A NATIONAL POLICY FRAMEWORK TO ADDRESS DROUGHT AND WATER SECURITY IN THE UNITED STATES

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Executive Summary

Summary

The purpose of this paper is to foster the development of a 21st century national framework for addressing drought and water security in the United States. In 2015, the American West experienced an unprecedented drought, with record-breaking temperatures and low snowpack and rainfall. This drought caused widespread impacts across communities, agriculture, industry and the environment. Drought is predicted to continue across much of the West in coming years and communities throughout the United States face significant water security challenges. It is a critical time to evaluate and develop strategies to address these challenges at the national level. This paper sets out a national framework to address water security challenges through the modernization of federal programs to support and finance sustainable, watershed-scale solutions, advance science and technology, and promote local and regional partnerships.

Congress has been called upon to develop comprehensive legislation to address drought and create a more secure water future. This call for legislation has come from states, tribes, local governments, utilities, agricultural producers and conservation groups. Since the 114th Congress began in January 2015, a number of legislative proposals have been introduced to address drought and water management needs at various scales. This paper builds on concepts included in existing proposals and incorporates ideas developed through engagement with state, tribal, local, federal, non-profit, academic and other stakeholders. The objective is to bring these ideas together and foster a public dialogue to further develop a comprehensive policy agenda that addresses national water security needs.

National Policy Framework to Address Drought and Long-Term Water Security

The following five policy principles are set forth as a national framework for drought and water security in the 21st century:

1. **Supporting collaborative watershed-scale solutions that are locally-driven.** Governance solutions should support and incentivize collaborative, locally-driven, watershed solutions by modernizing, coordinating and streamlining federal programs to make them more effective.

2. **Financing solutions through partnerships and streamlined federal funding.** Innovative water financing solutions should utilize an integrated watershed funding approach that streamlines federal funding and increases opportunities for public-private partnerships.

3. **Using and advancing the best science, technology and tools.** Science and technology solutions should focus on accelerating innovation and the advancement of tipping points in science, technology and tools to transform water management.

4. **<u>Advancing sustainable water supply solutions for people and the environment</u>**. Water supply solutions should take an integrated, portfolio approach that balances the needs of both people and the environment, including: (1) increased use of water markets, efficiency, conservation, recycling, reuse and desalination; (2) improvements in existing infrastructure, operations and low-impact infrastructure (such as aquifer storage and recovery); and (3) nature-based solutions and restoration of ecosystems and fisheries.

5. **<u>Partnering with Tribal Nations, Arctic and Island Communities</u>**. The federal government should partner with and support Tribal Nations, Arctic and Island communities as they face unique challenges in responding to and addressing long-term water security needs.

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Drought and Water Security in the United States: Challenges and Opportunities

Drought and Water Security Challenges Today

Fifteen years of drought across the American West have demonstrated the need to rethink water management in the United States in the 21st century. Since 1980, droughts have cost the United States more than $200 billion. In the last two decades, 12 drought events have each caused more than $1 billion in negative economic impacts, with some totaling more than $10 billion (NOAA 2016). Traditional ways of managing and developing water resources are proving to be increasingly difficult to implement, cost prohibitive and divisive. As the nation faces continuing water security challenges, it is critical to modernize federal programs to reflect 21st century values, needs and opportunities.

Continued drought over the last several years has resulted in unprecedented declines in surface and groundwater supplies throughout the West. Decreasing and unpredictable water supplies are exposing municipal, industrial, agricultural and ecological systems to substantial risks. These challenges are compounded by increasing demands for water with growing populations and economic development, as well as increased social and environmental concerns over the diversion of water. These pressures are likely to increase in the future as more variable and extreme hydrologic conditions become the new normal.

Drought and Water Security Challenges in the Future

Current patterns of precipitation, surface runoff, groundwater infiltration and other key aspects of the hydrologic cycle have departed substantially from historical records in recent years. In the coming decades, temperature, rain and snowpack trends are predicted to continue to depart from historical records. This will further impact hydrologic conditions, growing seasons and the availability of water to meet human and environmental needs. These conditions will present significant challenges for the nation, regions and local communities in managing water in the future. While water scarcity and periodic droughts have characterized the West throughout history, future droughts are projected to feature substantially hotter temperatures and in some regions are projected to become more frequent, intense and longer-lasting than in the historical record. Annual temperatures for the West are projected to rise (2.5° - 5.5° degrees Fahrenheit by 2041 - 2070), summertime heat waves are projected to become longer and hotter, and winters are projected to continue to be warmer (USGCRP 2014).

Severe and sustained drought will stress water supplies that are already over-subscribed in many areas, increasing competition for water among communities, industrial and energy producers, farmers and ecosystems. These changes will impact the lives and economies of the 56 million people that live in the West—a population that is expected to increase to 94 million (or by 68 percent) by 2050. These stressors will also have ripple effects beyond the region to the economies and food security of the nation, as more than half of the nation's high-value crops, including vegetables, fruits and nuts are produced in the West (USGCRP 2014).

The Need for a Comprehensive Approach to National Water Security

Providing water to meet human needs while preserving the integrity of sustainable ecosystems will require significant changes in water supply planning, management and infrastructure. Modernizing federal programs is critical to supporting a more water-secure future. For more than a century, the federal government—through its many agencies and programs—has played a key role in partnering with states, tribes and local governments in water management. The federal government's role has evolved over time to include a broad range of activities, including: construction, operation and funding of water infrastructure; management of water and other natural resources on federal lands; scientific monitoring, research and development; and providing technical assistance to partners. Through its multiple roles, the federal government has a crucial role to play in supporting drought and water security.

A comprehensive and integrated approach is needed. As a partner in watershed management, the federal government can help facilitate and support collaborative and locally-driven watershed planning and management. This will require that federal agencies work with partners across geographic and jurisdictional boundaries to achieve watershed-scale solutions. Fiscal constraints at all levels of government will require new and innovative financing solutions that leverage public funding with private capital, which the federal government can help to facilitate.

Innovations in science, technology and information have the capacity to transform water management in the 21st century through targeted efforts and partnerships with the federal government. Meeting growing water supply needs will require stretching existing supplies through water conservation, efficiency, reuse and transfers, and by improving the condition and operations of existing infrastructure. As new infrastructure is needed, low impact and sustainable solutions such as aquifer storage should be pursued in concert with natural and nature-based infrastructure. The federal government has a key role to play in providing technical assistance and advancing the implementation of sustainable water supply solutions. Finally, the federal government has the opportunity and responsibility to partner with and support communities facing particularly difficult and unique water security challenges, such as American Indian Tribes, Arctic and Island communities.

Changes in federal authorities, policies and cultures will be needed to bring about these changes. Congress and the executive branch will need to act. States, tribes, local governments and academic, non-profit, philanthropic and private entities all have a part to play in developing and implementing the ideas that will transform water management in the next century. The time to act is now.

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National Policy Framework to Address Drought and Water Security

1. Supporting Watershed Solutions that are Collaborative and Locally-Driven

Legislative Principle: Governance reforms are needed to address drought and water security. Reforms should support and incentivize collaborative, locally-driven, watershed-scale solutions by modernizing, coordinating and streamlining federal programs to make them more effective.

Watershed-Scale Challenges

Modernization of federal programs is needed for watershed management. Over the last several decades, a significant paradigm shift has occurred in water management. Federal programs and the policies that govern them need to be modernized and streamlined to more effectively support locally-driven and watershed-scale management. Managing and planning water resources at the watershed scale—that is, based on the geography of river systems and the landscapes they cross—is an ancient concept. However, water development and management in the United States has historically occurred largely in an *ad hoc* manner without consideration for the entire watershed. Management of water resources is further complicated by a complex web of state, tribal, local and federal authorities that often do not match watershed boundaries (Hanak et al. 2015, Mount et al. 2016, Szeptycki et al. 2015, TRCP et al. 2015).

