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California Drought: Hydrological and Regulatory Water Supply Issues

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Summary

California is in its fourth year of drought. As of late July 2015, 47% of California was experiencing *exceptional* drought—the most severe U.S. federal drought classification—and approximately 71% of the state was experiencing *extreme* drought. The 2014 water year (October 2013 through September 2014) was the third driest on record. Water users that receive water supplies from the state of California and federal water projects are experiencing unprecedented water supply shortages due to the drought. Severe water supply shortages also hampered the state during a recent three-year drought (2008-2010). Paleontological and tree-ring records indicate that California has experienced many multiyear droughts over several millennia; however, some experts estimate that the current drought may be the most severe in the past 1,200 years.

This report focuses on hydrological and regulatory compliance issues that affect operation and management of two large water supply projects that serve farms and communities throughout California: the federal Central Valley Project (CVP), owned and operated by the Bureau of Reclamation (Reclamation) in the Department of the Interior, and the State Water Project (SWP), owned and operated by the California Department of Water Resources (DWR). Reductions in water supplied by these projects in drought years result in economic disruption across the state such as concentrated crop and financial losses in agricultural areas throughout the Central Valley, including portions of the San Joaquin Valley. At the same time, several fish species—one of which may be close to extinction—whose habitat lies at the heart of California's water supply system and throughout its northern rivers are in decline. Declining fish species, exacerbated by drought, also may have economic implications, resulting in job and income losses in coastal areas. In addition, the drought and low water supplies affect recreation, power production, other industries, and small and large communities.

With below-average snowpack and severe water shortages again in 2015, a short-term issue for Congress is how to respond to demands for increased water deliveries given other policy concerns, such as avoiding harm to threatened and endangered species. Other issues include how to address water supply availability broadly and how to finance water supply or other projects. These are challenges given fiscal constraints and policies discouraging site-specific project authorizations and appropriations. A long-term issue for Congress is how to address federal water delivery reliability without destabilizing the aquatic ecosystems and related resources (e.g., clean water, commercial and recreational fisheries, etc.) upon which many communities depend.

Several bills were introduced in the 113th Congress to address short- and long-term water shortage issues and CVP and SWP water management (e.g., H.R. 3964, H.R. 5781, and S. 2198). These bills each passed their respective chambers but were not enacted. Legislation with similar aims—to maximize CVP and SWP water supplies—has been introduced in the 114th Congress (H.R. 2898 and S. 1894). H.R. 2898 passed the House on July 16, 2015, and S. 1894 was introduced on July 30, 2015. Other bills introduced in the 114th Congress that address California drought and water management include several authorizing conservation and water H.R. 291 recycling initiatives, among other activities (e.g., and S. 176; H.R. 2983 and S. 1837; and H.R. 3045).

Questions and debate are likely to continue as Congress considers legislation addressing CVP and SWP management and other activities to lessen the impacts of drought. This report provides background and analysis on factors affecting CVP and SWP water management. For information on legislation, see CRS In Focus IF10019, *H.R. 5781: Legislation Proposed to Maximize Water Supplies to Address Drought in California*; CRS Report R43820, *Analysis of H.R. 5781, California Emergency Drought Relief Act of 2014*; and CRS Insight IN10308, *Drought Legislation: H.R. 2898*.

California Drought: Hydrological and Regulatory Water Supply Issues

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Introduction

California is experiencing its fourth consecutive year of drought. As of late July 2015, 47% of California was experiencing exceptional drought and more than 94% of the state was facing drought conditions that ranged from severe to exceptional. According to the National Oceanic and Atmospheric Administration's (NOAA's) Climate Prediction Center (CPC), the outlook for California through the end of October calls for little if any chance for improvement in drought conditions.[1] Unless there is an anomalous weather event, California likely will experience persistent drought conditions for the rest of the 2015 water year (October 2014-September 2015).[2]

The Congressional Research Service (CRS) has analyzed a variety of data and information on current California hydrological conditions, regulatory factors affecting management of California's developed water supplies, and restrictions due to baseline water rights allocations and delivery priorities of the Central Valley Project (CVP), a large water supply project that serves farms and communities throughout California. This report provides a summary of California's 2012-2015 drought with comparisons, where applicable, to previous droughts; a summary of the key regulatory requirements that at certain times limit water deliveries (or *exports*) from the San Joaquin and Sacramento Rivers' Delta; and a brief discussion of California water rights and how they relate to different types of federal contracts and their associated water allocations.

The report specifically addresses issues related to management of the U.S. Bureau of Reclamation's (Reclamation's) CVP and to reductions in water deliveries to CVP water users—specifically, to irrigation districts, water districts, and others that have long-term contracts for delivery of CVP water (i.e., CVP contractors). The CVP delivers water to contractors throughout the state, largely serving agricultural water contractors as well as some municipal and industrial (M&I) contractors. A somewhat parallel state system, the State Water Project (SWP) serves primarily M&I water users and some agricultural users. The CVP and SWP are operated in conjunction under a Coordinated Operations Agreement (COA) pursuant to P.L. 99-546.[3]

Major CVP and SWP pumps that supply water for central and southern California are located at the southern portion of the Sacramento and San Joaquin Rivers' Delta confluence with San Francisco Bay (Bay-Delta, or Delta, see **Figure 1**). An estimated 25 million people get some, if not all, of their drinking and agricultural water supplies from the Bay-Delta—often referred to as the hub of California's water supply system.[4] **Figure 2** shows an overview of CVP and SWP facilities statewide.

[1] National Oceanic and Atmospheric Administration, National Weather Service Climate Prediction Center, *U.S. Seasonal Drought Outlook*, (valid for July 16 – October 31, 2015), http://www.cpc.ncep.noaa.gov/products/expert_assessment/sdo_summary.html.

[2] For more information on drought generally, see CRS Report R43407, *Drought in the United States: Causes and Current Understanding*, by Peter Folger and Betsy A. Cody.

[3] According to the Bureau of Reclamation, "The [Coordinated Operations Agreement, or COA] defines the rights and responsibilities of the CVP and SWP with respect to in-basin water needs and provides a mechanism to account for those rights and responsibilities." See U. S. Dept. of the Interior, Bureau of Reclamation, *Biological Assessment on the Continued Long-term Operations of the Central Valley Project and the State Water Project (OCAP)*, pp. 1-9, at http://www.usbr.gov/mp/cvo/OCAP/sep08_docs/OCAP_BA_001_Aug08.pdf.

[4] State of California, Department of Natural Resources and Department of Water Resources, *Sacramento-San Joaquin Delta Overview*, Sacramento, CA (no date), p. 2, at http://baydeltaoffice.water.ca.gov/sdb/tbp/deltaoverview/delta_overview.pdf.

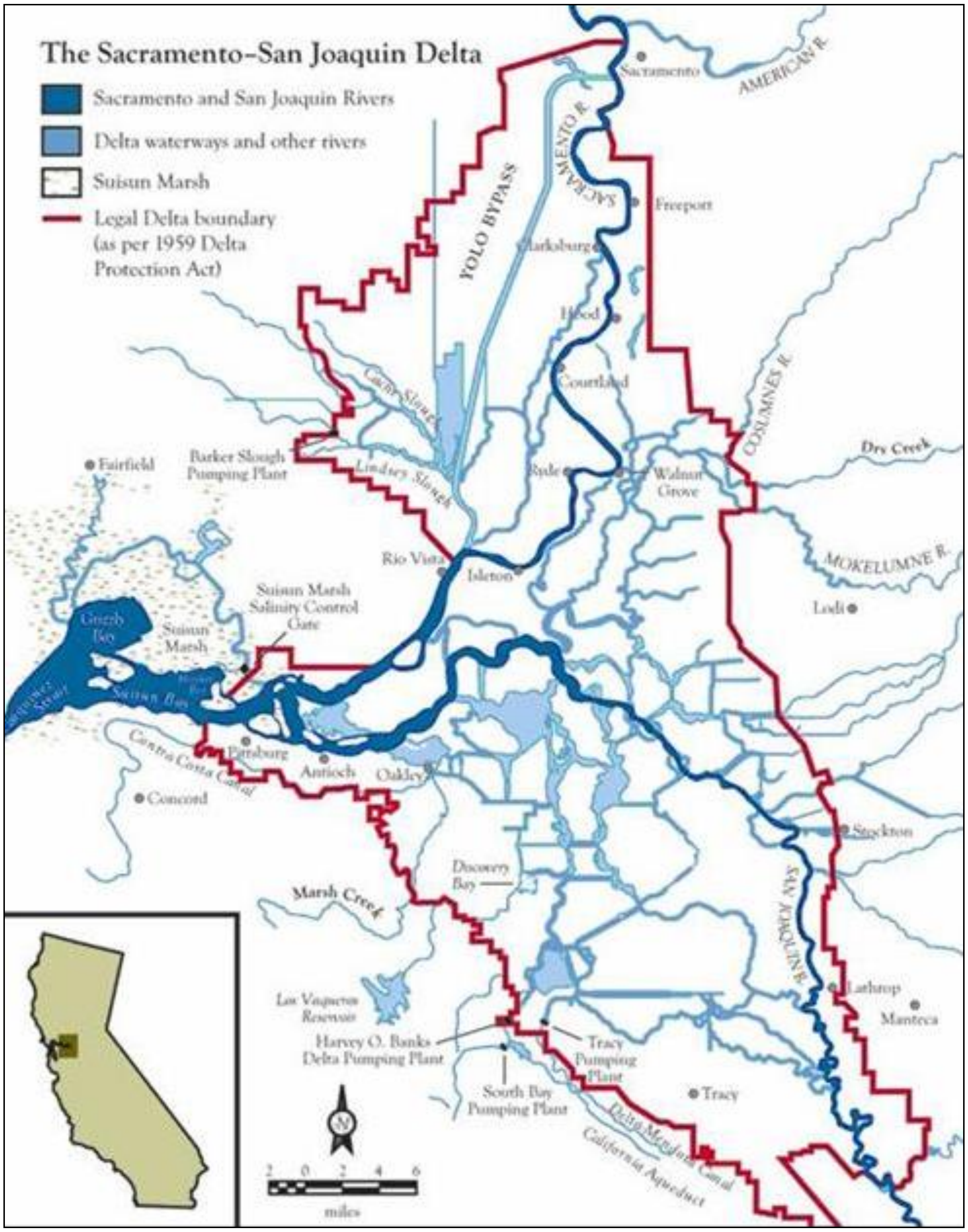
Many factors affect CVP water deliveries. These include hydrologic factors, state and federal laws and regulations, court orders implementing those laws and regulations, CVP contract and allocations policies, and the state's long-established state water rights system. The current hydrological drought in California (2012-present) has lasted longer than the previous California drought (2007-2009) and probably is more severe. For example, the 2014 water year (October 2013 through September 2014) [5] was the third driest in California since record-keeping began in 1895, and 2013 was the driest calendar year on record for the state. The human factors—laws and regulations, water rights, and CVP allocations policies—can magnify the impacts of drought on water deliveries to some contractors. The system of state water rights and water code, together with CVP contract allocations and priorities, largely dictates who gets how much water and when, particularly in times of drought or other changes in the hydrologic cycle.[6] As with the previous California drought, some stakeholders are questioning the extent to which compliance with environmental laws such as the federal Endangered Species Act (ESA; P.L. 93-205; 16 U.S.C. §§1531 et seq.) and with state water quality laws and regulations are worsening drought impacts and resulting in significantly reduced project water deliveries—particularly CVP and SWP exports of water from the Delta.

[5] The California Department of Water Resources and the Bureau of Reclamation typically gather data on precipitation, runoff, and water supply storage on a *water year* basis. A water year is from October 1 through September 30, as opposed to the calendar year: January 1 through December 31.

[6] For information on water rights, see CRS Legal Sidebar WSLG9, *Riparian vs. Appropriated Water Rights*, by Cynthia Brown.

Figure 1. Sacramento-San Joaquin Delta

(with CVP and SWP pumping plants)



Source: DeltaRevision, *Delta Maps*, at http://www.deltarevision.com/maps/Delta_land_use_ownership/legal_delta.jpg, 1990.

Notes: State and federal facilities that pump and export water out of the Delta for users south of the Delta are located on the southwestern edge of the legally defined Delta area. CVP = Central Valley Project; SWP = State Water Project.

Figure 2. Major Rivers and Water Infrastructure Facilities in California

(state, federal, and local water project facilities)

Source: California State Department of Water Resources, *California Water Plan Update 2013, Investing in Innovation & Infrastructure,* Vol. I, Chapter 3, Figure 2-3, issued Oct. 30, 2014.

Water shortages due to hydrologic variability, regulatory export, and other management restrictions have resulted in unequal impacts on CVP water contractors because of differences in priority of water rights and other legal agreements underlying different water contracts and federal and state allocation policies. Combined Delta exports have increased *on average* since the 1980s and early 1990s, even with implementation of several regulatory restrictions; nonetheless, CVP water allocations for some contractors have been reduced significantly.

Controversy over CVP water supply deliveries persists in part because even in years with high levels of precipitation and runoff,[7] such as 2011, water deliveries still are often reduced below their contract amount for some contractors—typically south-of-Delta (SOD) CVP water service contractors.[8] Due to low precipitation levels during the 2011-2012 winter months (2012 water year), and again throughout the 2012 and 2013 calendar years, water storage levels leading into the 2013-2014 winter were very low. The result was a low amount of water in reserve going into the spring of 2014—an unusually warm year with below-average precipitation. CVP and SWP contract deliveries were allocated at historic lows in 2014, and even senior water rights users were affected. Some municipalities nearly exhausted water supplies, and some unincorporated areas experienced wells going dry. Historically low levels of winter precipitation and snowpack for the 2015 water year have resulted in reduced water allocations again, including zero allocations for many agricultural water users throughout the CVP. Some communities reliant on groundwater also have experienced dry wells.

The California State Water Resources Control Board (SWRCB) summarized 2014 drought impacts as follows:[9]

- $2.2 billion in total economic costs due to drought;
- $1.5 billion direct loss to agriculture (3% of the state's total agricultural production value);
- 17,100 jobs lost (3.8% of farm employment);
- 428,000 acres idled (5%) in the Central Valley, Central Coast, and Southern California;
- $447 million in added groundwater pumping costs;
- 95% winter-run Chinook egg mortality due to high temperatures;
- high spring-run Chinook mortality due to high temperatures;
- lowest survey level of Delta smelt on record;
- second-lowest level of longfin smelt on record;
- population indexes of the striped bass, American shad, and threadfin shad near record lows; and
- potential (unaccounted) impacts to commercial and recreational fishing, recreation, and other nonagricultural water-dependent industries.

[7] Runoff is what occurs as a result of precipitation—rain or snow—that is in excess of evaporation from the land surface, transpiration from vegetation, and infiltration into soils. The remaining water—runoff—makes its way into rivers, streams, reservoirs, and possibly the ocean. USGS, California Water Science Center, "Annual Runoff Estimate for California, at http://ca.water.usgs.gov/data/drought/runoff.html, viewed August 2014.

[8] For example, even though water year 2011 was classified as a wet year and more water was pumped from the Delta than ever before (6.52 million acre-feet, or MAF), the CVP south-of-Delta agricultural water service contractors' allocation for 2011 started at 50% of contract supply. Although it increased monthly based on revised projections, it never rose above 80% from April 25 through the rest of the year. Most of the water exported from the Delta in 2011 went to the SWP (3.96 million acre-feet). The CVP total for 2011 was 2.63 MAF.

[9] California Water Boards, State Water Resources Control Board, Regional Water Quality Control Boards, *2015 Drought Water Project Operations,* PowerPoint presentation, pp. 2-3.

The 113th Congress responded to the 2014 drought by reauthorizing several drought programs, including the Reclamation States Emergency Drought Relief Act (RSEDR), the National Integrated Drought Information System (NIDIS), and agricultural assistance programs (2014 farm bill; Agricultural Act of 2014 [P.L. 113-79]). Congress also included provisions to facilitate water banking, water transfers, and new storage projects in the FY2014 Consolidated Appropriations Act (P.L. 113-76). In addition, the 113th Congress debated California-specific legislation, including S. 2016, S. 2198 (which passed the Senate in May 2014), H.R. 3964 (which passed the House in February 2014), and H.R. 5781, a compromise bill that passed the House in December 2014; however, none were enacted.

