilitation Program provides technical and financial assistance for planning, design, and implementation of activities 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.[140]
- **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.[141]

USACE Authorities[142]

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.[143] 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 a

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

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

[139] 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.

[140] 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 R47383, *Federal Assistance for Nonfederal Dam Safety*, coordinated by Anna E. Normand.

[141] 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.

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

[143] 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.

variety of activities, some of which must be reimbursed (i.e., 100% nonfederal expenses) and some of which are a fully federal expense (i.e., 100% federal), as follows:

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

Funding for actions pursuant to this authority is provided through the USACE Flood Control and Coastal Emergencies Account.

A governor, a governor's representative, or the governing body of a tribe must make a written CVP 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. 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.

Separate from this emergency water supply authority, USACE has the authority to contract for limited quantities of water (if available) from its reservoirs for municipal and industrial purposes. Congress also has provided USACE with a technical assistance authority for state and local entities, referred to as Planning Assistance to States (PAS). Under the PAS authority, USACE has worked with state and local governments in Texas, Virginia, and Iowa to support planning for drought conditions.

U.S. Environmental Protection Agency Programs[144]

Improving public water systems' resilience to droughts and to other events that may disrupt the provision of safe and reliable water supplies has been a focus of congressional attention. Congress has established programs, which are 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).[145]

Drinking Water State Revolving Fund[146]

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.[147] Projects that aim to increase water system drought resilience through the development of a new or alternative drinking water

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

[145] 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.

[146] 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.

[147] 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 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.

source(s) and/or through the construction or rehabilitation of water storage are eligible for DWSRF financial assistance.[148]

Congress annually appropriates DWSRF program funding, which EPA allots among the states as grants 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 prioritize projects that address the most serious human health risks, are necessary to ensure regulatory compliance, and assist systems most in 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 choose to prioritize DWSRF assistance for drought resilience projects, such as alternative water projects to replace diminished or contaminated water sources. While the primary type of DWSRF financial assistance is low-interest-rate loans, SDWA Section 1452 authorizes states to provide additional subsidization (including forgiveness of principal) to disadvantaged communities.[149] 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[150]

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.[151] WIFIA authorized EPA and USACE to provide credit assistance in the form of secured or direct loans for a range of water infrastructure projects.[152]

The range of eligible projects for the EPA-administered WIFIA program is broader than for the DWSRF program. WIFIA-eligible drinking water projects include those projects eligible for DWSRF financial assistance as well as 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

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

[149] 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.

[150] 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.

[151] 33 U.S.C. §§3901-3914.

[152] USACE's credit assistance program is in development. For more information on the USACE program, see CRS Insight IN12021, *Corps Water Infrastructure Financing Program (CWIFP)*, by Nicole T. Carter.

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 FY2022, the Administration's priorities for WIFIA included projects that were "new and innovative in regards to energy efficiency, addressing drought, or reducing water pollution and contaminants." The FY2022 NOFA also included the criteria for project selection, such as "the extent to which a project serves regions with significant water resource challenges."[153]

WaterSense

WaterSense is a voluntary labeling program that EPA created in 2006 to encourage the development and use of water-efficient products and services. Programs, like WaterSense, identify and promote the use of water-efficient products and/or services that may lessen the effects of drought though means other than providing financial assistance. 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).[154]

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 6.4 trillion gallons of water from 2006 to 2021.[155]

Selected Federal Drought Programs for Tribes[156]

Many *federally recognized tribes* and Alaska Native villages (ANVs) experience the effects of drought on their lands.[157] Federal agencies have a unique relationship with tribes due to the federal trust responsibility and government-to-government relationship. Agencies work with tribes in different ways (e.g., tribal consultation, grants or cooperative agreements, technical

[153] EPA, "Notification of Funding for Credit Assistance Under the Water Infrastructure Finance and Innovation Act (WIFIA) Program," 87 *Federal Register* 36489, June 17, 2022.

[154] 42 U.S.C. §6294b.

[155] EPA, *WaterSense 2021 Accomplishments Report*, EPA-832-F-22-011, June 2022.

[156] For more information on tribal natural resource issues, contact Mariel J. Murray, Specialist in Natural Resources Policy.

