Part 2: Appendix 2
Drought and Water Shortage Risk Scoring: Risk Score Results of Small Water Suppliers

Prepared for

County Drought Advisory Group Process
as Partial Fulfillment of Assembly Bill 1668

By
California Department of Water Resources

Water Use Efficiency Branch

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Appendix 2. Drought and Water Shortage Risk Score Results of Small Water Suppliers

CWC Section 10609.42(a) requires California Department of Water Resources (DWR), in consultation with other agencies and stakeholders, to identify small water suppliers and rural communities (areas of households on private supplies, also called self-supplied communities in this report) that may be at risk of drought and water shortage. DWR must then notify counties and groundwater sustainability agencies (GSA) of suppliers or communities that may be at risk within its jurisdiction and may make the information publicly accessible on the website.

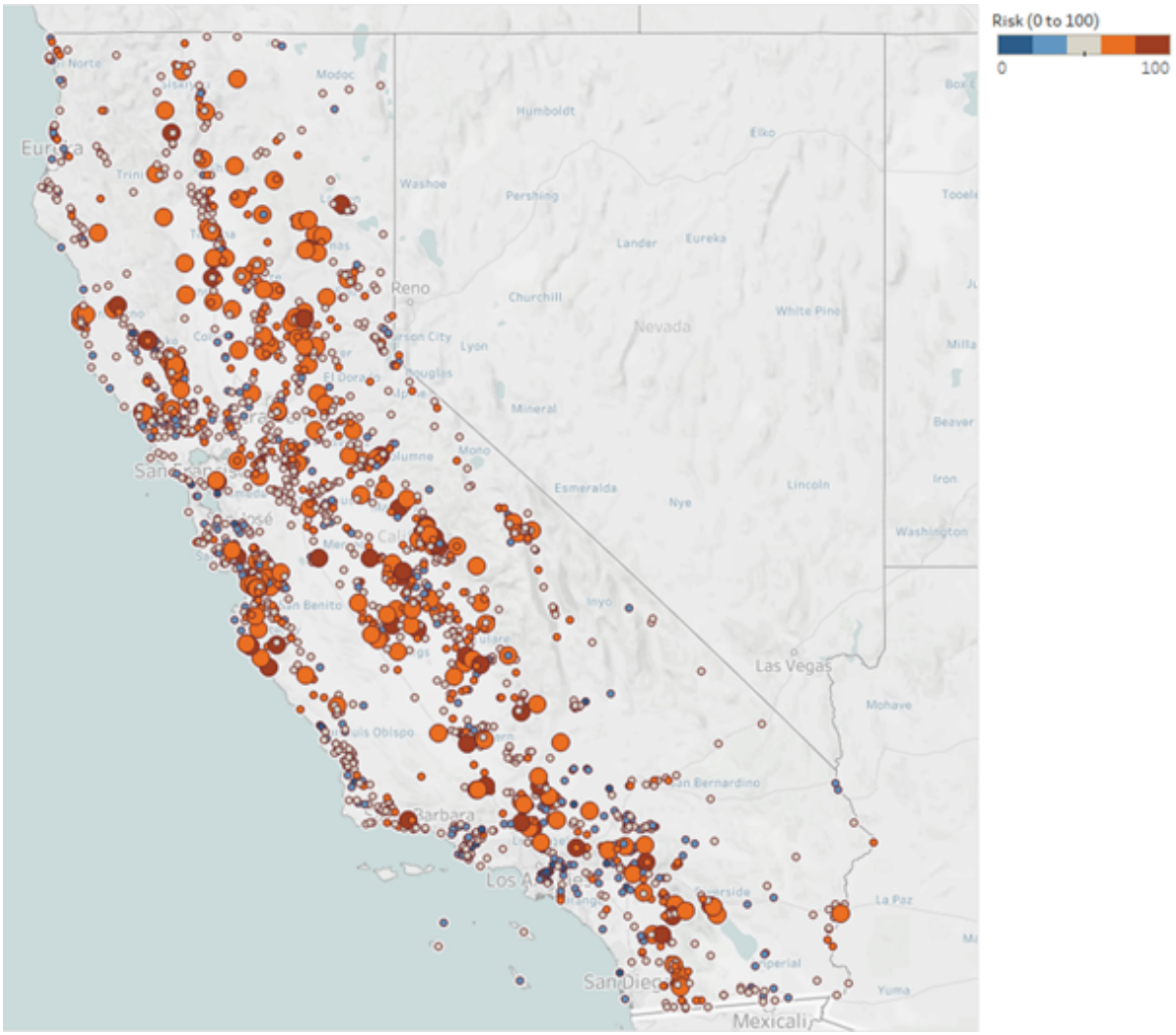
This appendix presents results of calculating risk scores using existing statewide datasets and the newly developed tools to estimate risk of drought and water shortage for small water suppliers. The risk was assessed based on a multi-pronged definition; this offers valuable information beyond helping to prioritize which suppliers and communities need assistance. Further, delivering not only the aggregated risk scores, but also the disaggregated measures of risk to water suppliers, counties, groundwater sustainability agencies, integrated regional water management programs, the State Water Board, and other stakeholders can be valuable for planning, prioritizing and improving drought and water shortage resilience.