Federal programs do not reflect the paradigm shift in water management. This shift in water management has occurred as increased water scarcity and impacts of past development have demonstrated the need for more holistic and integrated approaches that consider the needs of both communities and the environment at the river basin scale (Mount et al. 2016, Szeptycki et al. 2015). Integrated water resources management (IWRM) has become recognized as the adaptive framework for planning and managing water at the watershed-scale. This approach promotes a community-based, stakeholder-driven process that seeks to balance water needs across all sectors and ensure that ecological sustainability is a co-equal goal over the long-term (Mount et al. 2016, Szeptycki et al. 2015, Task Force 2011). However, federal agencies and programs are often unable to effectively support an integrated approach due to their history, cultures and legislative authorities under which they operate.

Strategic alignment of watershed programs and policies is needed. Poor federal coordination at the national and local level impact the ability of state, tribal and local stakeholders to effectively partner with the federal government to execute solutions on the ground. This includes implementing projects, accessing and leveraging funding, and timely navigation of regulatory and permitting processes (Mount et al. 2016). Comprehensive modernization, alignment and harmonization of federal programs is needed to ensure effective coordination at the national and local watershed level in order to address drought and water security needs into the future (Hanak et al. 2015, Mount et al. 2016, Szeptycki et al. 2015, Thompson 2015, Task Force 2011, WGA 2015, WSWC 2015).

Watershed-Scale Solutions

- **Coordinate federal policies and programs at the national level.** Institutionalize coordination at the highest levels of the federal government to ensure that federal programs are coordinating, aligning and harmonizing their programs, policies and funding to better address state, tribal and local watershed needs.

- **Institutionalize a coordinated, one-stop approach to support watersheds.** Institutionalize federal interagency coordination through programs to directly support watershed efforts at the local level; through coordinated delivery of technical assistance on planning, permitting, financing, information and tools; and through water supply and nature-based solutions. Implement coordination through a one-stop approach and provide targeted assistance at the local level through existing institutions.

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2. Financing Watershed Solutions through Partnerships and Streamlined Federal Funding

Legislative Principle: Innovative water financing is critical to addressing drought and water security and should be advanced though an integrated watershed funding approach that streamlines federal funding and increases public-private partnerships.

Watershed Funding Challenges

Challenges in Federal and Private Financing

Federal funding needs more effective streamlining and leveraging. One of the most significant challenges in addressing drought and water security needs in the 21st century is obtaining funding to implement solutions. The federal government has historically played a major role in financing water infrastructure, technical assistance and conservation activities to meet water needs. However, funding water solutions with federal monies is becoming increasingly challenging with growing demands, flat and declining budgets, Congressional moratoria on (and differing definitions of) earmarks, lack of coordination between programs and aging infrastructure (Cody et al. 2015). Non-federal financing of water projects has also been impacted by fiscal constraints at the state, tribal and local levels, and by difficulties in accessing funds through public and private mechanisms. Innovative approaches to financing are needed to advance a portfolio approach to integrated watershed financing. This includes streamlining and coordinating federal funds and more effectively leveraging non-federal public and private financing (Quesnel et al. 2016, Culp et. al 2014).

Financing infrastructure is particularly challenging. Financing water supply infrastructure is one of the most difficult challenges in this space. The United States has the most extensive water supply infrastructure in the world. Across the United States, there are approximately 85,000 dams and 73,400 locally-owned water supply and sanitation systems. Some 4,000 of these dams are federally-owned, including 337 reservoirs and 8,116 miles of canals operated by the Bureau of Reclamation. Much of this infrastructure is more than 50 years old and is in need of repair and upgrading (Cody et al. 2015). The replacement value of federally-owned water infrastructure totals approximately $352 billion (GAO 2014). It is estimated that improvements in drinking and wastewater infrastructure (largely non-federal) could total more than $600 billion in the next two decades (EPA 2016). Replacing, upgrading and developing new infrastructure—particularly with sustainable solutions—requires new approaches to financing such as increasing and incentivizing private investment and implementing full-cost accounting, recovery and pricing (Ajami and Thompson 2015, Johnson Foundation 2012).

Integrated watershed financing is needed. In addition to water supply infrastructure, investments are needed to fund other activities at the watershed level. This includes investments in water efficiency and conservation, restoration of ecosystems and use of nature-based and natural infrastructure to meet watershed needs (Thompson 2015). Nature-based and green infrastructure approaches work with and use natural features to provide water supply and other benefits, including forests, wetlands and coastal ecosystems. Federal funding for these activities is scattered across different agencies and is often targeted for specific purposes. More effective coordination and streamlining of funding for these activities are needed and should be coupled with funding for water supply infrastructure. Planning and funding these activities together is critical to implementing integrated water resources management (Johnson Foundation 2016, Quesnel et. al 2016, Ajami, and Wyss 2016). Streamlining and combining federal funds and aggregating them with non-federal, private and philanthropic funding for financing could have a transformative effect in integrated watershed management.

Watershed Financing Solutions

- **Streamline Access to Federal Funding.** Coordinate and streamline federal funding through mechanisms such as multi-year, performance-based block grants to support activities at the watershed-scale. Aggregate and leverage federal funds through financing partnerships that includes state, tribal, local, utility and non-governmental entities.

- **Unleash the Power of Private Capital.** Increase well-structured public-private partnerships by incentivizing private investment and providing authorities that allow federal, state and local agencies to enter into contracts and aggregate funds for infrastructure and watershed activities.

- **Work with Conservation Finance.** Increase and incentivize public-private partnerships to invest in conservation activities, such as land and water restoration, that have water supply benefits. Support and incentivize the development of environmental markets and evaluation of ecosystem services costs and benefits to increase investments in watershed protections and improvements.

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3. Using and Advancing the Best Science, Technology and Tools

Legislative Principle: The use of science and technology is critical to addressing drought and water security. Solutions should focus on tipping points and accelerating innovation in science, technology and tools to transform water management.

Water Science, Technology and Data Challenges

Information could transform water management but is not reaching users who need it. Data and information is transforming all sectors of society. Through computers and mobile electronic devices (such as phones and tablets), people are able to access and use vast quantities of information delivered to their fingertips to inform everyday decision-making. More effective delivery of science-based information to water users—such as utilities, irrigation districts and industrial, agricultural and municipal water users—has the potential to transform water management (Castle et al. 2015, Interagency Task Force 2011, WGA 2015, WSWC 2015). The technological capacity and information needed to develop transformative water information systems exists. However, delivery of such technologies into the hands of local water decision-makers is inhibited by three major challenges: the development and deployment of tools, information infrastructure and the data pipeline.

Public-private collaborations are needed to design tools and access data. Sophisticated water information and management tools do exist and are used by many large water entities, such as large-scale municipal and regional water utilities. However, smaller utilities, irrigation districts and individual water users largely do not have access to affordable, well-designed easy-to-use information tools to inform their decisions (Castle et al. 2015). Facilitating and incentivizing partnerships between water users and technology developers is critical to developing these tools. However, development of such tools also requires improving the infrastructure pipeline that provides data to support these tools. Water users and technology developers face significant challenges in identifying relevant and authoritative datasets and accessing data efficiently and at speeds needed for user applications (GAO 2015). Expanding and incentivizing federal partnerships with the private sector to improve data infrastructure, host data and otherwise add value to data could significantly accelerate tool development (NOAA 2016).

Agencies need to make datasets more accessible and interoperable. Data on earth systems are collected by more than one hundred different federal agencies (NSTC 2013). As a result, relevant data are often fragmented across different agencies and difficult to locate and identify. A focused federal effort is needed to identify and catalog key datasets and ensure that agencies are accountable for making these data open: easily discoverable, available and interoperable (GAO 2015). Addressing agency practices, cultures and resource needs are critical components to overcoming current barriers. Empowering a single entity to more effectively aggregate and share data across agencies would significantly advance these efforts.

Efforts are also needed to support aggregation of data and tools developed by non-federal entities such as states, tribes and utilities (TRCP et al. 2015). Finally, federal agencies have a key role to play in supporting resource managers within the federal government and partnering with non-federal water managers to help translate data into useful tools and decisions on the ground (Castle et al. 2015, GAO 2015).

