2022

DRINKING WATER
NEEDS ASSESSMENT
RISK ASSESSMENT FOR STATE SMALL WATER SYSTEMS & DOMESTIC WELLS

Full report:
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/2022needsassessment.pdf

CALIFORNIA
Water Boards
STATE WATER RESOURCES CONTROL BOARD
REGIONAL WATER QUALITY CONTROL BOARDS

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Acknowledgements

Contributors

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DEFINITION OF TERMS

This report includes the following defined terms.

"**Affordability Threshold**" means the level, point, or value that delineates if a water system's residential customer charges, designed to ensure the water systems can provide drinking water that meets state and federal standards, are unaffordable. For the purposes of the 2022 Affordability Assessment, the State Water Board employed affordability thresholds for the following indicators: Percent Median Household Income; Extreme Water Bill; Percent Residential Arrearages; and Residential Arrearage Burden. Learn more about current and future indicators and affordability thresholds in Appendix E.

"**Adequate supply**" means sufficient water to meet residents' health and safety needs at all times. (Health & Saf. Code, § 116681, subd. (a).)

"**Administrator**" means an individual, corporation, company, association, partnership, limited liability company, municipality, public utility, or other public body or institution which the State Water Board has determined is competent to perform the administrative, technical, operational, legal, or managerial services required for purposes of Health and Safety Code section 116686, pursuant to the Administrator Policy Handbook adopted by the State Water Board. (Health & Saf. Code, §§ 116275, subd. (g), 116686, subd. (m)(1).)

"**Affordability Assessment"** means the identification of any community water system that serves a disadvantaged community that must charge fees that exceed the affordability threshold established by the State Water Board in order to supply, treat, and distribute potable water that complies with federal and state drinking water standards. The Affordability Assessment evaluates several different affordability indicators to identify communities that may be experiencing affordability challenges. (Health & Saf. Code, § 116769, subd. (2)(B).

"**Arrearage**" means debt accrued by a water system's customers for failure to pay their water service bill(s) that are at least 60 days or more past due.

"**At-Risk public water systems**" or "**At-Risk PWS**" means community water systems with up to 30,000 service connections or 100,000 population served and K-12 schools that are at risk of failing to meet one or more key Human Right to Water goals: (1) providing safe drinking water; (2) accessible drinking water; (3) affordable drinking water; and/or (4) maintaining a sustainable water system.

"**At-Risk state small water systems and domestic wells**" or "**At-Risk SSWS and domestic wells**" means state small water systems and domestic wells that are located in areas where groundwater is at high-risk of containing contaminants that exceed safe drinking water standards. This definition may be expanded in future iterations of the Needs Assessment as more data on domestic wells and state small water systems becomes available.

"**California Native American Tribe**" means federally recognized California Native American Tribes, and non-federally recognized Native American Tribes on the contact list maintained by the Native American Heritage Commission for the purposes of Chapter 905 of the Statutes of 2004. (Health & Saf. Code, § 116766, subd. (c)(1).) Typically, drinking water systems for federally recognized tribes fall under the regulatory jurisdiction of the United States Environmental Protection Agency (U.S. EPA), while public water systems operated by non-federally recognized tribes currently fall under the jurisdiction of the State Water Board.

"**Capital costs**" means the costs associated with the acquisition, construction, and development of water system infrastructure. These costs may include the cost of infrastructure (treatment solutions, consolidation, etc.), design and engineering costs, environmental compliance costs, construction management fees, general contractor fees, etc. Full details of the capital costs considered and utilized in the Needs Assessment are in Appendix C.

"**Community water system**" or **CWS**" means a public water system that serves at least 15 service connections used by yearlong residents or regularly serves at least 25 yearlong residents of the area served by the system. (Health & Saf. Code, § 116275, subd. (i).)

"**Consistently fail**" means a failure to provide an adequate supply of safe drinking water. (Health & Saf. Code, § 116681, subd. (c).)

"**Consolidation**" means joining two or more public water systems, state small water systems, or affected residences into a single public water system, either physically or managerially. For the purposes of this document, consolidations may include voluntary or mandatory consolidations. (Health & Saf. Code, § 116681, subd. (e).)

"**Constituents of emerging concern**" means synthetic or naturally occurring chemicals or material that have been detected in water bodies, that cause public health impacts, and are not regulated under current primary or secondary maximum contaminant level (MCL). For purposes of the 2022 Risk Assessment, three chemicals: hexavalent chromium, 1,4-dioxane, and per- and polyfluoroalkyl substances (PFAS), were incorporated.

"**Contaminant**" means any physical, chemical, biological, or radiological substance or matter in water. (Health & Saf. Code, § 116275, subd. (a).)

"**Cost Assessment**" means the estimation of funding needed for the Safe and Affordable Drinking Water Fund for the next fiscal year based on the amount available in the fund, anticipated funding needs, and other existing State Water Board funding sources. Thus, the Cost Assessment estimates the costs related to the implementation of interim and/or emergency measures and longer-term solutions for HR2W list systems and At-Risk public water systems, state small water systems, and domestic wells. The Cost Assessment also includes the identification of available funding sources and the funding and financing gaps that may exist to support interim and long-term solutions. (Health & Saf. Code, § 116769.)

"**Disadvantaged community**" or "**DAC**" means the entire service area of a community water system, or a community therein, in which the median household income is less than 80% of the statewide annual median household income level. (Health & Saf. Code, § 116275, subd. (aa).)

"**Domestic well**" means a groundwater well used to supply water for the domestic needs of an individual residence or a water system that is not a public water system and that has no more than four service connections. (Health & Saf. Code, § 116681, subd. (g).)

“**Drinking Water Needs Assessment”** or “**Needs Assessment**” means the comprehensive identification of California drinking water needs. The Needs Assessment consist of three core components: the Affordability Assessment, Risk Assessment, and Cost Assessment. The results of the Needs Assessment inform the State Water Board’s annual Fund Expenditure Plan for the Safe and Affordable Drinking Water Fund and the broader activities of the SAFER Program. (Health & Saf. Code, § 116769.)

“**Electronic Annual Report**” or “**EAR**” means is a survey of public water systems, currently required annually, to collect critical water system information intended to assess the status of compliance with specific regulatory requirements, provides updated contact and inventory information (such as population and number of service connections), and provides information that is used to assess the financial capacity of water systems, among other information reported.

“**Fire flow**” it is the amount of water designated to be used for firefighting purposes.

“**Fund Expenditure Plan**” or “**FEP**” means the plan that the State Water Board develops pursuant to Article 4 of Chapter 4.6 of the Health and Safety Code for the Safe and Affordable Drinking Water Fund, established pursuant to Health and Safety Code section 116766.

“**Human consumption**” means the use of water for drinking, bathing or showering, hand washing, oral hygiene, or cooking, including, but not limited to, preparing food and washing dishes. (Health & Saf. Code, § 116275, subd. (e).)

“**Human Right to Water**” or “**HR2W**” means the recognition that “every human being has the right to safe, clean, affordable, and accessible water adequate for human consumption, cooking and sanitary purposes,” as defined in Assembly Bill 685 (AB 685). (California Water Code § 106.3, subd. (a).)

“**Human Right to Water list**” or “**Failing: HR2W list**” means the list of public water systems that are out of compliance or consistently fail to meet primary drinking water standards. Systems that are assessed for meeting the HR2W list criteria include Community Water Systems and Non-Community Water Systems that serve K-12 schools and daycares. The HR2W list criteria were expanded in April 2021 to better align with statutory definitions of what it means for a water system to “consistently fail” to meet primary drinking water standards. (Health & Saf. Code, § 116275(c).)

“Intertie” means an interconnection allowing the passage of water between two or more water systems.

“**Local Primacy Agency**” or “**LPA**” means a local health officer within a county to whom the State Water Board has delegated primary responsibility for the administration and enforcement of California Safe Drinking Water Act. LPA is authorized by means of a local primacy delegation agreement if the local health officer demonstrates that it has the capability to meet the local primacy program requirements established by the State Water Board pursuant to subdivision (h) of Health and Safety Code section 116375. (Health & Saf. Code, § 116330, subd. (a).)

“**Maximum Contaminant Level**” or “**MCL**” means the maximum permissible level of a contaminant in water. (Health & Saf. Code, § 116275, subd. (f).)

“**Median household income**” or “**MHI**” means the household income that represents the median or middle value for the community. The methods utilized for calculating median household income are included in Appendix A and Appendix E. Median household incomes in this document are estimated values for the purposes of this statewide assessment. Median household income for determination of funding eligibility is completed on a system-by-system basis by the State Water Board’s Division of Financial Assistance.

“**Medium Community Water Systems”** means water systems that served up to 30,000 service connections or 100,000 population served.

“**Non-Community Water System**” means a public water system that is not a community water system. (Health & Saf. Code, § 116275, subd. (j).)

“**Non-transient Non-Community Water System**” means a public water system that is not a community water system and that regularly serves at least 25 of the same persons for six months or more during a given year, such as a school. (Health & Saf. Code, § 116275, subd. (k).)

“**Operations and maintenance**” or “**O&M**” means the functions, duties and labor associated with the daily operations and normal repairs, replacement of parts and structural components, and other activities needed by a water system to preserve its capital assets so that they can continue to provide safe drinking water.

“**Point-of-use**” or **“POU**” means a water treatment device that treats water at the location of the back-end customer.

“**Point-of-entry**” **or “POE**” means a water treatment device that is located at the inlet to an entire building or facility.

“**Potentially At-Risk**” means community water systems with 30,000 service connections or less, or population served up to 100,000 and K-12 schools that are potentially at-risk of failing to meet one or more key Human Right to Water goals: (1) providing safe drinking water; (2) accessible drinking water; (3) affordable drinking water; and/or (4) maintaining a sustainable water system.

“**Primary drinking water standard**” means: (1) Maximum levels of contaminants that, in the judgment of the state board, may have an adverse effect on the health of persons. (2) Specific treatment techniques adopted by the state board in lieu of maximum contaminant levels pursuant to Health & Saf. Code, section 116365, subd. (j). and (3) The monitoring and reporting requirements as specified in regulations adopted by the state board that pertain to maximum contaminant levels. (Health & Saf. Code, § 116275, subd. (c).)