Risk scores were calculated for the following types of water systems presented in this appendix:

Community water systems and non-community non-transient water systems that are schools Water systems with fewer than 3000 service connections were included. Wholesalers were omitted from the analysis and small water systems that are listed as part of an Urban Water Management Plan (UWMP) were also omitted from the analysis because they are assumed to already have a water shortage contingency plan and drought risk assessment as part of the UWMP.

Part 2: Appendix 2
Drought and Water Shortage Risk Scoring Results:
Small Water Suppliers

Recognizing that the risk assessment conducted as part of this project is based on available data and reflects a snapshot of drought and water shortage risk, it is recommended that this assessment is updated annually (for more information, see Part 1 of the *Small Water Systems and Rural Communities Drought and Water Shortage Contingency Planning and Risk Assessment*).



Note: Large circles indicate top 10%, small circles indicate location of other water systems examined. Colors range by risk score, where the highest is dark red and the lowest is dark blue.

Figure 2-1. Map of Suppliers Examined for Risk of Drought and Water Shortage

The methods to estimate risk of water shortage and drought for small water systems in California are described in Appendix 1 and includes an explanation of each dataset used to represent the risk factors and how the

data was processed to develop metrics on a single scale of 0-1. Below covers the statistical summary of each risk factor included in the assessment.

For results of risk scores for each supplier examined, see the following links:

1. Table of scores for each small supplier examined is available for download at: https://data.cnra.ca.gov/dataset/drought-risk-small-suppliers-and-communities). To learn more about the methods and original datasets used, refer to Appendix 1.

2. Interactive Risk Explorer Tool to visit risk scores and underlying risk factors here: [https://dwr.maps.arcgis.com/apps/MapSeries/index.html?appid=3353b370f7844f468ca16b8316fa3c7b]

Summary Statistics of Indicators Representing Risk Factors

The small water systems analysis in this risk assessment cover 2,419 service areas of small water systems. Of these, 2244 are community water systems. The remaining 175 systems analyzed are small non-community non-transient water systems that serve schools for which there is available spatial information.

