Appendix D

Plan Addendum Information

3.3.3 Drought

General Background

Drought is a gradual phenomenon, occurring slowly over multi-year periods and increasing with the length of dry conditions. The severity of the drought depends upon the degree of moisture deficiency, the duration, and the size of the affected area. There are several ways that drought can be defined.

Meteorological - a measure of departure of precipitation from normal. Due to climatic differences, what might be considered a drought in one location of the country may not be a drought in another location.

Agricultural - refers to a situation where the amount of moisture in the soil no longer meets the needs of a particular crop.

Hydrological - occurs when surface and subsurface water supplies are below normal.

Socioeconomic – occurs when the results of drought impacts the health, well being, and quality of life, or when a drought starts to have an adverse economic impact on a region. (Source: National Drought Mitigation Center, University of Nebraska, Lincoln)

Regulatory – occurs when mandatory compliance with environmental protection laws (especially those pertaining to protection of endangered species) combined with low precipitation and runoff, produce deficiencies in agricultural and/or urban water supplies.

Location and Extent

In general, drought has the potential to directly and indirectly impact each and every person within the City, as well as adversely affect the local economy. Individuals and properties will be affected at varying levels, depending upon their water source and water needs. For example, a property owner with a large water demand and private well, are more likely to be impacted than a small City lot using groundwater from the City's domestic water supply system

As described in the following pages, over the course of time to prepare the 2015 Merced Hazard Mitigation Plan, drought conditions varied considerably.

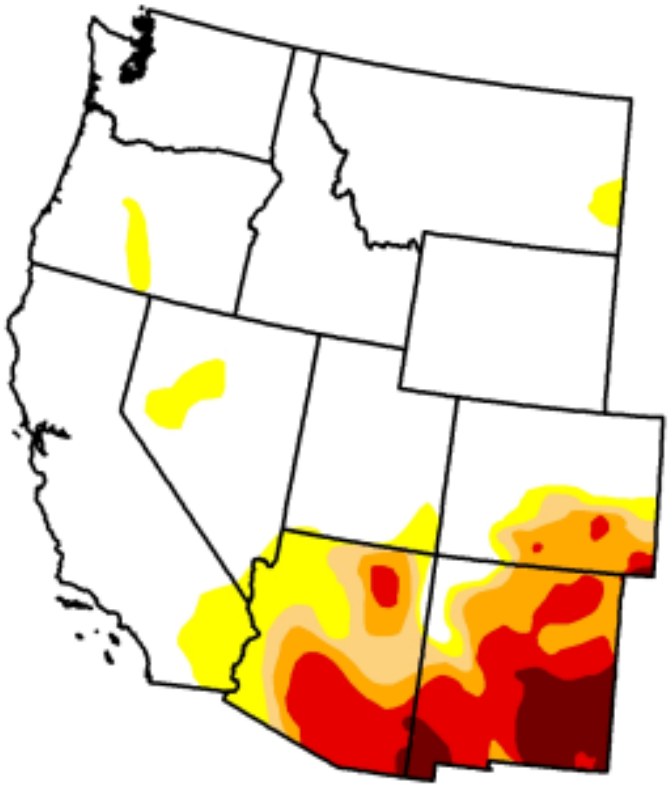
U.S. Drought Monitor

West

November 1, 2011
Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	74.16	25.84	18.67	15.19	9.60	2.87
Last Week (10/25/2011 map)	74.12	25.88	18.32	14.67	8.48	2.87
3 Months Ago (08/02/2011 map)	74.90	25.10	18.98	15.44	11.10	5.52
Start of Calendar Year (12/28/2010 map)	73.26	26.74	11.98	0.89	0.00	0.00
Start of Water Year (09/27/2011 map)	66.72	33.28	19.04	14.99	9.30	3.81
One Year Ago (10/26/2010 map)	69.02	30.98	5.39	0.19	0.00	0.00



Intensity:

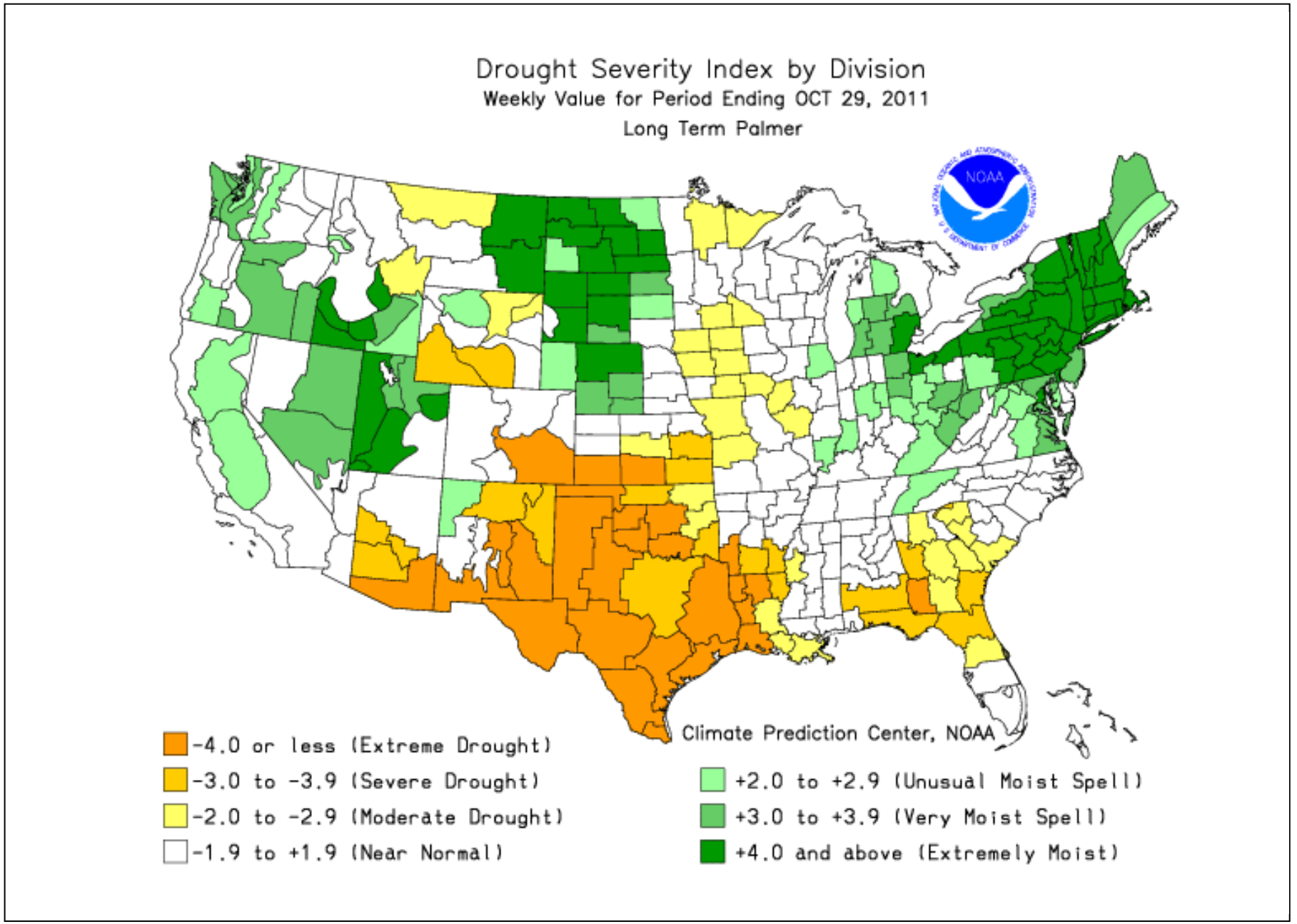
- D0 Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