“**Public water system**” or “**PWS**” means a system for the provision to the public of water for human consumption through pipes or other constructed conveyances that has 15 or more service connections or regularly serves at least 25 individuals daily at least 60 days out of the year. A PWS includes any collection, pre-treatment, treatment, storage, and distribution facilities under control of the operator of the system that are used primarily in connection with the system; any collection or pretreatment storage facilities not under the control of the operator that are used primarily in connection with the system; and any water system that treats water on behalf of one or more public water systems for the purpose of rendering it safe for human consumption. (Health & Saf. Code, § 116275, subd. (h).)

"**Resident**" means a person who physically occupies, whether by ownership, rental, lease, or other means, the same dwelling for at least 60 days of the year. (Health & Saf. Code, § 116275, subd. (t).)

"**Risk Assessment**" means the identification of public water systems, with a focus on community water systems and K-12 schools, that may be at risk of failing to provide an adequate supply of safe drinking water. It also includes an estimate of the number of households that are served by domestic wells or state small water systems in areas that are at high risk for groundwater contamination. Different Risk Assessment methodologies have been developed for different system types: (1) public water systems; (2) state small water systems and domestic wells; and (3) tribal water systems. (Health & Saf. Code, § 116769)

"**Risk indicator**" means the quantifiable measurements of key data points that allow the State Water Board to assess the potential for a community water system or a transient non-community water system that serves a K-12 school to fail to sustainably provide an adequate supply of safe drinking water due to water quality, water accessibility, affordability, institutional, and/or TMF capacity issues.

"**Risk threshold**" means the levels, points, or values associated with an individual risk indicator that delineates when a water system is more at-risk of failing, typically based on regulatory requirements or industry standards.

"**Sanitary survey**" means a comprehensive inspection to evaluate water system potency to provide safe drinking water to their customers and to ensure compliance with the federal Safe Drinking Water Act (SDWA).

"Sounder" means a tool used to measure groundwater depth in a well.

"**Significant Deficiencies"** means identified deficiencies by State Water Board staff or LPA staff during a Sanitary Survey and other water system inspections. Significant Deficiencies include, but are not limited to, defects in the design, operation, or maintenance, or a failure or malfunction of the sources, treatment, storage, or distribution system that U.S. EPA determines to be causing or have the potential for causing the introduction of contamination into the water delivered to consumers.

"**Safe and Affordable Drinking Water Fund**" or "**SADWF**" means the fund created through the passage of Senate Bill 200 (SB 200) to help provide an adequate and affordable supply of drinking water for both the near and long terms. SB 200 requires the annual transfer of 5 percent of the annual proceeds of the Greenhouse Gas Reduction Fund (GGRF) (up to $130 million) into the Fund until June 30, 2030. (Health & Saf. Code, § 116766)

"**Safe and Affordable Funding for Equity and Resilience Program**" or "**SAFER Program**" means a set of State Water Board tools, funding sources, and regulatory authorities designed to meet the goals of ensuring safe, accessible, and affordable drinking water for all Californians.

“**SAFER Clearinghouse**” means a database system, developed and maintained by the State Water Board to assist with the implementation, management, and tracking of the SAFER Program.

“**Safe drinking water**” means water that meets all primary and secondary drinking water standards, as defined in Health and Safety Code section 116275.

“**Score**” means a standardized numerical value that is scaled between 0 and 1 for risk points across risk indicators. Standardized scores enable the evaluation and comparison of risk indicators.

“**Secondary drinking water standards**” means standards that specify maximum contaminant levels that, in the judgment of the State Water Board, are necessary to protect the public welfare. Secondary drinking water standards may apply to any contaminant in drinking water that may adversely affect the public welfare. Regulations establishing secondary drinking water standards may vary according to geographic and other circumstances and may apply to any contaminant in drinking water that adversely affects the taste, odor, or appearance of the water when the standards are necessary to ensure a supply of pure, wholesome, and potable water. (Health & Saf. Code, § 116275, subd. (d).)

“**Service connection**” means the point of connection between the customer’s piping or constructed conveyance, and the water system’s meter, service pipe, or constructed conveyance, with certain exceptions set out in the definition in the Health and Safety Code. (See Health & Saf. Code, § 116275, subd. (s).)

“**Senate Bill No. 200**” means a legislative law that enabled the State Water Board to establish the Safe and Affordable Funding for Equity and Resilience (SAFER) Program to advance the goals of the Human Right to Water. (Senate Bill No. 200, CHAPTER 120)

“Senate Bill No. 552” means a legislative law that requires small water suppliers and non-transient non-community water systems, to apply draught resiliency measures subject to funding availability. (Senate Bill No. 552, CHAPTER 245)

“**Severely disadvantaged community**” or “**SDAC**” means the entire service area of a community water system in which the MHI is less than 60% of the statewide median household income. (See Water Code § 13476, subd. (j))

“**Source capacity**” means the total amount of water supply available, expressed as a flow, from all active sources permitted for use by the water system, including approved surface water, groundwater, and purchased water. (Title 22 of the California Code of Regulations, § 64551.40.)

“**Small community water system**” means a CWS that serves no more than 3,300 service connections or a yearlong population of no more than 10,000 persons. (Health & Saf. Code, § 116275, subd. (z).)

“**Small disadvantaged community**” or “**small DAC**” or “**SDAC**” means the entire service area, or a community therein, of a community water system that serves no more than 3,300 service connections or a year-round population of no more than 10,000 in which the median household income is less than 80% of the statewide annual median household income.

“**State small water system**” or “**SSWS**” means a system for the provision of piped water to the public for human consumption that serves at least five, but not more than 14, service connections and does not regularly serve drinking water to more than an average of 25 individuals daily for more than 60 days out of the year. (Health & Saf. Code, § 116275, subd. (n).)

“**State Water Board**” means the State Water Resources Control Board.

“Static well level” means the resting state of the water level in a well under normal, no pumping conditions.

“**Technical, Managerial and Financial capacity**” or “**TMF capacity**” means the ability of a water system to plan for, achieve, and maintain long term compliance with drinking water standards, thereby ensuring the quality and adequacy of the water supply. This includes adequate resources for fiscal planning and management of the water system.

“**Waterworks Standards**” means regulations adopted by the State Water Board entitled “California Waterworks Standards” (Chapter 16 (commencing with § 64551) of Division 4 of Title 22 of the California Code of Regulations). (Health & Saf. Code, § 116275, subd. (q).)

“**Weight**” means the application of a multiplying value or weight to each risk indicator and risk category within the Risk Assessment, as certain risk indicators and categories may be deemed more critical than others.

RISK ASSESSMENT RESULTS FOR STATE SMALL WATER SYSTEMS & DOMESTIC WELLS

OVERVIEW

The Risk Assessment methodology developed for state small water systems and domestic wells is focused on identifying areas where groundwater is at high-risk of containing contaminants that exceed safe drinking water standards and is at high-risk of water shortage for areas where groundwater is used or likely to be used as a drinking water source. This information is presented as an online map tool.[1] Water quality risk data is from the State Water Board's Aquifer Risk Map,[2] and water shortage risk data is from the Department of Water Resources Water Shortage Vulnerability Tool for Self-Supplied Communities.[3] Previous work is available on the State Water Board's Needs Assessment webpage.[4]

RISK ASSESSMENT METHODOLOGY

The State Water Board has limited water quality, water shortage, and location data for state small water systems and domestic wells, as these systems are not regulated by the state nor

[1] Combined Risk for State Small Water Systems and Domestic Wells (Needs Assessment) https://gispublic.waterboards.ca.gov/portal/apps/webappviewer/index.html?id=122823a570424891986ff72846b37b83

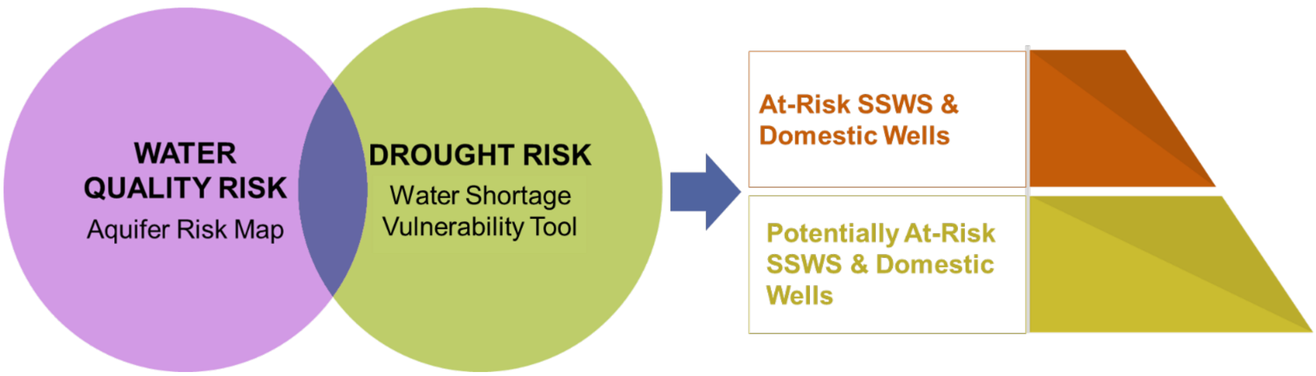
[2] Aquifer Risk Map Webtool https://gispublic.waterboards.ca.gov/portal/apps/webappviewer/index.html?id=17825b2b791d4004b547d316af7ac5cb

[3] Drought and Water Shortage Risk for Self-Supplied Communities https://tableau.cnra.ca.gov/t/DWR_IntegratedDataAnalysisBranch/views/DWRDroughtRiskExplorer-RuralCommunitesMarch2021/Dashboard?%3AshowAppBanner=false&%3Adisplay_count=n&%3AshowVizHome=n&%3Aorigin=viz_share_link&%3AisGuestRedirectFromVizportal=y&%3Aembed=y

[4] Drinking Water Needs Assessment Page https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/needs.html

are maximum contaminant levels directly applicable to domestic wells.[5] Therefore, a very different approach for conducting a Risk Assessment for these systems was developed in comparison with the Risk Assessment for public water systems. The risk assessment for state small water systems and domestic wells uses modeled and estimated data to assess risk, because data directly from these systems is unavailable in most cases. Water quality risk is based on data from nearby wells of similar depth, and water shortage information is based on multiple indicators from the surrounding area including climate change, current conditions, physical and socioeconomic vulnerability, and shortage record. This section provides an overview of the methods used to assess risk for state small water systems and domestic wells. A more detailed discussion of this methodology is included in Appendix B.

