Part 2: Appendix 3
Drought and Water Shortage Risk Scoring: Risk Score Results of Self-Supplied Communities

Prepared for

County *Drought* Advisory Group process as partial fulfillment of Assembly Bill 1668

By

California Department of Water Resources

Water Use Efficiency Branch

March 2021

Appendix 3. Drought and Water Shortage Risk Score Results of Self-Supplied Communities

Water Code Division 6 Part 2.55, Section 8 Chapter 10 (Assembly Bill 1668) effectively requires California Department of Water Resources (DWR), in consultation with other agencies and an advisory group, to identify small water suppliers and rural communities that are at risk of drought and water shortage. This list must be shared with counties, Groundwater Sustainability Agencies (GSA), other regional groups, and the public. This document presents the statewide results of the scoring for rural communities, referred to here and throughout as *self-supplied communities*. This scoring is designed to be updated annually to reflect changing conditions.

The unit of analysis for the self-supplied communities is Census Block Groups (ACS 2012-2016 Tiger Shapefile). The Census Block Groups do not necessarily represent socially defined communities, but they do cover areas where population resides. Using this spatial unit for this analysis allows us to access demographic information that is otherwise not available.

A downloadable table of the drought and water shortage risk scores of all communities examined, can be found here: https://data.cnra.ca.gov/dataset/drought-risk-small-suppliers-and-communities

A map of the communities examined and the associated drought and water shortage risk scores are shown below.