Science is advancing, but not at the pace it could. The federal government supports an extensive network of research, technology and data collection activities that are critical to water management across the nation. However, federal research and development (R&D) activities are often conducted without effective coordination across agencies or with non-federal R&D activities. Furthermore, R&D activities are often conducted with insufficient consideration for how new information and technologies can be scaled and translated into decision-making applications. Numerous efforts and institutions have been created to bring greater coordination to these efforts. However, increased focus, coordination and partnerships with non-federal institutions are needed to address critical gaps.

Coordinated and targeted research is needed. Research efforts should prioritize science needed to understand, predict and forecast and respond to drought and water security needs. Focused efforts in basic research are needed to understand and model earth and hydrologic processes including: the coupled ocean-atmosphere-land system, extreme and cyclic weather events, precipitation patterns and change (such as El Niño and atmospheric rivers), groundwater systems, water availability and use and ecological processes. Focused research to enhance prediction and forecasting is especially important, including research on drought triggers, onset, duration, severity and recovery. Assessment of and improvements in observational and monitoring capabilities are also critical. This includes the development of next-generation technologies to measure streamflow, snowpack, soil moisture, groundwater and water quality. Targeted technological advancements are also needed to advance and lower the costs of water storage, supply and treatment technologies; natural and nature-based infrastructure; and agricultural technologies. Finally, targeted research is needed in the social and behavioral sciences to move research to operations and improve the effectiveness and adoption of new technologies and science-based decision-making (GAO 2014, GSA 2006, NOAA 2016, NRC 2001, NRC 2004, NRC 2010, NRC 2013, Thompson 2015, USGS 2013). Efforts to improve federally-supported science in these areas will require increased interagency coordination and prioritization in science planning and investment.

Science, Technology and Data Solutions

Unleashing the Power of Information to Transform Water Management

- **Put tools into the hands of water users and planners.** Increase and incentivize partnerships with water users (utilities, irrigation districts and municipal, industrial and agricultural water users) and the private sector to develop easy-to-use tools that unlock the power of information to support local decision-making.

- **Partner with the private sector to develop tools and make data available.** Ensure that federal agencies have the infrastructure and governance mechanisms to make their data available and to partner with non-federal entities and the private sector to: identify high-value datasets, improve and add value to data, host data in the cloud for increased accessibility and develop products that can be delivered into water management tools.

- **Fix the federal data pipeline.** Ensure agencies are accountable and have the resources to make their data easily discoverable, accessible and interoperable. Streamline data delivery to aggregate and deliver high-value datasets and provide streamlined technical assistance and facilitate partnerships.

Harnessing Science and Technology to Respond to Drought

- **Advance science to understand, predict and respond to drought.** Dramatically advance the science needed to understand, forecast, predict and respond to drought and other watershed processes by directing and coordinating federally funded science activities in partnership with the academic and private sectors.

- **Advance next-generation technologies to monitor and respond to drought.** Accelerate research, development and technology transfer of next-generation water monitoring and modeling capabilities, water supply and treatment technologies, and advancements in agricultural technologies and practices.

- **Advance and accelerate integrated hydrologic and earth systems modeling.** Direct and sustain efforts to connect watershed models through integrated watershed modeling, and link them with other earth systems modeling efforts.

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4. Advancing Sustainable Water Supply Solutions for People and the Environment

Legislative Principle: Water supply solutions to address drought and water security should take a diversified, integrated, portfolio approach that balances the needs of both people and the environment, including: (1) increased use of water markets, efficiency, conservation, recycling, reuse and desalination; (2) improvements in existing infrastructure, operations and the use of low-impact infrastructure (such as aquifer storage and recovery); and (3) use of nature-based solutions and restoration of ecosystems and fisheries.

Sustainable Water Supply Challenges and Solutions

Water markets, efficiency, conservation, recycling, reuse and desalination. Responding to drought and meeting water security needs requires taking a portfolio approach to managing and developing water supplies for the benefit of people and the environment (Gonzales and Ajami 2015, NRC 2013). In many cases, the lowest cost and most efficient solutions involve moving water to where it is needed most, utilizing water markets and banking and improving water efficiency and conservation. While water markets and banking are widely identified as one of the most promising and cost-effective ways to address short-term water needs, there are a number of barriers to more widespread adoption. Increased use of water markets could be facilitated by support for information-sharing (especially on markets and best practices) and by modernizing operations of federal infrastructure to enable transfers and banking where appropriate (Culp, Glennon and Libecap 2014, TRCP et al. 2015, WGA 2015).

Increasing water efficiency and conservation across all sectors (including municipal, industrial and agricultural) is critical to extending current water supplies, saving energy and reducing the costs of water system operations (Interagency Task Force 2011). Many states and communities are already implementing efficiency and conservation programs. However, more widespread adoption could be facilitated by more targeted and coordinated technical assistance and tools. The portfolio for extending water supplies also includes water reuse, recycling, stormwater capture, groundwater recharge and brackish and seawater desalination projects (WGA 2015). Increased adoption of these techniques requires improvements in technology and science, reductions in costs and partnerships at all scales (Ajami and Thompson 2015, Cody et al. 2014, Thompson 2015, WGA 2015).

Sustainable water supply infrastructure and operations. Water supply infrastructure maintenance, management and operations are a critical component of addressing water supply challenges now and into the future. Much of the existing federal water infrastructure was built over the last century and is in need of rehabilitation, retrofitting and reinvestment (CRS 2014). Improving the condition, efficiency and uses of these assets will help to extend water supplies. Modernizing operations of this federal backbone is also key. Historically, projects were authorized and developed in isolation from one another, often for different and sometimes competing purposes (such as storage and flood control). To effectively stretch and manage water supplies, existing assets must be managed together in an integrated manner at the watershed-scale and in coordination with assets managed by non-federal entities (Hanak et al. 2015, TRCP et al. 2015). Infrastructure owned and managed by state and local governments, tribes, utilities, irrigation districts and other entities is also in need of critical repair and upgrades (WGA 2015).

Fiscal constraints, outdated legal authorities and agency policies that prohibit more efficient and coordinated operations need to be assessed and addressed. Where new infrastructure is needed, less costly and more sustainable options—such as potable reuse and aquifer storage and recovery—are critical and should be prioritized, as well as other options that provide both water supply and environmental benefits.

Working with nature to develop and manage water supplies. Maintaining and restoring the ecological integrity of watersheds is necessary to support drought response and long-term water security. The health of ecosystems—such as upland forests, riparian habitats, and estuary and coastal habitats—is critical for managing water supplies, maintaining water quality, buffering against changes and disturbances and supporting the resilience of human and natural systems. Protecting and restoring this natural capital requires a holistic and integrated approach that manages watersheds and landscapes together and incorporates evaluation of the ecosystem services that these natural systems provide. Ecosystem services are the benefits that ecosystems provide to society such as clean water, food and storm protection (Szeptycki et al. 2015, Thompson 2015). Water planning and development activities have historically not accounted for the value of ecosystem services or the costs of degrading those services. Accounting for the benefits of these services and internalizing costs in watershed planning is critical to implementing more cost-effective and low-impact solutions that benefit both people and the environment. Quantification of ecosystem services also has the potential to support environmental markets and mitigation strategies to offset the impacts of potential development. Planning and developing projects with nature has the potential to reduce conflict, litigation and costs. Federal water and land management programs need to be modernized and harmonized to support more integrated and cooperative approaches and to support partnerships with state, tribal, local, private and non-profit entities (Guerry et al. 2015, Millennium Ecosystem Assessment 2005, PCAST 2011, Schaefer et al. 2015. TRCP et al. 2015).

Sustainable Water Supply Solutions

Portfolio Approach: Markets, Efficiency, Conservation, Recycling, Reuse and Desalination

- **Support increased water efficiency and conservation.** Provide more targeted and coordinated technical assistance, tools and partnerships to support innovation in and implementation of water efficiency and conservation efforts across municipal, industrial and agricultural sectors. Facilitate and assist these sectors in planning their activities in concert with water supply planning at the watershed-scale.