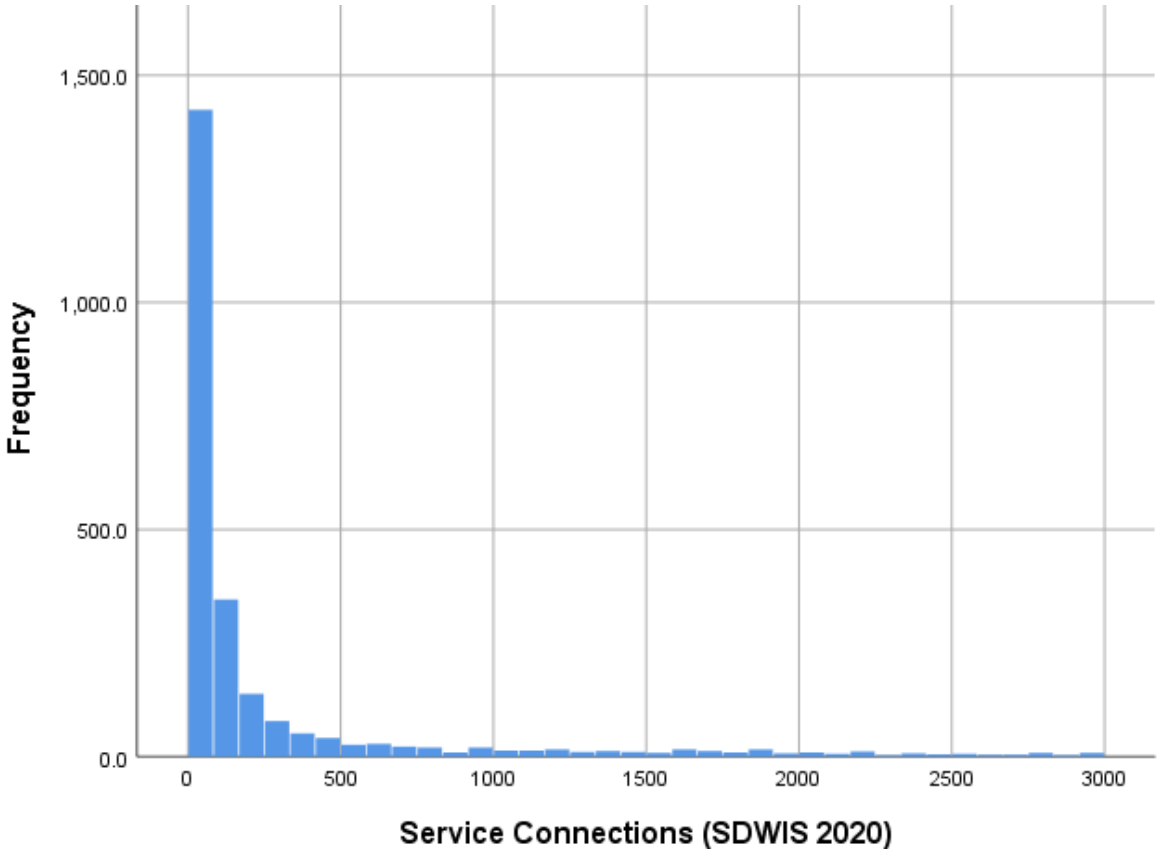


Figure 2-2. Histogram of Service Connections of the Water Systems Analyzed

Risk Score

The risk score across small water systems ranged from 0 to 100, where 100 is the highest score and 0 is the lowest. This range is based on a simple rescaling using the min/max/range equation and multiplied by 100. The mean and median are 54 (out of 100), indicating a normal distribution. The histogram showing the distribution of risk scores across the service areas analyzed is shown in Figure 2-3.