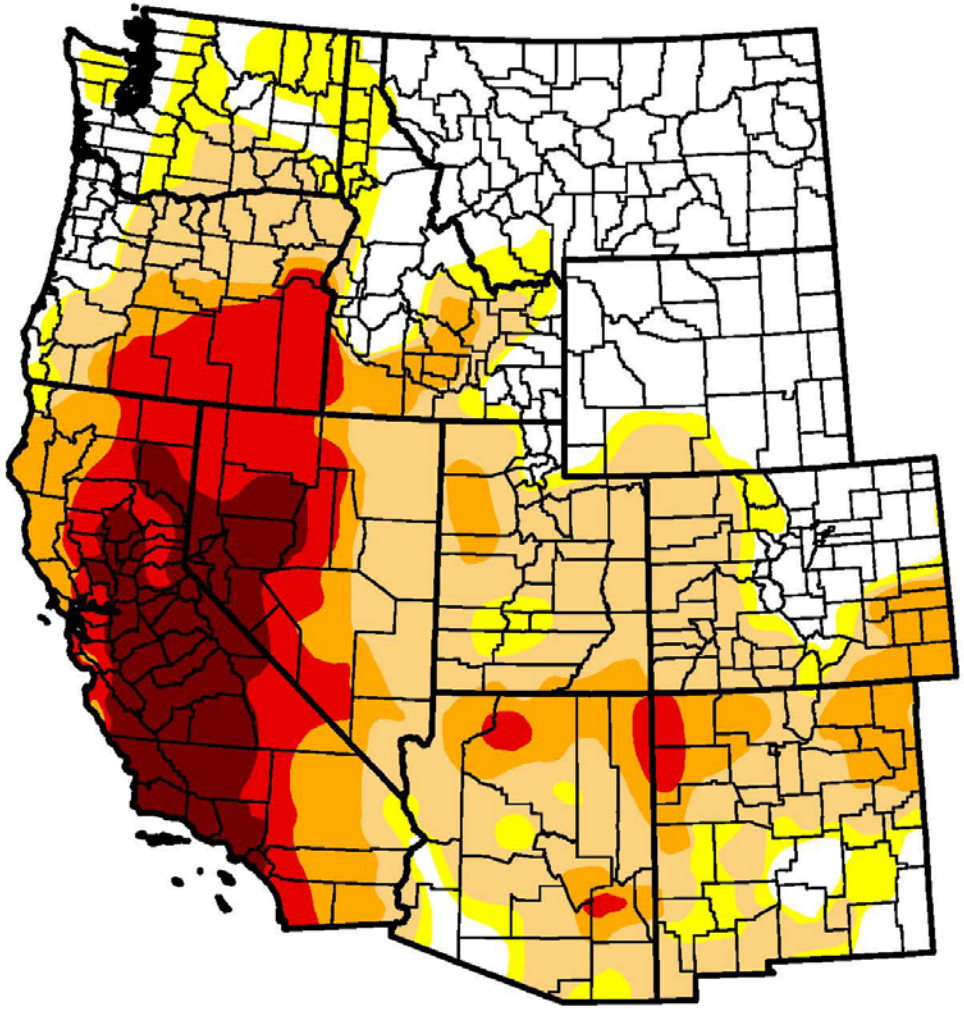
http://droughtmonitor.unl.edu

USDA National Drought Mitigation Center

Released Thursday, November 3, 2011
Brian Fuchs, National Drought Mitigation Center


Drought Severity Index by Division
Weekly Value for Period Ending OCT 29, 2011
Long Term Palmer
NOAA
Climate Prediction Center, NOAA
-4.0 or less (Extreme Drought)
-3.0 to -3.9 (Severe Drought)
-2.0 to -2.9 (Moderate Drought)
-1.9 to +1.9 (Near Normal)
+2.0 to +2.9 (Unusual Moist Spell)
+3.0 to +3.9 (Very Moist Spell)
+4.0 and above (Extremely Moist)

U.S. Drought Monitor
West



February 17, 2015
(Released Thursday, Feb. 19, 2015)
Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	31.20	68.80	58.53	30.61	17.23	7.21
Last Week *2/10/2015*	30.41	69.59	52.65	30.63	17.10	6.96
3 Months Ago *11/18/2014*	34.66	65.34	54.99	33.88	18.75	8.45
Start of Calendar Year *12/30/2014*	34.76	65.24	54.48	33.50	18.68	5.40
Start of Water Year *9/30/2014*	31.48	68.52	55.57	35.65	19.95	8.90
One Year Ago *2/18/2014*	21.76	78.24	59.88	40.17	14.89	2.58