- **Support states and others in implementing robust water markets.** Evaluate best practices and provide information and targeted technical assistance at the request of states and other entities to support water markets, transfers and banking.

- **Support increased water reuse, recycling, desalination, and stormwater capture.** Provide more targeted and coordinated technical assistance and partnerships to support innovation in technology and science, reductions in costs and environmental impacts, and opportunities for partnerships.

Sustainable Water Supply Infrastructure and Operations

- **Improve and upgrade existing infrastructure.** Assess, upgrade, retrofit and expand the use of existing federal infrastructure to improve water supply and environmental benefits.

- **Improve coordination and operations of existing federal infrastructure**. Modernize outdated federal authorities and programs to optimize and coordinate operations of existing infrastructure at a watershed-scale, for the benefit of people and the environment.

- **Support sustainable storage and conveyance infrastructure.** Assess and provide technical assistance to state and local entities in the development of sustainable water storage options, including aquifer storage and recovery and stormwater capture.

Working with Nature to Develop and Manage Water Supplies

- **Support improved water supplies through watershed restoration**. Modernize authorities to facilitate federal coordination and partnerships with non-federal entities to improve water supplies through watershed restoration across natural and working landscapes.

- **Evaluate opportunities for natural and nature-based infrastructure solutions.** Ensure federal agencies and federal assistance programs require consideration of nature-based alternatives and natural infrastructure in project planning and development. Ensure water planning, project development and management activities incorporate ecosystem services assessments.

- **Support basin-scale coordination for ecosystems and fisheries.** Modernize authorities to enable federal and non-federal coordination, partnerships and management at the basin-scale to maintain and restore aquatic ecosystems and fisheries. This includes improvements in science and technology and optimizing water management to maintain and restore hydrologic and ecological functions.

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5. Partnering with Tribal Nations, Arctic and Island Communities in Water Security

Legislative Principle: The federal government should partner with and support Tribal Nations, Arctic and Island Communities as they face unique challenges in responding to drought and in addressing long-term water security needs.

Water Challenges for Tribal Nations

Water challenges in Indian Country. Some 567 tribal nations manage more than 56 million acres of land and serve more than 2 million people. Although water is integral to the health, well-being, economies and cultures of these communities, 12 percent of tribal homes do not have access to safe drinking water or basic sanitation (NCAI 2016). There are significant opportunities to improve partnerships between tribes and the federal government and to enhance access to federal programs, in order to help meet drought and long-term water needs. Many tribal governments lack access to drought information and resources to plan for and respond to drought conditions (NWF 2011). Particularly needed is targeted support for data, tools and sharing of information and best practices (State, Local, and Tribal Leaders Task Force 2014). Improving and streamlining access to and eligibility for federal programs are also important.

Infrastructure is a critical need. The development and maintenance of water infrastructure on tribal lands is critical to responding to drought and water security. Water infrastructure on tribal lands is often lacking, inadequate and poorly maintained, due to limited financial resources. This includes infrastructure for storing and conveying water, as well as drinking water and sanitation systems. Poor water infrastructure impacts the health, general welfare and economic vitality of communities. These challenges are particularly acute in Alaska where basic sanitation and drinking water infrastructure are lacking in many rural villages (GAO 2014). Improved coordination and resources across federal agencies are needed to address these infrastructure challenges (Cozzetto 2012, GAO 2011, NCAI 2016).

Protecting Tribal Nations' waters. Infrastructure development is tied to the protection of tribal waters, which is another major water challenge in Indian County. Tribal rights to water are protected under federal law. However, water rights claims remain unresolved for the majority of tribal nations. For decades, U.S. policies have favored resolving tribal rights through negotiated settlements, but many settlements remain unresolved due to a lack of Congressional authorization and resources. Unresolved claims create difficulties in developing and managing water supplies and create uncertainty for neighboring states and communities, particularly during drought. These settlements are important to bringing certainty and supporting watershed management activities. Policies to improve programmatic engagement with tribes and improve authorization and funding mechanisms to complete settlements would bring significant benefits to Indian Country and neighboring communities (NARF 2015, NCAI 2015, WSWC 2015).

Protecting treaty rights. Many tribes also retain fishing and other resource rights through treaties with the U.S. government. Treaty rights and subsistence practices in some areas of the West and Great Lakes are threatened by declining fisheries and degradation of habitat. Coordinated efforts by the federal government are needed to protect and restore these rights and associated resources (NWIFC 2011).

Water Challenges in Arctic Communities

Water challenges in Arctic communities. Communities and ecosystems in the Arctic, and the majority of Alaska, are experiencing dramatic changes. Alaska is home to 227 federally recognized Alaska Native villages and communities, many of which are located in geographically isolated areas. Many residents engage in traditional subsistence hunting, fishing and gathering and are highly dependent on local natural resources (Cozetto 2013). Many of these communities face serious water-related challenges, including inadequate water and sanitation facilities, coastal erosion, flooding, permafrost degradation, reduced sea ice, drier landscapes and impacts to subsistence resources (GAO 2014, USGCRP 2015). These challenges are heavily impacting the livelihoods of people across the region (Palsbo 2015).

Partnerships are needed to help respond. Changing landscapes and hydrology are impacting the location and distribution of water supplies. Increased erosion from permafrost thawing is increasing sediment in water sources, impacting water quality, stressing water treatment systems and increasing risks for waterborne diseases. Subsidence due to thawing and erosion is also causing widespread physical damage to water infrastructure and at times interrupting service (Cozetto 2013). Coastal erosion is also threatening a number of villages, which are facing the prospect of relocating their communities altogether. The remote locations and extreme environments of many villages pose exceptional challenges and costs in addressing these needs. Complex jurisdictional issues also affect the ability of these communities to access state and federal funds (GAO 2014). The federal government could provide greater leadership and coordination in partnering with these communities to help address these challenges.

Water Challenges in Island Communities

Partnerships are needed to support Island communities. Island nations and communities, including those in the State of Hawaii, Puerto Rico, the Virgin Islands, Guam, American Samoa, the Northern Mariana Islands, Marshall Islands, Palau and Micronesia face unique drought and water security challenges. The availability of freshwater for household, agricultural, cultural and industrial uses may become increasingly strained in many island communities with growing demands and hydrologic change. In the coming decades, some islands are projected to see greater variability in precipitation and increased temperatures that could lead to drought and water shortages. Other islands are expected to receive increased precipitation, with heavier downpours that may cause flooding and impacts to water infrastructure systems. Rising sea levels also threaten water supplies and ecosystems with saltwater contamination, which is costly to treat and may degrade water infrastructure (UGCRP 2015). Improved partnerships between the federal government and island communities, as well as technical assistance, are needed to support these communities as they face increasing water challenges.

Solutions for Partnering with Tribal, Arctic and Island Communities

Partnering with Tribal Nations

- **Improve engagement and assistance to plan, monitor and respond to drought**. Improve and streamline federal programs that provide technical assistance for drought and watershed planning and management activities. Federal programs should engage in consultations and collaborate with tribal nations in planning and managing water.

- **Support improvements in tribal water infrastructure**. Improve federal coordination and streamline access to water infrastructure programs and assistance, including for clean water, sanitation, irrigation and flood control.

- **Support the protection and resolution of tribal water rights.** Improve federal coordination and engagement with tribes to complete technical work and negotiations as well as improve authorization and funding mechanisms to complete settlements.

- **Align and coordinate fisheries protection and restoration activities**. Align and harmonize federal programs and authorities to better coordinate the protection and restoration of tribal treaty rights.

Partnering with Arctic Communities

- **Improve partnerships and coordination to address water and sanitation needs.** Improve federal coordination and partnerships with villages to help address drinking water and sanitation needs.

- **Support villages in addressing coastal erosion issues.** Provide coordinated federal assistance at the request of a village to evaluate options and provide tools for addressing coastal erosion and other infrastructure impacts.

Partnering with Island Nations and Communities

- **Improve partnerships and programs to assist in drought and water planning.** Improve partnerships and extend federal programs to assist island communities in planning, preparing and responding to drought and in addressing long-term water security issues, including sea-level rise.

