2021

DRINKING WATER NEEDS ASSESSMENT

Informing the 2021-22 Safe & Affordable Drinking Water Fund Expenditure Plan

CALIFORNIA
Water Boards

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Acknowledgements

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UCLA in turn partnered with Corona Environmental Consulting (Corona), Sacramento State University Office of Water Programs, the Pacific Institute and the UNC Environmental Finance Center to carry out much of the analysis contained in this report.

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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 2021 Affordability Assessment, the State Water Board employed affordability thresholds for the following indicators: Percent Median Household Income; Extreme Water Bill; and Percent Shut-Offs. 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).

"**At-Risk public water systems**" or "**At-Risk PWS**" means community water systems with 3,300 service connections or less 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).)

“**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.)

“**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 § 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 “**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. (California Health and Safety Code § 116275(c).)

“**Interim replacement water**” or **“Interim solution”** includes, but is not limited to; bottled water, vended water, and point-of-use or point-of-entry treatment units. (Health & Saf. Code, § 116767, subd. (q).)

“**Loan**” means any repayable financing instrument, including a loan, bond, installment sale agreement, note, or other evidence of indebtedness.

“**Local cost share**” means a proportion of the total interim and/or long-term project cost that is not eligible for a State grant and would therefore be borne by water systems, their ratepayers, and/or domestic well owners. Some local cost share needs may be eligible for public or private financing (i.e. a loan). Some local costs share needs may not be eligible for financing and is typically funded through available reserves or cash on hand.

“**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.

“**Net present worth**” or “**NPW**” means the estimate of the total sum of funds that need to be set aside today to cover all expenses (capital, including other essential infrastructure costs, and annual O&M) during the potential useful life of the infrastructure investment, which is conservatively estimated at 20-years. The estimate of the total sum of funds is adjusted by an annual discount rate which accounts for the higher real cost of financial outlays in the immediate future when compared to the financial outlays in subsequent years.

“**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.

“**Other essential infrastructure**” or “**OEI**” encompasses a broad category of additional infrastructure needed for the successful implementation of the Cost Assessment’s long-term modeled solutions and to enhance the system’s sustainability. OEI includes storage tanks, new wells, well replacement, upgraded electrical, added backup power, replacement of distribution system, additional meters, and land acquisition.

“**Potentially At-Risk**” means community water systems with 3,300 service connections or less 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, § 116365, subd. (j). (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, pretreatment, 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).)

“**Refined grant needs**” means the estimated costs, generated from the Cost Assessment Model, that have been adjusted by removing costs for water systems that have existing funding agreements with the State Water Board and identifying the proportion of costs that are grant-eligible.

“**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.

“**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.

“**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).)

“**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))

“**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**” 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.

“**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 Section 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.

EXECUTIVE SUMMARY

In 2016, the California State Water Resources Control Board (State Water Board) adopted a Human Right to Water Resolution[1] making the Human Right to Water (HR2W), as defined in Assembly Bill 685, a primary consideration and priority across all of the state and regional boards' programs. The HR2W recognizes that "every human being has the right to safe, clean, affordable, and accessible water adequate for human consumption, cooking and sanitary purposes."

In 2019, to advance the goals of the HR2W, California passed Senate Bill 200 (SB 200), which enabled the State Water Board to establish the Safe and Affordable Funding for Equity and Resilience (SAFER) Program. SB 200 established a set of tools, funding sources, and regulatory authorities that the State Water Board harnesses through the SAFER Program to help struggling water systems sustainably and affordably provide safe drinking water.

The annual Drinking Water Needs Assessment (Needs Assessment) required to be carried out by the SAFER Program provides foundational information and recommendations to guide this work.[2] The Needs Assessment is comprised of Risk Assessment, Affordability Assessment, and Cost Assessment components. Development of the Needs Assessment consisted of stages between September 2019 and March 2021, each of which were detailed in publicly-available white papers and presented at public webinars. The public feedback was incorporated into the final methodology and results.

[1] State Water Resources Control Board Resolution No. 2016-0010
https://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/2016/rs2016_0010.pdf

[2] California Health and Safety Code Section 116769 (b) states "The fund expenditure plan shall be based on data and analysis drawn from the drinking water needs assessment..."

Four different water system types: public water systems, tribal water systems, state small water systems and domestic wells, are analyzed within the Needs Assessment. Different methodologies were developed for these system types based on data availability and reliability.

The results of the 2021 Needs Assessment will be utilized by the State Water Board and the SAFER Advisory Group[3] to inform the prioritization of available state funding and technical assistance within the Safe and Affordable Drinking Water Fund (SADWF) Fund Expenditure Plan (FEP).[4] The State Water Board will also be hosting a series of workshops between April and June 2021 to inform the FEP.

The Needs Assessment is not a static analysis. The State Water Board will annually update the assessment and it provides a valuable snapshot of the overall resources needed to bring failing systems into compliance with drinking water standards and prevent At-Risk water systems from failing. By incorporating this Needs Assessment into the SAFER Program and implementation of SADWF, the State Water Board will continue to lead on long term drinking water solutions. At the same time, this Needs Assessment gives clarity of the work that must collectively be done by state, federal, local and stakeholder partners. Only together will we be successful in achieving the Human Right to Water goal for all Californians.

HIGHLIGHTS

The results from the 2021 Needs Assessment illustrate the breadth and depth of challenges to safe and affordable water supply provision across system types in California for the first time. The Needs Assessment identifies water systems that are failing and those that are at-risk of failing to provide safe and affordable drinking water. The results of the assessment also show possible interim and long-term solution pathways to addressing identified challenges. Solution pathways include addressing the fragmentation and proliferation of small, underperforming systems through consolidation and regionalization. The gap between estimated implementation costs and available funding for solutions, however, clearly illustrates that, despite the passage of the SADWF, more resources are likely needed statewide to fully realize the goals of the HR2W.

Failing Water Systems: The HR2W list criteria, that identifies failing water systems, were expanded as a part of the Needs Assessment effort and now better align with the legislative mandates and authorities of the drinking water program and the goals of the HR2W. Approximately 30 community water systems were added to the expanded HR2W list 2021 due to issues which include E. coli violations, treatment technique violations, and/or repeated/unresolved monitoring and reporting violations.

At-Risk Public Water Systems: Approximately 620 public water systems were determined to be at-risk of failing to sustainably provide a sufficient amount of safe and affordable drinking

[3] SAFER Advisory Group
https://www.waterboards.ca.gov/safer/advisory_group.html

[4] Safe and Affordable Drinking Water Fund
https://www.waterboards.ca.gov/water_issues/programs/grants_loans/sustainable_water_solutions/safer.html

water. These systems are referred to as the “At-Risk” public water systems. Approximately 47 new water systems are added to the HR2W system list each year. Supporting these At-Risk systems, to proactively address identified risks, will reduce the probability of these issues resulting in violations or other public health concerns.

At-Risk State Small Water Systems & Domestic Wells: Approximately 610 state small water systems and 80,000 domestic wells were assessed via modelling as at high risk of exceeding health-based drinking water standards due to their location in aquifers with high risk of groundwater contaminants. Further sampling and investigation will be needed to assess the actual water quality concerns for these state small water systems and domestic wells.

Current Capital Cost Needs: The total estimated capital costs of addressing the challenges faced by currently failing HR2W list and At-Risk systems are approximately $4.5 billion for modeled long-term solutions and $1.6 billion for the estimated duration of modeled emergency/interim solutions.

Failing Water System O&M Needs for Long-term Solutions: The operations and maintenance costs of long-term modeled solutions for HR2W list systems over a 20-year period are estimated to be approximately $2.5 billion. These costs do not include the full O&M costs of running a sustainable water system, only the costs associated with the modeled solutions identified by the Cost Assessment Model.

Projected Cost of Implementing Long-term and Interim Solutions: The estimated total cost of implementing the interim and long-term solutions, for the projected number of water systems and domestic wells that need assistance within the next 5-years, is approximately $10.25 billion. This projected cost includes estimated grant-eligible costs of $3.25 billion, such as capital, planning, technical assistance costs, etc. The total cost estimate also includes the long-term local cost share needs of $7 billion. The local cost share needs represent non-grant eligible costs that are typically borne by communities through loans, cash on hand, or rate increases. Local cost share includes non-grant eligible capital costs, interest payments,[5] long-term solutions,[6] O&M for interim solutions.[7] This represents the total estimated cost of implementing interim and long-term solutions for HR2W list systems, At-Risk water systems and well owners.

Funding and Financing Gaps: An additional estimated $2.1 billion in grant funding and $2.6 billion in loan funding (financing) is needed to address failing and At-Risk systems and domestic wells over the next five years, after using all currently available State Water Board funding sources. It is important to highlight that other State, Federal, and private funding and financing may be available to meet some of these needs, and that large regionalization

[5] This is based on a 20-year loan for non-grant eligible capital costs.

[6] This was based on a 20-year O&M cost for the long-term modeled solutions of projects initiated within the 5-year period.

[7] Interim solution O&M costs are based on the assumption that 6-years of interim solutions are necessary for HR2W list systems (in order to allow for adequate time to obtain funding and install solutions) and 9-years for those domestic wells and state smalls utilizing point of entry/point of use solutions.

projects may reduce cost needs as well. See Appendix D for a summary of non-State Water Board funding and financing sources.

Affordability Challenges: Approximately 512 water systems (33% of systems analyzed) that serve economically disadvantaged communities exceeded at least one of three affordability indicator thresholds.

FAILING WATER SYSTEMS: THE HR2W LIST

The HR2W, as defined in Assembly Bill 685, recognizes that "every human being has the right to safe, clean, affordable, and accessible water adequate for human consumption, cooking and sanitary purposes." The State Water Board assesses water systems that fail to meet the goals of the HR2W and maintains a list and map of these systems on its website. The specific HR2W criteria were expanded in April 2021 to meet the new statutory definition of what it means for a water system to "consistently fail" to meet primary drinking water standards.[8] Expanded HR2W criteria includes unresolved E. coli violations, treatment technique violations, and repeated unresolved monitoring and reporting violations. This statutory change resulted in approximately 38 systems being added to this list of consistently failing systems. This change was necessary to ensure that broader issues, e.g. bacteriological violations, were being addressed in addition to chemical violations.

NEEDS ASSESSMENT RESULTS

RISK ASSESSMENT

The purpose of the Risk Assessment is to identify public water systems, tribal water systems,[9] and state small water systems and regions where domestic wells are at-risk of failing to sustainably provide a sufficient amount of safe and affordable drinking water.[10] Approximately 47 new water systems are added to the HR2W system list each year. The identification of At-Risk water systems and domestic wells allows the State Water Board to proactively target technical assistance and funding towards communities to prevent systems from failing to achieve the goals of the HR2W.

The State Water Board has developed two different Risk Assessment methodologies to identify At-Risk water systems and domestic wells. The first methodology is for community water systems with 3,300 service connections or less and K-12 schools. The second methodology identifies state small water systems and domestic wells that are at a high risk of

[8] Primary drinking water standards are defined in CHSC Section 116275(c).

[9] Tribal water systems are not included in the 2021 Risk Assessment Public Water System results. Appendix F details an alternative methodology developed to identify At-Risk equivalent tribal water systems. The State Water Board is partnering with Indian Health Services and the U.S. Environmental Protection Agency to collect data and adapt the Risk Assessment methodology for State and Federal tribal water systems located in California.

[10] Primary drinking water standards are defined in CHSC Section 116275(c).

accessing source water that may contain contaminants that exceed primary drinking water standards.

At-Risk Public Water Systems

The 2021 Risk Assessment was conducted for 2,779 public water systems and evaluated their performance across 19 risk indicators within the following four categories: Water Quality, Accessibility, Affordability, and Technical, Managerial, and Financial (TMF) Capacity. The results identified 617 (25%) At-Risk water systems, 552 (23%) Potentially At-Risk water systems, and 1,284 (52%) Not At-Risk water systems (Figure 1). The distribution of At-Risk systems varies substantially across the state, as shown in Figure 2.

Figure 1: Number of HR2W List, At-Risk, and Potentially At-Risk Systems

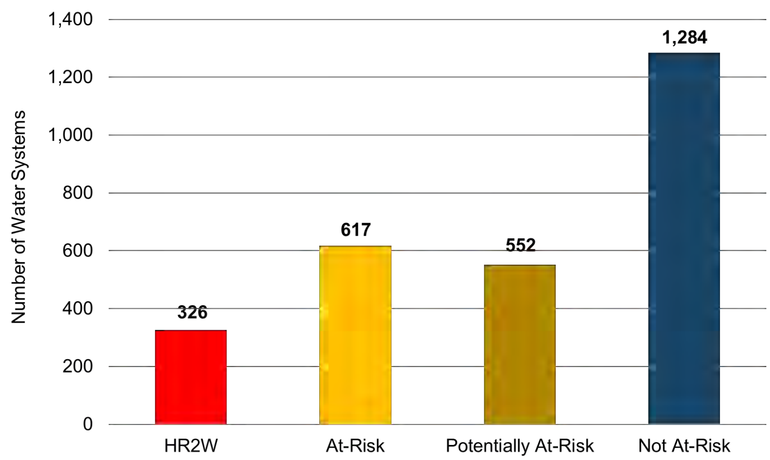
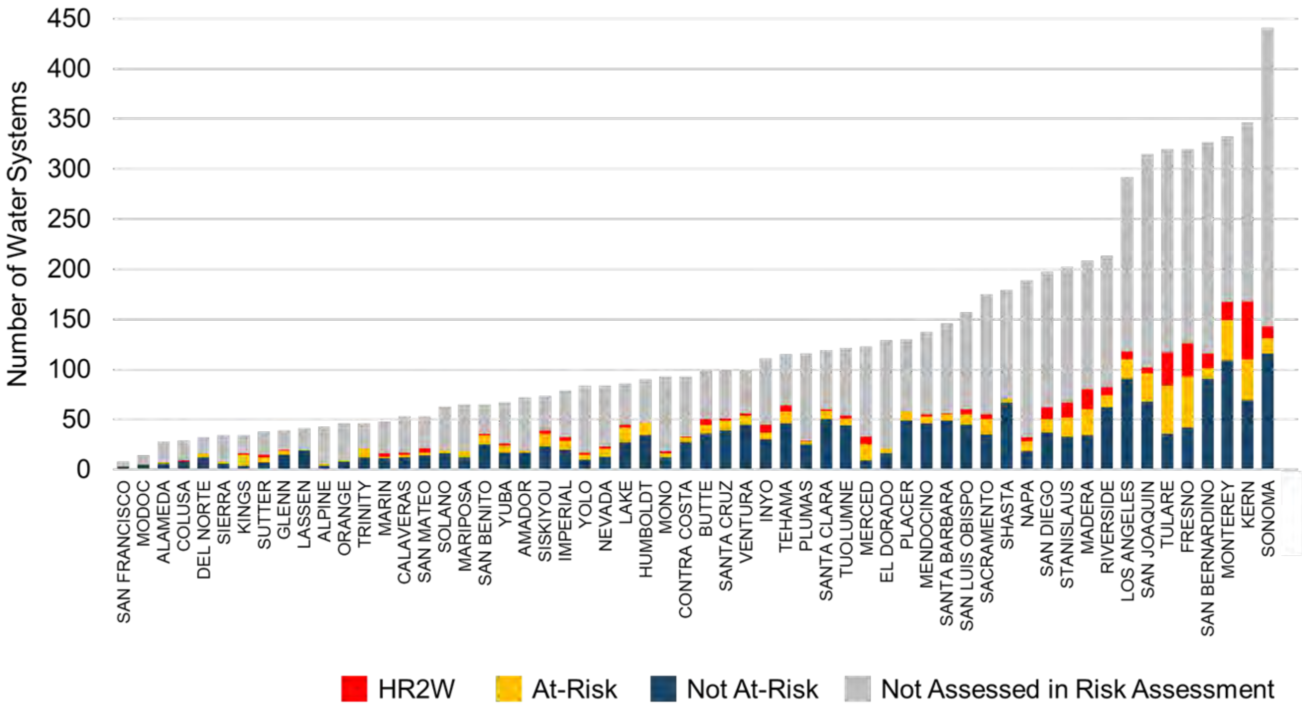


Figure 2: Proportion of HR2W and At-Risk Water Systems in Each County



At-Risk State Small Water Systems & Domestic Wells

The Risk Assessment methodology developed for state small water systems and domestic wells is designed to identify areas where groundwater is likely to be at high risk of containing contaminants that exceed safe drinking water standards and where groundwater is used or likely to be used as a drinking water source. 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.[11]

Just under one-third (32%) of the assessed domestic wells were classified as high risk. Among 1,236 state small water systems with available data, nearly one half (49%) were assessed as at high risk. However, it is important to note this portion of the risk analysis uses proxy data based on modelled groundwater quality. Thus, the presence of a given state small water system or domestic well within a high-risk area does not necessarily signify that they are accessing groundwater above primary drinking water standards, but does indicate that owners may wish to perform water quality testing.

[11] Hexavalent chromium does not currently have a maximum contaminant level. However, an MCL of 10 micrograms per liter was adopted in 2014 and rescinded in 2017. For the purposes of analysis of domestic wells and state small water systems a 10 microgram per liter concentration was utilized for the high-risk determination. The State Water Board anticipates that a new hexavalent chromium standard will be adopted in the future.

Table 1: State Small Water System and Domestic Wells by Section Water Quality Risk Designation

Section Water Quality Risk Designation	Domestic Wells[12]	State Small Water Systems
High Risk	77,973	611
Medium Risk	15,791	71
Low Risk	147,185	554
No Data	84,800	227

COST ASSESSMENT

The Cost Assessment methodology utilizes modeling to estimate the financial costs of both interim measures and longer-term solutions to bring HR2W list systems into compliance and address the challenges faced by At-Risk public water systems, as well as At-Risk state small water systems and domestic wells where data was available. The goal of the Cost Assessment is to inform the prioritization of existing funding sources, particularly via the SB 200-mandated annual Safe and Affordable Drinking Water Fund Expenditure Plan and to estimate the size of the current funding gap to continue to advance the HR2W for all Californians. Future versions of the Cost Assessment, which will be conducted annually alongside the Risk Assessment, will continue to incorporate new data and enhance existing data quality.

The embedded assumptions and cost estimates detailed in this report are purely for the purposes of the Needs Assessment. **Local solutions and actual costs will vary from system to system and will depend on site-specific details and community input. Therefore, the Cost Assessment will not be used to inform site-specific decisions but rather give an informative analysis on a statewide basis.**

Statewide Capital Cost Estimate for Long-Term Solutions

For HR2W list systems, the Cost Assessment Model identified multiple potential solutions based on the system's identified challenges and additional site-specific information. These long-term solutions included: treatment, physical consolidation, Point-of-use (POU) or point-of-entry (POE) treatment technologies, other essential infrastructure (OEI), and technical assistance (TA). A sustainability and resiliency assessment was conducted for each system's set of identified potential solutions to identify the top two most sustainable model solutions. The Cost Assessment Model then compared the long-term costs of these potential model solutions to select the best model solution of the system. The selected solution counts are summarized in Table 2.

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

Table 2: Count of Selected Modeled Long-Term Solutions

System Type	# of Systems	Treatment	Physical Consol.	POU/ POE	OEI & TA	No Solution
HR2W list	305	138 (45%)	61 (20%)	106 (35%)	305 (100%)	0
At-Risk[13] PWS	630	N/A	145 (23%)	N/A	630 (100%)	0
At-Risk SSWS	455	N/A	142 (31%)	303 (67%)	N/A	10 (2%)[14]
At-Risk Domestic Well	62,607	N/A	25,696 (41%)	36,911[15] (59%)	N/A	0

As shown in Table 3, the total estimated capital cost range of long-term solutions for all HR2W list and At-Risk PWSs, SSWSs and domestic wells is estimated between $2.3 and $9.1 billion.[16]

Table 3: Selected Modeled Solution Capital Cost, by System Type

System Type	# of Systems	Total Capital Cost Range Total
HR2W	305	**$887 M - $3,550 M**
At-Risk PWS	630	**$819 M - $3,280 M**
At-Risk SSWS	445	**$27 M - $106 M**
At-Risk Domestic Wells	62,607	**$548 M - $2,190 M**
TOTAL:		**$2,280 M - $9,120 M**

[13] The At-Risk number for the purposes of the cost analysis included some Expanded HR2W list systems because for costing purposes they modeled more closely to the At-Risk systems methodology (e.g. significant monitoring and reporting violations).

[14] Nitrate in 10 Monterey County systems has been measured above 25 mg/L as N, so POU is not considered a viable long-term treatment alternative and the systems are too far for consolidation to be cost effective.

[15] Nitrate modeled above 25 mg/L as N in 1,216 domestic wells and 15 SSWS. POU treatment is not a viable option if the nitrate concentration is this high. Water quality samples should be collected to determine which sources are above this threshold. POU treatment has been budgeted as the modeled solution.

[16] The long-term Cost Assessment results summarized in this report correspond with a Class 5 cost estimate as defined by Association for the Advancement of Cost Engineering (AACE) International. The full range of estimates is thus -50% to +100%. A Class 5 cost estimate is standard for screening construction project concepts.

The Cost Assessment results detailed in this report illustrate that there are relatively higher per connection costs associated with bringing small water systems into compliance, and thus the advantages of economies of scale.

Table 4: Average Long-Term Capital Cost per Connection by System Size for HR2W List and At-Risk Systems

System Type	3,300+[17]	3,300 – 1,001[18]	1,000 – 501	500 – 101	100 or less
HR2W	$4,900	$6,800	$11,700	$18,200	$86,900
HR2W Annual O&M	$230	$320	$560	$300	$910
At-Risk PWS	$3,620	$17,300	$15,500	$26,200	$90,700

Additional analysis of long-term solution costs included a breakdown of average costs for the selected modeled solutions categorized by contaminant. Nitrate is estimated to be the most expensive to address on average using all three cost measures.

Consolidation costs for the Cost Assessment were developed for HR2W list systems based on a one-system to one-system methodology. Regional consolidations were separately modeled for areas where significant numbers of water systems exist. Attachment C5 provides additional details of this work.[19] The analysis found significant potential cost savings can occur with regionalization. It is important to note that the results of the regional consolidation analysis were not included in the aggregated cost estimate.

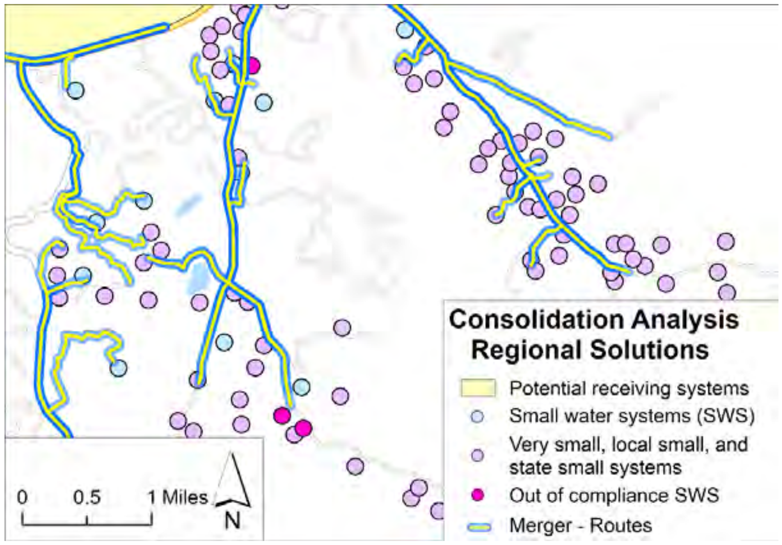
The State Water Board recognizes that additional cost efficiencies and better long-term solutions can occur where there are regional consolidation projects resulting in larger water systems with economies of scale. For example, Figure 3 shows a larger water system in Monterey County where 85 water systems are located in the vicinity of a larger water system. The average cost per connection of the project decreases from $39,000 per connection to $7,000 per connection when all the systems are included in the project.

[17] Larger water systems typically have multiple sources. Modeled treatment is based on addressing only those sources that have known contamination. Under the additional infrastructure costs, no additional wells were assumed to be needed for redundancy if there is more than one source. For these reasons and economies of scale, the costs for larger systems are significantly lower for smaller systems.

[18] Larger water systems typically have multiple sources. Modeled treatment is based on addressing only those sources that have known contamination. Under the additional infrastructure costs, no additional wells were assumed to be needed for redundancy if there is more than one source. For these reasons and economies of scale, the costs for larger systems are significantly lower for smaller systems.

[19] Attachment C5: Additional Cost Assessment Results & Regionalization Analysis
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/c5.pdf

Figure 3: Example of Regional Consolidation Analysis



Operations & Maintenance Costs for Long-Term Solutions

Table 5 shows the annual estimated operations and maintenance (O&M) costs for HR2W list systems. Estimated O&M costs allows for the estimate of the 20-year net present worth (NPW) of the modeled solutions for HR2W list systems. Here, the NPW estimates the total sum of funds that need to be set aside today to cover all the expenses during the potential useful life of the infrastructure investment, which is conservatively estimated at 20-years.

There is a large difference in the total annual costs for POE/POU O&M versus treatment O&M costs, $1.6 million and $52.4 million, respectively. However, the estimated O&M costs per connection favors treatment, at $1,500 per connection (or approximately $125 per month) addition to rates for POE/POU and $780 per connection (or approximately $65 per month) addition to rates for treatment.[20]

Table 5: Selected HR2W List Modeled Long-Term Solution Annual O&M Costs & Total 20-Year NPW Range[21]

Cost Type	Treatment	POU/POE	Total Annual O&M Range	Total 20-Yr. NPW Range
Total Cost for HR2W List Systems (n=305)	$52.4 M	$1.60 M	**$24 M - $108 M**	**$1.25 B - $5.02 B**

[20] It should be recognized that there are equity issues around the use of POU as it does not provide whole house treatment and only allows drinking water from one location in the home.

[21] Long-term modeled solution annual O&M costs and 20-Year NPW costs were not estimated for any At-Risk systems and domestic wells. This estimate also excluded physical consolidation O&M costs, which were based on electric costs for pumping. These costs were, in most cases, negligible and therefore excluded from this table.

Cost Type	Treatment	POU/POE	Total Annual O&M Range	Total 20-Yr. NPW Range
Average Cost Per Connection	$780	$1,500	**$1,140 - $4,560**	**$127,000 - $506,000**

Interim Solution Costs

Interim solution costs were calculated for a six-year term for populations served by HR2W list systems, and a nine-year term for At-Risk SSWSs and domestic wells.[22] Table 6 shows the estimated costs of providing interim solutions to all populations served by HR2W list systems and At-Risk SSWSs and domestic wells. The total NPW cost for the entire population in need is estimated at nearly $1.6 billion, with over $1 billion in cost for HR2W list systems alone. Estimated annual interim solution costs for bottled water are $850.00 per residential connection, and $54.00 per person in school settings.

Table 6: Total First Year and NPW Cost of Interim Solutions[23] ($ in Millions)

System Type	Total Systems Analyzed	Total First Year Cost Estimate	NPW Cost of Duration of Interim Solution
HR2W list	343	$216 M	$1,000 M
At-Risk SSWS	496	$18 M	$35 M
At-Risk Domestic Wells	59,370	$280 M	$547 M
TOTAL:		**$514 M**	**$1,580 M**

Funding & Financing Gap Analysis

For the purposes of analyzing the gap in available funding and financing to address these costs (Gap Analysis), the breakdown of funding needs were refined based on the assumption that a proportion of the total estimated cost needs would be borne by water systems, their ratepayers, and/or domestic well owners, and thus, not fully borne by the State Water Board's grant funding sources. Costs that are not grant eligible are referred to as "Local Cost Share" since these costs will need to be financed through a loan, rate increases, or any available cash on hand.

The Gap Analysis also identified available funding sources that could be used to support the identified funding needs based on potential project and borrower/grantee eligibilities. The Gap

[22] The six-year interim period for HR2W lists was chosen to allow adequate time for water systems to obtain funding and to return to compliance. The nine-year term for At-Risk SSWS and domestic wells was assumed to be the full length of the SADWF program.

[23] Interim costs were calculated for a six-year term for populations served by HR2W list systems, and a nine-year term for At-Risk SSWSs and domestic wells.

Analysis evaluated both the gap in available State Water Board grant dollars and the gap in State Water Board financing dollars (e.g. loan dollars).

Table 7 summarizes that of the total funding needed over the next five years, $3.25 billion is *eligible* for existing State Water Board grant programs. However, only $1.2 billion is available over that period, leaving approximately $2 billion more needed in grant funding over the next five years. It is important to highlight that in order to conduct the Gap Analysis, the methodology assumes the total project's costs are allocated the full amount of funding needs within a year. This does not align with actual State Water Board capital and technical assistance financing practices, which often stretch the allocation of committed funding over a span of many years.

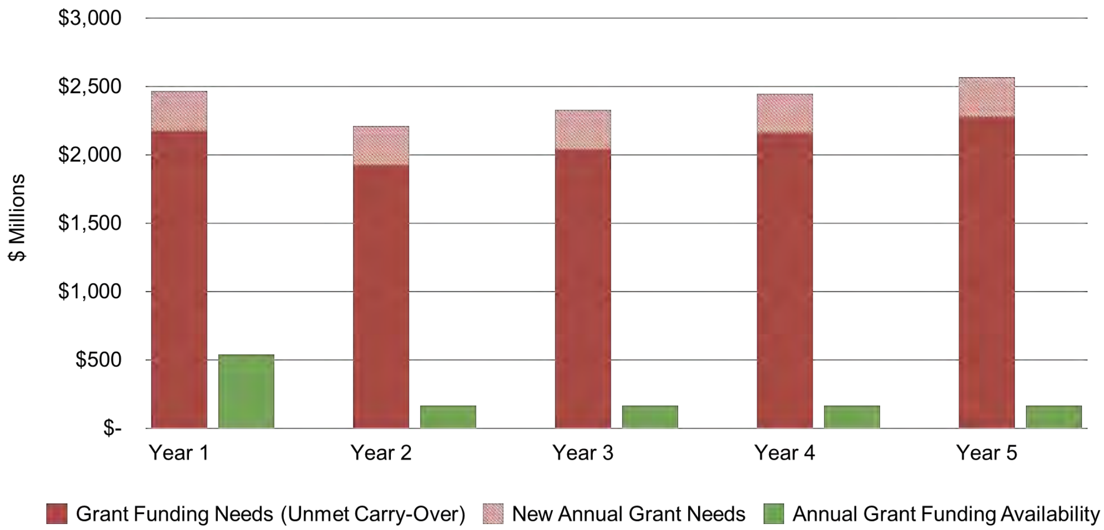
Table 7: Estimated 5-Year Grant Funding Gap[24]

State Water Board Funding Programs	5-Yr. Est. Grant Funding Availability	5-Yr. Est. Grant Eligible Needs	5-Yr. Est. Grant Funding Gap
All Grant Funding Programs	$1,200 M	$3,250 M	**$2,050 M**

The estimated additional new grant-eligible and loan-eligible needs are expected to exceed the State Water Board's grant and loan funds available, into perpetuity. Therefore, without additional funds, the future funding gap is expected to grow (Figure 4). However, it is important to highlight that other State, Federal, and private funding and financing may be available to meet some of these needs. See Appendix D for a summary of non-State Water Board funding and financing sources.

[24] Based on an analysis of State Water Board grant funding programs only.

Figure 4: 5-Year Grant Funding Needs & Funding Availability



Existing State Water Board funding eligibilities were used to calculate 5-year local cost share estimates. The total amount of local cost share needs, which includes non-grant eligible capital expenses and 5-year O&M, is estimated to be approximately $5 billion. Of that, approximately $4 billion may be eligible for loans, but only $1.5 billion is available from current State Water Board loan sources over the next five years, leaving a $2.55 billion more needed in loan financing capacity. Additionally, approximately $1 billion is estimated to be needed for costs that are not currently eligible for any existing state grant or loan programs and expected to be funded locally by ratepayers or other cash on hand.

Table 8: Estimated 5-Year Financing Gap[25] ($ in Millions)

5-Yr. Est. Local Cost Share Needs	5-Yr. Est. Local Cost Share SWB[26] Loan Eligible	5-Yr. Est. SWB Loan Capacity	5-Yr. Est. Financing Gap
$5,040[27]	$4,050	$1,500	**$2,550**

To better assess the potential costs of implementing the Cost Assessment's modeled solutions, the Gap Analysis calculated the loan interest payment costs and annual O&M costs

[25] Based on an analysis of the State Water Board's financing program (Drinking Water State Revolving Loan Fund) only.

[26] "SWB" means State Water Board.

[27] 5-year local cost share includes non-grant eligible capital costs and 5 years of O&M for long-term and interim solutions.

for the estimated useful life of the solutions: 20 years.[28] Table 9 summarizes the estimated 20-year local cost share burden for all interim and long-term modeled 5-year solution costs which are not eligible for grant funding. The total cumulative estimated 20-year local cost share burden statewide is $7 billion.

Table 9: Estimated Total 20-Yr. Local Cost Share

Water System Types	Total 20-Yr. Local Cost Share Burden[29]	Average 20-Yr. Local Cost Share Burden per System	Average 20-Yr. Local Cost Share Burden per Connection
HR2W List Systems	$2,770 M	$6.4 M	$11,300
At-Risk PWSs	$1,930 M	$1.6 M	$14,700
At-Risk SSWSs	$65 M	$78,300	$9,500
At-Risk Domestic Wells	$2,210 M	$22,500	$22,500
TOTAL:	**$6,980 M**		

The total refined cost estimate for the 5-year projected number of HR2W list and At-Risk systems and domestic wells is approximately $10.25 billion. This includes the estimated 5-year grant-eligible costs of $3.25 billion plus the long-term 20-year local cost share costs of $7 billion (non-grant eligible capital costs, 20-year interest payments, 20-year annual O&M for modeled long-term solutions, and 6 or 9 years of O&M for interim solutions). **$10.25 billion represents the total estimated cost of implementing interim and long-term solutions for HR2W list systems, At-Risk water systems and well owners.**

AFFORDABILITY ASSESSMENT

The purpose of the Affordability Assessment is to identify disadvantaged community water systems, that have instituted customer charges that exceed the “Affordability Threshold” established by the State Water Board in order to provide drinking water that meets State and Federal standards.[30] Figure 5 illustrates the nexus of affordability definitions that exist.

[28] Total estimated 20-year local cost share burden includes non-grant eligible capital costs, 20-year interest costs (for loan eligible capital costs), 20-year O&M for long-term solutions (not met by a grant) and 6 or 9 years of O&M for interim solutions. Details on how local cost share was calculated is detailed in Appendix D.

[29] Refer to Appendix D for more information on how local cost share is calculated.

[30] California Health and Safety Code, Section 116769, subd. (a)(2)(B)

Figure 5: Nexus of Affordability Definitions

(1) Household Affordability: The ability of individual households to pay for an adequate supply of water.

(2) Community Affordability: The ability of households within a community to pay for water services to financially support a resilient water system.

(3) & (4) Water System Financial Capacity: The ability of the water system to financially meet current and future operations and infrastructure needs to deliver safe drinking water. The financial capacity of water systems affects future rate impacts on households. The inability to provide adequate services may lead households served by the system to rely on expensive alternatives such as bottled water.

The Affordability Assessment was conducted for 2,877 California community water systems. The Affordability Assessment included large and small community water systems but excluded non-transient, non-community water systems, like schools. It also excluded tribal water systems, SSWSs, and households supplied by domestic wells.

For the Affordability Assessment, the State Water Board analyzed three affordability indicators that were also utilized in the Risk Assessment.

% Median Household Income: average residential customer charges for 6 hundred cubic feet per month meet or exceed 1.5% of the annual Median Household Income within a water system's service area.

Extreme Water Bill: customer charges that meet or exceed 150% and 200% of statewide average drinking water customer charges at the 6 hundred cubic feet level.

% Shut-Offs: 10% or more of a water system's residential customer base experienced service shut-offs due to non-payment in 2019.

Figure 6 shows the relationship between systems, by DAC status, and the number of Affordability indicator thresholds they exceeded. The analysis indicated that 1,911 systems do not exceed any of the affordability indicator thresholds.

Figure 6: Number of DAC/SDAC Water Systems that Exceeded Each Minimum Affordability Indicator Threshold

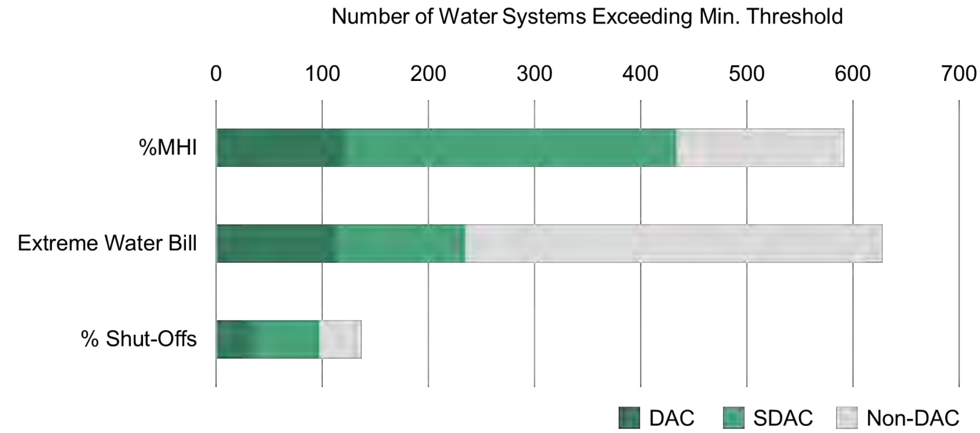
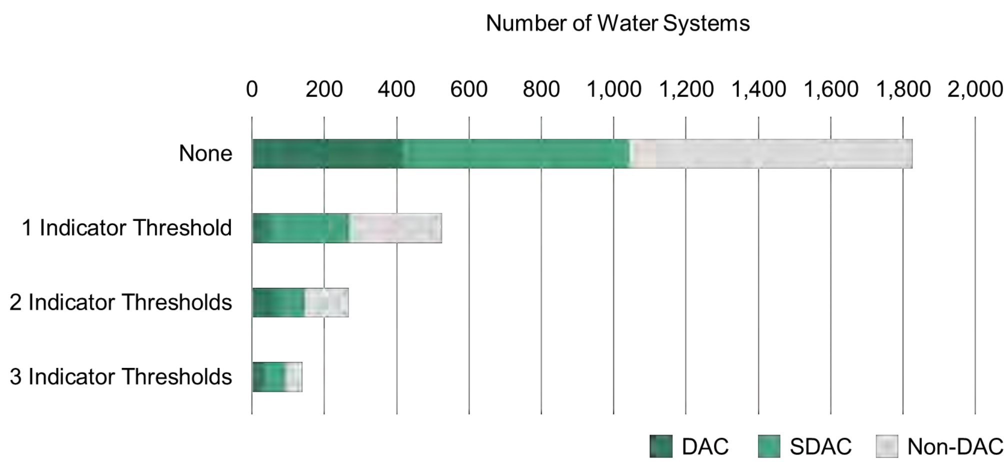


Figure 7 shows the cumulative number of affordability indicator thresholds exceeded by individual DAC and SDAC systems.

Figure 7: Total Number of DAC/SDAC Water Systems that Exceeded an Affordability Indicator Threshold



The State Water Board recognizes the need to refine the affordability indicators utilized in the Affordability Assessment. New affordability indicators will ultimately be included in the Assessment, while others, like % Shut-Offs will be removed (due to the 2020 shut-off moratorium Executive Order). The State Water Board will begin conducting research and stakeholder engagement needed to develop a more refined Affordability Assessment and appropriate affordability thresholds.

TRIBAL NEEDS ASSESSMENT RESULTS

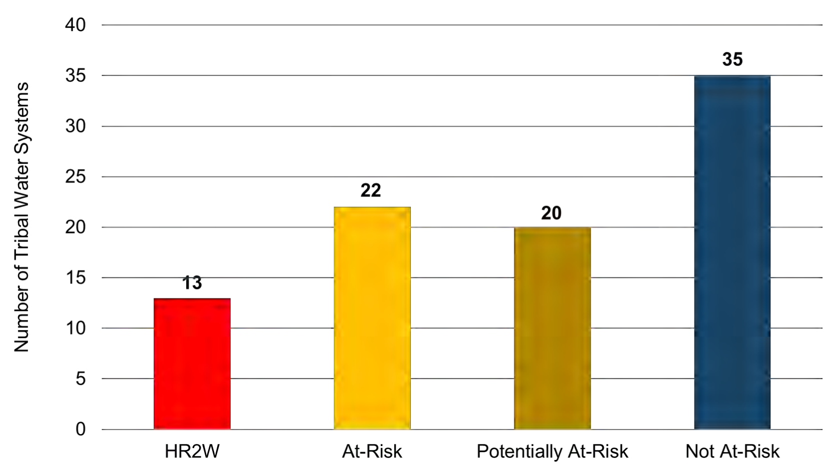
The Needs Assessment is an iterative process and tribal community inclusion is a fundamental principle of the SAFER Program. The State Water Board recognizes tribal governments as sovereign nations within California's boundaries. In June 2021, the State Water Board's Office of Public Participation anticipates conducting outreach to tribal leaders and members to inform them of the SAFER Program to ensure they can fully participate, if desired. Tribal representatives and Federal partners are part of the SAFER Advisory Group and help provide additional specialized expertise on tribal outreach and inclusion.

Due to data limitations, the State Water Board was unable to assess the needs of tribal water systems in the 2021 Needs Assessment using the same methodology employed for evaluation of public water systems, state small water systems, and domestic wells. Therefore, the State Water Board developed an alternative approach for conducting a tribal water system Needs Assessment which relies upon approximating of HR2W list equivalent and At-Risk equivalent water systems (Appendix F). The State Water Board was able to conduct a Risk Assessment and Cost Assessment for tribal water systems. However, the State Water Board did not have access to the data necessary to conduct an Affordability Assessment or Gap Analysis for tribal water systems. The State Water Board, in coordination with Indian Health Services (IHS), U.S. EPA, and other partners, will be reaching out to tribal water systems and tribal leaders to explore interest in data sharing which may enable a tribal water system Affordability Assessment and more comprehensive Risk and Cost Assessments in the future.

HR2W LIST AND AT-RISK EQUIVALENT

State Water Board staff reviewed violation data across the Southwest to review tribal water system violation data to proportionally relate that date to California statewide violations. State Water Board staff then worked with U.S. EPA tribal drinking water personnel to calibrate their assumptions on the number of tribal equivalent HR2W list systems. Using the State Water Board's expanded HR2W list criteria, U.S. EPA identified 13 tribal community water systems that met the criteria.

Figure 8: Estimated Tribal HR2W List and At-Risk Water Equivalent Systems



TRIBAL COST ASSESSMENT

The Cost Assessment methodology for tribal water systems generally follows the statewide methodology (Appendix C). However, two significant changes were made: 1) physical consolidation was not considered as a modeled solution, and 2) the sustainability and resiliency analysis for potential modeled solutions was not performed for tribal water systems due to inadequate data availability. For the purposes of this assessment, it was generally assumed that consolidation would not be a preferred option based on the special sovereign status of Federally recognized tribal water systems and previous input from tribal members. As with the statewide Cost Assessment, these modeled solutions are utilized for broad policy efforts and are not a substitute for individual evaluations and outreach for the actual solution implementation for each water system.

The total estimated capital costs to address both the tribal equivalent HR2W list and At-Risk is $98.3 million. The estimated O&M cost for the three tribal water systems associated with a treatment solution for equivalent HR2W list systems is $152,000 per year, or $10 million dollars for 20 years. Interim costs were also estimated for tribal HR2W list equivalent water systems. The total estimated 6-year tribal emergency/interim equivalent estimated costs were $6.7 million.

OPPORTUNITIES FOR REFINEMENT

Future iterations of the annual Needs Assessment carried out by the SAFER Program will build upon the foundational information and recommendations provided in this year’s work. Expected improvements to the Assessment include the incorporation of additional and better-quality risk and cost data; experience and analysis of trends from implementing the SAFER Program; refinement of the Affordability Assessment; and further input from the State Water Board, public, and the SAFER Advisory Group. The following summarizes some Needs Assessment refinement opportunities:

Improved Data: The State Water Board has already begun taking necessary steps to improve data coverage and accuracy for the Needs Assessment by improving data collection and validation through the Electronic Annual Report (EAR); developing strategies to capture more detailed funded project and technical assistance cost data; and hosting tools to improve the water system area boundaries dataset. A concerted effort will be made to begin collecting data related to water system TMF capacity, water source capacity, and domestic well location/water quality.

Expanded Outreach to Tribal Water Systems: Additional outreach strategies to Federally regulated California tribal water systems are planned for May and June 2021. These outreach efforts will be centered on informing tribal leaders about the purpose of the SAFER Program and informing them of the benefits of sharing information so that they may be included in future Risk Assessments. In the interim, SAFER Program staff will continue to work with individual tribes, as requested by tribal leaders or in response to requests from the U.S. EPA.

Alignment with other State Efforts: The Department of Water Resources (DWR), the Office of Environmental Health Hazard Assessment (OEHHA) and the California Public Utilities

Commission (CPUC) have recently begun assessing different aspects of drinking water systems' risks and performance with respect to the HR2W. The State Water Board has begun coordination with these agencies to try to avoid duplication of efforts and ensure the most productive long-term statewide assessment of water system performance possible. The State Water Board is also making this information publicly available so other statewide efforts can incorporate the Needs Assessment into their programs.

Refinement of the Affordability Assessment: The State Water Board will begin working with the public to further refine the affordability indicators and thresholds utilized in the Affordability Assessment. The State Water Board will continue to collaborate with other State agencies and work towards better alignment amongst complimentary affordability efforts.

Learning by Doing – SAFER Program Maturation: As the State Water Board's SAFER Program matures, better tracking of systems that come on and off the HR2W list and At-Risk list will take place. Deeper investigation into areas where results did not fully reflect the breadth or depth of staff or community experiences (e.g. complexity of urban areas, emerging contaminants, and self-supplied homes using unfiltered surface water) will be incorporated into future efforts.

Continued Public Engagement: The State Water Board is committed to engaging the public and key stakeholder groups to solicit feedback and recommendations as it refines its Needs Assessment methodologies. The State Water Board will continue to provide opportunities for stakeholders to learn about and contribute to the refinement process.

WATER SYSTEM REQUESTS FOR DATA UPDATES

The State Water Board is accepting inquiries related to underlying data change requests for the Risk Assessment and Affordability Assessment. The data used for both Assessments are drawn from multiple sources and are detailed in Appendix A and Appendix E. Water systems are encouraged to reach out via the online webform below:

Water System Data Change Request Webform: https://bit.ly/2Q5DLML

The State Water Board will be updating the Risk Assessment Results in Attachment A1 as data changes occur.[31] Therefore, the list of water systems designated At-Risk and Potentially At-Risk in this Attachment will evolve from the aggregated assessment results summarized in this report over time.

[31] Attachment A1: 2021 Risk Assessment Results
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/docs/a1.xlsx

INTRODUCTION

ABOUT THE NEEDS ASSESSMENT

In 2016, the State Water Board adopted a Human Right to Water Resolution making the Human Right to Water (HR2W), as defined in Assembly Bill 685, a primary consideration and priority across all of the state and regional boards' programs.[32] The HR2W recognizes that "every human being has the right to safe, clean, affordable, and accessible water adequate for human consumption, cooking and sanitary purposes."

In 2019, to advance the goals of the HR2W, California passed Senate Bill 200 (SB 200) which enabled the State Water Board to establish the Safe and Affordable Funding for Equity and Resilience (SAFER) Program. SB 200 established a set of tools, funding sources, and regulatory authorities the State Water Board can harness through the SAFER Program to help struggling water systems sustainably and affordably provide safe drinking water to their customers. Foremost among the tools created under SB 200 is the Safe and Affordable Drinking Water Fund. The Fund provides up to $130 million per year through 2030 to enable the State Water Board to develop and implement sustainable solutions for underperforming drinking water systems. The annual Fund Expenditure Plan[33] prioritizes projects for funding, documents past and planned expenditures, and is "based on data and analysis drawn from the drinking water Needs Assessment", per California Health and Safety Code Section 116769.