[157] The term *tribe* reflects statutory language denoting tribal entities that, through a process known as federal recognition or federal acknowledgment, have a government-to-government relationship with the United States and are entitled to certain rights and privileges. See, for example, 25 U.S.C. § 5131(a). Alaska Native village (ANV) is defined in Section 3 of the Alaska Native Claims Settlement Act (43 U.S.C. §1602).

assistance, monitoring, research). Tribes are eligible for many federal drought assistance programs available to state and local governments, as outlined elsewhere in this report. Tribes are also eligible for specific programs and funding that can be used to prepare for or address drought impacts on tribal lands and waters, some of which are described below.[158]

U.S. Department of Agriculture

Many tribes are located in rural areas and, as such, are eligible for certain USDA Rural Development infrastructure programs. In addition, USDA has selected tribal-specific programs:

- **USDA Grants for Rural and Native Alaskan Villages.** These grants are to help ANVs provide safe drinking water and waste disposal systems to households and businesses.[159]
- **Water and Waste Facility Loans and Grants to Alleviate Health Risks on Tribal Lands and Colonias.**[160] These grants are to help low-income communities facing significant health risks on tribal lands and in colonias access safe drinking water and waste disposal facilities.[161]

USACE

Since 2000, under USACE's *Tribal Partnership Program* authority, USACE has been able to assist tribes to become more drought resilient.[162] Congress has expanded the Tribal Partnership Program's authority from a technical assistance program to also include project design and construction. Congress in 2018 and in subsequent amendments has authorized USACE to undertake construction of certain water projects with tribes.[163] These plans and projects can range from environmental restoration actions to build resilience and protect important cultural landscapes to infrastructure investments to improve water supply reliability.[164]

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[158] This is not a comprehensive list of programs available to tribes.

[159] USDA Rural Development, "Grants for Rural and Native Alaskan Villages," at https://www.rd.usda.gov/programs-services/water-environmental-programs/grants-rural-and-native-alaskan-villages.

[160] The term *colonias* refers to state-designated, low-income, unincorporated areas along the U.S.-Mexico border that lack basic infrastructure (especially for drinking water and wastewater) or have inadequate infrastructure (7 C.F.R. §1777.4).

[161] USDA Rural Development, "Water and Waste Facility Loans and Grants to Alleviate Health Risks on Tribal Lands," at https://www.rd.usda.gov/programs-services/water-environmental-programs/water-and-waste-facility-loans-and-grants-alleviate-health-risks-tribal-lands; USDA Rural Development, "Water and Waste Facility Loans and Grants to Alleviate Health Risks for Colonias," at https://www.rd.usda.gov/programs-services/water-environmental-programs/water-and-waste-facility-loans-and-grants-alleviate-health-risks-colonias.

[162] 33 U.S.C. §2269.

[163] P.L. 115-270, Title I, §1157(i); P.L. 116-260, Division. AA, Title III, §303; P.L. 117-263, Division H, Title LXXXI, §8111.

[164] The Tribal Partnership Program's authority provides for no nonfederal cost sharing for planning and technical assistance activities. The program's authority provides for nonfederal cost sharing for construction projects (which varies depending on the project purpose) and notes that cost sharing agreements under the program are subject to a tribe's ability to pay, as determined by the Secretary of the Army (33 U.S.C. §2269(d)(1)(A) and 33 U.S.C. §2269(d)(4)(B)). The nonfederal cost share under the program can be met through in-kind services (33 U.S.C. §2269(d)(2)). USACE construction projects performed pursuant to the program's authority do not require congressional project authorization if their federal costs are less than $26 million. Separately, Congress waived a portion of most USACE study and project costs for tribes (33 U.S.C. §2310; the amount of the waiver is adjusted annually with inflation).

Department of the Interior

Various agencies in the Department of the Interior are authorized to specifically assist tribes. Below is a selected set of the DOI agencies and their authorities and activities relevant to tribal efforts to address drought impacts on tribal lands and waters and related water-resource management, planning, preparedness, and infrastructure investments.