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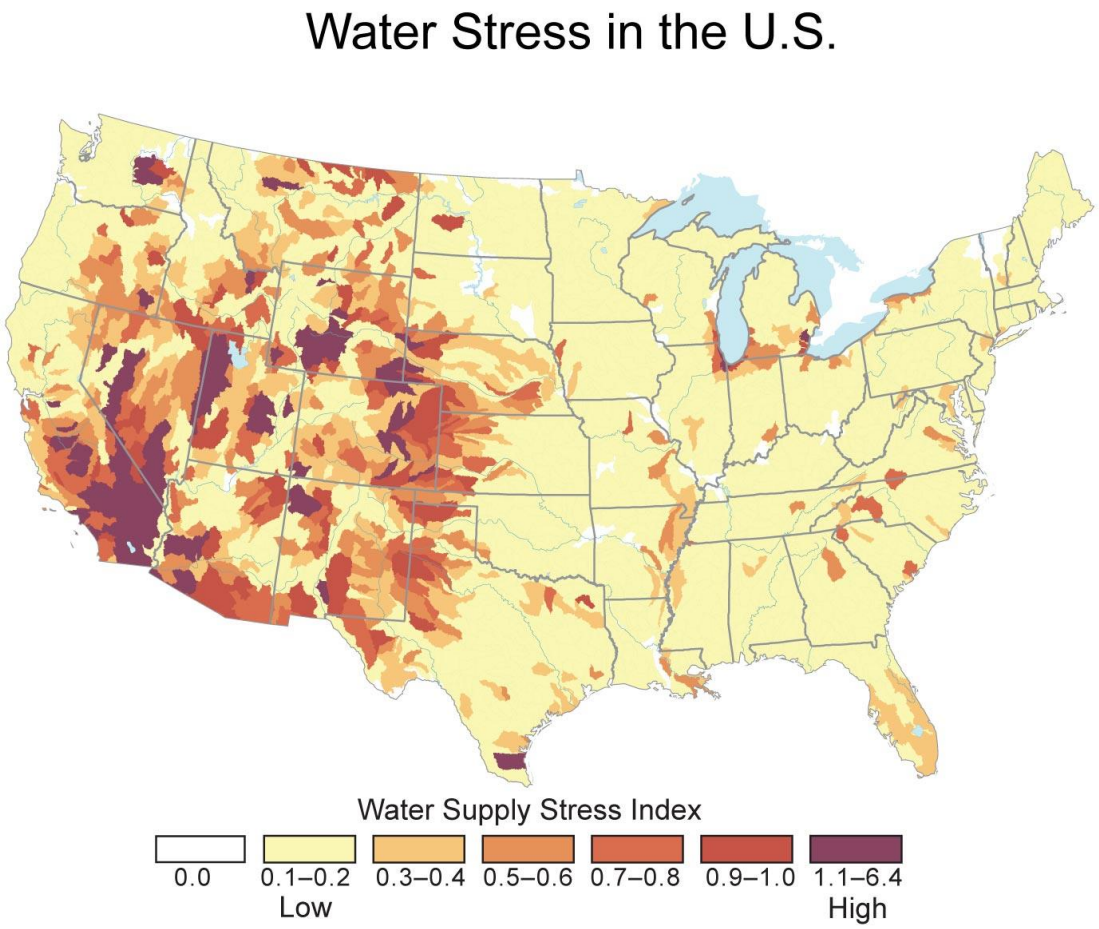
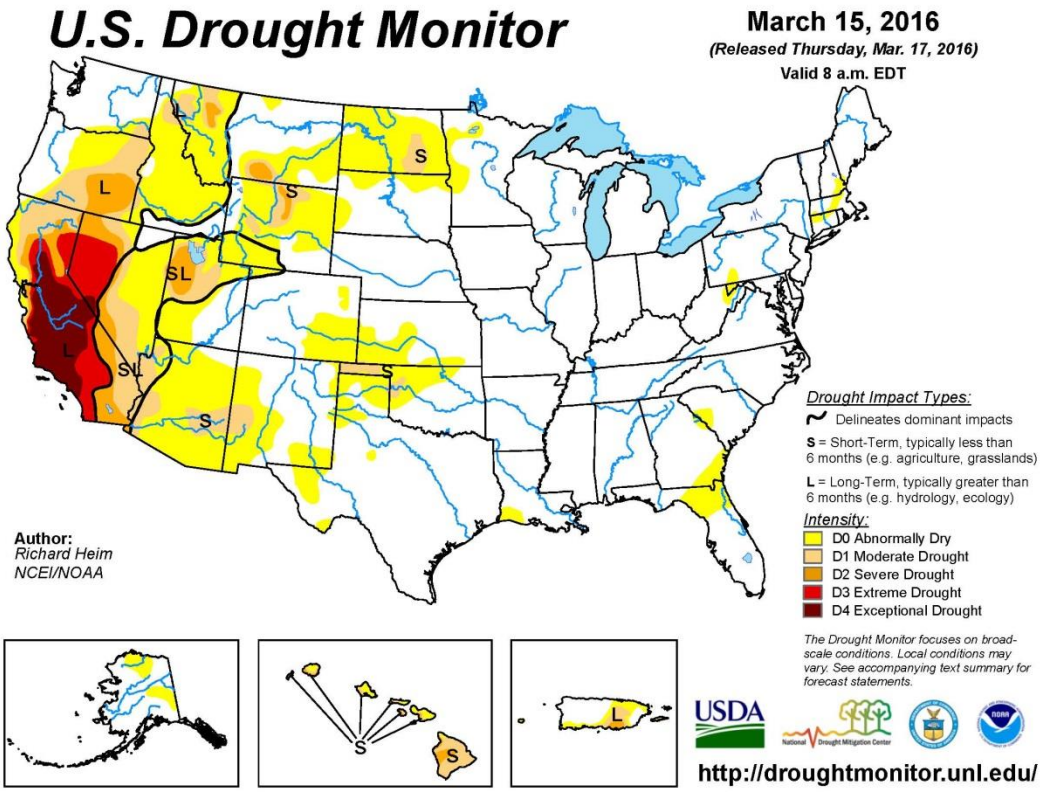
Figures