Several bills have been introduced in the 114th Congress. For example, H.R. 2898 passed the House on July 16, 2015. The bill is similar in several aspects to previously passed House bills (H.R. 3964 and 5781 from the 113th Congress). Several titles of H.R. 2898 focus on maximizing CVP and SWP water deliveries, while other titles address Bureau of Reclamation project authorization and financing throughout the West. With regard to California-specific provisions, a key challenge for legislators is whether to increase water supplies for CVP and SWP water users, particularly those in the San Joaquin Valley and Southern California areas (SOD), and how this could be accomplished without further threatening or endangering the survival of several fish species and degrading water quality for in-Delta water users. Other bills introduced in the 114th Congress would address drought management in California more broadly by focusing on increasing the provision of water supplies through conservation and recycling, among other activities (e.g., H.R. 291 and S. 176; H.R. 2983 and S. 1837; and H.R. 3045). The state also has been active in addressing the drought, including funding specific water projects and conservation activities and calling for mandatory statewide reductions in water use.[10]

What Is Drought?

Droughts have affected the United States, particularly the American West, for centuries. *Drought* is defined in a number of ways; the simplest may be as a deficiency of precipitation over an extended period of time, usually a season or more, resulting in a water shortage for some activity, group, or environmental sector.[11] The deficiency usually is evaluated relative to some long-term average condition or balance between precipitation, evaporation, and transpiration by plants. Drought, which has a beginning and an end, is distinguished from *aridity*, which describes to low-rainfall regions and is a relatively permanent feature of climate (e.g., deserts are regions of relatively permanent aridity).[12]

At the national level, drought is monitored and reported in an index known as the U.S. Drought Monitor, which synthesizes various drought indexes and impacts and represents a consensus among academic and federal scientists of ongoing drought conditions. The U.S. Drought Monitor uses five key indicators[13] as well as expert opinion and other indexes, such as those that account

[10] See "California Drought" at http://ca.gov/drought/. See also activities of local water districts at http://www.acwa.com/content/local-agencies-find-innovative-ways-reduce-use.

[11] National Drought Mitigation Center (NDMC), "What Is Drought?" at http://drought.unl.edu/DroughtBasics/WhatisDrought.aspx.

[12] Permanently arid conditions reflect the *climate* of the region, which is the composite of the day-to-day weather over a longer period of time. Climatologists traditionally interpret climate as the 30-year average. See NDMC, "What Is Climatology?" at http://www.drought.unl.edu/DroughtBasics/WhatisClimatology.aspx.

[13] The five key indicators include the Palmer Drought Index, the Climate Prediction Center soil moisture model, U.S. Geological Survey (USGS) weekly streamflow data, the Standardized Precipitation Index, and short- and long-term (continued...)

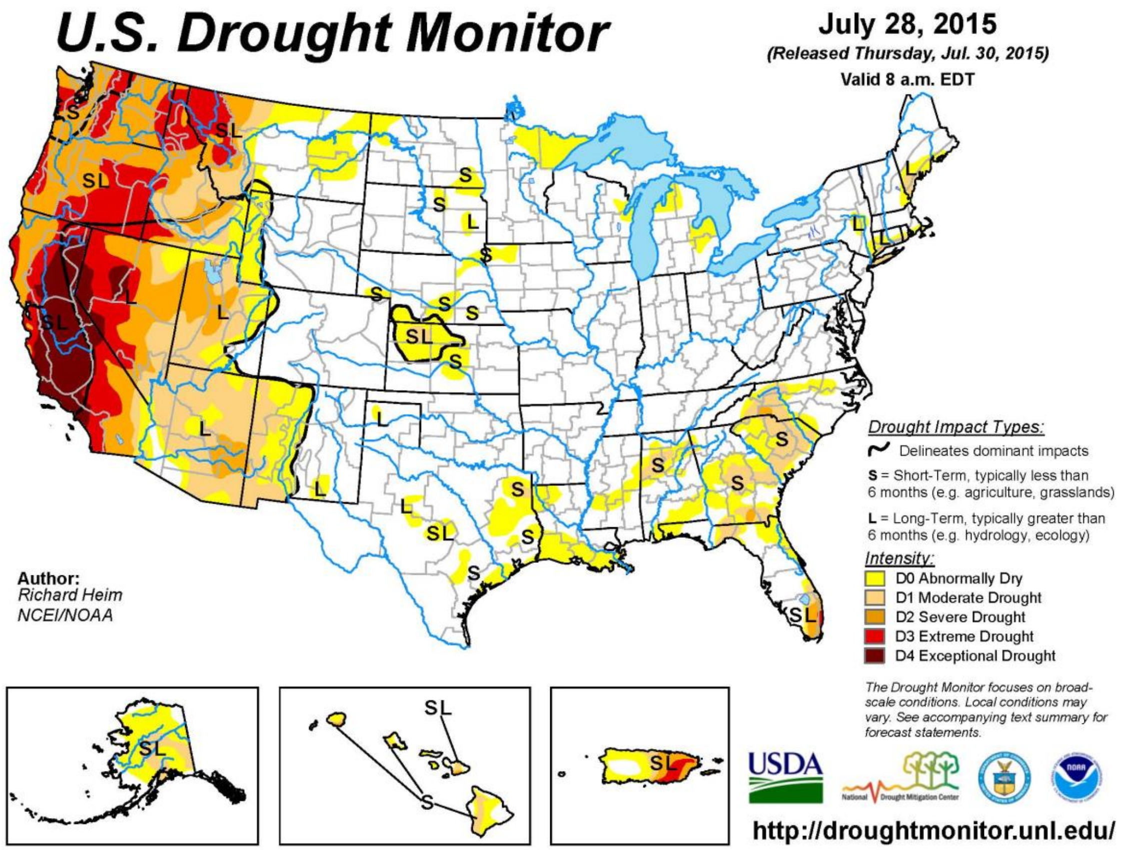
for conditions in the West where snowpack is relatively important and those that are used mainly during the growing season. Drought indexes typically are used to assess and classify the intensity and type of drought. The classification of drought intensity, such as that shown in **Figure 3**, may depend on a single indicator or on several indicators, often combined with expert opinion from the academic, public, and private sectors.

The U.S. Drought Monitor intensity scheme—D0 to D4—is used to depict broad-scale conditions but not necessarily drought circumstances at the local scale. For example, the large regions depicted as red and brown, most notably California and parts of Nevada, in **Figure 3** faced extreme to exceptional drought conditions for the week of July 28, 2015, but they may contain local areas and individual communities that experienced less (or more) severe drought. The U.S. Drought Monitor in **Figure 3** does not reflect availability of water supplied by federal or state reservoirs or projected water deliveries. It strictly represents the hydrological status of California from factors other than deliveries of water mandated or restricted by regulation (e.g., precipitation, snowpack, streamflow, soil conditions, as described above). In addition to the color-coded D0-D4 designations, U.S. Drought Monitor maps often include an *S* and *L* designation to provide additional information about the nature of drought. The *S designation* indicates a combination of drought indexes that reflect impacts that respond to precipitation over several days up to a few months (short-term effects). These effects would include impact to agriculture, topsoil moisture, unregulated streamflows, and aspects of wildfire danger. The *L designation* approximates responses to precipitation over several months up to a few years (long-term effects). These effects would include reservoir levels, groundwater, and lake levels. As **Figure 3** shows, some regions of the United States, such as California, include both an S and an L designation, indicating that in late July 2015 those regions experienced both short- and long-term impacts.

(...continued)

drought indicator blends. For a discussion of drought indexes, see NDMC, http://www.droughtmonitor.unl.edu/AboutUs/ClassificationScheme.aspx.

Figure 3. U.S. Drought Conditions



Source: United States Drought Monitor, at http://droughtmonitor.unl.edu/.

California Drought and Hydrological Conditions

At the beginning of the 2015 water year—as of October 1, 2014—nearly 60% of California was experiencing exceptional drought, the most severe U.S. federal drought classification. The dry conditions resulted, in part, because the 2014 water year was the third driest on record in terms of precipitation (2013 was the driest calendar year on record, whereas the 1924 water year was the driest on record).[14] California typically receives more than 80% of its annual precipitation in the November-April winter precipitation season, and the November 2013-April 2014 precipitation for the state as a whole was the sixth driest since records began in 1895.[15]

[14] California Department of Water Resources, "Water Year 2014 Ends as 3rd Driest in Precipitation," press release, September 30, 2014, at http://www.water.ca.gov/waterconditions/.

[15] Richard Seager et al., *Causes and Predictability of the 2011-2014 California Drought,* National Oceanic and Atmospheric Administration, Assessment Report, December 2014, p. 3, at http://cpo.noaa.gov/sites/cpo/MAPP/Task%20Forces/DTF/californiadrought/california_drought_report.pdf. Hereafter referred to as NOAA Assessment Report 2014.

The state is experiencing its fourth consecutive dry year. As of July 28, 2015, 47% of California still was experiencing exceptional drought and more than 94% of the state was facing drought conditions that ranged from severe to exceptional.[16]

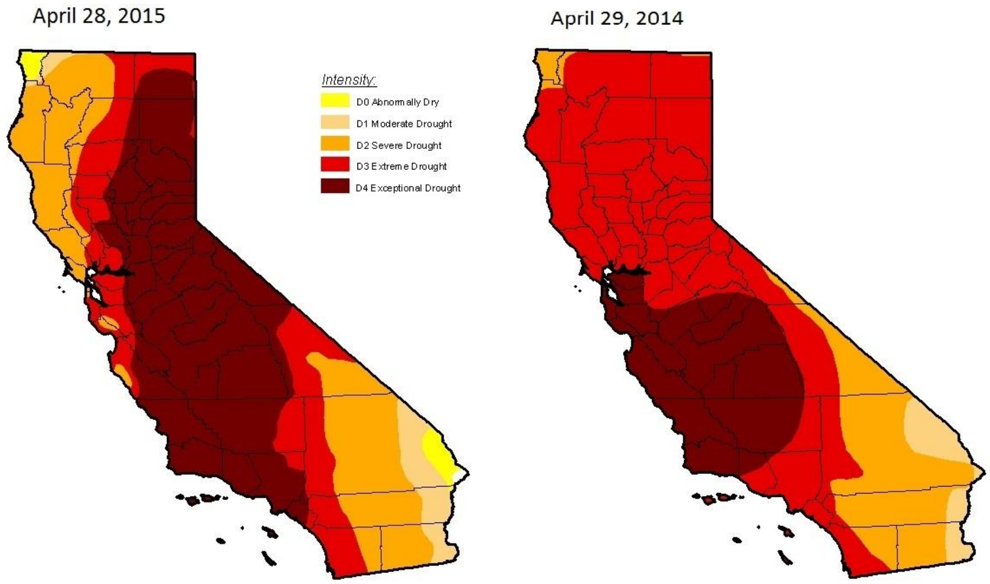
Water users receiving supplies from California state and federal water projects are experiencing unprecedented water supply shortages due to the drought. Severe water supply shortages also hampered the state during the 2007-2009 drought. Other severe droughts in the last 100 years include a six-year drought (1987–1992); a two-year drought (1976–1977), and an extended dry period during the 1920s and 1930s which included the single driest water year on record—1924. (The driest winter on record was 1976-1977.) Studies of relict tree stumps, tree rings, and other evidence indicate that parts of California have experienced numerous multiyear droughts, some of which lasted for decades or even centuries, during the past 2,000 years.[17] Whether the current drought is the worst in California's history is currently being debated. The role of human-induced climate change also is being debated, in particular whether the record high temperatures in 2014 combined with low precipitation are a fingerprint of human influence on climate (see text box below).

Figure 4 provides a comparison of drought conditions in California on April 29, 2014, and April 28, 2015. **Figure 4** shows that the area of exceptional drought expanded considerably over the course of the year. According to the U.S. Drought Monitor, exceptional drought nearly doubled in a year, from 25% of California at the end of April 2014 to nearly 47% in late April 2015.

[16] U.S. Drought Monitor, July 28, 2015.

[17] Rachel Berkowitz, "A Dry State in the West," *Physics Today*, July 2014, at http://scitation.aip.org/content/aip/magazine/physicstoday/news/10.1063/PT.5.4004. See also Scott Stine, "Extreme and Persistent Drought in California and Patagonia During Mediaeval Time," *Nature*, vol. 369 (June 16, 1994), pp. 546-549.

Figure 4. Comparison of California Drought Conditions for April 2014 and April 2015



Source: U.S. Drought Monitor**,** http://droughtmonitor.unl.edu/MapsAndData/MapArchive.aspx, modified by CRS.

Notes: Colors matching drought intensity are identical to those shown in **Figure 3.**

California has experienced years of consecutive drought in the past. Observations of below-average runoff, reservoir levels, and groundwater levels for 2007-2009 were broadly comparable to those observed during previous episodes of drought in California (e.g., 1977-1978 and 1987-1992). Drought conditions for 2015 appear more severe and widespread in scope.

Runoff and Storage

The 2014 water year was one of the driest on record, which has led to below-average storage levels and runoff for the year. According to the California Department of Water Resources (DWR):

> Water Year 2014—overlapping with California's driest calendar year—ended on September 30 as the state's third driest in 119 years of record, based on statewide precipitation.
>
> As the Water Year ended on September 30, the state's major reservoirs collectively held only 60 percent of average storage for the date, or about 41 percent of capacity. Cumulative reservoir storage in 1977, California's driest calendar year on record, was approximately five million acre-feet less than this year, but the state had 16 million fewer people then.[18]

[18] California Department of Water Resources, "Water Year 2014 Ends as 3rd Driest in Precipitation," press release, September 30, 2014, at http://www.water.ca.gov/waterconditions/news-archive.cfm.

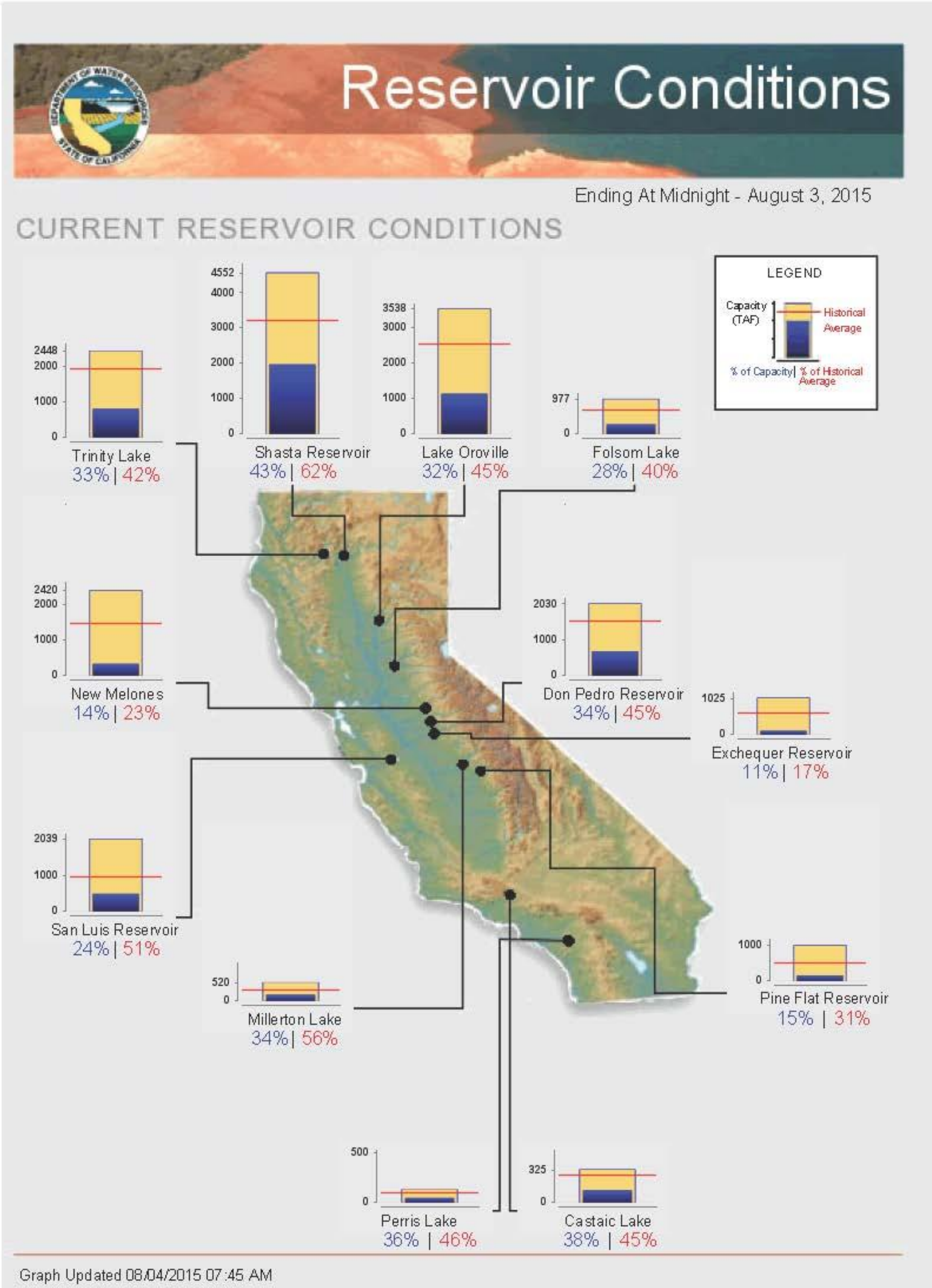
Runoff in California has declined since 2012 and is continuing its downward trend in 2015. According to the U.S. Geological Survey, runoff in California has shown a downward trend since 2006, despite relatively wet years in 2010 and 2011.[19] Below-average runoff indicates an underlying deficit in precipitation, which would support a common definition of drought: less rain or snow than a region would receive compared with some long-term average (consistent with the description of hydrological drought; see "What Is Drought?" above). California has experienced three dry years in a row, and so far 2015 is a fourth dry year, compared with the long-term average.