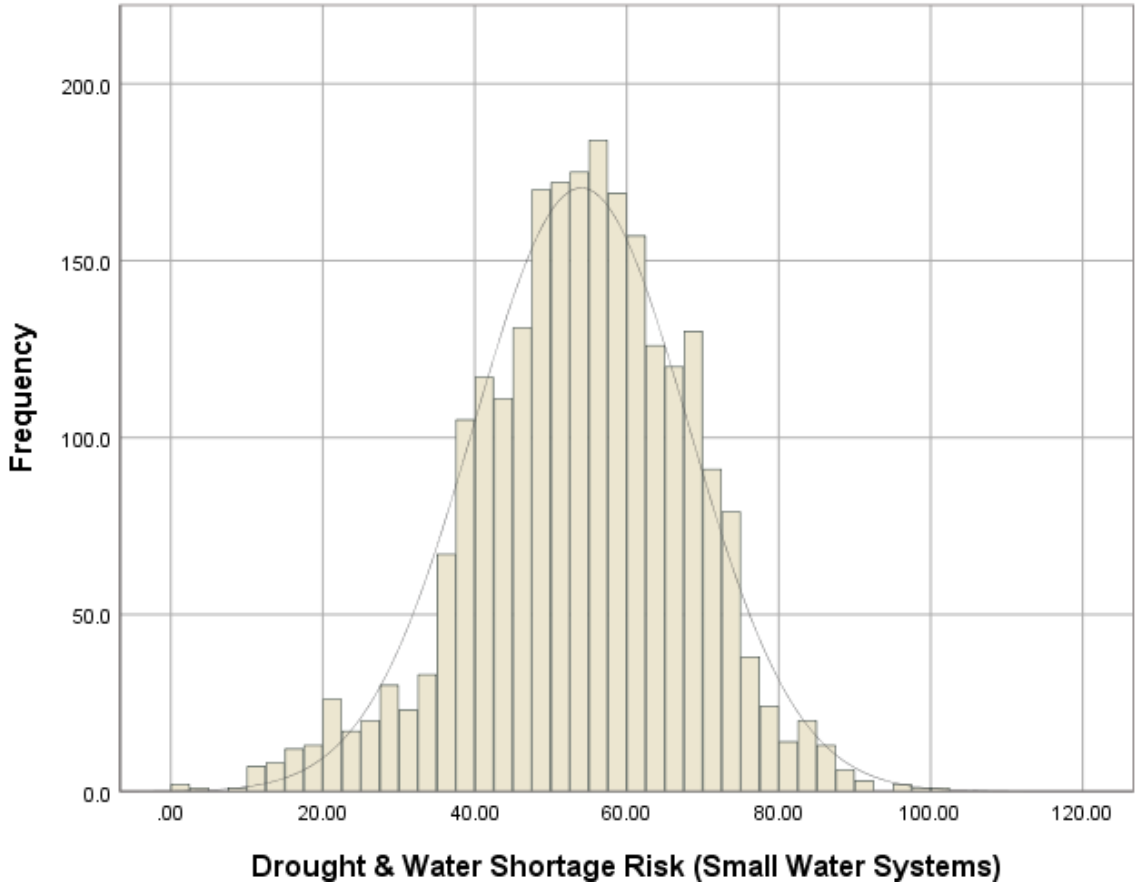


Figure 2-3. Distribution of Drought & Water Shortage Risk for Small Water Systems Analyzed as Part of this Assessment

Note on Scoring Method

The equation to calculate risk (see Appendix 1) does not include a ranking, therefore maintains the numeric distance between two service areas. For this analysis, the top scoring water system is 100 (because of our rescaling), then 99, followed by a score of 96. If we had calculated the rank percentile, the top 25 scoring systems would have received a score of 99 or 100, which makes is more difficult to interpret the score.

Component 1: Exposure to Climate Change

The climate change grouping of risk factors is composed of projected temperature, projected wildfire, and projected saltwater intrusion in coastal aquifers. All projections are models of conditions by mid-century under the business as usual carbon emissions (for more information on greenhouse gas emission scenarios and Representative Concentration Pathway [RCP] 8.5 see Riahi et al. 2011). Temperature and wildfire projections are scalar data,

ranging up to nearly 4 degrees Celsius in some locations. Summary statistics for projected wildfire are based on the maximum grid cell of acres projected to burn within each service area. See methods documentation in Appendix 1 for more information on the data sources and processing.

Table 2-1. Summary Statistics of Risk Factors from Climate Change (Component 1)

Risk Factor (ID)	Description	Min.	Max.	Mean (+- SD)	% water systems with presence of risk factor
Projected temperature (SC1a)	Change in Celsius by mid-century	1.72	3.75	2.85 (0.4)	N/A
Projected wildfire (SC1b)	Max acres projected in grid cell to be burned per service area	0	98	25	N/A
Projected saltwater intrusion (SC1c)	Presence/ absence saltwater intrusion in aquifers with 1m sea level rise	N/A	N/A	N/A	4.4% (106)

Component 2: Exposure to Current Conditions

This grouping of risk factors covers existing conditions and episodic events that could contribute to drought-like conditions and/or water shortages. The early dry year forecast for the Water Year 2020 covered nearly the entire state is classified as being high risk for drought based on an early forecast indicator based on precipitation levels. This is updated annually to reflect current conditions. This group of risk factors also includes geological attributes and current conditions that indicate higher likelihood to experiencing impacts from a dry period or other water shortage. Several cover groundwater conditions only, most of which are compiled into a sub-index to represent these as a single unit (subsidence, saltwater intrusion, critically over drafted designation, declining groundwater levels, and irrigated crops).