Figure 1: Combined Risk Assessment for State Small Water Systems and Domestic Wells



The Risk Assessment for domestic wells and state small systems involved the following steps:

STEP 1: Use State Water Board's 2022 Aquifer Risk Map data to identify water quality risk to state small water systems and domestic wells. The Aquifer Risk Map identifies areas where long-term average or recent water quality results are above the Maximum Contaminant Limit (MCL). A normalized water quality score is calculated for each square mile section.

STEP 2: Use the DWR Water Shortage Vulnerability Tool for Self-Supplied Communities to identify drought/water shortage risk to domestic wells and state small water systems. This tool calculates water shortage risk based on a suite of factors including exposure to hazard, climate change, current conditions, physical and socioeconomic vulnerability, and record of shortage. A normalized drought/water shortage score is calculated for each square mile section.

STEP 3: Use the DWR Online System for Well Completion Reports and State Water Board's state small water system location data to identify areas where groundwater is accessed by state small water systems or domestic wells. The count of state small water systems and domestic well records is reported by per square mile section.

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[5] State small water systems are typically required to conduct minimal monitoring. If water quality exceeds an MCL, corrective action is required only if specified by the Local Health Officer. State small water systems provide an annual notification to customers indicating the water is not monitored to the same extent as public water systems.

STEP 4: Calculate the combined risk score for each square mile section by adding the normalized water quality and water shortage scores and dividing by two. An Overlay of the state small water systems and domestic well location data is used to determine how many systems and wells are in each risk category.

Combined risk scores are calculated for all areas of the state, but the risk assessment is only intended for areas with a state small water system or domestic well record. The online webtool includes a filter that only shows the risk scores for areas of the state with at least one domestic well or state small water system, although this filter can be turned off to see the risk scores for all areas.

RISK ASSESSMENT RESULTS

Due to the lack of data from actual state small water systems and domestic wells, it is difficult to precisely determine the count of systems and wells at-risk. The risk analysis described above uses proxy groundwater quality data to identify areas where shallow groundwater quality may exceed primary drinking water standards, and a suite of risk indicators to indicate where state small water systems and domestic wells may experience water shortage issues. *These proxy data do not assess the compliance or water shortage status of any individual well or system.* As a result, the presence of a given state small water system or domestic well within an “at-risk” area does not signify that they are accessing groundwater above primary drinking water standards or that the well has gone dry. Conversely, a state small water system or domestic well mapped in a “not at-risk” area may be accessing groundwater above primary drinking water standards or be experiencing water shortage issues. Physical monitoring and testing of state small water systems and individual domestic well water is needed to determine if those systems are unable to access safe drinking water.

Table 1 shows the approximate counts of state small water systems and domestic wells[6] statewide located in different risk areas based on data from the 2022 Needs Assessment. Based on the 2022 analysis there are 631 state small water systems At-Risk for water quality and 321 At-Risk for drought respectively. When analyzed, using the Combined Risk Assessment method, there are 797 state small water systems at-risk for water quality or water shortage. Of these systems, there are 265 unique systems that are at-risk for water quality only and 154 unique systems that are at-risk for water shortage only. There are 378 state small water systems that are at-risk for both water quality and water shortage. These are the most vulnerable At-Risk state small water systems.

Table 1: State Small Water System Results (Statewide)

Assessment	At-Risk	Potentially At-Risk	Not At-Risk	Not Assessed
Water Quality Risk Only	631 (50%)	75 (6%)	426 (33%)	141 (11%)

[6] Domestic well locations are approximated using the OSWCR domestic well completion records. Learn more in Appendix B.

Assessment	At-Risk	Potentially At-Risk	Not At-Risk	Not Assessed
Drought Risk Only	321 (25%)	411 (32%)	535 (42%)	6 (0%)
Combined Risk Assessment	**378 (30%)**	**438 (34%)**	**455 (36%)**	**2 (0%)**

Figure 2: At-Risk State Small Water Systems

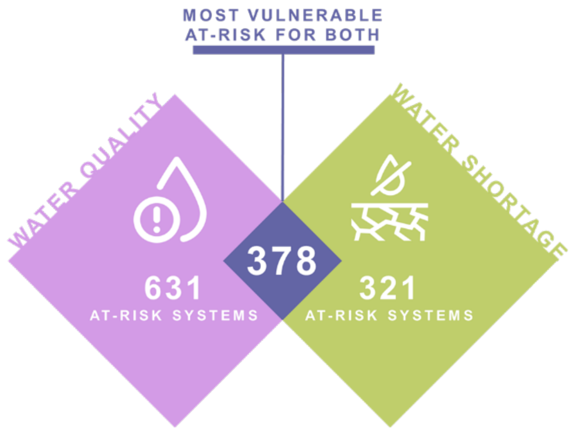


Table 2 shows the approximate counts of At-Risk domestic wells[7] statewide located in different risk areas based on data from the 2022 Needs Assessment. Based on the 2022 analysis there are approximately 93,635 domestic wells At-Risk for water quality and 90,974 At-Risk for drought respectively. When analyzed, using the Combined Risk Assessment method, there approximately 64,176 domestic wells that are At-Risk for both water quality and drought risk. These domestic wells can be viewed as the most vulnerable of the At-Risk wells identified.

Table 2: Domestic Well Results (Statewide)

Assessment	At-Risk	Potentially At-Risk	Not At-Risk	Not Assessed
Water Quality Risk Only	92,635 (30%)	17,078 (5%)	134,282 (43%)	68,192 (22%)
Drought Risk Only	90,974 (29%)	88,340 (28%)	132,709 (43%)	164 (0%)
Combined Risk Assessment	**64,176 (21%)**	**90,840 (29%)**	**157,146 (50%)**	**25 (0%)**

[7] Domestic well locations are approximated using the OSWCR domestic well completion records. Learn more in Appendix B.

Figure 3: At-Risk Domestic Wells

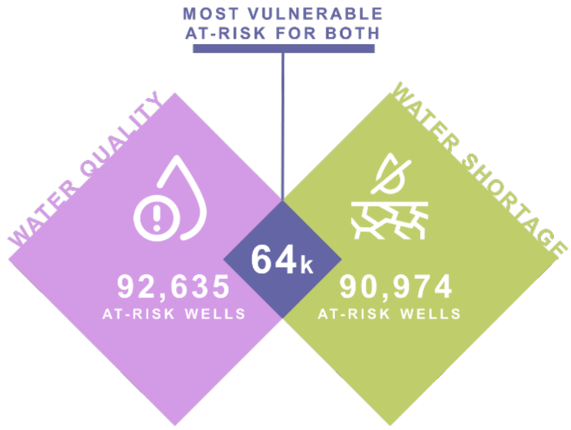


Figure 4 shows the count of domestic wells in each risk designation per county. Figure 5 shows the count of state small systems in each risk designation per county. For more detail about the Section Risk Designations, please refer to Appendix B. Figure 6 is a map that shows the combined risk for areas of the state with a domestic well or state small water system.

Figure 4: Domestic Well Records by Combined Risk (By County)

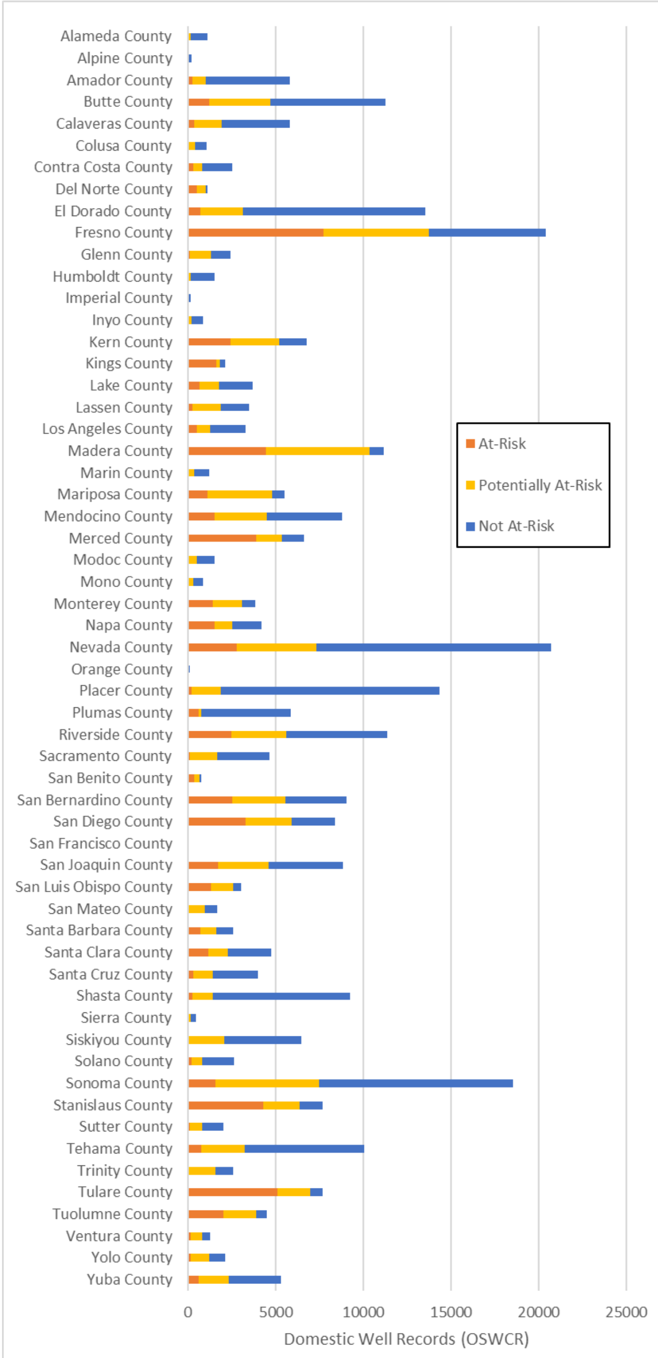


Figure 5: State Small Water Systems by Combined Risk (By County)