The State Water Board's Drinking Water Needs Assessment (Needs Assessment) consists of three core components: the Affordability Assessment, Risk Assessment, and Cost Assessment. The State Water Board's Needs Analysis Unit in the Division of Drinking Water (DDW) is leading the implementation of the Needs Assessment in coordination with the Division of Water Quality (DWQ) and Division of Financial Assistance (DFA). The University of California, Los Angeles (UCLA) was contracted (agreement term: 09.01.2019 through 03.31.2021) to support the initial development of Needs Assessment methodologies for the Risk Assessment and Cost Assessment.

[32] State Water Board Resolution No. 2016-0010

https://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/2016/rs2016_0010.pdf

[33] The FY 2020-21 Fund Expenditure Plan does not utilize the Needs Assessment methodologies or results from the efforts detailed in this report.

SB 200 calls for the identification of "public water systems, community water systems, and state small water systems that may be at risk of failing to provide an adequate supply of safe drinking water." As well as "an estimate of the number of households that are served by domestic wells or state small water systems in high-risk areas."[34] Therefore, different Risk Assessment methodologies have been developed for different system types:

Public Water Systems
The State Water Board partnered with UCLA to develop the Risk Assessment methodology which utilized 19 risk indicators to identify At-Risk public water systems with 3,300 service connections or less and K-12 schools.

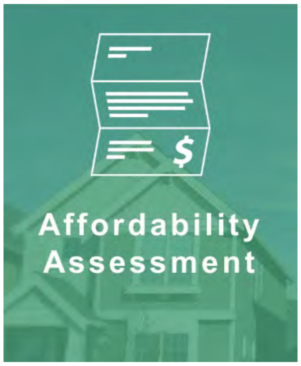
State Small Water Systems & Domestic Wells
The State Water Board's DWQ's Groundwater Ambient Monitoring and Assessment Program (GAMA) Unit developed the Risk Assessment methodology for state small water systems and domestic wells that is focused on groundwater quality. This effort was accomplished through the mapping of aquifers that are used as a source of drinking water that are at high risk of containing contaminants that exceed primary drinking water standards.

Tribal Water Systems
The State Water Board is partnering with Indian Health Services and the U.S. Environmental Protection Agency to collect data and adapt the Risk Assessment methodology for State and Federal tribal water systems located in California.

SB 200 also directs the State Water Board to "estimate of the funding needed for the next fiscal year based on the amount available in the fund, anticipated funding needs, other existing funding sources."[35] Thus, the Cost Assessment estimates the costs related to the implementation of interim and/or emergency measures and longer-term solutions for HR2W list and At-Risk systems. 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.

[34] California Health and Safety Code Section 116769

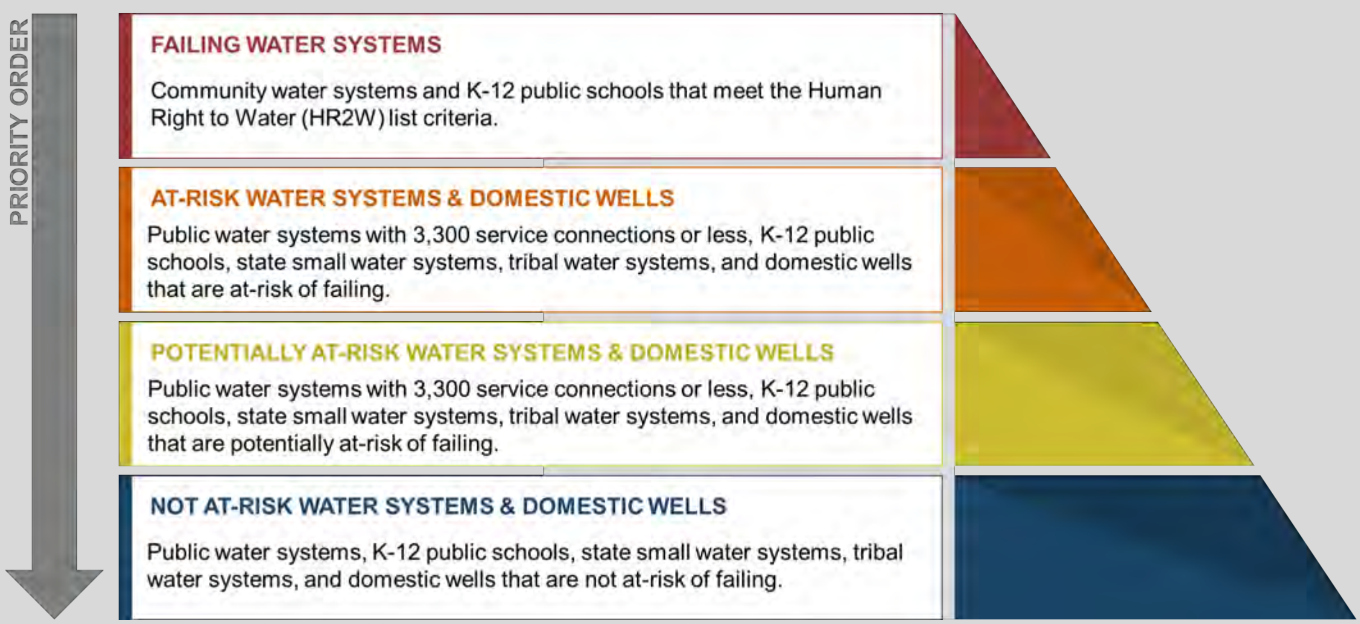
[35] California Health and Safety Code Section 116769



SB 200 also calls for the identification of "any community water system that serves a disadvantaged community that must charge fees that exceed the affordability threshold established by the board in order to supply, treat, and distribute potable water that complies with Federal and state drinking water standards."[36] Therefore, the Affordability Assessment evaluates several different affordability indicators to identify communities that may be experiencing affordability challenges.

The State Water Board will be conducting the Needs Assessment annually to inform the annual Fund Expenditure Plan and support implementation of the SAFER Program. The results of the Needs Assessment will be used by the State Water Board and the SAFER Advisory Group[37] to inform prioritization of public water systems, tribal water systems, state small water systems, and domestic wells for funding in the Safe and Affordable Drinking Water Fund Expenditure Plan; inform direction for State Water Board technical assistance; and to develop strategies for implementing interim and long-term solutions (Figure 9).

Figure 9: SAFER Program Priorities, From Highest to Lowest



[36] California Health and Safety Code Section 116769 (2) (B).

[37] SAFER Advisory Group
https://www.waterboards.ca.gov/safer/advisory_group.html

NEEDS ANALYSIS CONTRACT

Before SB 200 was passed in 2019, the State Water Board was appropriated $3 million in funding in 2018 from the state legislature via Senate Bill 862 (Budget Act of 2018) to implement a "Needs Analysis" on the state of drinking water in California. The State Water Board contracted the University of California, Los Angeles Luskin Center for Innovation (UCLA) to support the initial development of Needs Assessment methodologies for the Risk Assessment and Cost Assessment from September 1, 2019 to March 31, 2021. UCLA in turn collaborated with subcontractors Corona Environmental Consulting (Corona), the Sacramento State University Office of Water Programs (OWP), the Pacific Institute, and the University of North Carolina Environmental Finance Center (UNC EFC) to produce a portion of the work contained in this report and previous white papers.

Three State Water Board workshops hosted in early 2019 informed the original scope of the Needs Analysis contract with UCLA. The contract between the State Water Board and UCLA was scoped and written prior to the passage of SB 200. The Needs Analysis contract with UCLA was also originally designed to conduct a one-time Risk Assessment and Cost Assessment. As such, the efforts to develop the current Assessments went far beyond the original contract scope and represent a unique state level effort to characterize risk for public water systems and estimate costs for interim and long-term solutions, that is linked to the mandates of SB 200.

Overall, the contract with UCLA consisted of two core Elements:

(1) Identification of Public Water Systems in Violation or At-Risk: focused primarily on developing and evaluating risk indicators for drinking water community water systems up to 3,300 connections and non-transient non-community water systems. The focus on these systems was due to the large number of historical violations associated with smaller systems.

(2) Cost Analysis for Interim and Long-Term Solutions: develop a model to estimate the costs related to both necessary interim and/or emergency measures and longer-term solutions to bring systems into compliance and address the challenges faced by At-Risk systems. This element also includes the identification of available funding sources and the funding gaps that may exist to support interim and long-term solutions.

The Needs Assessment methodologies developed under this contract provides the SAFER Program with foundational methodologies for evaluating drinking water risk for public water systems and domestic well users and estimating the cost to ameliorate these challenges.

STAKEHOLDER INVOLVEMENT

The State Water Board and UCLA-led contractor team have been committed to engaging the public and key stakeholder groups to solicit feedback and recommendations to inform the development of the Needs Assessment methodologies: Risk Assessment, Cost Assessment, and Affordability Assessment. Since 2019, 14 workshops have been hosted, two in-person, and 12 webinars to inform the core methodologies (Figure 10). White papers, presentations, public feedback received, and webinar recordings can be found on the State Water Board’s Needs Assessment webpage.[38]

The State Water Board will continue to host public workshops to provide opportunities for stakeholders to learn about and contribute to the State Water Board’s efforts to develop a more robust Needs Assessment.

Figure 10: Needs Assessment Public Engagement Workshops

NEEDS ASSESSMENT COMPONENTS	2019	Q1 2020	Q2 2020	Q3 2020	Q4 2020	2021
Risk Assessment: Public Water Systems*	1.11		4.17	7.22	10.13, 12.14	4.13
Risk Assessment: State Small Water Systems & Domestic Wells	1.18		4.17	7.22	10.09, 11.04	4.13
Cost Assessment*	1.11		5.10	8.28	11.20	2.26, 4.13
Affordability Assessment			4.17	7.22, 9.11	10.30	4.13

* The 2020-21 workshops for the Risk Assessment for public water systems and Cost Assessment were conducted in collaboration with UCLA and its partners.

[38] State Water Board Needs Assessment Webpage: https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/needs.html#risk-assessment

FAILING WATER SYSTEMS: THE HR2W LIST

The State Water Board assesses water systems that fail to meet the goals of the Human Right to Water and maintains a list and map of these systems on its website. Systems that are on the Human Right to Water list (HR2W list) are those 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 (CWSs) and Non-Community Water Systems (NCWSs) that serve 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.[39]

Table 10 summarizes the new expanded criteria. The expansion of the criteria results in approximately 30 community water systems being added to the HR2W list. Additional details regarding the history of the HR2W list and criteria methodology can be found on the State Water Board's HR2W webpage.[40]

Table 10: Expanded Criteria for Failing, HR2W List Water Systems

Criteria	Before 3.2021	After 4.2021
Primary MCL Violation with an open Enforcement Action	Yes	Yes
Secondary MCL Violation with an open Enforcement Action	Yes	Yes
E. coli Violation with an open Enforcement Action	No	Yes
Treatment Technique Violations (in lieu of an MCL): • One or more Treatment Technique violations (in lieu of an MCL), related to a primary contaminant, with an open enforcement action; and/or	Partially	Expanded

[39] California Health and Safety Code Section 116275(c)

[40] Human Right to Water | California State Water Resources Control Board
https://www.waterboards.ca.gov/water_issues/programs/hr2w/

Criteria	Before 3.2021	After 4.2021
• Three or more Treatment Technique violations (in lieu of an MCL), related to a primary contaminant, within the last three years.		
Monitoring and Reporting Violations (related to an MCL or Treatment Technique): • Three Monitoring and Reporting violations (related to an MCL) within the last three years where at least one violation has been open for 15 months or greater.	No	Yes

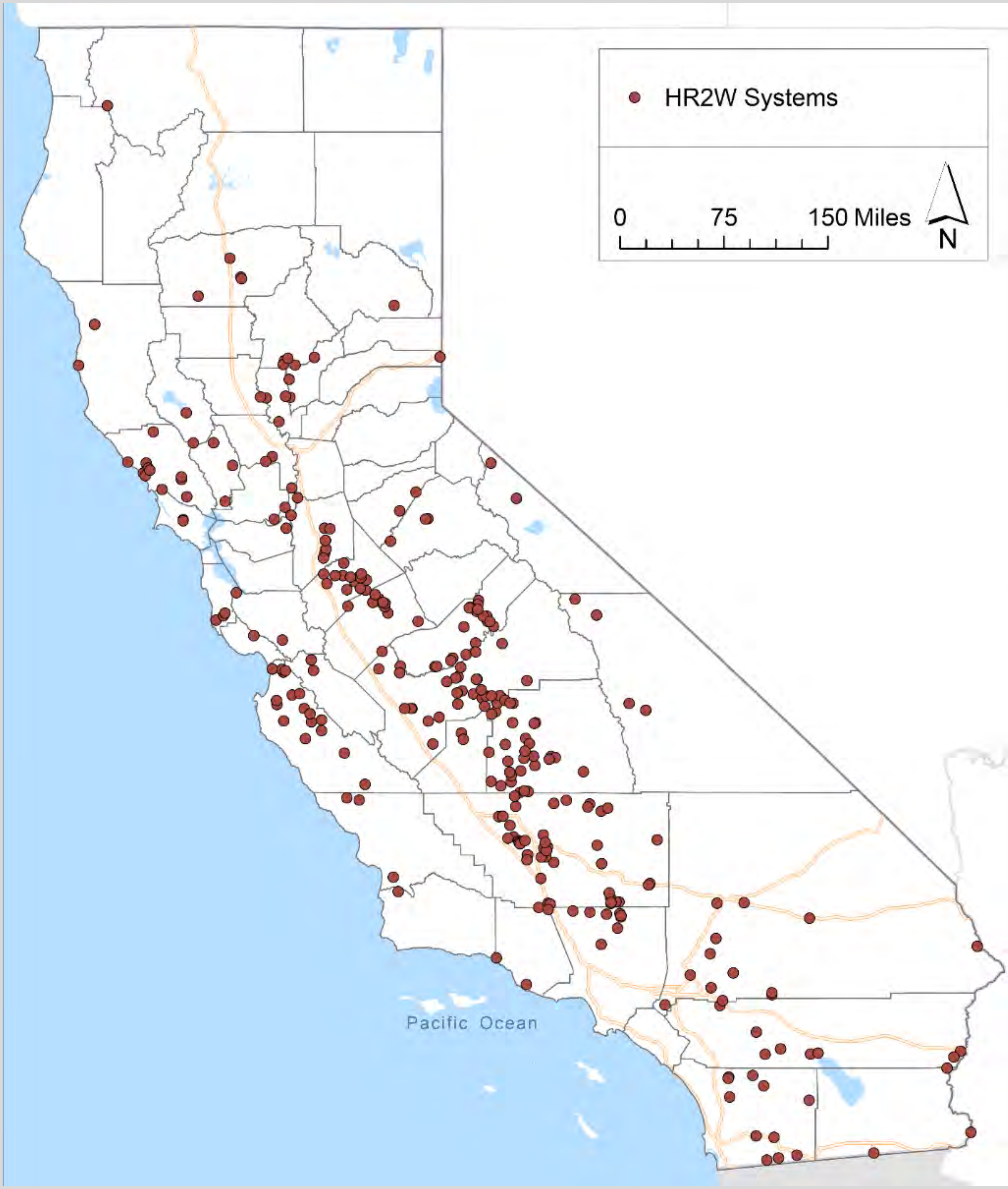
Multiple components of the Needs Assessment rely on the HR2W list of systems. For the purposes of the Risk Assessment, HR2W list systems are excluded from the Assessment's results, except for comparison purposes. If a water system meets one or more of the HR2W list criteria, then that system is considered a failing water system and cannot be considered "at-risk" of failing. However, once a water system is removed from the HR2W list, it may be added to the At-Risk list of water systems if it meets the Risk Assessment criteria. On the other hand, HR2W list systems are, featured in the Cost Assessment and included in the Affordability Assessment.

The HR2W list is refreshed on an ongoing basis and updated quarterly on the State Water Board website. The Needs Assessment represents an analysis of data at a snapshot in time and different components of the Assessment were initiated on different dates, utilizing HR2W lists from different dates:

- **Risk Assessment Results**: *Excluded* HR2W list with 3300 or less connections as of December 21, 2020
- **Cost Assessment Results**: Included HR2W list as of December 1, 2020
- **Affordability Assessment Results**: Included HR2W list as of December 21, 2020

As shown in Figure 11 below, the HR2W list from December 1, 2020 had 305 water systems and the HR2W list from December 21, 2020 had 326 water systems with 3300 connections or less (343 total). 17 water systems came back into compliance over this timeframe and 38 new water systems were added to the HR2W list that met the expanded HR2W list criteria detailed in Table 10 above. There were 288 water systems that remained on the HR2W list from December 1, 2020 to December 20, 2020.

Figure 11: Map of HR2W Systems on 12.01.2020 Utilized in the Cost Assessment



RISK ASSESSMENT RESULTS FOR PUBLIC WATER SYSTEMS

OVERVIEW

The purpose of the Risk Assessment for public water systems is to identify systems at risk or 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. Data on performance and risk is most readily available for public water systems and thus the risk assessment methodology for public water systems allows for a multi-faceted examination across four risk indicator categories: Water Quality, Accessibility, Affordability; and TMF (technical, managerial, and financial) Capacity.

PUBLIC WATER SYSTEMS ASSESSED

The Risk Assessment for public water systems was conducted for community water systems with 3,300 service connections or less and all non-transient non-community water systems which serve K-12 schools. 72 wholesalers were not included in the Risk Assessment because they do not provide direct service to residential customers and larger water systems were excluded in this assessment because the overwhelming majority of violations occur in small systems. See Table 11 for details.

Table 11: Public Water Systems Analyzed in the Risk Assessment

Water System Type[41]	Number	Water Quality	Accessibility	Affordability	TMF Capacity
Public Water Systems[42] (≤ 3,300 connections)	2,241	Yes	Yes	Yes	Yes

[41] Systems on the HR2W list were included in the Risk Assessment analysis, however, they were excluded from the final Risk Assessment results.

[42] Wholesalers were excluded.

Water System Type[41]	Number	Water Quality	Accessibility	Affordability	TMF Capacity
K-12 Schools[43]	383	Yes	Yes	No	Yes
Other Public Water Systems[44]	155	Yes	Yes	No	Yes
TOTAL ANALYZED:	**2,779**				

RISK ASSESSMENT METHODOLOGY

The State Water Board and UCLA developed the 2021 Risk Assessment methodology though a phased public process from January 2019 through January 2021. One in-person and four public webinar workshops were hosted to solicit public feedback. The Risk Assessment methodology and the development process are detailed in Appendix A. The Risk Assessment methodology relies on three core elements which are utilized to calculate an aggregated risk score for the public water system assessed (Figure 12):

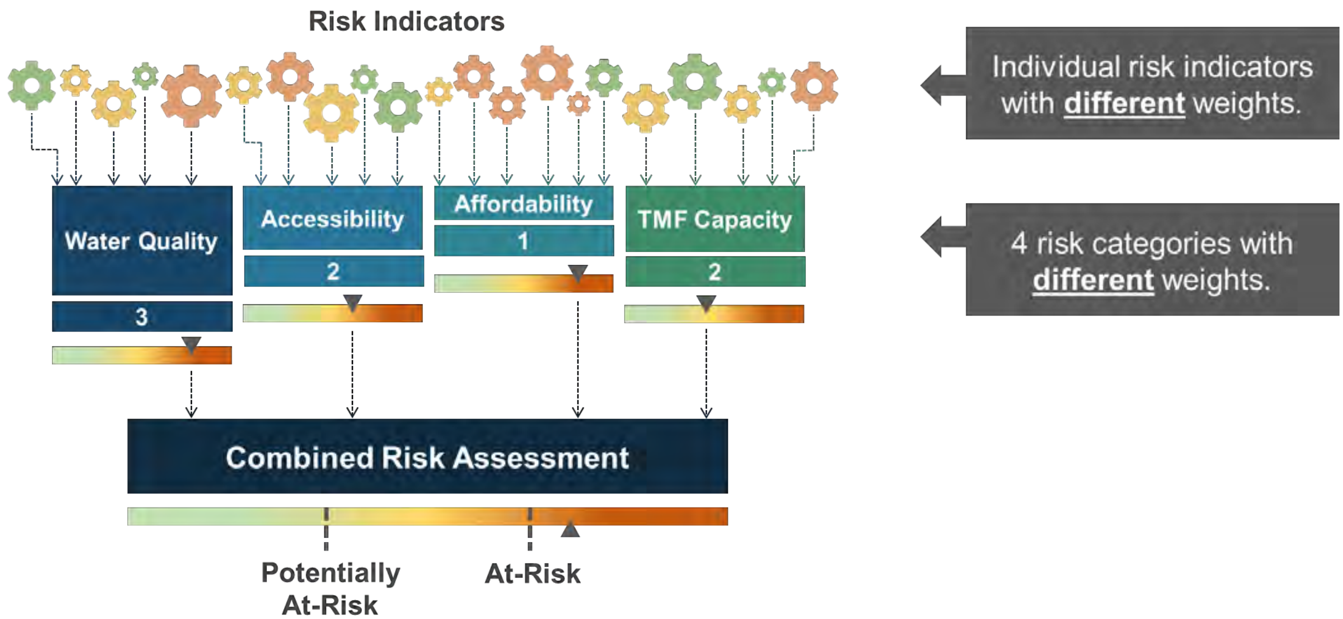
Risk Indicators: quantifiable measurements of key data points that allow the State Water Board to assess the potential for a water system to fail to sustainably provide an adequate supply of safe drinking water due to water quality, water quantity, infrastructure, and/or institutional issues. Risk indicators that measure water quality, accessibility, affordability, and TMF capacity are incorporated based on their criticality as it relates to a system's ability to remain in compliance with safe drinking water standards and their data availability and quality across the State.

Risk Indicator Thresholds: 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.

Scores & Weights: the application of a multiplying value or weight to each risk indicator and risk category, as certain risk indicators and categories may be deemed more critical than others and/or some may be out of the control of the water system. The application of weights to risk indicators and risk categories allows the State Water Board multiple ways to assess all risk indicators within each category together in a combined Risk Assessment score.

[43] These systems were manually identified by the State Water Board.
[44] Transient Areas, Recreational Facilities, Hotels, Summer Camps, Prisons, Medical Facilities, Military Complexes

Figure 12: Illustration of the Risk Assessment Methodology



RISK INDICATORS

The State Water Board, in partnership with UCLA and with public feedback, identified 19 risk indicators to utilize in the Risk Assessment. A concerted effort was made to select a range of risk indicators that measure water quality, accessibility, affordability, and TMF capacity based on their criticality as it relates to a system's ability to remain in compliance with safe drinking water standards.

The effort to identify and select these risk indicators included full consideration of indicators identified in efforts conducted by the Office of Environmental Health Hazard Assessment (OEHHA), the Department of Water Resources (DWR), and the California Public Utilities Commission. Risk indicators were also assessed based on the availability of quality statewide data. The definitions and calculation methodologies for each risk indicator are summarized in Appendix A. Information on how the 19 risk indicators were selected from a list of 129 potential risk indicators is detailed in the October 7, 2020 white paper.[45]

[45] October 7, 2020 White Paper:
Evaluation of Potential Indicators and Recommendations for Risk Assessment 2.0 for Public Water Systems
https://www.waterboards.ca.gov/safer/docs/e_p_i_recommendations_risk_assessment_2_public_water_systems.pdf

Table 12: Risk Assessment Risk Indicators

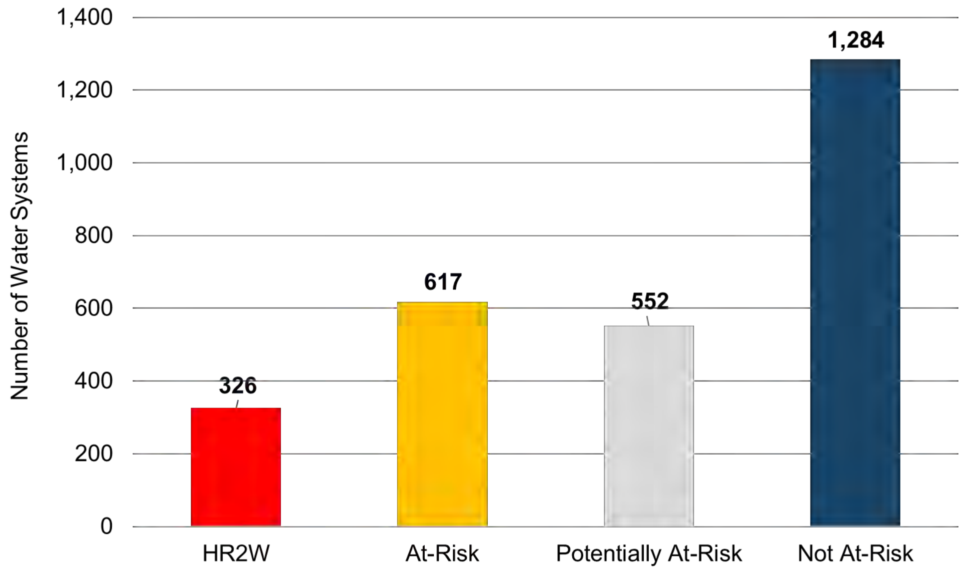
Risk Indicator Category	Risk Indicators
Water Quality	History of E. coli Presence
	Increasing Presence of Water Quality Trends Toward MCL
	Treatment Technique Violations
	Past Presence on the HR2W List
	Maximum Duration of High Potential Exposure (HPE)
	Percentage of Sources Exceeding an MCL
Accessibility	Number of Sources
	Absence of Interties
	Water Source Types
	DWR – Drought & Water Shortage Risk Assessment Results
	Critically Overdrafted Groundwater Basin
Affordability	Percent of Median Household Income (%MHI)
	Extreme Water Bill
	% Shut-Offs
TMF Capacity	Number of Service Connections
	Operator Certification Violations
	Monitoring and Reporting Violations
	Significant Deficiencies
	Extensive Treatment Installed

RISK ASSESSMENT RESULTS

AT-RISK WATER SYSTEMS

The 2021 Risk Assessment was conducted for 2,779 public water systems. After removing 326 (12%) HR2W systems with 3300 connections or less, the results identified 617 (25%) At-Risk water systems, 552 (23%) Potentially At-Risk water systems, and 1,284 (52%) Not At-Risk water systems (Figure 13).

Figure 13: Number of Public Water Systems (3,300 service connection or less) and K-12 Schools At-Risk and Potentially At-Risk (excluding HR2W list systems)



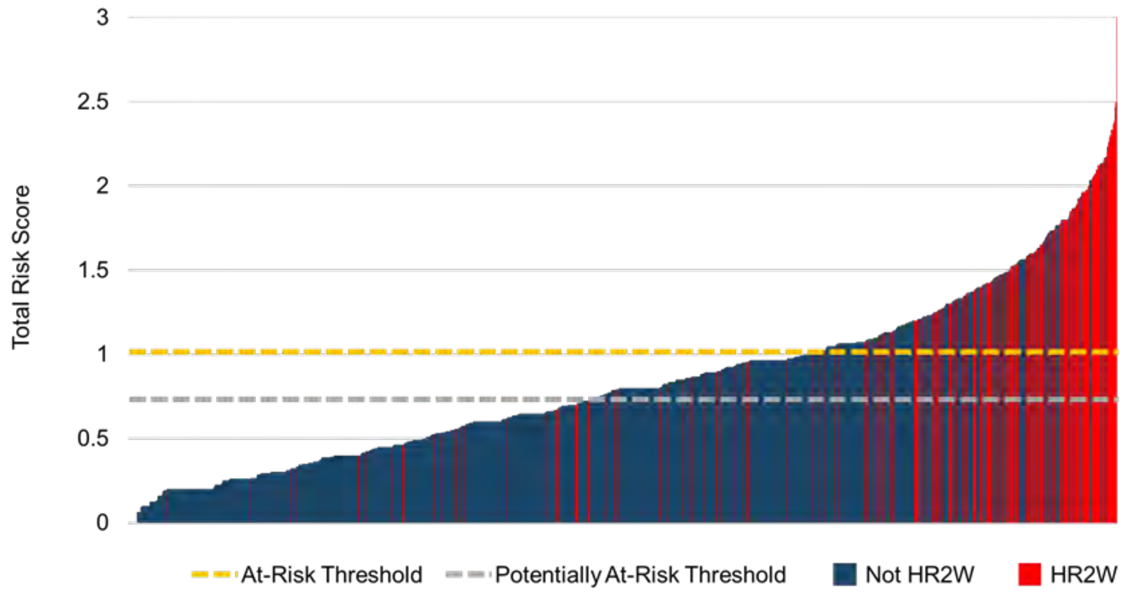
Access the Current List of At-Risk and Potentially At-Risk Water Systems:

The full list of At-Risk and Potentially At-Risk water systems is available in Attachment A1.[46] The State Water Board will be maintaining this list as data changes occur. Therefore, the list of water systems designated At-Risk and Potentially At-Risk in this Attachment may have evolved from the aggregated assessment results summarized in this report.

[46] Attachment A1: 2021 Risk Assessment Results
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/docs/a1.xlsx

The Risk Assessment results for public water systems is supported by the results which indicated that failing systems on the HR2W list had more than double the average risk score (1.5 vs. 0.7). Furthermore, 268 (82%) HR2W list systems exceeded the At-Risk threshold compared to all 2453 (25%) of the other systems analyzed (Figure 14).

Figure 14: Distribution of Total Risk Score for Water Systems (n=2,779)



The distribution of At-Risk and Potentially At-Risk systems also varies substantially across the state, as shown in Figures 16 and 17. For instance, Kings County has the highest proportion of At-Risk systems (75%), whereas Modoc County and San Francisco County have the lowest proportion of At-Risk systems (0%).

Figure 15: Population of At-Risk and Potentially At-Risk Communities

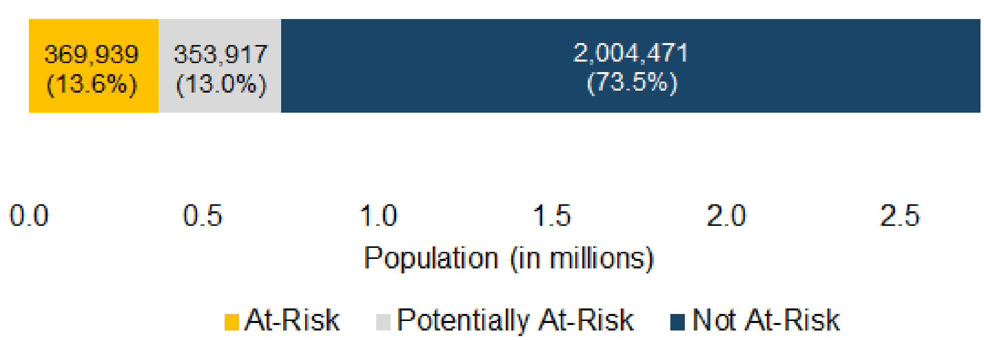
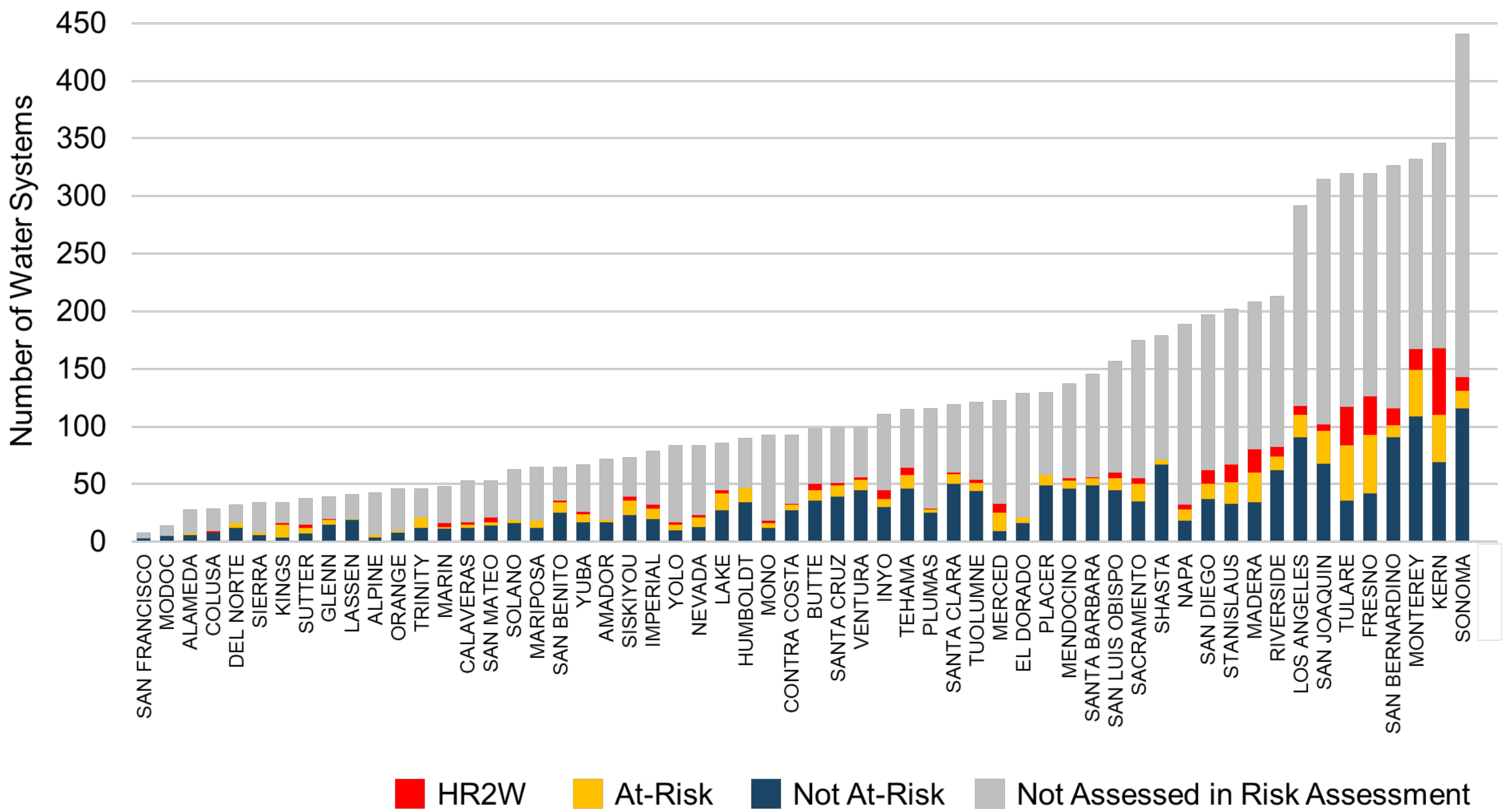


Figure 16: Proportion of HR2W List and At-Risk Water Systems in Each County[47]



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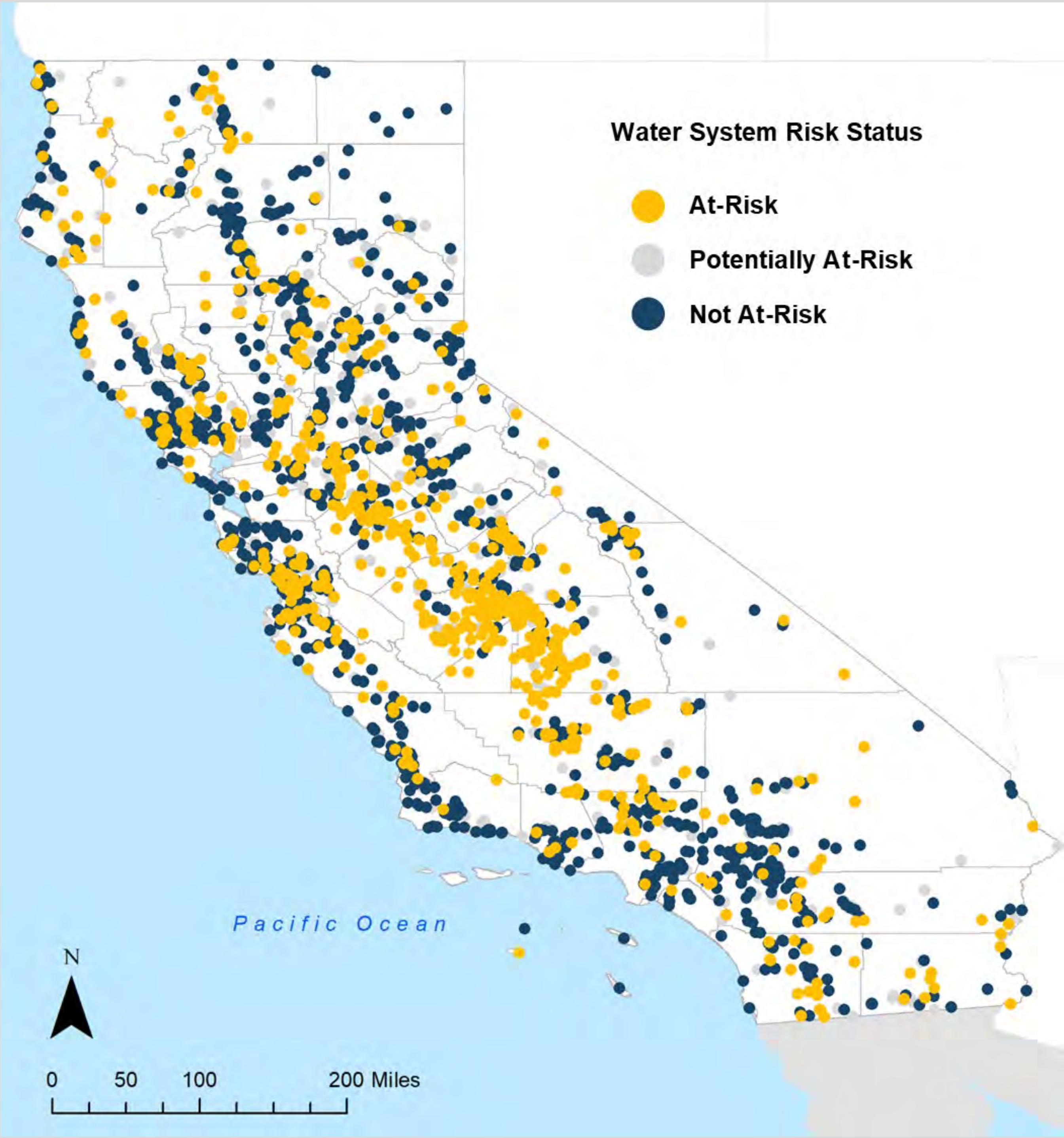
47 [Attachment A1: 2021 Risk Assessment Results](https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/docs/a1.xlsx)
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/docs/a1.xlsx

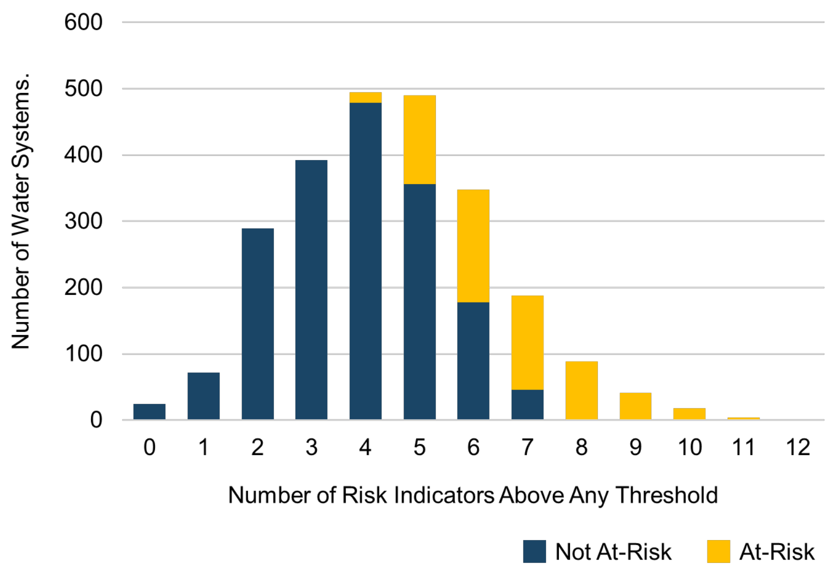
Figure 17: Map of Public Water Systems Evaluated for the Risk Assessment (n=2,779)



RISK INDICATOR DRIVERS

As Figure 18 below shows, all At-Risk systems exceed a threshold of concern for at least 4 risk indicators, with the average At-Risk system exceeding more than six risk indicator thresholds of concern. This means that systems were not designated as At-Risk based on a single or even a handful of risk indicators. Moreover, At-Risk systems tended to have many more indicator concerns than Not At-Risk systems.

Figure 18: Distribution of the Number of Risk Indicator Thresholds Exceeded by At-Risk and Not At-Risk Water Systems (n=2,426)



Certain individual risk indicators and risk indicator categories also had more influence than others on water systems' total risk scores. Table 13 shows in descending order the 10 risk indicators which contributed the most weighted points to the final risk scoring, for both all At-Risk systems and those with the top quintile of risk scores.

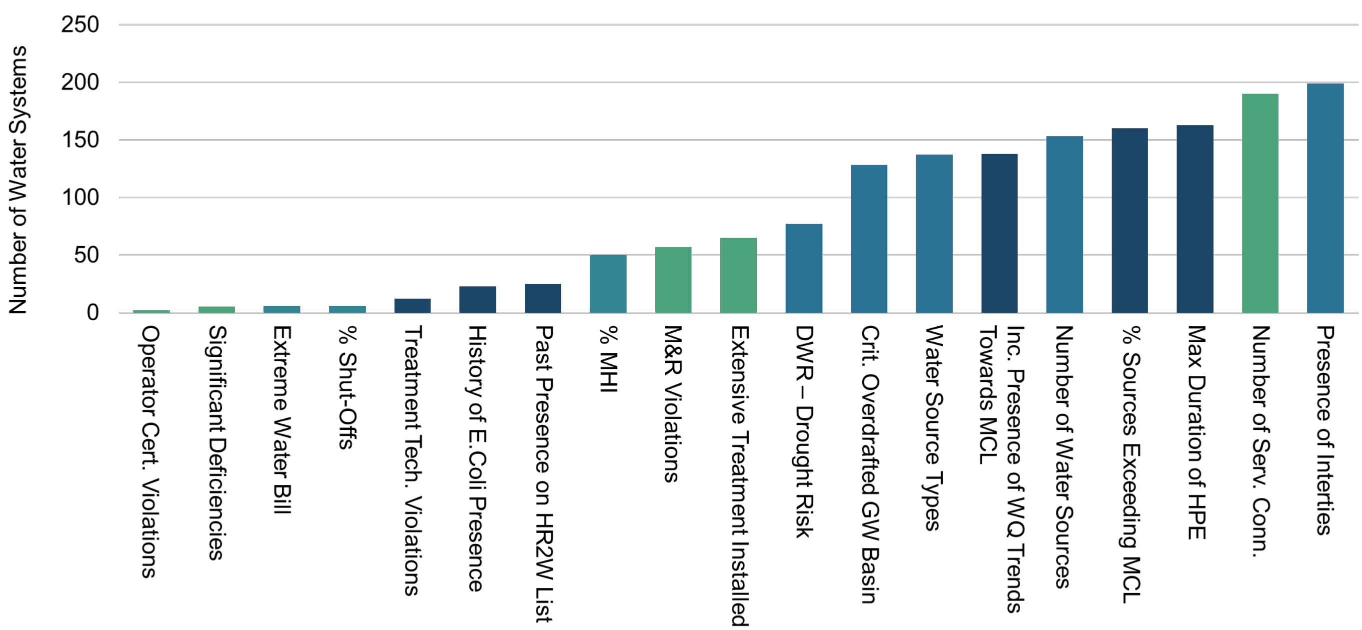
Table 13: Risk Indicators Ranked by Their Average Weighted Score Among At-Risk Water Systems

Category	Risk Indicator	All At-Risk	Top 20% At-Risk
Accessibility	Number of Water Sources	2.24	2.61
Water Quality	Maximum Duration of High Potential Exposure (HPE)	1.35	2.32
Water Quality	Percentage of Sources Exceeding an MCL	1.13	2.14
Accessibility	Presence of Interties	0.97	0.98
TMF Capacity	Number of Service Connections	0.94	0.98

Category	Risk Indicator	All At-Risk	Top 20% At-Risk
Affordability	Percent of Median Household Income (%MHI)	0.92	1.14
Accessibility	Critically Overdrafted Groundwater Basin	0.85	0.99
Accessibility	Water Source Types	0.73	0.85
Water Quality	Increasing Presence of Water Quality Trends Toward MCL	0.68	1.00
Accessibility	DWR – Drought & Water Shortage Risk Assessment Results	0.59	0.74

An analysis was also conducted to examine the effect of each individual risk indicator on the number of water systems it moved onto the At-Risk list, holding all other indicators constant. As shown in Figure 19, the 'Presence of Interties', 'Number of Service Connections', 'Maximum Duration of High Potential Exposure', 'Percentage of Sources Exceeding a MCL', and 'Number of Water Sources' are the five risk indicators that had the greatest effect on the number of At-Risk systems. Two of these risk indicators fall into the Accessibility category, one is in the TMF Capacity category, and two are in the Water Quality category.

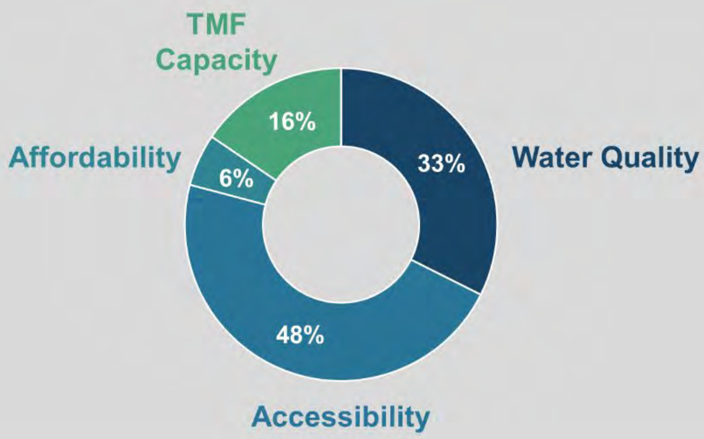
Figure 19: Risk Indicators Ranked by Their Effect on the Number of At-Risk Systems



RISK INDICATOR CATEGORY RESULTS

The performance of water systems across all individual risk indicators shows that the Accessibility category contributes the most weighted risk points to At-Risk scoring (48%), with Water Quality coming second (33%) and the TMF Capacity (16%) and Affordability (6%) categories contributing distant third and fourth highest shares of risk points. Data availability for the Affordability risk indicators was poor compared to the other categories. In future iterations of the Risk Assessment, the State Water Board will incorporate additional TMF Capacity and Affordability risk indicators to better reflect their contribution to water system performance risk.

Figure 20: Share of Each Risk Indicator Category in Calculating the Total Risk Score for At- Risk Water Systems (n=613)



WATER QUALITY

Figure 21 illustrates how HR2W list and non-HR2W list water systems perform in the Water Quality risk category, which is the second most influential category in the overall Risk Assessment. Risk category scores reflect the average of weighted water quality indicators included in the Risk Assessment. About 38% (n=1,050) of systems score 0 points, whereas the average score for this category across all other systems is 0.52. Systems on the HR2W list score significantly higher in this category than systems that are not on the HR2W list.