The Bureau of Indian Affairs has several relevant programs.[165]

- **Water Management, Planning & Pre-Development**. BIA performs technical studies to help tribes gather hydrology data, develop best practices to use water, create drought management plans that include water conservation techniques, and undertake projects to support Indian water rights.[166]
- **Construction**. Construction activities occur under multiple authorities and include construction of Indian irrigation and power systems, as well as construction associated with the safety of dams on Indian reservations, BIA-owned drinking water and sanitation systems, and other facilities.[167]
- **Tribal Climate Adaptation Grants**. These grants *s*upport the tribal development of science, tools, and climate resilience assessment and planning, including adaptation planning and activities for areas facing drought conditions.[168]

The Bureau of Reclamation has several relevant programs in addition to its more general authorities addressing drought.

- **Native American Affairs Program**. This program provides technical support for Indian water rights settlements, and assists tribal governments with developing, managing, and protecting their water resources.[169]
- **Emergency Drought Relief for Tribes**. Reclamation received new authority and funding under P.L. 117-169, a budget reconciliation measure commonly referred to as the Inflation Reduction Act of 2022 ($12.5 million over five years), to provide near-term relief for tribes whose water availability is negatively impacted by a Reclamation water project during drought. This relief may take the form of direct financial assistance to address drinking water shortages and to mitigate the loss of tribal trust resources.[170]
- **Indian Water Rights Settlements**. Individually authorized settlements between the federal government, tribes, and others provide federal funding and support to develop tribal water rights, often in water-stressed areas.[171]

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[165] The Bureau of Indian Affairs (BIA)'s mission is to enhance the quality of life, promote economic opportunity, and carry out the responsibility to protect and improve the trust assets of American Indians, tribes, and Alaska Natives (U.S. Department of the Interior- Indian Affairs, "Bureau of Indian Affairs (BIA)," at https://www.bia.gov/bia).

[166] U.S. Department of the Interior, The United States Department of the Interior Budget Justifications and Performance Information for Fiscal Year 2023- Bureau of Indian Affairs, p. IA-TNR-11, at https://www.bia.gov/sites/default/files/dup/inline-files/fy2023-bia-greenbook_0.pdf.

[167] Ibid at IA-ES-6., and IA-CON-OTH-3.

[168] Ibid at p. IA-TNR-7.

[169] Bureau of Reclamation, "Native American Affairs Program," at https://www.usbr.gov/native/programs/TAPprogram.html.

[170] P.L. 117-169.

[171] For more information see CRS Report R44148, *Indian Water Rights Settlements*, by Charles V. Stern.

U.S. Environmental Protection Agency[172]

- **DWSRF Tribal Set-Aside**. Of the amounts appropriated annually for DWSRF, Congress authorizes EPA to set aside as much as 2% for grants for Indian tribes and ANVs.[173] Colonias, tribes (including state-recognized tribes), and ANVs can apply to state DWSRFs.[174] EPA's list of the types of projects eligible for funding under the federal Drinking Water Tribal Set-Aside program includes projects to rehabilitate or develop sources of drinking water.[175] For tribal applicants to state DWSRFs, a state may prioritize DWSRF assistance for drought resilience projects, such as alternative water projects to replace diminished or contaminated water sources.
- **Indian Reservation Drinking Water Grant Program**. America's Water Infrastructure Act of 2018 (P.L. 115-270) authorized a grant program at EPA for public water systems that serve Indian tribes, called the Indian Reservation Drinking Water Program. The Infrastructure Investment and Jobs Act (IIJA; P.L. 117-58) revised the program directing EPA to establish this grant program, and expanded the eligible uses of the funds to either drinking water infrastructure improvements or wastewater system improvements. The Consolidated Appropriations Act, 2023 (P.L. 117-328) provided the first appropriation of $4 million for FY2023 for this program. The extent to which this funding will be used for water infrastructure projects to address drought is unclear.

Proposed Drought Authorities and Enacted Supplemental Funding 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 has included 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.[176] The following sections discuss some drought-related legislative proposals considered by and additional funding enacted by the 117th Congress.