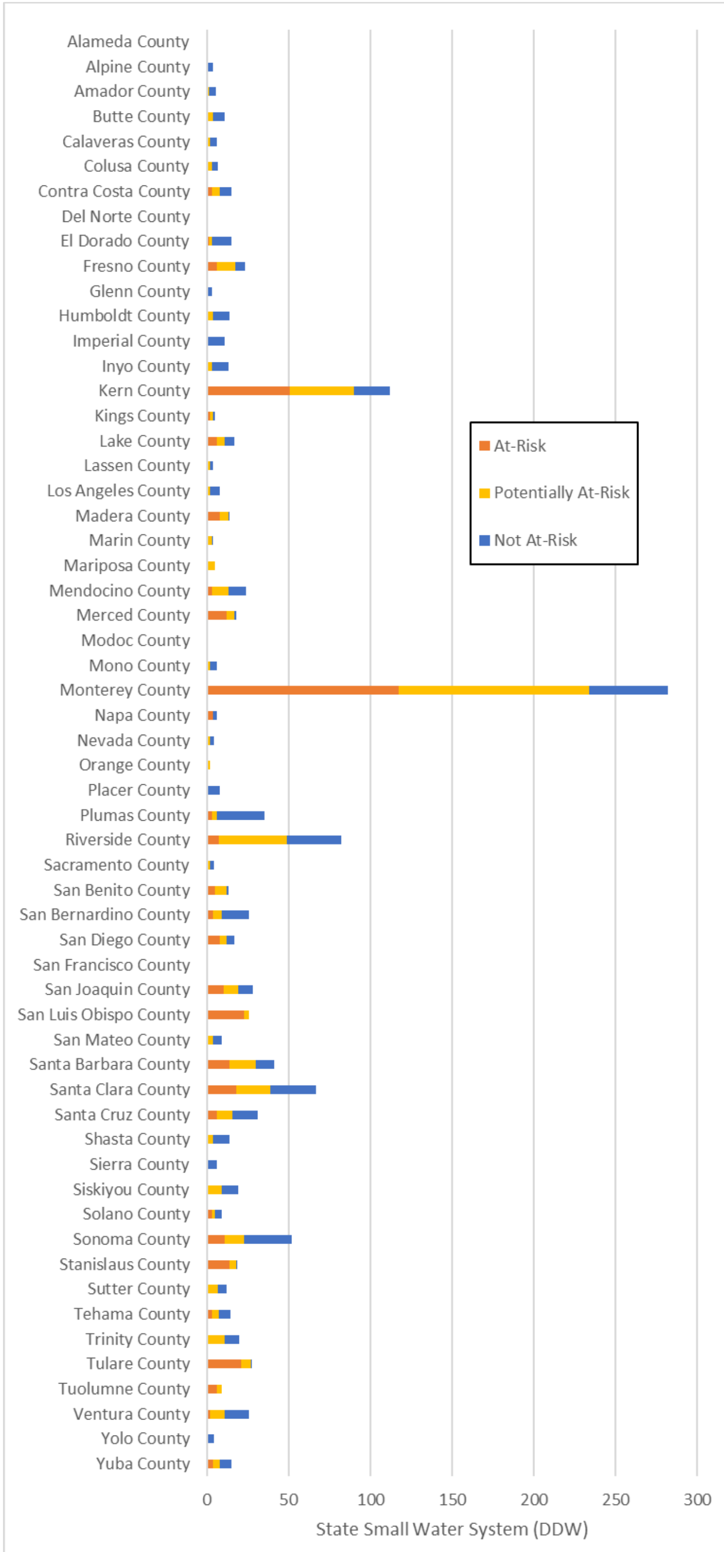
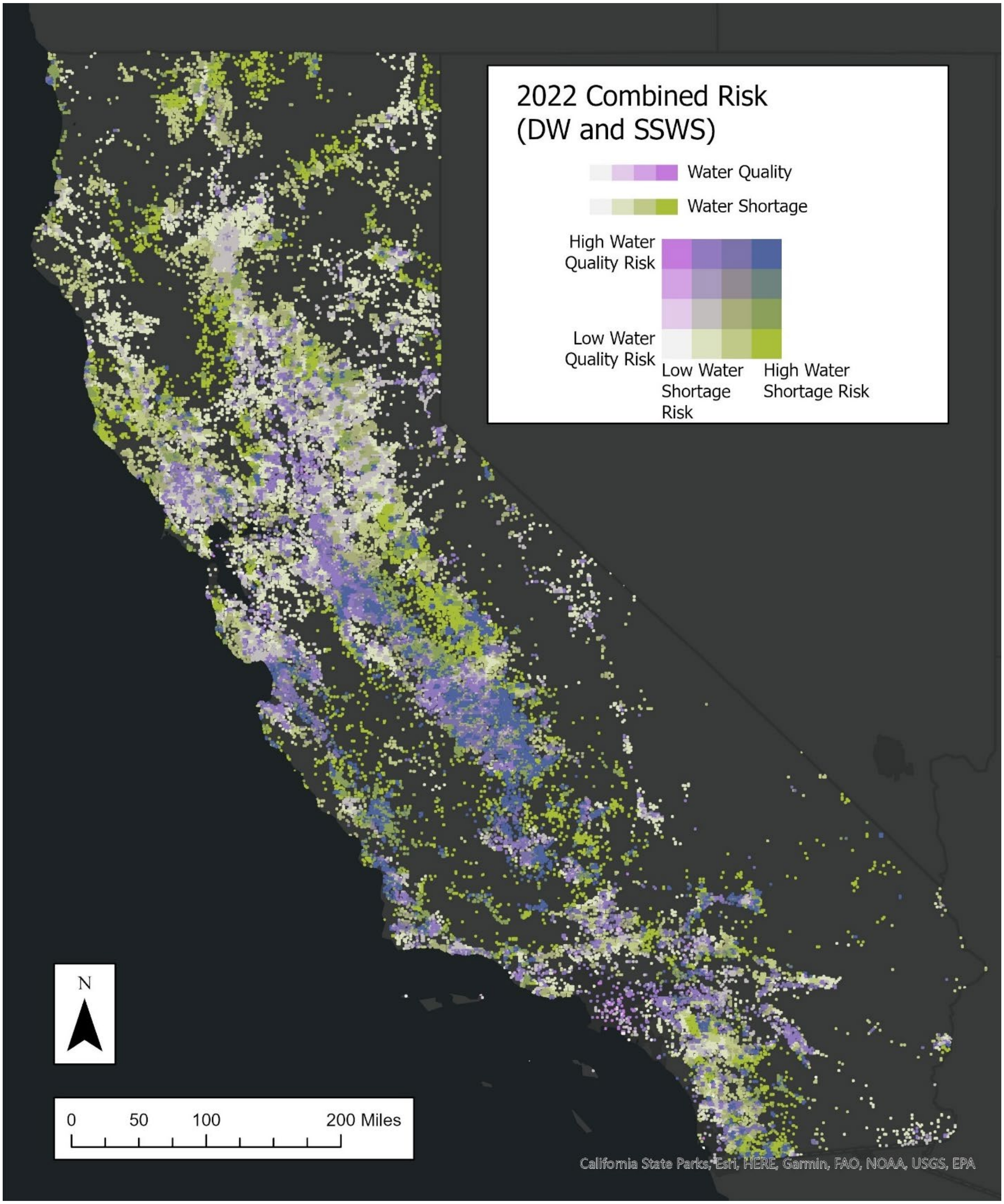
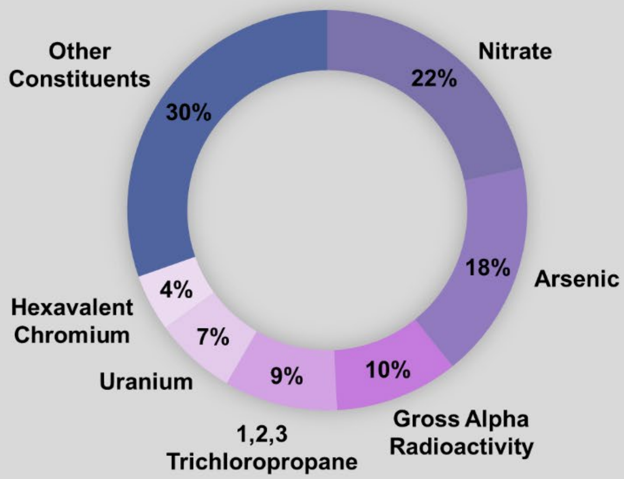


Figure 6: Combined Risk for State Small Water Systems (SSWS) and Domestic Wells (DW)



Statewide, the top contaminants that contributed to higher risk designations in domestic wells and state small water systems are nitrate, arsenic, 1,2,3-trichloropropane, gross alpha, uranium, and hexavalent chromium. Figure 7 shows the proportion of domestic wells in high water quality risk areas where the contaminant may exceed drinking water standards. Note that multiple contaminants may exceed drinking water standards at a single location.

Figure 7: Constituents Contributing to Shallow Water Quality Risk



SOCIOECONOMIC ANALYSIS OF AT-RISK STATE SMALL WATER SYSTEMS AND DOMESTIC WELL AREAS

Results for the 2022 Risk Assessment for state small water systems and domestic wells can be combined with demographic data to better understand the populations most at-risk for water shortage and water quality issues. However, there are several limitations to this demographic analysis. Demographic data is collected at the census block group or census tract level, and current census surveys do not indicate household drinking water source type. Therefore, the demographic information presented in the tables below may not represent the population served by state small water systems or domestic wells. Any interpretation of these results should keep in mind the limitations of the analysis.