Figure 5 shows reservoir storage in early August 2015 for several of the major CVP and SWP water storage reservoirs. All the major reservoirs shown in **Figure 5** are well below their historical average capacity.

Snowpack is an essential component of water storage in California. Runoff from the snowpack typically contributes to a large portion of storage in many of the reservoirs shown in **Figure 5**. For a year with average or above-average snowpack levels in early May, runoff from spring snowmelt would be expected to contribute additional water storage in reservoirs through May and June before dropping off in the summer months. **Figure 6** shows this pattern for a wet year (1983), a dry year (1977), the 30-year average, and for 2014 and 2015 (through June 2015). However, the very low snowpack levels in spring 2015 resulted in low amounts of runoff, compared with average values, in early summer. As the figure shows, June runoff in 2015 was about 0.15 inches and trending downward, whereas the 30-year average runoff for June is 0.54 inches. That value likely reflects the unusually low snowpack levels in the Sierras in 2015 (approximately 5% of average for April). Absent the unlikely event of significant amounts of summer precipitation, the trend of below-average runoff shown in **Figure 6** probably will continue.

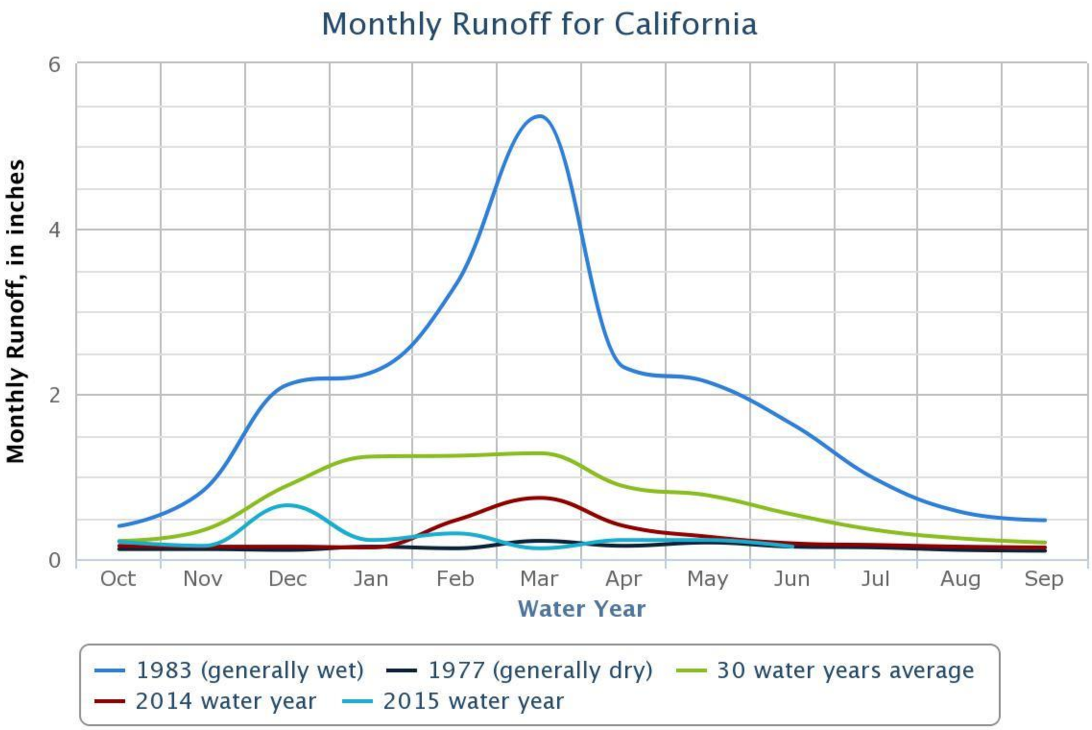
[19] Ibid. USGS plotted a smoothed curve that trended downward from the relatively wet year in 2006 through March 2015, even though water years 2010 and 2011 were relatively wet. The overall downward trend reflects the consecutive dry years 2007-2009, the last three dry years (2012-2014), and a dry 2015 to date.

Figure 5. Major California State and Federal Reservoirs



Source: California Department of Water Resources, California Data Exchange Center, Current Conditions for Major Reservoirs, http://cdec.water.ca.gov/cgi-progs/products/rescond.pdf.

Figure 6. Comparison of Runoff Amounts for California Between a Wet Year, Dry Year, 30-Year Average, 2014, and 2015 Through June



Source: U.S. Geological Survey (USGS), California Water Science Center, *Annual Runoff Estimate for California*, at http://ca.water.usgs.gov/data/drought/runoff.html, viewed August 4, 2015.

Notes: The original source is an interactive feature, enabling the user to scroll over the lines on the figure and extract runoff amounts in inches for the midpoint of each month. All 2015 data are provisional and subject to change.

Timing

Persistently dry or drought conditions in most of California since 2012 do not necessarily mean that all locations throughout California have experienced similar drought conditions at all times. Drought conditions change over time and vary by location. For example, January is normally the wettest month for California, averaging approximately 4.1 inches of precipitation in the state.[20] (See **Table 1**.) In January 2015, however, California received only 0.47 inches, or 12% of average precipitation for the month. By contrast, in December—also one of the wettest months for California—the state received 7.3 inches of precipitation, or 202% of the monthly average of about 3.6 inches. Despite the relatively wet months of November and December 2014, very dry conditions in January and below-average precipitation through April resulted in the cumulative average of annual precipitation at 76% through the first seven months of the water year. During the months of October through March, California typically receives more than 80% of its annual precipitation for the 12-month water year.

[20] California Climate Tracker, at http://www.wrcc.dri.edu/monitor/cal-mon/frames_data.html. CRS calculated the average monthly values using California Climate Tracker data back to 1895.

Table 1 also shows that July 2015 was an unusually wet month in California, receiving roughly 10 times the average amount of precipitation that normally falls during the month. However, the above-average rainfall likely will not affect drought conditions significantly. Even though California received more than 1.6 inches of precipitation averaged over the state, well above the normal 0.16 inches, the total amount that fell was less than what the state usually receives each month from November through March, and the total was equal to about the average precipitation California receives in April at the end of the wet season (**Table 1**). Despite the relatively very wet July, the first 10 months of the 2015 water year cumulatively were still below average (about 83% of normal), reflecting the dry winter months in early 2015.

Timing of precipitation, and the consequent amount of runoff in the spring that flows into the state's reservoirs, is a critical factor leading to water delivery decisions in the spring. Where and how precipitation occurs (e.g., snow versus rain) also are critical to water delivery decisions for the SWP and CVP. Both projects rely on precipitation data, including data indicating the water content of snowpack and projected runoff, to decide how much water to allocate to water users early in the water year (February-May).

Table 1. Average and Observed Statewide Precipitation, by Month

(percentage of average by month and cumulatively for water year 2015, through July 31, 2015)

Month	Average Precipitation Statewide (inches)	Water Year 2015 Observed Precipitation (inches)	% of Average (by month)	% of Average (cumulative)
October	1.16	0.71	61%	61%
November	2.40	2.0	82%	75%
December	3.60	7.3	202%	139%
January	4.08	0.47	12%	93%
February	3.58	2.7	75%	88%
March	3.03	0.55	18%	77%
April	1.59	1.1	69%	76%
May	0.86	0.77	88%	76%
June	0.34	0.21	62%	76%
July	0.16	1.63	1051%	83%
Total	**20.82**	**17.36**	**83%**	**83%**

Source: California Climate Tracker, at http://www.wrcc.dri.edu/monitor/cal-mon/frames_data.html. CRS calculated the average monthly values from using California Climate Tracker data back to 1895.

Note: Totals may not sum due to rounding.

Nature of the California Drought: Possible Causes and Consequences

The immediate cause of the current California drought appears to be the region of persistent atmospheric high pressure over the northeast Pacific Ocean offshore Oregon and Washington. The *resilient ridge*, as it is sometimes referred to, has changed the atmospheric circulation patterns so that the wintertime streams of intense precipitation are blocked from reaching the northern California coastline. These weather features are referred to as *atmospheric rivers* (ARs) and are extremely important contributors to California's precipitation during the winter months. Some shifts in the high-pressure ridge in December 2014 led to a few AR storms in northern California, as discussed above, but since that time the resilient ridge has reestablished itself.

Atmospheric Rivers

ARs play an extremely important role in making or "busting" California droughts. The absence of ARs in January 2014 led to precipitation levels of only 0.43 inches statewide, or 11% of average for the month. January 2015 precipitation was 0.47 inches statewide, nearly mirroring the previous year.[21] Again, the absence of ARs was in part responsible for the lack of significant precipitation during the crucial month of January. Further, some have speculated that up to half of California droughts are busted by ARs that provide a significant proportion of annual precipitation over a relatively short period.[22] However, from May through September, California typically receives less than an inch of precipitation statewide per month, so the occurrence of a drought-busting AR in the 2015 water year is increasingly unlikely.

Did Human-Induced Climate Change Cause the 2012-2015 California Drought?

Two studies published in late 2014 provide examples of the ongoing scientific discussion about whether emissions of heat-trapping greenhouse gases by human activities have influenced the current California drought. One study claimed that the current drought is the most severe in the past 1,200 years of California's history.[23] The study stated that diminished snowpack, streamflows, and reservoir levels resulted in a convergence of reduced surface water supply with increased demand, a combination that appears unique in the state's history. The study stated that 2014 was the worst single drought year in at least the last 1,200 years in California but that it was not the driest year. What made the 2012-2014 drought—and 2014 in particular—stand out was the combination of lack of precipitation and record high temperatures, resulting in extreme dryness according to a soil-moisture metric known as the Palmer Drought Severity Index.[24] Attributing a human influence is more tenuous, according to the study, as attribution of a human influence on California rainfall and Pacific storm tracks is equivocal. The study, however, stated that "projections for a continued trend toward higher mean and extreme temperatures are robust." Further, the study linked the future warming to human activities, claiming that "future 'hot' droughts driven by increasing temperatures due to anthropogenic emissions of greenhouse gases ... are assured."

Another study also published in 2014 found that the 2012-2014 dry conditions were not without precedent in California's history. Even with the current drought, the study did not find a clear trend toward wetter or drier conditions over the past 120 years in California.[25] It noted that the impacts of lack of precipitation were exacerbated by warm temperatures and that November 2013 through April 2014 was the warmest winter half-year on record.[26] This second study focused on the influence of sea surface temperatures (SSTs) on atmospheric behavior (SST forcing) and examined the role of natural atmospheric variability and SST forcing as factors influencing the California drought. In its examination of the causes of the current drought, the study observed that generally California dry winters arise from internal atmospheric variability, but that the past three winters also contained a component of SST forcing. In addition, the study noted that many climate model projections show a future *increase* in California precipitation over the midwinter and that "the recent severe all-winter rainfall deficit is thus not a harbinger of future precipitation

[21] California Climate Tracker, at http://www.wrcc.dri.edu/monitor/cal-mon/frames_data.html. CRS calculated the average monthly values from using California Climate Tracker data back to 1895.

[22] Discussions at the April 20-22, 2015, American Geophysical Union Chapman Conference on California drought.

[23] Daniel Griffin and Kevin J. Anchukaitis, "How Unusual is the 2012-2014 California Drought?," *Geophysical Research Letters*, published online December 3, 2014, DOI: 10.1002/2014GL062433.

[24] For a description of the Palmer Drought Severity Index, see the National Drought Mitigation Center, at http://drought.unl.edu/Planning/Monitoring/ComparisonofIndicesIntro/PDSI.aspx.

[25] Richard Seager et al., *Causes and Predictability of the 2011-2014 California Drought*, National Oceanic and Atmospheric Administration, Assessment Report by the NOAA Drought Task Force, December 2014, at http://cpo.noaa.gov/sites/cpo/MAPP/Task%20Forces/DTF/californiadrought/california_drought_report.pdf.

[26] California receives most of its precipitation during the winter and early spring months, November through April.

change." However, this second study also stated that in the future California may experience a net surface moisture deficit due to the projected increase in evapotranspiration, driven by warmer temperatures, which would exceed the projected increase in precipitation. Both studies appear to support that prediction.

Prospects for a Continuing Hydrologic Drought

California receives the bulk of its precipitation in the late fall and winter months (see **Table 1**), and it is difficult to predict with any certainty what the precipitation patterns will be going forward. According to the National Oceanic and Atmospheric Administration's Climate Prediction Center (CPC), the outlook for California through the end of October calls for little if any chance for improvement in drought conditions.[27] Unless there is an anomalous weather event, California likely will experience persistent drought conditions for the rest of the 2015 water year. The CPC notes that August to October is a dry time in California, a fact that strongly favors drought persistence for much of the state. Any improvement in drought conditions likely would be limited to the southeast California desert, which might receive some rainfall associated with the monsoon and tropical cyclone activity in the eastern Pacific.

As of July 2015, atmospheric and oceanic features reflected an ongoing and strengthening El Niño. They also reflected a greater than 90% chance that El Niño will continue through the 2015-2016 winter in the Northern Hemisphere and an 80% chance it will last into early spring 2016.[28] Within the modeling community, there appears to be a consensus predicting a strong El Niño, with temperature and precipitation impacts expected to increase in the late fall and winter.[29] Strong El Niño conditions have been associated with a greater probability of above-normal precipitation for California and parts of the American Southwest, whereas La Niña conditions often appear to be correlated with drier conditions in those regions.[30] However, the relationship between El Niño-Southern Oscillation (ENSO) conditions and the atmospheric circulation patterns and SSTs in the eastern and northeastern Pacific Ocean—which have been shown to be the immediate cause of California's drought—are complex and unclear.[31]

Groundwater and Land Subsidence

In the Central Valley, one of the typical consequences of below-average precipitation, reduced snowpack levels, and lower reservoir levels is an increase in groundwater pumping to offset reduced surface-water supplies. In an average year, groundwater provides about 45% of California's water supply; in a drought year such as 2015, it may supply as much as 65%.[32] A

[27] National Oceanic and Atmospheric Administration, National Weather Service Climate Prediction Center, "U.S. Seasonal Drought Outlook,"(valid for July 16-October 31, 2015, at http://www.cpc.ncep.noaa.gov/products/expert_assessment/sdo_summary.html.

[28] Climate Prediction Center, *El Nino/Southern Oscillation (ENSO) Diagnostic Discussion*, July 9, 2015, at http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/enso_advisory/ensodisc.pdf.

[29] Ibid.

[30] National Drought Mitigation Center, "ENSO and Drought Forecasting," at http://drought.unl.edu/DroughtBasics/ENSOandForecasting.aspx.

[31] For more information on ENSO and drought, see CRS Report R43407, *Drought in the United States: Causes and Current Understanding*, by Peter Folger and Betsy A. Cody.

[32] Luhdorff and Scalmanini Consulting Engineers, James W. Borchers, and Michael Carpenter, *Land Subsidence from Groundwater Use in California*, California Water Foundation, Summary Report, April 2014, at http://www.californiawaterfoundation.org/uploads/1397858037-SubsidenceShortReportFINAL%2800248030xA1C15%29.pdf.

result of increased pumping is often a decrease in groundwater storage, as indicated by lower water table levels. (See text box for a discussion of groundwater storage and availability in the Central Valley.) In addition to affecting groundwater storage, rapid and/or large decreases in water table levels, especially when they decline past historical lows, may lead to land subsidence and may pose risks to surface infrastructure such as roads, pipelines, levees, and canals. Land subsidence has been a longtime issue in the Central Valley, with historical levels of subsidence approaching 30 feet (**Figure 7**).