Figure 21: Water Quality Score for Each Water System (n=1,729)

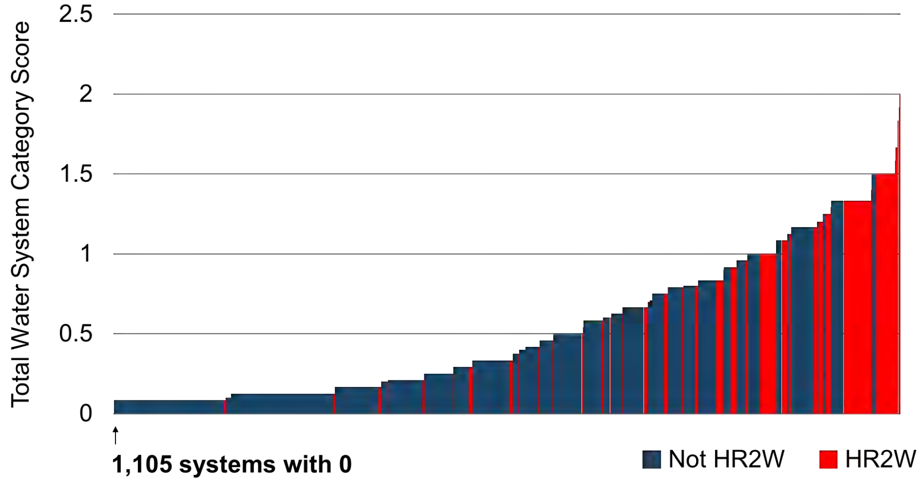
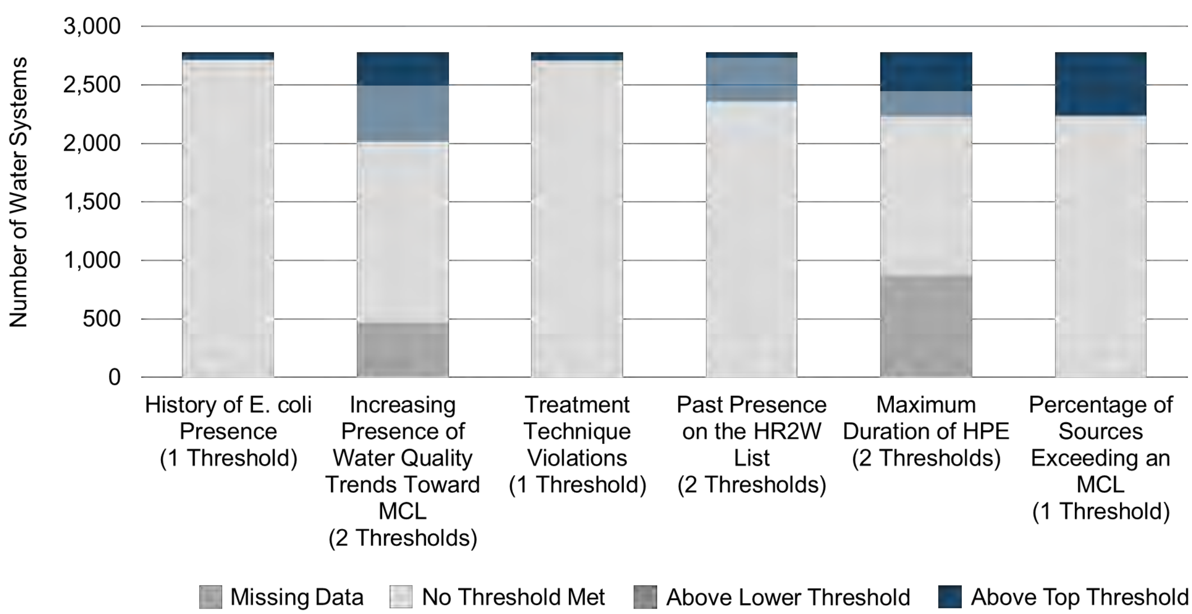


Figure 22 illustrates the number of water systems that exceeded the risk indicator thresholds within the Water Quality category. The range of potential thresholds for each risk indicator are summarized in the respective risk indicator labels.

Figure 22: Systems Exceeding Thresholds for Each Water Quality Risk Indicator



ACCESSIBILITY

Figure 23 illustrates how HR2W list and non HR2W list water systems perform in the Accessibility risk category, which is the most influential category in the overall Risk Assessment. Risk category scores reflect the average of weighted water accessibility indicators included in the Risk Assessment. Only about 7% (n=185) of systems score 0 points, whereas the average score for this category across all other systems is 0.78. Systems on the HR2W list score slightly higher (average score= 0.88) in this category than systems that are not on the HR2W list (average score=0.76).

Figure 23: Accessibility Score for Each Water System (n=2,594)

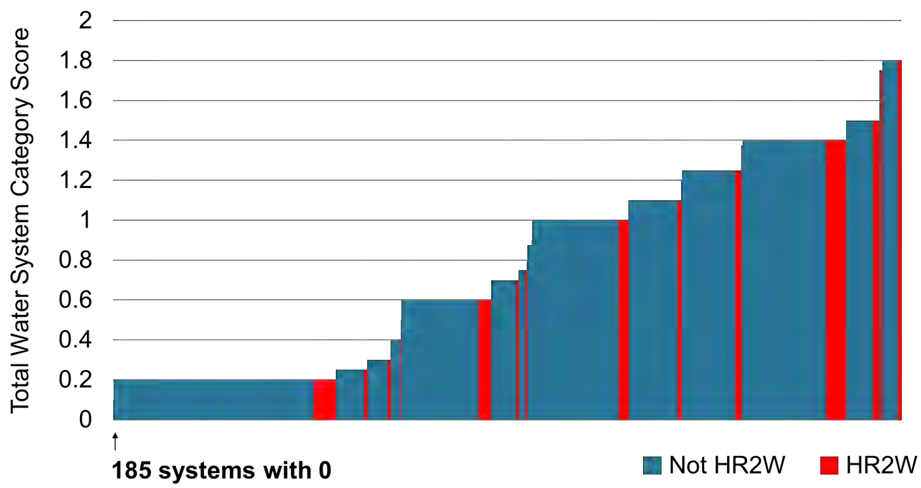
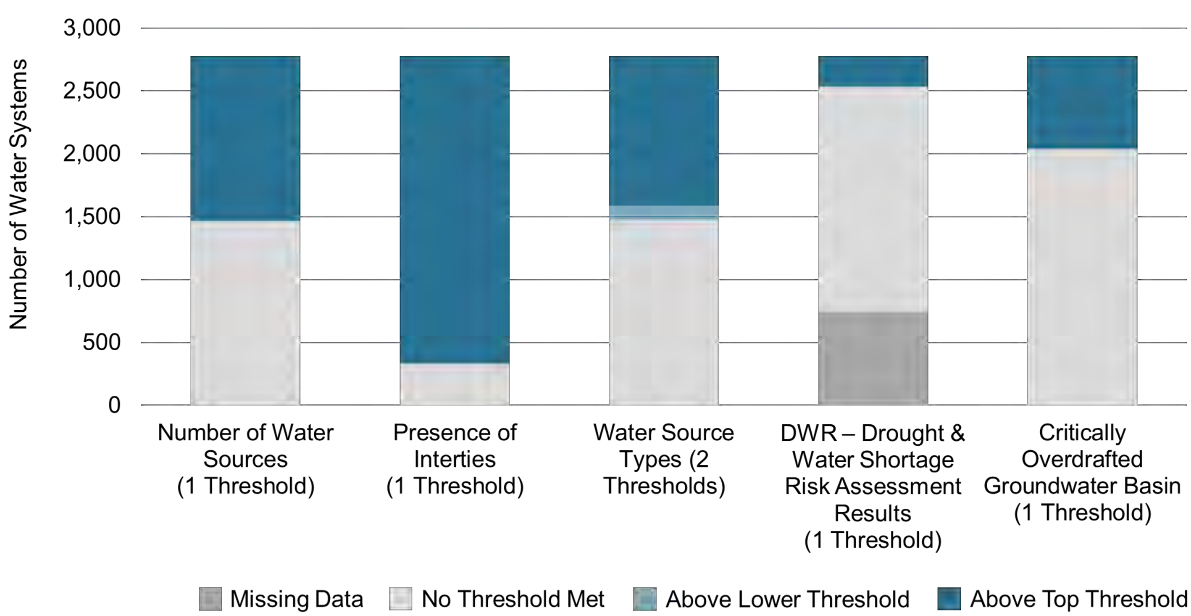


Figure 24 illustrates the number of water systems that exceeded the risk indicator thresholds within the Accessibility category. The range of potential thresholds for each risk indicator are summarized in the respective risk indicator labels.

Figure 24: Systems Exceeding Thresholds for Each Accessibility Risk Indicator



AFFORDABILITY

Figure 25 shows how HR2W list and non HR2W list water systems perform in the Water Accessibility risk category, which is the least influential category in the overall Risk Assessment. Risk category scores reflect the average of weighted water affordability indicators included in the Risk Assessment. Keeping in mind that 541 water systems were excluded from the affordability scoring due to lack of data, about 76% (n=1,772) scored 0 points, whereas the average score for this category across all other systems is 0.86. Systems with insufficient data did not receive a score for the Affordability category. For these systems, instead the other risk categories were more heavily weighted to account for the absence of an affordability score.

Systems on the HR2W list score the same as systems that are not on the HR2W list (both have an average of 0.76). It is important to note that water systems that do not have the necessary treatment may have lower operations and maintenance costs and therefore these are not necessarily expected to directly correspond.

Figure 25: Affordability Score for Each Water System (n=466)

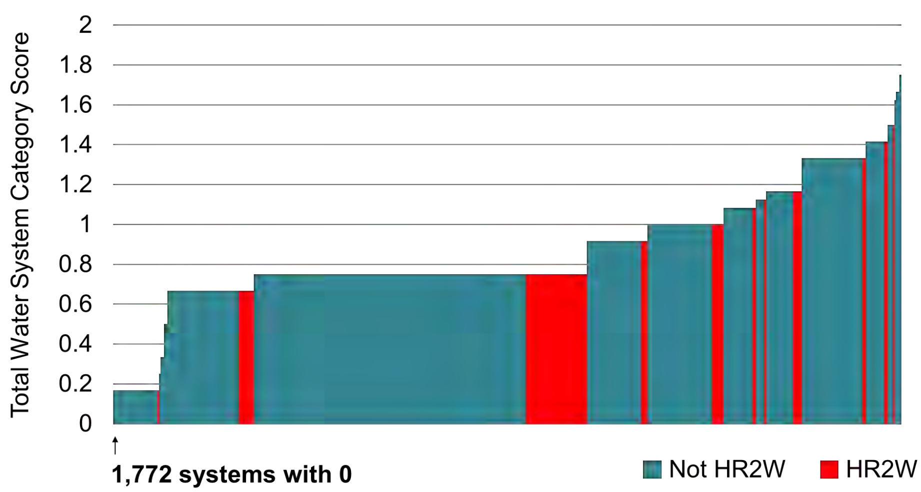
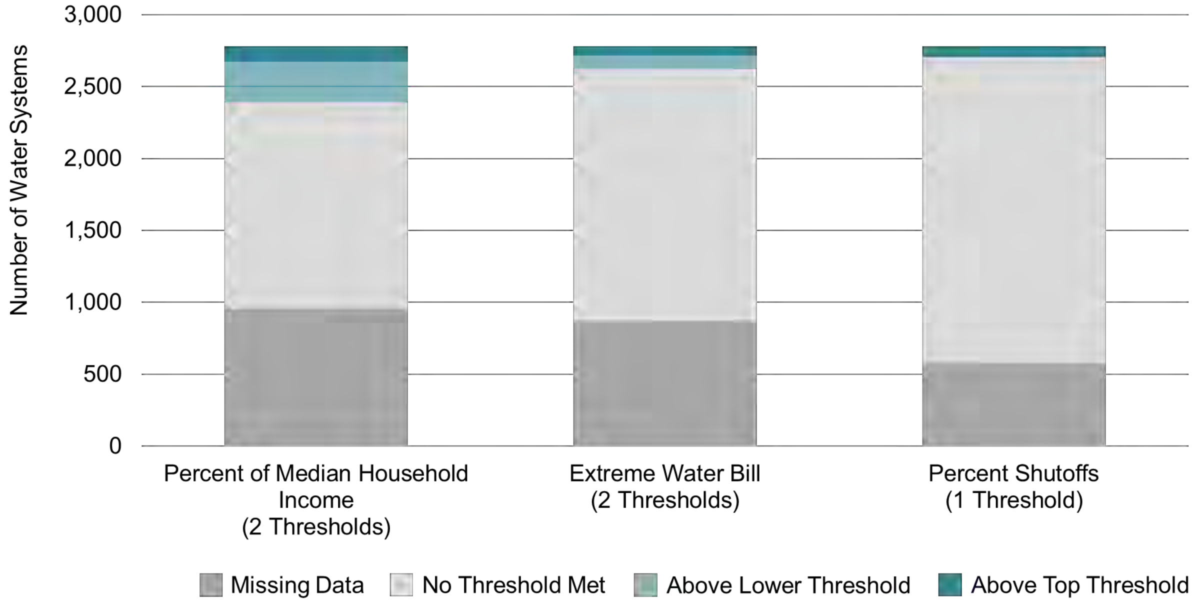


Figure 26 illustrates the number of water systems that exceeded the risk indicator thresholds within the Affordability category. The range of potential thresholds for each risk indicator are summarized in the respective risk indicator labels.

Figure 26: Systems Exceeding Thresholds for Each Affordability Risk Indicator



TMF CAPACITY

Figure 27 shows how HR2W list and non HR2W list water systems perform in the TMF Capacity risk category, which is the second least influential category in the overall Risk Assessment. Risk category scores reflect the average of weighted TMF Capacity indicators included in the Risk Assessment. Only 10% (n=279) of systems score 0 risk points. Systems on the HR2W list score higher in this category (average risk score=0.36) than systems that are not on the HR2W list (average risk score=0.30).

Figure 27: TMF Capacity Score for Each Water System (n=2,500)

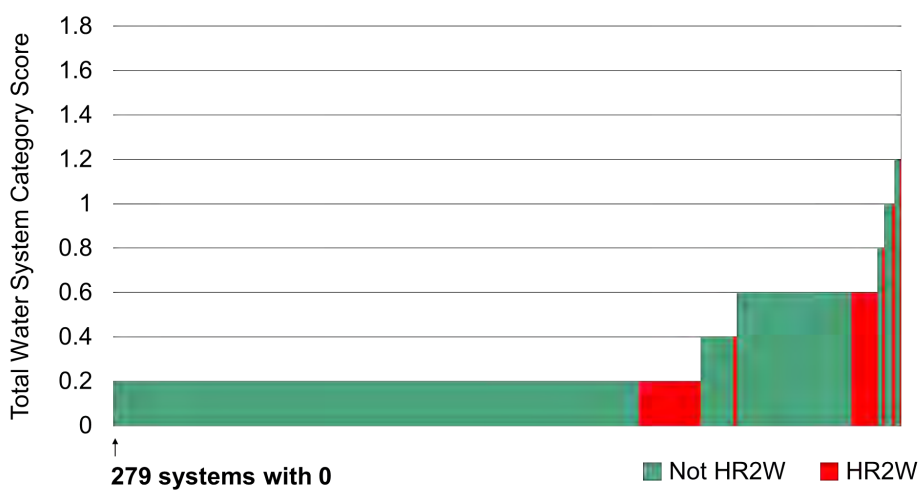
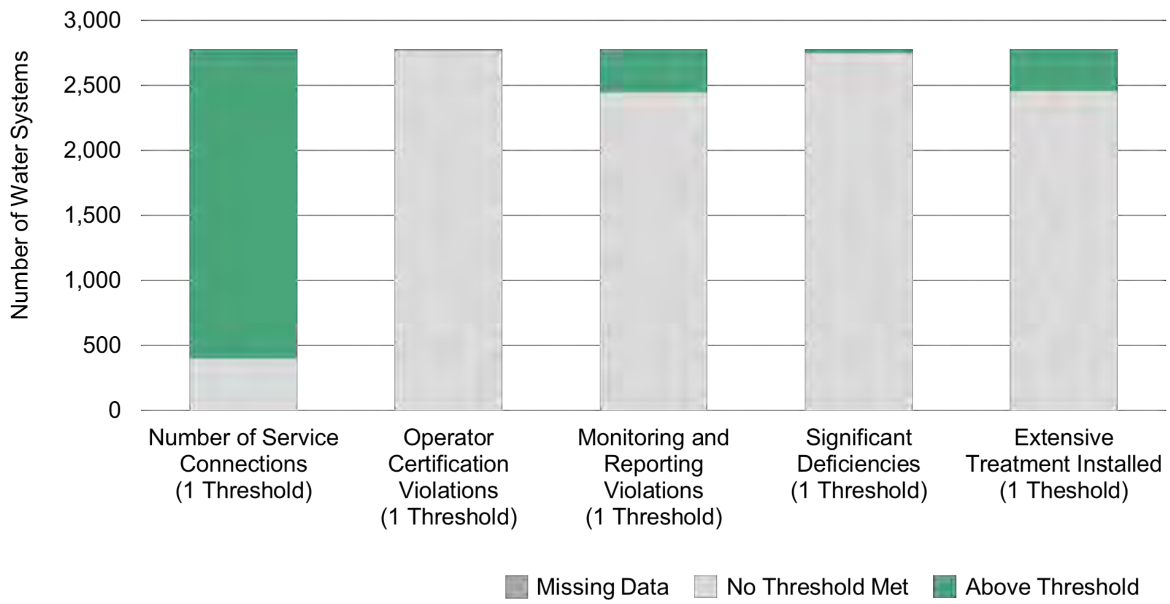


Figure 28 illustrates the number of water systems that exceeded the risk indicator thresholds within the TMF Capacity category. The range of potential thresholds for each risk indicator are summarized in the respective risk indicator labels.

Figure 28: Number of Systems Exceeding Thresholds for Each TMF Capacity Risk Indicator



LIMITATIONS OF THE RISK ASSESSMENT FOR PUBLIC WATER SYSTEMS

The 2021 Risk Assessment for public water systems represents a major first step in assessing risk for systems with 3,300 connections or less, and which can be applied to all public water systems in future years. While the State Water Board and UCLA have worked to advance the methodology as far as possible since 2019, the following limitations exist in the current methodology and approach:

Water Systems Not Assessed

Three types of systems were not able to be incorporated in the 2021 Risk Assessment. First, Federally recognized tribal systems were originally envisioned to be included, and attempts were made to gather data to this end, but ultimately tribal systems had to be excluded from the assessment due to missing data although general estimates of the potential number of equivalent systems were developed in an alternative Tribal Needs Assessment detailed in Appendix F. Second, public water systems with 3,300 connections or more were not included, due to State Water Board and contractor capacity to analyze them, but these larger systems may be included in future iterations of the Risk Assessment. Finally, wholesalers were also excluded from the 2021 Risk Assessment. To evaluate the performance risk of wholesalers, the State Water Board may need to develop an alternative approach to assessing these systems than the methodology developed for other public water systems and there are not always direct correlations on risk indicators.

Missing Data for Selected Risk Indicators

The State Water Board and UCLA conducted an extensive evaluation of the risk indicators recommended for the Risk Assessment. Many potential risk indicators were excluded from the 2021 Risk Assessment due to limitations in the coverage, availability, and quality (collectively, "fitness") of the data necessary for calculating these indicators.[48] Ultimately, however, the inclusion of some risk indicators with data coverage issues was necessary to achieve diversity of indicators within each of the four risk indicator categories: Water Quality, Accessibility, Affordability, and TMF Capacity. In particular, many water systems lacked necessary data for the Affordability risk indicator category. For example, 872 water systems lacked water rates data necessary for two of the three Affordability risk indicators, '% MHI' and 'Extreme Water Bill.' The Assessment indicated 578 water systems lacked data for the third Affordability risk indicator '% Shut-Offs.' The Risk Assessment methodology has an approach for addressing missing data, but the lack of data resulted in a limited Affordability Assessment for these systems.

Limited Risk Indicator Selection

As previously mentioned, the State Water Board and UCLA conducted an extensive evaluation of potential risk indicators for the 2021 Risk Assessment. Unfortunately, many of the identified potential risk indicators did not meet the data fitness requirements necessary for inclusion. In particular, insufficient data is currently available to assess the financial capacity of water systems, capital asset conditions, source capacity, etc. The limited range of risk indicators currently available for the TMF Capacity category may help explain why this category is not contributing much to overall risk scoring for the vast majority or water systems assessed.

Furthermore, some risk indicators may be more applicable to some governance types of systems than others. For instance, some of the feedback received on the Affordability risk indicators was that using rates-based indicators does not capture the ways in which some systems finance the full cost of service provision. Another point raised was that some individual water systems are connected to larger utility structures that help mitigate TMF capacity and affordability risk in ways that are currently uncaptured in the Risk Assessment.

Database and Data Collection Limitations

The State Water Board's primary violation, enforcement and regulatory tracking database, Safe Drinking Water Information Systems (SDWIS), was designed for reporting compliance to the U.S. Environmental Protection Agency (U.S. EPA) for national tracking purposes. The database was not designed for the type of complex risk assessments being done in California or tailored to California's specific water quality regulations or drought-monitoring needs. SDWIS is limited in its ability to store technical, managerial and financial data and currently does not separate out other key system-level data components such as source capacity

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[48] October 7, 2020 White Paper:
Evaluation of Potential Indicators and Recommendations for Risk Assessment 2.0 for Public Water Systems
https://www.waterboards.ca.gov/safer/docs/e_p_i_recommendations_risk_assessment_2_public_water_systems.pdf

enforcement actions, boil water notices, how water system connections are utilized, water quality trends, etc. Several efforts to augment this data collection and management have been made by the State Water Board through project-specific efforts, such as Modified Drinking Water Watch,[49] the Electronic Annual Reports (EAR)[50] and the creation of the SAFER Clearinghouse. The ideal solution would likely entail the creation of a comprehensive data management system to fully support the transparent and data driven work required for this program.

RISK ASSESSMENT REFINEMENT OPPORTUNITIES

The Risk Assessment methodology will evolve over time to incorporate additional and better-quality data; evidence from targeted research to support existing and new risk indicators and thresholds; experience from implementing the SAFER Program; and further input from the State Water Board and public. The following highlights are near-term opportunities for Risk Assessment refinement:

Outreach to Tribal Water Systems
Concerted outreach to Tribal water systems is planned for 2021. These outreach efforts will be centered on informing tribal leaders about the purpose of the SAFER Program and informing them on the benefits of sharing information so that they may be included in future Risk Assessments. Outreach may also include combined efforts with the Department of Water Resources (DWR) to obtain drought related information to minimize State related information requests. In the interim, SAFER Program staff will continue to work with individual tribes, as requested by tribal leaders or in response to requests from the U.S. EPA.

Mid-Sized Urban Disadvantaged Water Systems
Mid-sized urban disadvantaged water systems, like those in Los Angeles County, in some cases appear to be ranking lower on the At-Risk list than expected. This may be attributed to the fact that many of the risk indicators in the Water Quality category do not score issues related to secondary standards as high compared to primary standards. Furthermore, many of these systems have interties and multiple sources, which means they do not score as many risk points in the Accessibility category. The limitations of the TMF Capacity Category discussed above also contribute to the lower risk scores for some of these systems. Thus, the State Water Board will be both working internally and partnering with the Water Replenishment District of Southern California (WRD) on their Needs Assessment efforts to help find ways to refine statewide data collection to ensure that more representative results are seen within these mid-sized systems.[51]

Expanded Data Collection Efforts
The State Water Board has already begun taking necessary steps to improve data coverage

[49] Drinking Water Watch
https://sdwis.waterboards.ca.gov/PDWW/

[50] Electronic Annual Report (EAR) | California State Water Resources Control Board
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/ear.html

[51] Draft State Water Resources Control Board, Resolution No. 2020-
https://www.waterboards.ca.gov/board_info/agendas/2020/jul/072120_4_drftreso.pdf

and accuracy for the Risk Assessment. Improvements to the 2020 reporting year EAR include new requirements for completing survey questions focused on customer charges.[52] EAR functionality has been developed that will help auto-calculate average customer charges for 6 HCF, which will help reduce data errors. Furthermore, the EAR will be able to better distinguish between water systems that do not charge for water compared to those that do.

The 2020 EAR also has a new section that will begin collecting annual revenues and incurred expenses data from community water systems. This data may be integrated into future iterations of the Risk Assessment to better assess water system financial risk. The State Water Board will also begin developing a new TMF Capacity section for future iterations of the EAR. Recommendations on potential TMF Capacity risk indicators identified through the Risk Assessment methodology development process[53] will serve as a starting point for this effort.

Source Capacity
Currently, source capacity violation and enforcement data in SDWIS is coded under the broad Waterworks Violation category because of its location in drinking water regulations.[54] As a result, source capacity violations and enforcement actions cannot be easily separated from other types of violations, e.g. failing to use certified chemicals or equipment, etc., without review of actual enforcement documents. The Waterworks Violation category as a whole will be revisited for its inclusion in future Risk Assessment iterations, as well as possible policy changes that would allow for clearer tracking of source capacity specific violations.

Refinement of Risk Indicators and Thresholds
During the Risk Assessment methodology development process, three additional Affordability risk indicators were recommended for inclusion in future iterations of the Risk Assessment:[55] 'Household Burden Indicator,' 'Poverty Prevalence Indicator,' and 'Housing Burden.'[56] The

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[52] Electronic Annual Report (EAR) | California State Water Resources Control Board
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/ear.html

[53] October 7, 2020 White Paper:
Evaluation of Potential Indicators and Recommendations for Risk Assessment 2.0 for Public Water Systems
https://www.waterboards.ca.gov/safer/docs/e_p_i_recommendations_risk_assessment_2_public_water_systems.pdf

[54] California Code of Regulation, Title 22, Chapter 16. California Waterworks Standards §64551.40 Source Capacity

[55] October 7, 2020 White Paper:
Evaluation of Potential Indicators and Recommendations for Risk Assessment 2.0 for Public Water Systems
https://www.waterboards.ca.gov/safer/docs/e_p_i_recommendations_risk_assessment_2_public_water_systems.pdf

[56] *Household Burden Indicator*: This indicator measures the economic burden that relatively low income households face in paying their water service costs by focusing on the percent of these costs to the 20th percentile income (i.e. the Lowest Quintile of Income (LQI) for the service area). This indicator is calculated by adding the average drinking water customer charges, dividing them by the 20th Percentile income in a community water system, and multiplying this by one hundred.

Poverty Prevalence Indicator: This indicator measures the percentage of population served by a community water system that lives at or below 200% the Federal Poverty Level. This measurement indicates the degree to which relative poverty is prevalent in the community.

State Water Board will begin conducting the proper research and stakeholder engagement needed to develop the appropriate affordability thresholds necessary for inclusion in the Risk Assessment and potentially the Affordability Assessment as well.

Furthermore, as data on water system risk indicators and failures is tracked consistently over time going forward, future versions of the Risk Assessment will be able to more fully evaluate data-driven weighting and scoring approaches to characterizing water system risk. This may lead to dropping risk indicators from the assessment which demonstrate less relationship to risk than expected, and adding others which reflect new, or previously underestimated dimensions of risk.

The intent of the State Water Board going forward is to update the Risk Assessment annually, and in so doing, enhance the accuracy and inclusiveness of the assessment via an iterative, engaged process. Accordingly, future versions of the Risk Assessment will continue to incorporate new data and enhance existing data quality.

Housing Burden: This indicator measures the percent of households in a water system's service area that are both low income and severely burdened by housing costs (paying greater than 50% of their income for housing costs). This metric is intended to serve as an indicator of the affordability challenges low-income households face with respect to other non-discretionary expenses, which may impact their ability to pay for drinking water services.

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 where groundwater is used or likely to be used as a drinking water source. This information is presented as an online map tool called the Aquifer Risk Map.[57] The first version of the Aquifer Risk Map was released on January 1, 2021 and will be updated annually with new data. Previous work is available on the State Water Board's Needs Assessment webpage.[58]

RISK ASSESSMENT METHODOLOGY

The State Water Board has limited water quality and location data for state small water systems and domestic wells, as these systems are not regulated by the State nor are maximum contaminant levels directly applicable to domestic wells.[59] 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 (Figure 29). 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.

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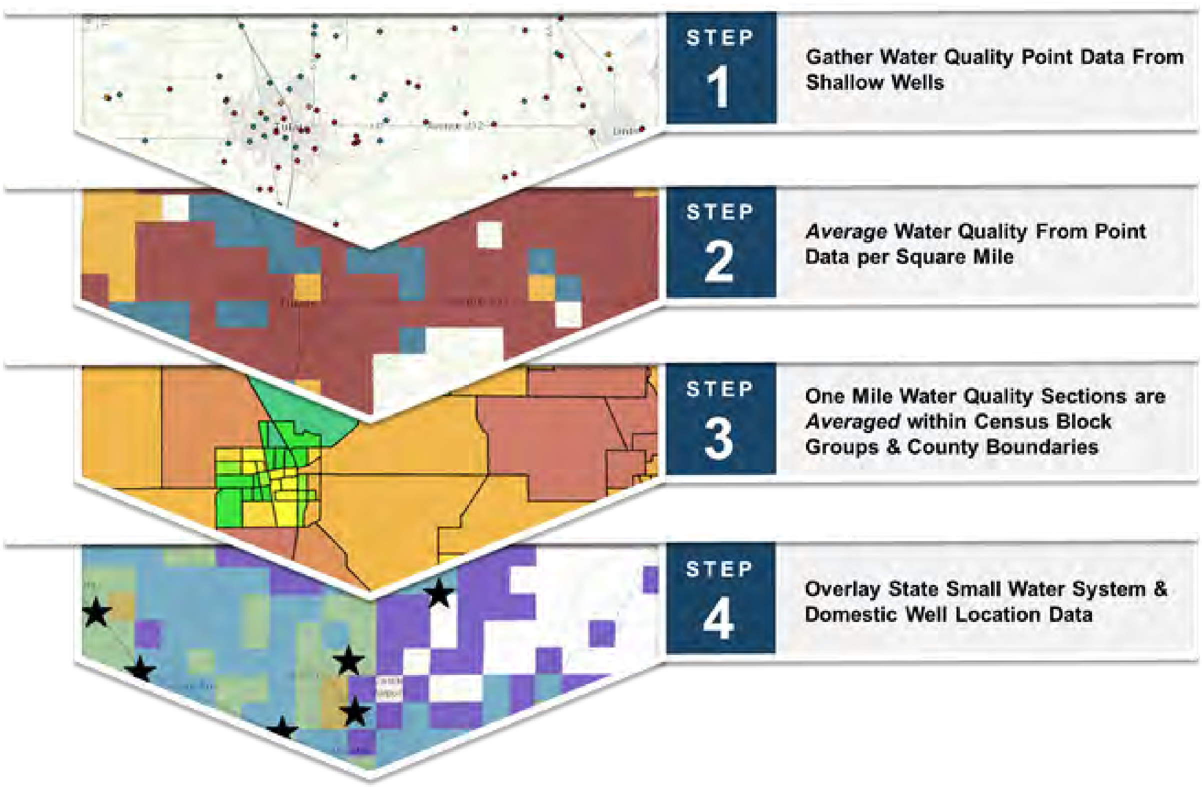
[57] Aquifer Risk Map Webtool
https://gispublic.waterboards.ca.gov/portal/apps/webappviewer/index.html?id=17825b2b791d4004b547d316af7ac5cb

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

[59] 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.

Figure 29: Risk Assessment Methodology for State Small Water Systems & Domestic Wells



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

STEP 1: Publicly available source water quality data from shallow wells was collected.

STEP 2: This data was averaged per square mile to provide a best estimate of state small water system and domestic well depth groundwater quality. The average groundwater quality for each square mile section was compared to the maximum contaminant level (MCL) to classify sections as "high", "medium", or "low" risk. Sections without data were classified as "no data". For more detail on this comparison criteria, refer to Appendix B.

STEP 3: The groundwater quality estimates per square mile sections were averaged by census block groups to rank the relative risk that a census block group may not meet primary drinking water standards (water quality risk). This averaging characterized each census block group based on the number of contaminants that may exceed primary drinking water standards, the magnitude of this exceedance, and the area potentially affected.

STEP 4: Location data for domestic wells was obtained from Department of Water Resources well completion record database, and location data for state small water systems was obtained from the Rural Community Assistance Corporation. This location data was used to calculate the density of state small water systems and domestic well users per square mile in each census block group (exposure risk).

The water quality and exposure risk scores were added together to calculate the combined risk, which identified census block groups that are most likely to have a high density of state small water system and domestic well users and to have water quality that exceeds primary drinking water standards. Other reference information for each census block group included the names of specific contaminants that are above or close to the MCL, the data coverage, and the disadvantaged community status based on median household income.

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. *These proxy data do not assess the compliance of any individual well or system.* As a result, the presence of a given state small water system or domestic well within a high-risk area does not signify that they are accessing groundwater above primary drinking water standards. Conversely, a state small water system or domestic well mapped in a low-risk area may be in fact accessing groundwater above primary drinking water standards. Physical monitoring and testing of state small water systems and individual domestic well water is needed to determine if those systems are producing water that does not meet drinking water standards.

Table 14 shows the approximate counts of state small water systems and domestic wells statewide located in source water quality risk designations based on data from the 2020 Aquifer Risk Map.

Table 14: Domestic Well and State Small Water System Counts by Section Water Quality Risk Category (Statewide)

Section Water Quality Risk Designation	Domestic Wells[60]	State Small Water Systems
High Risk	77,973	611
Medium Risk	15,791	71
Low Risk	147,185	554
No Data	84,800	227

Figure 30 shows the counties that have the highest number of domestic wells mapped in high risk sections, as well as the total number of domestic wells per county. Figure 31 shows the counties that have the highest number of state small systems mapped in high risk sections, as well as the total number of state small systems per county. Figure 32 shows the highest risk areas based on the census block group combined risk percentile ranking from the 2020 Aquifer

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

Risk Map. For more detail about the Section Water Quality Risk Designations, please refer to Appendix B.

Figure 30: Domestic Well Records by Section Water Quality Risk Bin (By County)

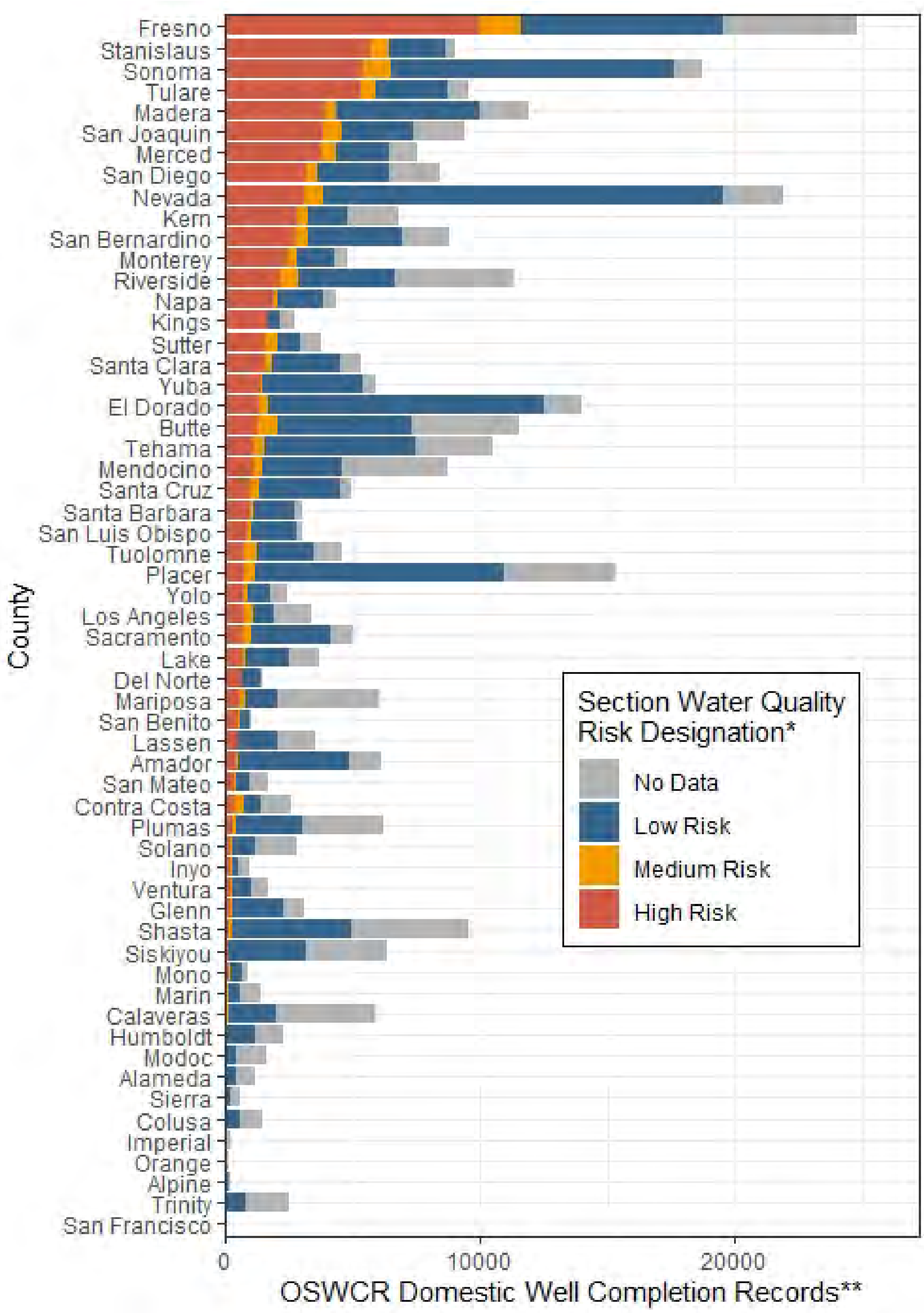


Figure 31: State Small Water Systems by Section Water Quality Risk Bin (By County)

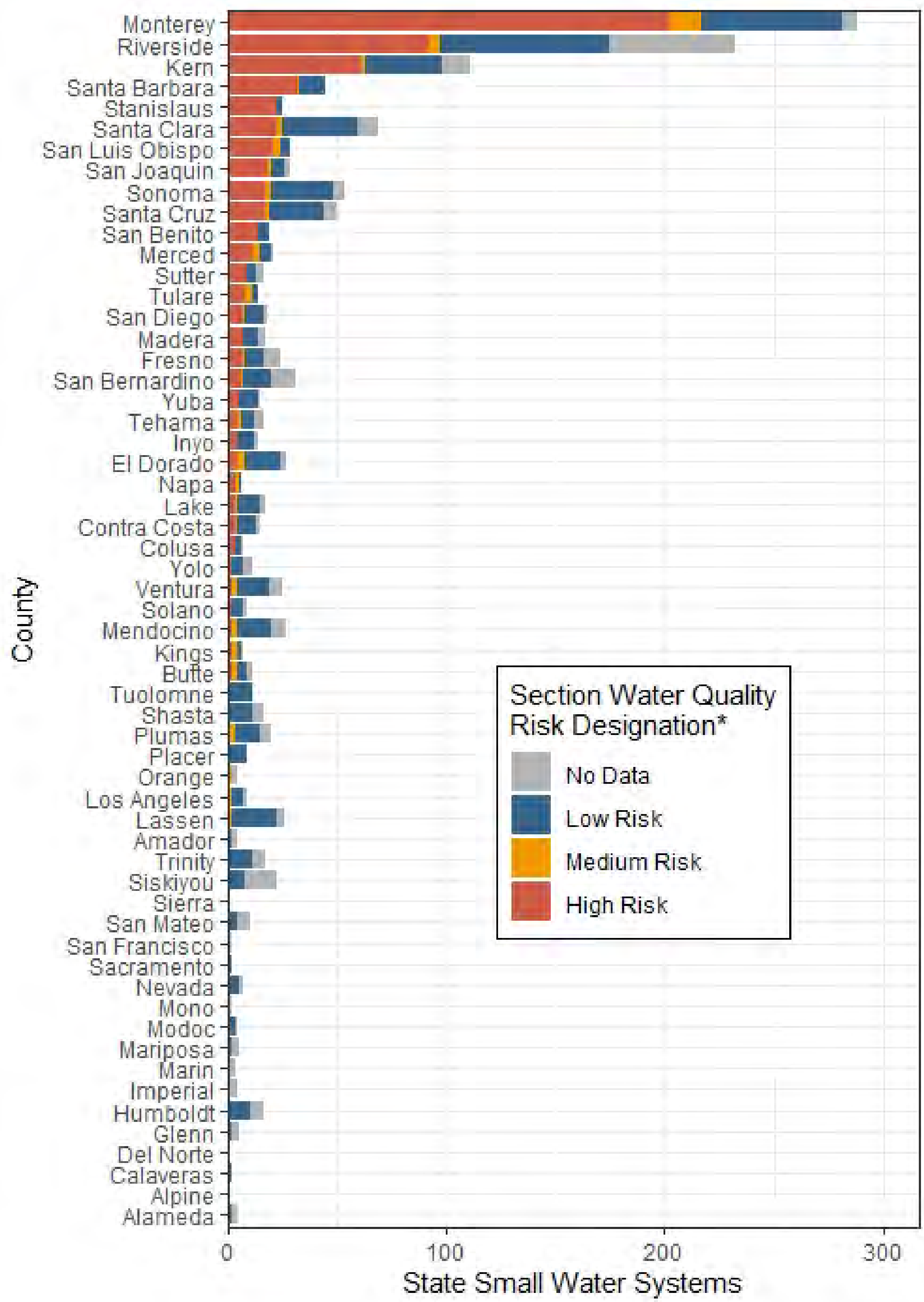
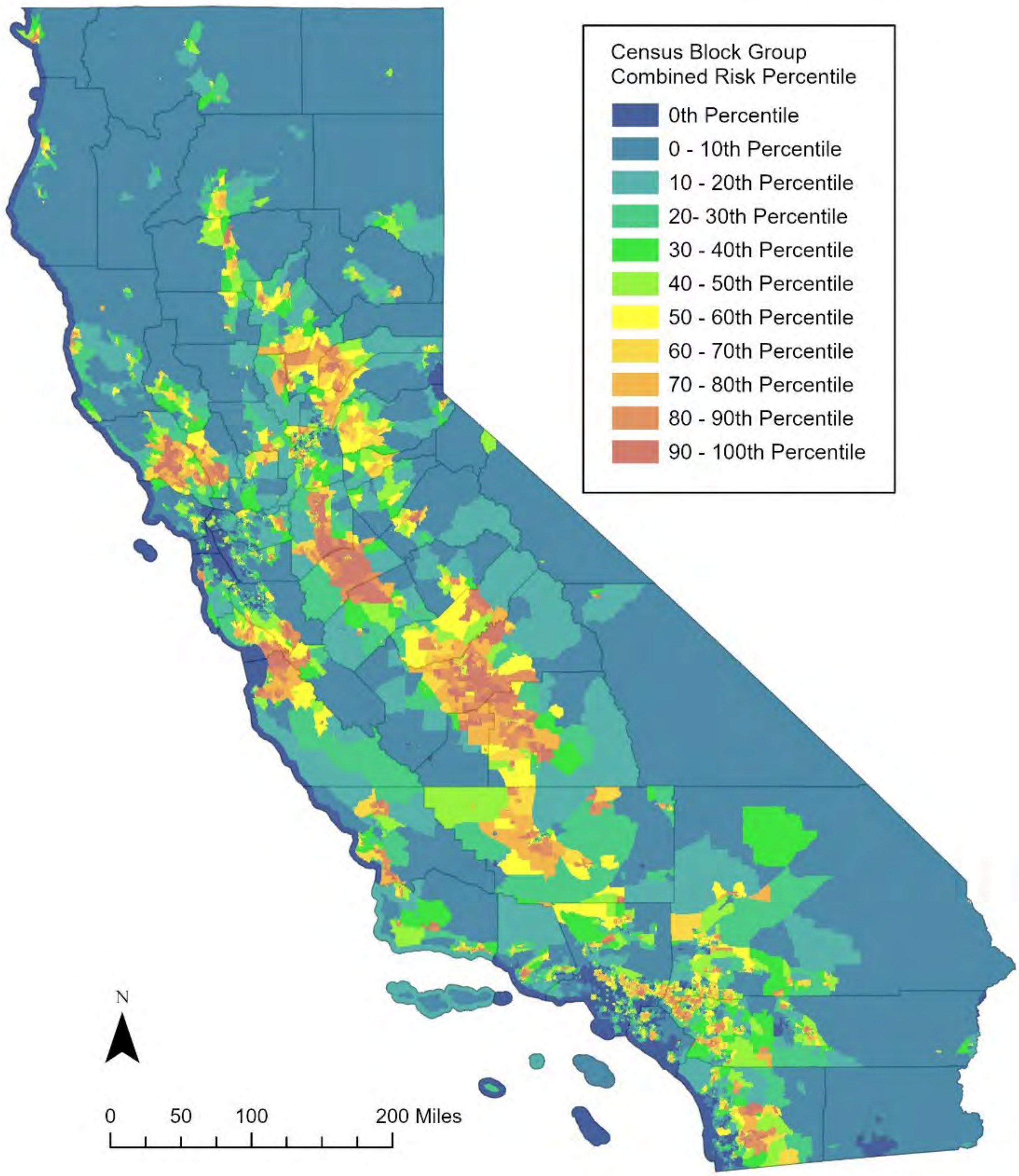
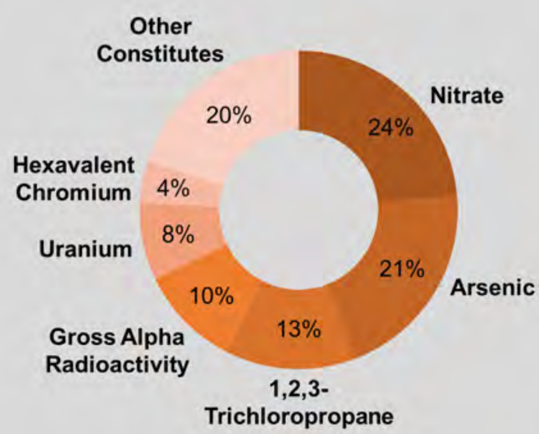


Figure 32: Combined Risk Percentile for Domestic Wells and State Small Water Systems (Census Block Groups)



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 33 shows the proportion of domestic wells in high risk areas where the contaminant may exceed drinking water standards. Note that multiple contaminants may exceed drinking water standards at a single location.

Figure 33: Constituents Contributing to Shallow Water Quality Risk



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 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 risk for state small water systems and domestic wells.

REFINEMENT OPPORTUNITIES

Provisions under SB 200 requires 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.[61] 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.

Future work may involve connecting the State Water Board's source water quality risk data to the Department of Water Resources drought risk assessment of rural/self-supported communities. The drought risk assessment identifies census block groups that are at risk of water shortage or water supply issues.