Demographic data (household size, linguistic isolation, poverty, median household income, and race/ethnicity) is from the 2019 American Community Survey. CalEnviroScreen 4.0 data is from OEHHA[8]. The CalEnviroScreen 4.0 data is displayed as percentiles, with higher percentiles indicating areas that are most affected by pollution and where people are especially vulnerable to the effects of pollution. The socioeconomic analysis was calculated by assigning data to square mile sections, grouping sections by 2022 combined risk scores, and calculating averages. This methodology means that there may be a bias towards demographic

[8] OEHHA CalEnviroScreen: https://oehha.ca.gov/calenviroscreen

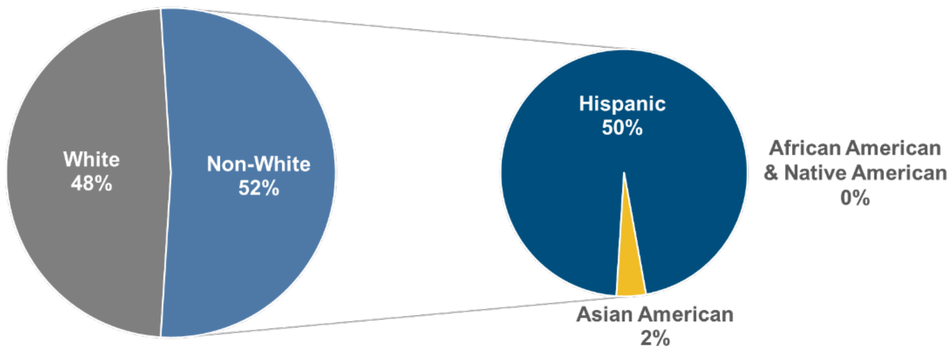
data from larger, rural tracts/block groups as these areas contain more square mile sections than smaller, urban tracts/block groups.

When compared with not at-risk state small water systems areas, at-risk state small water system areas tend to have higher CalEnviroScreen scores, a higher percentage of households in poverty, a higher percentage of limited English speaking households, a larger household size, and are equally likely to be in a DAC or SDAC area. Regardless of risk, areas with domestic wells have similar CalEnvironScreen scores to areas of the state without state small water systems.

Table 3: Socioeconomic Analysis for Areas with Combined At-Risk State Small Water Systems

	Statewide (all areas)	Statewide (SSWS areas only)	Not At-Risk	Potentially At-Risk	At-Risk
Total Count of SSWS	**1,273**	**1,273**	**455**	**438**	**378**
Average CalEnviroScreen 4.0 Percentile	42.2	40.4	34.8	40.0	48.5
Average CalEnviroScreen 4.0 Population Characteristics Percentile	46.0	42.0	39.5	41.4	46.1
Average CalEnviroScreen 4.0 Pollution Burden Percentile	38.8	40.5	32.8	40.2	51.8
Average percentage of households 2x below federal poverty	36.2%	31.5%	30.0%	32.0%	33.1%
Average percentage of households with limited English speaking	5.21%	7.84%	6.19%	8.47%	9.24%
Average household size	2.51	2.78	2.59	2.79	3.02
Percent of SSWS in DAC/SDAC areas	34% (427)	34% (427)	32% (146)	36% (159)	32% (121)
Percent of SSWS in majority non-white areas	38% (487)	38% (487)	31% (140)	34% (148)	52% (198)

Figure 8: Distribution of At-Risk State Small Water Systems by Majority Race/Ethnicity of Census Tract



When compared with not at-risk domestic well areas, at-risk domestic well areas tend to have higher CalEnviroScreen scores, a higher percentage of household poverty, a higher percentage of households with limited English speaking, larger household size, and are more likely to be in a DAC or SDAC area. Regardless of risk, areas with domestic wells have similar CalEnvironScreen scores to areas of the state without domestic wells.

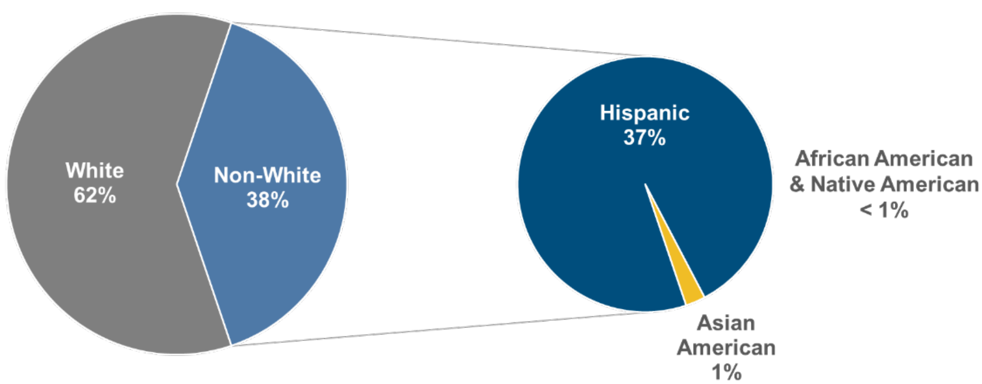
Table 4: Socioeconomic Analysis for Areas with Combined At-Risk Domestic Wells

	Statewide (all areas)	Statewide (domestic well areas only)	Not At-Risk	Potentially At-Risk	At-Risk
Total Count of Domestic Wells	**312,187**	**312,187**	**157,146**	**90,840**	**64,176**
Average CalEnviroScreen 4.0 Percentile	42.2	41.6	34.5	44.0	56.5
Average CalEnviroScreen 4.0 Population Characteristics Percentile	46.0	43.7	39.0	45.1	53.8
Average CalEnviroScreen 4.0 Pollution Burden Percentile	38.8	40.7	33.0	43.3	56.7
Average percentage of households 2x below federal poverty[9]	36.2%	32.7%	30.0%	34.3%	37.6%

[9] The DWR Water Shortage Vulnerability Tool (one component of the combined risk scoring) uses poverty as one indicator of social vulnerability (QPoverty; RC4). For more information, please refer to the Water Shortage Vulnerability Tool methodology.

	Statewide (all areas)	Statewide (domestic well areas only)	Not At-Risk	Potentially At-Risk	At-Risk
Average percentage of households with limited English speaking[10]	5.21%	5.46%	3.68%	5.92%	9.43%
Average household size	2.51	2.72	2.62	2.72	3.00
Percent of domestic wells in DAC/SDAC areas[11,12]	33% (102,166)	33% (102,166)	24% (38,326)	40% (36,246)	43% (27,591)
Percent of domestic wells in majority non-white areas	20% (61,604)	20% (61,604)	11% (17,722)	21% (19,424)	38% (24,448)

Figure 9: Distribution of At-Risk Domestic Wells by Majority Race/Ethnicity of Census Tract



[10] The DWR Water Shortage Vulnerability Tool (one component of the combined risk scoring) uses linguistic isolation as one indicator of social vulnerability (Qlang; RC4). For more information, please refer to the Water Shortage Vulnerability Tool methodology.

[11] DAC/SDAC stand for "disadvantaged communities" and "severely disadvantaged communities" and include census block groups with a Median Household Income less than 80% of the California Median Household Income ($60,188; DAC) or less than 60% of the California Median Household Income ($45,141; SDAC).

[12] The DWR Water Shortage Vulnerability Tool (one component of the combined risk scoring) uses median household income as one indicator of social vulnerability (MHI; RC4). For more information, please refer to the Water Shortage Vulnerability Tool methodology.

LIMITATIONS OF THE RISK ASSESSMENT FOR STATE SMALL WATER SYSTEMS & DOMESTIC WELLS

The state small water system and domestic well risk ranking developed using this methodology is not intended to depict actual groundwater quality conditions at any given domestic supply well or small water system location. The purpose of this risk map analysis is to prioritize areas that may not meet primary drinking water standards or have water shortage risk to inform additional investigation and sampling efforts. The current lack of available state small water system and domestic well water quality data makes it impossible to characterize the actual water quality for any individual state small water system or domestic well. The analysis described here thus represents a good faith effort at using readily available data to estimate water quality and water shortage risk for state small water systems and domestic wells.

REFINEMENT OPPORTUNITIES

Provisions under SB 200 require counties to provide location and any available water quality data for state small water systems and domestic wells. The State Water Board is assisting counties in complying with these provisions and is developing a new database to collect and validate this data as it is submitted.[13] Future iterations of the Aquifer Risk Map and Risk Assessment for state small water systems and domestic wells will incorporate the locational and water quality data collected through this effort. When sufficient information becomes available, it may be possible to expand the Risk Assessment methodology for state small water systems and domestic wells to better align with the approach employed by the Risk Assessment for public water systems. This can only be achieved if specific, rather than proxy, state small water system and domestic well water quality data are available.

State Water Board staff are partnering with OEHHA to explore additional metrics that may be incorporated into future iterations of the Risk Assessment for state small water systems and domestic wells. In particular, the group will be exploring data availability of metrics that align with the risk indicator categories employed by the Risk Assessment for public water systems: Water Quality, Accessibility, Affordability, and TMF Capacity.

[13] State Small Water System and Domestic Well Water Quality Data
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/small_water_system_quality_data.html

APPENDIX B:
RISK ASSESSMENT METHODOLOGY FOR STATE SMALL WATER SYSTEMS & DOMESTIC WELLS

INTRODUCTION

The 2022 Needs Assessment uses both water quality data (State Water Board's Aquifer Risk Map) and water shortage data (DWR Water Shortage Vulnerability Tool) to determine risk for state small water systems and domestic wells. The methodology for the Aquifer Risk Map[14] and the Water Shortage Vulnerability Tool[15] are explained in greater detail in their respective write-ups.

The 2021 Needs Assessment was based solely on data from the Aquifer Risk Map. In response to stakeholder feedback, the State Water Board has incorporated an additional risk indicator for water shortage to the 2022 Needs Assessment for state small water systems and domestic wells.

RISK ASSESSMENT METHODOLOGY DEVELOPMENT PROCESS

The Aquifer Risk Map was developed from 2019-2020 with stakeholder feedback, including three public webinars held by the State Water Board over the course of 2020 to solicit feedback on the development of the aquifer risk map. The Aquifer Risk Map work was influenced by previous work developing the Domestic Well Water Quality Tool, which provided an estimate of the number and location of domestic wells at-risk for water quality issues. Development of the Domestic Well Water Quality Tool involved a public workshop in 2019.