Intensity:

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

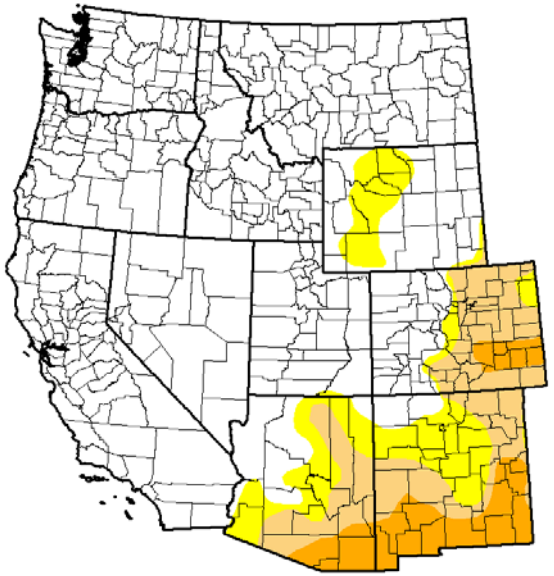
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Author:
Richard Heim
NCDC/NOAA

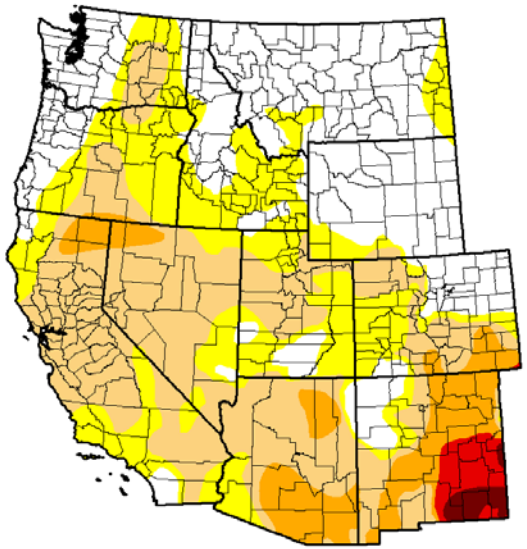
USDA National Drought Mitigation Center

http://droughtmonitor.unl.edu/

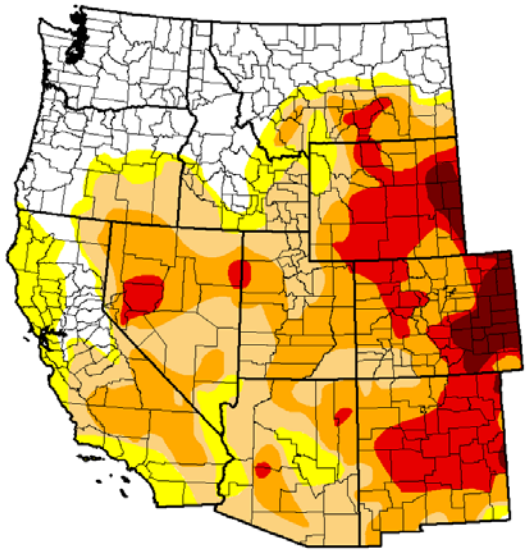
February 22, 2011



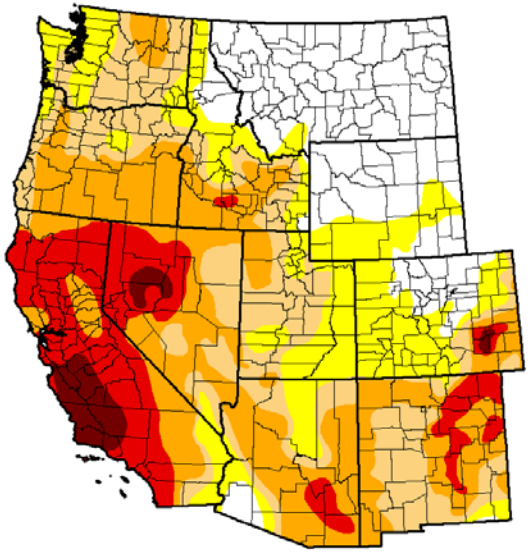
February 21, 2012



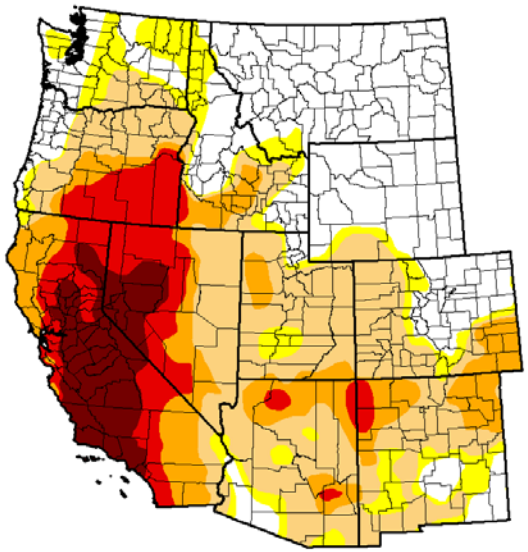
February 19, 2013



February 18, 2014



February 17, 2015



Conditions that Exacerbate or Mitigate Potential Effects

Drought is a major determinant of wildfire hazard, in terms of greater propensity for fire starts and larger, more prolonged conflagrations fueled by excessively dry vegetation and reduced water supply for firefighting purposes.

Previous Occurrences

Drought is different than many of the other natural hazards in that it is not a distinct event and usually has a slow onset. Periods of actual drought with adverse impacts can vary in duration, and the period between droughts is often extended. Although an area may be under an extended dry period, determining when it becomes a drought is based on impacts to individual water users.

The 1975-1977 Drought: From November 1975 through November 1977, California experienced one of its most severe droughts. Thirty-one counties were disaster-declared. Although people in most areas of the state are accustomed to almost no precipitation during the growing season (April to October), they expect it in the winter. In 1976 and 1977, the winters brought only one-half and one-third of normal precipitation, respectively, leading to the state's fourth and first driest years on record. Most surface storage reservoirs were substantially drained in 1976, leading to widespread water shortages when 1977 turned out to be even drier. Due to this drought, water rights issues moved to the top of political agendas, and low-flow water fixtures and natural landscaping in California were ushered in. [42] Merced County was one of many areas that suffered crop damage, which totaled $2.67 billion statewide during this drought period.