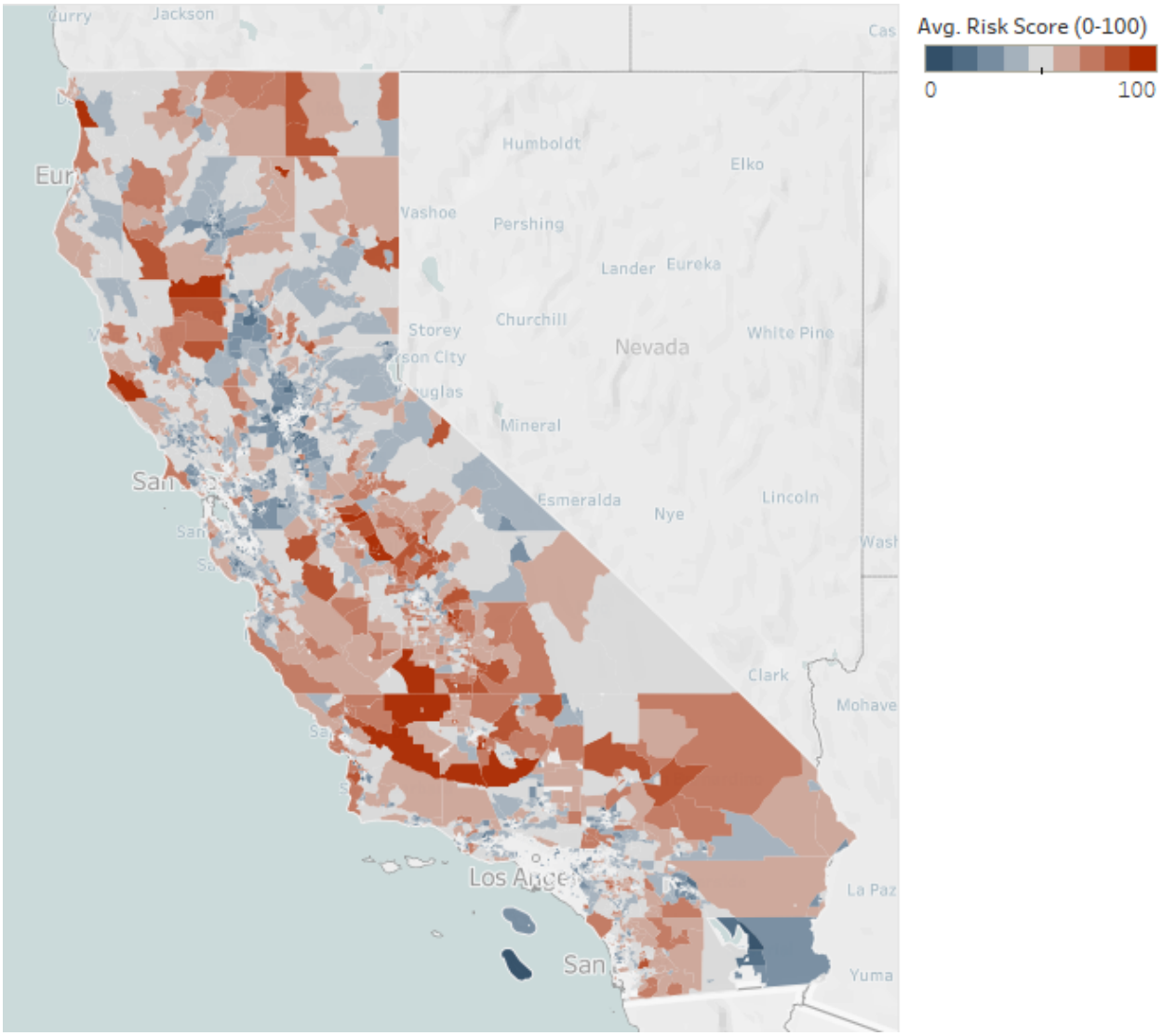

Figure 3-1. Map of Drought and Water Shortage Risk Score Results for Self-Supplied Communities (December 2020)

The methods to estimate risk of water shortage and drought for self-supplied communities 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.

Summary Statistics of Indicators Representing Risk Factors

The block groups analyzed in this assessment covered an estimated 3,048,140 households (ACS 2012-2016). The size of block groups ranges

from 6,948 households to 0 (mean = 611, median = 526). Domestic wells within these block groups total 283,742 (according to the DWR Well Completion Report, filtered by 1970-2019). Within the block groups analyzed, there are an estimated 24,779 tribal homes (information received from Indian Health Services, pers. comm. 2019).

Risk Score

The risk score across block groups ranged from 0 to 100, based on a simple rescaling using the min/max/range equation, and multiplied by 100. The mean and median are 42, indicating a normal distribution. The histogram showing the distribution of risk scores across the block groups is shown in Figure 3-2.

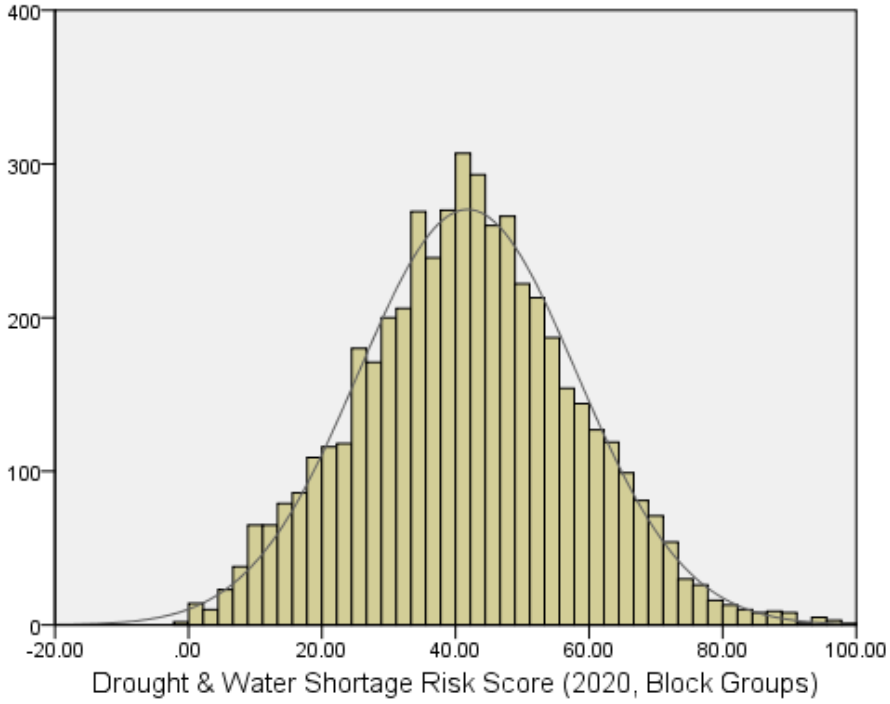

Figure 3-2. Distribution of Risk Scores Across Block Groups Analyzed

For the block groups examined, the following statistics are provided based on the statewide assessment:

- Block groups analyzed in this assessment covered an estimated 3,048,140 households
- Domestic wells within these block groups total 283,742

- 480 block groups have a record of one or more domestic well outage in the last decade
- Within the block groups analyzed, there are an estimated 24,779 tribal homes, based on information received from Indian Health Services
- Median per capita income of block groups with domestic wells (all examined – approximately $29,000) is substantially lower than the median statewide (approximately $39,000)

The following sections present information summaries for each of the risk factors, organized by component. This is followed by a description of estimated domestic well reliance and how it relates to risk scores.

Component 1: Exposure to Climate Change

The Component of climate change risk factors was composed of projected temperature, projected wildfire, and projected saltwater intrusion in coastal aquifers. Temperature and wildfire projections were 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 block group. See methods documentation in Appendix 1 for more information on the data sources and processing.

Table 3-1. Summary of Risk Factors from Climate Change (Component 1)

Risk Factor (ID)	Unit	Min	Max.	Mean (+_ SD)	% BG with Presence of risk factor
Projected Temperature (RC1a)	Change in Celsius	1.83	3.94	2.87 (0.39)	N/A
Projected Wildfire (RC1b)	Max acres projected to be burned	0.06	100	22.9 (17.7)	N/A
Projected Saltwater Intrusion (RC1c)	Presence or absence	N/A	N/A	N/A	4% (306)

Component 2: Exposure to Existing Conditions

This component 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 as being at early risk of drought in 2020. This is updated annually. The component of risk factors also includes geological attributes and current conditions that can indicate higher likelihood of experiencing impacts from a dry period or other water shortage. Several cover groundwater basins only, 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 3-2. Summary of Risk Factors from Existing Conditions (Component 2)

Risk Factor (ID)	Description	Min	Max.	Mean (+_ SD)	% BG with Presence of Risk Factor
Early Dry Year Forecast WY 2020 (RC2a)	Proportion of precipitation received by Jan 31, 2020 compared to historic average	0.00	1.79	0.4	99% (4956)
Wildfire Risk (RC2b)	Maximum hazard code from CalFire risk map	0	3	1.14	N/A
Fractured Rock (RC2c)	Presence of fractured rock area	N/A	N/A	N/A	48.5% (2427)
Subsidence (RC2d)	Feet of subsidence (2015-2019)	0	-3.85	-0.11 (0.4)	N/A
Saltwater Intrusion (RC2e)	Presence/absence	N/A	N/A	N/A	93.9% (306)
Critically Overdrafted Basin (RC2f)	Presence/absence	N/A	N/A	N/A	21.1% (1054)
Groundwater Decline (RC2g)	Number of wells that are in decline	1	57	4.32 (6.3)	10.4% (523)
Population Growth (RC2h)	Growth rate 2016-2021	-0.1	0.17	0.04	N/A

Table 3-2. Summary of Risk Factors from Existing Conditions (Component 2) (contd.)

Risk Factor (ID)	Description	Min	Max.	Mean (+_ SD)	% BG with Presence of Risk Factor
Quality Flag (RC2i)	Indication of likelihood that groundwater likely accessed by domestic wells may contain concentrations of constituents above regulatory levels.	0	1	.43	N/A
Irrigated Crops (RC2j)	Proportion of each block group with irrigated crops	0	0.89	0.11	N/A

Component 3: Physical Vulnerability

Stakeholders of the County Drought Advisory Group (CDAG) expressed agreement that shallow wells are a useful indicator of risk to drought and water shortage for those relying on wells. Because California has variable climate, geology, hydrology, and competing water uses for groundwater, what is considered shallow in one place may not be considered shallow in another location in California. Therefore, rather than using a single numeric threshold to represent what is a shallow depth for a well, we calculated how deep the domestic wells were to the depth of public supplier wells. Those block groups with domestic wells that were 10% more shallow than the public supply wells were flagged. This marks the presence of relatively shallow domestic wells in the block group (RC3a). Similarly, to capture the extent of the shallow domestic wells, we calculated the proportion of shallow domestic wells located in the block group (RC3b).