Figure 7. Land Subsidence in the San Joaquin Valley Southwest of Mendota Between 1925 and 1977

Source: Devin Galloway et al., USGS Circular 1182, "Land Subsidence in the United States," 1999, p. 23, at http://pubs.usgs.gov/circ/circ1182/pdf/06SanJoaquinValley.pdf.

Notes: Approximate location of the maximum land subsidence in the United States, showing the approximate altitude of the land surface in 1925, 1955, and 1977.

In a 2014 summary report, the California Department of Water Resources (DWR) documented that groundwater levels since 2008 in much of the state, and particularly in the Central Valley, were at or below historical lows experienced sometime prior to 2000.[33] The report examined

[33] State of California Department of Water Resources, *Summary of Recent, Historical, and Estimated Potential for Future Land Subsidence in California*, 2014, at http://www.water.ca.gov/groundwater/docs/
(continued...)

water-level data from long-term wells with a record of 10 or more years. Some wells, especially from portions of the Sacramento Valley, southern San Joaquin Valley, and a few other locations, exhibit groundwater levels more than 50 feet below historical levels. In the Central Valley in 2014, 36% of the long-term wells in the Sacramento Valley and 55% of the long-term wells in the San Joaquin Valley were at or below historical levels recorded during springtime conditions.[34] (See **Figure 8**.)

As a result of increased groundwater pumping, subsidence is occurring or reoccurring in many portions of the state. In some cases, it has damaged land surface features (e.g., one study indicated subsidence of 1.35 feet between 1995 and 2010 along the Coachella Branch of the All American Canal in the Coachella Valley, causing earth fissures).[35] The California DWR report estimates that areas with the highest potential for future subsidence are in the southern San Joaquin, Antelope, Coachella, and western Sacramento Valleys. (See **Figure 9**.)

(...continued)

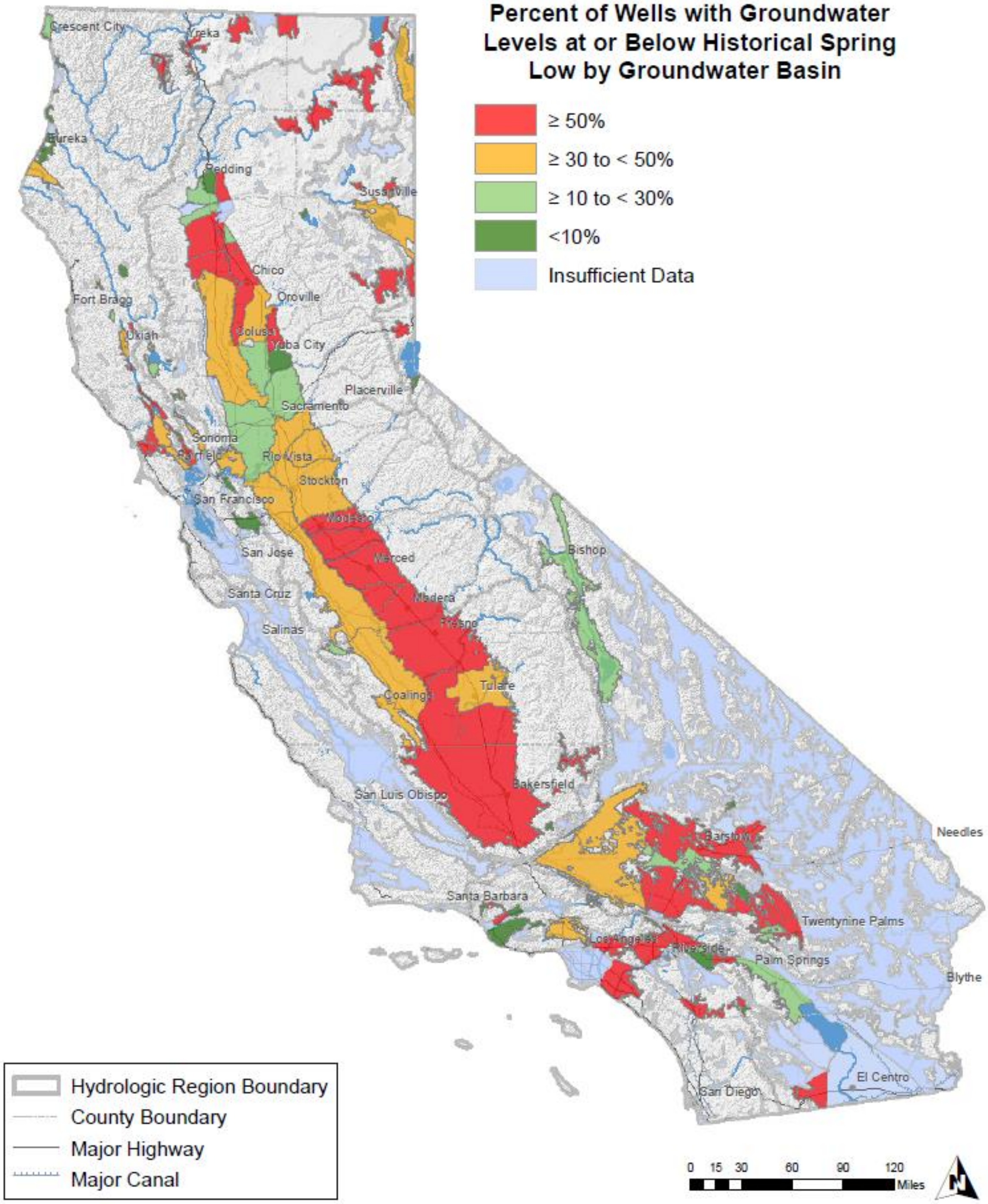
Summary_of_Recent_Historical_Potential_Subsidence_in_CA_Final_with_Appendix.pdf.

[34] Ibid.

[35] Luhdorff and Scalmanini Consulting Engineers, James W. Borchers, and Michael Carpenter, 2014, p. 3.

Figure 8. Percentage of Wells with Groundwater Levels at or Below Historical Lows

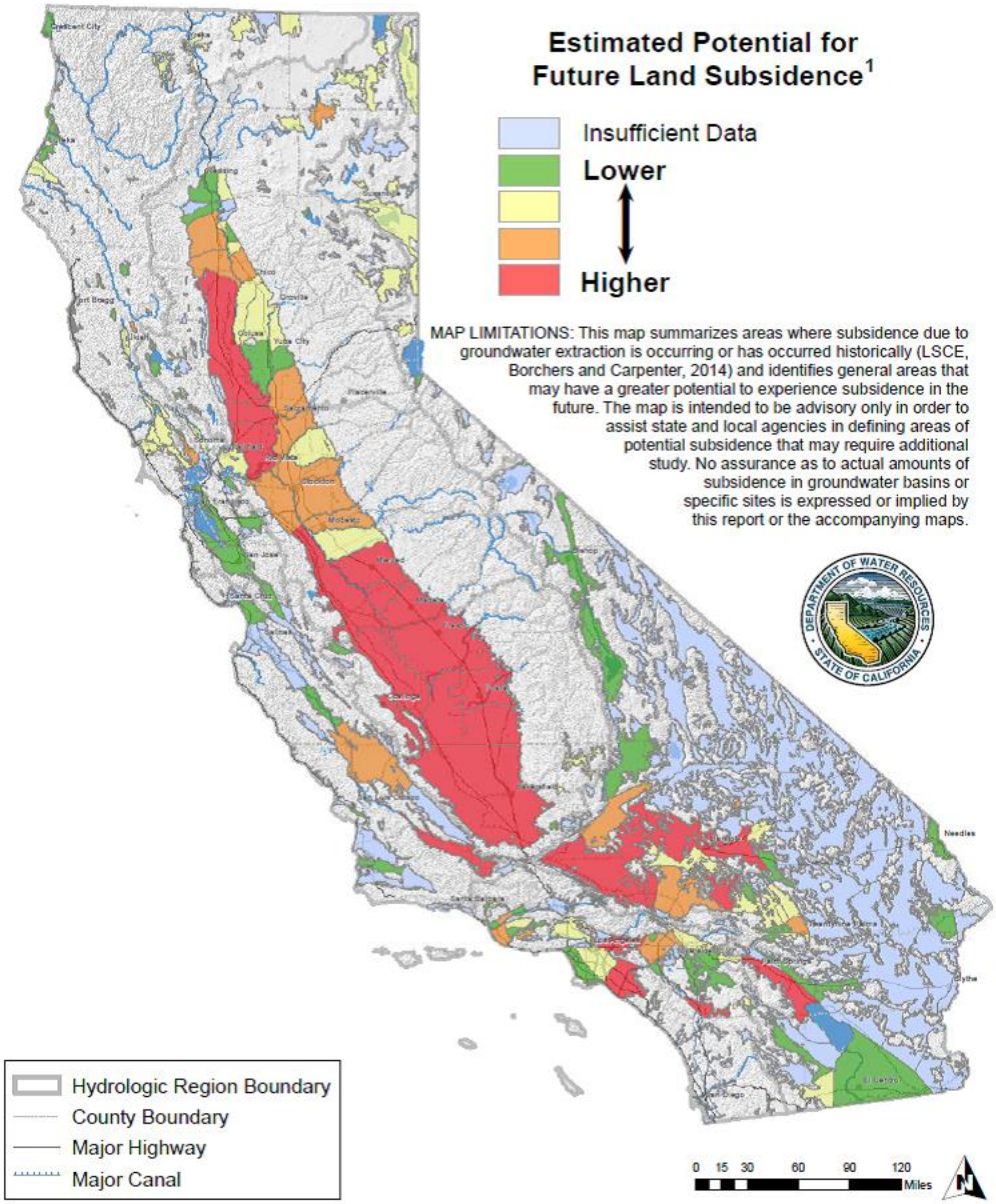
(regions shown by groundwater basin for spring levels)



Source: State of California Department of Water Resources, *Summary of Recent, Historical, and Estimated Potential for Future Land Subsidence in California*, 2014, p. 4.

Note: Wells with 10 or more years of data were used to construct the map.

Figure 9. Estimated Potential for Future Land Subsidence in California



Source: State of California Department of Water Resources, *Summary of Recent, Historical, and Estimated Potential for Future Land Subsidence in California*, 2014, p. 10.

Notes: According to the report, land subsidence potential shown in the figure was calculated using groundwater level data, previous subsidence studies, instruments in boreholes, and GPS.

Groundwater Availability and Storage in the Central Valley[36]

Groundwater has been an integral component of water supply for towns and farms in the Central Valley for over a century. Today, groundwater is the principal supply for municipal and industrial use in the San Joaquin Valley. By volume, however, agricultural demand for groundwater dwarfs municipal and industrial demand in the Central Valley, which comprises three-quarters of irrigated land in California and one-sixth of all irrigated land in the United States. The huge agricultural demand exceeds the availability of surface water or groundwater by themselves; it is met only by a combination of surface water and groundwater supplies. According to a U.S. Geological Survey (USGS) analysis, between 1961 and 2003 surface water supplied, on average, about 10 million acre-feet (MAF) per year for irrigation in the Central Valley and groundwater supplied slightly less than 9 MAF per year. Groundwater pumping from Central Valley aquifers constitutes about 20% of total U.S. groundwater demand, which makes it the second-most-pumped aquifer system in the nation.

Groundwater Demand Increases in Dry Years

The relationship between surface water use and groundwater use for irrigation in the Central Valley is complex and variable, but historically the proportion of groundwater use has increased during drier and drought years and has decreased during wetter years. That is, the aquifers function to some extent as multiyear reservoirs that are tapped more heavily when surface water is less available. In the USGS modeling analysis, for example, in a wet year groundwater pumping may be only 4.5 MAF, about half of the surface water deliveries for irrigation, whereas in a dry year groundwater pumping may be nearly 12 MAF and exceed the amount supplied by surface water.

Central Valley Groundwater Supply Decreases

Some question whether groundwater stored in Central Valley aquifers could be further used to help farmers meet their irrigation demands during periods of extended drought or as a long-term substitute for decreased deliveries of surface water as a result of regulatory requirements, legal actions, or other curtailments. The answer depends in part on what is known as the water budget. Put simply, when the amount of groundwater pumped from the Central Valley equals the amount of water returned to the aquifer system, the amount of groundwater held in storage remains the same—the hydrological equivalent of a balanced budget. However, if the amount of groundwater pumped exceeds the amount returned, then groundwater storage decreases. Over the period 1961-2003, USGS estimated that the amount of groundwater held in storage decreased by an average of 1.4 MAF per year, signifying that pumping exceeded recharge even though California went through cycles of wetter and drier years. Decreases in groundwater storage typically are indicated by declines in the water table (i.e., the elevation of the groundwater surface that lies below the land surface). Thus, if groundwater storage continues to decline, then water levels also would be expected to decline.

Increased Groundwater Use Has Consequences

How much the water table would decline is difficult to predict because the geology of the Central Valley aquifer system is not homogenous. Different agricultural regions likely would pump groundwater at different rates depending on a host of factors, such as cost of pumping (which depends partly on the depth to the water table), availability of alternate supplies, groundwater quality, and others. Parts of the Central Valley, such as the western side of the San Joaquin Valley, experienced hundreds of feet of water table decline in the 20th century because of groundwater pumping, which in some places resulted in actual land subsidence approaching 30 feet. Reduced pumping in some of those areas has allowed groundwater levels to recover, however, the compaction of the aquifer from land subsidence means that the volume of groundwater storage has been permanently decreased.

The use of groundwater to offset diminished surface water supplies during droughts is therefore not without consequences. Although the absolute amount of groundwater held in storage in the Central Valley aquifer system is likely huge (one estimate is 800 MAF in the upper 1,000 feet of sediments), increased pumping that outstrips the amount of water returned means that water table levels likely will drop. Lower water tables generally increase pumping costs, increase the likelihood of land subsidence, and may reduce the availability of groundwater to regions where the aquifer sediments are thinner and less extensive or may have impaired water quality.

New California Groundwater Law

[36] C. C. Faunt et al., *Groundwater Availability of the Central Valley Aquifer, California*, USGS Professional Paper 1766, 2009, p. 62, at http://pubs.usgs.gov/pp/1766/PP_1766.pdf; U.S. Bureau of Reclamation, *The Central Valley Project: Introduction*, by Eric A. Stene, at http://www.usbr.gov/history/cvpintro.html; W. M. Alley, "Tracking U.S. Groundwater Reserves for the Future," *Environment*, vol. 48, no. 3 (2006), pp. 10-25; Devin Galloway, David R. Jones, and S.E. Ingebritsen, *Land Subsidence in the United States, San Joaquin Valley, California*, USGS Circular 1182, 2005, at http://pubs.usgs.gov/circ/circ1182/; and California Department of Water Resources, California Groundwater, *Sustainable Groundwater Management*, at http://www.water.ca.gov/cagroundwater/.

California Governor Brown signed three bills into law on September 16, 2014, collectively referred to as the Sustainable Groundwater Management Act. The new law establishes a framework that requires local agencies to manage groundwater in a sustainable manner. The law sets out a schedule that begins with the California DWR adopting regulations for evaluating groundwater sustainability plans by June 1, 2016. It also requires formation of regional groundwater sustainability agencies, identifies high- and medium-priority basins in critical groundwater overdraft status, and implements the plans. It ultimately would result in sustainably groundwater management by January 2040.

California's Drought and CVP Operations

Several factors in addition to hydrology affect the operation of the CVP and SWP. These include protections for threatened and endangered species under the federal Endangered Species Act (ESA; P.L. 93-205; 16 U.S.C. §§1531 et seq.); state water quality protections under state law and the federal Clean Water Act (CWA; P.L. 92-500); and other federal and state laws, including the state's system of water rights.

Some observers of the 2012-2015 drought have cited regulatory compliance—particularly restrictions on pumping and proscribed reservoir storage releases under the federal ESA—as a key driver of reduced water supplies, referring to the drought as "Congress-made" or "man-made."[37] The argument stems from the fact that stored water has been released to support threatened and endangered fish species during wet years, rather than storing the water for delivery to users in these dry times. Conversely, fish protection requirements at times require holding back water in reservoirs to provide cold water for fish during warmer periods of the year. Thus, the regulations do not allow that water to be released and pumped further south during the winter for storage or for use at a later time south of the Bay-Delta. Even in above-normal precipitation years, water deliveries have been curtailed for some water users—typically water and irrigation districts with more junior water priorities relative to others receiving water from the CVP system. Such actions have led some to blame federal ESA restrictions for water supply reductions. It is not clear how much more water might have been available to CVP water users had supplies not been restricted due to species protection requirements in prior years—particularly wet years; however, some have estimated that it could be as high as 1.1 million acre-feet (MAF) in a wet year, or 440,000 acre-feet (AF) annually, on average.[38]

Based on federal and state estimates provided for the 2014 water year—a drought year—it appears that ESA compliance was not the predominant controlling factor in CVP and SWP pumping restrictions.[39] State water quality standards and other factors also play an important role

[37] Kendall Breitman, "Carly Fiorina Blames Environmentalists for California Drought," *Politico*, April 6, 2015, at http://www.politico.com/story/2015/04/carly-fiorina-california-drought-116711.html. See also U.S. House Committee on Natural Resources at http://naturalresources.house.gov/issues/issue/?IssueID=5921.