[61] 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

COST ASSESSMENT RESULTS

OVERVIEW

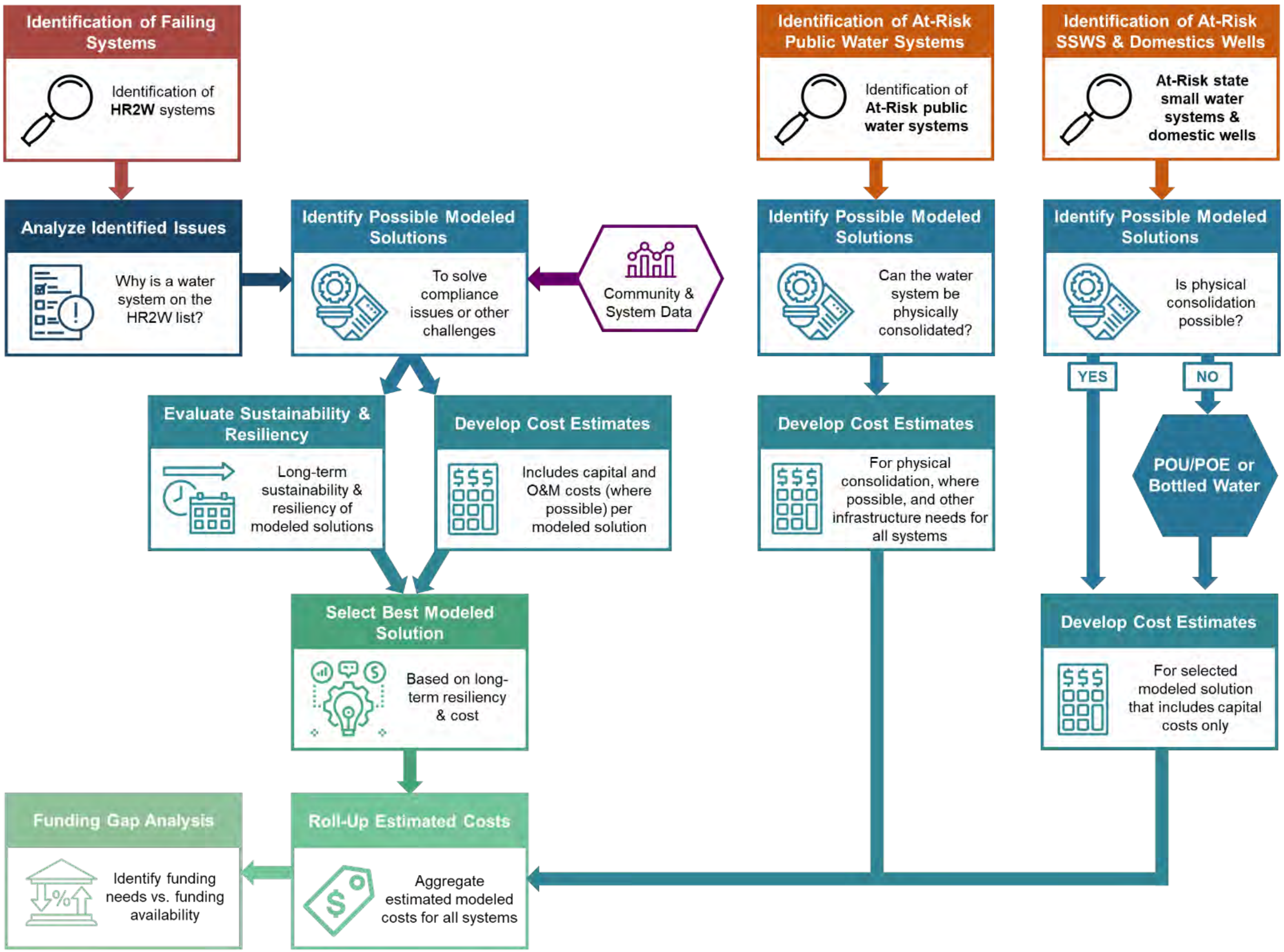
The State Water Board, in partnership with UCLA, Corona, and Sacramento State University OWP, developed a Cost Assessment methodology for estimating the cost of interim and long-term solutions for HR2W list and At-Risk public water systems, tribal water systems (Appendix F), At-Risk state small water systems, and domestic wells (Figure 34). The scope of the Cost Assessment is to assess the overall need of the systems analyzed by the SAFER Program. The estimated costs and resulting Gap Analysis will be utilized to inform the broader demands of the SAFER Program as well as the annual funding needs for the Safe and Affordable Drinking Water Fund. The embedded assumptions and cost estimates detailed in this report are purely for the purposes of the Needs Assessment. Local solutions and actual costs will vary from system to system and will depend on site-specific details. Therefore, the Cost Assessment will not be used to inform site-specific decisions but rather give an informative analysis on a statewide basis.

COST ASSESSMENT MODEL

Development of the Cost Assessment Model comprised of multiple stages between September 2019 and March 2021, each of which were detailed in publicly-available white papers, presented at public webinars, the public feedback from which was incorporated into the final Cost Assessment Model methodology and results. A brief summary of the Cost Assessment Model is provided below, while a detailed description is provided in Appendix C. Attachment C5 has more detailed information on the outcomes of the Cost Assessment.[62]

[62] Attachment C5: Additional Cost Assessment Results & Regionalization Analysis https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/c5.pdf

Figure 34: Cost Assessment Model Process



Water Systems & Domestic Wells Assessed

The Cost Assessment models potential solution costs for HR2W list systems, At-Risk public water systems (PWSs), as well as At-Risk state small water systems (SSWSs) and At-Risk domestic wells. Table 15 documents the counts of different system types and domestic wells on the dates that they were included in the 2021 Cost Assessment. Water system compliance fluctuates and therefore this report represents a snapshot in time used to provide a comprehensive statewide estimate. The total number of systems, by system type, differ from the list of systems included in the Risk Assessment and Affordability Assessment results sections due to the timing requirements necessary to complete the Cost Assessment. Therefore, earlier lists of systems were utilized for this assessment.

Table 15: Summary of HR2W List & At-Risk Systems Included in the Cost Assessment

System Type	Total Systems	Notes
HR2W	305	Includes HR2W list systems as of 12/1/2020
At-Risk Public Water System (PWS)	630	Includes At-Risk and Expanded HR2W list systems as of 1/21/2021
At-Risk State Small Water System (SSWS)	455[63]	Monterey County SSWSs are based on actual water quality data, other counties' SSWSs are based on GAMA Model as of 9/21/2020
At-Risk Domestic Wells	62,607	Based on GAMA Model as of 9/21/2020

Possible Solutions Considered

The Cost Assessment considered various potential modeled solutions for HR2W list and At-Risk systems and domestic wells. Below are brief descriptions of the potential modeled solutions and Table 16 summarizes the number of potential solutions considered by water system type.

Physical Consolidation: The physical connection of two or more water systems that are geographically close. This solution was modeled for:

- HR2W list systems, At-Risk PWS, At-Risk SSWS, & At-Risk domestic wells.

Treatment: An infrastructure solution used to lower the concentration of contaminants that exceed water quality standards to ensure compliance. For the full list of treatment solutions considered, please refer to Appendix C. Treatment solutions were modeled for:

[63] The number of At-Risk state small water systems and domestic wells in the long-term solutions cost analysis is different than the number in the Risk Assessment results and the interim solutions cost analysis because the data for the long term cost was based on the GAMA model for the six contaminants that were available at the time the data was used. The interim solutions cost model was based on a later GAMA model that has all contaminants with an MCL.

- HR2W list systems only.

POU/POE: Point-of-use (POU) or point-of-entry (POE) treatment technologies are used to address contaminants that exceed water quality standards to ensure compliance, when other solutions are not cost effective or may be infeasible to maintain for a very small community. This solution was modeled for:

- HR2W list systems (200 connections or less), At-Risk SSWS, & At-Risk domestic wells.

Other Essential Infrastructure (OEI): A broad category of additional needed infrastructure for the successful implementation of the long-term modeled solution and to enhance system sustainability that includes storage tanks, new wells, well replacement, upgraded electrical, added backup power, replacement of distribution system, additional meters, and land acquisition. A percentage of these additional solutions were modeled for the system types below and applied to the total modeled cost:

- HR2W list systems & At-Risk PWSs.

Operations & Maintenance (O&M): Ongoing, day-to-day O&M of a treatment system, including operator labor. This solution was modeled for:

- HR2W list systems only.

Interim or Emergency Solutions: Due to data limitations for other potential interim solutions, only bottled water and POU and POE interim treatment, including the O&M costs for maintaining a temporary installment of POU/POE systems, were assessed. These solutions were modeled for:

- HR2W list systems, At-Risk SSWSs, & At-Risk domestic wells.

Technical Assistance (TA): A broad category of support to assist water system operators and managers with planning, construction projects, financial management and O&M tasks. This solution was modeled for:

- HR2W list systems & At-Risk PWSs.

Table 16: Frequency of Modeled Long-Term Solution Type Considered

System Type	# of Systems	Treatment	Physical Consolidation	POU/POE	OEI & TA
HR2W	305	305 (100%)	107 (35%)	194 (64%)	305 (100%)
At-Risk PWS	630	N/A	234 (37%)	N/A	630 (100%)
At-Risk SSWS	455	N/A	262 (58%)	455 (100%)	N/A
At-Risk Domestic Wells	62,607	N/A	25,696 (41%)	62,607 (100%)	N/A

Interim and/or emergency modeled solutions were only assessed for HR2W list systems and At-Risk SSWSs and domestic wells, as shown in Table 17 below. Interim modeled solutions were not calculated for At-Risk PWSs. Due to the timing constraints of the Cost Assessment Model development process, the interim modeled solutions were assessed for the inventory of HR2W list[64] and At-Risk SSWSs and domestic wells that were derived from the Risk Assessment results.[65]

Table 17: Frequency of Modeled Interim Solution Types Considered

System Type	# of Systems	POU	POE	POU & POE	Bottled Water
HR2W list	343	273 (80%)	273 (80%)	273 (80%)	343 (100%)
At-Risk SWSS	611	611 (100%)	611 (100%)	611 (100%)	611 (100%)
At-Risk Domestic Wells	77,569	77,569 (100%)	77,569 (100%)	77,569 (100%)	77,569 (100%)

Evaluating Possible Modeled Solutions

For some systems, the Cost Assessment Model identified multiple potential solutions based on the system's identified challenges and additional site-specific information. For these systems, the Cost Assessment Model needed to select one of the potential model solutions for the aggregated cost estimate. For the HR2W list systems, the State Water Board recognized that the lowest-cost model solution may not always be the best long-term solution for a system and the community it serves. Therefore, a sustainability and resiliency assessment (SRA) was used to narrow down the potential modeled solutions per system by evaluating a set of sustainability metrics: O&M Cost per Connection, Relative Operational Difficulty, Operator Training Requirements, and Waste Stream Generation (refer to Appendix C and Attachment C4 for additional details).[66]

Selecting Modeled Solutions for Aggregated Cost Estimate

Long-Term Modeled Solutions

The resulting SRA scores were then compared against solution costs to select one modeled solutioned (the "selected modeled solution") for each system. For example, of the 107 HR2W list water systems where physical consolidation was a potential modeled solution, the SRA and cost analysis indicated that this was the best modeled solution for 61 (57%) systems. The costs for HR2W and At-Risk consolidations utilize a one-water system to one-water system

[64] HR2W list of water systems from 12.21.2020. The long-term Cost Assessment Model utilizes the HR2W list of systems from 12.02.2020.

[65] The long-term Cost Assessment Model utilizes an older set of At-Risk PWSs, SSWSs, and domestic wells. The most notable difference is the number of At-Risk domestic wells 77,569 for interim modeled solutions vs. 62,607 for long-term modeled solutions.

[66] Attachment C4: Sustainability and Resiliency Assessment
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/c4.pdf

approach, which may make some consolidations unaffordable. More information on cost reductions that can occur as a result of regional cost estimates for consolidation models is discussed below and Appendix C but not utilized in this iteration of the Cost Assessment. As a result, few consolidations and more POU/POE devices may have been selected during the assessment.

The costs for the selected modeled solutions were then used for the aggregated cost estimates presented in this report. Appendix C and Attachment C4 provide additional details of the SRA methodology and the model solution selection criteria which is based on the SRA score and costs estimates.[67] The selected solution counts are summarized in Table 18.

Table 18: Count of Selected Modeled Solution

System Type	# of Systems	Treatment	Physical Consol.	POU/ POE	OEI & TA	No Solution
HR2W list	305	138 (45%)	61 (20%)	106 (35%)	305 (100%)	0
At-Risk PWS	630	N/A	145 (23%)	N/A	630 (100%)	0
At-Risk SSWS	455	N/A	142 (31%)	303 (67%)	N/A	10[68] (2%)
At-Risk Domestic Well	62,607	N/A	25,696 (41%)	36,911[69] (59%)	N/A	0

Interim Modeled Solutions

Due to sustainability concerns, bottled water was only assigned in the cost estimation modeling as an interim solution if POU or POE was deemed infeasible from a treatment or monitoring standpoint. The full list of contaminants for which these treatment technologies were deemed sufficient for water quality compliance was manually determined in conjunction with State Water Board staff, and the list is provided in Appendix C. For example, high concentrations of nitrate (above 25 mg/L) cannot be effectively removed to regulatory standards by POU devices. Bacteriological growth, hard water, or the presence of iron or manganese may also cause issues with POU membrane fouling.

For HR2W list systems, POU, POE or a combination of the two technologies was thus assigned in every case where these technologies were appropriate and the system had 200

[67] Attachment C4: Sustainability and Resiliency Assessment
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/c4.pdf

[68] Nitrate in 10 Monterey County systems has been measured above 25 mg/L as N, so POU is not considered a viable treatment alternative.

[69] Nitrate modeled above 25 mg/L as N in 1,216 domestic wells and 15 SSWS. POU treatment is not a viable option if the nitrate concentration is this high. Water quality samples should be collected to determine which sources are above this threshold. POU treatment has been budgeted as the modeled solution.

connections or less, as this system size was deemed in the model to be the maximum practical for device monitoring purposes. Because there was no connection size concern with At-Risk SSWSs and domestic wells, bottled water was only assigned in the estimation as an interim solution for these system types if POU or POE was infeasible from a treatment standpoint.

Based on the model decision criteria outlined above, Table 19 shows that nearly 43% of HR2W list systems were assigned bottled water as an interim modeled solution in the Cost Assessment. However, only 4% - 5% of At-Risk SSWSs and domestic wells were assigned bottled water as an interim solution.

Table 19: Interim Solutions Estimated by System Type[70]

System Type	# of Systems	POU	POE	POU & POE	Bottled Water
HR2W list	343	139 (41%)	37 (12%)	20 (6%)	147 (43%)
At-Risk SWSS	496	382 (77%)	30 (6%)	61 (12%)	23 (5%)
At-Risk Domestic Wells	59,366	39,656 (67%)	8,731 (15%)	7,501(13%)	3,478 (6%)

COST ESTIMATION LEVEL OF ACCURACY

It is important to note that the long-term Cost Assessment results summarized in the subsequent section correspond with a Class 5 cost estimate as defined by Association for the Advancement of Cost Engineering (AACE) International.[71] Class 5 cost estimates are considered appropriate for screening level efforts, such as the Cost Assessment, and have a level of accuracy ranging from -20% to -50% on the low end and +30% to +100% on the high end. The full range of estimate is thus -50% to +100%. A Class 5 cost estimate is standard for screening construction project concepts. These costs are for budgetary purposes only. A more site specific and detailed assessment will be needed to refine the costs and select a local solution that is most appropriate.

For the recommended long-term modeled solution costs, a point estimate of the cost estimates is sometimes shown; however, it is important the reader view each value with the accuracy in mind. For example, if a cost of $100 is presented, the corresponding range of anticipated costs is $50 to $200. Costs have been rounded to three significant figures in many cases so that the cost accuracy is not overrepresented.

[70] A total of 77,569 domestic wells and 611 SWSSs were analyzed to determine interim solution cost. Any domestic well or SWSSs with a recommended POU or POE filter combination interim solution that matches the recommended filter long term solution were excluded. The domestic wells and SWSSs in this analysis are in high risk aquifer risk map sections placing them at priority for long term solution spending.

[71] AACE International Recommended Practice No. 17R-97 Cost Estimate Classification System, TCM Framework: 7.3 - Cost Estimating and Budgeting, Rev. August 7, 2020.

STATEWIDE CAPITAL COST ESTIMATE

The capital cost range for the selected long-term modeled solutions, including OEI needs is shown in Table 20. Treatment options were not considered for At-Risk PWSs. OEI needs costs were applied to *all* HR2W list and At-Risk PWSs (why costs are high). Table 21 shows the average cost per connection for the selected modeled solutions.

Table 20: Selected Modeled Solution Costs, Excluding O&M, by System Type (in $ Millions)

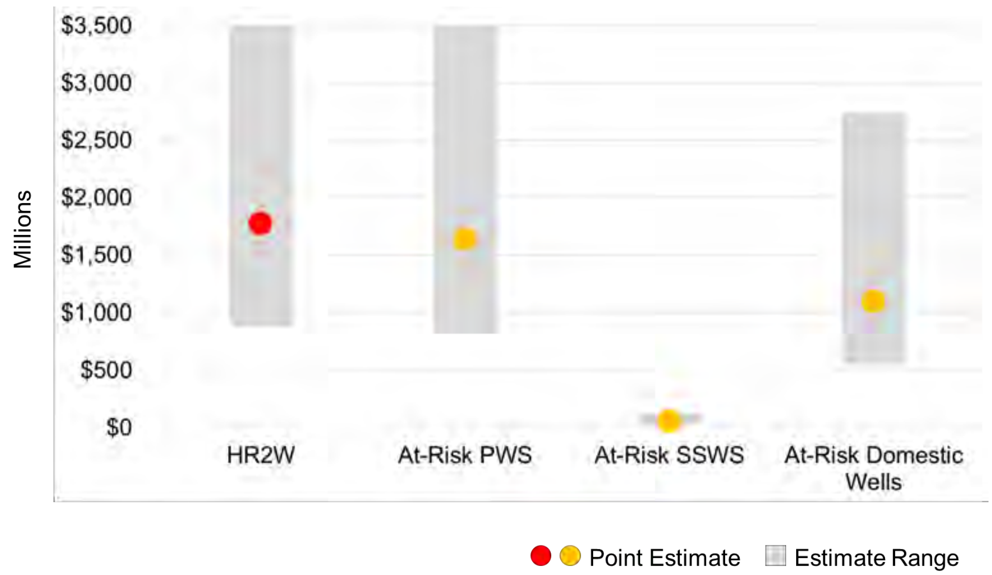
System Type	Treatment	Physical Consol.[72]	POU/ POE	OEI & TA	Point Est. Total	Range Total
HR2W	$201 - $802	$65 - $261	$9 - $37	$612 - $2,450	**$1,770**	**$887 - $3,550**
At-Risk PWS	N/A	$146 - $585	N/A	$673 - $2,690	**$1,640**	**$819 - $3,280**
At-Risk SSWS	N/A	$17 - $69	$9 - $37	N/A	**$53**	**$27 - $106**
At-Risk Domestic Wells	N/A	$400 - $1,600	$148 - $592	N/A	**$1,100**	**$548 - $2,190**
TOTAL:	**$201 - $802**	**$628 - $2,520**	**$166 - $666**	**$1,290 - $5,140**	**$4,560**	**$2,280 - $9,130**

Table 21: Selected Modeled Solution Average Costs per Connection, by System Type

System Type	Treatment	Physical Consol.	POU/ POE	OEI & TA
HR2W	$9,430 - $37,700	$14,700 - $58,800	$8,730 - $34,900	$34,300 - $137,300
HR2W Annual O&M	$388 - $1,600	$6 - $24	$727 - $2,900	N/A
At-Risk PWS	N/A	$17,400 - $69,700	N/A	$8,400 - $33,500
At-Risk SSWS	N/A	$15,000 - $59,900	$3,790 - $15,200	N/A
At-Risk Domestic Wells	N/A	$15,600 - $62,300	$1,000 - $4,000	N/A

[72] This analysis only considered system-to-system consolidation rather than regional consolidation due to data limitations. However, based on preliminary analysis of cost comparisons for regional consolidation as opposed to system-to-system consolidations, the State Water Board believes significant cost savings for consolidations can be achieved through a regional approach. See Attachment C5 for additional information. https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/c5.pdf

Figure 35: Statewide Modeled Long-Term Capital Cost Estimates, By System Type



Average Capital Cost per Connection

The cost per connection of a solution is an important consideration for state funding eligibility, as further detailed in the funding Gap Analysis section of this report. Generally, the State Water Board can more easily grant fund projects for small, economically disadvantaged systems. The project funding range cap is often between $30,000 to $60,000 per connection, depending on the type of project. Table 22 summarizes the cost per connection of modeled capital costs, including OEI needs. The systems have been categorized by the number of connections they serve, from larger to smaller systems. This display of results illustrates the relatively higher per connection cost of bringing small systems into compliance, and thus the advantages of economies of scale.

Table 22: Average Long-Term Capital Cost per Connection by System Size for HR2W List Systems

System Type	3,300+[73]	3,300 – 1,001[74]	1,000 – 501	500 – 101	100 or less
HR2W	$4,900	$6,800	$11,700	$18,200	$86,900
HR2W Annual O&M	$230	$320	$560	$300	$910
HR2W Schools	N/A	N/A	N/A	$11,423	$87,863[75]
HR2W Schools Annual O&M	N/A	N/A	N/A	$47	$208

Table 23: Average Long-Term Capital Cost per Connection by System Size for At-Risk Systems

System Type	3,300+	3,300 – 1,001	1,000 – 501	500 – 101	100 or less
At-Risk PWS	$3,620	$17,300	$15,500	$26,200	$90,700
At-Risk Schools	N/A	N/A	N/A	$14,765	$1.82 M
At-Risk SSWS	N/A	N/A	N/A	N/A	$9,350[76]
At-Risk Domestic Wells	N/A	N/A	N/A	N/A	$17,500[77]

[73] Larger water systems typically have multiple sources. Modeled treatment is based on addressing only those sources that have known contamination. Under the additional infrastructure costs, no additional wells were assumed to be needed for redundancy if there is more than one source. For these reasons and economies of scale, the costs for larger systems are significantly lower for smaller systems.

[74] Larger water systems typically have multiple sources. Modeled treatment is based on addressing only those sources that have known contamination. Under the additional infrastructure costs, no additional wells were assumed to be needed for redundancy if there is more than one source. For these reasons and economies of scale, the costs for larger systems are significantly lower for smaller systems.

[75] The number of connections was adjusted to account for population size.

[76] Costs associated with domestic wells and SSWSs do not include additional infrastructure costs that are similar to public water systems. For example, well replacement costs and second wells for redundancy are not included since they are expected to be paid for by the homeowner.

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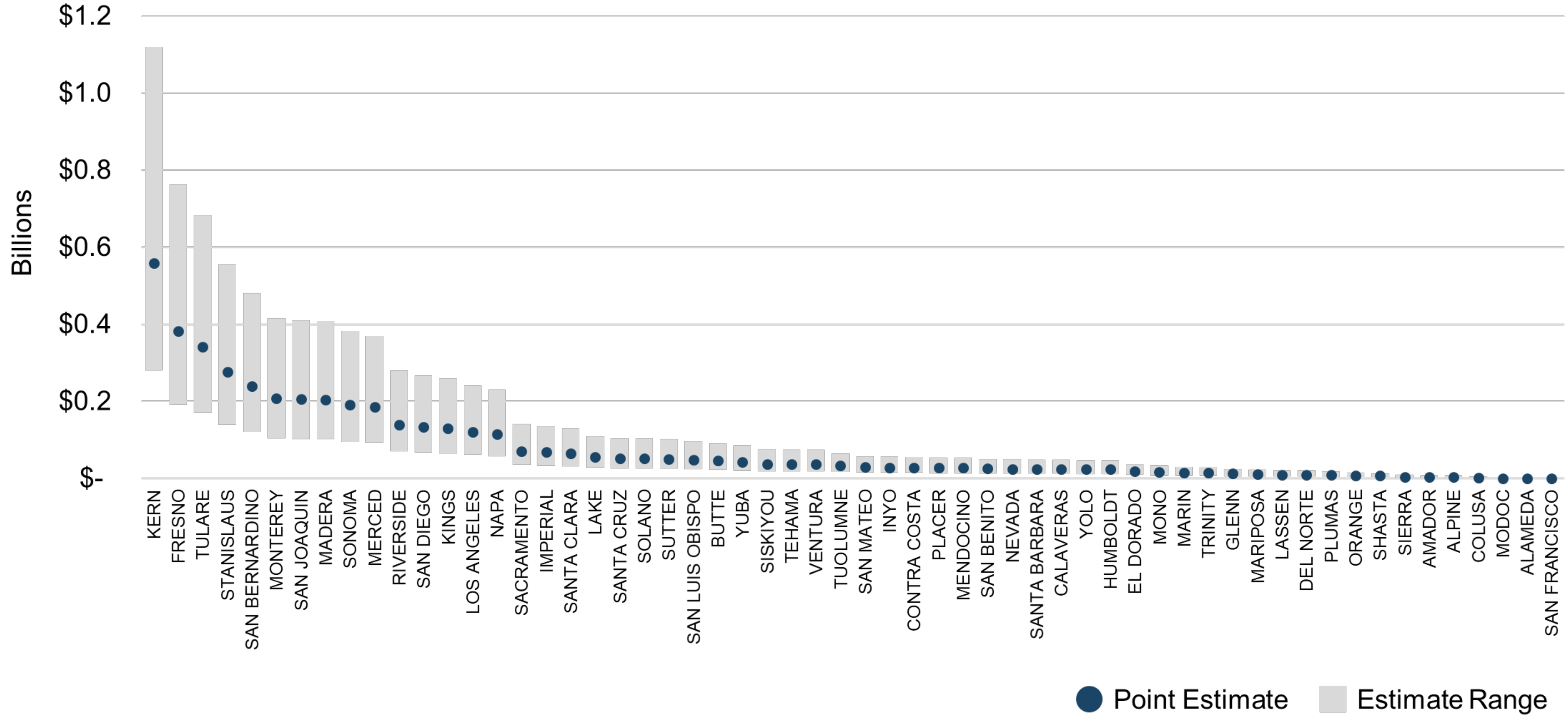
Estimated Capital Costs by County

Figure 36 shows the total capital cost by county for HR2W list systems, At-Risk PWSs, SSWSs, and domestic wells. Some areas of the state have noticeably more need when compared with other areas. For example, the Central Valley counties of Kern, Fresno, Tulare, and Stanislaus are four of the top five highest need counties, with San Bernardino being the lone county outside the Central Valley in the top five.

Figure 36: Total Long-Term Capital Costs, Including OEI Costs, by County



STATEWIDE O&M COSTS ESTIMATE

Table 24 shows the annual estimated O&M costs for HR2W list systems. There is a large difference in the total annual costs for POU/POE solutions versus treatment, $1.6 million and $52.4 million, respectively. However, the estimated O&M costs per connection are more comparable, at $1,500 per connection (POU/POE) and $780 per connection (treatment). Costs modeled for physical consolidation were focused on electrical pumping costs and found to be negligible. Estimated annual O&M costs for At-Risk systems were not included because the model proposed infrastructure upgrades and additional technical assistance in lieu of O&M support for systems where the model determined consolidation was not an option.

Table 24: Selected HR2W List Modeled Solution Total and Per Connection Annual O&M Costs[78]

Cost Type[79]	Treatment	POU/ POE	O&M Point Estimate Total	O&M Range Total
Total Cost	$52.4 M	$1.60 M	**$54.1 M**	**$24.0 M - $108 M**
Average Cost Per Connection	$780	$1,500	**$2,280**	**$1,140 - $4,560**

The 20-year net present worth (NPW) was estimated only for HR2W list systems, as shown in Table 25. Here, the NPW estimates the total sum of funds that need to be set aside today to cover all the expenses (capital, including OEI costs, and annual O&M) during the potential useful life of the infrastructure investment, which is conservatively estimated at 20-years. This calculation is only meaningful in the context of systems that have a calculated estimated annual O&M expense, thus NPW was not estimated for At-Risk systems and domestic wells, except in the case of interim solutions. The NPW for the HR2W list systems has a point estimate of $2.51 billion and range (-50%, +100%) of $1.25 billion to $5.3 billion.

Table 25: Selected Modeled Solution Total 20-Year Net Present Worth (NPW) for HR2W Systems, Including OEI Costs and O&M[80]

Total Cost	20-Yr. NPW Point Estimate Total	20-Yr. NPW Range Total
Total Cost for HR2W List Systems	**$2.51 B**	**$1.25 B - $5.02 B**
Average Cost per Connection	**$252,900**	**$126,500 - $505,900**

[78] Annual O&M costs were not estimate for any At-Risk systems

[79] Physical consolidation was evaluated for O&M costs based on electric costs for pumping, however, these costs were in most cases were negligible and therefore excluded from this table.

[80] NPW is only meaningful in the context of systems that have a calculated annual operations and maintenance expense, thus NPW was not estimated for At-Risk systems.

ADDITIONAL LONG-TERM COST ASSESSMENT ANALYSIS

Additional analysis of long-term solution costs was conducted as part of the Cost Assessment effort. Further analysis is also detailed in Attachment C5.[81]

Estimated Long-Term Costs by Contaminant

Table 26 shows the average costs for the selected modeled solution categorized by contaminant. Nitrate is estimated to be the most expensive to address on average using all three cost measures (capital costs, annual O&M costs, and 20-year NPW costs). Factors such as water system size have significant impact to the average capital costs. Additional information can be found on the assumptions impacting this data in Attachment C5.[82]

Table 26: Estimated Average HR2W List Costs per Contaminant per Connection, Excluding OEI Costs

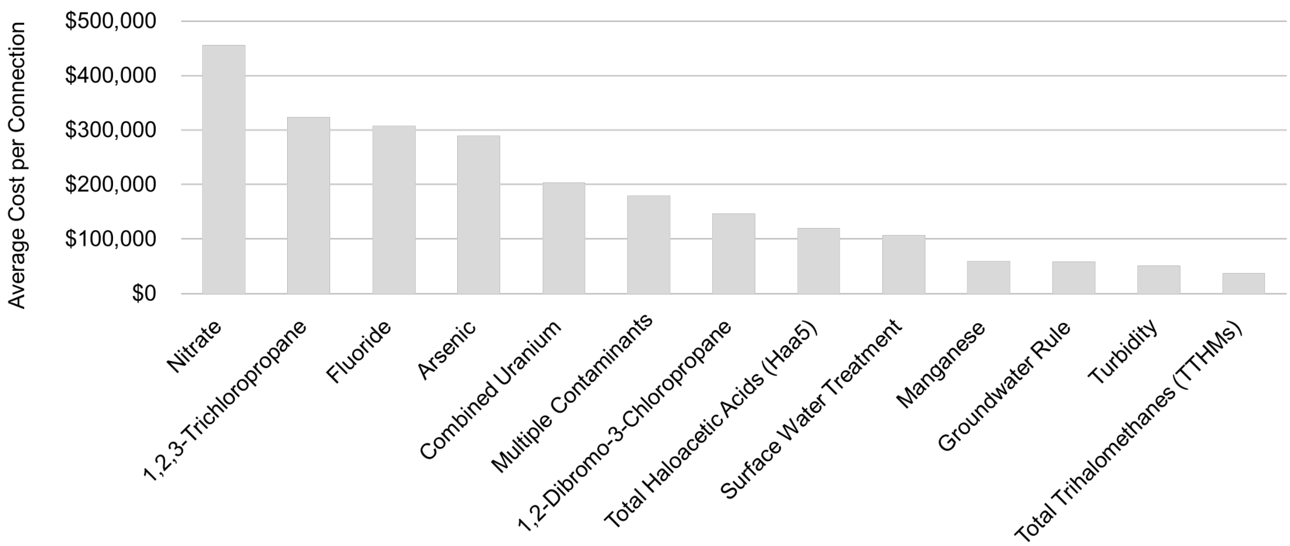
Contaminant	# of Systems	Average Capital Cost per Conn.	Average O&M Cost per Conn.	Average 20-Yr. NPW per Conn.
1,2,3-Trichloropropane	49	$319,000	$462	$324,000
1,2-Dibromo-3-Chloropropane	1	$146,000	N/A	$146,000
Arsenic	63	$279,000	$918	$290,000
Combined Uranium	17	$190,500	$1,320	$203,000
Fluoride	8	$304,000	$295	$308,000
Groundwater Rule	2	$57,000	$164	$58,000
Manganese	3	$55,800	$261	$59,400
Nitrate	37	$437,000	$1,760	$456,000
Surface Water Treatment	8	$94,000	$1,090	$106,800
Total Haloacetic Acids (Haa5)	7	$107,800	$1,002	$119,000
Total Trihalomethanes (TTHMs)	11	$32,060	$430	$36,900

[81] Attachment C5: Additional Cost Assessment Results & Regionalization Analysis https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/c5.pdf

[82] Attachment C5: Additional Cost Assessment Results & Regionalization Analysis https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/c5.pdf

Contaminant	# of Systems	Average Capital Cost per Conn.	Average O&M Cost per Conn.	Average 20-Yr. NPW per Conn.
Turbidity	1	$43,200	$612	$51,500
Multiple Contaminants[83]	98	$165,000	$1,340	$180,000

Figure 37: Average 20-Yr. NPW Cost per Contaminant per Connection



Consolidation vs. Regionalization Considerations

Cost Assessment Consolidation

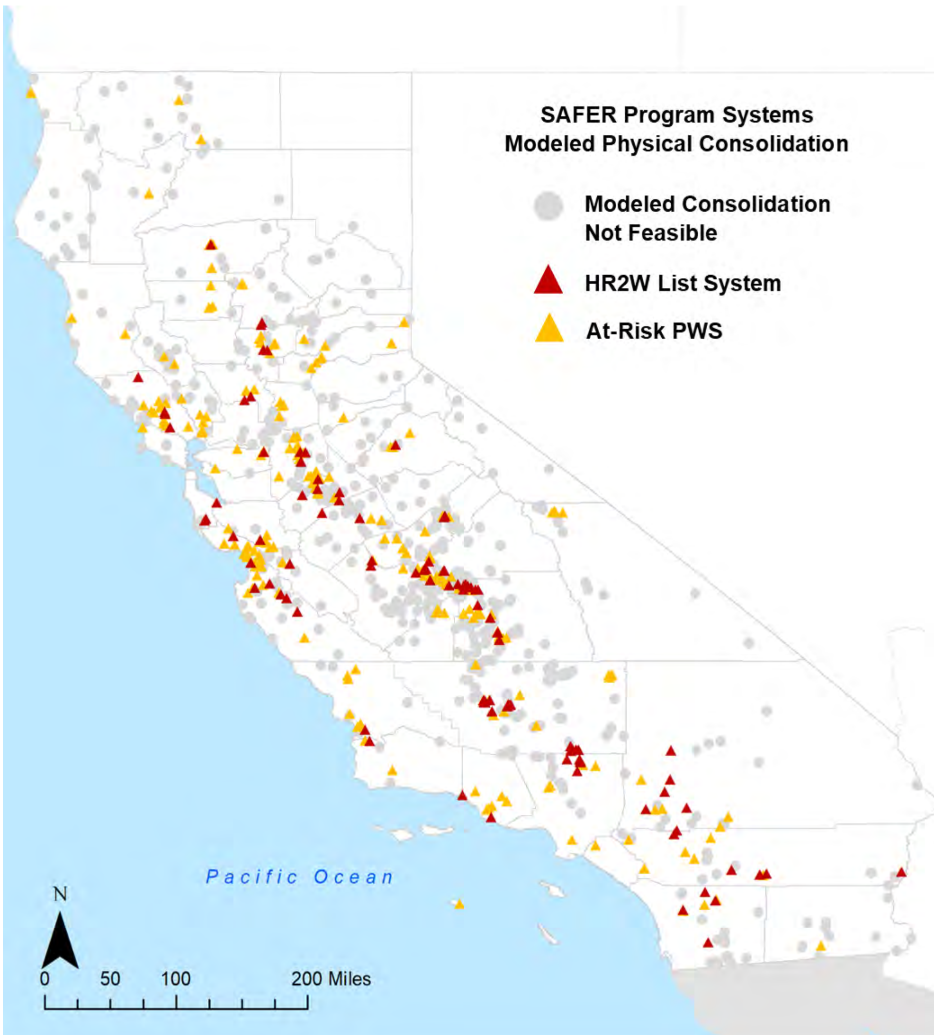
Physical consolidation options have been considered as potential solutions for HR2W list and At-Risk PWSs, SSWSs, and domestic wells. The costs for HR2W and At-Risk consolidations utilize a one-water system to one-water system approach, which may make some consolidations unaffordable. HR2W list system and At-Risk PWS consolidation costs reflect the cost to connect to a nearby larger non-HR2W public water system within a maximum of a 3-mile area along public access roads. SSWSs and domestic wells were analyzed for

[83] The Multiple Contaminant category includes all possible contaminant combinations in systems with two or more contaminants of concern. Consequently, this category may show lower average costs than other single-contaminant categories due to the following: (1) The high sample size (n) of multi-contaminant systems (98 of 305 HR2W systems), relative to single-contaminant systems, lowers the calculated average costs of multi-contaminant systems vis-à-vis single-contaminant systems. (2) The nature of contaminant combinations included in this category. While the treatment costs of some contaminant combinations (e.g. inorganic and VOC contaminants) are costly because they require multiple technology trains to treat, other contaminant combinations, which require a single technology train to address, have lower costs. For instance, 48 of 98 multi-contaminant systems have inorganic contaminant combinations that may be treated with a lower cost single treatment train.

consolidation costs only if they were along the pipeline path of another HR2W list system consolidation or an At-Risk consolidation. Details of the methodology are included in Attachment C1.[84]

Figure 38 illustrates the location of HR2W list systems and At-Risk PWSs where physical consolidation was considered as a potential solution (107 HR2W list and 234 At-Risk systems). Physical consolidation of systems was the selected modeled solution for 20% of HR2W list systems (61 of 305) and 23% At-Risk PWSs (145 of 630).

Figure 38: Map of Modeled Physical Consolidations



[84] Attachment C1: Geographic Information System and Database Methodologies
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/c1.pdf

Regional Consolidation Potential
All non HR2W list, not At-Risk PWSs, SSWSs and domestic wells were also assessed for potential regional consolidations, **but they were not included in the aggregated cost estimate**. These systems were excluded from the aggregated Cost Assessment results because the scope of the Needs Assessment is to *only* estimate the needs for the HR2W list systems and At-Risk systems and domestic wells.

The State Water Board recognizes that additional cost efficiencies and better long-term solutions occur where there are regional consolidation projects resulting in larger water systems with economies of scale. For example, for the top 10 water systems that could potentially consolidate the most water systems within their regions, the average cost per connection drops 68% from $99,900 per connection to $25,200 per connection. The majority of these systems are located in Monterey, Sonoma, Fresno and Stanislaus counties, as shown the in Table 27 below. More information is provided in Attachment C5.[85]

Table 27: Regional Modeled Physical Consolidation Costs for the Top 10 Highest Number of Potential Joining Systems

Nearby City (County)	# Potential Joining Systems	Total Distance of Individual Routes (Mi)	Total Distance of Consol. Routes (Mi)	Individual Routes, Pipeline $/Connection	Regional Route, Pipeline $/Connection
Prunedale (Monterey)	177	321.4	32.3	$153,000	$15,000
West Salinas (Monterey)	100	173.3	36.8	$98,000	$21,000
Marina (Monterey)	85	138.3	25.4	$39,000	$7,000
Los Lomas (Monterey)	55	93.8	13.6	$169,000	$24,000
Pajaro (Monterey)	55	93.5	22.0	$90,000	$21,000
Fresno[86] (Fresno)	51	78.9	44.6	$38,000	$22,000
East Salinas (Monterey)	38	70.2	19.9	$217,000	$61,000
Sebastopol (Sonoma)	44	64.7	20.7	$118,000	$38,000

[85] Attachment C5: Additional Cost Assessment Results & Regionalization Analysis
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/c5.pdf

[86] The State Water Board is currently collaborating on initial consolidation outreach in this area.

Nearby City (County)	# Potential Joining Systems	Total Distance of Individual Routes (Mi)	Total Distance of Consol. Routes (Mi)	Individual Routes, Pipeline $/Connection	Regional Route, Pipeline $/Connection
Modesto (Stanislaus)	55	60.8	34.6	$43,000	$25,000
Santa Rosa[87] (Sonoma)	44	55.7	30.4	$34,000	$18,000

Table 28 provides a summary of the number of systems and wells statewide with physical consolidation or regionalization potential. This modeling represents a snapshot of where there is consolidation potential based on individual pipelines between joining and receiving systems, as well as for integrating domestic wells along a pipeline connecting water systems to a nearby larger compliant system. However, the State Water Board recognizes that in addition to funding it is essential that community and local leader input be incorporated in order to bring these projects to fruition. Additionally, consolidation can be impacted by water rights or water allocation challenges as well. Therefore, Table 28 represents an estimate, but not a complete picture, of consolidation and regionalization potential in California.

Table 28: System Assessed for Modeled Regional Consolidation

System Type	# of Systems	Evaluated for Physical Consol.[88]	Potential Physical Consol. Identified
All Small Water Systems[89] (SWS)	7,190	7,070	**3,201**
All SSWS	1,848	1,848	**1,006**
All Domestic Wells	347,293	347,293	**133,265**

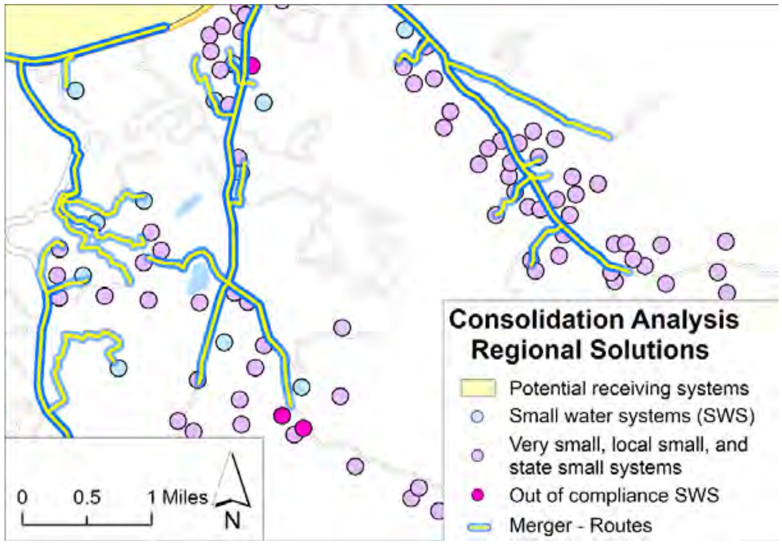
Figure 39 shows an example from Monterey County of a modeled regional consolidation which would integrate public water systems, state small water systems and domestic wells.

[87] The State Water Board is currently working with the City of Santa Rosa on a regional consolidation of eight water systems. The City had previously completed a regional consolidation of four water systems.

[88] Systems without location information were excluded from the analysis.

[89] All systems with 3,300 service connections or less.

Figure 39: Example of Regional Consolidation Analysis



INTERIM SOLUTION COST ASSESSMENT RESULTS

Interim solution costs were calculated for a six-year term for populations served by HR2W list systems, and a nine-year term for At-Risk SSWSs and domestic wells. Table 29 shows the estimated costs of providing interim solutions to all populations served by HR2W list systems and At-Risk SSWSs and domestic wells in need of such a solution,[90] both for the initial year in nominal cost terms and by the net present worth over the duration of the period envisioned for each population. The total NPW cost for the entire population in need is estimated at nearly billion, with over $1 billion in cost for HR2W list systems alone.

Table 29: Total First Year and NPW Cost of Interim Solutions (in $ Millions)

System Type	Total Systems Assigned an Interim Solution	Total First Year Cost Estimate	NPW Cost of Duration of Interim Solution[91]
HR2W list	343	$216	$1,000
At-Risk SSWS	496	$18	$35
At-Risk Domestic Wells	59,366	$280	$547
TOTAL:		**$514**	**$1,580**

[90] A total of 77,569 At-Risk domestic wells and 611 SWSS were originally identified as potentially in need of an interim solution. However, any At-Risk domestic well or SWSS which was already assigned POU or POE as the modeled selected long-term solution was excluded from the estimate of cost to receive the same technology as an interim solution. The rationale for this was that these long-term interventions and their costs are prioritized for SAFER spending, and thus these populations would not need an interim solution.

[91] Interim costs were calculated for a six-year term for populations served by HR2W list systems, and a nine-year term for At-Risk SSWSs and domestic wells.

Table 30 shows the estimated costs of providing interim solutions only to DAC populations served by HR2W list systems and At-Risk SSWSs and domestic wells in need of such a solution. Narrowing the focus of providing interim solutions to DAC populations lowers the total NPW cost by about a third. However, given that many HR2W list systems serve DAC populations, the total NPW of solutions remains above $1 billion.

Table 30: Total First Year and NPW Cost of Interim Solutions to DAC Populations ($ in Millions)[92]

System Type	Total Systems Assigned an Interim Solution	Total First Year Cost Estimate	Total Cost for Duration of Interim Solution[93]
DAC HR2W	222	$172	$845
DAC SSWSs	130	$5	$9
DAC Domestic Wells	20,443	$96	$192
TOTAL:		**$273**	**$1,050**

Table 31 further shows that over two-thirds of the cost of providing interim solutions to HR2W list is represented by large HR2W list systems (those with more than 3,300 connections).

Table 31: Total 6-Year NPW Interim Solution Cost by Number of Connections for HR2W List Systems (in $ Millions)

System Type	3,300+	3,300 – 1,001	1,000 – 501	500 – 101	100 or less
HR2W	$671	$176	$39	$80	$47

COST ASSESSMENT LIMITATIONS

The cost estimates developed for the 2021 Needs Assessment have several limitations and opportunities for improvement in future iterations. Overall, modeled solutions that have been developed lack some of the system-specific information that would be necessary to generate the level of precision for cost estimates such as those found in State Water Board planning studies for system-level funding agreements. Actual costs will vary from system to system and

[92] A total of 27,861 domestic wells and 181 SWSS serving DAC populations were analyzed to determine interim solution cost. Any domestic well or SWSS with a recommended POU or POE filter combination interim solution that matches the recommended filter long term solution were excluded. The domestic wells and SWSSs in this analysis are in high risk aquifer risk map sections placing them at priority for long term solution spending.

[93] Interim costs were calculated for a six-year term for populations served by HR2W list systems, and a nine-year term for At-Risk SSWSs and domestic wells.

will depend on site-specific details. The Cost Assessment will thus not be used to inform site-specific decisions but rather give an informative analysis on a statewide basis.

Timing Synchronization with the Risk Assessment

The long-term Cost Assessment for At-Risk state small water systems and domestic wells used a version of the GAMA model from September 2020. At that time six contaminants of concern were modeled. The version of the GAMA Aquifer Risk Map, released in January of 2021, has a model for all contaminants with a primary MCL. The number of SSWSs and domestic wells estimated as At-Risk is now higher than the number used in the Cost Assessment, and thus the cost to mitigate the issues in these additional wells may likely increase the estimates in the next Cost Assessment.

Similarly, the timing of the Risk Assessment for PWSs did not allow for full utilization of the At-Risk PWS drivers at the system level to be utilized by the Cost Assessment Model to refine potential solutions. Broad assumptions were made about the types of solutions these systems might require. The lack of system-specific information about At-Risk PWSs limits the accuracy of the Cost Assessment.

Water System Data Availability and Accuracy

A lack of inventoried data on water system assets and their condition for HR2W list and At-Risk PWS, led to the application of general assumptions around replacement and/or upgrade needs. Some of the information about existing infrastructure and asset condition, water production, and use rates is recorded in system-level sanitary surveys but is not in a database where it can be used. A lack of information around source capacity issues has also resulted in the Cost Assessment not addressing this challenge.

Water system boundary layers often show where a water system is currently serving or is allowed to serve, rather than where pipeline infrastructure ends. The potential inconsistency or accuracy of this data makes the physical consolidation analysis component of the Cost Assessment less precise. In such cases, physical consolidation costs may be higher than modeled costs for systems that currently show an allowed service area boundary. Additionally, the consolidation costs do not take into account where water rights or supply limitations may prevent consolidations.

Lack of data availability also prevented the inclusion of blending, new wells to avoid treatment, and managerial consolidation as potential modeled solutions that could be costed out in this iteration of the Cost Assessment. The only technical assistance that is currently included in the cost model is for managerial support.

Cost Data Quality

Cost estimates are based on consultant estimates, rather than historical cost data, especially work funded by the State Water Board, which would incorporate prevailing wage and have other administrative costs. Currently, the State Water Board captures funding agreement costs in the aggregate, but costs are not captured at the granular detail needed to directly inform the modeling for the long-term component of the Cost Assessment. For example, land acquisition costs for new wells is difficult to identify in current State Water Board data.

Interim Solution Costs

Interim costs are based on 6-9-year timeframes of need. In some cases, it may take longer to implement a long-term solution. For domestic wells, bottled water or POE/POU treatment may also be the only viable permanent solution and is not included in this model. Cost data for the full range of potential interim solutions is limited, this year's assessment was only able to assign POE/POU and bottled water interventions because there is so little data on other potential solutions such as vended and hauled water.