Figure 1. Water Stress in the United States



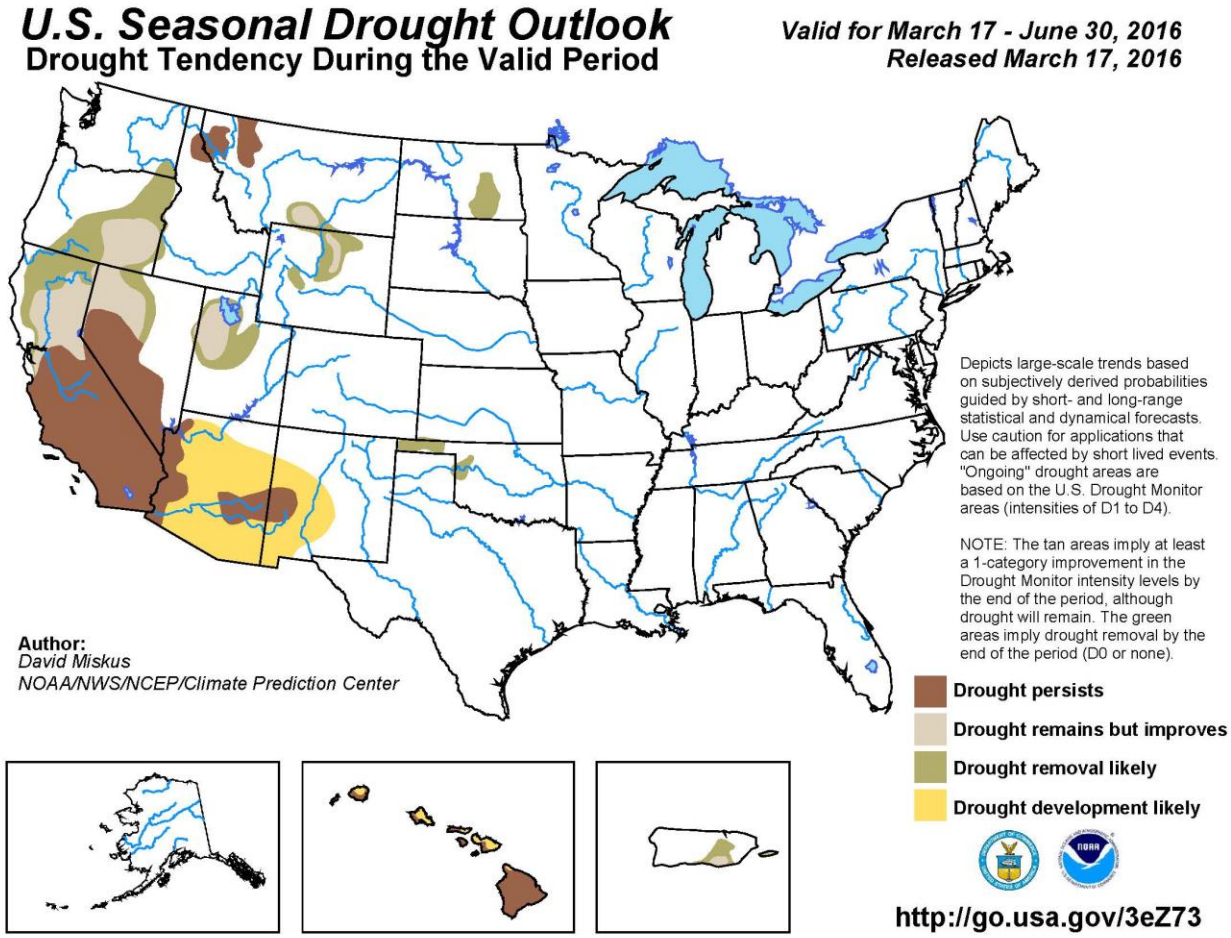
Source: Averyt, K., J. Fisher, A. Huber-Lee, A. Lewis, J. Macknick, N. Madden, J. Rogers, and S. Tellinghuisen, 2011: Freshwater Use by US Power Plants: Electricity's Thirst for a Precious Resource. A Report of the Energy and Water in a Warming World initiative. 62 pp., Union of Concerned Scientists. Available at (http://www.ucsusa.org/assets/documents/clean_energy/ew3/ew3-freshwater-use-by-us-power-plants.pdf)

Figure 2. Current Drought Conditions in the United States



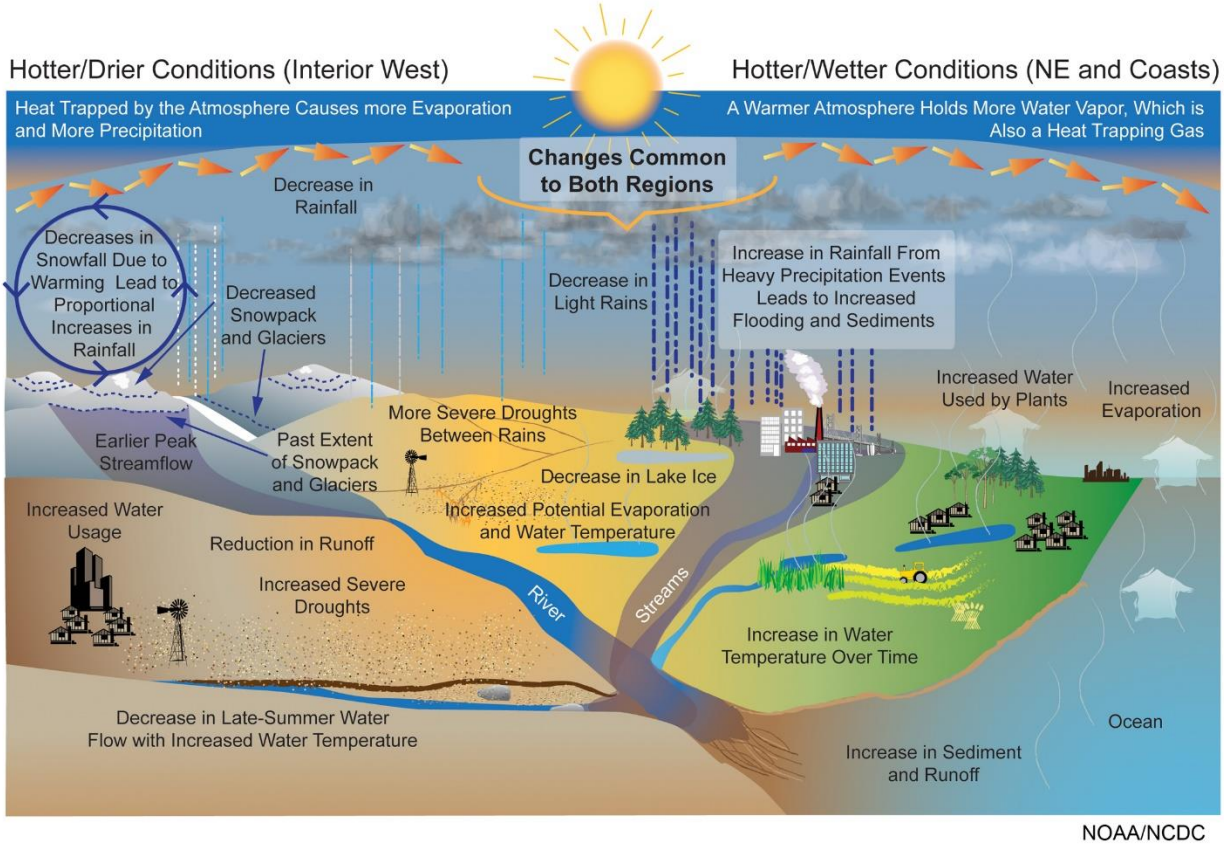
Source: National Drought Mitigation Center. 17 Mar 2016. Available at (http://droughtmonitor.unl.edu/)

Figure 3. Seasonal Drought Outlook



Source: National Weather Service, National Oceanic and Atmospheric Administration. 17 Mar 2016. Available at (http://www.cpc.ncep.noaa.gov/products/expert_assessment/sdo_summary.php)

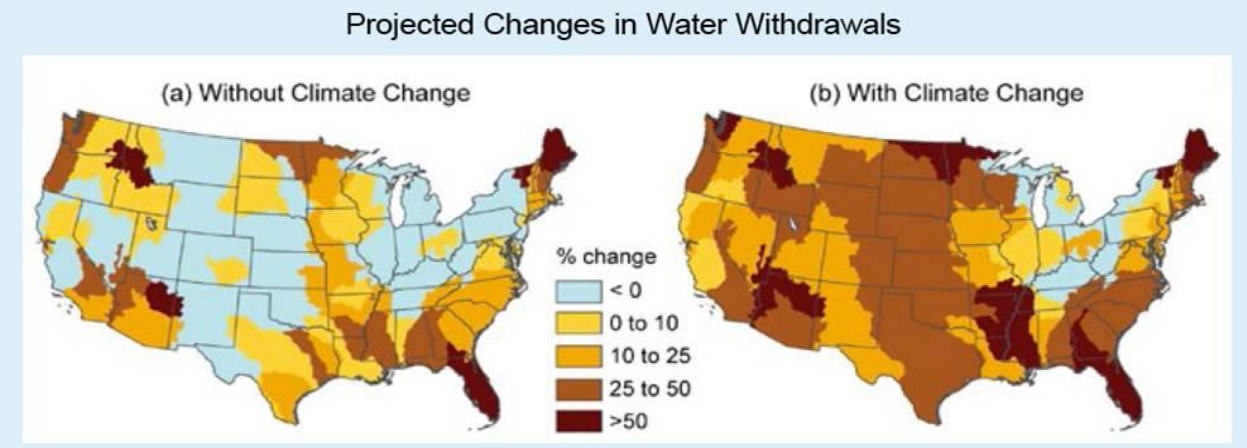
Figure 4. Projected Changes in the Water Cycle



The water cycle exhibits many changes as the earth warms. Wet and dry areas respond differently.