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

[173] The term *Indian tribe* is defined to include federally recognized tribes and ANVs (42 U.S.C. §300f(14)). Under Section 1452(i) (42 U.S.C. §300j-12(i)) of the Safe Drinking Water Act, EPA may use 1.5% of the amounts appropriated annually to make grants to Indian tribes and ANVs. Starting in FY2010 (the Department of the Interior, Environment, and Related Agencies Appropriations Act, 2010, P.L. 111-88), Congress has authorized EPA to reserve up to 2.0% of the appropriated funds for Indian tribes and ANVs and has continued through the terms and conditions of subsequent appropriations. For funding information, see EPA, "Tribal Drinking Water Program Fund Allotments," at https://www.epa.gov/tribaldrinkingwater/tribal-drinking-water-program-fund-allotments.

[174] The Administration for Native Americans defines *state recognized tribes* as Indian tribes and heritage groups that are recognized by individual states for their various internal state government purposes.

[175] EPA, "Tribal Drinking Water Program Eligibility Requirements," at https://www.epa.gov/tribaldrinkingwater/drinking-water-infrastructure-grants-tribal-set-aside-program#elig.

[176] New and amended authorities are described in the sections above.

Proposed Drought Authorities

The 117th Congress introduced and considered several pieces of legislation regarding drought response, some of which were enacted into law. New and amended proposed authorities included those related to coordination, monitoring and research, NOAA drought support programs, and Reclamation water supply programs.

Coordination

Some legislation introduced in the 117th Congress would have directed agencies to work together on aspects of water data and management that could have affected drought preparedness and response. Such provisions would have directed the heads of multiple departments, including USDA, Commerce, DOI, EPA, and others, to develop and implement a national water data framework for "integrating, sharing, and using water data" and establish an interagency council to support development and implementation of the framework.[177]

Monitoring and Research

Other provisions introduced in the 117th Congress would have focused on water-related monitoring and research. For example, one piece of proposed legislation that contained a number of provisions related to water monitoring and research would have directed the Secretary of the Interior to make all planned Federal Priority Streamgages operational in 10 years.[178] It also would have directed the Secretary to establish an Open Access Evapotranspiration (ET) Data Program that would deliver satellite-based evapotranspiration data to advance the quantification of evaporation and consumptive water use.[179] Other bills would have directed NOAA and NSF to improve the understanding of the impacts of drought, and other factors, on wildfire.[180]

Other proposed legislation would have directed agencies to study the effects of drought in certain geographic areas or on specific entities. One bill would have directed NOAA to report to Congress on the impacts of drought, among other phenomena, on ocean, coastal, and Great Lakes ecosystems.[181] Others would have directed federal agencies to develop plans to identify and adapt to the impacts of drought, among other phenomena, on the agencies' missions and to serve on an interagency council on climate-related planning and preparedness.[182]

NOAA Drought Support Programs

Under some proposals, the Secretary of Commerce would have been required to distribute 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.[183] Other bills

[177] For example, see Title VI, §602 of H.R. 5118, 117th Congress.

[178] For example, see Division B, §223 of H.R. 5118, 117th Congress. In FY2020, 3,470 of the 4,760 designated Federal Priority Streamgages were operational. 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.

[179] For example, see Division B, Title III of H.R. 5118, 117th Congress. For more information federal satellite-based evapotranspiration technologies, see "OPENET," at https://openetdata.org/. S. 2568 would also create an Open Access Evapotranspiration Data Program.

[180] For example, see H.R. 5781 and S. 4274, 117th Congress.

[181] For example, see H.R. 3764, 117th Congress.

[182] For example, H.R. 5477 and S. 3156, 117th Congress.