Methodology for Domestic Wells and State Small Water Systems
State small water systems had several data limitations including a lack of complete information on location, the number of connections, and water quality data. Similar data limitations exist for domestic wells. Availability of actual well location and whether the well is still in production for drinking water is limited. Additionally, domestic wells are not required to be sampled for water quality, unless mandated by local ordinance. Therefore, domestic well water quality data varies between counties and data gaps provides a challenge.

Modeled Solutions
The Cost Assessment Model may not be identifying the appropriate local solution for each water system due to limitations in data and the potential modeled solutions analyzed. For example, this effort did analyze regional consolidation project opportunities for State Water Board outreach purposes. However, the Cost Assessment did not include these efforts in the potential modeled solutions for HR2W systems and At-Risk systems. This choice was due to data limitations associated with water system boundaries, including jurisdictional uncertainties, as well as unknown community interest in each area. As a result, costs associated with consolidations are potentially higher and more water systems are chosen for POU/POE. POU/POE has several implementation limitations, such as bacteriological growth and long-term maintenance challenges, which may not make it the best long-term solution for some communities. There is also an equity concern with POU/POE solutions, because they do not provide the same level of service as typical public water systems. Therefore, because the Cost Assessment Model may be selecting potential solutions that ultimately may not be selected as the "real world" long-term solution for some communities, the aggregated cost estimates may not align with what actual costs may be.

Sustainability and Resilience Assessment
The Sustainability and Resiliency Assessment was limited by the number of metrics that could be included to evaluate the modeled solutions' long-term longevity and efficacy. Given its high-level analysis, only metrics that were applicable on a statewide scale could be incorporated into the assessment. Viable metrics that required site-specific data to accurately evaluate modeled solutions were not considered. Also, some recommended metrics could not be considered because they did not apply to all potential modeled solutions. Attachment C4 describes these limitations in detail.[94]

In terms of evaluating modeled solutions, the Cost Assessment Model can potentially overestimate the sustainability and resiliency of physical consolidation relative to other treatment solutions. This is primarily influenced by the selection of metrics, which focus on assessing sustainability and resiliency within the context of locally implementable treatment solutions. Consequently, physical consolidation is assigned a very high score because many of

[94] Attachment C4: Sustainability and Resiliency Assessment
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/c4.pdf

the considerations and challenges affecting these treatment solutions, as evaluated by the Cost Assessment's metrics, are circumvented by physically consolidating into an established receiving system.

Regional Cost Differences
Regional differences in California may have significant impacts on costs, e.g. the cost to replace a pipeline in a downtown portion of the Bay Area is significantly different than the cost to replace the same length of pipe in a rural Central Valley area. The baseline cost estimates obtained from the subcontractors for this analysis were more focused on rural areas. A standard factor was utilized to attempt to correlate between urban and rural areas to the extent possible. However, those correlations were based on broad assumptions of land use in various counties. Review of future projects funded by the State Water Board's Division of Financial Assistance may allow for more detailed information in future iterations.

COST ASSESSMENT REFINEMENT OPPORTUNITIES

The Cost Assessment methodology will evolve over time to incorporate additional and better-quality data; better approaches modeling potential solutions for At-Risk water systems and domestic wells; and further input from the State Water Board and public. The following highlights are near-term opportunities for Cost Assessment refinement and Attachment C5 detailed additional opportunities for consideration.[95]

Correlation Between Risk Assessment and Cost Assessment
The State Water Board will continue to refine the Risk Assessment for public water systems, tribal water systems, state small water systems, and domestic wells. Further refinement will help improve the inventory of systems included in the Cost Assessment, resulting in an aggregated statewide cost estimate that better reflects potential need.

Future iterations of the Cost Assessment Model will better utilize the detailed results of the Risk Assessment to better match potential, and estimate costs for, modeled solutions. For example, At-Risk water systems face TMF capacity issues. The Cost Assessment model will be able to better estimate costs for non-capital potential solutions, including Administrator costs as that data becomes available.

Regionalization Cost Savings Over System to System Consolidations
The State Water Board recognizes that significant cost savings may be obtained using strategic regionalization strategies when compared to single system-to-system consolidations. As discussed, the average modeled cost per connection drops 68% from $99,900 per connection to $25,200 per connection for the top 10 potential areas of regionalization in the state. This illustrates the potential benefits of economies of scale. Areas where significant costs savings could be realized will be the target of increased outreach and engagement by the SAFER Program.

[95] Attachment C5: Additional Cost Assessment Results & Regionalization Analysis
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/c5.pdf

The Coachella Valley Water District's approach to consolidation is an example model for regionalization efforts. The District identified nearby systems for potential consolidation and prioritized their regionalization efforts based on location and community interest. Large regionalization efforts are time-intensive endeavors and require community buy-in, comprehensive planning, and clear communication. Therefore, this may drive the need for increased funding for large-scale regionalization feasibility studies.

Cost Data Collection

The State Water Board's Division of Financial Assistance has begun developing a strategy to capture more detailed cost data. Adjustments to State Water Board managed databases will be made to better capture project and technical assistance cost data, especially for State Water Board funded projects through the SAFER Program.

Water System Boundaries

Improvement of water system boundary data statewide will enhance the accuracy of the Cost Assessment's modeling of potential physical consolidation solutions for HR2W list systems and At-Risk water systems and domestic wells. The State Water Board is currently working on developing the System Area Boundary Layer Admin App (SABL Admin), an administrative tool that allows District Offices, Local Primacy Agencies and public water system staff to upload and verify water system area boundaries to the SABL. Concurrently, State Water Board has developed a new SABL-Look up Application that will combine the SABL, other reference geographical information systems (GIS) layers and analysis tools, and water system data.

FUNDING GAP ANALYSIS RESULTS

OVERVIEW

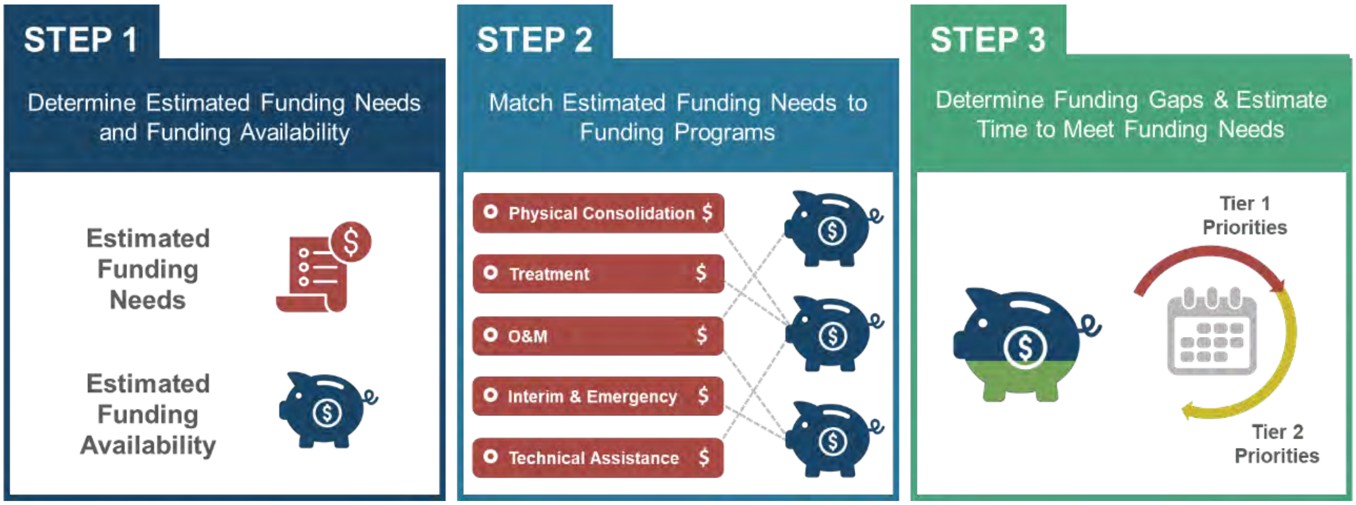
The Cost Assessment modeling process helps to determine the costs related to the implementation of interim and longer-term solutions for HR2W list and At-Risk public water systems (PWSs), state small water systems (SSWSs), and domestic wells. The Gap Analysis is the final step within the Cost Assessment.

Pacific Institute, a subcontractor to the Needs Analysis contract with UCLA, along with key State Water Board stakeholders, developed a Gap Analysis approach to (1) estimate the funding needed for solutions for HR2W list and At-Risk systems and (2) estimate the gap between the funding potentially available and the amount needed over one-year and five-year time increments looking forward. These estimates will help the State Water Board inform future Safe and Affordable Drinking Water Fund Expenditure Plans (SADWF FEP). This statewide analysis is not intended to inform specific funding decisions, nor local decisions, for drinking water system solutions.

GAP ANALYSIS METHODOLOGY

The Gap Analysis methodology is composed of three main steps (Figure 40). The first step focused on refining the funding needs, modeled by the Cost Assessment, associated with the implementation of interim and long-term solutions for current HR2W list and At-Risk systems. The second step identified State Water Board funding sources and external funding sources that can be leveraged to support the identified funding needs based on potential project and borrower/grantee eligibilities. DAC status and other system-level characteristics were utilized to refine this analysis. The third and final step uses the State Water Board's SAFER Program funding priorities to determine the funding gap for a refined estimated funding need. This third step of the analysis also estimates how many years it may take to meet all identified and projected funding needs. Together, these steps provide an estimate of how much it may cost and how long it may take to achieve the HR2W with existing funding sources. For a detailed description of the Gap Analysis methodology, please refer to Appendix D.

Figure 40: Gap Analysis Methodology



STEP 1: ESTIMATED NEEDS & FUNDING AVAILABILITY

ESTIMATED FUNDING & FINANCING NEEDS

The Gap Analysis methodology refined the modeled interim and long-term solution cost estimates produced by the Cost Assessment. The refinement process included the:

(1) Removal of Solution Costs for Systems with Funding Agreements: The first step taken to refine the Cost Assessment's estimated funding need was to remove the estimated interim and long-term solution costs associated with systems that already have funding agreements in place with the State Water Board. Refer to Appendix D for more details.

(2) Addition of Estimated New Costs Associated with New HR2W List and At-Risk Systems: The State Water Board estimates that approximately 47 unique water systems will be added to the HR2W list each year, starting with Year 1 (2021).[96] For purposes of the Gap Analysis, it is assumed that 95[97] new At-Risk PWSs added to the At-Risk list each year.[98] The Gap Analysis assumes no new additional At-Risk SSWSs and domestic wells will be added to the At-Risk list given the nature of the Risk Assessment employed for these systems.

[96] This estimate was derived from State Water Board analysis of historical HR2W lists from 2017-2019.

[97] No historical data exists for the number of systems added to the At-Risk list annually since this is the first year of the Risk Assessment. The Gap Analysis assumes the same proportion (approximately 15%) of PWSs will be added to the At-Risk list as to the HR2W list.

[98] The Gap Analysis takes the average cost per system (HR2W list or At-Risk PWS) derived from the Cost Assessment model and applies that cost to each of the new systems per year out to Year 5. The Gap Analysis also assumes these new groups of HR2W list systems and At-Risk PWSs have the same proportion of DAC status as the systems on the current HR2W list and At-Risk list.

(3) Removing Local Cost Share Estimates: The Cost Assessment's estimated funding needs were further refined based on the assumption that a proportion of the total cost burden would be borne by water systems, their ratepayers, and/or domestic well owners, and thus, not fully borne by the State Water Board's grant funding sources. Interim and long-term solution estimated funding needs were separated into three categories: costs that are grant eligible, costs that are loan eligible, and costs that are not loan or grant eligible. Costs that are not grant eligible are referred to as "Local Cost Share" since these costs will need to be financed by the water system or domestic wells owner through a loan or available cash on hand. Water systems may need to adjust their customer charges to meet these needs. Refer to Appendix D for more details on how local cost share estimates were calculated.

(4) Identifying Loan Eligible Local Cost Share Estimates: The local cost share estimate was further refined by identifying the portion of local cost share that would be eligible for financing (i.e. loans). These estimates were used to calculate the financing gap for the loan and the long-term 20-year local cost share burden that includes 20-year interest payment costs, 20-year O&M costs for long-term solutions, and 6 or 9 year O&M costs for interim solutions.

Together, these four steps produce the refined estimated funding and financing need utilized in the Gap Analysis. The funding and financing need for the implementation of modeled solutions for HR2W and At-Risk systems was estimated both for this current year ("Year 1") and for five years looking forward into the future ("Year 5"). This provides a short-term and longer-term understanding of the estimated funding and financing need over time. The Gap Analysis did not extend 9 years into the future, which is the full duration of the SADWF, due to the uncertainty surrounding future needs.

Tables 32 summarizes the results of the Cost Assessment estimated refined need for Year 1.

Table 32: Year 1 Refined Estimated Grant Eligible Funding Needs (in $ Millions)

System Type	# of Systems	Cost Assessment Model Results	Removed Existing Funding Agreement Costs[99]	Removed Local Cost Share[100]	Total Refined Yr. 1 Grant Funding Needs
HR2W list	352[101]	$2,350	$381	$981	**$992**
At-Risk PWS	725[102]	$2,360	$79	$1,200	**$1,080**

[99] Removed Existing Funding Agreement Costs are equal to the sum of modeled cost results for water systems with existing funding agreements with DFA.

[100] Local Cost Share includes modeled costs that for the Gap Analysis are projected to be borne by water systems, communities, and individual domestic well owners, based on grant eligibility requirements described in Appendix D, Table D3. Some of this financing need may be met with a State Water Board DWSRF loan.

[101] Year 1 assumes the addition of 47 new HR2W list systems.

[102] Year 1 assumes the addition of 95 At-Risk PWSs.

System Type	# of Systems	Cost Assessment Model Results	Removed Existing Funding Agreement Costs[99]	Removed Local Cost Share[100]	Total Refined Yr. 1 Grant Funding Needs
At-Risk SSWS	496[103]	$72	N/A	$9	**$64**
At-Risk Domestic Wells	59,366[104]	$1,400	N/A	$1,090	**$310**
TOTAL:		**$6,180[105]**	**$460**	**$3,280**	**$2,450**

Table 33 summarizes the estimated aggregated total funding needs in Year 5. This includes the additional funding needs associated with the estimated new 235 HR2W list systems (47/yr.) and 475 At-Risk PWSs (95/yr.) that are assumed to need assistance during this time and 5-year O&M costs for all grant-eligible interim and long-term solutions.

Table 33: Refined Total 5-Year Cumulative Estimated Grant Funding Needs (in $ Millions)

System Type	# of Systems	5-Yr. Est. Funding Need	5-Yr. Removed Local Cost Share	Total Refined 5-Yr. Grant Funding Needs
HR2W list	540[106]	$3,200	$1,800	**$1,400**
At-Risk PWS	1,200[107]	$3,450	$1,920	**$1,530**
At-Risk SSWS	496	$82	$22	**$60**
At-Risk Domestic Wells	59,366	$1,560	$1,300	**$260**
TOTAL:		**$8,290**	**$5,040**	**$3,250**

[103] Count of At-Risk SSWS represents interim solution count, but costs are representative of the combination of the interim and long-term costs for 830 SSWS. This is due to differences in the data sets used for calculating interim and long-term solutions.

[104] This figure represents the number of At-Risk domestic wells with interim solutions, but the costs needs represent the combination of interim and long-term costs for 98,315 domestic wells. This is due to differences in the data sets used for calculating interim and long-term solutions.

[105] Due to rounding, this figure appears $1 million above the actual sum of the column total.

[106] Assumes additional new 235 HR2W list systems (47/yr.).

[107] Assumes additional new 475 At-Risk PWSs (95/yr.).

Table 34 summarizes the estimated total Year 1 and cumulative 5-year local cost share needs. Total local cost share needs include non-grant eligible capital costs and 5-year O&M cost for long-term and interim solutions. Only a portion of local cost share are eligible for a State Water Board loan. Appendix D provides more details on State Water Board loan eligibilities utilized for this analysis.

Table 34: Estimated Year 1 and 5-Year Local Cost Share Needs ($ in Millions)

Water System Types	Total Yr. 1 Local Cost Share Needs	Total Yr. 1 Local Cost Share SWB Loan Eligible	Total 5-Yr. Local Cost Share Needs	Total 5-Yr. Local Cost Share SWB Loan Eligible
HR2W List Systems	$981	$854	$1,800	$1,470
At-Risk PWSs	$1,200	$1,200	$1,920	$1,920
At-Risk SSWSs	$9	$3	$22	$3
At-Risk Domestic Wells	$1,090	$658	$1,300	$658
TOTAL:	**$3,280**	**$2,720**	**$5,040**	**$4,050**

Table 35 summarizes the estimated long-term 20-year local cost share burden for all interim and long-term modeled 5-year solution costs[108] which are not eligible for grant funding. Total estimated 20-year local cost share burden includes non-grant eligible capital costs, 20-year interest costs (for loan eligible capital costs), 20-year O&M for long-term solutions, and 6 or 9 year O&M costs for interim solutions (not met by a grant).[109] The total cumulative estimated 20-year local cost share burden statewide is approximately $7 billion. This estimate was not included in the funding or financing gap analysis. The purpose of the total 20-year long-term local cost share that includes 20-year interest costs and O&M needs is to provide a more accurate estimate of how much Californian communities will need to pay to implement the Cost Assessment's modeled solutions.

[109] Details on how local cost share was calculated is detailed in Appendix D.

Table 35: Estimated Total 20-Yr. Local Cost Share ($ in Millions)

Water System Types	Total 20-Yr. Local Cost Share Capital Costs[110]	Total 20-Yr. Local Cost Share Interest Costs	Total 20-Yr. Local Cost Share O&M Costs[111]	Total 20-Yr. Local Cost Share Burden[112]
HR2W List Systems	$1,590	$242	$936	**$2,770**
At-Risk PWSs	$1,920	$7	$1	**$1,930**
At-Risk SSWSs	$7	$2	$56	**$65**
At-Risk Domestic Wells	$1,040	$414	$756	**$2,210**
TOTAL:	**$4,560**	**$665**	**$1,750**	**$6,980**

Table 36: Estimated Total 20-Yr. Local Cost Share per System and per Connection

Water System Types	Average 20-Yr. Local Cost Share Burden per System	Average 20-Yr. Local Cost Share Burden per Connection
HR2W List Systems	$6.4 M	$11,300
At-Risk PWSs	$1.6 M	$14,700
At-Risk SSWSs	$78,300	$9,500
At-Risk Domestic Wells	$22,500	$22,500

Ultimately, the refinement of the Cost Assessment's interim and long-term solution cost estimates is:

> **Year 1 Need**: Grant need is $2.45 billion, and the financing need is $2.72 billion.
>
> **Cumulative 5-Year Need**: Grant need is $3.43 billion, and the financing need is $4.05 billion.

The total refined cost estimate for the 5-year projected number of HR2W list and At-Risk systems and domestic wells is approximately $10.25 billion. This includes the estimated 5-year grant-eligible costs of $3.25 billion plus the long-term 20-year local cost share costs of $7 billion (non-grant eligible capital costs, 20-year interest payments, 20-year annual O&M for modeled long-term solutions, and 6 or 9 year O&M costs for interim solutions). $10.25 billion represents the total estimated cost of implementing interim and long-term solutions for HR2W

[110] Local Cost Share capital costs are the portion of capital costs that are not eligible for a State Water Board grant.

[111] 20-Year O&M costs include 20-year O&M costs for long-term solutions and 6 or 9 years of O&M costs for interim solutions.

[112] Refer to Appendix D for more information on how local cost share is calculated.

list systems, At-Risk water systems and well owners.

ESTIMATED FUNDING AND FINANCING AVAILABILITY

Potentially available funding and financing sources that can support the goals of the State Water Board's SAFER Program were divided into two categories. The first, State Water Board-managed funds, included the Safe and Affordable Drinking Water Fund (SADWF) and other sources administered by the State Water Board's Division of Financial Assistance (e.g. proposition funds). A summary list of these funds and their eligibility requirements are presented in Appendix D.

For the Gap Analysis, all funding programs managed by the State Water Board were considered and included based on each funds' relevance to the SAFER Program. Relevance was assessed using established fund eligibility criteria and their match to interim and long-term solutions modeled for HR2W list and At-Risk PWSs, SSWSs, and domestic wells. However, it is important to highlight that other State, Federal, and private funding may be available to meet some of these needs

Table 37 provides a summary of current State Water Board funds' capacity and estimated cumulative future fund sizes. It is important to highlight that in order to conduct the Gap Analysis, the methodology assumes the total project's costs are allocated the full amount of funding needs within a year. This does not align with actual State Water Board capital and technical assistance financing practices, which often stretch the allocation of committed funding over a span of many years.

Table 37: State Water Board Funding (Grant) and Financing (Loan) Availability ($ in Millions) [104]

State Water Board Fund	Yr. 1 Est. Fund Size	Cumulative Est. 5-Yr. Fund Size
Safe and Affordable Drinking Water Fund (SADWF) (Grant)	$137[113]	$593
Drinking Water State Revolving Fund (DWSRF)[114] (Grant)	$120	$320
DWSRF Loan Capacity	*$ 300*	*$ 1,500*

[113] The Gap Analysis assumes approximately $137 million in grant funding availability in Year 1, which includes $130 million from new SADWF appropriations, reduced by $16 million for Administrator and State Water Board staff costs, and an added $23 million from fiscal year 2020-21 carryover U.S. EPA Pacific Southwest (Region 9) Drinking Water Tribal Set-Aside Program
https://www.epa.gov/tribal-pacific-sw/epa-pacific-southwest-region-9-drinking-water-tribal-set-aside-program

The Drinking Water Tribal Set Aside Program is limited to community and not-for-profit, non-community public water systems that serve tribal populations. Water systems that serve commercial entities and/or non-tribal populations are not eligible for U.S. EPA funding.

[114] For principal forgiveness.

State Water Board Fund	Yr. 1 Est. Fund Size	Cumulative Est. 5-Yr. Fund Size
Small Community Drinking Water Funding Program (Grant)	$275	$275
Emergency Drinking Water/Cleanup & Abatement Account Programs – Urgent Drinking Water Needs Projects (Grant)	$9	$9
Water Board Household & Small Water System Drought Assistance Program; CAA – DW Well Replacement Program (Grant)	$0.861	$0.861
Water System Administrator Program (Grant)	$8	$8
TOTAL:	**$850**	**$2,710**

STEP 2: MATCHING FUNDING NEEDS TO FUNDING PROGRAMS

State Water Board funding sources each have specific eligibility requirements regarding applicant type and project type. When estimating funding availability, the Gap Analysis used these eligibility requirements to ensure the most appropriate funds are applied to specific categories of systems and solution types. Table 38 shows which funds were considered for which types of systems and solutions types. In the estimation for the funding gap, each fund's total available amount was spread proportionately between all eligible solution and system types. This process was applied to Approach 1 of the Gap Analysis described below in order to help match State Water Board fund sources to the solutions and systems identified by the Cost Assessment Model.

Table 38: State Water Board Funds Matched to Funding Needs

State Water Board Funds	System Types	Modeled Solution Types
Safe and Affordable Drinking Water Fund (SADWF)	HR2W, At-Risk	Capital/Construction (i.e., Physical Consolidation, Treatment, OEI), O&M, Interim solutions, Technical Assistance
Drinking Water State Revolving Fund (DWSRF)	HR2W, At-Risk	Capital/Construction (i.e., Physical Consolidation, Treatment, OEI), Technical Assistance
Small Community Drinking Water Funding Program	DAC/SDAC HR2W, DAC/SDAC At-Risk	Capital/Construction (i.e., Physical Consolidation,

State Water Board Funds	System Types	Modeled Solution Types
		Treatment, OEI), Technical Assistance
Emergency Drinking Water/Cleanup & Abatement Account Programs – Urgent Drinking Water Needs Projects	DAC/SDAC HR2W, DAC/SDAC At-Risk	Interim solutions, emergency supplies and repairs
Water Board Household & Small Water System Drought Assistance Program; CAA – DW Well Replacement Program	HR2W and At-Risk SSWS, Domestic Wells	Capital/Construction (i.e., Physical Consolidation, Treatment, OEI), Technical Assistance
Water System Administrator Program	HR2W, At-Risk	N/A[115]

This effort also evaluated non-State Water Board funds, both loan and grant programs, that could potentially be pursued to help fund solutions for HR2W list and At-Risk drinking water systems in California (e.g. U.S. Department of Agriculture's Rural Development Loan Program, DWR's Integrated Regional Water Management Implementation Grants, etc.). While these funding sources were not used in calculating the estimated funding gap, they are summarized in Appendix D.

STEP 3: GAP ANALYSIS RESULTS

The estimated funding gap has been assessed using the tiered prioritization of solution project types, based on the priorities established in the SADWF fiscal year 2020-21 FEP. The tiered prioritization was applied to all State Water Board funding programs relevant to drinking water needs. This approach considers the refined funding needs for all water systems and domestic wells included in the Cost Assessment. The results of the Gap Analysis will be utilized to inform the annual funding needs for the SADWF as well as the broader demands on State Water Board's drinking water funding programs.

GAP ANALYSIS OF ALL STATE WATER BOARD FUNDS

For the first approach to estimating the funding gap, available funding across all State Water Board's funding programs relevant to drinking water were analyzed and compared to the estimated total funding need. The total funding need was organized into **two tiers of**

[115] Currently, there is limited cost data to support the inclusion of the Administrator funding program into the Gap Analysis for the 2021 Needs Assessment. Future iterations will be able to assess the gap for Administrators when data becomes available.

spending prioritization based on the SADWF fiscal year 2020-21 FEP's "General Funding Approach and Prioritization."[116] (Figure 41).

Figure 41: Gap Analysis

Tier 1 Priority Systems: includes emergency/interim assistance, systems with a primary MCL violation, and consolidation projects for both HR2W list and At-Risk SSWSs and domestic wells. The number of systems that are State Water Board grant eligible and fall within Tier 1 are detailed in Table 39.[117]

Tier 2 Priority Systems: includes HR2W list systems with secondary MCL violations or monitoring and reporting violations and long-term O&M costs for these systems. Tier 2 also includes capital costs for At-Risk PWSs not captured in Tier 1 and long-term O&M costs for all At-Risk systems, for all solution types except consolidation.[118] The number of systems that are State Water Board grant eligible and are in Tier 2 are detailed in Table 39.

[116] FY 2020-21 Fund Expenditure Plan, Pg. 12

https://www.waterboards.ca.gov/water_issues/programs/grants_loans/sustainable_water_solutions/docs/sadwfep_2020_07_07.pdf

[117] It is important to highlight that some systems in Tier 1 have both interim assistance and long-term capital needs. Therefore, the total number of systems in Table 39 do not represent unique water systems or domestic wells, but rather reflect the number of unique projects related to each system type. There was also overlap between the Tier 1 Priority categories in cases where systems with a primary MCL violation also have a modeled consolidation project solution. In the Gap Analysis, care was taken to ensure that no systems were dually allocated estimated funding in both categories, to avoid double counting of costs.

[118] Long-term O&M costs for At-Risk SSWS and domestic wells are included in the total (unrefined) need and local cost share estimates only.

Table 39: Total Number of Systems in Year 1 that Qualify for Grant Funding Assistance[119]

Priority Level	HR2W	At-Risk PWS	At-Risk SSWS	At-Risk Domestic Wells
Tier 1 Priorities				
Emergency/Interim Assistance	230	50	492	19,022
Systems w/ Primary MCL Violation	273	N/A	303	10,372
Consolidation Projects[120]	57	88	143	4,966
Tier 2 Priorities				
HR2W List Systems & At-Risk Systems not Captured in Tier 1	4	405	0	0
Long-Term O&M for Tier 1 and Tier 2 Systems	199	3	303	10,372

The Gap Analysis estimates that over the next 5 years approximately 34% (131) HR2W list systems will not be economically disadvantaged. The 2020-21 DWSRF IUP allows small DAC and Non-DAC systems with an MCL violation to obtain up to 75% grant for capital projects, recognizing that many of these small systems do not have adequate economies of scale to fund large capital projects. This relatively new provision is included in these eligibility assumptions.

Grant Funding Gap Estimate

Table 40 summarizes the estimated Year 1 grant funding need and gap for Tier 1 and Tier 2 priority systems. Based on the Gap Analysis' assumptions, the Year 1 grant funding need is $1.72 billion for Tier 1 priority systems and $727 million for Tier 2 priority systems. In Year 1, it is assumed that all available grant funding (estimated to be $541 million) is allocated towards Tier 1 priority systems, and no grant funding is available for any Tier 2 priority systems. This leaves a $1.18 billion grant funding gap for Tier 1 priority systems and a $727 million grant funding gap for Tier 2 priority systems.

[119] Tier 1 Priority, Emergency/Interim Assistance and Systems w/Primary MCL Violation are non-exclusive because the former is for modeled costs for interim solutions while the latter is for modeled costs of long-term solutions; therefore total counts in these rows include duplicates of some systems. However, systems with Primary MCL Violation and Consolidation Projects are mutually exclusive because many systems have a primary MCL violation and their modeled long-term solution is consolidation.

[120] Consolidation projects for small DAC systems out of compliance with an MCL violation, At-Risk PWSs, SSWSs, and domestic wells.

Table 40: Total Estimated Year 1 Grant Funding Gap for Tier 1 and Tier 2 Priority Systems (in $ Millions)

Priority Level	Yr. 1 Est. Refined Grant Need	Yr. 1 Est. Grant Funding Availability	Yr. 1 Est. Grant Funding Gap
Tier 1 Priorities			
Emergency/Interim Assistance	$208	$25	$183
Systems w/ Primary MCL Violation	$898	$306	$592
Consolidation Projects	$617	$210	$407
TIER 1 SUBTOTAL:	**$1,720**	**$541**	**$1,180**
Tier 2 Priorities			
HR2W systems not captured in Tier 1	$12	$0	$12
At-Risk PWSs not captured in Tier 1	$666	$0	$666
Long-Term O&M for Tier 1 and Tier 2 Systems	$49	$0	$49
TIER 2 SUBTOTAL:	**$727**	**$0**	**$727**
YEAR 1 TOTAL:	**$2,450**	**$541**	**$1,910**

Based on the estimated grant funding needs for Tier 1 priority systems alone, most available State Water Board grant programs would be fully expended in Year 1 if they could theoretically be spent immediately. For example, the Small Community Drinking Water Funding Program, Emergency Drinking Water/Cleanup & Abatement Account Programs, and Water Board Household & Small Water System Drought Assistance Program would be completely depleted in Year 1. In this analysis only the SADWF and DWSRF, which are estimated to receive annual funding allocations, would have available funds (approximately $164 million a year combined) to meet a portion of estimated grant funding needs for Year 2 and beyond.

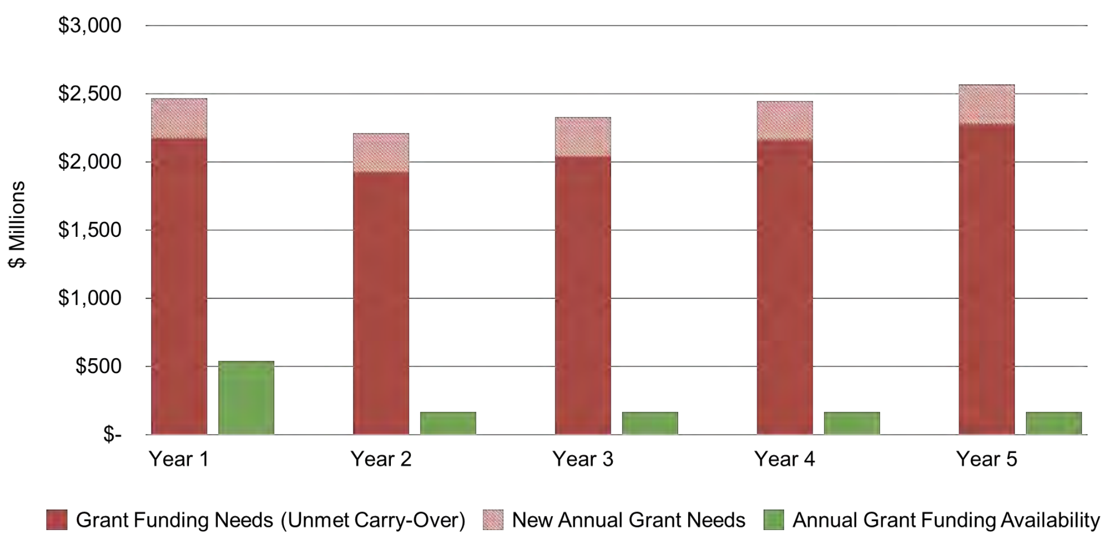
The grant Gap Analysis was analyzed over the next 5 years to better understand how the grant funding gap would change over time. Table 41 summarizes the estimated 5-year cumulative number of systems that are State Water Board grant eligible.

Table 41: Cumulative 5-Year Number of Systems that Qualify for Grant Funding Assistance[121]

Priority Level	HR2W	At-Risk PWS	At-Risk SSWS	At-Risk Domestic Wells
Tier 1 Priorities				
Emergency/Interim Assistance	350	102	492	19,022
Systems w/ Primary MCL Violation	461	N/A	303	10,372
Consolidation Projects	97	136	143	4,966
Tier 2 Priorities				
HR2W List Systems & At-Risk Systems not Captured in Tier 1	8	545	0	0
Long-Term O&M for Tier 1 and Tier 2 Systems	367	47	303	10,372

Figure 42 illustrates the combined 5-year estimated grant funding needs for Tier 1 and Tier 2 priority systems. The Gap Analysis indicated that the estimated new annual needs are greater than annual grant availability; therefore, the total estimated annual funding needs continue to increase each year. This is reflected in the estimated 5-year funding gap detailed in Table 42.

Figure 42: 5-Year Grant Funding Needs & Funding Availability



[121] Tier 1 Priority, Emergency/Interim Assistance and Systems w/Primary MCL Violation are non-exclusive because the former is for modeled costs for interim solutions while the latter is for modeled costs of long-term solutions; therefore total counts in these rows include duplicates of some systems. However, systems with Primary MCL Violation and Consolidation Projects are mutually exclusive because many systems have a primary MCL violation and their modeled long-term solution is consolidation.

Table 42 summarizes the 5-year cumulative grant funding gap for Tier 1 and Tier 2 priority systems. Based on the Gap Analysis assumptions, the cumulative 5-year grant funding needs are $2.35 billion for Tier 1 priority systems and $892 million for Tier 2 priority systems. The cumulative 5-year State Water Board grant funding available is estimated to be $1.2 billion. The 5-year estimated grant funding gap is thus $1.16 billion for Tier 1 priority systems and $892 million for Tier 2 priority systems, with the total cumulative 5-year State Water Board grant funding gap being $2.05 billion.

Ultimately, the analysis estimates that no State Water Board grant funding would be available to meet any Tier 2 priority system needs over the 5-Year period. Furthermore, the annual grant funding gap for Tier 1 priority systems increases each year, which indicates that currently available State Water Board grant funds will never be able to meet all estimated grant funding needs. It is important to highlight that other State, Federal, and private funding may be available to meet some of these needs. See Appendix D for a summary of non-State Water Board funding and financing sources.

Table 42: 5-Year Cumulative Grant Funding Gap for Tier 1 and Tier 2 Priority Systems (in $ Millions)

Priority Level	Total Est. 5-Yr. Refined Grant Need	Total 5-Yr. Grant Funding Availability (Needs Met)	5-Yr. Grant Funding Gap
Tier 1 Priorities			
Emergency/Interim Assistance	$122	$61	$61
Systems w/ Primary MCL Violations	$1,360	$692	$672
Consolidation Projects	$869	$444	$425
TIER 1 SUBTOTAL:	**$2,350**	**$1,200**	**$1,160**
Tier 2 Priorities			
HR2W systems not captured in Tier 1	$21	$0	$21
At-Risk PWSs not captured in Tier 1	$863	$0	$863
Long-Term O&M for Tier 1 and Tier 2 Systems	$8	$0	$8
TIER 2 SUBTOTAL:	**$892**	**$0**	**$892**
5-YEAR TOTAL:	**$3,240**	**$1,200**	**$2,050**[122]

[122] Due to rounding, this figure appears $1 million below the actual sum of the column total.

Financing Gap Estimate

Table 43 shows the estimated local cost share needs in Year 1 for all Tier 1 and Tier 2 priority systems' capital and O&M needs not met by a State Water Board grant. The only State Water Board financing (e.g. loan) program included in the Gap Analysis is the DWSRF loan program. In Year 1 the estimated loan capacity of the DWSRF is $300 million. Refinement of local cost share needs estimates approximately $1.91 billion of Tier 1 and $810 million of Tier 2 local cost share needs are eligible for a State Water Board loan. The Year 1 gap in available financing is $2.42 billion.

Table 43: Total Estimated Year 1 Local Cost Share for Tier 1 and Tier 2 Priority Systems (in $ Millions)

Priority Level	Yr. 1 Est. Local Cost Share Needs	Yr. 1 Est. Local Cost Share SWB Loan Eligible	Yr. 1 Est. SWB Loan Capacity	Yr. 1 Est. Financing Gap
Tier 1 Priorities				
Emergency/Interim Assistance	$301	$0	N/A[123]	N/A
Systems w/ Primary MCL Violation	$1,031	$810	$127	$683
Consolidation Projects	$1,096	$1,096	$173	$923
TIER 1 SUBTOTAL:	**$2,430**	**$1,910**	**$300**	**$1,610**
Tier 2 Priorities				
HR2W systems not captured in Tier 1	$20	$20	$0	$20
At-Risk PWSs not captured in Tier 1	$790	$790	$0	$790
Long-Term O&M for Tier 1 and Tier 2 Systems	$42	$0	N/A	N/A
TIER 2 SUBTOTAL:	**$852**	**$810**	**$0**	**$810**
YEAR 1 TOTAL:	**$3,280**	**$2,720**	**$300**	**$2,420**

Table 44 provides an overview of the estimated cumulative 5-year financing needs and gap for Tier 1 and Tier 2 systems. The 5-year estimated loan capacity of the DWSRF is $1.5 billion. The 5-year estimated local cost share needs are $3.38 billion for Tier 1 priority systems and $1.66 billion for Tier 2 priority systems. Refinement of local cost share needs over the 5-year period yields an estimate of approximately $2.74 billion of Tier 1 and $1.31 billion of Tier 2 local cost share needs being eligible for a State Water Board loan. The 5-year gap in available

[123] The State Water Board does not have a financing/loan program that funds interim or emergency assistance.

financing is $2.57 billion. It is important to highlight that other State, Federal, and private financing may be available to meet some of these needs. See Appendix D for a summary of non-State Water Board funding and financing sources.

Table 44: 5-Year Cumulative Local Cost Share Analysis for Tier 1 and Tier 2 Priority Systems (in $ Millions)

Priority Level	Total 5-Yr. Est. Local Cost Share Needs (cap. and O&M)	Total 5-Yr. Est. Local Cost Share SWB Loan Eligible	Total 5-Yr. Est. SWB Loan Capacity	Total 5-Yr. Est. Financing Gap
Tier 1 Priorities				
Emergency/Interim Assistance	$418	$0	N/A	N/A
Systems w/ Primary MCL Violation	$1,620	$1,400	$766	$636
Consolidation Projects	$1,340	$1,340	$734	$609
TIER 1 SUBTOTAL:	**$3,380**	**$2,740**	**$1,500**	**$1,250**
Tier 2 Priorities				
HR2W systems not captured in Tier 1	$27	$27	$0	$27
At-Risk PWSs not captured in Tier 1	$1,280	$1,280	$0	$1,290
Long-Term O&M for Tier 1 and Tier 2 Systems	$352	$0	N/A[124]	N/A
TIER 2 SUBTOTAL:	**$1,660**	**$1,310**	**$0**	**$1,320**
TOTAL:	**$5,040**	**$4,050**	**$1,500**	**$2,570**

Gap Analysis Results Summary

Ultimately the results of the Gap Analysis yield a cumulative 5-Year estimated grant funding gap of $2.05 billion and a financing gap of $2.55 billion for Tier 1 and Tier 2 priority systems. It is important to highlight that other State, Federal, and private funding and financing may be available to meet some of these needs. See Appendix D for a summary of non-State Water Board funding and financing sources.

[124] The State Water Board does not have a loan program that funds O&M.

SUPPLEMENTAL GAP ANALYSIS FOR THE SADWF

A second funding Gap Analysis approach estimated the potential funding gap specifically for the Safe and Affordable Drinking Water Fund (SADWF). This analysis of the SADWF was conducted two different ways. First, in Approach 2A, a Gap Analysis was conducted for only the funding needs of small DAC/SDAC systems and domestic wells and compared that to available SADWF funding.[125] Second, in Approach 2B, an even smaller subset of funding needs was analyzed to examine only those DAC/SDAC costs that are only eligible for SADWF funding and not eligible for any other State Water Board long-term funding source. That small subset of costs was then compared to the funding available from the SADWF.

The results of the Gap Analysis Approach 2A indicate that the estimated 5-year cumulative SADWF funding gap for only DAC/SDAC water systems and domestic wells is $2.18 billion. When the analysis narrowed the sub-set of funding needs to those uniquely eligible to the SADWF, the estimated 5-year cumulative grant funding gap is $77 million for small DAC/SDAC systems and domestic wells only. The details of this analysis are available in Attachment D1.[126]

GAP ANALYSIS CONCLUSIONS

The purpose of the Gap Analysis is to provide an opportunity for the State Water Board and the public to view the refined estimated funding and financing needs from different perspectives. The results of the refinement of the Cost Assessment interim and long-term solution funding needs and the results of the Gap Analysis will be utilized to inform the annual funding plan for the SADWF as well as the broader demands on State Water Board's drinking water funding programs. The following is a summary of the results:

- **Refined Statewide Cost Estimate**: The total estimated grant and local cost share needs for the 5-year projected number of HR2W list and At-Risk systems and domestic wells is $10.2 billion. The combination of these refined needs represents the total estimated cost of implementing interim and long-term solutions for these systems and well owners.
- **Grant Funding Gap**: The Gap Analysis estimates a cumulative 5-year grant funding gap of $2.05 billion.[127]
- **Financing Gap**: The Gap Analysis estimated a cumulative 5-year financing gap of $2.55 billion.[128]
- **The Growing Funding & Financing Gap**: The estimated additional new grant-eligible and loan-eligible needs are expected to exceed the grant and loan funds available, into perpetuity. Therefore, without additional funds, the future grant funding and financing gaps are expected to grow. It is important to highlight that other State, Federal, and

[125] Small DAC/SDAC systems are prioritized in the 2020-21 SADWF FEP.

[126] Attachment D1: Supplemental Gap Analysis for the Safe and Affordable Drinking Water Fund https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/d1.pdf

[127] Grant Funding Gap is based on an analysis of State Water Board grant programs only.

[128] Financing Gap is based on an analysis of the State Water Board's DWSRF only.

private funding and financing may be available to meet some of these needs. See Appendix D for a summary of non-State Water Board funding and financing sources.

GAP ANALYSIS LIMITATIONS

The Gap Analysis contains an inherent amount of uncertainty that must be recognized when interpreting and applying the results. Earlier steps in the Risk Assessment and Cost Assessment Model each contain different amounts of uncertainty, and because the Gap Analysis is applying results from earlier steps, it includes the cumulative uncertainty from all previous steps.

Uncertainty embedded in the Gap Analysis also stems from additional assumptions made that were necessary to complete the estimation. The assumptions that contribute the most uncertainty in the Gap Analysis, not including estimates from the Cost Assessment, are:

Change in Funding Needs Over Time
The Gap Analysis assumes 47 unique new HR2W list systems and 95 new At-Risk PWSs are added to the cumulative funding need each year. While historical data was used to estimate the average number of new systems added to the HR2W list annually, no data exists to closely approximate the number of new unique systems added to the At-Risk list each year. The gap analyses therefore assumed the same proportion of systems may be added to the At-Risk list annually as on the HR2W list. The approximation of new additional funding needs over time can impact the accuracy of the results of the Gap Analysis. For example, in Approach 1 of the Gap Analysis, the estimated new need based on the annual addition of 47 HR2W list systems and 95 At-Risk PWSs is greater than the available funding added annually, which ultimately leads to a growing grant funding gap.

It is important to highlight that the approximation of new funding needs over time also does not take into consideration new regulatory requirements which may result in considerably more water systems being added to both the HR2W list and the At-Risk list than are accounted for using historical averages. Other challenges are also likely to impact funding needs such as drought and ongoing impacts of the COVID-19 pandemic that have left many communities and water systems with financial challenges.

Funding Availability
Projecting funding gaps are based on assumptions around funding availability. New funding sources may reduce the funding gaps. For example, if the DWSRF does not receive an annual allotment of $50 million per year for grant funds and $300 million per year for loans, the grant and local cost share funding gaps could be larger.

Project Funding & Financing
It typically takes several years to transact a funding agreement to facilitate actual project funding and financing for long-term solutions. Furthermore, funds for a long-term project are not typically disbursed in one year, and full commitment of funds annually is not typical. There is often carryover from the previous year. Thus, the yearly allocation and commitment

estimates in the Gap Analysis will not exactly match project funding and financing patterns on the ground.

Estimated Local Cost Share

The Gap Analysis employs a number of assumptions around the calculation of local cost share. It assumes that all capital projects which are not funded via a grant are instead financed through either a public or private loan to the party executing the project. This assumption was made to be conservative in the estimate of local cost share burden. Some water systems and domestic well owners may have enough cash on hand to fund long-term solutions without the need for financing or may receive grant funds from sources outside the State Water Board's funding options, thus removing the portion of cost share estimated which is pure loan interest payment. This would result in a lower statewide local cost share estimate. The proportion of systems and domestic well owners that can pay some or the full portion of their project cost upfront in cash is unknown, which is why the Gap Analysis assumes no capital needs are funded in a pay-as-you-go fashion.

Determining Community Economic Status

The Gap Analysis used available data to approximate community economic status to designate systems as DAC, SDAC, or Non-DAC. A community's economic status influences the amount of grant funding that a water system is eligible for. Administrative data sources, however, lacked necessary detail to make this determination for some systems. This was particularly true for domestic wells. For public water systems and SSWSs with missing data, regional proportions based on a spatial analysis used in the Cost Model were used to assign systems as DAC, SDAC, or Non-DAC. Where data was missing for domestic wells, the Gap Analysis conservatively assumes these systems are Non-DAC.

GAP ANALYSIS REFINEMENT OPPORTUNITIES

Future gap analyses will compare the outcomes from this first annual snapshot to observed trends in the estimated need, funding availability, and application of the funds to solutions over time. Actual trend data will be used to modify assumptions to improve accuracy in future estimates.

Better Tracking of New SAFER Systems

The State Water Board is developing a new database to assist with the implementation of the SAFER Program. The SAFER Clearinghouse will be able to track the number of unique new HR2W list systems and At-Risk systems that are identified each year. This will help improve the accuracy of the projected needs estimated by the Gap Analysis.

Improved Tracking of Funding Assistance

The SAFER Clearinghouse will also create a 'pipeline' to track and measure the rate at which HR2W list and At-Risk systems move through the state's funding processes to finalize a long-term solution. Better information regarding the amount of time it takes to implement a long-term solution will enhance the accuracy of the Gap Analysis.

Incorporate Non-State Water Board Funding Programs

The Gap Analysis performed an initial identification of non-State Water Board funds that may be leveraged to meet the funding and financing capital needs identified through the Needs Assessment. These additional funding sources, however, were not included in the calculation of the Gap Analysis. Additional information about these funding programs, such as funding availability and local cost share requirements, would be needed to integrate into Gap Analysis estimates. Additionally, more information on the capability of bundling between funding programs, by different project and recipient types, would need to be explored before these programs can be incorporated into the Gap Analysis.