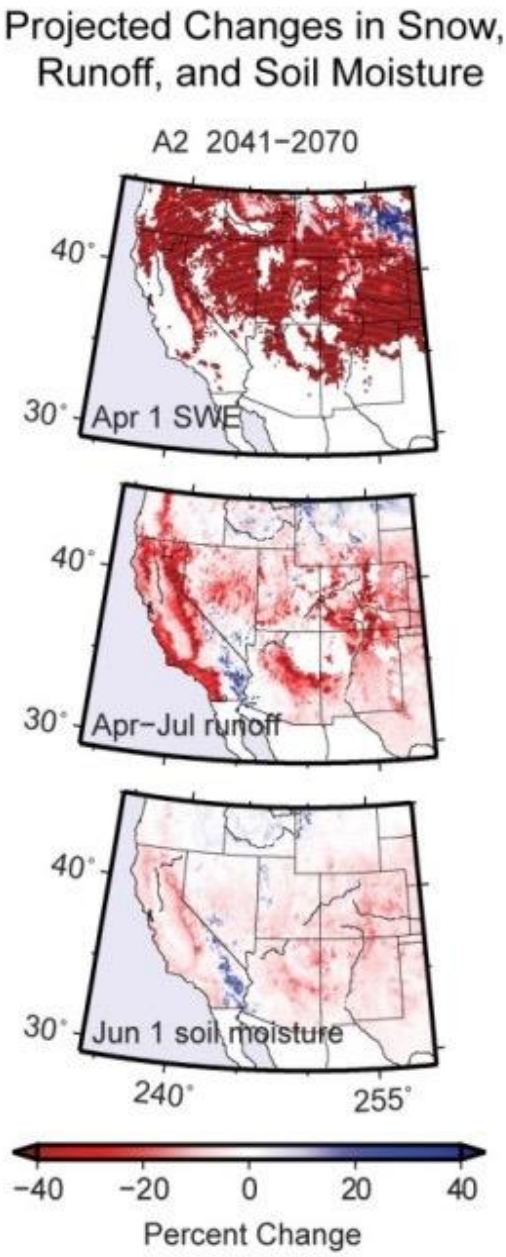
Source: U.S. National Oceanic and Atmospheric Administration. 2009. Available at: (https://downloads.globalchange.gov/usimpacts/pdfs/climate-impacts-report.pdf)

Figure 5. Projected Changes in Water Withdrawals



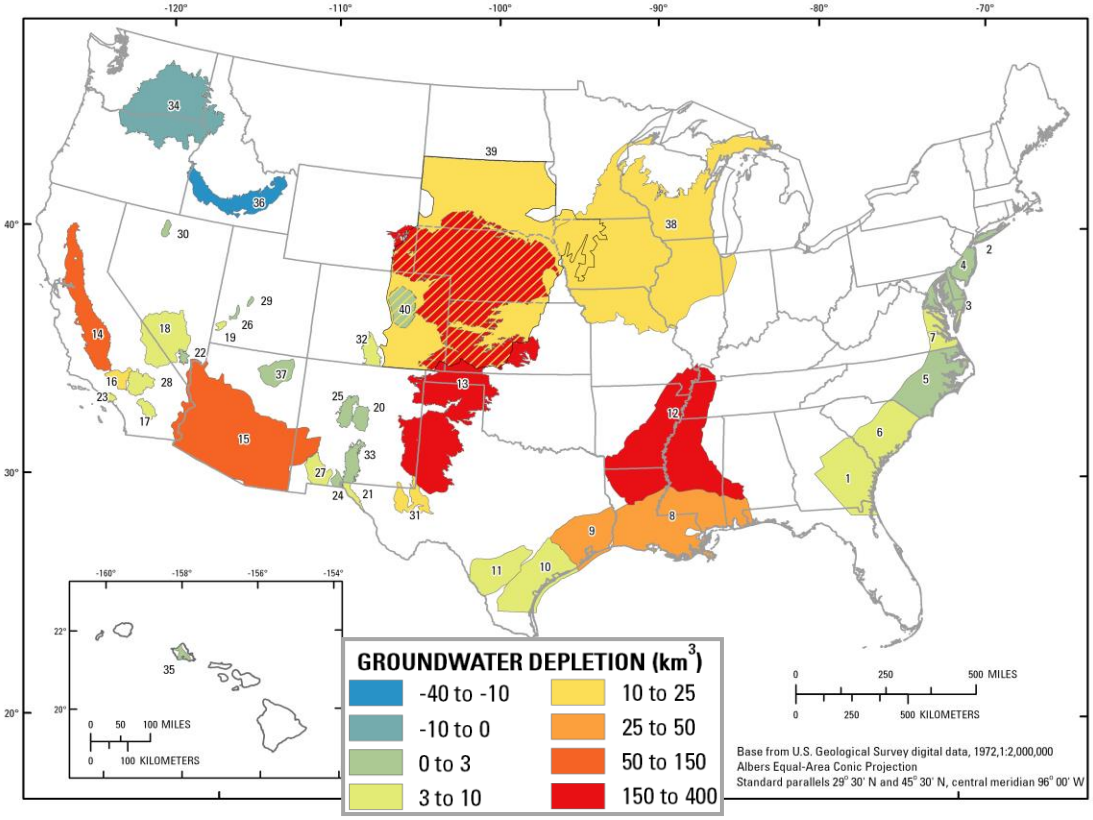
Source: Brown, T. C., R. Foti, and J. A. Ramirez, 2013: Projecting fresh water withdrawals in the United States under a changing climate. Water Resources Research, 49, 1259-1276, doi:10.1002/wrcr.20076. (Available online at http://onlinelibrary.wiley.com/doi/10.1002/wrcr.20076/pdf)

Figure 6. Projected Changes in Snow, Runoff, and Soil Moisture



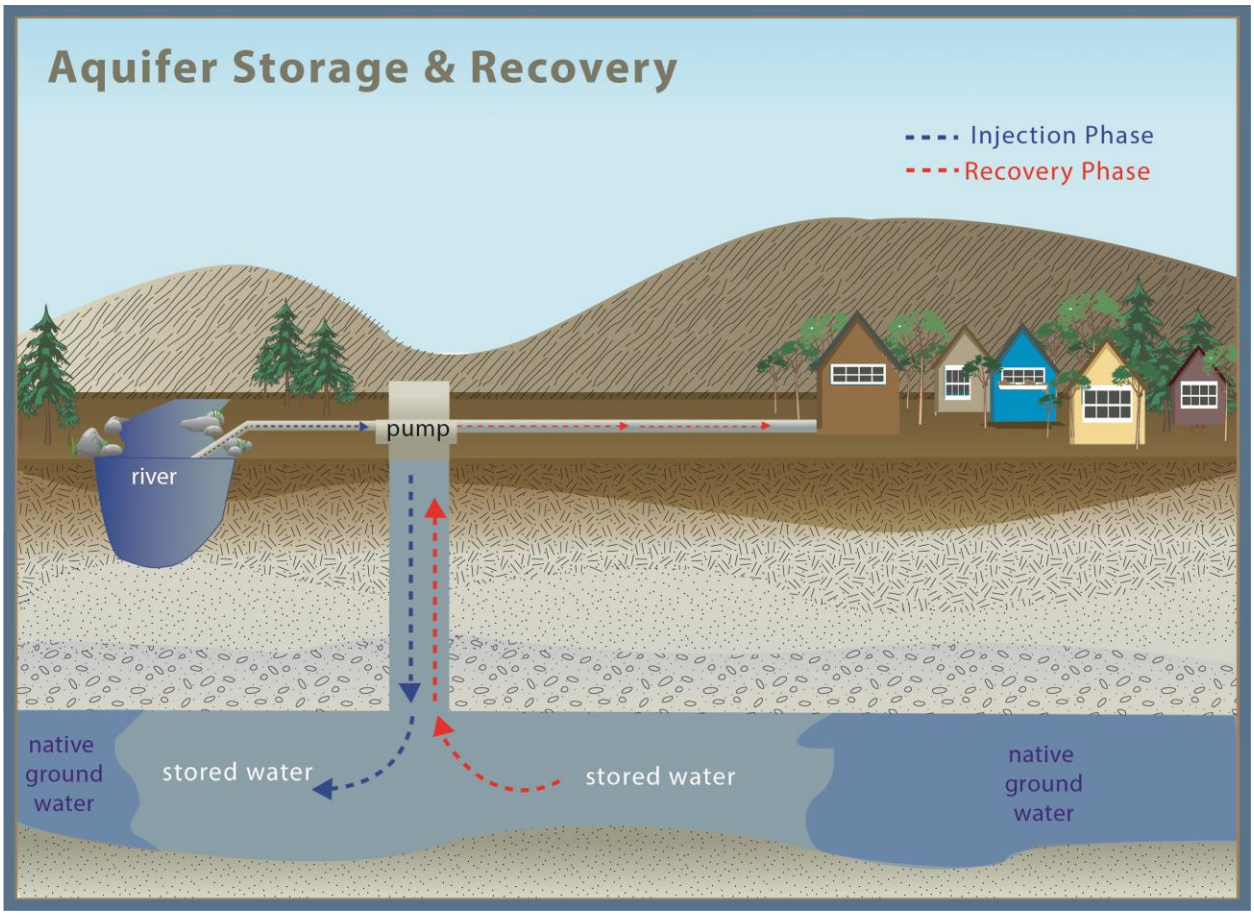
Source: Cayan, D., K. Kunkel, C. Castro, A. Gershunov, J. Barsugli, A. Ray, J. Overpeck, M. Anderson, J. Russell, B. Rajagopalan, I. Rangwala, and P. Duffy, 2013: Ch. 6: Future climate: Projected average. Assessment of Climate Change in the Southwest United States: A Report Prepared for the National Climate Assessment, G. Garfin, A. Jardine, R. Merideth, M. Black, and S. LeRoy, Eds., Island Press, 153-196. (http://nca2014.globalchange.gov/report/sectors/water/graphics/projected-changes-snow-runoff-and-soil-moisture)