The 1987-1992 Drought: The 1987-92 drought was notable for its six-year duration and the statewide nature of its impacts. For the central coast and central Sierra Nevada, 1987 to 1990 was the driest period on record. In 1988, 45 California counties experienced water shortages that adversely affected about 30 percent of the state's population, much of the dry farmed agriculture, and over 40 percent of the irrigated agriculture. Fish and wildlife resources suffered; recreational use of lakes and rivers decreased; forestry losses and fires increased; and hydroelectric power production decreased. Not since the 1928-34 drought had there been such a prolonged dry period.

The 2007-2009 Drought: ~~California's last major statewide drought was 2007-2009, notably~~ This drought affected~~ing~~ Central Valley communities, including those in Merced County. Following two critically dry years, 2009 had the potential to be one of the most severe drought years in California's recorded history. Water supplies in major reservoirs and many groundwater basins were already well below average. Additionally, court-ordered restrictions on water deliveries from the Delta had significantly reduced supplies from the state's two largest water systems. [43]

The 2014- ??__ Drought: In 2012 and 2013 dry conditions were experienced statewide according to the Department of Water Resources and the U.S. Drought Monitor. Parts of the Central Valley and Southern California have experienced perpetually extreme drought conditions and the situation worsens with every day the state goes without rain. On Jan. 17, 2014, with California facing water shortfalls in the driest year in recorded state history, Governor Edmund G. Brown Jr. proclaimed a State of Emergency and directed state officials to take all necessary actions to prepare for these drought conditions.

Merced's water source is groundwater, which is principally replenished by local rivers fed by snowmelt. The most recent snowpack survey, conducted on January 29, 2015, recorded California snowpack at 12% of normal. A more recent update using automated devices shows snowpack at 22% of normal as of February 2, 2015.