Table 2-2. Summary Statistics for Risk Factors from Current Conditions (Component 2)

Risk Factor (ID)	Description	Min.	Max.	Mean (+- SD)	% water systems with presence of risk factor
Early Dry Year Forecast WY 2020 (SC2a)	Proportion of precipitation received by Jan 31, 2020 compared to historic average	N/A	N/A	N/A	93%
Wildfire Risk (SC2b)	Maximum hazard code from CalFire risk map (ordinal data)	0	4	1.6	N/A
Fractured Rock (SC2c)	Located in any non-basin area	N/A	N/A	N/A	29% (700)
Subsidence (SC2d)	Feet of subsidence (2015-2019)	.21	-2.75	-.05 (.20)	N/A
Saltwater Intrusion (SC2e)	Presence/absence	N/A	N/A	N/A	4% (95)
Critically Overdrafted Basin (SC2f)	Presence/absence	N/A	N/A	N/A	20% (487)
Groundwater Decline (SC2g)	Presence of wells that are in decline	N/A	N/A	N/A	2% (44)
Population Growth Rate (SC2h)	Growth rate 2016-2021 (vendor)	-12%	17%	3% (5%)	N/A
Source Water Quality Risk (SC2i)	Potential risk of contaminants in groundwater	0	1	0.48	86% (2076)
Land Use (Irrigated Crops) (SC2j)	Proportion of each service area with irrigated crops	0	96%	3% (11%)	N/A

Component 3: Physical Vulnerability (Sensitivity)

Several factors played a role in past droughts, according to the experience and knowledge of the stakeholders who participated in the County Drought

Advisory Group from 2018-2020. This component of physical vulnerability captures the infrastructure-related attributes of a water system that can make it more or less vulnerable to dry conditions and/or other water shortage events.

Table 2-3. Summary statistics for risk factors from Current Conditions (Component 2)

Risk Factor (ID)	Description	Min.	Max.	Mean (+- SD)	% Water Systems with Presence (Count)
Interties (SC3a)	Presence of intertie	N/A	N/A	N/A	12% (294)
Emergency Interties (SC3b)	Presence of emergency intertie	N/A	N/A	N/A	3% (72)
Source Monitoring (SC3c)	Level of monitoring (none, medium, high)	N/A	N/A	N/A	Low: 421; Medium: 383; High: 142
Customers Metered (SC3d)	Percent system connections without meter	0%	100%	46% (out of 2219 systems)	N/A
Water Sources (SC3e)	Only one or no water source	N/A	N/A	N/A	45% (1098)
Source Types (SC3f)	Only one or zero water source types	N/A	N/A	N/A	90% (2171)
Distribution Outage (SC3h)	Distribution problems of water outage count	0	265	.99 (9.8)	N/A
Water Level Status (SC3i)	Level of water source(s): recovering (0), steady (.5), declining (1)	N/A	N/A	N/A	Declining: 2.1% (51); Recovering: 3.5% (85); Steady 24% (588)

Component 4: Organizational Vulnerability (Capacity)

The grouping of risk factors under the Organizational Vulnerability category covers mostly social and economic vulnerability indicators. Whether and when the rate structure has been updated and what type is implemented can lend additional capacity for a supplier when planning for drought and preparing for potential water shortage scenarios. Similarly, having a drought preparedness plan in place is a signal of the organization's capacity to mitigate the impacts of a dry period.

Table 2-4. Summary Statistics for Risk Factors from Current Conditions (Component 2)

Risk Factor (ID)	Description	Min.	Max.	Mean (+- SD)	# or % water systems with presence of risk factor
Rate Updated (SC4a)	Years since rate updated	N/A	N/A	N/A	Updated in 2015-2019: 867; 2010-2014: 189; 2003-2009: 105; Before 2003 or no rate: 626
Rate Type (SC4b)	Flat base rate or no rate	N/A	N/A	N/A	1286 (53%)
Supplier Size (SC4c)	Service connections count	1	2982	171	N/A
Drought Preparedness Plan (SC4d)	Have drought plan; year written or updated	N/A	N/A	N/A	2015-present: 325; 2004-2014: 112; No plan or before 2003: 11
Customer Base Socioeconomics (SC4e)	Multiple population characteristics combined score	N/A	N/A	N/A	See Table 2-5

Part 2: Appendix 2
Drought and Water Shortage Risk Scoring Results:
Small Water Suppliers

Some demographic and socioeconomic attributes of a population have been shown in disaster risk management to reduce the ability of a population to prepare for or otherwise mitigate impacts of drought, water shortage, and other disasters. To account for the water systems' customer base demographics and socioeconomics, the 13 characteristics listed below in Table 2-5 were selected based on the CDAG's experiences and agreed upon by the United States Center for Disease Control as indicators of social vulnerability of a population to be impacted by the recent past droughts. Compared to populations statewide, it is notable that per capita income is lower in the small water systems analyzed in this report.