AFFORDABILITY ASSESSMENT RESULTS

OVERVIEW

Ensuring drinking water is affordable is key to meeting California's Human Right to Water mandate.[129] The COVID-related economic crisis has served to further highlight the need to address affordability, both to ensure that households can afford the water that they drink as well as to support drinking water systems in maintaining enough financial viability to provide safe reliable drinking water.[130]

The purpose of the Affordability Assessment is to identify disadvantaged community water systems, that have instituted customer charges that exceed the "Affordability Threshold" established by the State Water Board in order to provide drinking water that meets State and Federal standards.[131] Legislation does not define what the Affordability Threshold should be. Nor is there specific guidance on the perspective in which the State Water Board should be assessing the Affordability Threshold. Figure 43 illustrates the nexus of affordability definitions that exist.

Figure 43: Nexus of Affordability Definitions

[129] [State Water Board Resolution No. 2016-0010](https://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/2016/rs2016_0010.pdf)
https://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/2016/rs2016_0010.pdf

[130] [Drinking Water COVID-19 Financial Impacts Survey | California State Water Resources Control Board](https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/covid-19watersystemsurvey.html)
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/covid-19watersystemsurvey.html

[131] California Health and Safety Code, § 116769, subd. (a)(2)(B)

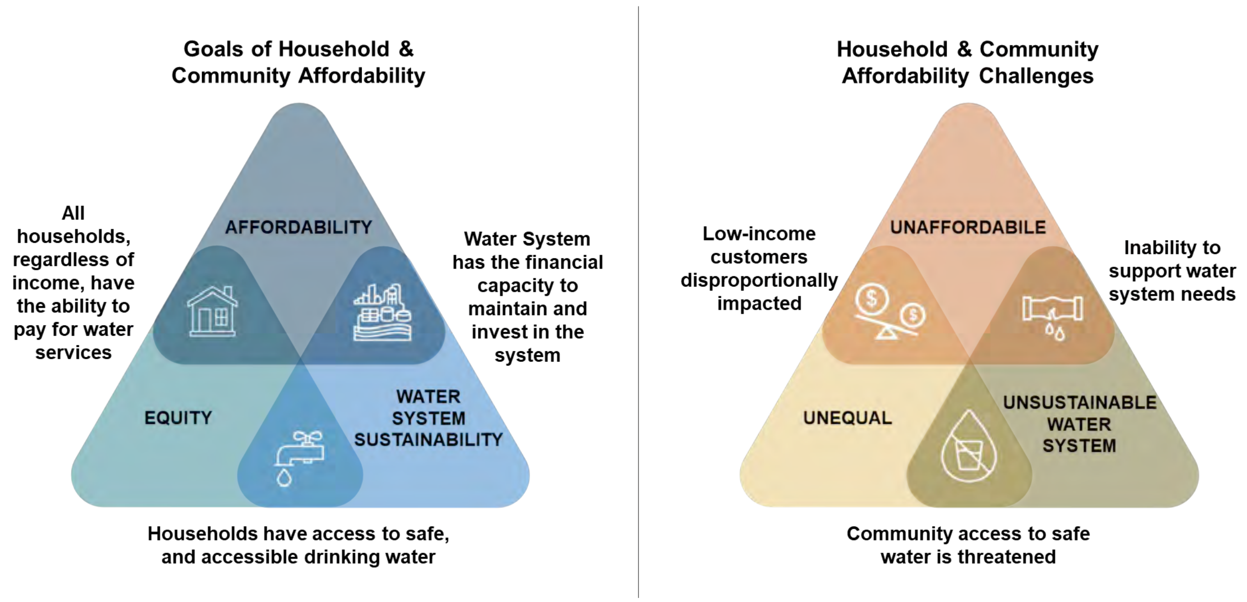
(1) Household Affordability: The ability of individual households to pay for an adequate supply of water.

(2) Community Affordability: The ability of households within a community to pay for water services to financially support a resilient water system.

(3) & (4) Water System Financial Capacity: The ability of the water system to financially meet current and future operations and infrastructure needs to deliver safe drinking water. The financial capacity of water systems affects future rate impacts on households. The inability to provide adequate services may lead households served by the system to rely on expensive alternatives such as bottled water.

Affordability of drinking water services is an important challenge to assess because issues surrounding equity and water system sustainability overlap in numerous aspects of addressing affordability challenges and ensuring that all Californians have safe drinking water. Figure 44 illustrates this relationship and the potential consequences of inaction.

Figure 44: The Relationship Between Affordability, Equity and Water System Sustainability



AFFORDABILITY ASSESSMENT METHODOLOGY

The Affordability Assessment is conducted annually for all Californian community water systems. It is worth noting that, while there is some overlap, the systems included in the Affordability Assessment differ from the list of water systems analyzed in the Risk Assessment for public water systems. The Affordability Assessment includes large and small community water systems and excludes non-transient, non-community water systems, like schools. The Risk Assessment, on the other hand, analyzed smaller public water systems with 3,300 service connections or less and non-transient, non-community K-12 schools are included. Table 45 provides an overview of the systems included in the Affordability Assessment.

Table 45: Systems Included in the Affordability Assessment

SAFER Program Status	Risk Assessment	Affordability Assessment
HR2W List Systems	**326**	**276**
At-Risk Systems	**617**	**467**
Not HR2W or At-Risk System	**1,836**	**2,134**
TOTAL:	**2,779**	**2,877**

In 2020, the State Water Board conducted an Affordability Assessment for community water systems, which analyzed one affordability indicator, water charges as a percent of median household income (%MHI), for the FY 2020-21 Safe and Affordable Drinking Water Fund Expenditure Plan. The Fund Expenditure Plan used an affordability threshold of 1.5% MHI to identify DAC water systems that may have customer charges that are unaffordable.[132]

For the 2021 Needs Assessment, the State Water Board explored additional affordability indicators to identify disadvantaged communities (DAC)[133] and Severely Disadvantaged Communities (SDAC)[134] that may be experiencing affordability challenges. The identification of additional affordability indicators was undertaken in conjunction with the identification of possible affordability risk indicators for the Risk Assessment. A full list of potential affordability indicators considered can be found in the white paper *Evaluation of Potential Indicators & Recommendations for Risk Assessment 2.0 for Public Water Systems.*[135]

Ultimately, the affordability indicators "Extreme Water Bill" and "% Shut-Offs" were included in the 2021 Risk Assessment and Affordability Assessment alongside %MHI. The State Water Board analyzed all three affordability indicators for the Affordability Assessment and applied the same thresholds as utilized in the Risk Assessment. The prevalence of community water systems that meet these thresholds, and are DAC or SDAC systems, are summarized for each affordability indicator in the sections below.

Additional analysis was conducted to identify the DAC and SDAC water systems that met more than one affordability indicator threshold. Scores of 0 (no threshold met), 1 (lower "minimum"

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132 FY 2020-21 Fund Expenditure Plan https://www.waterboards.ca.gov/water_issues/programs/grants_loans/sustainable_water_solutions/docs/sadwfep_2020_07_07.pdf

133 Disadvantaged Community or DAC mean the entire service area of a community water system, or a community therein, in which the median household income is less than 80 percent of the statewide annual median household income level.

134 Severely Disadvantaged Community or SDAC means the entire service area of a community water system in which the median household income is less than sixty percent of the statewide median household income.

135 October 7, 2020 White Paper: Evaluation of Potential Indicators & Recommendations for Risk Assessment 2.0 for Public Water Systems https://www.waterboards.ca.gov/safer/docs/e_p_i_recommendations_risk_assessment_2_public_water_systems.pdf

threshold met), and 1.5 (higher “maximum” threshold met) were applied to each affordability indicator threshold and tallied across the three indicators for each system to identify which systems may be facing the greatest affordability challenges.

% Median Household Income

This indicator measures annual system-wide average residential customer charges for 6 Hundred Cubic Feet (HCF) per month relative to the annual Median Household Income (MHI) within a water system’s service area. Six HCF indoor water usage per month is roughly equivalent to 50 gallons per person per day for a three-person household for 30 days.

Percent median household income (%MHI) is commonly used by state and Federal regulatory agencies and by water industry stakeholders for assessing community-wide water charges affordability for decades. %MHI is utilized by the State Water Board (at 1.5% threshold) and the U.S. EPA (at 2.5% threshold) for assessing affordability. The State Water Board uses %MHI to determine DAC status[136] and has for some time used the 1.5% MHI threshold in the Drinking Water State Revolving Fund (DWSRF) program as a metric for determining whether a small DAC will receive repayable (loan) or non-repayable (e.g., grant or non-repayable) funding.

The FY 2020-21 Fund Expenditure Plan uses 1.5% of the annual median household income (MHI) of the community served by the water system as the Affordability Threshold. Any community water system with annual customer charges, based on residential customer water usage of six hundred cubic feet (HCF) of water per month, that exceeded 1.5% of the MHI was identified on the list included in Appendix A for the FY 2020-21 Fund Expenditure Plan.[137]

For the 2021 Affordability Assessment, the State Water Board utilized two % MHI affordability thresholds. These thresholds correspond to the same thresholds used in the Risk Assessment. The minimum affordability threshold is 1.5% MHI and the maximum affordability threshold was set at 2.5% MHI. Additional details on the data sources, calculation methodology, and full analysis results for % MHI are in Appendix E

While exceeding these thresholds alone does not necessarily mean that water charges are unaffordable for a community, the 1.5% and 2.5% MHI affordability thresholds allow for a preliminary evaluation of systems that may have challenges with affordable customer charges.

[136] It is important to note that the estimated designation of community economic status is for the purposes of the Affordability Assessment only and will not be used by the State Water Board’s Division of Financial Assistance (DFA) to make funding decisions. Further MHI analysis on a per system basis will be conducted by DFA when a system seeks State Water Board assistance.

[137] FY 2020-21 Fund Expenditure Plan Appendix A

https://www.waterboards.ca.gov/board_info/agendas/2020/jul/070720_6_draftfinal_sadwfep_appendices_clean.pdf

Extreme Water Bill

This indicator measures drinking water customer charges that meet or exceed 150% and 200% of statewide average drinking water customer charges at the six HCF level of consumption. The State Water Board's AB 401 report[138] recommended statewide low-income rate assistance program elements which utilize the two recommended tiered indicator thresholds of 150% and 200% of the state average drinking water bill for 6 HCF.

% Shut-Offs

This affordability indicator measures the percentage of a water system's residential customer base which experienced service shut-offs due to non-payment in a given year. For the purposes of the State Water Board's Needs Assessment a threshold of 10% or greater customer shut-offs over the last calendar year for non-payment was utilized.

It is worth noting that on April 20, 2020, in response to the COVID-19 crisis, Governor Newsome issued an Executive Order N-42-20 to temporarily restrict water shut-offs due to non-payment.[139] The data used for this indicator is from the 2019 reporting year Electronic Annual Report (EAR). While the data utilized in the 2021 Needs Assessment was not impacted by the Executive Order, it will be taken into account in future years of the Needs Assessment.

AGGREGATED AFFORDABILITY ASSESSMENT RESULTS

AFFORDABILITY RESULTS BY COMMUNITY ECONOMIC STATUS

For the 2021 Affordability Assessment, State Water Board staff analyzed 2,877 community water systems, of which approximately 32 water systems lacked the data necessary to calculate any of the three affordability indicators. Some additional water systems lacked the necessary data for calculation of some of the affordability indicators and are summarized in Table 46.

Overall, comparing the three indicators in cases where data were available, systems were slightly more likely to exceed an Extreme Water Bill threshold (22% of systems with data) than a %MHI threshold (21% of systems with data). Systems were much less likely to exceed the % Shut-Offs threshold. Staff identified 592 water systems that exceeded the minimum 1.5% MHI affordability threshold, 222 of which exceeded the maximum 2.5% MHI threshold. Of those, 121 systems were identified that serve DACs and 313 systems that serve SDACs. The Assessment identified 628 water systems that exceeded the minimum 150% extreme water bill threshold and 365 of those systems exceeded the maximum 200% extreme water bill threshold. Of those that exceeded the 150% extreme water bill threshold, 113 systems were

[138] AB 401 Final Report:
Recommendations for Implementation of a Statewide Low-Income Water Rate Assistance Program
https://www.waterboards.ca.gov/water_issues/programs/conservation_portal/assistance/docs/ab401_report.pdf

[139] Executive Department, State of California. Executive Order N-42-20
https://www.gov.ca.gov/wp-content/uploads/2020/04/4.2.20-EO-N-42-20.pdf

identified that serve DACs and 122 that serve SDACs. Finally, staff identified 139 systems that exceeded the 10%+ shut-offs for non-payment affordability threshold. Of those, 35 systems were identified that serve DACs and 62 that serve SDACs.

Table 46 summarizes the number of water systems, by their community economic status, that exceeded the minimum affordability threshold for each indicator assessed.

Table 46: Aggregated Assessment Results by Community Economic Status

Community Status	Total Systems	% MHI Min. Threshold Met	Extreme Water Bill Min. Threshold Met	% Shut-Offs Min. Threshold Met
DAC	578	121 (21%)	113 (20%)	35 (6%)
SDAC	993	313 (32%)	122 (12%)	62 (6%)
Non-DAC	1,210	158 (13%)	393 (32%)	40 (3%)
Missing DAC Status	96	0 (0%)	0 (0%)	2 (2%)
TOTAL:	**2,877**	**592 (21%)**	**628 (22%)**	**139 (5%)**
Missing Data		*201 (7%)*	*118 (4%)*	*49 (2%)*

Figure 45: Number of Water Systems, by Community Economic Status, that Exceeded Each Minimum Affordability Indicator Threshold

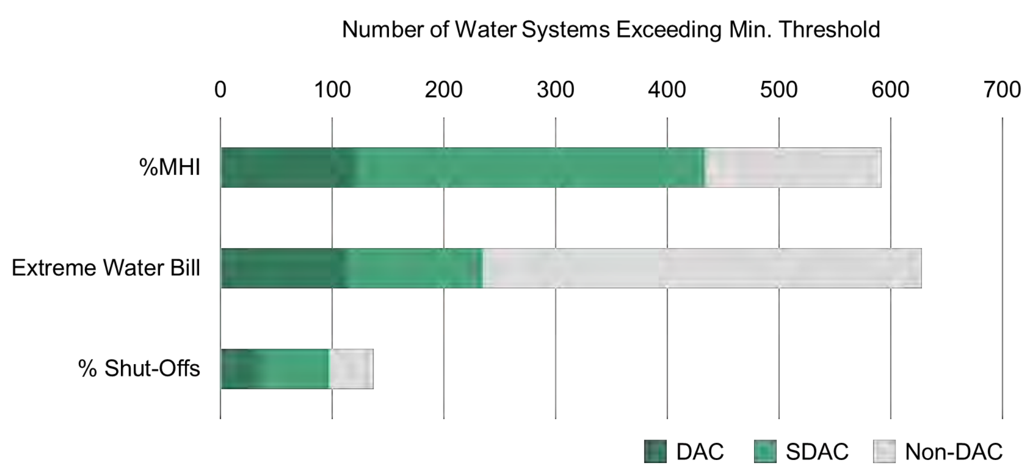
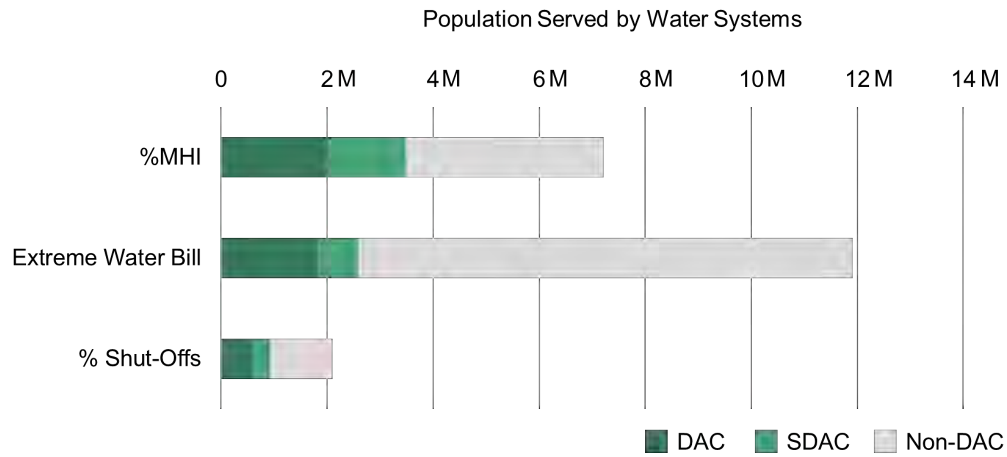


Figure 46: Population of Systems that Exceeded Each Affordability Indicator Threshold



To assess which systems may be facing the greatest affordability challenges, State Water Board staff further analyzed how many water systems exceeded the affordability threshold for one or more affordability indicator (Table 47). Of the 2,877 water systems analyzed, two thirds of water systems (n=1911) did not exceed any of the minimum affordability thresholds for the three indicators assessed. It is worth noting, there are no clear trends across community economic status and the number of systems exceeding affordability thresholds.

Staff identified 585 water systems that exceeded only one of the three minimum affordability thresholds, 46 of which are DACs and 224 are SDACs. The Assessment identified 267 water systems that exceeded two of the three minimum affordability thresholds, 73 of which are DACs and 74 are SDACs. Finally, staff identified 139 water systems that exceeded all three minimum affordability thresholds; 35 of these water systems are DACs and 60 are SDACs. It is worth noting that of the 139 water systems that exceeded all three affordability indicator thresholds, 7 systems exceeded all maximum affordability thresholds (e.g. 2.5% MHI, 200% Extreme Water Bill, and 10% or greater % Shut-Offs).

Table 47: Total Number of Systems that Exceeded an Affordability Indicator Threshold

Community Status	Total Systems	None	1 Indicator	2 Indicators	3 Indicators
DAC	578	416 (72%)	46 (8%)	73 (13%)	35 (6%)
SDAC	993	627 (63%)	224 (23%)	74 (7%)	60 (6%)
Non-DAC	1,210	784 (65%)	256 (21%)	120 (10%)	44 (4%)
Missing DAC Status	96	84 (88%)	2 (2%)	0 (0%)	0 (0%)
TOTAL:	**2,877**	**1,911 (66%)**	**528 (18%)**	**267 (9%)**	**139 (5%)**
Missing Data		*32* (1%)*			

* These water systems were missing data necessary to calculate all three affordability indicators. All other water systems had sufficient data to calculate at least one affordability indicator.

Figure 47: Total Number of Systems, by Community Economic Status, that Exceeded an Affordability Indicator Threshold

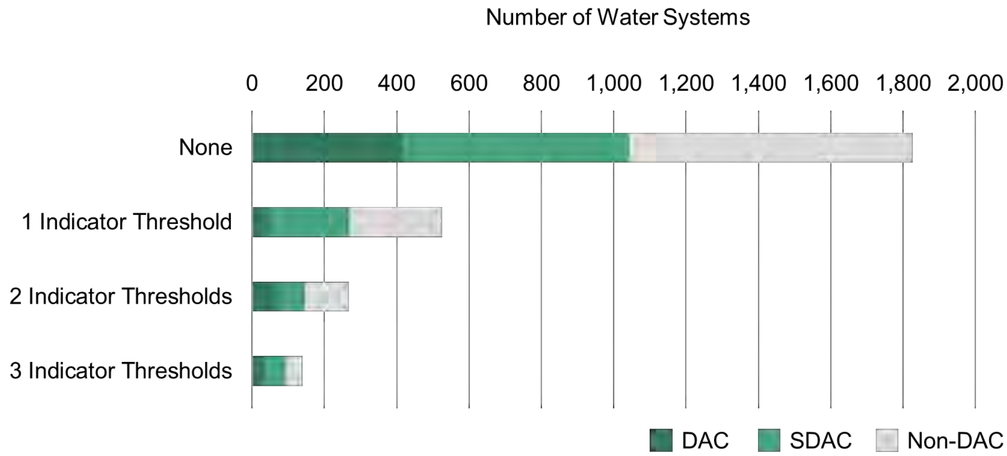


Figure 48: Population of Water Systems, by Community Economic Status, that Exceeded an Affordability Indicator Threshold

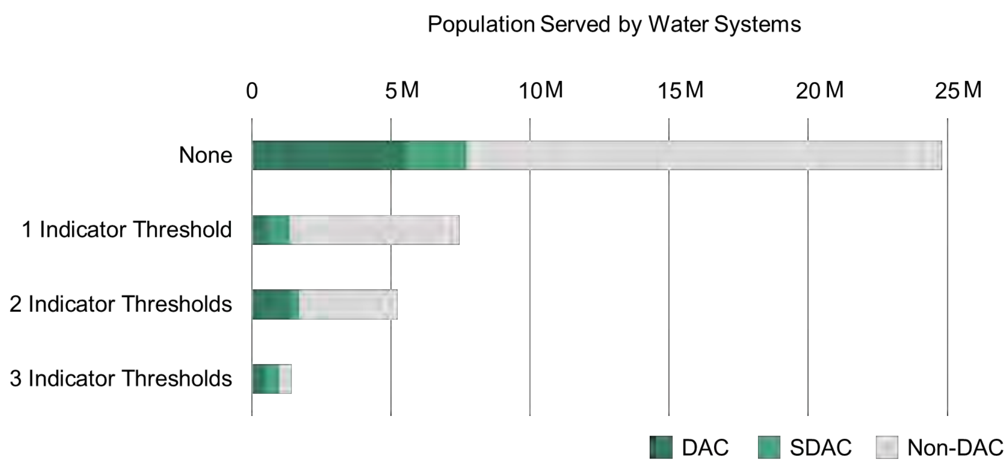
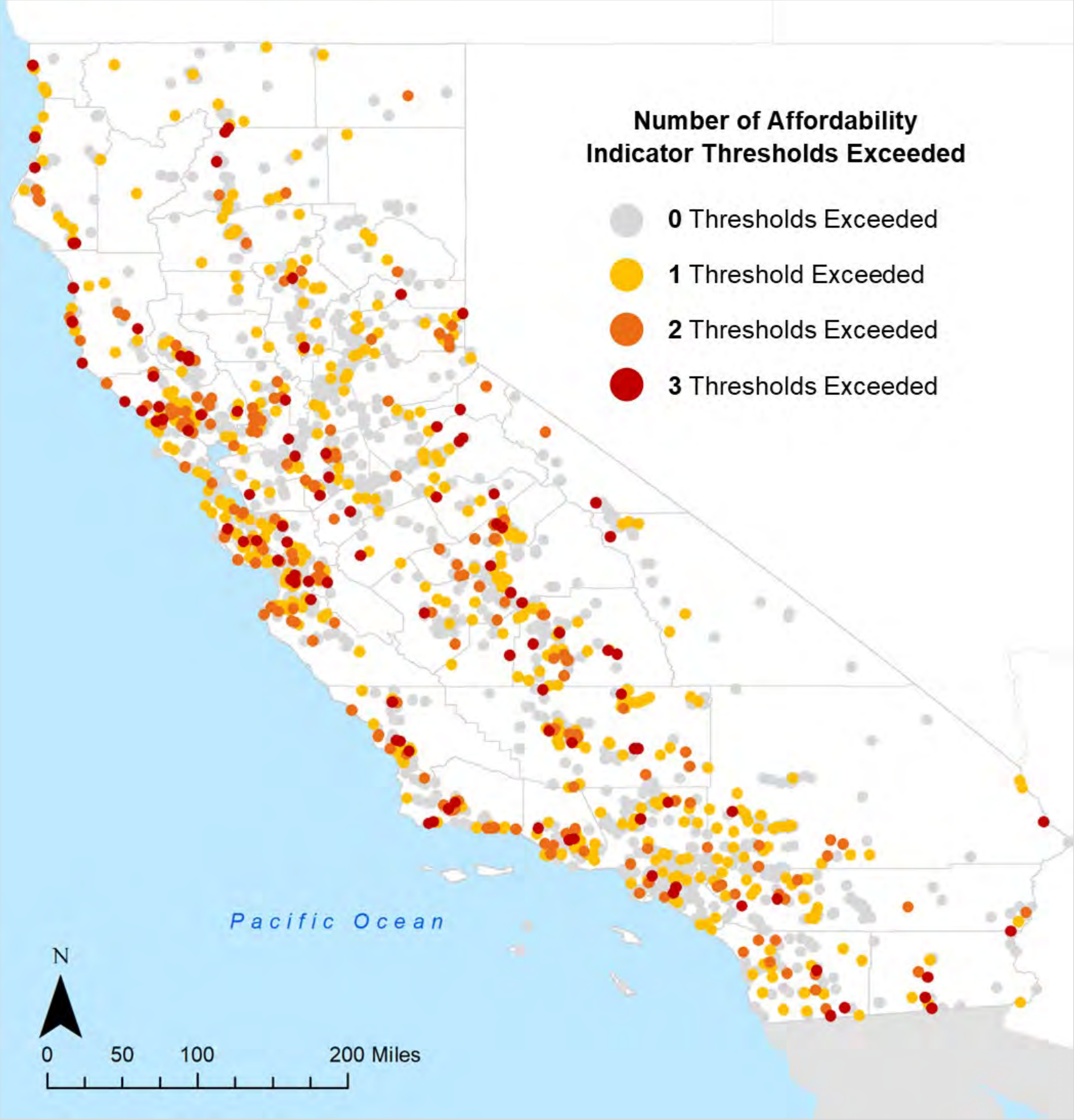
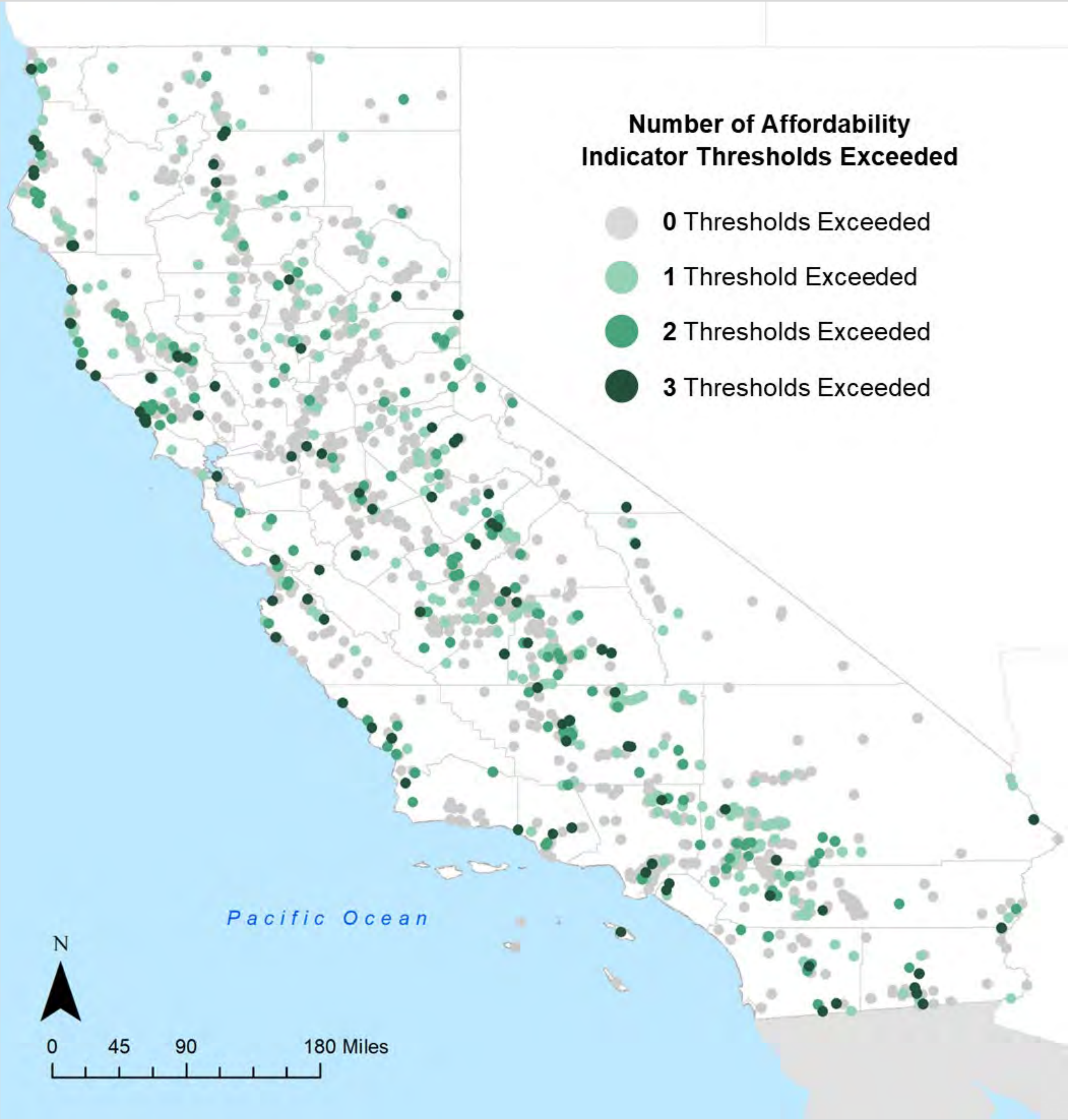


Figure 49: All Water Systems that Exceeded an Affordability Indicator Threshold (n=2,189)*



* 86 water systems were not able to be mapped due to missing service area boundaries.

Figure 50: DAC and SDAC Water Systems that Exceeded an Affordability Indicator Threshold (n=1,554)*



* One system was unable to be mapped due to missing service area boundary.

AFFORDABILITY RESULTS BY WATER SYSTEM SAFER PROGRAM STATUS

While SB 200 only mandates the identification of DAC water systems that have customer charges that exceed affordability thresholds, the 2021 Affordability Assessment also identified if HR2W list and At-Risk public water systems exceeded affordability thresholds as well. Table 48 and the section below summarizes the number of failing HR2W list and At-Risk water systems, by their community economic status, that exceeded the minimum affordability threshold for each indicator assessed.

% MHI: Staff identified 77 HR2W list systems (10 DAC and 56 SDAC) and 119 At-Risk (20 DAC and 63 SDAC) water systems that exceeded the minimum 1.5% MHI affordability threshold. Of these, 32 HR2W list systems (5 DAC and 23 SDAC) and 55 At-Risk (5 DAC and 40 SDAC) water systems exceeded the maximum 2.5% MHI threshold.

Extreme Water Bill: 54 HR2W list systems (10 DAC and 20 SDAC) and 106 At-Risk (19 DAC and 33 SDAC) water systems exceeded the minimum 150% statewide MHI affordability threshold. Of these, 29 HR2W list systems (6 DAC and 8 SDAC) and 67 At-Risk (9 DAC and 17 SDAC) systems exceeded the maximum 200% statewide MHI threshold.

% Shut-Offs: Finally, staff identified 21 HR2W list systems (4 DAC and 13 SDAC) and 17 At-Risk (2 DAC and 12 SDAC) water systems that exceeded the 10% or greater shut-offs for non-payment affordability threshold.

The full results of this analysis by affordability indicator are detailed in Appendix E.

Table 48: Aggregated Affordability Assessment Results by Water System SAFER Program Status

SAFER Program Status*	Total Systems	% MHI Min. Threshold Met	Extreme Water Bill Min. Threshold Met	% Shut-Offs Min. Threshold Met
HR2W Systems	**276**	**77 (28%)**	**54 (20%)**	**21 (8%)**
HR2W DAC	45	10	10	4
HR2W SDAC	142	56	20	13
At-Risk Systems	**467**	**119 (25%)**	**106 (23%)**	**17 (4%)**
At-Risk DAC	103	20	19	2
At-Risk SDAC	189	63	33	12
Not HR2W or At-Risk System	**2,134**	**396 (19%)**	**468 (22%)**	**101 (5%)**
DAC	430	91	84	29
SDAC	662	194	69	37
TOTAL:	**2,877**	**592 (21%)**	**628 (22%)**	**139 (5%)**
Missing Data		*201 (7%)*	*118 (4%)*	*49 (2%)*

* Water systems that are not DAC/SDAC or are missing DAC status designations are excluded from sub-categories within this table.

Figure 51: Total Number of HR2W List and At-Risk Water Systems that Exceeded Each Minimum Affordability Indicator Threshold

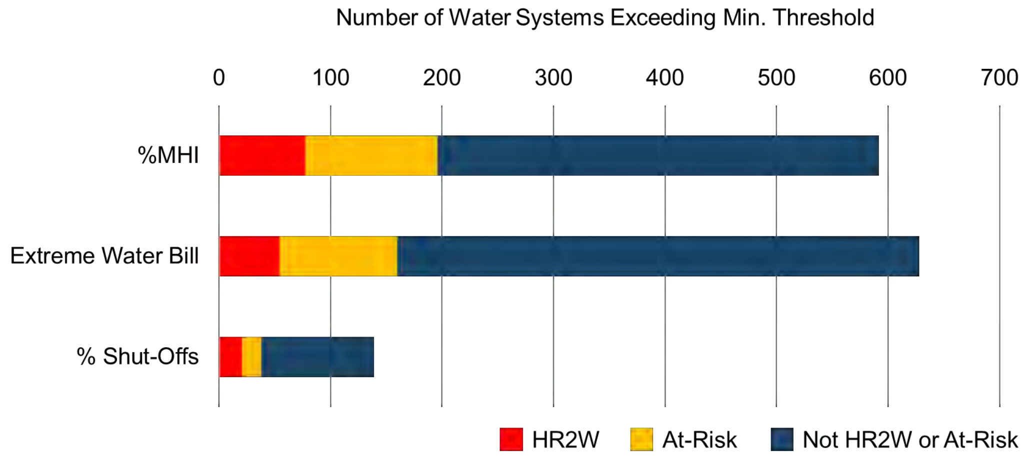
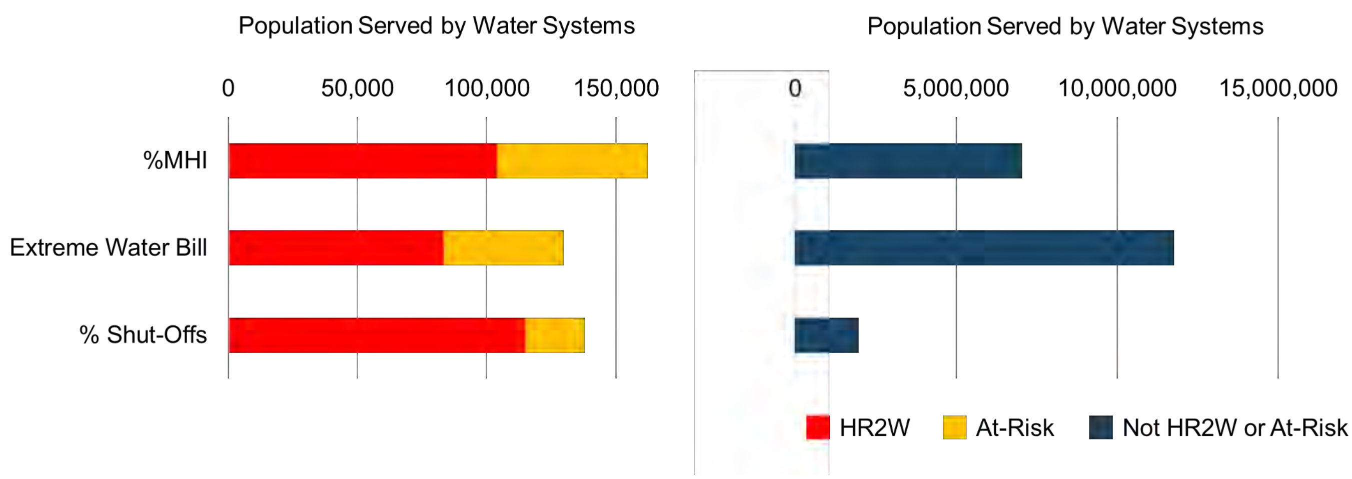


Figure 52: Total Population of Water Systems that Exceeded Each Affordability Indicator Threshold



Further analysis of the aggregated Affordability Assessment results shows that HR2W list systems and At-Risk water systems exceeded one or more affordability thresholds at the same proportion (within 30%) as Not-HR2W or Not At-Risk water systems (Table 49).

Table 49: Aggregated Affordability Assessment Results by Water System SAFER Program Status: Total Number of Systems that Exceeded an Affordability Indicator Threshold

SAFER Program Status	Total Systems	None	1 Indicator	2 Indicators	3 Indicators
HR2W Systems	**276**	**168 (61%)**	**58 (21%)**	**28 (10%)**	**18 (7%)**
HR2W DAC	45	30	3	5	5
HR2W SDAC	142	77	38	16	9
At-Risk Systems	**467**	**311 (67%)**	**63 (13%)**	**54 (12%)**	**34 (7%)**
At-Risk DAC	103	80	5	13	5
At-Risk SDAC	189	114	39	17	16
Not HR2W or At-Risk System	**2,134**	**1,432 (67%)**	**407 (19%)**	**185 (7%)**	**87 (4%)**
DAC	430	306	38	55	23
SDAC	662	436	147	41	34
TOTAL:	**2,877**	**1,911 (66%)**	**528 (18%)**	**267 (9%)**	**139 (5%)**
Missing Data		*32* (1%)*			

* These water systems were missing data necessary to calculate all three affordability indicators. All other water systems had sufficient data to calculate at least one affordability indicator.

Figure 53: Total Number of HR2W List and At-Risk Systems that Exceeded an Affordability Indicator Threshold

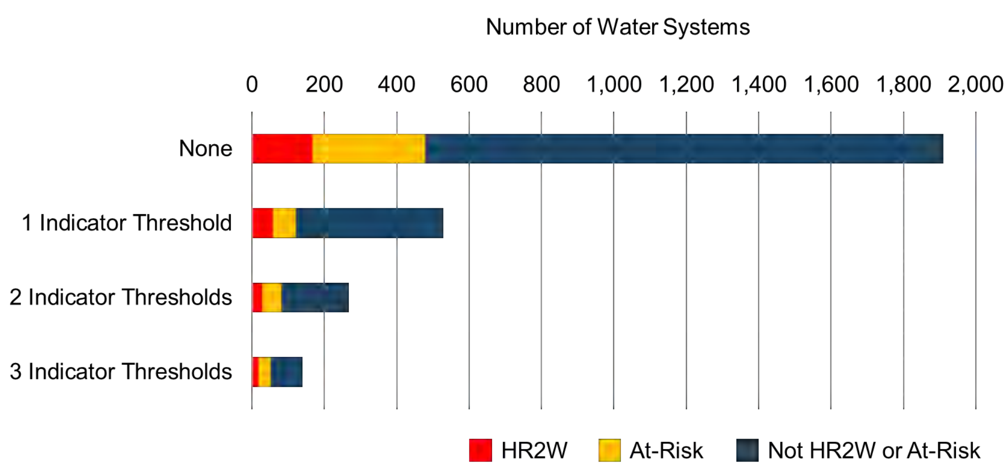


Figure 54: Total Population of Water Systems that Exceeded an Affordability Indicator Threshold

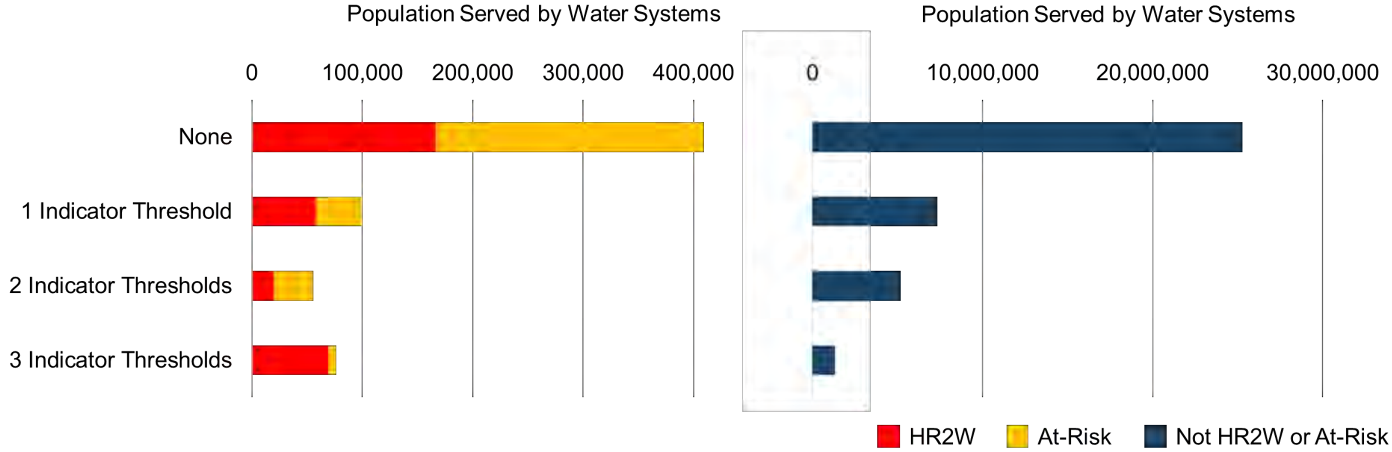
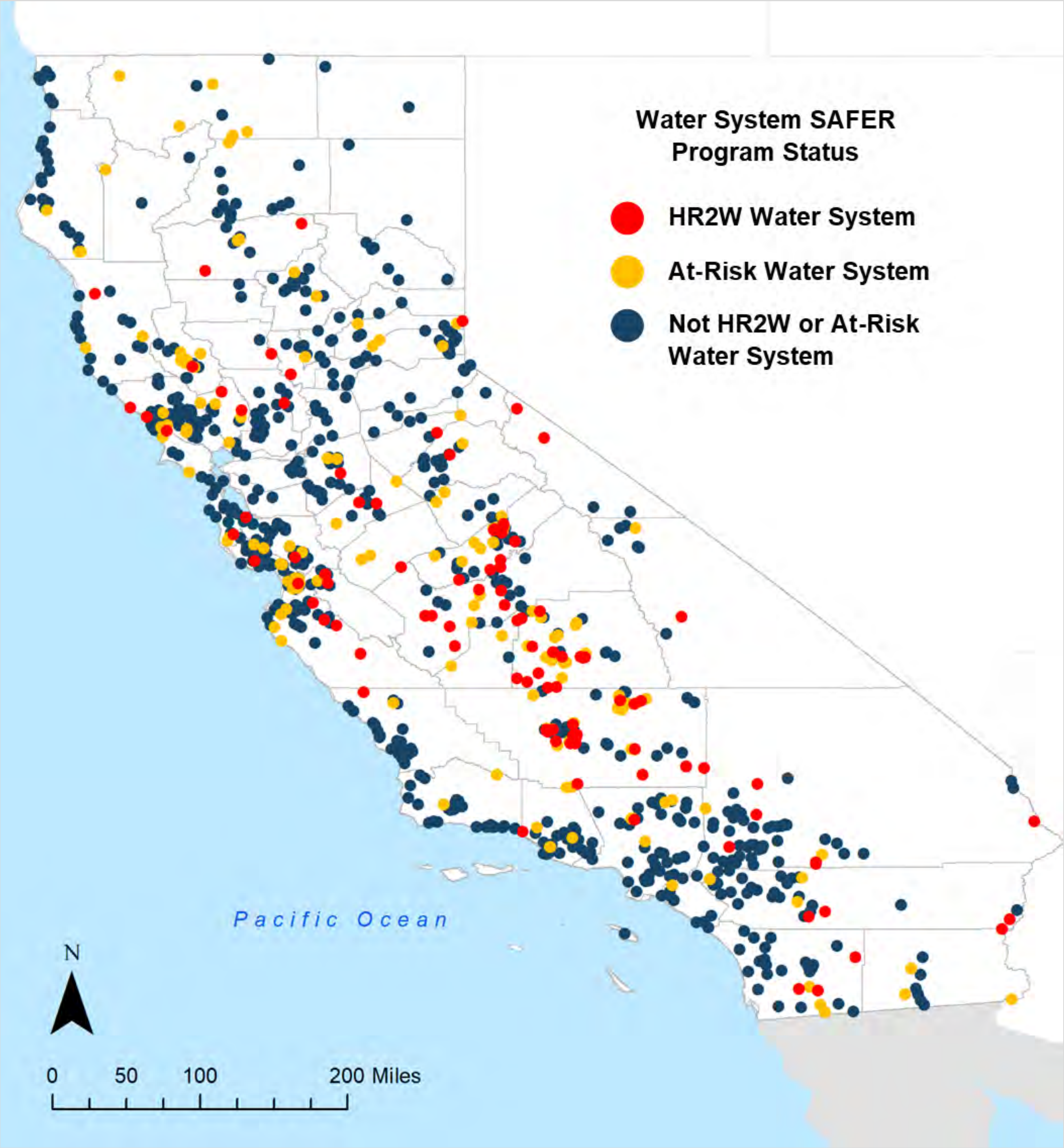


Figure 55: HR2W List and At-Risk Water Systems that Exceeded an Affordability Indicator Threshold (n=932)*



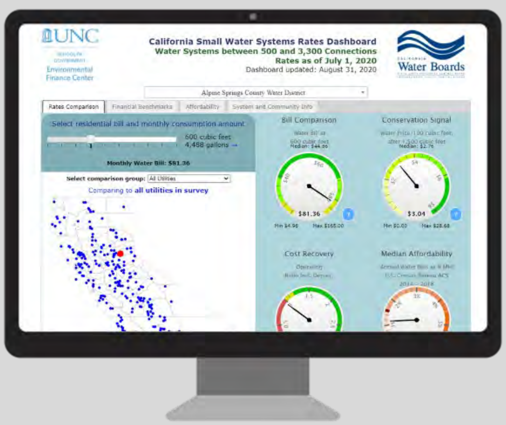
* Two water systems were not able to be mapped due to missing service area boundaries.

SMALL WATER SYSTEM RATES DASHBOARD

The California Small Water Systems Rates Dashboard (dashboard) is an online information sharing resource with an interactive interface that allows users to compare or benchmark residential rates, financial, and system performance data of community water systems serving between 500 and 3,300 connections. This dashboard was commissioned by the State Water Board as a pilot resource for small community water systems as part of the Needs Analysis contract with UCLA. The dashboard was created by the Environmental Finance Center at the University of North Carolina, Chapel Hill (EFC at UNC), working with the UCLA Luskin Center for Innovation, during the spring and summer of 2020. A publicly available white paper[140] on the dashboard was published and a public webinar was held on its potential uses on October 30, 2020.[141] The release of the publication and webinar was followed by a public comment period.

The dashboard utilizes an interactive interface that visualizes information via easy-to-understand graphics. The visualization allows the user to gain a multi-faceted understanding of the water system's financial health and performance. The dashboard is already populated with data for each water system and no data inputs are required.

The dashboard was created with data that were available during the summer of 2020. Not all data were available for every water system on the dashboard. As detailed in the white paper and dashboard itself, key data categories are: residential water rates and rate structures, water system financial indicators, other water system characteristics including compliance status data, and socioeconomic and population data joined from the U.S. Census. The data displayed in the dashboard are not updated by the State Water Board or the EFC at UNC. The State Water Board is exploring how tools like the dashboard can help water systems better assess affordability of drinking water services in their community.