[38] For example, see San Luis & Delta-Mendota Water Authority, et al., California Department of Water Resources v. Kenneth Lee Salazar, et al., Natural Resources Defense Council, 1:09-cv-00407-LJO-DLB 9 (9th Cir. Court of Appeals 2014), p. 3 *infra* note 1. Plaintiffs refer to reports projecting that had 2009 been a wet year, the BiOps (biological opinions) would have resulted in "water losses of 1.1 MAF, with an average annual loss over time of 440,000 acre feet" and to a DWR report stating exports in September and October might be reduced by 70%.

[39] E-mail communications from the California Department of Water Resources on May 22, 2015, noting that Endangered Species Act (ESA) impacts to SWP for the 2014 water year are estimated to be 47,000 acre-feet; and email communication from Reclamation on July 14, 2015, noting that ESA impacts on CVP pumping are estimated to be 62,200 acre-feet for the 2014 water year. See also CALFED Operations Group, *Water Year 2014 CVPIA Section 3406(b)(2) Operations and accounting*, January 28, 2015, p. 12, at http://www.usbr.gov/mp/cvo/data/FINAL_WY14_b2_presentation.pdf.

in CVP water management, particularly in dry years, whereas ESA compliance may play a larger role in non-drought years.[40]

The following sections discuss the range of factors that affect Delta pumping and CVP water deliveries. Specifically, they discuss key regulatory and water management factors that contribute to annual water allocation decisions (e.g., biological opinions [BiOps] under the federal ESA, other federal laws such as the Central Valley Project Improvement Act (CVPIA), the federal CWA and resultant state water quality requirements, and the state system of water rights and CVP water allocation priorities). Understanding the limits of the underlying hydrological system upon which CVP water supply allocations are based is critical to addressing short-term and long-term water supply issues for the state. Similarly, it is important to understand the complex mix of regulatory and statutory restrictions, water rights, and contract priorities that affect CVP water management.

Regulatory and Statutory Restrictions Affecting CVP and SWP Water Deliveries

There are at least four key regulatory compliance factors that affect the timing and amount of water that is available for delivery to CVP and SWP contractors.[41] The factors relate primarily to the following:

- State water quality requirements pursuant to state and federal water quality laws;
- Regulations and court orders pertaining to implementation of the federal ESA;[42]
- Implementation of the 1992 CVPIA; and
- State water rights and CVP water allocation priorities.

Another compliance factor related to state water rights priorities is the contracting process for water delivered from the CVP and SWP. Water users enter contracts with Reclamation and the DWR that include provisions for the amount of water to be delivered and conditions under which water may not be delivered. Specifically, these contracts include provisions noting that contractors are not guaranteed full contracted amounts of water.[43] The contracts also provide exceptions for Reclamation to reduce the contract quantity due to hydrologic conditions and other conditions outside the control of the contracting officer.[44] Other considerations at play during drought years include maintaining deliveries for essential human health and safety and maintaining reservoir reserves for future years in case of long-term or extended drought.

[40] See, *Infra* note 2.

[41] For purposes of this report, *regulatory compliance restrictions* are defined as restrictions for which the basis in state or federal law generally falls into three categories and has resulted in flow or other requirements restricting pumping: (1) water quality protection; (2) fish and wildlife protection, enhancement, and restoration; and (3) threatened and endangered species protection.

[42] Requirements of the California Endangered Species Act (CESA) are currently being satisfied through implementation of the federal ESA due to a California state determination that project operations under the federal BiOps are consistent with requirements under CESA. Presumably, if protections afforded to threatened and endangered species under the federal ESA were no longer in place, the state of California could invoke protections under CESA.

[43] In total, the CVP has issued contracts for approximately 9 MAF of water, more water than it delivers on average (6 MAF to 7 MAF).

[44] See U.S. Bureau of Reclamation, Mid-Pacific Region, *Final Form of Contract,4-19-2004*, Articles 3b, 11, 12a, and 12b, at http://www.usbr.gov/mp/cvpia/3404c/lt_contracts/index.html.

Limitations on Delta Pumping

An estimated 25 million people get some portion, if not all, of their drinking and agricultural water supplies from the Sacramento and San Joaquin Rivers Delta confluence with San Francisco Bay—often referred to as the hub of California's water supply system.[45] Water from the Sacramento and San Joaquin Rivers enters the Bay-Delta estuary and mixes with tidally influenced saline water from San Francisco Bay. At the southern tip of the Delta, two sets of large pumps—one for the SWP (the Harvey O. Banks pumping station) and one for the CVP (the William C. "Bill" Jones pumping station)—extract water from the Delta and pump it into state and federal canals for delivery to "south-of-Delta" (SOD) water users. For decades, this transfer of water from northern California through the Delta to supply farms and cities in southern California has had profound impacts on fish and wildlife resources, water quality, and regional water supplies. For example, commercial and recreational fisheries on which many north coast fishermen depend are affected by water management and water quality in the Delta and its tributaries, as are communities and farmers within the Delta area who divert water from the Delta for their own use. At the same time, large agricultural areas in the southern portions of the Central Valley and communities as far south as Los Angeles and San Diego also rely on water diverted (or exported) from the Delta.

Over decades—particularly since the 1950s—both state and federal laws have been enacted and implemented to protect Delta resources and the fish, wildlife, and human populations that rely on these resources.[46] More recently—since the early 1990s—state water quality requirements, ESA requirements, and CVPIA provisions have combined to limit Delta pumping (Delta exports) and thus deliveries to some SOD water users, even in relatively wet years.

Thus, in addition to hydrologic or drought-related restrictions on water supplies, also at issue is how state and federal laws and regulations affect deliveries of water from the CVP and SWP. The effects of reduced pumping—or Delta exports—can and have resulted in economic losses in some of California's most productive agricultural areas. Some estimate such losses for 2014 at $1.5 billion in direct agricultural losses ($800 million in the Central Valley and Tulare Basin, which receive a significant amount of water from the CVP) and $2.2 billion in total economic costs due to drought.[47]

Changes in water deliveries due to reduced water supplies can pit widespread economic losses in some areas of central and southern California against (1) possible extinction of several species and economic losses to north-coast communities and others dependent on salmon and recreation industries, and (2) in-Delta farmers and communities that rely on freshwater in the Delta to maintain reasonable salinity levels. For example, the 95% loss of winter-run Chinook salmon reproduction and high mortality of spring-run Chinook salmon spawning may result in closures of north-coast commercial or recreational fishing in subsequent years, as occurred during the last

[45] State of California, Department of Natural Resources and Department of Water Resources, Bay-Delta Conservation Plan, "About the Delta," at http://baydeltaconservationplan.com/AboutTheDelta/AbouttheDelta.aspx.

[46] For example, as early as 1959, the state of California enacted the Delta Protection Act to provide "assurances to [Delta water interests] that an adequate water supply in the Delta would be maintained" and would "provide protection to the Delta from the effects of tidal salinity." See Craig M. Wilson, Delta Watermaster, *California's Area of Origin Laws,* a report to the State Water Resources Control Board and the Delta Stewardship Council, (no date), pp. 5-7. See also CRS Report RL34554, *California Water Law and Related Legal Authority Affecting the Sacramento-San Joaquin Delta,* by Cynthia Brown.

[47] California Water Boards, State Water Resources Control Board, Regional Water Quality Control Boards, *2015 Drought Water Project Operations,* PowerPoint presentation, pp. 2.

drought.[48] And the situation involving reduced Delta pumping is more complex than "farms vs. fish." Freshwater flows and mixing in the Delta are required for a number of reasons, including maintaining adequate water quality for in-Delta farmers and communities dependent on Delta water supplies and maintaining a salinity barrier to avoid saltwater intrusion deep into the estuary.

Following is a brief description of some of the major regulations and statutory requirements that sometimes restrict flows or otherwise affect Delta pumping and thus at times limit Delta exports to SOD water contractors. Some of these requirements serve more than one purpose. For example, the state Water Quality Control Plan (WQCP, or D-1641), discussed below, includes a significant number of water quality and flow actions to protect or maintain in-Delta water quality (primarily from saltwater intrusion) and to protect fish and wildlife habitat generally.

The 1995 Delta Water Quality Control Plan and Decision 1641

The WQCP was issued by the California State Water Resources Control Board (SWRCB) to comply with state obligations under the federal CWA.[49] The plan requires the SWP and CVP to meet certain water-flow objectives in the Delta to maintain desired salinity and other water quality objectives, including conditions and actions to support fish and wildlife habitat. These objectives (e.g., outflow targets, export to inflow ratios, X2 and the Vernalis Adaptive Management Program [VAMP] targets or objectives) often affect the amount and timing of water available to be pumped, or exported, from the Delta, and thus at times result in reduced Delta exports to CVP and SWP water users south of the Delta.[50] According to Reclamation, implementation of D-1641 significantly reduced water for export and included significant "new 'export limitation' criteria such as the export to inflow [E/I] ratios and San Joaquin River pulse period export limits"[51] to manage Delta salinity levels and protect fish and wildlife.

Central Valley Project Improvement Act

In 1992 (at the end of a major six-year California drought), Congress passed the CVPIA.[52] The act established fish and wildlife purposes as official project purposes of the CVP and called for a number of actions both to protect and restore fish and wildlife resources and to mitigate CVP damages to fish and wildlife resources. These actions included directives to double certain fish populations by 2002 (which has not occurred), allocate 800,000 AF of project water (600,000 AF in drought years) to fish and wildlife purposes (often referred to as *(b)(2) water*, after the

[48] California Water Boards, State Water Resources Control Board, Regional Water Quality Control Boards, *2015 Drought Water Project Operations,* PowerPoint presentation, pp. 2-3.

[49] The CWA requires the states to implement water quality standards that designate water uses to be protected and adopt water quality criteria that protect the designated uses. For application to California, see United States v. State Water Resources Control Board (Racanelli), 182 Cal. App. 3d 82, 109 (Cal. Ct. App. 1986). Through the Porter-Cologne Act (a state law), California implements federal CWA requirements and authorizes the State Water Resources Control Board to adopt water quality control plans, or basin plans (see Cal. Water Code §13160).

[50] Inability to reach agreement on water quality objectives through deliberation and litigation nearly shut down Delta pumping in the early 1990s and was a significant factor in creation of the Bay-Delta Accord—a partnership between federal and state agencies with projects, responsibilities, and activities affecting the Delta. Habitat protection commitments in the accord were incorporated into the WQCP, as were actions called for under the Vernalis Adaptive Management Program (VAMP), and were included by the State Water Resources Control Board in a document known as D-1641, which amended the underlying water rights of the SWP and CVP. (See U.S. Department of the Interior, Bureau of Reclamation, Mid-Pacific Region, *Long-Term Central Valley Project Operations Criteria and Plan (CVP-OCAP),* Sacramento, CA, May 22, 2008, p. 2-6.)

[51] Ibid.

[52] P.L. 102-575, P.L. 102-575, Title 34, 106 Stat. 4706.

provision in the act calling for the allocation), and provide water supplies for Central Valley refuges (full Level 4 supplies have not been fully implemented).[53] The (b)(2) allocation often has resulted in less water being exported annually from the Delta and thus has reduced the amount of water available to some CVP water service contractors with junior priority within the CVP system.

However, the (b)(2) allocation is sometimes also used to meet other state and federal requirements, such as fish and wildlife aspects of the WQCP as implemented under D-1641, and thus is not always an additional requirement.[54] For example, for the 2014 water year, CVP accounting of (b)(2) allocations note that of the 402,000 AF (b)(2) assets used, 176,300 AF (44%) was attributed to export reductions for WQCP Delta outflow requirements.[55] The remainder was attributed to reservoir releases (163.5 MAF) for both CVPIA anadromous fish restoration and salmonid BiOp purposes, and to export actions (62.2 MAF) under the 2009 salmonid BiOp.[56]

ESA Biological Opinions

Until 2004, a federal 1993 winter-run Chinook salmon Biological Opinion (BiOp) and a 1995 Delta smelt BiOp (as amended) governed Delta exports for federal ESA purposes (see text box).[57] However, a proposed change in coordinated operation of the SWP and CVP in 2004 (including increased Delta exports), known as OCAP (Operations Criteria and Plan),[58] resulted in development of new BiOps by the National Marine Fisheries Service (NMFS) in 2004 and the Fish and Wildlife Service (FWS) in 2005 to assess the effects of increased pumping and other proposed operations on threatened and endangered species. While the first OCAP BiOps found "no jeopardy" to listed species, the 2005 FWS BiOp was found unlawful and inadequate by a federal court[59] and the NMFS BiOp was subsequently voluntarily withdrawn and redone. Subsequent BiOps include a host of actions to protect listed species, including restrictions on pumping during certain periods, prescriptions on the release and storage of cold water to support fisheries, and other CVP management prescriptions.

Implementation of the reasonable and prudent alternatives (RPAs) contained in the federal BiOps, which limit pumping and call for water releases from key reservoirs to support listed species, has been modified due to temporary urgency change orders (TUCs) issued by the SWRCB in 2014 and again in 2015. These TUCs have been sanctioned by NMFS and FWS. Such changes have

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[53] Level 4 water supplies are defined as the increment over Level 2 supplies needed to provide the optimal amount of water supply for the refuges, to be acquired from willing sellers or sources outside the CVP.

[54] U.S. Department of the Interior, Fish and Wildlife Service and Bureau of Reclamation, *Water Year 2014 Final Accounting - Fishery and Water Quality Control Plan Actions*, January 28, 2015, p. 1, at http://www.usbr.gov/mp/cvo/data/FINAL_b2_2014_fish_action_summary.pdf.

[55] CALFED Operations Group, *Water Year 2014 CVPIA Section 3406(b)(2) Operations and Accounting*, January 28, 2015, p. 12, at http://www.usbr.gov/mp/cvo/data/FINAL_WY14_b2_presentation.pdf. (The full 600,000 AF (b)(2) allocation was not used in 2014.)

[56] Ibid.

[57] DWR has relied on federal restrictions for compliance with the California Endangered Species Act (CESA), a decision that has been the subject of some controversy.

[58] U.S. Department of the Interior, Bureau of Reclamation, Mid-Pacific Region, *Long-Term Central Valley Project Operations Criteria and Plan (CVP-OCAP)*, June 30, 2004. On July 31, 2015, Reclamation released a new environmental impact statement (EIS) on implementation of the 2008 and 2009 BiOps. CRS was not able to analyze the EIS prior to preparation of this report.

[59] Natural Resources Defense Council v. Kempthorne, 506 F. Supp. 2d 322 (E.D. Cal. 2007). In 2007, a federal court held that the 2005 Fish and Wildlife Service Delta Smelt BiOp, which found that Operations Criteria and Plan (OCAP) posed no jeopardy to the Delta smelt, was unlawful and inadequate.

allowed more water to be pumped during certain periods based on real-time monitoring of species and water conditions. The state DWR estimates that approximately 400,000 AF of water was made available for export due to these orders in 2014.[60]

Biological Opinions Under ESA

Federal agencies are required to consult with the Fish and Wildlife Service (FWS) or the National Marine Fisheries Service (NMFS) to determine whether an agency project might jeopardize the continued existence of species listed as endangered or threatened pursuant to the federal Endangered Species Act (ESA) [61] or might destroy or adversely modify a species' critical habitat. This process is known as *consultation*. Consultation concludes with the appropriate service issuing a biological opinion (BiOp) on the potential harm the project poses. If a project could jeopardize a species, a *jeopardy opinion* is released, along with any reasonable and prudent alternatives (RPAs) to the agency action that would avoid jeopardy. If no jeopardy is found, a *no jeopardy opinion* is issued.

FWS and NMFS each have issued federal BiOps on the effects of changes to the coordinated operation of the State Water Project (SWP) and Central Valley Project (CVP) and found that proposed changes, including increased pumping from the Delta, would jeopardize the continued existence of several species protected under the ESA and thus risk the extinction of these species. To avoid such jeopardy, the FWS and NMFS BiOps included RPAs for project operations. Actions needed to avoid jeopardy to Delta smelt under the FWS BiOp issued in December 2008[62] resulted in restrictions on the amount of water exported via SWP and CVP Delta pumps (Delta exports). The June 2009 NMFS BiOp on salmon and other anadromous and ocean species includes further limitations on pumping and release of stored water.[63] These restrictions, combined with reductions necessitated by drought conditions, have resulted in some water users receiving less or no water normally supplied by the CVP.