[183] For example, see H.R. 2013 and S. 873, 117th Congress.

also would have authorized the Secretaries of Commerce and the Interior to approve and provide funding for the implementation of state plans to maintain or enhance the ability of fish, wildlife, and plants to adapt to droughts, among other phenomena.[184]

Federal Facilities: Western Water Supplies and Reclamation Programs

Several legislative proposals would have reauthorized and/or amended existing authorities related to Reclamation and drought in the West. Several proposals focused on extending or amending Reclamation drought provisions in the WIIN Act. Some bills would have extended the WIIN Act's California water provisions, which aimed to provide operational flexibility during drought for the nation's largest water project, the Central Valley Project (CVP, see "Drought Flexibilities and the Endangered Species Act" above).[185] Other legislation also would have renewed the WIIN Act CVP operational provisions and would have explicitly directed the Secretary of the Interior to operate the CVP to maximize water supplies for users (within the law and regulations) by approving any projects that would provide additional water supplies and requiring CVP operations to be carried out consistent with the 2019 CVP BiOps,[186] among other requirements.[187] Some of these bills would have extended WIIN Act authorities to study and fund new water storage projects in the West or extended WIIN Act provisions authorizing additional storage projects throughout the West through 2031 and 2028, respectively.[188]

Some legislation would have addressed multiple western water priorities, including water storage and water conservation. For example, one bill would have authorized funding in several different areas with the goal of increasing drought resiliency, including authorizing 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.[189] Another would have authorized new funding for infrastructure development for water reuse and recycling and desalination projects, as well as for ecosystem restoration to support biodiversity in droughts and protect fisheries, among other priorities.[190]

Enacted Supplemental Funding for Drought Activities

In addition to funding provided through annual appropriations laws, the 117th Congress appropriated additional funding to address drought concerns in 2021 and 2022 via several laws.[191]

Infrastructure Investment and Jobs Act

In the IIJA, Congress enacted funding for a number of nationwide and regional drought-related provisions. Many of these programs received significantly more in funding under the bill than

[184] For example, see H.R. 2872 and S. 1420, 117th Congress.

[185] For example, H.R. 737 and H.R. 1563, 117th Congress.

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

[187] For example, see H.R. 4018, 117th Congress.

[188] For example, see H.R. 737 and H.R. 1563, 117th Congress.

[189] For example, see H.R. 3404, 117th Congress.

[190] For example, see S. 953, 117th Congress.

[191] For a discussion of new EPA authorizations enacted through the Infrastructure Investment and Jobs Act, see "U.S. Environmental Protection Agency Programs."

they typically have in annual discretionary appropriations. Selected IIJA appropriations for drought-related activities included the following, in the order listed in the law:

- $918 million for NRCS watershed programs, including the WFPO, Watershed Rehabilitation, and EWP Programs[192]
- $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[193]
- $25 million over three years to NOAA for data acquisition and $1 million over four years to NOAA for the study of a soil moisture and snowpack monitoring pilot program in the Upper Missouri River Basin[194]
- $80 million to remain available through FY2024 to NOAA for research supercomputing to improve climate and weather modeling capabilities related to drought, flood and wildfire prediction, detection, and forecasting
- $40 million to USACE for Upper Missouri River Basin soil moisture and snowpack monitoring
- $1.15 billion over five years to Reclamation for new and augmented surface and groundwater storage projects, including projects under Section 4007 of the WIIN Act
- $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 over five years for Reclamation WaterSMART water and energy efficiency grants;
- $300 million over five years to Reclamation for Colorado River Basin funding pursuant to the Colorado River Drought Contingency Plan Authorization Act (P.L. 116-14)[195]
- $11.7 billion over five years to EPA for the DWSRF that could support public water system resilience to drought, among a range of eligible projects[196]

[192] 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.

[193] For more information about these activities, see NOAA, "Research supercomputing," at https://www.noaa.gov/infrastructure-law/infrastructure-law-climate-data-and-services/research-supercomputing, and NOAA, "Flood and inundation mapping and forecasting," at https://www.noaa.gov/infrastructure-law/infrastructure-law-climate-data-and-services/flood-and-inundation-mapping-and-forecasting.

[194] For more information about these activities, see NOAA, "Water Resources Development Act data acquisition" at https://www.noaa.gov/infrastructure-law/infrastructure-law-climate-data-and-services/water-resources-development-act-data-acquisition.

[195] For more information about Colorado River Drought authorities and funding, see CRS Report R45546, *Management of the Colorado River: Water Allocations, Drought, and the Federal Role*, by Charles V. Stern and Pervaze A. Sheikh.