A public webinar was held in October 2021 to solicit feedback on updates to the 2022 Aquifer Risk Map. A public workshop was hosted on February 2, 2022 to present the new Combined Risk Assessment for State Small Water Systems and Domestic Wells. Recommendations and feedback from the public are used to refine the methodology and analysis for current and future iterations of the Risk Assessment.

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[14] Methodology for 2022 Aquifer Risk Map
https://gispublic.waterboards.ca.gov/portal/home/item.html?id=62b116bb7e824df098b871cbce73ce3b

[15] Methodology for DWR Water Shortage Vulnerability Tool
https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Water-Use-And-Efficiency/Urban-Water-Use-Efficiency/CDAG/Part-2-Appendix-1-Scoring-Method-Final.pdf

INTENDED USE OF THIS ANALYSIS

The risk rankings developed using this methodology are not intended to depict actual groundwater quality conditions at any given domestic supply well or small water system location. The purpose of this risk map analysis is to prioritize areas that may not meet primary drinking water standards or may be at risk of water shortage to inform additional investigation and sampling efforts. The current lack of available domestic well and state small system water quality data, water shortage data, and locational data makes it impossible to characterize the risk for individual domestic wells and state small systems. The analysis described here thus represents a best effort at using the available data to estimate risk for domestic wells and state small systems in a square mile section.

METHODOLOGY

WATER QUALITY RISK (AQUIFER RISK MAP)

A complete description of the 2022 Aquifer Risk Map methodology is available online.[16] The Aquifer Risk Map uses previously collected water quality results from various datasets, including the Division of Drinking Water (DDW), the US Geological Survey (USGS)-Groundwater Ambient Monitoring and Assessment (GAMA) programs' Priority Basin and Domestic Well Projects, the USGS-National Water Information System dataset, the Department of Water Resources (DWR), local groundwater monitoring projects, the Irrigated Lands Regulatory Program (AGLAND), and monitoring/clean-up sites (GeoTracker). These water quality results are depth-filtered to only focus on data from groundwater depths accessed by domestic wells and state small water systems. Data from all chemical constituents with a Maximum Contaminant Level (MCL) are assessed, and several additional chemical constituents including hexavalent chromium, copper, lead, and N-Nitrosodimethylamine (NDMA) are included in the analysis as well[17]. Water quality results were converted to an MCL Index[18] to allow comparison between chemical constituents (Table B1) for chemical constituent codes and MCL values). The R script used to download, process, and filter the water quality data is available on GitHub.[19]

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[16] Methodology for 2022 Aquifer Risk Map
https://gispublic.waterboards.ca.gov/portal/home/item.html?id=62b116bb7e824df098b871cbce73ce3b

[17] The comparison concentration values for chemicals without an MCL are as follows: Hexavalent Chromium – 10 micrograms per liter (µG/L); Copper – 1.3 milligrams per liter (MG/L); Lead – 15 µG/L; N-Nitrosodimethylamine (NDMA) – 0.1 µG/L. For a complete list of contaminants and comparison levels please refer to Appendix A of the 2022 Aquifer Risk Map Methodology document.

[18] See page the 2022 Aquifer Risk Map Methodology for more details. The MCL index consists of the finding divided by the MCL, with a special consideration for non-detect results with a reporting limit above the MCL.

[19] Methodology script (GitHub)
https://github.com/EmilyHoulihan/Aquifer_Risk_Map

Table B1: Chemical Constituent Codes and Maximum Contaminant Values for Aquifer Risk Map Chemical Constituents

Chemical Abbreviation (Web Tool)	Chemical Name	Units	Comparison Concentration Value	Comparison Concentration Type
24D	2,4-Dichlorophenoxyacetic acid (2,4 D)	µg/L	70	MCL
AL	Aluminum	µg/L	1000	MCL
ALACL	Alachlor	µg/L	2	MCL
ALPHA	Gross Alpha radioactivity	pCi/L	15	MCL
AS	Arsenic	µg/L	10	MCL
ATRAZINE	Atrazine	µg/L	1	MCL
BA	Barium	mg/L	1	MCL
BDCME	Bromodichloromethane (THM)	µg/L	80	MCL
BE	Beryllium	µg/L	4	MCL
BETA	Gross beta	pCi/L	50	MCL
BHCGAMMA	Lindane (Gamma-BHC)	µg/L	0.2	MCL
BIS2EHP	Di(2-ethylhexyl)phthalate (DEHP)	µg/L	4	MCL
BRO3	Bromate	µg/L	10	MCL
BTZ	Bentazon	µg/L	18	MCL
BZ	Benzene	µg/L	1	MCL
BZAP	Benzo(a)pyrene	µg/L	0.2	MCL
BZME	Toluene	µg/L	150	MCL
CD	Cadmium	µg/L	5	MCL
CHLORDANE	Chlordane	µg/L	0.1	MCL
CHLORITE	Chlorite	mg/L	1	MCL
CLBZ	Chlorobenzene	µg/L	70	MCL
CN	Cyanide (CN)	µg/L	150	MCL
CR	Chromium	µg/L	50	MCL
CR6	Chromium, Hexavalent (Cr6)	µg/L	10	Temporary comparison level*
CRBFN	Carbofuran	µg/L	18	MCL
CTCL	Carbon Tetrachloride	µg/L	0.5	MCL
CU	Copper	mg/L	1.3	Action Level
DALAPON	Dalapon	µg/L	200	MCL

Chemical Abbreviation (Web Tool)	Chemical Name	Units	Comparison Concentration Value	Comparison Concentration Type
DBCME	Dibromochloromethane (THM)	µg/L	80	MCL
DBCP	1,2-Dibromo-3-chloropropane (DBCP)	µg/L	0.2	MCL
DCA11	1,1-Dichloroethane (1,1 DCA)	µg/L	5	MCL
DCA12	1,2 Dichloroethane (1,2 DCA)	µg/L	0.5	MCL
DCBZ12	1,2 Dichlorobenzene (1,2-DCB)	µg/L	600	MCL
DCBZ14	1,4-Dichlorobenzene (p-DCB)	µg/L	5	MCL
DCE11	1,1 Dichloroethylene (1,1 DCE)	µg/L	6	MCL
DCE12C	cis-1,2 Dichloroethylene	µg/L	6	MCL
DCE12T	trans-1,2, Dichloroethylene	µg/L	10	MCL
DCMA	Dichloromethane (Methylene Chloride)	µg/L	5	MCL
DCP13	1,3 Dichloropropene	µg/L	0.5	MCL
DCPA12	1,2 Dichloropropane (1,2 DCP)	µg/L	5	MCL
DINOSEB	Dinoseb	µg/L	7	MCL
DIQUAT	Diquat	µg/L	20	MCL
DOA	Di(2-ethylhexyl)adipate	mg/L	0.4	MCL
EBZ	Ethylbenzene	µg/L	300	MCL
EDB	1,2 Dibromoethane (EDB)	µg/L	0.05	MCL
ENDOTHAL	Endothall	µg/L	100	MCL
ENDRIN	Endrin	µg/L	2	MCL
F	Fluoride	mg/L	2	MCL
FC11	Trichlorofluoromethane (Freon 11)	µg/L	150	MCL
FC113	1,1,2-Trichloro-1,2,2-Trifluoroethane (Freon 113)	mg/L	1.2	MCL
GLYP	Glyphosate (Round-up)	µg/L	700	MCL
H-3	Tritium	pCi/L	20000	MCL
HCCP	Hexachlorocyclopentadiene	µg/L	50	MCL
HCLBZ	Hexachlorobenzene (HCB)	µg/L	1	MCL

Chemical Abbreviation (Web Tool)	Chemical Name	Units	Comparison Concentration Value	Comparison Concentration Type
HEPTACHLOR	Heptachlor	µg/L	0.01	MCL
HEPT-EPOX	Heptachlor Epoxide	µg/L	0.01	MCL
HG	Mercury	µg/L	2	MCL
MOLINATE	Molinate	µg/L	20	MCL
MTBE	MTBE (Methyl-tert-butyl ether)	µg/L	13	MCL
MTXYCL	Methoxychlor	µg/L	30	MCL
NI	Nickel	µg/L	100	MCL
NNSM	N-Nitrosodimethylamine (NDMA)	µg/L	0.01	NL
NO2	Nitrite as N	MG/L	1	MCL
NO3N	Nitrate as N	mg/L	10	MCL
OXAMYL	Oxamyl	µg/L	50	MCL
PB	Lead	µg/L	15	Action Level
PCA	1,1,2,2 Tetrachloroethane (PCA)	µg/L	1	MCL
PCATE	Perchlorate	µg/L	6	MCL
PCB1016	Polychlorinated Biphenyls (PCBs)	µg/L	0.5	MCL
PCE	Tetrachloroethene (PCE)	µg/L	5	MCL
PCP	Pentachlorophenol (PCP)	µg/L	1	MCL
PICLORAM	Picloram	mg/L	0.5	MCL
RA-226	Radium 226	pCi/L	5	MCL
RA-228	Radium 228	pCi/L	5	MCL
SB	Antimony	µg/L	6	MCL
SE	Selenium	µg/L	50	MCL
SILVEX	2,4,5-TP (Silvex)	µg/L	50	MCL
SIMAZINE	Simazine	µg/L	4	MCL
SR-90	Strontium 90	pCi/L	8	MCL
STY	Styrene	µg/L	100	MCL
TBME	Bromoform (THM)	µg/L	80	MCL
TCA111	1,1,1-Trichloroethane	µg/L	200	MCL
TCA112	1,1,2-Trichloroethane	µg/L	5	MCL
TCB124	1,2,4- Trichlorobenzene (1,2,4 TCB)	µg/L	5	MCL

Chemical Abbreviation (Web Tool)	Chemical Name	Units	Comparison Concentration Value	Comparison Concentration Type
TCDD2378**	2,3,7,8-Tetrachlorodibenzodioxin (Dioxin)	µg/L	3.00E-05	MCL
TCE	Trichloroethene (TCE)	µg/L	5	MCL
TCLME	Chloroform (THM)	µg/L	80	MCL
TCPR123	1,2,3-Trichloropropane (1,2,3 TCP)	µg/L	0.005	MCL
THIOBENCARB	Thiobencarb	µg/L	70	MCL
THM	Total Trihalomethanes	µg/L	80	MCL
TL	Thallium	µg/L	2	MCL
TOXAP	Toxaphene	µg/L	3	MCL
U	Uranium	pCi/L	20	MCL
VC	Vinyl Chloride	µg/L	0.5	MCL
XYLENES	Xylenes (total)	µg/L	1750	MCL

*Since there is currently no MCL for Hexavalent Chromium (CrVI, a temporary comparison value was used to remain consistent with the risk assessment for public water systems.