Other Factors Affecting Pumping

In addition to the ESA, several other state and federal laws enacted to protect Delta resources have resulted in restrictions on how much, and when, water may be pumped from the Delta by the SWP and CVP. For example, the California Endangered Species Act (CESA) was the basis for halting pumps in 2008,[64] and in 2014 California's water quality control plan (D-1641) often came into play restricting pumping before ESA. These restrictions, while protecting the interests of those who rely on and value Delta resources and the goods and services they provide (e.g., cleaner, less saline water; viable fish habitat for recreational and commercial fish species; and water supply for in-Delta or near-Delta users), also have resulted in some water users receiving less water than they originally contracted to receive from the SWP and CVP. Although many of these water users benefit from better-quality water than what otherwise might be delivered, these regulatory restrictions to protect threatened and endangered species and water quality have reduced the quantity of water available to those south-of-Delta SWP and CVP users with contracts based on water rights junior in priority to other senior rights holders or with otherwise lower priority for CVP project deliveries.[65]

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[60] California Environmental Protection Agency and State Water Resources Control Board, March 5, 2015 Order Modifying an Order that Approved in Part and Denied in Part a Petition for Temporary Urgency Changes to Permit Terms and Conditions Requiring Compliance with Delta Water Quality Objectives in Response to Drought Conditions, p. 4, at http://www.waterboards.ca.gov/waterrights/water_issues/programs/drought/docs/tucp/tucp_order030515.pdf.

[61] Act of December 28, 1973, P.L. 93-205; 87 Stat. 884, codified at 16 U.S.C. §§1531 et seq. This report assumes a basic knowledge of the act; an overview of the ESA and its major provisions may be found in CRS Report RL31654, *The Endangered Species Act: A Primer*, by M. Lynne Corn and Kristina Alexander.

[62] U.S. Department of the Interior, Fish and Wildlife Service, California and Nevada Region, Formal Endangered Species Act Consultation on the Proposed Coordinated Operations of the Central Valley Project (CVP) and State Water Project (SWP), Memorandum to Operation Manager, Bureau of Reclamation, from Regional Director, FWS Region 8, Sacramento, CA, December 15, 2008, at http://www.fws.gov/sacramento/es/documents/SWP-CVP_OPs_BO_12-15_final_OCR.pdf.

[63] U.S. Department of Commerce, National Marine Fisheries Service, Southwest Region, Biological Opinion and Conference Opinion on the Long-term Operations of the Central Valley Project and State Water Project, Endangered Species Act Section & Consultation, Sacramento, CA, June 4, 2009, at http://swr.nmfs.noaa.gov/ocap/NMFS_Biological_and_Conference_Opinion_on_the_Long-Term_Operations_of_the_CVP_and_SWP.pdf.

[64] *Watershed Enforcers v. California Dep't of Natural Resources*, No. RG06292124 (Sup. Ct. Alameda Co. March 22, 2007).

[65] Lack of sufficient water supplies in 2014 also resulted in historically low water deliveries to senior water rights (continued...)

Many of those adversely affected have expressed anger over export reductions and frustration with federal and state officials who are responsible for or who implement Delta export reductions.[66] Others, including Pacific Coast fishermen's organizations and groups concerned about the effects of increased pumping on declining fish species and north-coast fish-dependent economies, generally oppose efforts to halt or modify implementation of the BiOps, including recent legislative attempts to increase pumping.[67]

Effects of Regulatory and Statutory Restrictions

The above restrictions, combined with hydrologic conditions, contribute to reductions in pumping from the Bay-Delta at both the CVP and SWP pumping plants and to significant reductions in SOD water deliveries for some users. For example, CVP agricultural water service contractors have had their deliveries reduced from full contract supplies in all but 3 of the last 25 years—since the regulatory factors noted above have been in place—and reduced by 50% or more in 12, or nearly half, of those 25 years, even though total combined exports rates are on average higher than in the past (see **Table 2**).

It is not clear to what extent each of the above statutory and regulatory requirements independently has contributed to Delta export reductions in any given year. In managing SWP and CVP operations, both DWR and Reclamation must balance flow and other criteria in the Delta with temperature requirements and other factors in disparate places within the projects' system, including stretches of the Sacramento River. Thus, some of these requirements overlap and at times also may conflict with one another. For example, river temperature requirements may dictate release of water from upstream reservoirs at certain times when such releases may leave less water available for species needs at a later date. These factors make it especially difficult to ascertain to what extent the different water quality and/or CVPIA obligations noted above contribute to Delta export reductions in any given year.

Recent Delta Export Reductions: Selected Examples[68]

Combined CVP and SWP Delta exports in the 2014 water year are estimated to have been 1.86 MAF (or 38% of total average annual exports of 4.84 MAF) from 1976-2014, the lowest combined export recorded during that 38-year time period (see **Table 2**).[69] Reclamation estimates that the amount of CVP water not pumped (CVP export reduction) due to ESA restrictions was 62,200 AF (0.062 MAF) of water in 2014; approximately 2%of the total reduction in pumping

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(...continued)

holders south of the Delta. Some water users argue that had these regulatory restrictions not been in place in wet water years, there would have been more water available for use during these drought years.

[66] See House Committee on Natural Resources, Oversight Field Hearing on "California Water Crisis and Its Impact: The Need for Immediate and Long-Term Solutions," March 19, 2014, and congressional floor debate on H.R. 2898, July 15 and 16, 2015.

[67] John McManus, Dick Pool, and Randy Repass, et al., *The Impact of the California Drought on Salmon*, Golden Gate Salmon Association, handout from presentation for congressional staff, April 15, 2015, p. 1.

[68] Examples are based on data supplied by Reclamation or more readily available in operations reports.

[69] The annual combined exports of the SWP and CVP averaged 5.7 MAF from 1998 through 2007. However, a five-year average (2003-2007) was 6.1 MAF, and a three-year average (2004-2006, when OCAP changes were in effect), was 6.2 MAF. U.S. Department of the Interior, Bureau of Reclamation, Mid-Pacific Region, *Biological Assessment on the Long-Term Operations of the Central Valley Project and the State Water Project*, Sacramento, CA, August 2008, Table 2-25, p. 120, at http://www.usbr.gov/mp/cvo/OCAP/sep08_docs/OCAP_BA_Aug08.pdf (hereinafter referred to as the 2008 BA).

from the long-term average of 4.84 MAF.[70] The state estimates that SWP exports were reduced by approximately 47,000 AF (0.047 MAF) over 29 days due to ESA restrictions in 2014.[71] Combined, it appears that 0.109 MAF (109,000 acre-feet) of the total reduction in combined exports can be attributed to pumping restrictions required to protect listed species under ESA. The remaining reductions were most likely due to a lack of runoff and operational changes needed to control salinity levels in the Delta.

In contrast to the estimated reductions for ESA, Reclamation estimates that CVP export reductions made for state D-1641 habitat and fishery purposes in 2014 totaled 176,300 AF.[72] As noted earlier, Reclamation identified these state-mandated reductions as actions counting toward CVPIA (b)(2) water allocation for (b)(2) accounting purposes. In years past, it has been noted that up to 450,000 AF annually could be used to meet Delta D-1641 water quality and habitat obligations from the 800,000 AF (b)(2) allocation set aside for fish and wildlife purposes under the CVPIA.[73] Thus, in some years, pumping restrictions are controlled more often by D-1641, resulting in CVP pumping reductions for D-1641 greater than for ESA purposes. In wet years, however, ESA restrictions may have a higher nominal impact on exports and proportionally higher impacts in certain months.[74] DWR does not account for reductions from historical levels due to D-1641 standards.[75]

Reclamation estimated that restrictions for the protection of salmon and other fish species resulted in approximately 250,000 AF of CVP export reductions in 2013. This figure represents nearly 39% of the total CVP export reductions for 2013 (depending on agency calculations). Reclamation noted similar reductions in 2009 during the previous drought (see below).[76] For 2011 (a wet year), Reclamation estimated that pumping restrictions totaled 90,000 AF (62,000 AF for endangered species and 28,000 AF for CVPIA purposes), or approximately 1.4% of the 6.9 MAF that was exported from the Delta that year. **Figure 10**shows CVP and SWP pumping levels from 1976 through 2014. As shown in **Figure 10**, higher-than-average combined pumping levels were sustained from 2000 through 2007.

Under several different scenarios (using different export baseline totals), the estimated impacts of ESA restrictions on exports in 2009 ranged from 20% to 25% (see text box below). The 2008

[70] Personal communication via email from the Bureau of Reclamation, February 11, 2015, and response of Michael C. Connor, Deputy Secretary of the Department of the Interior at a House Interior, Environment, and Related Agencies Subcommittee budget hearing on February 25, 2015 (See http://www.eenews.net/eedaily/2015/02/26/stories/1060014067.)

[71] Personal communication via email from the Department of Water Resources, February 10 and February 13, 2015, and May 22, 2013.

[72] CALFED Operations Group, *Water Year 2014 CVPIA Section 3406(b)(2) Operations and accounting*, January 28, 2015, p. 12, at http://www.usbr.gov/mp/cvo/data/FINAL_WY14_b2_presentation.pdf.

[73] According to CALFED documents, the agencies, "in conjunction with the Governor's Drought Contingency Plan ... will use their available resources to create an insurance policy that will seek to eliminate impacts to water users, while not adversely affecting other uses." See CALFED Bay-Delta Program, Programmatic Record of Decision, vol. 1, Record of Decision and Attachments 1-4, Aug. 28, 2000, p. 55.

[74] *San Luis & Delta-Mendota Water Authority, et al., California Department of Water Resources v. Kenneth Lee Salazar, et al., Natural Resources Defense Council*, 1:09-cv-00407-LJO-DLB 9 (9th Cir. Court of Appeals 2014), p. 3 *infra* note 1. Plaintiffs refer to reports projecting that had 2009 been a wet year, the BiOps would have resulted in "water losses of 1.1 MAF, with an average annual loss over time of 440,000 acre feet" and to a DWR report stating exports in September and October might be reduced by 70%.

[75] Email communication with the California Department of Water Resources, February 10 and February 13, 2015, and May 22, 2015.

[76] U.S. Department of the Interior, Bureau of Reclamation, *California Drought Response Fact Sheet*, revised September 17, 2009, p. 1.

FWS Delta smelt BiOp actions initially were estimated to reduce Delta exports by 500,000 AF (0.5 MAF). However, a district court prevented those measures from fully taking effect in 2009,[77] and drought conditions affected operations such that other factors reduced pumping ability before ESA restrictions could fully take effect. For example, at a March 31, 2009, House Committee on Natural Resources hearing, acting Reclamation Commissioner William McDonald noted that although FWS Delta smelt BiOp pumping restrictions became effective in early March 2009, Reclamation at the same time needed to restrict pumping due to other statutory restrictions (i.e., CVPIA). The Commissioner stated: "There was actually no net reduction in pumping [from federal pumps in early 2009] merely because of ESA."[78] Later in the year, however, ESA did come into play resulting in restricted pumping, as discussed below.

Caveats Regarding Factors Affecting Exports

The volume of water estimated to make up the export reductions in any given year depends on assumptions underlying calculations of the estimate (e.g., the amount of rescheduled water from a prior year that might have been moved earlier to make space available for additional storage, water that might have been hydrologically available for pumping, etc.). (See http://www.usbr.gov/newsroom/newsrelease/detail.cfm?RecordID=42804 for information on actions to make up for reduced pumping.)

Additionally, the export reduction as a percentage of exports will vary depending on the baseline used for the total average export. For example, the average annual combined export level based on a selective three-year average (e.g., 2004-2006, when Reclamation increased pumping under the new coordinated operations plan [OCAP]) is 6.2 MAF (see **Table 2**). This three-year window approximates the time between the issuance of OCAP and court-imposed restrictions on pumping levels. The estimated exports for 2009 of 3.6 MAF under this scenario represent a reduction of 2.6 MAF for 2009, or 42% from the three-year average. Of this amount, approximately 19% (0.5 MAF) could be attributed to Delta smelt restrictions and 81% (2.1 MAF) to drought and other factors. However, the average pumping levels during this time were 0.05 MAF higher than the average from 1998 to 2007 and substantially higher than in any other period except 1989 and 1990. Different baselines would yield different results. For example, if the 10-year average from 2000 through 2009 (5.4 MAF) were used, the pumping reduction would be smaller—1.8 MAF as opposed to 2.6 MAF—but the percentage attributable to Delta smelt restrictions would be higher (28%). The percentage reductions attributable to Delta smelt restrictions in non-dry (non-drought) years in all scenarios are estimated to be higher than those estimated for 2009.

In sum, although the RPAs for threatened and endangered species protection under ESA affect Delta exports, other requirements also restrict exports and contribute to RPA actions. Together these elements are intended to provide a network of protection for species and water quality for in-Delta uses such as farming and drinking water, and one element is not easily separated from others. Thus, even if the ESA were waived or overridden, federal and state agencies would still be required to comply with several state and federal laws and directives that in combination limit Delta exports (e.g., the federal Clean Water Act and CVPIA, the state Porter-Cologne Act and its implementing directive D-1641, the California Endangered Species Act, and the California Fish and Game Code). Crafting congressional solutions to the water supply restrictions thus becomes difficult and involves many interested parties and stakeholders with differing interests, as well as interactions with state law and policies.

[77] San Luis and Delta-Mendota Water Authority v. Salazar, 2009 WL 1575169 (E.O. Cal. May 29, 2009). It is not clear what effect this decision had on the 500,000 AF estimate.

[78] Statement of William McDonald, Acting Commissioner of Reclamation, during a U.S. House of Representatives Natural Resources Committee hearing on drought conditions in California, *The California Drought: Actions by Federal and State Agencies to Address Impacts on Lands, Fisheries, and Water Users,* March 31, 2009, pp. 124-125.

Table 2. Central Valley Project (CVP) and State Water Project (SWP) Delta Exports, 1976-2014

Water Year	Water Year Type	CVP Total (MAF)	SWP Total (MAF)	CVP/SWP Combined Exports	CVP SOD-Ag[a]	Shasta Index Critical[b]
1976	C	3.01	1.82	4.83	100%	
1977	C	1.41	0.76	2.17	25%	X
1978	AN	2.38	2.01	4.39	100%	
1979	BN	2.61	1.76	4.37	100%	
1980	AN	2.43	2.17	4.60	100%	
1981	D	2.80	1.97	4.77	100%	
1982	W	2.25	2.43	4.68	100%	
1983	W	2.72	1.76	4.48	100%	
1984	W	2.54	1.40	3.94	100%	
1985	D	3.43	2.16	5.59	100%	
1986	W	2.94	2.46	5.40	100%	
1987	D	3.16	2.01	5.17	100%	
1988	C	3.42	2.32	5.74	100%	
1989	D	3.40	2.70	6.10	100%	
1990	C	3.07	2.85	5.92	50%	
1991	C	1.65	1.64	3.29	25%	
1992	C	1.49	1.51	3.00	25%	X
1993	AN	2.22	2.53	4.75	50%	X
1994	C	2.37	1.73	4.10	35%	
1995	W	2.70	2.48	5.18	100%	X
1996	W	2.68	2.66	5.34	95%	
1997	W	2.96	2.12	5.08	90%	
1998	W	2.66	2.09	4.75	100%	
1999	W	2.44	2.37	4.81	70%	
2000	AN	2.83	3.45	6.28	65%	
2001	D	2.65	2.38	5.03	49%	
2002	D	2.75	2.70	5.45	70%	
2003	AN	2.86	3.39	6.25	75%	
2004	BN	2.93	3.14	6.07	70%	
2005	AN	2.83	3.58	6.41	85%	
2006	W	2.74	3.50	6.24	100%	
2007	D	2.90	2.82	5.72	50%	
2008	C	2.15	1.49	3.49	40%	
2009	D	2.09	1.49	3.47	10%	
2010	BN	2.29	2.39	4.58	45%	
2011	W	2.63	3.96	6.52	80%	
2012	BN	2.27	2.60	4.87	40%	

Water Year	Water Year Type	CVP Total (MAF)	SWP Total (MAF)	CVP/SWP Combined Exports	CVP SOD-Ag[a]	Shasta Index Critical[b]
2013	D	2.03	2.16	4.19	75%	
2014	C	0.95	0.91	1.86	0%	X
Average[c]		2.56	2.30	4.84		

Source: CRS from data provided by the U.S. Dept. of the Interior, Bureau of Reclamation, email communication, November 14, 2014, *Total Annual Pumping at Banks, Jones, and Contra Costa Pumping Plants 1976-2014 (MAF)*.