Explore the Rates Dashboard

The California Small Water Systems Rates Dashboard allows comparison and benchmarking of water rates, financial metrics, and other system performance measures with peers, according to important factors such as system size and customer demographics.

https://efc.sog.unc.edu/resource/california-small-water-systems-rates-dashboard

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[140] October 30, 2020 White Paper:
[Introducing the California Small Water Systems Rates Dashboard](https://www.waterboards.ca.gov/drinking_water/programs/safer_drinking_water/docs/introducing_california_small_water_systems_rates_dashboard.pdf)
https://www.waterboards.ca.gov/drinking_water/programs/safer_drinking_water/docs/introducing_california_small_water_systems_rates_dashboard.pdf

[141] [October 30, 2020 Webinar Presentation](https://www.waterboards.ca.gov/drinking_water/programs/safer_drinking_water/docs/rates_dashboard.pdf)
https://www.waterboards.ca.gov/drinking_water/programs/safer_drinking_water/docs/rates_dashboard.pdf

AFFORDABILITY ASSESSMENT LIMITATIONS

The 2021 Affordability Assessment makes progress in identifying communities that may be struggling with water affordability challenges; however, State Water Board staff have identified the following limitations that are worth noting:

Affordability Assessment Scope

As described above, there are multiple lenses through which to assess water “affordability.” SB 200 does not define how the State Water Board should measure affordability. Nor does it specify if the “Affordability Threshold” is meant to assess household affordability, community affordability, and/or a water system’s financial capacity. All three aspects of affordability are interrelated, but metrics or indicators that measure each can differ greatly. More engagement with the public, water systems, and stakeholders is needed to better define the scope of the Affordability Assessment and how its results will be utilized.

Affordability Indicator Data

The State Water Board acknowledges that there are some data coverage issues and data quality uncertainties for all the affordability indicators utilized in the Affordability Assessment. Customer charges, MHI, and/or customer shut-off data are not available for some water systems included in this assessment. Water system customer charge data do not always represent the current same or current year for systems in the Affordability Assessment and Risk Assessment. This data is self-reported and has historically lacked full quality assurance. Finally, water system boundaries, which are used to calculate MHI, may not be accurate. In some cases, they reflect a water system’s jurisdiction boundary rather than their service area boundary.

An additional consideration that may be impacting the results of the Affordability Assessment is that water system customer charges may not reflect the full cost water systems face in order to meet current and future operations and infrastructure needs to deliver safe drinking water. For example, many small water systems lack asset management plans, capital improvement plans, and financial plans to assist them in setting customer charges appropriately. This may result in customer charges that are lower than what is needed to support resilient water systems. If more systems were to implement full-cost pricing of their customer charges, the Affordability Assessment results may be different.

Affordability Indicators

There has been criticism of %MHI by academics, water system associations, and the broader water sector mostly around its accuracy in measuring household affordability for those truly in need and the setting of arbitrary %MHI thresholds, limitations which the U.S. EPA has recently acknowledged. Furthermore, some affordability indicators may be more applicable to some governance types of systems than others. For instance, some of the feedback received on the affordability indicators from the Risk Assessment public engagement was that using rates-based indicators, like %MHI and Extreme Water Bill, does not capture the ways in which some systems finance the full cost of service provision. Another point raised was that some individual water systems are connected to larger utility structures that help mitigate affordability challenges in ways that are not currently in the Affordability Assessment.

It is also worth noting that many other State agencies are developing and utilizing affordability indicators in similar complementary efforts. The selection of affordability indicators for the Needs Assessment fully considered affordability indicators used by the Office of Environmental Health Hazard Assessment (OEHHA), the Department of Water Resources (DWR), and the California Public Utilities Commission (CPUC). However, many of the indicators selected for the Needs Assessment differ from those used by these other efforts. The use of different indicators, and corresponding thresholds, across State agencies and Federal agencies can lead to some confusion for water systems and communities. The State Water Board will continue to collaborate with other State agencies and work towards better alignment.

AFFORDABILITY ASSESSMENT REFINEMENT OPPORTUNITIES

The State Water Board will be conducting the Affordability Assesses on an annual basis as part of the Needs Assessment. To begin addressing the limitations highlighted above, the State Water Board will begin exploring new opportunities to refine the next iteration of the Affordability Assessment:

Better Define Affordability Scope
The State Water Board will begin conducting targeted stakeholder engagement to better define the scope of the Affordability Assessment.

Improved Data Collection Efforts
The State Water Board has already begun taking necessary steps to improve data coverage and accuracy for the Affordability Assessment. Improvements to the 2020 reporting year EAR include new requirements for completing survey questions focused on customer charges and affordability.[142] EAR functionality has been developed that will help auto-calculate average customer charges for 6 HCF, which will help reduce data errors. Furthermore, the EAR will be able to better distinguish between water systems that do not charge for water compared to those that do.

Refinement of Affordability Indicators and Thresholds
During the Risk Assessment methodology development process, three additional Affordability indicators were recommended for inclusion in future iterations of the Risk Assessment and, potentially, the Affordability Assessment as well:[143] 'Household Burden Indicator,' 'Poverty Prevalence Indicator,' and 'Housing Burden.'[144] The State Water Board will begin conducting

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[142] Electronic Annual Report (EAR) | California State Water Resources Control Board
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/ear.html

[143] October 7, 2020 White Paper:
Evaluation of Potential Indicators and Recommendations for Risk Assessment 2.0 for Public Water Systems
https://www.waterboards.ca.gov/safer/docs/e_p_i_recommendations_risk_assessment_2_public_water_systems.pdf

[144] *Household Burden Indicator*: This indicator measures the economic burden that relatively low income households face in paying their water service costs by focusing on the percent of these costs to the 20th percentile income (i.e. the Lowest Quintile of Income (LQI) for the service area). This indicator is calculated by adding the average drinking water customer charges, dividing them by the 20th Percentile income in a community water system, and multiplying this by one hundred.

the proper research and stakeholder engagement needed to develop the appropriate affordability thresholds necessary for inclusion in the Risk Assessment and potentially the Affordability Assessment as well.

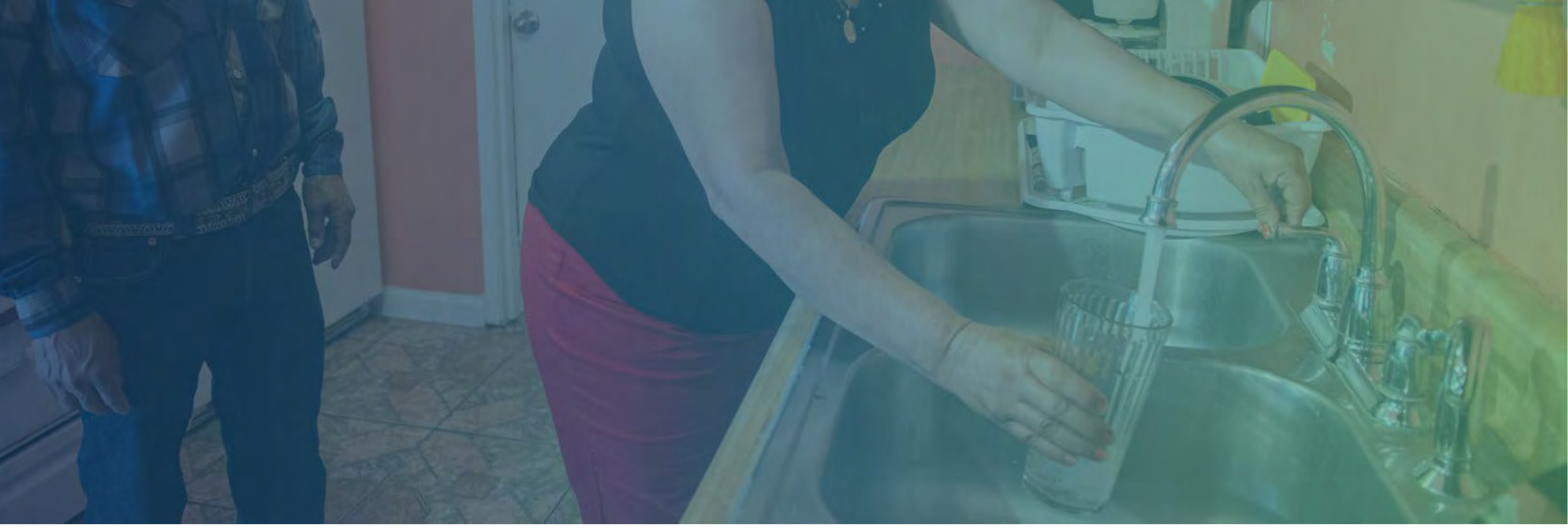
Improved Aggregated Assessment

Moving forward, the State Water Board will explore the possibility of developing a singular Affordability Threshold that can then be applied to a combined assessment of the identified affordability indicators.

Further consideration will also be given to how systems that do not charge for water services or have extremely low customer charges should be assessed for affordability and more broadly for risk. These systems may be more at-risk for falling out of water quality compliance or may be imposing affordability burdens on their customers through other means other than customer charges.

Poverty Prevalence Indicator: This indicator measures the percentage of population served by a community water system that lives at or below 200% the Federal Poverty Level. This measurement indicates the degree to which relative poverty is prevalent in the community.

Housing Burden: This indicator measures the percent of households in a water system’s service area that are both low income and severely burdened by housing costs (paying greater than 50% of their income for housing costs). This metric is intended to serve as an indicator of the affordability challenges low-income households face with respect to other non-discretionary expenses, which may impact their ability to pay for drinking water services.



CONCLUSIONS

NEEDS ASSESSMENT OBSERVATIONS & FUTURE ITERATIONS

Moving forward, the State Water Board will be conducting the Needs Assessment annually to support the implementation of the SAFER Program. The results of the Needs Assessment will be used to dynamically prioritize public water systems, tribal water systems, state small water systems, and domestic wells for funding in each year's Safe and Affordable Drinking Water Fund Expenditure Plan; inform State Water Board technical assistance; and to develop strategies for implementing interim and long-term solutions. The State Water Board will also use the Needs Assessment results for targeted outreach on engagement and partnership activities.

The Needs Assessment methodology will be refined over time to incorporate additional and better-quality data; experience from implementation of the SAFER Program; and further input from the public and the SAFER Advisory Group. The following summarizes Needs Assessment refinement opportunities:

Improved Data

The State Water Board has already begun taking necessary steps to improve data coverage and accuracy for the Needs Assessment. Improvements to the 2020 reporting year EAR include new requirements for public water systems in completing survey questions focused on customer charges and affordability.[145] EAR functionality has been developed that will help improve data accuracy as well. Additionally, the State Water Board's Division of Financial Assistance has begun developing a strategy to capture more detailed funded project and technical assistance cost data. Finally, The State Water Board is currently working on developing the System Area Boundary Layer Admin App (SABL Admin), an administrative tool that allows District Offices, Local Primacy Agencies and public water system staff to upload and verify water system area boundaries to a central database. Improvement of water system boundary data statewide will enhance the calculation of %MHI and other important data points

[145] Electronic Annual Report (EAR) | California State Water Resources Control Board
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/ear.html

for the Risk and Affordability Assessments, as well as increase the accuracy of the Cost Assessment's modeling of potential physical consolidation solutions.

Better Alignment Across Needs Assessment Components
The State Water Board will continue to refine and align the three Needs Assessment components. In 2020-21, one challenge faced by the State Water Board, UCLA, and its sub-contractors was the timing of the initial development and implementation of the different Needs Assessment components. This led to different datasets being utilized by different Assessments. For example, the inventory of At-Risk SSWSs and domestic wells analyzed differs between the Risk Assessment and the Cost Assessment. This occurred because in order to complete the Needs Assessment in time for the 2021-22 Fund Expenditure Plan, certain components of the Cost Assessment needed to rely on earlier GAMA data. This resulted in a different inventory of At-Risk SSWSs and domestic wells identified and modeled for long-term solution costs. The newer GAMA data and Risk Assessment results for SSWSs and domestic wells were utilized to identify and calculate the interim cost estimates. The next iteration of the Needs Assessment will strive to include a more time-consistent inventory of systems across the three components for the purposes of clarity and consistency.

Additionally, future iterations of the Cost Assessment Model will better utilize the detailed results of the Risk Assessment to better match potential, and estimate costs for, modeled solutions. For example, an At-Risk water system facing TMF Capacity issues but not water quality issues could be assigned a modeled solution focused on non-capital-based assistance, including Administrator costs as that data becomes available.

Focused Scope
The 2021 Needs Assessment attempts to analyze the needs of public water systems, state small water systems, individual domestic wells, and tribal water systems. It also attempts to analyze several different topics and stages of problem-solution development: the Risk Assessment, Cost Assessment (including a funding Gap Analysis), and Affordability Assessment. Given the full breadth of this effort and decreased contractional support in future years, additional input from SAFER Advisory Group members and stakeholders on future focus areas to help streamline the scope of the Needs Assessment may be warranted. For example, the 2021-2022 Needs Assessment refinement period could prioritize the development of additional affordability indicators over additional water quality indicators. Additionally, prioritization of the Needs Assessment on target system or community types could focus the scope. A more focused scope may result in a more useful analysis for the SAFER Program.

Expanded Outreach to Tribal Water Systems
Federally regulated California tribal water systems were originally envisioned to be included in the 2021 Needs Assessment, and attempts were made to gather data to this end, but ultimately tribal systems had to be excluded from the Needs Assessment for public water systems due to missing data. However, broad estimates of the potential number of At-Risk equivalent systems and cost estimates were developed in an alternative Tribal Needs Assessment detailed in Appendix F.

Additional outreach strategies to Federally regulated California tribal water systems are planned for May and June 2021. These outreach efforts will be centered on informing tribal leaders about the purpose of the SAFER Program and informing them of the benefits of sharing information so that they may be included in future Risk Assessments. Outreach may also include combined efforts with the Department of Water Resources to obtain drought related information to minimize State related information requests. In the interim, SAFER Program staff will continue to work with individual tribes, as requested by tribal leaders or in response to requests from the U.S. EPA.

Alignment with other State Efforts
Multiple other California state agencies have recently begun assessing different aspects of drinking water systems' risks and performance with respect to the HR2W. These agencies include the Department of Water Resources (DWR), the Office of Environmental Health Hazard Assessment (OEHHA) and the California Public Utilities Commission (CPUC). Both State Water Board staff and the contracted Needs Assessment team led by UCLA engaged in discussions with staff from each of these agencies to try to avoid duplication of efforts and to ensure the most productive long-term statewide assessment of water system performance possible. Moving forward, the State Water Board will continue to pursue collaborative inter-agency opportunities to enhance the Needs Assessment.

The State Water Board is making the data from the Needs Assessment available to other State agencies and the public in an effort to encourage the utilization of its results into broader decision making. The State Water Board is partnering on the implementation of other statewide water program efforts that may impact drinking water, such as the Sustainable Groundwater Management Act (SGMA), Central Valley Salinity Alternatives for Long-Term Sustainability Initiative (CV-Salts), and County Drought Advisory Group (CDAG). The State Water Board is seeking to ensure that core drinking water sustainability approaches, such as the importance of water partnerships and regionalization activities, are included in these discussions. For example, considerations of local solutions around new wells should include the results of the Risk Assessment, particularly affordability and TMF capacity needs when deliberating between installing new wells and consolidation.

Refinement of the Affordability Assessment
The State Water Board will begin working with the public to further refine the affordability indicators and thresholds utilized in the Affordability Assessment. The State Water Board will continue to collaborate with other State agencies and work towards better alignment amongst complimentary affordability efforts. Affordability Assessment refinement efforts will also include the exploration of developing a singular Affordability Threshold that can then be applied to a combined assessment of affordability indicators.

Further consideration will also be given to how systems that do not charge for water services or have extremely low customer charges should be assessed for affordability and more broadly for risk. These systems may be more at-risk for falling out of water quality compliance or may be imposing affordability burdens on their customers through other means other than customer charges.

Learning by Doing – SAFER Program Maturation
The 2021 Needs Assessment is the inaugural edition of this report. While every effort was made to make it comprehensive, this assessment is designed to be an annual, iterative process and it is the State Water Board's expectation that it will continue to improve over time.

As the State Water Board's SAFER Program matures, better tracking of systems that come on and off the HR2W list and At-Risk will occur within the State Water Board's new SAFER Clearinghouse database. These improvements along with reflection and deeper investigation into areas where results did not fully reflect the breadth or depth of staff or community experiences (e.g. complexity of urban areas, emerging contaminants, and self-supplied homes using unfiltered surface water) will be incorporated into future efforts.

Continued Public Engagement

The State Water Board is committed to engaging the public and key stakeholder groups to solicit feedback and recommendations as it refines its Needs Assessment methodologies. The State Water Board will continue to host public workshops to provide opportunities for stakeholders to learn about and contribute to the refinement process. Stakeholders are encouraged to sign-up for the SAFER Program's email list-serve to receive notifications of when these public workshops are scheduled to occur.[146]

NEEDS ASSESSMENT NEXT STEPS

WATER SYSTEM REQUESTS FOR DATA UPDATES

The State Water Board is accepting inquiries related to underlying data change requests for the Risk Assessment and Affordability Assessment. The data used for both Assessments are drawn from multiple sources and are detailed in Appendix A and Appendix E. Water systems are encouraged to reach out via the online webform below:

Water System Data Change Request Webform: https://bit.ly/2Q5DLML

The State Water Board will be updating the Risk Assessment Results in Attachment A1 as data changes occur.[147] Therefore, the list of water systems designated At-Risk and Potentially At-Risk in this Attachment will evolve from the aggregated assessment results summarized in this report over time.

2021-22 SAFE AND AFFORDABLE DRINKING WATER FUND EXPENDITURE PLAN

The results of the 2021 Needs Assessment will be utilized by the State Water Board and the SAFER Advisory Group[148] to inform the prioritization of funding and technical assistance within the Safe and Affordable Drinking Water Fund Expenditure Plan.[149] The SAFER Advisory

[146] SAFER Program Email List-Serve (bottom of webpage)
https://www.waterboards.ca.gov/safer/

[147] Attachment A1: 2021 Risk Assessment Results
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/docs/a1.xlsx

[148] SAFER Advisory Group
https://www.waterboards.ca.gov/safer/advisory_group.html

[149] Safe and Affordable Drinking Water Fund
https://www.waterboards.ca.gov/water_issues/programs/grants_loans/sustainable_water_solutions/safer.html

Group is composed of 19 appointed members that represent public water systems, technical assistance providers, local agencies, nongovernmental organizations, the public and residents served by community water systems in disadvantaged communities, state small water systems, and domestic wells.

The SAFER Advisory Group meets up to four time a year at locations throughout California to provide many opportunities for public and community input. All meetings are widely publicized, open to the public, and offer language translation services. The State Water Board will also be hosting a series of workshops between April and June 2021 to inform the Fund Expenditure Plan.

APPENDIX A:
RISK ASSESSMENT METHODOLOGY FOR PUBLIC WATER SYSTEMS

INTRODUCTION

The purpose of the Risk Assessment for public water systems is to identify systems at-risk or 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 and resilient water system. Data on performance and risk is most readily available for public water systems and thus the risk assessment methodology for public water systems allows for a multi-faceted examination across four risk indicator categories: Water Quality, Accessibility, Affordability; and TMF (technical, managerial, and financial) Capacity.

PUBLIC WATER SYSTEMS ASSESSED

The Risk Assessment for public water systems was conducted for community water systems with 3,300 service connections or less and all non-transient non-community water systems which serve K-12 schools. 72 wholesalers were not included in the Risk Assessment because they do not provide direct service to residential customers and larger water systems were excluded in this assessment because approximately 90% of the violations occur with systems less than 500 connections. See Table A1 for details.

Table A1: Public Water Systems Analyzed in the Risk Assessment

Water System Type*	Number	Water Quality	Accessibility	Affordability	TMF Capacity
Public Water Systems (3,300 connections or less; wholesalers *excluded*)	2,241	Yes	Yes	Yes	Yes
K-12 Schools**	383	Yes	Yes	No	Yes
Other Public Water Systems***	155	Yes	Yes	No	Yes
TOTAL ANALYZED:	**2,779**				

* Systems on the HR2W list were included in the Risk Assessment analysis, however, they were excluded from the final Risk Assessment results.

** These systems were manually identified by the State Water Board.

*** Transient Areas, Recreational Facilities, Hotels, Summer Camps, Prisons, Medical Facilities, Military Complexes

RISK ASSESSMENT METHODOLOGY DEVELOPMENT PROCESS

The initial draft Risk Assessment methodology was developed by UCLA from September 2019 to March 2020 and incorporated 14 risk indicators. Details on the initial draft Risk Assessment methodology and results are provided in the July 22, 2020 white paper *Identification of Risk Assessment 2.0 Indicators for Public Water Systems.*[150]

The State Water Board and UCLA refined the initial draft Risk Assessment methodology through multiple stages of development between April 2020 and March 2021. This effort was designed to encourage public and stakeholder participation, providing opportunities for feedback and recommendations throughout the methodology development process. Figure A1 provides an overview of the Risk Assessment development phases. Each of these development phases were detailed in publicly available white papers, presented at public webinars, and the public feedback received was incorporated into the final Risk Assessment methodology and results.

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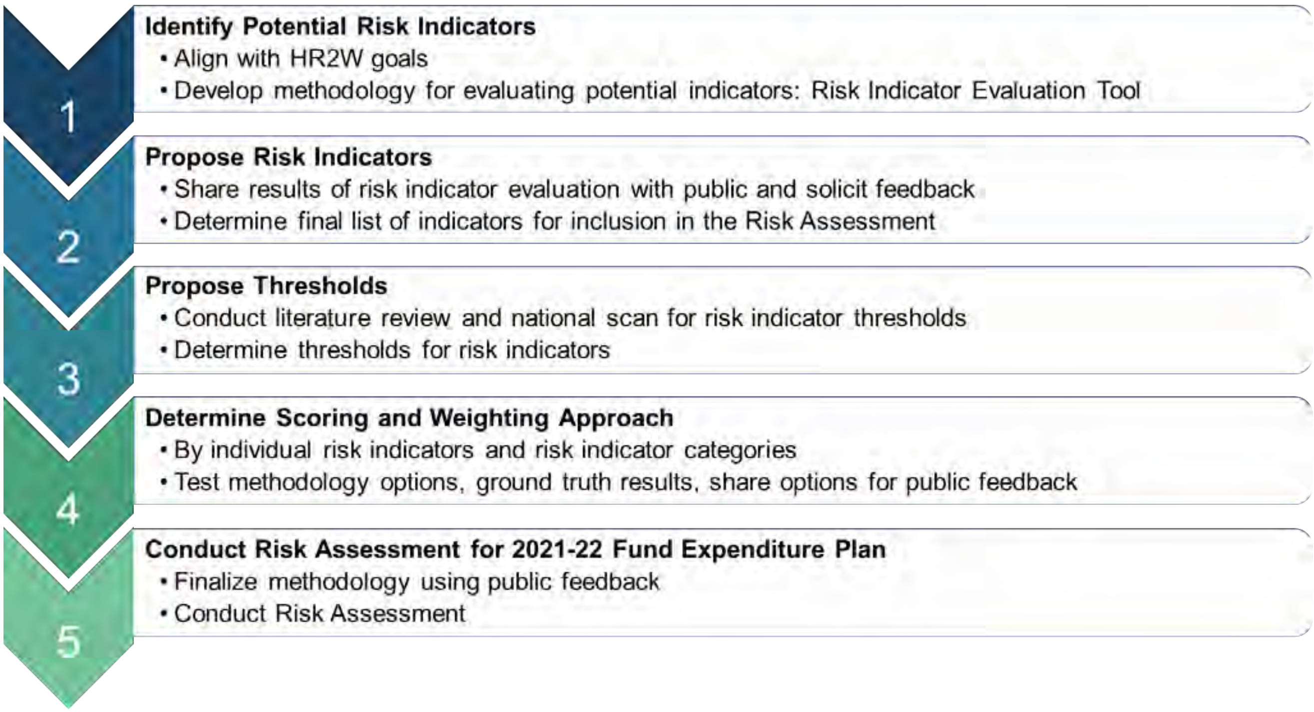
[150] July 16, 2020 White Paper:
Identification of Risk Assessment 2.0 Indicators for Public Water Systems
https://www.waterboards.ca.gov/drinking_water/programs/safer_drinking_water/docs/draft_white_paper_indicators_for_risk_assessment_07_15_2020_final.pdf

July 22, 2020 Webinar Presentation
https://www.waterboards.ca.gov/drinking_water/programs/safer_drinking_water/docs/july22_risk_assessment_slides.pdf

July 22, 2020 Webinar Recording
https://www.youtube.com/embed/H57wBnWij1Y?modestbranding=1&rel=0&autoplay=1

Figure A1: Phases of Risk Assessment Development

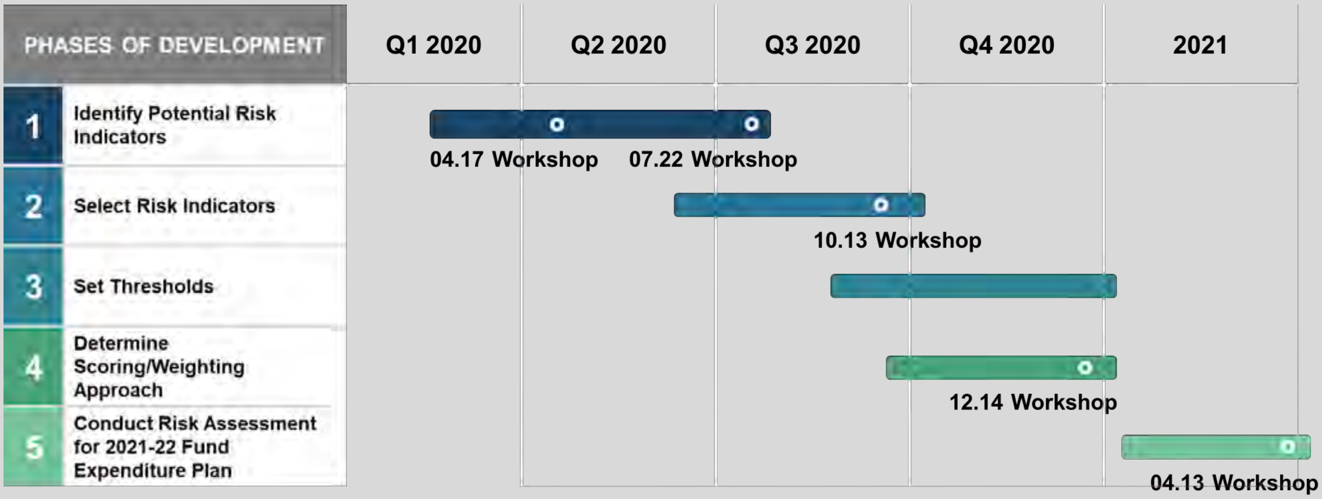


The State Water Board and UCLA hosted four public webinar workshops in 2020 to solicit feedback and recommendations on the development of the Risk Assessment (Figure A2). Approximately 683 individuals[151] participated in these workshops through either Zoom or CalEPA's live webcast. The following sections summarize the workshops and more information about each event, including white papers, presentations, and webinar recordings can be found on the State Water Board's Needs Assessment webpage.[152]

[151] Individuals that participated in more than webinar workshop are double counted in this figure.

[152] California Drinking Water Needs Assessment webpage
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/needs.html

Figure A2: 2020 Public Engagement for the Development of the Risk Assessment for Public Water Systems



PUBLIC WEBINAR WORKSHOP – APRIL 17, 2020

On April 17, 2020, the State Water Board and UCLA hosted a public webinar workshop to introduce the results of the initial Risk Assessment methodology developed by UCLA and solicit public feedback and recommendations on how to improve it. Feedback from this workshop led the State Water Board and UCLA to identify additional potential risk indicators that align with the three fundamental components of the HR2W (*i.e.* water quality, accessibility, and affordability), and extended its search to incorporate technical, managerial, and financial (TMF) capacity risk indicators as well. More information about this webinar workshop can be accessed on the State Water Board's Needs Assessment webpage.[153]

PUBLIC WEBINAR WORKSHOP – JULY 22, 2020

On July 16, 2020, the State Water Board and UCLA made publicly available a white paper on the *Identification of Risk Assessment 2.0 Indicators for Public Water Systems.*[154] On July 22, 2020, the State Water Board and UCLA hosted a webinar workshop to solicit stakeholder feedback and recommendations on:

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[153] California Drinking Water Needs Assessment webpage
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/needs.html

[154] July 16, 2020 White Paper:
Identification of Risk Assessment 2.0 Indicators for Public Water Systems
https://www.waterboards.ca.gov/drinking_water/programs/safer_drinking_water/docs/draft_white_paper_indicators_for_risk_assessment_07_15_2020_final.pdf

- Draft definitions of the four risk indicator categories: Water Quality, Accessibility, Affordability, and TMF Capacity.
- Expanded list of 118 potential risk indicators to be considered for inclusion in the Risk Assessment Version. This effort included full consideration of risk indicators identified in complementary efforts conducted by the Office of Environmental Health Hazard Assessment (OEHHA),[155] the Department of Water Resources (DWR), and the California Public Utilities Commission (CPUC), as well as additional indicators that are recognized by the water sector and its advocates to be key measures of water system resiliency.
- Draft Risk Indicator Evaluation Tool used to assess the applicability and data fitness of the identified potential risk indicators.

Stakeholder feedback and recommendations provided through the public webinar, written comments, and continued dialogue during the feedback period (07.16.2020 – 08.21.2020) are detailed in the white paper.[156] The following is a brief summary of incorporated feedback:

- 11 new potential risk indicators were identified for consideration and added to the list of indicators to be evaluated. Three potential risk indicators were removed from the list due to redundancy.
- Step 3 of the Risk Indicator Evaluation Tool was modified to strengthen the criteria for "Maybe": changing from "Step 1 results may be Good or Fair" to "Step 1 results *must* be Good."
- Specific comments regarding the applicability of individual potential risk indicators were considered when determining Step 1 evaluation scores (Supplemental Appendices D.1 through D.4).[157]

PUBLIC WEBINAR WORKSHOP – OCTOBER 13, 2020

On October 7, 2020, the State Water Board made publicly available a white paper on the *Evaluation of Potential Indicators & Recommendations for Risk Assessment 2.0 for Public*

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[155] The Human Right to Water in California | OEHHA
https://oehha.ca.gov/water/report/human-right-water-california

[156] October 7, 2020 White Paper (p.28):
Evaluation of Potential Indicators & Recommendations for Risk Assessment 2.0 for Public Water Systems
https://www.waterboards.ca.gov/safer/docs/e_p_i_recommendations_risk_assessment_2_public_water_systems.pdf

[157] October 7, 2020 White Paper Supplemental Appendices:

D.1 Potential Water Quality Risk Indicator Evaluations
https://www.waterboards.ca.gov/safer/docs/safer_supp_appxd1_101320.pdf

D.2 Potential Accessibility Risk Indicator Evaluations
https://www.waterboards.ca.gov/safer/docs/safer_supp_appxd2_101320.pdf

D.3 Potential Affordability Risk Indicator Evaluations
https://www.waterboards.ca.gov/safer/docs/safer_supp_appxd3_101320.pdf

D.4 Potential TMF Capacity Risk Indicator Evaluations
https://www.waterboards.ca.gov/safer/docs/safer_supp_appxd4_101320.pdf

Water Systems.[158] On October 13, 2020, the State Water Board and UCLA hosted a webinar workshop to solicit stakeholder feedback and recommendations on:

- Evaluation results of 129 potential risk indicators using the Evaluation Tool.
- The State Water Board and UCLA's recommendation of 22 risk indicators for inclusion in the Risk Assessment for public water systems.
- How the State Water Board should utilize a number of the potential risk indicators that are non-MCL violations. Specifically, how these metrics should be assessed for systems that "consistently fail" or are "At-Risk."
- Initial considerations on scoring and weighting options for individual risk indicators and risk indicator categories.

Stakeholder feedback and recommendations provided through the public webinar, written comments, and continued dialogue during the feedback period (10.07.2020 – 10.30.2020) are detailed in white paper.[159] The following is a brief summary of incorporated feedback:

- Based on feedback and further assessment of the proposed risk indicator "Increasing Presence of Water Quality Trends Towards MCL," the State Water Board is proposing removing this risk indicator from the Risk Assessment for the 2021-22 Fund Expenditure Plan so that more time can be dedicated to setting more appropriate thresholds, scores, and weight.[160]
- In most cases, the State Water Board and UCLA proposed higher risk indicator and category weights for indicators that may be influenced by water system management and lower weights for those that are outside a water system's sphere of influence.
- The State Water Board explored and proposed expanded "failing" criteria for the HR2W list.[161]

PUBLIC WEBINAR WORKSHOP – DECEMBER 14, 2020

On December 10, 2020, the State Water Board made a white paper publicly available on the *Recommendations for Risk Assessment 2.0 Thresholds, Scores, & Weights for Public Water*

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[158] October 7, 2020 White Paper:
Evaluation of Potential Indicators & Recommendations for Risk Assessment 2.0 for Public Water Systems
https://www.waterboards.ca.gov/safer/docs/e_p_i_recommendations_risk_assessment_2_public_water_systems.pdf

[159] December 14, 2020 White Paper (pp.39-48):
Recommendations for Risk Assessment 2.0 Thresholds, Scores, & Weights for Public Water Systems
https://www.waterboards.ca.gov/safer/docs/draft_white_paper.pdf

[160] December 14, 2020 White Paper (pp.54-60):
Recommendations for Risk Assessment 2.0 Thresholds, Scores, & Weights for Public Water Systems
https://www.waterboards.ca.gov/safer/docs/draft_white_paper.pdf

[161] December 14, 2020 White Paper (pp.115-132):
Recommendations for Risk Assessment 2.0 Thresholds, Scores, & Weights for Public Water Systems
https://www.waterboards.ca.gov/safer/docs/draft_white_paper.pdf

Systems.[162] On December 14, 2020, the State Water Board and UCLA hosted a webinar to solicit stakeholder feedback and recommendations on:

- Proposed expanded criteria for including systems on the HR2W list that are out of compliance or consistently failing.
- Impacts of setting thresholds of concern and criticality weighting each risk indicator.
- Proposed risk indicator thresholds and scores.
- Proposed risk indicator and category weights.
- "At-Risk" scoring methodology options and recommendations to inform the 2021-22 Fund Expenditure Plan.

Stakeholder feedback and recommendations were provided through the public webinar, written comments, and continued dialogue during the feedback period (12.10.2020 – 1.6.2021). The following is a brief summary of incorporated feedback and changes that were made to the Risk Assessment following the December 14, 2020 webinar:

- The underlying data for the following 12 indicators was updated to enhance data recency, accuracy, and coverage:
    - Extreme Water Bill
    - History of E. Coli Presence
    - Increasing Presence of Water Quality Trends Toward MCL
    - Maximum Duration of High Potential Exposure
    - Monitoring and Reporting Violations
    - Number of Service Connections
    - Operator Certification Violations
    - Percent Shutoffs
    - Percent of Median Household Income (% MHI)
    - Percentage of Sources Exceeding an MCL
    - Significant Deficiencies
    - Treatment Technique Violation
- 71 water systems were removed from the analysis because they were identified as either wholesalers or inactive systems, reducing the total number of water systems assessed from 2,850 to 2,779.
- The risk indicator "Increasing Presence of Water Quality Trends Toward MCL" was incorporated into the Risk Assessment, as explained further below.

RISK ASSESSMENT METHODOLOGY

The Risk Assessment methodology relies on three core elements which are utilized to calculate an aggregated risk score for the public water system assessed:

[162] December 14, 2020 White Paper:
Recommendations for Risk Assessment 2.0 Thresholds, Scores, & Weights for Public Water Systems
https://www.waterboards.ca.gov/safer/docs/draft_white_paper.pdf

Risk Indicators: quantifiable measurements of key data points that allow the State Water Board to assess the probability of a water system's failure to deliver safe drinking water or other infrastructure and institutional failures. Risk indicators that measure water quality, accessibility, affordability, and TMF capacity are incorporated based on their criticality as it relates to a system's ability to remain in compliance with safe drinking water standards and their data availability and quality across the State.

Risk Indicator Thresholds: the levels, points, or values associated with an individual risk indicator that delineates when a water system is more at-risk of failing.

Scores & Weights: the application of a multiplying value or weight to each risk indicator and risk category, as certain risk indicators and categories may be deemed more critical than others and/or some may be out of the control of the water system. The application of weights to risk indicators and risk categories allows the State Water Board multiple ways to assess all risk indicators within each category together in a combined Risk Assessment score.

RISK INDICATORS

The State Water Board, in partnership with UCLA, began an effort in April 2020 to identify potential risk indicators to be considered for inclusion in the Risk Assessment for public water systems. The initial version of the draft Risk Assessment utilized 14 risk indicators.[163] In response to public feedback from its April 17, 2020 webinar workshop, the State Water Board and UCLA expanded the Risk Assessment scope to evaluate a much broader number of risk indicators. The State Water Board, UCLA, and the public identified 129 potential risk indicators, several from other complementary State agency efforts, to help predict the probability of a water system's failure to deliver safe drinking water. A concerted effort was made to identify potential risk indicators that measure water quality, accessibility, affordability, and TMF capacity based on their criticality as it relates to a system's ability to remain in compliance with safe drinking water standards. This effort included full consideration of risk indicators identified in efforts conducted by the Office of Environmental Health Hazard Assessment (OEHHA),[164] the Department of Water Resources (DWR),[165] and the California Public Utilities Commission.[166]

To facilitate the selection of the final indicators for the Risk Assessment, the State Water Board and UCLA conducted an extensive potential risk indicator evaluation process (Figure A3) with

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[163] July 16, 2020 White Paper:
[Identification of Risk Assessment 2.0 Indicators for Public Water Systems](https://www.waterboards.ca.gov/drinking_water/programs/safer_drinking_water/docs/draft_white_paper_indicators_for_risk_assessment_07_15_2020_final.pdf)
https://www.waterboards.ca.gov/drinking_water/programs/safer_drinking_water/docs/draft_white_paper_indicators_for_risk_assessment_07_15_2020_final.pdf

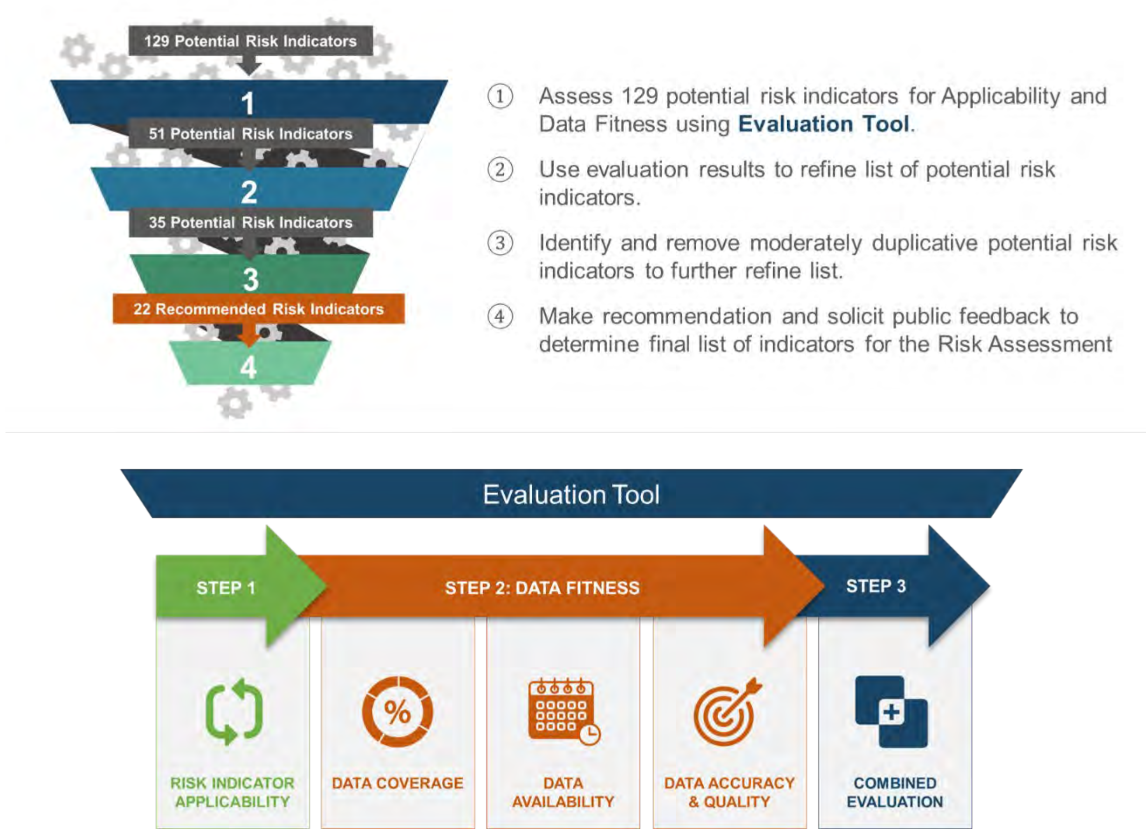
[164] The Human Right to Water in California | OEHHA
https://oehha.ca.gov/water/report/human-right-water-california

[165] Countywide Drought and Water Shortage Contingency Plans | DWR
https://water.ca.gov/Programs/Water-Use-And-Efficiency/Making-Conservation-a-California-Way-of-Life/CountyDrought-Planning

[166] California Public Utilities Commission
https://www.cpuc.ca.gov/

internal and external feedback to refine the list of 129 potential risk indicators to a recommend list of 22 risk indicators for the Risk Assessment. Learn more about the risk indicator identification, refinement, and selection process in the October 7, 2020 white paper *Evaluation of Potential Indicators & Recommendations for Risk Assessment 2.0 for Public Water Systems.*[167]

Figure A3: Potential Risk Indicator Evaluation Process



The potential risk indicator evaluation process yielded a recommended list of 22 risk indicators, but three of these are affordability risk indicators that need to be further refined and verified in terms of determining important thresholds of risk before they can be incorporated into the Risk Assessment. Table A2 provides a summary of the selected 19 risk indicators utilized in the 2021 Risk Assessment. Sections below provide details on each individual risk indicator including definitions, required datapoints, and calculation methodologies.

[167] October 7, 2020 White Paper:
[Evaluation of Potential Indicators & Recommendations for Risk Assessment 2.0 for Public Water Systems](https://www.waterboards.ca.gov/safer/docs/e_p_i_recommendations_risk_assessment_2_public_water_systems.pdf)
https://www.waterboards.ca.gov/safer/docs/e_p_i_recommendations_risk_assessment_2_public_water_systems.pdf

Table A2: Risk Assessment Risk Indicators

Risk Indicator Category	Risk Indicator
Water Quality	History of E. coli Presence
	Increasing Presence of Water Quality Trends Toward MCL
	Treatment Technique Violations
	Past Presence on the HR2W List
	Maximum Duration of High Potential Exposure (HPE)
	Percentage of Sources Exceeding an MCL
Accessibility	Number of Sources
	Absence of Interties
	Water Source Types
	DWR – Drought & Water Shortage Risk Assessment Results
	Critically Overdrafted Groundwater Basin
Affordability	Percent of Median Household Income (%MHI)
	Extreme Water Bill
	% Shut-Offs
TMF Capacity	Number of Service Connections
	Operator Certification Violations
	Monitoring and Reporting Violations
	Significant Deficiencies
	Extensive Treatment Installed

RISK INDICATOR THRESHOLDS, SCORES, & WEIGHTS

THRESHOLDS

To develop thresholds for the 19 risk indicators in the Risk Assessment, UCLA and the State Water Board reviewed multiple available types of evidence, looking both within California, across other state agencies nation-wide, and at the U.S. EPA's standards. Few exact risk indicator thresholds relating to water system failure were derived from sources beyond California legislative and regulatory definitions, given both the unique definition of water system failure employed in this assessment and the unique access to indicator data which this assessment enabled. However, similar indicators and associated thresholds to inform this process were also identified across other sources. The results of this effort are detailed in white paper *Recommendations for Risk Assessment 2.0 Thresholds, Scores, & Weights for Public Water Systems*.[168]

Based on the research conducted, most of the risk indicators did not have regulatorily-defined thresholds. For binary risk indicators (*e.g.* operator certification violations), the process of setting thresholds was straightforward because it is either present or absent. For other risk indicators with continuous or categorical data, thresholds were derived using cut points in the distribution of a given risk indicator, where HR2W list systems started to cluster, as well as the professional opinion of the broader research team contracted through UCLA, DDW staff, as well as an internal advisory group of District Engineers. Where possible tiered thresholds were determined to capture more nuanced degrees of risk within indicators. Sections below provide more details about the rationale for the thresholds developed for each indicator.

Moving forward, the State Water Board will continue to refine the risk indicator thresholds as data availability improves and the SAFER Program matures. The process may include refining thresholds by analyzing historical data trends such as looking at the relationship between historical thresholds and the likelihood that systems came out of compliance.

SCORES

To enable the evaluation and comparison of risk indicators, a standardized score between 0 and 1 has been applied to each developed risk indicator threshold. This is important since many of the risk indicators are measured in different units and scales. The score normalizes the thresholds and allows the Risk Assessment to assess water system performance across all risk indicators. The scores assigned to the risk indicator thresholds were developed with the professional opinion of the broader research team contracted through UCLA, DDW staff, as well as an internal advisory group of District Engineers (Table A3). The thresholds scores were shared with the public for feedback with white paper *Recommendations for Risk Assessment 2.0 Thresholds, Scores, & Weights for Public Water Systems*[169] and December 14, 2021 webinar.[170]

[168] December 14, 2020 White Paper:
Recommendations for Risk Assessment 2.0 Thresholds, Scores, & Weights for Public Water Systems
https://www.waterboards.ca.gov/safer/docs/draft_white_paper.pdf

[169] December 14, 2020 White Paper:
Recommendations for Risk Assessment 2.0 Thresholds, Scores, & Weights for Public Water Systems
https://www.waterboards.ca.gov/safer/docs/draft_white_paper.pdf

[170] December 14, 2020 Webinar Presentation
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/safer_risk_assessment_webinar_accessible.pdf

December 14, 2020 Webinar Recording
https://www.youtube.com/embed/6XDak8R5IDk?cc_load_policy=1&modestbranding=1&rel=0&autoplay=1

WEIGHTS

When evaluating the risk indicators, the Risk Assessment methodology can either apply the same "weight" to each risk indicator or apply different weights (see Figure A4). Public feedback during four public workshops indicated that the Risk Assessment should weight some risk indicators higher than others because they may be more "critical" as they relate to a water system's ability to stay in compliance. Weights between 1 and 3 were applied to individual risk indicators (see Table A3, with a weight of 3 indicating the highest level of criticality). The individual risk indicator weights were developed with the professional opinion of the broader research team contracted through UCLA, DDW staff, as well as an internal advisory group of District Engineers. An analysis of how the application of risk indicator weights impacts the performance of HR2W list systems was shared with the public for feedback with white paper *Recommendations for Risk Assessment 2.0 Thresholds, Scores, & Weights for Public Water Systems*[171] and December 14, 2021 webinar,[172] which ultimately supported the final inclusion decision regarding individual risk indicator weights in the Risk Assessment.