As the dry weather continues, reservoirs fall further behind of their annual averages of water supplies. Local reservoir Levels as of January 29, 201 remain low, including: *Don Pedro* 41% of capacity (59% of year to date average), and *Excheguer* 6% of capacity (13% of average). [61]

Lake McClure. Early 2015

Water Year 2014 – overlapping with California's driest calendar year -- ended on September 30 as the San Joaquin Valley's driest in 119 years of record. [62]

Dry Water Year (October 1 –September 30) rankings, by inches of precipitation

Statewide		North Coast		North Central		Northeast		Sacramento-Delta		Sierra	
Year	Rainfall	Year	Rainfall	Year	Rainfall	Year	Rainfall	Year	Rainfall	Year	Rainfall
1924	9.23	**1924**	29.98	**1924**	20.12	**1924**	7.66	**1924**	6.46	**1924**	14.89
1977	11.81	1977	30.36	1977	23.10	1926	11.68	1920	7.87	1977	15.86
2014	12.08	2014	33.48	1920	24.17	1977	12.43	1913	8.13	2014	20.76
1898	13.35	1931	36.32	1898	26.30	1931	12.44	1977	8.57	1987	20.89
1920	13.43	2001	39.43	1931	28.67	1920	12.59	1976	9.15	1976	22.64

San Joaquin Valley		Central Coast		South Coast		South Interior		Mojave		Sonoran	
Year	Rainfall	Year	Rainfall	Year	Rainfall	Year	Rainfall	Year	Rainfall	Year	Rainfall
2014	4.81	**1924**	9.30	**2014**	5.63	**2007**	5.70	**2013**	2.77	**1956**	0.91
1924	5.30	2014	11.94	2007	5.87	2002	5.82	2014	2.90	2002	1.06
1972	5.71	1977	11.95	2002	6.34	1961	6.98	2002	2.96	1896	1.22
1977	6.18	1913	12.81	1961	7.22	1959	8.94	2007	3.45	1996	1.42
2013	6.18	1976	12.91	1898	7.30	2014	9.04	1934	3.46	1902	1.47

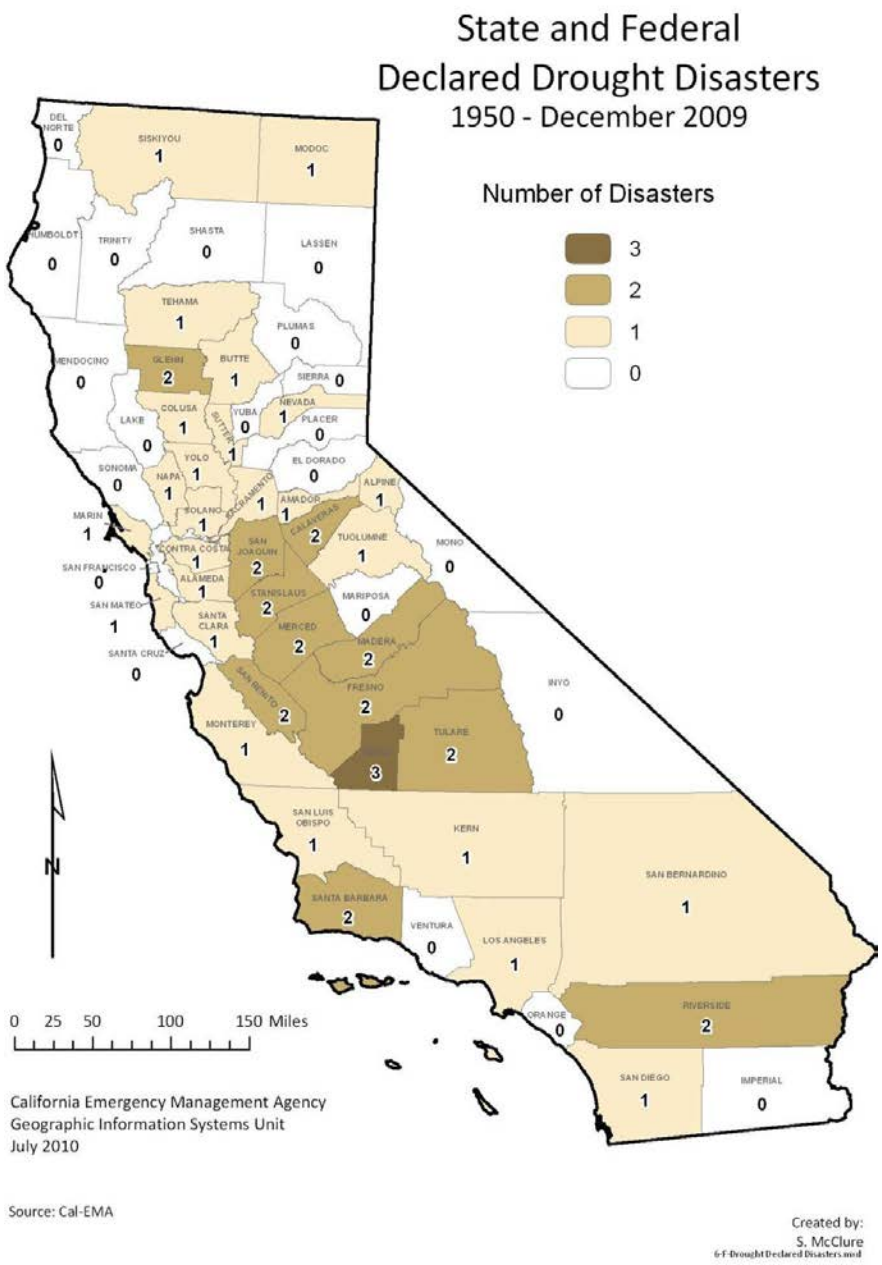
Summary of 2014 Water Year (October 1, 2013 – September 30, 2014)