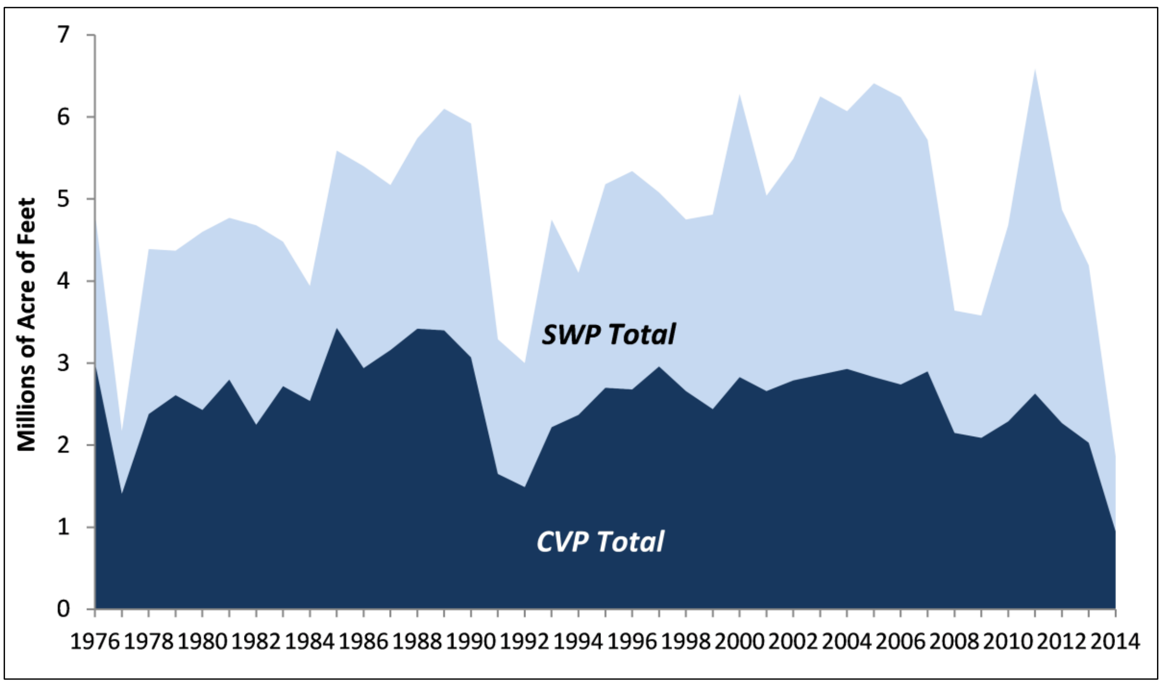
Notes: Water year types are as follows: AN = Above Normal; BN = Below Normal; D = Dry; W = Wet; and C= Critical (critically dry). MAF = Million acre-feet.

a. In the sixth column, SOD-Ag refers to south-of-Delta agricultural water service contractors (junior water rights holders under California water law). Percentages show water allocations for these contractors as a percentage of their maximum contract total.

b. In the seventh column, the "Shasta Index" refers to an index used to determine water allocations based on unimpaired inflows into Shasta Lake, the reservoir behind Shasta Dam in Northern California. Water year types and thus water allocations are determined based on the elevation of Shasta Lake at certain times of the year. Critical refers to a critically dry year in which the Shasta inflows were below specified levels, triggering reduced water allocations for CVP contractors.

c. Averages may not square due to rounding.

Figure 10. CVP and SWP Delta Water Exports, 1976-2014



Source: CRS from data provided by the U.S. Dept. of the Interior, Bureau of Reclamation, November 14, 2014: Total Annual Pumping at Banks, Jones, and Contra Costa Pumping Plants 1976-2014 (MAF).

Notes: The spike in 2001 correlates to the filling of Diamond Valley reservoir and the ability of the SWP to export high excess winter flows; albeit in an overall dry year. The troughs in 1977, 1991-1992, and 2008-2009 reflect exports during previous California droughts.

How Do Recent Exports Compare to Previous Droughts?

California is experiencing its fourth significant drought in approximately 40 years, averaging one each decade: 1976-1977; 1987-1992; 2008-2010; and 2012-the present. Combined CVP and SWP exports were curtailed to 2.71 MAF in 1977 but reached a record high for the time in 1989 and 1990 (6.1 MAF and 5.92 MAF, respectively) in the middle of a six-year drought.[79] It was not until 1991 and 1992, the last two years of the drought, that combined CVP and SWP exports were significantly curtailed to 3.29 MAF and 3.0 MAF, respectively (see **Table 2**).

Reclamation estimates that during the last drought, combined 2008 water year exports totaled 3.49 MAF, a difference of +0.2 to +0.49 MAF compared with 1991 and 1992. All three water years (1991, 1992, and 2008) were classified as *critical dry*. Thus, it appears that more water was exported in 2008 than during the driest years of the 1987-1992 drought.[80] Further, the relatively large export values occurred even though post-1992 regulatory restrictions—such as the new Delta smelt BiOp (see **Figure 10**), those contained in CVPIA, and D-1641—were not then in place. Similarly, combined exports for the dry 2009 water year, the second year of the recent three-year drought, were 3.47 MAF—higher than the end of the six-year drought in the early 1990s and with more recent regulatory restrictions in place. For the 2014 water year, however, combined exports were only 1.86 MAF, far less than in any year since 1977, and 0.31 MAF less than in 1977, the previous drought of record affecting CVP deliveries.

Combined exports have exceeded 6.0 MAF seven times since 1977. Six of those times have been since 2000, and four were between 2003 and 2006. The highest combined export, 6.52 MAF, occurred in 2011 (a very wet year). Once between 1976 and 2000 combined exports reached more than 6.0 MAF (6.10 MAF in 1989, during the fourth year of a six-year drought). For example, combined exports averaged 4.38 MAF for the 10-year period 1976-1985, and they averaged roughly 5.05 MAF for the 10 year-period 1980-1989. Average combined exports during both these periods were less than the average deliveries for the 10-year period 2000-2009 (5.44 MAF), and they were less than the average deliveries during the last 15 years (5.10 MAF). Thus, even with numerous restrictions, combined CVP and SWP Delta exports have in recent times averaged more annually—they exceeded exports during the 1976-1985 and 1980-1989 timeframes—than in any time prior to enactment of the CVPIA and other more recent regulatory restrictions (e.g. D-1641 and ESA BiOps). CVP exports, however, have declined in proportion to SWP exports, resulting in reduced water deliveries to some CVP contractors south of the Delta.[81]

Some of the differences between recent pumping levels and pre-2000 pumping levels can be explained by successive wet years from 1995 to 1999 and other wet years in 2006 and 2011 (resulting in more water stored in reservoirs), as well as by significant increases in SWP pumping (see **Table 2**) from 2003 through 2006 (reflecting increased demand SOD).[82] It is not clear, however, how much of the difference can be explained without analyzing total supplies available

[79] These pumping levels have since been exceeded in 2000 (6.28 MAF), coinciding with filling of Diamond Valley Lake in Southern California, and in 2003–2006 (ranging from 6.07 MAF to 6.25 MAF), roughly coinciding with increased pumping under the proposed new OCAP in 2004.

[80] Combined pumping during the 2009 and 2010 drought years also was higher than in 1991 and 1992; however, the former years were classified as dry and below normal years, respectively, whereas the latter were critical dry years.

[81] Some attribute the switch from CVP having the higher proportional exports to SWP having the larger share to the SWP having larger canal capacity and being able to take on more water when more is available to be pumped.

[82] Demand for water from growing urban areas in Southern California, which have experienced an increase in population of 8 million-10 million people since the early 1990s, development of new SWP contractor storage facilities south of the Delta, and declines in water availability to Southern California from the Colorado River have resulted in increased pressure on Delta and Northern California supplies and increased SWP exports from the Delta.

for each year, the timing of supplies available for export, and the availability of SOD storage capacity and canal capacity. Such analysis is beyond the scope of this report.

Regardless of the exact causes behind differences in annual pumping totals, CVP agricultural water service contractors have received *less* water than contracted for in most of the last 15 years (see "SOD-Ag" column in **Table 2**), even with record high combined exports. This appears to be due to relatively static CVP pumping levels (relative to increased SWP pumping levels) as indicated in **Figure 10**, restrictions affecting Delta exports, and some exported water now going to CVPIA wildlife refuges. For example, CVP water allocations have been reduced in part because of obligations under CVPIA to deliver water to SOD wildlife refuges. Other factors may also limit storage at the San Luis Reservoir (SOD). Thus, although combined exports have on average increased since the 1980s, CVP water allocations for SOD agricultural water service contractors have been significantly reduced. In contrast, SWP exports, primarily serving SOD municipal and industrial contractors, increased in 2000 and 2003-2006[83] (see **Table 2** and **Figure 10**)—a reversal of prior proportions serving CVP and SWP contractors.

California Water Rights: Acquisitions and Allocations

Another factor affecting water allocations is state water rights. The system of state water rights has a profound effect on who gets how much water and when, particularly during times of drought or other restrictions on water supply. California law provides for several limits on the use of the state's water, and these limits have a direct effect on how much water state and federal contractors receive both north and south of the Delta.[84] Because the waters of California are considered to be "the property of the people of the State," anyone wishing to use those waters must acquire a right to do so.[85] California follows a dual system of water rights, recognizing both the riparian and prior appropriation doctrines.[86] Under the riparian doctrine, a person who owns land that borders a watercourse has the right to make reasonable use of the water on that land (riparian rights).[87] Riparian rights are reduced proportionally during times of shortage.[88] Under the prior appropriation doctrine, a person who diverts water from a watercourse (regardless of his location relative thereto) and makes reasonable and beneficial use of the water acquires a right to that use of the water (appropriated rights).[89] Appropriated rights are filled in order of seniority during times of shortage.[90] Before exercising the right to use the water, appropriative users must

[83] Some contend that the increased pumping under earlier BiOps in the mid-2000s, combined with poor ocean conditions, contributed to a sharp decline in returning adult fall run salmon in subsequent years. See, for example, John McManus, Dick Pool, and Randy Repass, et al., *The Impact of the California Drought on Salmon*, Golden Gate Salmon Association, handout from presentation for congressional staff, April 15, 2015, p. 1.

[84] For a legal discussion of California's water laws and system of allocation, see CRS Report RL34554, *California Water Law and Related Legal Authority Affecting the Sacramento-San Joaquin Delta*, by Cynthia Brown.

[85] Cal. Water Code §102. See National Audubon Society v. Superior Court, 33 Cal. 3d 419, 441 (Cal. 1983).

[86] See In re Determination of Rights to Water of Hallett Creek Stream System, 44 Cal. 3d 448, 455 (Cal. 1988); National Audubon Society v. Superior Court, 33 Cal. 3d 419, 441 (Cal. 1983); People v. Shirokow, 26 Cal. 3d 301, 307 (Cal. 1980).

[87] A. Dan Tarlock, Law of Water Rights and Resources, ch. 3 "Common Law of Riparian Rights."

[88] Ibid.

[89] See generally, Ibid. at ch. 5, "Prior Appropriation Doctrine."

[90] Ibid.

obtain permission from the state through a permit system run by the State Water Resources Control Board (SWRCB).

Water Rights and Allocations for Water Delivered via the CVP

Both the CVP and SWP acquired appropriative rights for water use from the state of California, receiving several permits for water diversions at various points between 1927 and 1967.[91] Section 8 of the Reclamation Act of 1902[92] requires Reclamation to comply with state law, including requiring the agency to acquire water rights for its projects, such as the CVP.[93] If Reclamation found it necessary to take the water rights of other users, those users would be entitled to just compensation.[94] In some cases, Reclamation found it necessary to enter into *settlement* or *exchange* contracts with water users who had rights predating the CVP and thus were senior users in time and right. Many of these special contracts were entered into in areas where water users were diverting water directly from the Sacramento and San Joaquin Rivers. **Figure 11** shows the distribution of areas served under different types of CVP contracts, including senior water rights contractors known as the Sacramento River Settlement Contractors north of the Delta and the Exchange Contractors south of the Delta.

[91] For a discussion of the projects' permit process, see Racanelli, 182 Cal. App. 3d at 106.

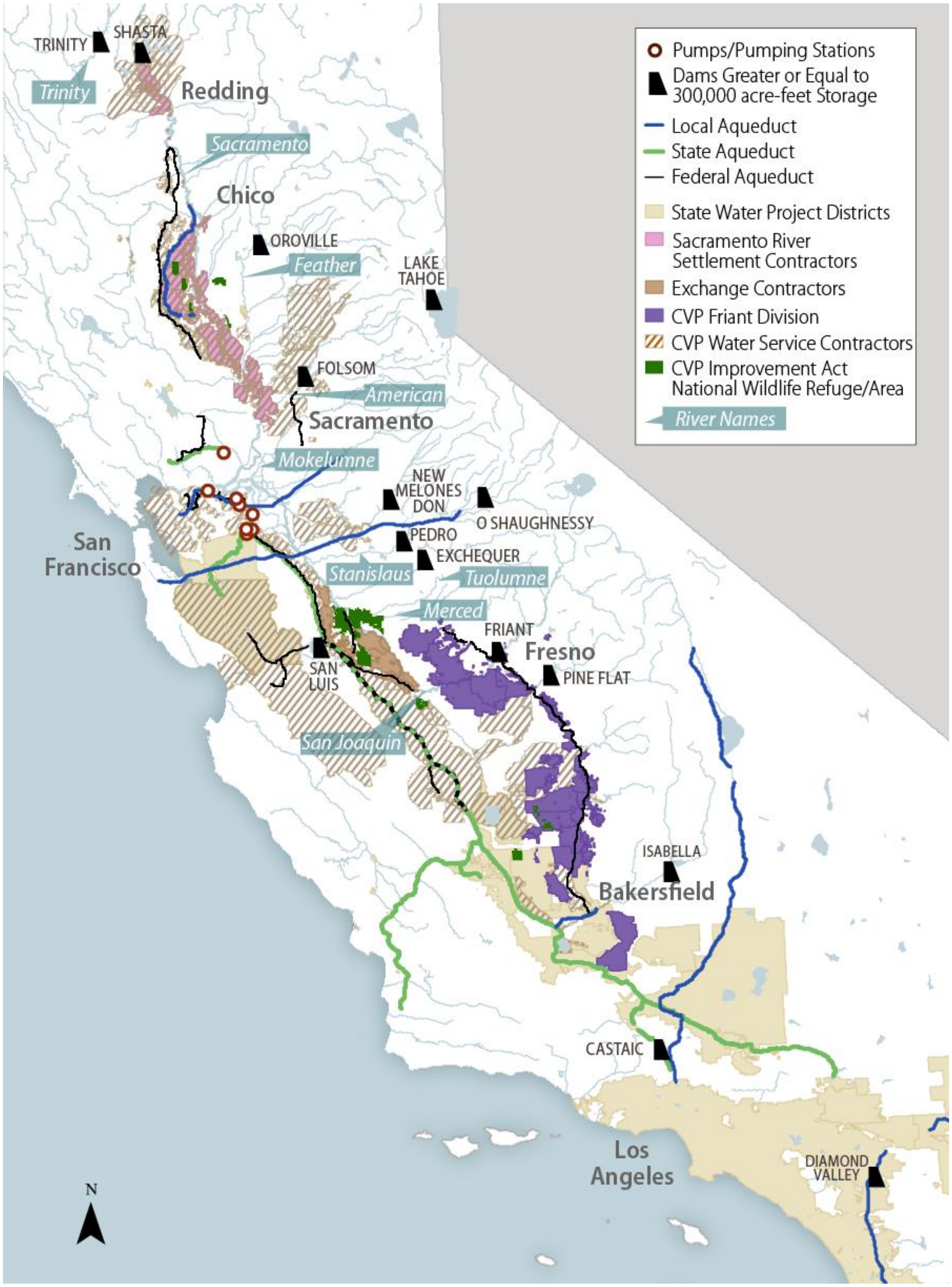
[92] 43 U.S.C. §383.