Table 3-3. Summary of Risk Factors from Existing Conditions (Component 2)

Risk Factor (ID)	Description	Min	Max.	Mean (+_ SD)	% BG with Presence of Risk Factor
Well Depth Score, Part 1 (RC3a)	Well Depth Score: Binary	N/A	N/A	N/A	49%
Well Depth Score, Part 2 (RC3b)	Well Depth Score: Proportion	0	1	0.37	N/A

Component 4: Social Vulnerability

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. The 13 characteristics listed below in Table 3-5 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.

Table 3-4. Summary of Risk Factors from Existing Conditions (Component 2)

Demographic Variable	Mean	Median	Standard Deviation	Minimum	Maximum
Per Capita Income	33,618	29,080	20,497	759	218,142
Median Household Income	72,335	63,292	38,661	12,045	250,001
Over 65 years	17%	15%	11%	0%	94%
Under 5 years	6%	5%	4%	0%	30%
Renters	34%	29%	21%	0%	100%
Mobile Homes	8%	1%	14%	0%	98%
No Vehicle	5%	3%	6%	0%	73%
Education	2%	2%	2%	0%	26%
Single Parent	42%	42%	17%	0%	100%
Unemployment	9%	8%	7%	0%	62%
Language	6%	3%	8%	0%	58%
Poverty	12%	9%	10%	0%	100%
Group Housing	2%	0.0	12%	0.00%	100%

Component 5: Record of Shortage

Component 5 variables were constructed using a single dataset, configured slightly differently to represent both the presence of any dry well located in the block (RC5a) and the extent of that presence (RC5b). There are 480 block groups with a record of domestic well outages.

Table 3-5. Summary of Risk Factors from Existing Conditions (Component 2)

Risk Factor (ID)	Description	Min	Max.	Mean (+_ SD)	% BG with Presence of risk factor
Outage Record, Part 1 (RC5a)	Presence of one or more households reported outage in block group	N/A	N/A	N/A	480
Outage Record, Part 2 (RC5b)	Proportion of household in block group with reported outages	0	0.25	0.009	N/A

Domestic Well Reliance

The final risk score across block groups indicates a normal distribution, as shown in Figure 3-1. Below we examine the relationship between estimated domestic well reliance and Drought and Water Shortage Risk. The population exposed to the risk factors was not used to calculate exposure. In some other constructs of risk assessments, depending on the purpose and intent of the assessment (Preston et al. 2011), the hazard risk factors are multiplied by the population or the proportion of population in order to inform political prioritization. This is useful when the assessment needs a statement such as "Two thousand people are at risk to a certain hazard." Such a dramatic number can then be used to highlight the need for funding or building awareness among elected officials that the hazard is in fact a problem that affects a large number of their constituents. However, in the case of the Drought and Water Shortage Risk Assessment, we do not multiple by the population because it would dramatically reduce the risk score for those in very rural areas. It would defeat the purpose of the analysis to conflate the number of people in an area with the hazards and vulnerabilities. Nevertheless, it is still useful and relevant to explore the relationship of population and areas that rely on domestic wells against the backdrop of Drought & Water Shortage Risk.

We estimate domestic well reliance by dividing the number of households in a block group (ACS 2012-2016) by the number of domestic well completion

reports installed in the last 50 years (DWR Well Completion Reports, queried October 2019). Figure 3-7 shows a plot of the risk score for each block group and how it corresponds to the estimated level of domestic well reliance. This plot shows clearly that the majority of block groups have a low level of domestic well reliance across all risk score values. The plot, especially if made to be interactive for interested parties, could be useful for informing prioritization of state or non-governmental spending to support those populations most reliant on domestic wells and at the highest risk of drought and water shortage (along the upper right side of the plot).