Region	WY2014 Value (inches)	% of Average	Rank	# Years
Sierra	20.76	53%	3	119
Northeast	15.21	63%	15	119
North Central	28.87	56%	6	119
Sacramento Delta	10.68	54%	8	119
San Joaquin Valley	4.81	38%	1	119
North Coast	33.48	51%	3	119
Central Coast	11.94	47%	2	119
South Coast	5.63	32%	1	119
South Interior	9.04	50%	5	119
Mojave	2.9	39%	2	119
Sonoran	2.41	54%	21	119
Statewide	12.08	52%	3	119

NOAA's National Climatic Data Center reported that in the first nine months of 2014, California temperatures averaged 63.7º F, or 4.1º F above the 20th century average of 59.6 ºF. Temperatures from April to September averaged 70.0º F, breaking the old record for the period of 69.4º F set in 2013.

STATE AND FEDERAL DECLARED DROUGHT DISASTERS

Map on this page shows the pattern of drought-declared State and Federal Declared Drought Disasters in California between 1950 and December 2009, [14]disasters. Heaviest concentrations are in the Central Valley and inland areas.



Probability/Frequency of Future Events

The identification and ranking of hazards, applicable to Merced, is detailed in Section 3.2 of the LHMP. "Probability of Occurrence" is one of the risk factors used to rank each hazard. The following thresholds and numeric scoring were utilized by the LHMP Disaster Council to rank the Probability of Occurrence:

0 Infeasible Event – not applicable due to geographic location characteristics
1 Rare Event – occurs less than once every 50 years
2 Infrequent Event – occurs between once every 8 years and once every 50 years (inclusive)
3 Regular Event – Occurs between once a year and once every 7 years
4 Frequent Event – occurs more than once a year

Hazard probability scoring was based on a variety of sources, including: 1) the City's *ACS Firehouse Software* -- a nine-year database for fire, hazardous conditions and severe weather and other natural disasters (page 3-23 of the LHMP); 2) a qualitative "probability" scoring based on rankings by the Disaster Council and attending stakeholders at the March 9, 2012, Disaster Council meeting; 3) the 2009 City of Merced Community Risk Assessment; and 4) the hazard occurrence data presented in this hazard risk assessment.

Based on these inputs, the Probability of Occurrence for "Drought" in Merced is generally considered an infrequent event, but recent local drought events have occurred as regular events.