Table 2-5. Customer Based Estimated Socioeconomic Characteristics of Population within Service Areas of Small Water Systems Analyzed

Customer Base Population Characteristics	Minimum	Maximum	Mean	Median	Standard Deviation
Per Capita Income ($)	$35	$94,902	$30,497	$28,400	$14,073
Median Household Income	$19,000	$216,304	$60,215	$54,158	$25,831
Over 65 years	0	.68	.19	.19	.09
Under 5 years	0.0	0.17	0.05	0.05	0.03
Renters	0.0	1.0	0.32	0.29	0.17
Mobile Homes	0.0	1.0	0.14	0.09	0.16
No Vehicle	0.0	0.49	0.04	0.03	0.04
Education (No high school diploma)	0.0	0.37	.08	.07	.05
Single Parent	0.0	0.38	0.07	0.06	0.06
Unemployment	0.0	0.33	0.6	0.6	0.3
Language	0.0	1.0	0.26	0.18	0.22
Poverty	0.0	0.7	0.11	0.09	0.10
Group Housing %	0.0	0.99	0.02	0.0	0.08

Component 5: Record of Shortage

Component 5 variables were constructed using three datasets indicating whether a system self-reported that it projected to experience a water shortage between 2011 and 2018 (SC5a), whether a system had a curtailment order (SC5b), and whether the system was on a record for having received drought assistance during the last major drought (SC5c). There are 253 systems (of the 2419 analyzed) on record for having one or more presence of these indicators.

Table 2-2. Summary Statistics for Risk Factors from Current Conditions (Component 2)

Risk Factor (ID)	Description	Min.	Max.	Mean (+- SD)	% (#) Water Systems with Presence of Risk Factor
Projected Shortage (2011-17) (SC5a)	N/A	N/A	N/A	N/A	4% (105)
Curtailment (SC5b)	N/A	N/A	N/A	N/A	1% (17)
Drought assistance funds	N/A	N/A	N/A	N/A	6% (149)

Drought and Water Shortage Risk Support Tool: Small Water Suppliers

In creating a list of small suppliers and self-supplied communities at risk of drought and water shortage, the DWR with its Project Team and the County Drought Advisory Group recognized the value of the underlying data to evaluate drought and water shortage risk. The group agreed it would benefit suppliers and communities to be able to access specific information about their area relating to drought and water shortage risk. Understanding the factors driving the risk score can be helpful as small water suppliers develop their own drought plans. Therefore, in addition to developing a list of suppliers and self-supplied communities with a single scoring of risk, a planning support tool was developed for the water suppliers, counties, GSAs, and other stakeholders to access the information behind the supplier risk

assessment. This tool offers a way to access the diverse suite of environmental, infrastructural, organizational, and socioeconomic conditions that contribute to risk in their area.

The following link offers an interactive tool to allow interested parties to explore the indicators of risk for each small water supplier. Users may select a county, groundwater basin or other region of interest, or specific small water supplier examined to view the results of each of the 29 indicators examined as part of the drought and water shortage risk analysis. Tool is accessible through the following link:

https://dwr.maps.arcgis.com/apps/MapSeries/index.html?appid=3353b370f7844f468ca16b8316fa3c7b

References

DWR 2020. *Drought and Water Shortage Risk: Small Suppliers and Rural Communities* [Dataset]. California Natural Resources Agency Open Data Portal. https://data.cnra.ca.gov/dataset/drought-risk-small-suppliers-and-communities

Riahi, K., S. Rao, V. Krey, C. Cho, V. Chirkov, G. Fischer, G. Kindemann, N. Nakicenovic, and P. Rafaj. 2011. RCP 8.5 – A scenario of comparatively high greenhouse gas emissions. Climatic Change 109(33). https://link.springer.com/article/10.1007/s10584-011-0149-y