**No data for 2,3,7,8-Tetrachlorodibenzodioxin (Dioxin) was available for this analysis, because there are no samples from wells that met our depth and time criteria.

DEPTH FILTER

Most available groundwater quality data is sourced from public (municipal) supply wells. This is a result of California's requirement for monitoring and reporting of groundwater from wells that are part of a public water system that supplies water to 15 or more service connections. In contrast, domestic wells (any system that serves less than 5 connections) and state small water systems (5 – 14 connections) are not regulated by the state and therefore lack comprehensive data.

For many regions, municipal supply wells access a deeper portion of the groundwater resource when compared with domestic wells. This deeper groundwater is typically less affected by contaminants introduced at the ground surface than shallower groundwater. As a result, use of data from municipal wells would likely result in a systematically low bias for an estimate of the shallower groundwater typically accessed by domestic wells.

Accordingly, staff developed a method to filter data that more likely represents shallower groundwater accessed by domestic wells, as summarized below.

Since well depth varies throughout the state, a domestic depth zone was defined numerically for each groundwater unit[20] based on Total Completed Depth statistics from the Online System of Well Completion Reports (OSWCR) database. Based on well depth data in the OSCWR database, a well depth interval per groundwater unit was determined for wells classified as domestic and for wells classified as public (Figure B1). These well depth statistics were then compared to assess whether domestic and public well depth intervals overlap, which indicates that they access the same groundwater source. For groundwater units where the depth interval for public and domestic wells overlapped (or the public interval was shallower) water quality data from public wells was included in the analysis. For groundwater units where the depth interval for public wells was deeper than the depth interval for domestic wells, water quality data from public wells was screened out of the analysis. For details on the maximum domestic well depth and the comparison of public and domestic wells for each groundwater unit, see Attachment B1.[21]

Figure B1 illustrates the numeric depth filter which is based on the average of section maximum/minimum well depths per Groundwater Unit. Wells with a known depth that fall within the “domestic well depth interval” are included in the analysis. Wells with a known depth that fall outside the “domestic well depth interval” are screened out of the analysis. For wells without a known depth - if the “public bottom” depth of a Groundwater Unit is shallower or within 10% of the “domestic bottom” depth, then wells classified as public are included in the analysis. If the “public bottom” depth of a Groundwater Unit is more than 10% deeper than the “domestic bottom” depth, then wells classified as public are screened out of the analysis.

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[20] This project uses Groundwater Units as areas of analysis. Groundwater Units consist of groundwater basins as defined by DWR Bulletin 118 (https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Bulletin-118/Files/B118-Interim-Update-2016.pdf), and the connecting upland areas associated with each of these basins as delineated by the USGS (https://www.sciencedirect.com/science/article/pii/S2214581814000305?via%3Dihub). Use of Groundwater Units results in coverage of the entire state. Averaging of well depths and groundwater quality within a Groundwater Unit was considered reasonable based on the assumed relative consistency of hydrogeologic conditions within each Unit.

[21] Attachment B1 lists the depth filter output for each groundwater unit in California. The table shows the ID, name, maximum domestic depth (in feet) and whether that groundwater unit has domestic and public wells at similar depths. The numeric value in the third column indicates the domestic depth maximum cutoff – only wells with shallower depths are used to estimate domestic/state small water quality. A “no” in the final column indicates that domestic and public wells are accessing different groundwater depths, and public wells are not used to estimate domestic/state small water quality when well depth is unknown. A “yes” in the final column indicates that domestic and public wells are accessing similar groundwater depths, and public wells are used to estimated domestic/state small water quality when well depth is unknown.
Depth filtered by groundwater unit arm
https://gispublic.waterboards.ca.gov/portal/home/item.html?id=55258176731a4cefb24fc571d8136276

Figure B1: Numeric Depth Filter

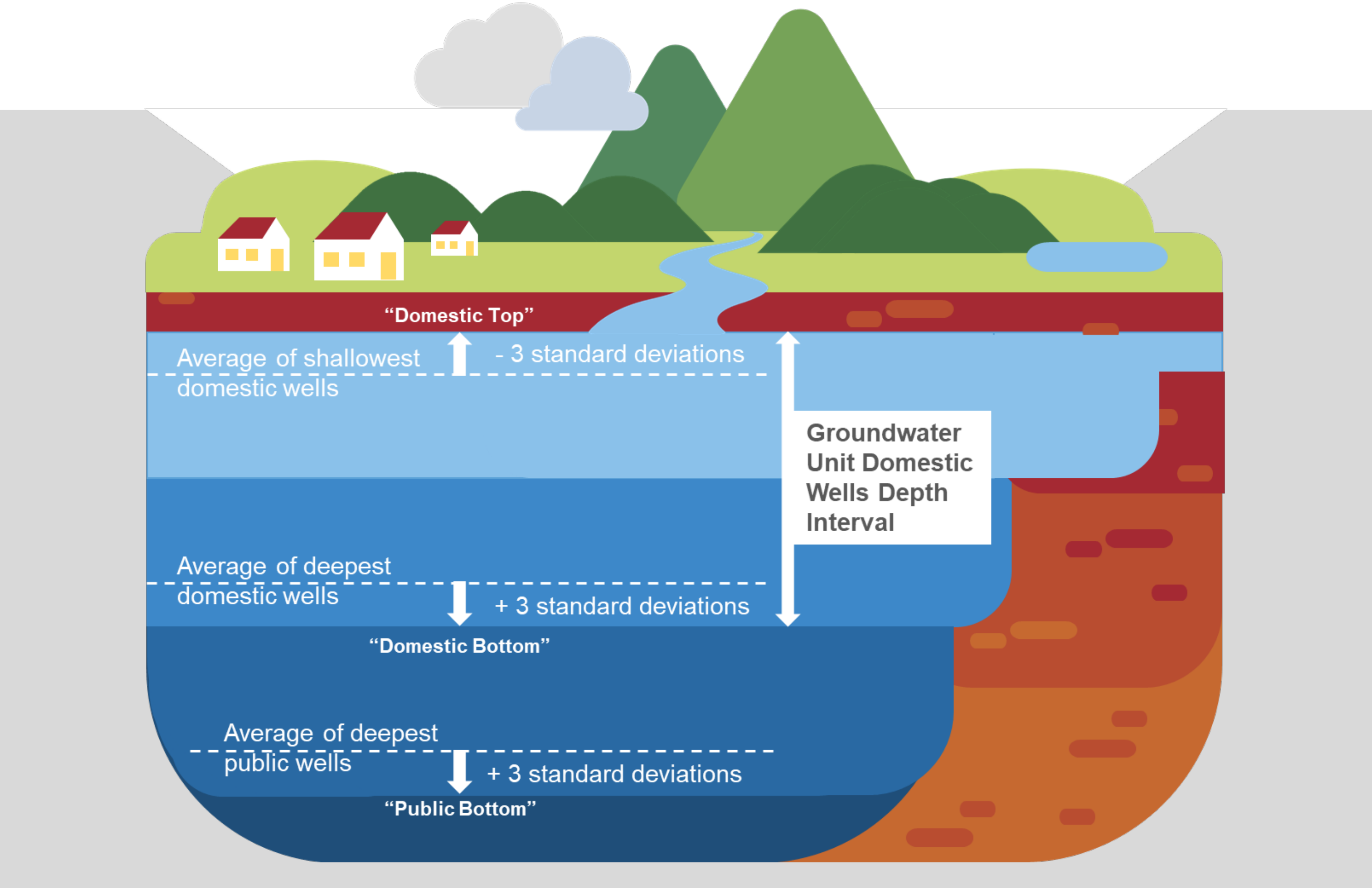
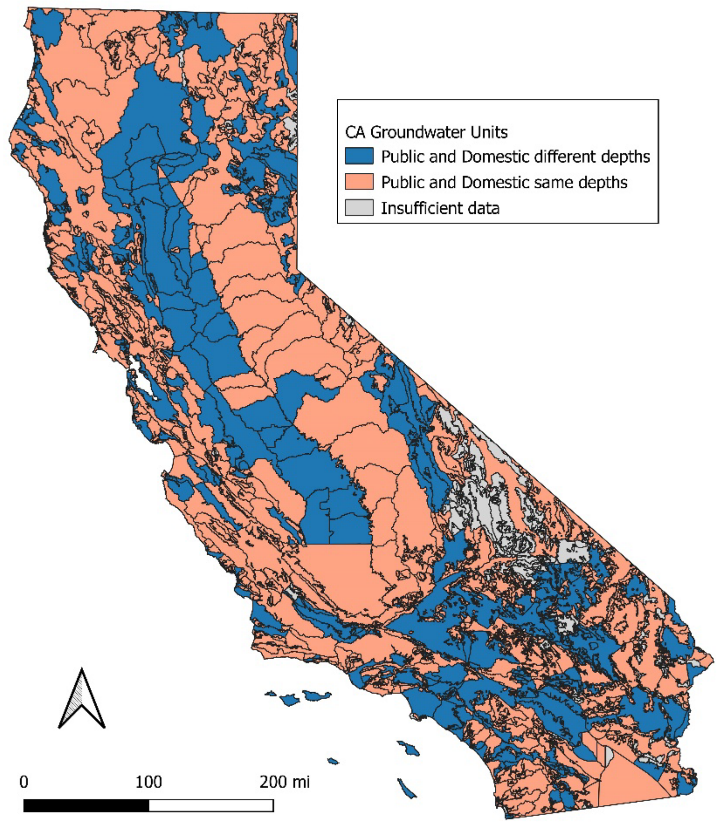


Figure B2 illustrates the depth filter by well type (for wells with unknown depth) in California. This map shows basins where domestic wells and public wells may be accessing similar groundwater depths (pink) and basins where domestic wells and public wells are accessing different groundwater depths (blue). For the basins show in pink, public wells were used as a proxy for domestic depth water quality.