[93] The U.S. Supreme Court has held that Section 8 "requires the Secretary to comply with state law in the 'control, appropriation, use or distribution of water'" by a federal project. See California v. United States, 438 U.S. 645, 674-75 (1978). This requirement to comply with state law applied so long as the conditions imposed by state law were "not inconsistent with clear congressional directives respecting the project." See id. at 670-73; see also Ivanhoe Irrig. Dist. v. McCracken, 357 U.S. 275 (1958); City of Fresno v. California, 372 U.S. 627 (1963). In the context of the CVP, a court has held that the permit conditions were consistent with the project purpose of river regulation. Racanelli, 182 Cal. App. 3d at 135. See also United States v. State Water Resources Control Board, 694 F.2d 1171 (9th Cir. 1982).

[94] See Int'l Paper Co. v. United States, 282 U.S. 399, 407 (1931); United States v. Gerlach Live Stock Co., 339 U.S. 725, 736-39 (1950).

Figure 11. CVP and SWP Service Areas

(with major federal and state water conveyance systems)



Sources: Prepared by CRS based on data from the U.S. Bureau of Reclamation; California Spatial Information Library; Census Bureau TIGER/Line data files; and ESRI Community Data, 2008.

Notes: Areas displayed do not correspond to amount of water in contracts; rather, they correspond to water or irrigation district boundaries and bear no relation to the amount of contracted water supplies.

For example, many farmers were diverting water from the Sacramento River before construction of the Shasta Dam. For Reclamation to undertake the CVP as planned, it had to come to agreement with these prior users on use and delivery of Sacramento River water supplies. The result was a series of Sacramento River settlement contracts, which guarantee prior users certain amounts of *base supply* water. Some of these contractors also have contracts for CVP *project* water. North-of-Delta settlement contracts total approximately 2.1 MAF. Similarly, Reclamation entered into exchange contracts with certain water users who diverted water from the San Joaquin River prior to construction of the Friant Dam. These users exchanged their use of river water for water delivered from the Delta through the CVP Delta-Mendota canal; however, they retain a right to divert water from the San Joaquin River if Reclamation cannot deliver CVP water. South-of-Delta water rights contracts total approximately 880,000 AF. (See **Table 3** for a summary of 2015 water allocations by contract type and **Table 4** for a summary of 2009 water allocations.) In 2014, for the first time in the history of this exchange agreement, Reclamation was not able to deliver the base 75% of the exchange contractors' water. This resulted in the exchange contractors calling on their right to divert water from the San Joaquin River and left Friant Division with a first-time zero allocation of CVP water.[95] For 2015, an agreement has been reached among Reclamation, exchange contractors, and others to deliver approximately 63,000 AF to Friant water users through a number of purchases and exchanges.[96]

Table 3. CVP Contractors and 2015 Water Allocations

(allocations as percentages of maximum contract quantities)

CVP Contractors	February	March	April	May
Senior Water Rights				
San Joaquin Exchange Contractors	75%	75%	75%	75%
Sacramento River Settlement Contractors	75%	75%	75%	75%
Wildlife Refuges				
NOD Refuges (level 2)[a]	75%	75%	75%	75%
SOD Refuges (level 2)[a]	75%	75%	75%	75%
Friant Division				
Class I Contractors	25%	25%	25%	25%
Class II Contractors	0%	0%	0%	0%
Other CVP Water Service Contractors				
NOD Ag. Service	0%	0%	0%	0%
NOD M&I	25%	25%	25%	25%
SOD Ag. Service	0%	0%	0%	0%
SOD M&I	25%	25%	25%	25%

Source: U.S. Department of the Interior, Bureau of Reclamation, *Summary of Water Supply Allocations*, p 4. See, "Water Allocations Historical" at bottom of webpage: http://www.usbr.gov/mp/cvo/.

[95] Friant subsequently filed a lawsuit on this action: http://www.friantwater.org/docs/legislative_issues/Friant_Files_Legal_Challenge_Over_State_Board_Drought_Emergency_Decision_Process.pdf

[96] See http://www.usbr.gov/newsroom/newsrelease/detail.cfm?RecordID=49298. For more information on settlement and exchange contracts generally, see CRS Report RL34554, *California Water Law and Related Legal Authority Affecting the Sacramento-San Joaquin Delta*, by Cynthia Brown.

Notes: According to Reclamation's website, no changes in allocations have been made since February, 2015. NOD = North-of-Delta; SOD = South-of-Delta; M&I = Municipal and Industrial.

a. Level 2 supplies are less than full level 4 supplies, which refuges are granted under the Central Valley Project Improvement Act.

Table 4. CVP Contractors and 2009 Water Allocations

(allocations as percentages of maximum contract quantities)

CVP Contractors	February	March	April	May
Senior Water Rights				
San Joaquin Exchange Contractors	75%	100%	100%	100%
Sacramento River Settlement Contractors	75%	100%	100%	100%
Wildlife Refuges				
NOD Refuges (level 2)[a]	75%	100%	100%	100%
SOD Refuges (level 2[a])	75%	100%	100%	100%
Friant Division				
Class I Contractors	25%	65%-85%	90%	100%
Class II Contractors	0%	0%	0%	18%
Other CVP Water Service Contractors				
NOD Ag. Service	0%	5%	15%	40%
NOD M&I	50%	55%	65%	75%- 100%
SOD Ag. Service	0%	0%	10%	10%
SOD M&I	50%	50%	60%	60%

Source: U.S. Department of the Interior, Bureau of Reclamation, *Summary of Water Supply Allocations*, p 4, at http://www.usbr.gov/mp/cvo/vungvari/water_allocations_historical.pdf.

Notes: Increases in allocations were made on March 20, March 30, April 21, and May 22, 2009. NOD = North-of-Delta; SOD = South-of-Delta; M&I = Municipal and Industrial..

a. Level 2 supplies are less than full level 4 supplies to which refuges are granted under the Central Valley Project Improvement Act. Class I and Class II refer to Friant Division contractors only. Class I contractors have a higher priority for receiving supplies when available.

Other CVP contracts, known as *water service contracts* (shown as an overlay by brown crosshatch marks in **Figure 11**), are held by users for water supply generally based on water rights that Reclamation holds (issued by the state) for water stored, diverted, and delivered as part of the CVP.[97] The amount of water supplied to users under these contracts generally is determined by the terms of the contract rather than the legal doctrines of water rights. These contracts also incorporate the requirements of federal Reclamation law.[98] Specifically, the contracts typically include provisions that address the possibility of water shortages due to drought and other conditions that may affect users' access to water provided under their contract.[99] Generally, courts have allowed the federal government to reduce water allocations provided by contract if the

[97] Some water and irrigation districts or individual contractors hold more than one type of contract, hence the CVP crosshatch overlay for some areas in **Figure 11**.

[98] CVP Contract preamble. For a CVP-wide form of contract (CVP Contract) that Reclamation uses, see http://www.usbr.gov/mp/cvpia/3404c/lt_contracts/cvpwide_final_form_contract_04-19-04.pdf.

[99] See CVP Contract art. 3(b) ("Because the capacity of the Central Valley Project to deliver Project Water has been constrained in recent years and may be constrained in the future due to many factors including hydrologic conditions and implementation of Federal and State laws, the likelihood of the Contractor actually receiving the amount of Project Water set out [in this contract] in any given Year is uncertain.") See also contract articles 11 and 12.

reduction is made necessary by federal law, but the extent of liability depends on the terms of the specific contract used in each case.[100]

Senior water rights holders (i.e., settlement contractors, shown in pink, and exchange contractors, shown in brown, in **Figure 11**) have a combined first priority to approximately 3.0 MAF of CVP water. This water rights priority, together with drought and regulatory restrictions, means that water service contractors with contracts based on CVP water rights that are junior to settlement and exchange contractors may face significant cuts during times of water supply shortages (particularly SOD water service contractors). For example, in dry years (indicated by certain water levels at Shasta Lake by a certain time early in the water year), senior water rights contractors are allocated 75% of their contract amounts, whereas CVP water service contractors might be allocated as little as 0% of their contracted supplies. For 2015, senior water rights contractors have been allocated 75% of their contract supplies, while M&I water service contractors have been allocated 25%, and agricultural water service contractors north and south of the Delta have been allocated 0% of their contracted water.[101] (See **Table 3**.) When water is scarce due to hydrologic conditions, regulatory restrictions, or both, water supply reductions are primarily a function of state water rights, legal settlements, and agreements with landowners who were senior water rights holders. Without these agreements, construction of the CVP and irrigation of new areas south of the Delta likely would not have been possible.

Issues for Congress

As California endures its fourth year of drought, Congress faces a number of issues that confront California in the short term. One such issue is how to respond to immediate demands for water deliveries during the drought, given other policy concerns, such as avoiding harm to several fish species. Other issues include how to address water supply availability in general and how to finance any improvement or increase in water supply storage given current fiscal constraints and congressional policies discouraging site-specific project authorizations and appropriations. Longer-term issues for Congress include how to improve federal water delivery reliability for an array of users and how to stabilize aquatic ecosystems to improve resilience to inevitable future droughts. Water and power users that are part of diverse economies depend on reliable water supplies and healthy aquatic ecosystems. California agriculture is important not only to the state but also to the nation. At the same time, protecting, conserving, and improving habitat for federally listed species is required under federal and state endangered species laws. Another long-term issue is what role the federal government should play in providing or improving water supplies nationwide.

[100] See Stockton E. Water Dist. v. United States, 76 Fed. Cl. 321, 358-59 (Fed. Cl. 2007) (Bureau not liable where reductions "occurred due to implementation of amendments to federal Reclamation law"); O'Neill v. United States, 50 F.3d 677, 682-83 (9th Cir. 1995) (contract provision relieving government of liability "for any damage ... arising from a shortage on account of errors in operation, drought, or any other causes" included protection for shortages caused by "the effects of subsequent Congressional mandates"). But see Tulare Lake Basin Water Storage Dist. v. United States, 49 Fed. Cl. 313 (Fed. Cl. 2001) (federal government liable when federal legislation forced reductions under state contract to which the federal government was not a party). Six years later, the same judge that wrote the *Tulare* decision repudiated the physical taking characterization, citing intervening case law and noting the absence of a physical diversion. See Casitas Municipal Water Dist. v. United States, 76 Fed. Cl. 100 (Fed. Cl. 2007). On appeal, the U.S. Court of Appeals for the Federal Circuit reversed the district court's holding in Casitas, noting that the intervening caselaw did not bear on the case. Casitas Municipal Water Dist. v. United States, 543 F.3d 1276 (Fed. Cir. 2008).

[101] Historical CVP water allocations can be viewed at http://www.usbr.gov/mp/cvo/vungvari/water_allocations_historical.pdf.

Legislation addressing the management of the CVP and SWP can generate controversy because of the enormous complexity of the water delivery system in California. The coordinated operation and management of the CVP and SWP involves a web of federal and state law, encompassing state water rights priorities; water delivery contracts; federal, state, and local agency regulations and policies; multiagency agreements and other factors, as noted above. Achieving consensus on such legislation often is difficult because if legislation leads to a change in any of these factors, it can affect multiple parties and interests by potentially altering the timing or amount of water made available to such parties or to the underlying ecosystem. For example, if legislation directs that the volume of water pumped from the Delta is to be increased beyond the status quo, a number of questions arise: Where will the additional water come from? What effect might the increased pumping have on other water users or species? How will the increased pumping affect in-Delta water quality?

Similarly, legislation that prohibits involuntary reductions in water supply to those who receive water from the CVP and SWP could affect other water users, reducing their water supplies or changing the timing of water availability. Such legislative directions might conflict with the declaration that the CVP must be operated in conformity with state water law. There is a question about whether it would be possible to pump at the levels specified in certain bills without having redirected impacts on other water users. If it is possible, the question becomes how such impacts might be avoided. If these impacts cannot be avoided, the question then becomes who might bear responsibility or pay for unavoidable costs.

These were some of the issues raised by legislation in the 113th Congress that specifically addressed short- and long-term CVP and SWP water management. Three bills—H.R. 3964, H.R. 5781, and S. 2198—passed their respective chambers, but a compromise among the different proposals was not reached before the end of the 113th Congress.[102] Legislation with similar aims—to maximize water supplies—has been introduced in the 114th Congress (e.g., H.R. 2898, which passed the House on July 16, 2015, and S. 1894, introduced July 30, 2015). Both bills also include several titles that go beyond CVP and SWP water management. Other bills introduced in the 114th Congress that address California drought and water management include several that would authorize conservation and water recycling initiatives, among other activities (e.g., H.R. 291 and S. 176; H.R. 2983 and S. 1837; and H.R. 3045). For more information on legislation, see CRS In Focus IF10019, *H.R. 5781: Legislation Proposed to Maximize Water Supplies to Address Drought in California*; CRS Report R43820, *Analysis of H.R. 5781, California Emergency Drought Relief Act of 2014*; and CRS Insight IN10308, *Drought Legislation: H.R. 2898*.

[102] H.R. 3964, the Sacramento-San Joaquin Valley Emergency Water Delivery Act, aimed to reduce the negative effects of environmental and other laws on CVP water deliveries. Critics contend, however, that although the bill may have improved the water supply situation for some, it could have contributed to continued decline of threatened and endangered fish species. Likewise, S. 2198, the Emergency Drought Relief Act of 2014, aimed to direct the Bureau of Reclamation to "maximize water supplies" while also protecting species. Some believe that S. 2198 did not go far enough to ensure reliable water supplies, while others feared it could effectively negate protections for threatened and endangered species, depending on how the law would have been implemented. H.R. 5781 addressed similar issues but would have affected CVP operations only during drought. (For information on H.R. 3964 and S. 2198, see CRS Report R43649, *Federal Response to Drought in California: An Analysis of S. 2198 and H.R. 3964*, by Pervaze A. Sheikh, Betsy A. Cody, and Charles V. Stern; CRS Report R43594, *Analysis of Senate-Passed S. 2198: Emergency Drought Relief Act of 2014*, by Betsy A. Cody and Pervaze A. Sheikh; and CRS Report R43648, *H.R. 3964: Analysis of Key Provisions*, by Charles V. Stern, Betsy A. Cody, and Pervaze A. Sheikh. For information on H.R. 5781, see CRS In Focus IF10019, *H.R. 5781: Legislation Proposed to Maximize Water Supplies to Address Drought in California*, by Betsy A. Cody, Pervaze A. Sheikh, and Charles V. Stern; CRS Report R43820, *Analysis of H.R. 5781, California Emergency Drought Relief Act of 2014*, by Betsy A. Cody, Pervaze A. Sheikh, and Charles V. Stern.

Outlook

California is in its fourth year of drought, with many areas of the state experiencing extreme to exceptional drought conditions. The current drought has created a fundamental water supply shortage. In addition to hydrological limitations on water supplies, several federal and state statutes, regulations, and policies have reduced reservoir storage and water deliveries from the federal CVP and California's SWP. The extended drought conditions have exacerbated controversy over water delivery restrictions from state and federal projects. Some argue that the restrictions would not be so severe had water in wet years been allowed to be pumped or held in storage for later use. Regulatory or court-imposed restrictions related to species and water quality, as well as the long-established state water rights system, have intensified effects of the drought for agricultural and urban water users. For example, even in the wettest years, some CVP contractors have had their water deliveries cut due to environmental factors. These effects are not always perceived as equitable or fair to those with CVP contracts based on CVP project water rights junior in priority to senior water rights holders or to those who otherwise have lower priority for receiving SWP and CVP water.

The effects on water deliveries resulting directly from federal ESA requirements have become a flash point of sorts over CVP water management. For the 2014 water year, ESA compliance was estimated to have been approximately 2% of total water delivery reductions for 2014. The remaining water reductions presumably are due to drought and other factors, such as state water quality control requirements. However, reductions due to compliance with the federal ESA in other years have constituted a higher percentage of total water delivery reductions. For example, reductions due to ESA restrictions in 2009 ranged roughly from 20% to 25% of total water delivery reductions, depending on the time period used for estimating annual deliveries, and were as high as 39% for 2013. It is clear that various regulatory restrictions have contributed to reduced exports of water to water users south of the Delta; however, year over year, there appears to be wide variation in reductions due solely to regulatory compliance versus other factors—both in percentage and nominal terms.

In sum, although the reasonable and prudent alternatives (RPAs) for threatened and endangered species protection under ESA affect Delta exports, other requirements also restrict exports and contribute to RPA actions. Together, these elements provide a network of protection for species and water quality for in-Delta uses such as farming and drinking water, and one element is not easily separated from others. Thus, even if the ESA were waived or overridden, federal and state agencies still would be required to comply with several state and federal laws and directives that, in combination, limit Delta exports (e.g., the federal CWA and CVPIA, the state Porter-Cologne Act and its implementing directive D-1641, the California Endangered Species Act, and the California Fish and Game Code). Crafting congressional solutions to the water supply restrictions thus becomes difficult and involves many interested parties and stakeholders with various interests, as well as interactions with state law and policies.

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