[196] The White House Drought Interagency Working Group identifies the IIJA DWSRF appropriations as supporting "long-term resiliency projects" to drought and other water scarcity issues (Drought Resilience IWG, *1-Year Summary*, 2022).

Extending Government Funding and Delivering Emergency Assistance Act

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 FY2018, Congress funded ad hoc assistance for agricultural losses for the first time in over a decade.[197] Drought was included as an eligible loss condition in subsequent appropriations.[198] Division B of the Extending Government Funding and Delivering Emergency Assistance Act (P.L. 117-43) included payments for agricultural losses in calendar years 2020 and 2021, added qualifying disaster events (including extreme heat), and appropriated $10 billion to remain available through calendar year 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 calendar year 2021 due to drought and wildfires. USDA implemented the 2022 supplemental appropriation through the creation of the Emergency Relief Program and the Emergency Livestock Relief Program.[199]

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.[200]

Inflation Reduction Act of 2022

In P.L. 117-169, a budget reconciliation measure commonly referred to as the Inflation Reduction Act of 2022 (IRA 2022), Congress provided additional appropriations for drought-related activities to several agencies. The bill provided Reclamation with the following, as listed in the law:

- $550 million in FY2022 (expiring at the end of FY2031) for up to 100% of the costs for grants, contracts, and financial assistance agreements for water supply projects in disadvantaged communities (§50231)

[197] The Bipartisan Budget Act of 2018 (P.L. 115-123) authorized $2.36 billion for agricultural losses in calendar year 2017. Most of this funding was made available through the creation of the Wildfires and Hurricanes Indemnity Program (WHIP) and block grants to states. For more information on WHIP, see CRS In Focus IF11539, *Wildfires and Hurricanes Indemnity Program (WHIP)*, by Megan Stubbs.

[198] The Additional Supplemental Appropriations for Disaster Relief Act of 2019 (P.L. 116-20) added $3 billion in funding for losses in calendar years 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. Congress required that eligible drought include counties with a U.S. Drought Monitor classification of D3 (extreme) or D4 (exceptional) in calendar years 2018 and 2019.

[199] For more information, see USDA, FSA, "Emergency Relief," https://www.fsa.usda.gov/programs-and-services/emergency-relief/index.

[200] 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.

- $4.0 billion in FY2022 (expiring at the end of FY2026) to mitigate the impact of drought in reclamation states, with priority given to projects in the Colorado River basin (§50233)
- $25 million (expiring at the end of FY2031) for projects to cover water conveyance facilities with solar panels and increase water efficiency (§50233)
- $25 million in FY2022 (expiring at the end of FY2031) for drought support for tribes (§80004)

Additional provisions provided funding to multiple agencies for activities that could be indirectly related to drought, such as research and development infrastructure and scientific equipment (e.g., §§40004 and 40005).

IRA 2022 also provided nearly $20 billion in additional funding to the USDA agricultural conservation programs. Many of these conservation programs can address drought-related concerns as part of their broad purpose (see "Conservation"). While this IRA 2022 funding was directed to climate change-related goals, specifically greenhouse gas mitigation activities, it could indirectly increase the availability of existing conservation program funds for other resource concerns related to drought (e.g., water conservation).[201]

Disaster Relief Supplemental Appropriations Act, 2023

The Disaster Relief Supplemental Appropriations Act, 2023 (passed as Division N of the Consolidated Appropriations Act, 2023 [P.L. 117-328]), included emergency appropriations related to drought in addition to annual appropriations for federal agencies and their activities. Specifically, P.L. 117-328 included payments for agricultural losses in calendar year 2022 from qualifying disaster events, including drought and extreme heat. The 2023 supplemental appropriations provided $3.74 billion, of which $494.5 million is to compensate livestock owners for losses in calendar year 2022 due to drought and wildfires. The remaining funds are to be carried out in the same manner as funds appropriated under the 2022 supplemental appropriations act; qualifying losses related to drought include counties with D2 (severe) classification for eight consecutive weeks or D3 or higher classification according to the U.S. Drought Monitor.

[201] For additional information, see CRS Insight IN11978, *Inflation Reduction Act: Agricultural Conservation and Credit, Renewable Energy, and Forestry*, by Jim Monke et al.

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