Figure B2: Depth by Well Type



Most wells with water quality data do not have well construction data (indicating the depth of well or screen interval). Wells with depth data were filtered based on their numeric well construction; wells without numeric construction data were filtered by well type.

Wells with Known Numeric Depths

Staff used OSWCR Total Completed Depth section summary statistics to determine a "Domestic Bottom" and "Domestic Top" depth for each Groundwater Unit. The domestic well depth zone was defined as the range between "Domestic Bottom" depth[22] and "Domestic Top" depth[23]. For Group 1 wells, if the given depth of the well fell between the "Domestic Top" depth and the "Domestic Bottom" depth, water quality data from that well was included in the analysis.

[22] Domestic Bottom = average of section maximum domestic well depths (from OSWCR) plus 3 standard deviations of section maximum well depths for each groundwater unit.

[23] Domestic Top = average of section minimum domestic well depths (from OSWCR) minus 3 standard deviations of section minimum well depths for groundwater unit.

Wells with Unknown Numeric Depths

Staff used OSWCR well depth information to compare “Domestic Bottom” depth (defined above) to “Public Bottom” depth[24] (defined below). If the “Public Bottom” depth for a given Groundwater Unit was shallower than the “Domestic Bottom” depth, or within 10% of “Domestic Bottom” depth (shallower or deeper), then it was considered reasonable to include data from public wells into the analysis for that Groundwater Unit. If the “Public Bottom” depth for a given Groundwater Unit was more than 10% deeper than the “Domestic Bottom” depth, water quality data from public wells was screened out of the analysis for that Groundwater Unit.

DE-CLUSTERING

Available water quality results were spatially and temporally de-clustered to square mile sections to account for differences in data sampling density within each section over space and time. This was conducted to prevent certain areas with a high density of wells and frequent sampling to achieve a disproportionate weighting to the overall risk characterization of an area. To expand the coverage of the water quality risk map, averaged, de-clustered data from sections that contain a well(s) that provide water quality data (“source sections”) are projected onto neighboring sections that do not include a well providing water quality data.

Water quality data is assessed using two metrics - the long-term (20 year) average and all recent results (within 5 years). The temporal and spatial de-clustering methodology for each metric is outlined below.

Long-Term Average

- Water quality results from each well for each chemical constituent are averaged per year (for the past 20 years).
- The results from step one are averaged per well.
- The results from step two are averaged for all the wells that lie within a section.
- For sections that do not contain a well with water quality data, the de-clustered data from step three are projected onto adjacent sections.

Recent Results

- All recent (within the past 5 years) results in a section are categorized as “under” (less than 80 percent of MCL), “close” (80 percent – 100 percent of MCL), or “over” (greater than MCL).
- The count of recent results in each category are summarized per square mile section for each constituent.
- For square mile sections that do not contain a well with recent water quality data, the results from step two is averaged for all adjacent sections.

[24] Public Bottom = average of section maximum public well depths (from OSWCR) plus 3 standard deviations of section maximum well depths for groundwater units.

NORMALIZING WATER QUALITY RISK DATA

In summary, the Aquifer Risk Map uses available raw source groundwater quality data to estimate the water quality risk to state small water systems and domestic wells. For the combined Risk Assessment for state small water systems and domestic wells, the 2022 Aquifer Risk Map data is normalized into four risk bins summarized in Table B2.

Table B2: Normalizing Aquifer Risk Map Results

Aquifer Risk Map Result	Normalized Risk Score	Risk Level
No nearby water quality data available for any contaminants.	N/A	Unknown Risk
Water quality estimates for all measured contaminants is below 80% of the MCL.	0	Low Risk
Water quality estimates for one or more contaminants is between 80% - 100% of the MCL.	0.25	Medium Risk
Water quality estimates for one or more contaminants is above the MCL.	1	High Risk

Since the water quality risk estimates are limited to areas within ~2 miles of a well with water quality data, much of the state is assigned the "unknown risk". However, there majority of state small water systems and domestic well locations do have water quality data (89% of state small water systems and 78% of domestic wells have known water quality risk estimates).

WATER SHORTAGE (DWR WATER SHORTAGE VULNERABILITY TOOL)

The drought and water shortage risk scores are from the DWR's Drought Risk Vulnerability Tool for Self-Supplied Communities. The complete methodology for this analysis is available online.[25] In summary, the DWR assessment utilizes a suite of risk factors to assess drought and water shortage risk for census block groups with self-supplied communities (reliant on domestic wells), including exposure to hazard, climate change, physical vulnerability, socioeconomic vulnerability, and record of outages. For the combined Risk Assessment for state small water systems and domestic wells, the DWR drought and water shortage risk scores were normalized into four risk bins summarized in Table B3.

Table B3: Normalizing DWR Water Shortage Vulnerability Results

DWR Drought Assessment Result	Normalized Risk Score	Risk Level
No drought and water shortage risk scores are available for this area.	N/A	Unknown Risk

[25] Methodology for DWR Water Shortage Vulnerability Tool
https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Water-Use-And-Efficiency/Urban-Water-Use-Efficiency/CDAG/Part-2-Appendix-1-Scoring-Method-Final.pdf

DWR Drought Assessment Result	Normalized Risk Score	Risk Level
Below top 25% of block groups most at risk for drought and water shortage.	0	Low Risk
Top 25% of block groups most at risk for drought and water shortage.	0.25	Medium Risk
Top 10% of block groups most at risk for drought and water shortage.	1	High Risk

The DWR drought and water risk assessment for self-supplied communities used census block groups as the area of analysis. In order to accurately combine this data with the Aquifer Risk Map results and overlay with the count of state small water systems and domestic wells at high- risk for both variables, the drought and water shortage risk scores were converted to public land survey system (PLSS) square mile sections. To do this, the risk score for each block group was assigned to every PLSS section within the block group. For sections that overlapped one or more block groups, the highest overlapping water shortage risk score was assigned to the section.

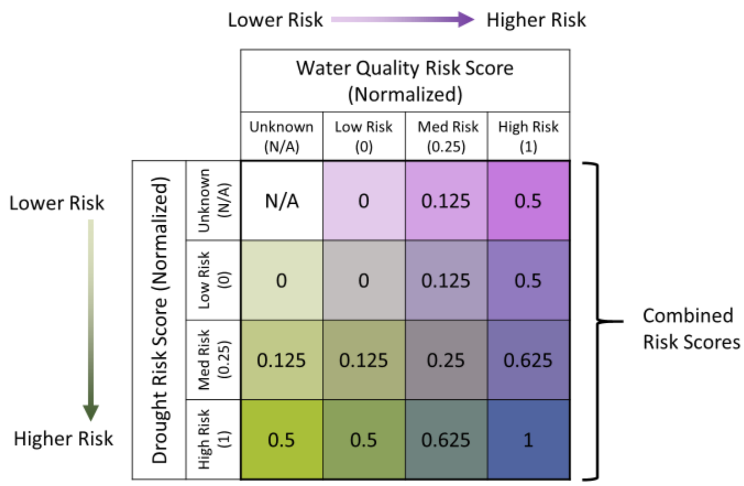
COMBINED RISK

The two variables of drought risk and water quality risk were combined following a similar methodology as the combined Risk Assessment for public water systems. The normalized scores for water quality and drought risk for each PLSS section were added together and divided by the number of variables (two). Unlike the Risk Assessment for public water systems, the calculation does not adjust the denominator for missing data. This approach is recommended to reduce the bias (higher risk score) for locations that are missing data.

Equation B1: Combined Risk Score Calculation Method

$$\text{Combined Risk Score} = \frac{\text{Normalized Water Quality Risk Score} + \text{Normalized Drought Risk Score}}{2}$$

Figure B3: Example of Combined Risk Scores for each PLSS Section



These combined risk scores are converted into risk designations, as shown in Table B4.

Table B4: Combined Risk Scores and Designations

Combined Risk Score	Combined Risk Designation
N/A (-99)	Not Assessed
0	Not At-Risk
0.125	Not At-Risk
0.25	Potentially At-Risk
0.5	Potentially At-Risk
0.625	At-Risk
1	At-Risk

The 2022 combined Risk Assessment assessed 1,273 state small water systems and 312,187 domestic wells. State small water system locations were provided to the State Water Board through county reporting required through SB 200. Domestic well locations were sourced from the Online System for Well Completion Records[26] (managed by DWR) and consist of "domestic" type well records, excluding those drilled prior to 1970 and excluding any destruction records. To calculate the state small water system and domestic well statewide results the total number of system and well records in each combined risk designation bin were summed. To calculate the county results the square mile section boundaries were intersected with county boundaries and the count of wells and systems were apportioned to each county based on intersecting area.

[26] The Department of Water Resources Online System for Well Completion Reports (OSWCR) https://data.ca.gov/dataset/well-completion-reports

The socioeconomic analysis for areas with a domestic well or state small water system was calculated by assigning demographic and CalEnviroScreen 4.0 data to all intersecting square mile sections, then grouping the sections by their 2022 Needs Assessment Combined Risk category and calculating averages or counts for each risk bin. For square mile sections that overlapped more than one census tract/block group, the data from the maximum overlapping tract/block group was used. For the domestic well analysis, only square miles sections with at least one domestic well record were used to calculate the averages. For the state small water system analysis, only square mile sections with at least one state small water system location were used to calculate the averages. The number of domestic well records or state small water systems was not used to weight the socioeconomic data, meaning that this analysis is just of *areas* with domestic wells or state small water systems, not a socioeconomic analysis for these systems specifically. This methodology also means that socioeconomic data was area-weighted, because final numbers were calculated by assigning data to square mile sections and then calculating averages. Also, note that several socioeconomic data points used in this analysis (poverty, MHI, and limited English-speaking households) were also used as risk factors in the Water Shortage Vulnerability Tool, which was used to calculate the combined risk score.