Figure 7. Groundwater Depletion in the United States between 1900 and 2008



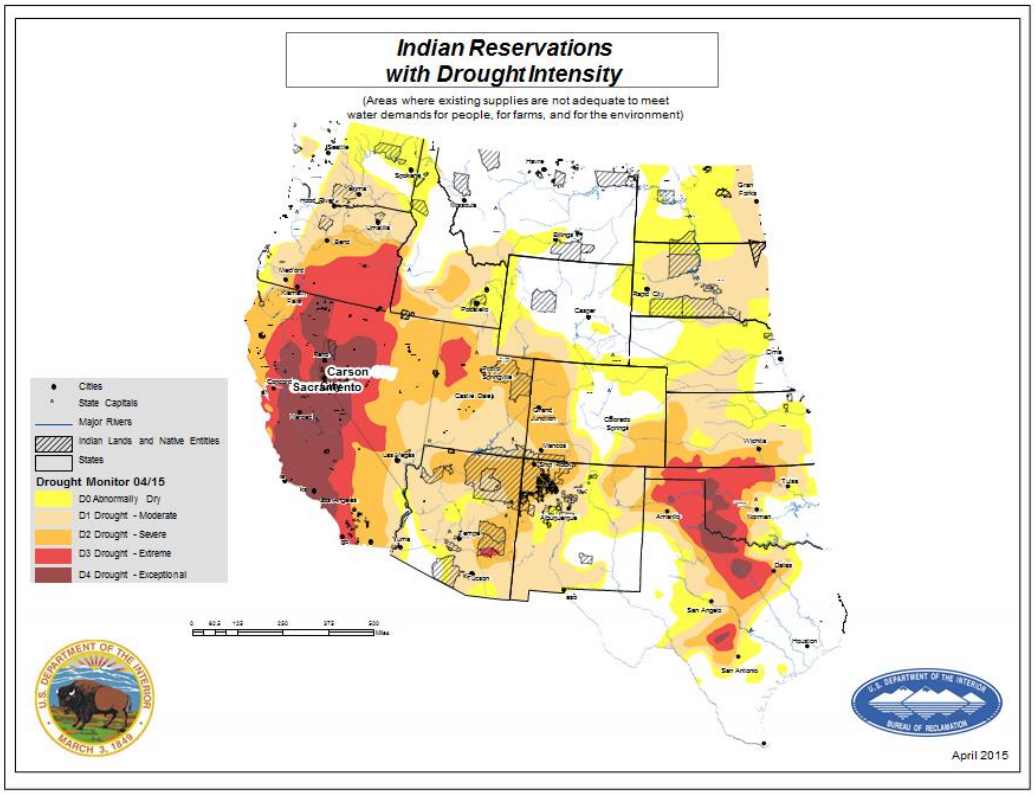
Source: Konikow, L.F., 2013, U.S. Geological Survey. Available at (http://pubs.usgs.gov/sir/2013/5079).

Figure 8. Sustainable Storage through Aquifer Storage and Recovery



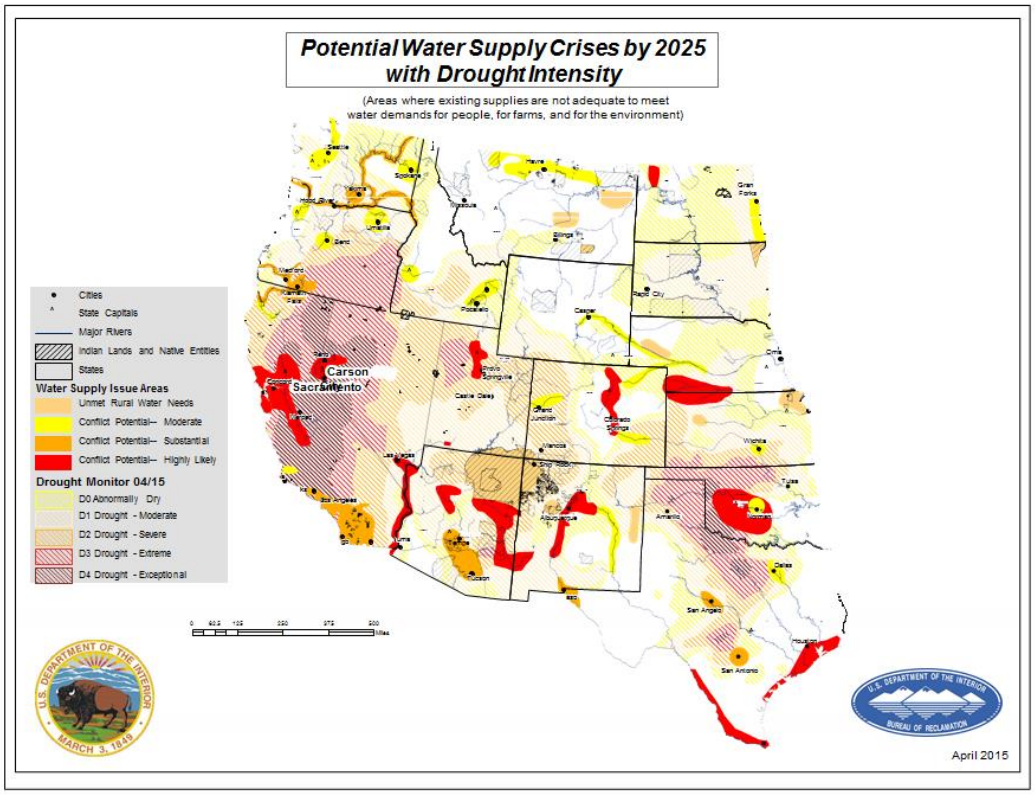
Source: Washington State Department of Ecology, Office of Columbia River, 2016.

Figure 9. American Indian Reservations with Drought Intensity



Source: U.S. Department of the Interior, April 2015.

Figure 10. Potential Water Supply Crises in the West by 2025 with Drought Intensity



Source: U.S. Department of the Interior, April 2015.

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