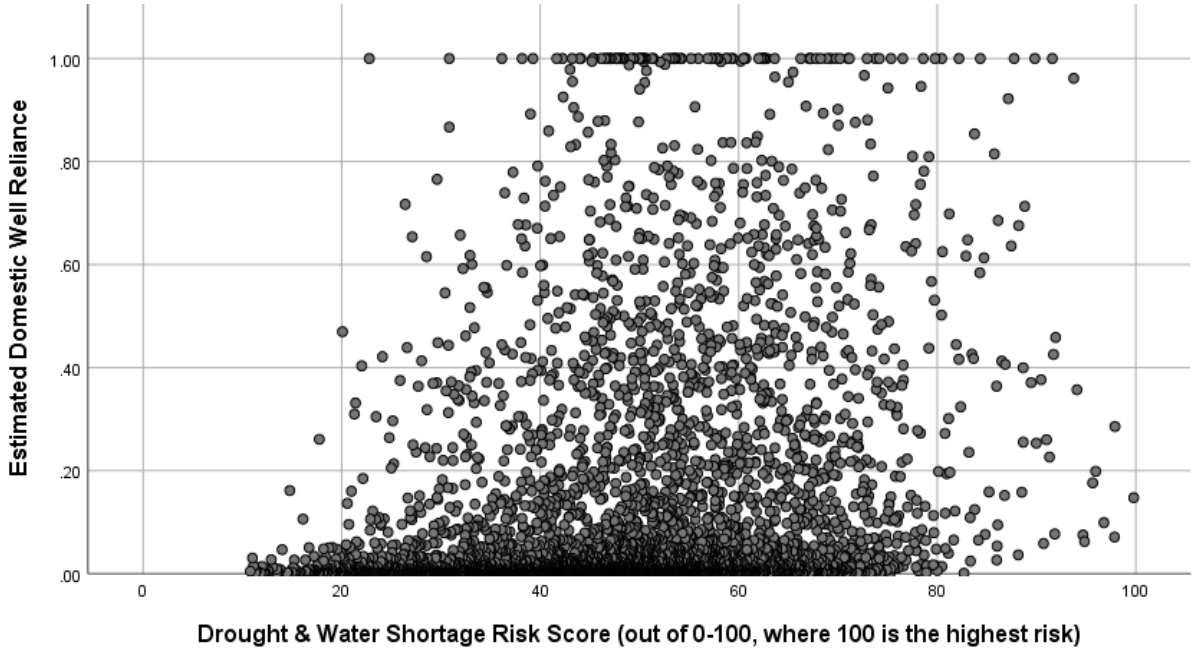

Figure 3-7. A Scatter Plot of the Risk Score of Block Groups Along the x-Axis and Estimated Domestic Well Reliance Along the y-Axis

Drought and Water Shortage Risk Support Tool: Self-Supplied Communities

In identifying small suppliers and self-supplied communities at risk of drought and water shortage, the Project Team and CDAG agreed it would benefit suppliers, communities, and regional planning authorities to be able to access specific information used in this analysis about their area relating to drought and water shortage risk. 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 public, GSAs, and counties. This tool offers a way to access the diverse suite of environmental,

infrastructural, organizational, and socioeconomic conditions that contribute to drought and water shortage risk in their area.

The following link offers an interactive tool to allow interested parties to explore the indicators of risk for each self-supplied community (community). Users may select a county or specific block group to view the results of each of the 21 indicators examined as part of the drought and water shortage risk analysis for self-supplied communities. Communities with a record of one or more domestic wells installed within the past 50 years are included in the analysis.

Tool is accessible through the following link:

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

References

DWR. *Online System of Well Completion Reports*, [Dataset]. Queried October 2019, for more information. https://water.ca.gov/Programs/Groundwater-Management/Wells/Well-Completion-Reports

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

Preston, B.L, Yuen, E.J., Westaway, R.M. 2011. Putting vulnerability to climate change on the map: a review of approaches, benefits, and risks. *Sustainability Science* 6:177-202. https://link.springer.com/article/10.1007%252Fs11625-011-0129-1

United States Census Bureau. *2016 Tiger Shapefiles* [Dataset]. United States Census. https://www.census.gov/geographies/mapping-files/time-series/geo/tiger-line-file.2016.html

United State Census Bureau. 2016. *American Communities Survey (ACS) 2012-2016 5-year Estimates* [Dataset]. https://www.census.gov/programs-surveys/acs/technical-documentation/table-and-geography-changes/2016/5-year.html