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[171] December 14, 2020 White Paper:
Recommendations for Risk Assessment 2.0 Thresholds, Scores, & Weights for Public Water Systems
https://www.waterboards.ca.gov/safer/docs/draft_white_paper.pdf

[172] December 14, 2020 Webinar Presentation
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/safer_risk_assessment_webinar_accessible.pdf

December 14, 2020 Webinar Recording
https://www.youtube.com/embed/6XDak8R5IDk?cc_load_policy=1&modestbranding=1&rel=0&autoplay=1

Figure A4: Water Quality Category Results with and Without Risk Indicator Weights

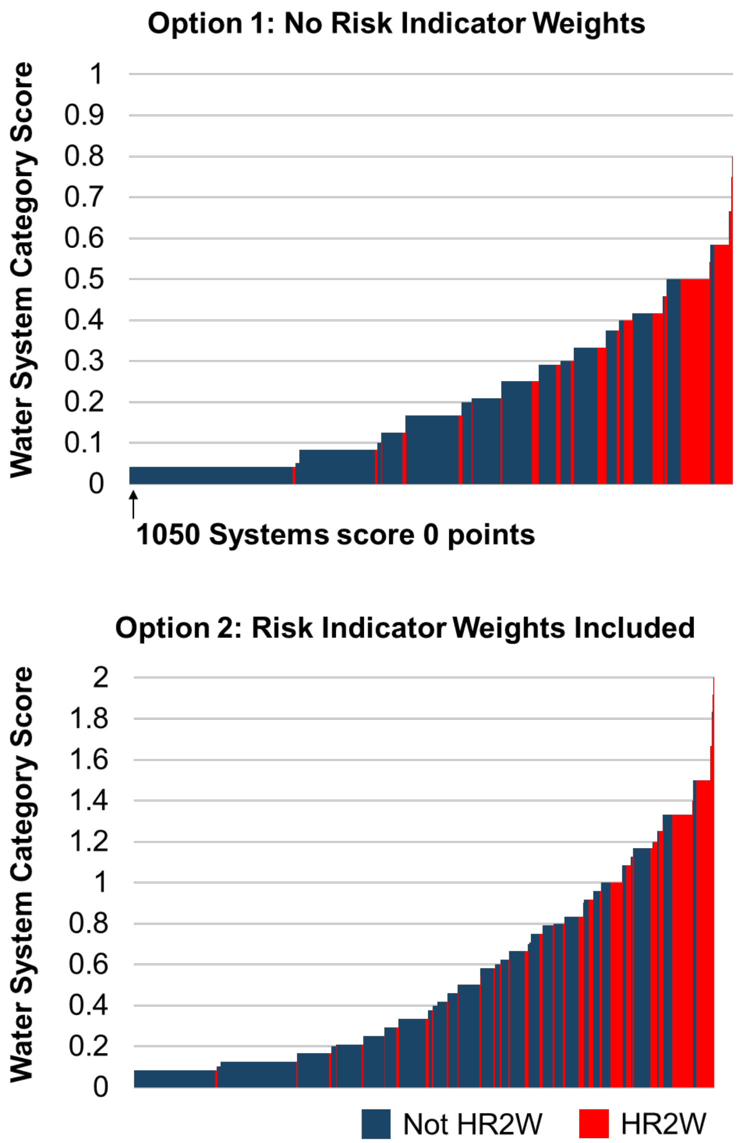


Table A3: Individual Risk Indicator Thresholds, Scores, and Weights

Risk Indicator	Thresholds	Score	Weight
History of E. coli Presence	**Threshold 0** = **No** history of E. coli presence within the last three years.	0	N/A
	Threshold 1 = **Yes**, history of E. coli presence (E. coli violation and/or Level 2 Assessment) within the last three years.	1	3
Increasing Presence of Water Quality Trends Toward MCL	**Threshold 0** = **No** Increasing Presence of Water Quality Trends Toward MCL.	0	N/A
	Threshold 1 = **Secondary Contaminants**: 9-year average of running annual average is at or greater than 80% of MCL and running annual average has increased by 20% or more.	0.25	2
	Threshold 2 = **Primary Non-Acute Contaminants**: 9-year average of running annual average is at or greater than 80% of MCL and running annual average has increased by 5% or more.	0.5	2
	Threshold 3 = **Acute Contaminants**: • 9-year average (no running annual average) is at or greater than 80% of MCL; or • 24-month average is at or greater than 80% of MCL; or • Any one sample over the MCL.	1	2
Treatment Technique Violations	**Threshold 0** = **0** Treatment Technique violations over the last three years.	0	N/A
	Threshold 1 = **1 or more** Treatment Technique violations over the last three years.	1	1

Risk Indicator	Thresholds	Score	Weight
Past Presence on the HR2W List	**Threshold 0** = **0** HR2W list occurrence over the last three years.	0	N/A
	Threshold 1 = **1** HR2W list occurrence over the last three years.	0.5	2
	Threshold 2 = **2 or more** HR2W list occurrences over the last three years.	1	2
Maximum Duration of High Potential Exposure (HPE)	**Threshold 0** = **0** years of HPE over the last nine years.	0	N/A
	Threshold 1 = **1** year of HPE over the last nine years.	0.25	3
	Threshold 2 = **2** years of HPE over the last nine years.	0.5	3
	Threshold 3 = **3 or more** years of HPE over the last nine years.	1	3
Percentage of Sources Exceeding an MCL	**Threshold 0** = **less than 49.9%** of sources exceed an MCL.	0	N/A
	Threshold 1 = **50% or greater** of sources exceed an MCL.	1	3
Number of Sources	**Threshold X** = **0** sources.	Automatically At-Risk	N/A
	Threshold 0 = **multiple** sources.	0	N/A
	Threshold 1 = **1** source only.	1	3
Absence of Interties	**Threshold 0** = **1 or more** interties.	0	N/A
	Threshold 1 = **0** interties.	1	1
Water Source Types	**Threshold 0** = **2 or more** water source types.	0	N/A
	Threshold 1 = **1** water source type and that source is **purchased** water.	0.5	1
	Threshold 2 = **1** water source type and that source is either **groundwater or surface water**.	1	1

Risk Indicator	Thresholds	Score	Weight
DWR – Drought & Water Shortage Risk Assessment Results	**Threshold 0** = **Below top 25%** of systems most at risk of drought and water shortage.	0	N/A
	Threshold 1 = **Between top 25% - 10.01%** of systems most at risk of drought and water shortage.	0.25	2
	Threshold 2 = **Top 10%** of systems most at risk of drought and water shortage.	1	2
Critically Overdrafted Groundwater Basin	**Threshold 0** = **Less than 74.99%** of system's service area boundary is within a critically overdrafted basin.	0	N/A
	Threshold 1 = **75% or greater** of systems service area boundary is within a critically overdrafted basin.	1	2
Percent of Median Household Income (%MHI)	**Threshold 0** = **Less than 1.49%**	0	N/A
	Threshold 1 = **1.5% - 2.49%**	0.75	3
	Threshold 2 = **2.5% or greater**	1	3
Extreme Water Bill	**Threshold 0** = **Below 149.99%** of the statewide average.	0	N/A
	Threshold 1 = **150% - 199.99%** of the statewide average.	0.5	1
	Threshold 2 = **Greater than 200%** of the statewide average.	1	1
% Shut-Offs	**Threshold 0** = **less than 9.99%** customer shut-offs over the last calendar year.	0	N/A
	Threshold 1 = **10% or greater** customer shut-offs over the last calendar year.	1	2
Number of Service Connections	**Threshold 0** = **greater than 501** service connections.	0	N/A
	Threshold 1 = **500 or less** service connections.	1	1

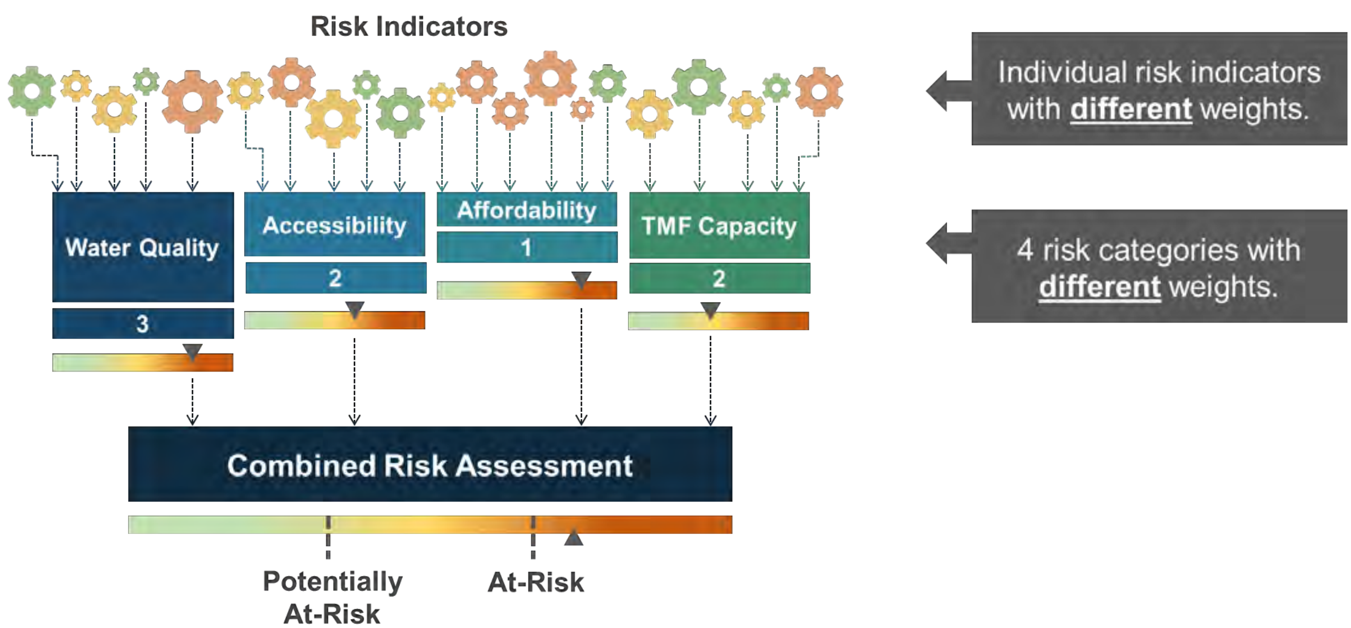
Risk Indicator	Thresholds	Score	Weight
Operator Certification Violations	**Threshold 0** = **0** Operator Certification violations over the last three years.	0	N/A
	Threshold 1 = **1 or more** Operator Certification violations over the last three years.	1	3
Monitoring & Reporting Violations	**Threshold 0** = **1 or less** Monitoring & Reporting violations over the last three years.	0	2
	Threshold 1 = **2 or more** Monitoring & Reporting violations over the last three years.	1	2
Significant Deficiencies	**Threshold 0** = **0** Significant Deficiencies over the last three years.	0	N/A
	Threshold 1 = **1 or more** Significant Deficiencies over the last three years.	1	3
Extensive Treatment Installed	**Threshold 0** = **No** extensive treatment installed.	0	N/A
	Threshold 1 = **Yes**, extensive treatment is installed.	1	2

RISK INDICATOR CATEGORY WEIGHTS

Another methodology option is to weight the aggregated categories of the Risk Assessment (*i.e.* Water Quality, Accessibility, Affordability and TMF Capacity). The assessment methodology can either apply the same "weight" to each risk indicator category or apply different weights. Public feedback from four public workshops indicated that the Risk Assessment a risk indicator category weighted approach based on criticality is preferred to no weights. Weights between 1 and 3 were applied to each risk indicator category, with a weight of 3 indicating the highest level of criticality (Figure A5).

The risk indicator category weights were developed with the professional opinion of the broader research team contracted through UCLA, DDW staff, as well as an internal advisory group of District Engineers. An analysis of how the application of risk indicator category weights impacts the performance of HR2W list systems was shared with the public for feedback with white paper *Recommendations for Risk Assessment 2.0 Thresholds, Scores, & Weights for Public Water Systems* [173] and December 14, 2021 webinar,[174] which ultimately supported the final inclusion category weights in the Risk Assessment.

Figure A5: Aggregated Risk Assessment Methodology with Category Weights



[173] December 14, 2020 White Paper:
[Recommendations for Risk Assessment 2.0 Thresholds, Scores, & Weights for Public Water Systems]
https://www.waterboards.ca.gov/safer/docs/draft_white_paper.pdf

[174] December 14, 2020 Webinar Presentation
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/safer_risk_assessment_webinar_accessible.pdf

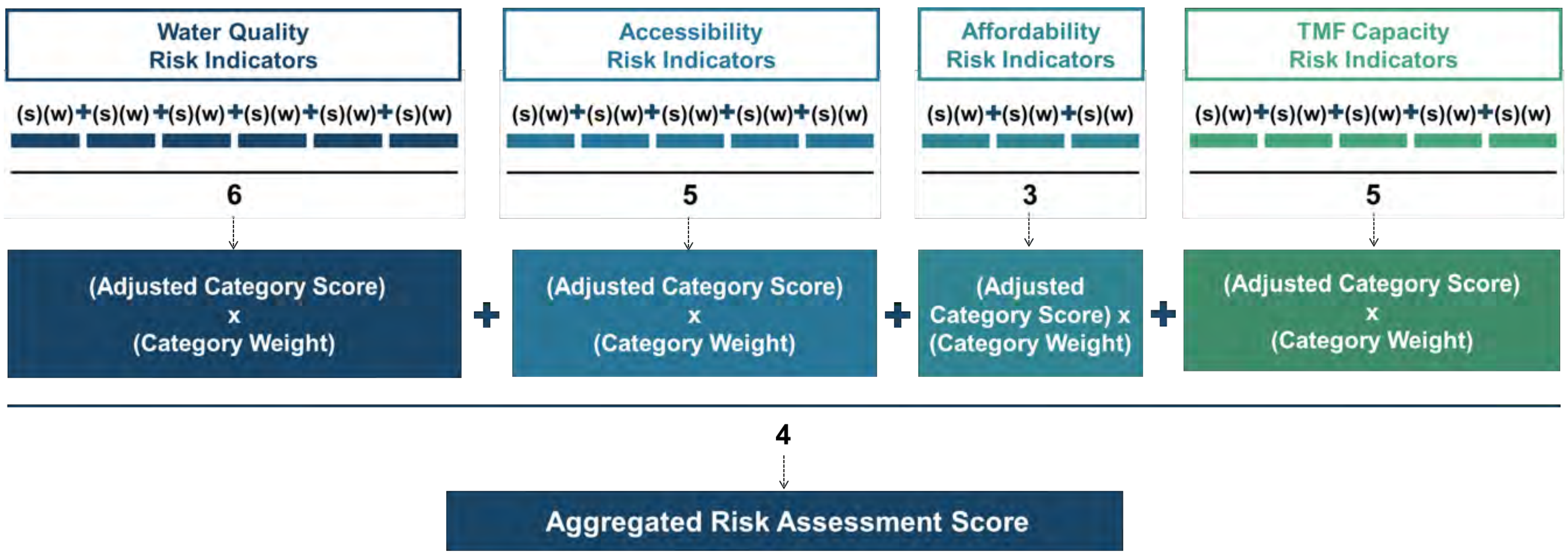
December 14, 2020 Webinar Recording
https://www.youtube.com/embed/6XDak8R5IDk?cc_load_policy=1&modestbranding=1&rel=0&autoplay=1

AGGREGATED RISK ASSESSMENT CALCULATION METHODOLOGY

The assessment of individual risk indicators within each category and for the aggregated risk assessment relies on: (1) the amount of risk scores or points each systems accrues per indicator, (2) the number of indicators that system is assessed for in each category, and (3) the weights applied to individual risk indicators and categories. Figure A6 provides an illustration of the aggregated Risk Assessment calculation method.

The aggregated Risk Assessment methodology takes the standardized score, between 0 and 1, for each risk indicator and applies a criticality weight to each indicator, between 1 and 3. Then a criticality weight is also applied to each risk indicator category (*e.g.* Water Quality, Accessibility, *etc.*), between 1 and 3. The final score is an average of the weighted category scores.

Figure A6: Illustration of the Risk Assessment Calculation Methodology with Risk Indicator Scores (s) and Risk Indicator and Categories Weights (w)



ADJUSTING FOR MISSING DATA

It is important that the Risk Assessment methodology adapt for where data may be missing for certain water systems, either because a system failed to report necessary data or because the system may not have data to report. For example, some water systems do not charge for water. Therefore, those systems do not have the necessary data (*i.e.* customer charges) for two of the three risk indicators in the Affordability category.

Multiple different methods for handling missing data, including DWR and OEHHA's methods, as well as statistical imputation methods, were considered for the Risk Assessment.[175] [176] Ultimately, the strategy that was chosen for the Risk Assessment was to omit any value for a missing risk indicator and to instead re-distribute the weights/scores to risk indicators within the same category which did have valid values (Figure A7). In future versions of the Risk Assessment, however, systems with considerable missing data due to non-reporting of required data may be assessed negative points in a new indicator developed in the TMF Capacity category.

Figure A7: Example of How the Aggregated Risk Assessment Adjusts for Missing Risk Indicator Data

There were some cases where risk indicator data for a whole category, particularly the Affordability category, were missing. However, many of these systems were unconventional community water systems in the sense that they have a stable population base, but no ratepayer base (for example, schools, prisons, parks). These systems, where identifiable, were excluded from the Affordability category of the Risk Assessment altogether. The Risk Assessment redistributes the weights/score of a missing risk indicator category to the other categories when an entire category is excluded from the assessment, as illustrated in Figure A8.

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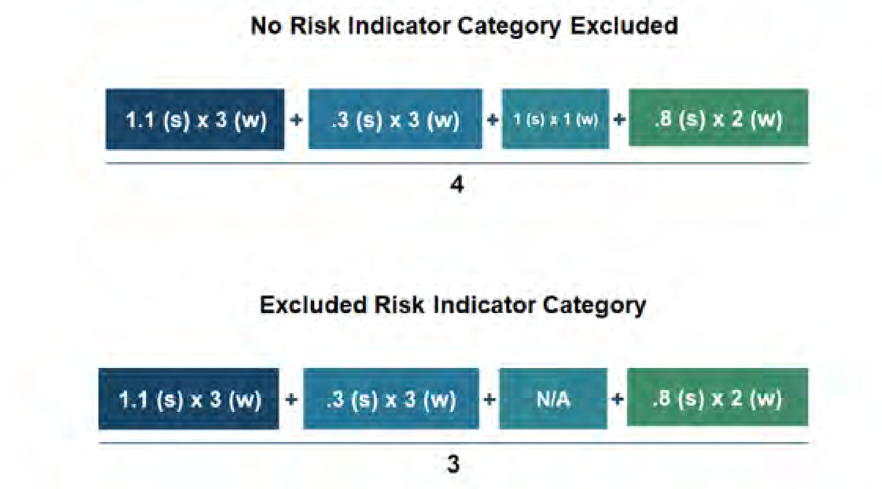
[175] For instance, see Rubin, D. B. (1976). Inference and missing data. Biometrika, 63(3), 581-592. doi:10.1093/biomet/63.3.581; Little, R. J. (1998). A Test of Missing Completely at Random for Multivariate Data with Missing Values. Journal of the American Statistical Association, 83(404), dec, 1198-1292. doi:10.2307/2290157; Rhoads, C. H. (2012). Problems with Tests of the Missingness Mechanism in Quantitative Policy Studies. Statistics, Politics, and Policy, 3(1). doi:10.1515/2151-7509.1012

[176] OECD (2008). Handbook on Constructing Composite Indicators: Methodology and User Guide. https://www.oecd.org/sdd/42495745.pdf

Figure A8: How the Aggregated Risk Assessment Adjusts for a Missing Risk Indicator Category



AGGREGATED RISK ASSESSMENT THRESHOLDS

Based on the distribution of the HR2W list systems in the aggregated and weighted Risk Assessment results, the State Water Board recommended a "Potentially At-Risk" threshold of 0.75 and an "At-Risk" threshold of 1.0 for public consideration (Figure A9). These threshold recommendations were determined based on where the current and expanded HR2W list systems started to cluster. These recommendations were shared with the public for feedback with white paper *Recommendations for Risk Assessment 2.0 Thresholds, Scores, & Weights for Public Water Systems*[177] and December 14, 2021 webinar.[178] Ultimately, public feedback supported the recommended thresholds and no objections were received.[179]

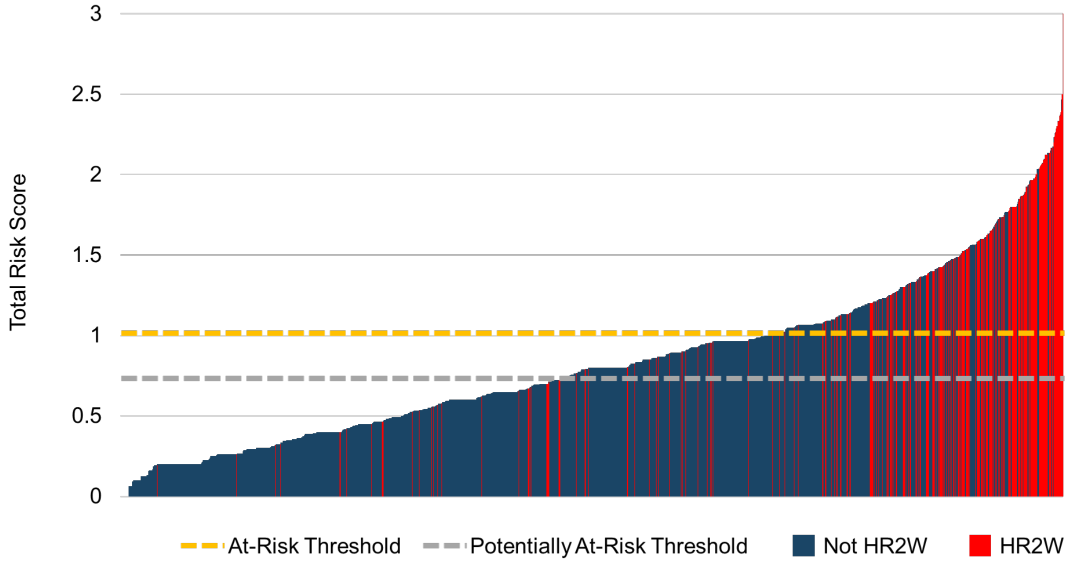
[177] December 14, 2020 White Paper: Recommendations for Risk Assessment 2.0 Thresholds, Scores, & Weights for Public Water Systems https://www.waterboards.ca.gov/safer/docs/draft_white_paper.pdf

[178] December 14, 2020 Webinar Presentation https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/safer_risk_assessment_webinar_accessible.pdf

December 14, 2020 Webinar Recording https://www.youtube.com/embed/6XDak8R5IDk?cc_load_policy=1&modestbranding=1&rel=0&autoplay=1

[179] At the time the recommended thresholds were shared, the list of water systems that would be designated At-Risk and Potentially At-Risk was not made publicly available in order to (1) prevent bias in recommendations and (2) to limit unintended consequences of being on a preliminary draft At-Risk list.

Figure A9: Distribution of Total Weighted Risk Score for Assessed Water Systems (n=2,779)

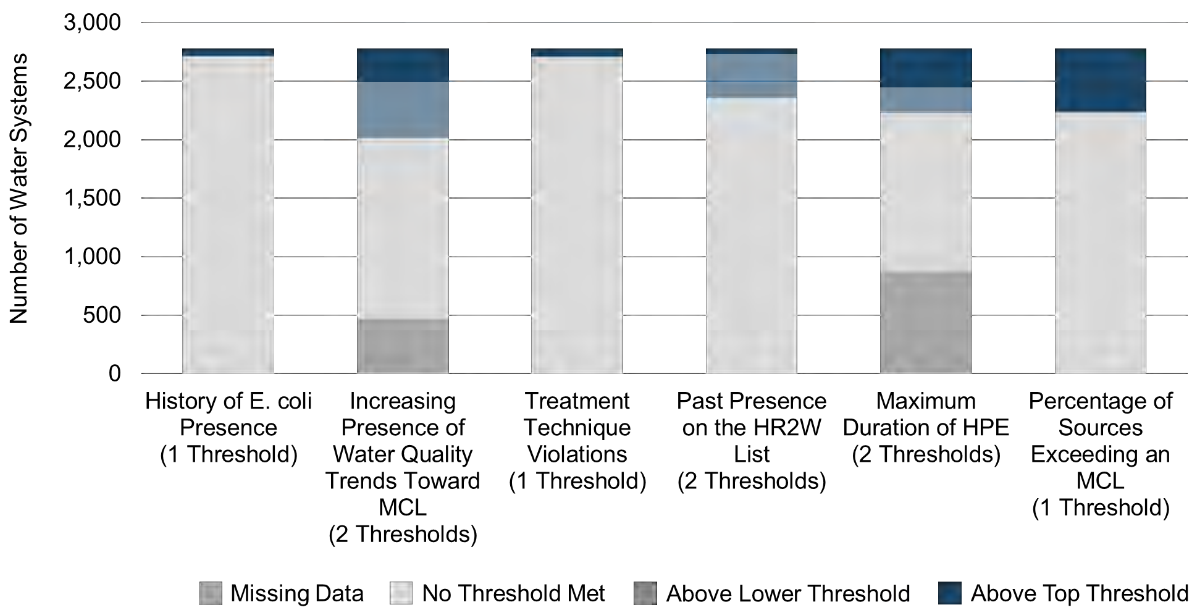


RISK INDICATOR DETAILS

WATER QUALITY RISK INDICATORS

This section provides full details on each Water Quality risk indicator used in the Risk Assessment. Water Quality risk indicators measure current water quality and trends to identify compliance with water quality and treatment technique regulatory requirements, as well as frequency and duration of exposure to drinking water contaminants. Figure A10 illustrates the number of water systems that exceeded the risk indicator thresholds within the Water Quality category. The range of potential thresholds for each risk indicator are summarized in the respective risk indicator label and detailed below.

Figure A10: Number of Systems Exceeding Thresholds for Each Water Quality Risk Indicator



HISTORY OF E. COLI PRESENCE

The presence of E. coli in drinking water suggests that the supply has fecal contamination, and in turn, that other pathogens could be present. The presence of these contaminants could also suggest that water treatment is inadequate, interrupted, or intermittent. Water systems are required to conduct a Level 1 and/or a Level 2 Assessment if conditions indicate they might be vulnerable to contamination.

A Level 1 Assessment is performed by a water system owner or operator when laboratory results indicate that bacteriological threats may exist, an assessment form must be filled and submitted to the State within 30 days. Level 1 Assessment is triggered by any of the following conditions.[180]

- A public water system collecting fewer than 40 samples per month has 2 or more total coliform positive routine/repeat samples in the same month.
- A public water system collecting at least 40 samples per month has greater than 5.0 percent of the routine/repeat samples in the same month that are total coliform positive.
- A public water system fails to take every required repeat sample after any single total coliform positive sample.

A Level 2 Assessment is performed by the State or State-approved entity, but the water system is responsible for ensuring the completion of the assessment regardless of the entity conducting it. Once Level 2 is triggered an assessment form must be completed and submitted to the State within 30 days. A Level 2 Assessment is triggered by the following conditions[181]:

- A water system incurs an E. coli MCL violation.
- A water system has a second Level 1 Assessment within a rolling 12 months period.
- A water system on State-approved annual monitoring has a Level 1 Assessment trigger in two consecutive years.

Water systems must fix any sanitary defects within a required timeframe.

Calculation Methodology

Required Risk Indicator Data Points & Sources:

- E. coli violations – Analyte Code 3014: Safe Drinking Water Information System (SDWIS).
    - Query systems that only have E. coli related treatment technique and/or MCL violations. See list of violation codes below:

Table A4: Identified Violation Types Related to E. coli

Violation Number	Violation Type	Description
01*	**MCL, Single Sample**	MCL violation based on a single sample, or an organic analyte that is 10X the MCL.
1A	**MCL, E. coli, Positive E. coli (RTCR)**	E. coli MCL violation based on a single sample.

[180] Level 1 Assessment: A Quick Reference Guide
https://www.epa.gov/dwreginfo/revised-total-coliform-rule-and-total-coliform-rule

[181] Level 2 Assessment: A Quick Reference Guide
https://www.epa.gov/dwreginfo/revised-total-coliform-rule-and-total-coliform-rule

Violation Number	Violation Type	Description
02*	**MCL, Numeric Average of Samples Taken**	A violation for an inorganic, organic, or radiological constituent where compliance is based on a running annual average or more monitoring period average.
T1*	**State Violation – Treatment Technique**	A violation where the water system failed to treat water using the treatment process the State has primacy to regulate (*i.e.* treatment failed per the system's permit).

* These violations were inadvertently used to record an E. coli violation and therefore are being shown in this Table. Violation Number 1A is the code that should be used to record these violations.

- Level 2 Assessments
  - Violation Type Code (2B): SDWIS.
  - Level 2 Assessment Activities Spreadsheet: Maintained by State Water Board's Program Liaison Unit (PLU).

Risk Indicator Calculation Methodology:

- Determine which systems have had E. coli violations within the last three years with a SOX (State Compliance Achieved) Enforcement Action.
- Determine which systems have had a Level 2 Assessment over the last three years.

Threshold Determination

The State Water Board has adopted a threshold for E. coli violations for the expanded HR2W list criteria which relies on whether the water system has an open enforcement action for the violation. [182] For the Risk Assessment, a modified version of the expanded HR2W list criteria threshold was developed for the "History of E. Coli Presence" risk indicator. Systems that have had an E. coli violation or Level 2 Assessment within the last three years are considered more at risk than systems that have not.

Correlational and regression analysis between the risk indicator as defined with this threshold and water system failure to deliver safe drinking water as defined in the HR2W list shows a statistically significant relationship.

Risk Indicator Scoring & Weighting

To enable the evaluation and comparison of risk indicators, a standardized scale between 0 and 1 for risk scores has been applied to each threshold. Public feedback during with Risk Assessment methodology development process indicated that some risk indicators should be

[182] Systems that meet the HR2W list criteria will not be included in the Risk Assessment.

weighted higher than others because they may be more "critical" as they relate to a water system's ability to stay in compliance. Risk indicator weights between 1 and 3 were applied to individual risk indicators. Based on feedback from the State Water Board's engineers, the maximum weight of 3 is applied to the "History of E. Coli Presence" risk indicator. Therefore, the minimum risk score is 0 and the maximum risk score is 3. Table A5 summarizes the thresholds, scores, and weight for this risk indicator.

Table A5: "History of E. coli Presence" Thresholds & Scores

Threshold Number	Threshold	Score	Weight
0	**No** history of E. coli presence over the last three years.	0	N/A
1	**Yes**, history of E. coli presence (E. coli violation and/or Level 2 Assessment) over the last three years.	1	3

Figure A11: Water Systems (3,300 service connections or less) with a History of E. coli Presence Within the Last 3 Years (n=2,779)

Presence of E. coli was found by analyzing E. coli violation and Level 2 Assessment (L2) data for all 2,779 water systems. Presence of E coli was determined for any system identified with either an E. coli violation or L2. 53 water systems had no E. coli violation but did have an L2. Four systems had an E. coli violation but no L2. Seven systems had both. The average number of violations per water system is 0.03, the minimum is 0, and the maximum is 4. 62 water systems (2%) meet Threshold 1 having a presence of E. coli. 2,788 water systems (98%) meet Threshold 0 having no E. coli presence.

INCREASING PRESENCE OF WATER QUALITY TRENDS TOWARD MCL

Increasing presence of one or more regulated contaminants, especially those attributable to anthropogenic causes, that are detected at or greater than 80% of the MCL within the past nine years. Additional discussion is provided below. The risk indicator may be utilized in future a Risk Assessment after additional analysis are included.

Important Note*: As previous white papers have detailed, this risk indicator was initially excluded from the Risk Assessment methodology due to concerns regarding how its inclusion* *was affecting the overall risk scoring and distribution.*[183] *However, errors in the original calculations were identified and corrected, and the use of the raw data to construct the risk indicator and its weighting was re-considered and executed in a new way. After making these changes, the effect of this risk indicator on overall scoring was in line with original expectations for its use. Thus, it has been included in the final Risk Assessment.*

Calculation Methodology
Required Risk Indicator Data Points & Source:

WQIr chemical table[184] for the following:

Acute Contaminants[185] – Per the Tier 1 public notification rule[186]

Table A6: Acute Contaminants with a Primary MCL

Contaminant	Analyte Number
Nitrate (as Nitrogen)	00618
Nitrate + Nitrite (as Nitrogen)	A-029
Nitrite (as Nitrogen)	00620
Perchlorate	A-031
Chlorite	50074
Chlorine Dioxide (MRDL instead of MCL)	50070

Non-Acute Primary Contaminants

Table A7: Non-Acute Constituents[187] that have a Primary MCL

Contaminant	Analyte Number
Aluminum	01105
Antimony	01097
Arsenic	01002
Asbestos	81855
Barium	01007

183 December 14, 2020 White Paper:
[Recommendations for Risk Assessment 2.0 Thresholds, Scores, & Weights for Public Water Systems](https://www.waterboards.ca.gov/safer/docs/draft_white_paper.pdf)
https://www.waterboards.ca.gov/safer/docs/draft_white_paper.pdf

184 Bacteriological constituents are excluded from this risk indicator.

185 CCR § 64400. Acute Risk. "Acute risk" means the potential for a contaminant or disinfectant residual to cause acute health effects, *i.e.*, death, damage or illness, as a result of a single period of exposure of a duration measured in seconds, minutes, hours, or days.

186 CCR § 64463.1. Tier 1 Public Notice.

187 Beryllium was inadvertently omitted from the list of Non-Acute Primary Contaminants included in the Risk Assessment presented in this report. The State Water Board will be updating the Risk Assessment results to include this constituent in the near future.

Contaminant	Analyte Number
Cadmium	01027
Chromium	01034
Cyanide	01291
Fluoride	00951
Mercury	71900
Nickel	01067
Selenium	01147
Thallium	01059
Benzene	34030
Carbon Tetrachloride	32102
1,2-Dichlorobenzene	34536
1,4-Dichlorobenzene	34571
1,1-Dichloroethane	34496
1,2-Dichloroethane	34531
1,1-Dichloroethylene	34501
cis-1,2-Dichloroethylene	77093
trans-1,2-Dichloroethylene	34545
Dichloromethane	34423
1,2-Dichloropropane	34541
1,3-Dichloropropene	77173
Ethylbenzene	34371
Methyl-tert-butyl ether	46491
Monochlorobenzene	34301
Styrene	77128
1,1,2,2-Tetrachloroethane	34516
Tetrachloroethylene	34475
Toluene	34010
1,2,4-Trichlorobenzene	34551
1,1,1-Trichloroethane	34506
1,1,2-Trichloroethane	34511
Trichloroethylene	39180
Trichlorofluoromethane	34488
1,1,2-Trichloro-1,2,2-Trifluoroethane	34511
Vinyl Chloride	39175
Xylenes	81551
Alachlor	77825
Atrazine	39033
Bentazon	38710

Contaminant	Analyte Number
Benzo(a)pyrene	34247
Carbofuran	81405
Chlordane	39350
2,4-D	39730
Dalapon	38432
Dibromochloropropane	38761
Di(2-ethylhexyl)adipate	A-026
Di(2-ethylhexyl)phthalate	39100
Dinoseb	81287
Diquat	78885
Endothall	38926
Endrin	39390
Ethylene Dibromide	77651
Glyphosate	79743
Heptachlor	39410
Heptachlor Epoxide	39420
Hexachlorobenzene	39700
Hexachlorocyclopentadiene	34386
Lindane	39340
Methoxychlor	39480
Molinate	82199
Oxamyl	38865
Pentachlorophenol	390032
Picloram	39720
Polychlorinated Biphenyls	39516
Simazine	39055
Thiobencarb	A-001
Toxaphene	39400
1,2,3-Trichloropropane (1,2,3-tcp)	77443
2,3,7,8-TCDD (Dioxin)	34676
2,4,5-TP (Silvex)	39045
Radium-226	A-074
Radium–228	A-075
Gross Alpha particle (excluding radon/uranium)	01501
Uranium	28012
Beta/photon emitters	03501
Strontium-90	13501
Tritium	07000

Secondary Contaminants

Table A8: Constituents that have a Secondary MCL*

Contaminant	Analyte Number
Aluminum	01105
Color	00081
Copper	01042
Foaming Agent (MBAS)	38260
Iron	01045
Manganese	01056
Methyl-*tert*-butyl ether (MTBE)	46491
Odor	00086
Silver	01077
Thiobencarb	A-001
Turbidity	82078
Zinc	01092

*Total Dissolved Solids, Specific Conductance, Chloride, and Sulfate are excluded.

Threshold Determination
The increasing presence of water quality trends toward an MCL violation, as defined here or a similar measure, has not been assessed in other previous studies as related to water system failure or employed by other regulatory agencies or stakeholders as a threshold of concern. The State Water Board's workgroup of district engineers determined the draft tiered thresholds for this risk indicator based on their experience working with water systems throughout the state. These draft thresholds were shared with the public and ultimately incorporated into the Risk Assessment.

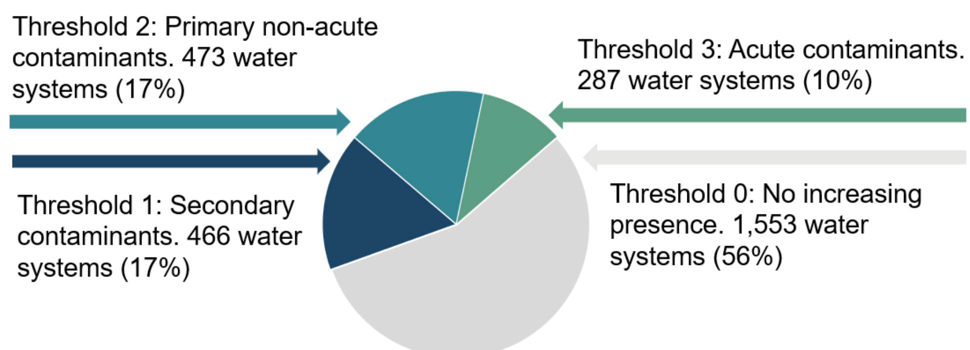
Risk Indicator Scoring & Weighting
To enable the evaluation and comparison of risk indicators, a standardized scale between 0 and 1 for risk scores has been applied to each threshold. Public feedback during with Risk Assessment methodology development process indicated that some risk indicators should be weighted higher than others because they may be more "critical" as they relate to a water system's ability to stay in compliance. Risk indicator weights between 1 and 3 were applied to individual risk indicators. Based on feedback from the State Water Board's engineers, the maximum weight of 2 is applied to the "Increasing Presence of Water Quality Trends Toward MCL" risk indicator. Therefore, the minimum risk score is 0 and the maximum risk score is 2. Table A9 summarizes the thresholds, scores, and weight for this risk indicator.

Table A9: "Increasing Presence of Water Quality Trends Toward MCL" Thresholds & Scores

Threshold Number	Threshold	Score	Weight
0	**No** Increasing Presence of Water Quality Trends Toward MCL	0	N/A
1	**Secondary Contaminants**: 9-year average of running annual average is at or greater than 80% of MCL and running annual average has increased by 20% or more.	0.25	2
2	**Primary Non-Acute Contaminants**: 9-year average of running annual average is at or greater than 80% of MCL and running annual average has increased by 5% or more.	0.5	2
3	**Acute Contaminants**: • 9-year average (no running annual average) is at or greater than 80% of MCL; or • 24-month average is at or greater than 80% of MCL; or • Any one sample over the MCL.	1	2

Figure A12 shows 1,553 water systems (56%) had no increasing presence of water quality trends toward MCL. 466 water systems (17%) exhibited increasing trends in secondary contaminants, whereas 473 water systems (17%) exhibited increasing trends in primary non-acute contaminants. Finally, 287 water systems (10%) exhibited increasing trends in acute contaminants.

Figure A12: Increasing Presence of Water Quality Trends Toward MCL (n=2,779)



TREATMENT TECHNIQUE VIOLATIONS

According to U.S. EPA and State Water Board regulations, systems must carry out specified treatment when there is no reliable or feasible method to measure the concentration of a contaminant to determine if there is a public health concern. A treatment technique is an enforceable procedure or level of technological performance, which public water systems must follow to ensure control of a contaminant. The treatment technique rules also list the best available technology for meeting the standard, and the compliance technologies available for small systems. Some examples of treatment technique rules are the following:

- Surface Water Treatment Rule[188] (disinfection and filtration)
- Ground Water Rule[189]
- Lead and Copper Rule (optimized corrosion control)
- Acrylamide and Epichlorohydrin Rules (purity of treatment chemicals)

This type of violation (which is distinct from more commonly-known MCL or monitoring and reporting violations) is incurred when a water system does not follow required treatment techniques to reduce the risk from contaminants, *e.g.*, exceeding the maximum allowable turbidity or flow rate of a surface water treatment plant.

Calculation Methodology

Required Risk Indicator Data Points & Sources:

- Treatment Technique violations: SDWIS

Table A10: Treatment Technique Violation Codes

Violation Type Code	SDWIS Violation Name
07	Treatment Techniques (Other)
12	Qualified Operator Failure
33	Failure Submit Treatment Requirement Report
37	Treatment Tech. No Prior State Approval
40	Treatment Technique (FBRR)
41	Failure to Maintain Microbial Treatment
42	Failure to Provide Treatment
43	Single Turbidity Exceed (Enhanced SWTR)
44	Monthly Turbidity Exceed (Enhanced SWTR)
45	Failure to Address A Deficiency

[188] Title 22 CCR, Division. 4, Chapter 17 Surface Water Treatment

https://govt.westlaw.com/calregs/Browse/Home/California/CaliforniaCodeofRegulations?guid=I501543B0D4BA11DE8879F88E8B0DAAAE&originationContext=documenttoc&transitionType=Default&contextData=(sc.Default)

[189] Title 22 CCR, Division 4, Chapter 15, Article 3.5 Groundwater Rule

https://govt.westlaw.com/calregs/Browse/Home/California/CaliforniaCodeofRegulations?guid=I729BEDE0B98711E0B493EB23F8012672&originationContext=documenttoc&transitionType=Default&contextData=(sc.Default)

Violation Type Code	SDWIS Violation Name
46	Treatment Technique Precursor Removal
47	Treatment Technique Uncovered Reservoir
48	Failure to Address Contamination
57	OCCT/SOWT Recommendation
58	OCCT/SOWT Install Demonstration
59	WQP Level Non-Compliance
63	MPL Level Non-Compliance
64	Lead Service Line Replacement (LSLR)
65	Public Education
2A	Level 1 Assessment Treatment Technique
2B	Level 2 Assessment Treatment Technique
2C	Corrective Actions/Expedited Actions TT
2D	Start-up Procedures Treatment Technique
T1	State Violation-Treatment Technique

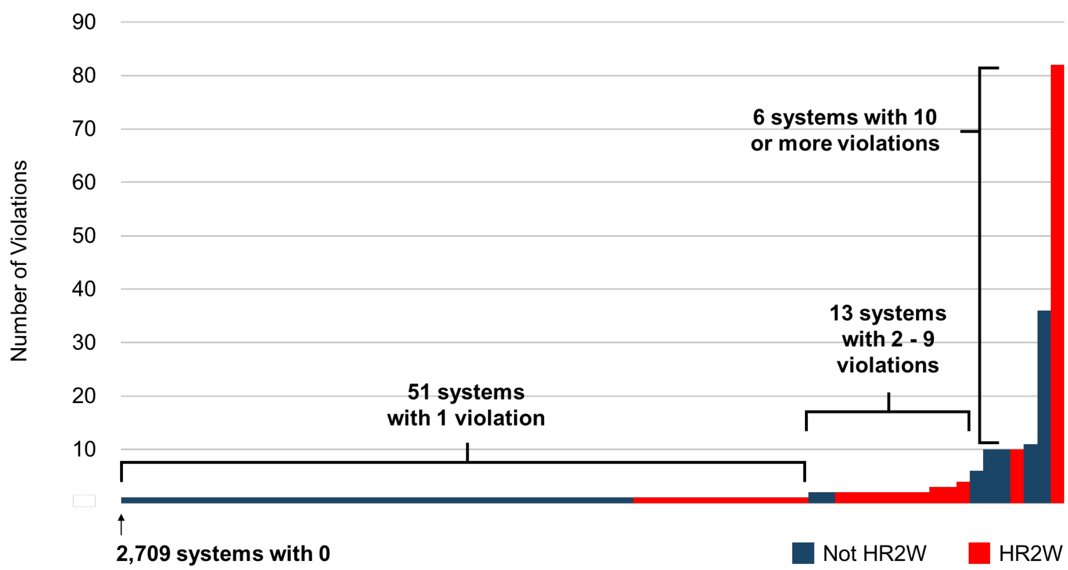
Risk Indicator Calculation Methodology:

- Determine which systems have had one or more Treatment Technique violations within the last three years using the Treatment Technique violation codes listed in Table A10 and excluding the following scenarios below:
    - Systems with an open Enforcement Action are excluded from the Risk Assessment because they meet the criteria for the expanded HR2W list.
    - Systems that have had three or more Treatment Technique violations within the last three years are also excluded from the Risk Assessment because they meet the criteria for the HR2W list.

Threshold Determination

Treatment Technique violation data was analyzed for 2,779 water systems (Figure A13). The minimum number of violations found was 0, the maximum for one water system was 82 violations in the last 3 years, and the average violation count was 0.09 per system. 2,709 water systems had 0 violations, 51 water systems had 1 violation, 9 water systems had 2 violations, 2 water systems had 3 violations, water systems had 4 violations, 1 water system had 6 violations, and 7 water systems had more than 10 violations.

Figure A13: Water Systems with Treatment Technique Violations Over the Last 3 Years (n=2,779)



The State Water Board has developed a threshold for Treatment Technique violations (in lieu of an MCL) for the expanded HR2W list criteria that relies on: (1) whether the water system has an open enforcement action for the violation or (2) the system has had three or more Treatment Technique violations in the past three years.[190] For the Risk Assessment, a modified version of the expanded HR2W criteria threshold was developed for the "Treatment Technique Violations" risk indicator. Systems that have one or more treatment technique violations within the last three years are considered more at risk than systems that have not.

Correlational and regression analysis between the risk indicator as defined with this threshold and water system failure to deliver safe drinking water as defined in the HR2W list shows a statistically significant relationship.

Risk Indicator Scoring & Weighting

To enable the evaluation and comparison of risk indicators, a standardized scale between 0 and 1 for risk scores has been applied to each threshold. Public feedback during with Risk Assessment methodology development process indicated that some risk indicators should be weighted higher than others because they may be more "critical" as they relate to a water system's ability to stay in compliance. Risk indicator weights between 1 and 3 were applied to individual risk indicators. Based on feedback from the State Water Board's engineers, the maximum weight of 1 is applied to the "Treatment Technique Violations" risk indicator. Therefore, the minimum risk score is 0 and the maximum risk score is 1. Table A11 summarizes the thresholds, scores, and weight for this risk indicator.

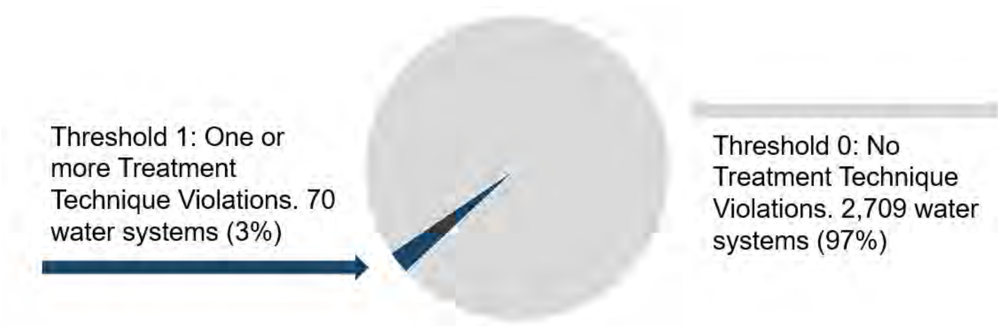
[190] Systems that meet the HR2W list criteria will not be included in the Risk Assessment.

Table A11: "Treatment Technique Violations" Thresholds & Scores

Threshold Number	Threshold	Score	Weight
0	**0** Treatment Technique violation over the last three years.	0	N/A
1	**1 or more** Treatment Technique violations over the last three years.	1	1

Figure A14 shows 70 water systems meet Threshold 1, having one or more treatment technique violations within the last three years. The remaining 2,709 water systems (97%) had no treatment technique violations within the last three years.

Figure A14: Water Systems with Treatment Technique Violations within the Last 3 Years (n=2,779)



PAST PRESENCE ON THE HR2W LIST

This indicator reflects past presence on the HR2W list within the last three years. The expanded HR2W list includes systems that have an open enforcement action for a primary MCL violation, secondary MCL violation, E. coli violation, monitoring and reporting violation (15 months or more), treatment technique violation, and/or systems that have had three of more treatment technique violations. A system is removed from the HR2W list after they have come back into compliance and a return to compliance enforcement action has been issued and/or the system has less than three treatment technique violations over the last three years.

Calculation Methodology

Required Risk Indicator Data Point & Source:

- Violation Data: SDWIS
- Enforcement Action Data: SDWIS

- Refer to State Water Board's HR2W website[191] for detailed criteria and methodology for the HR2W list.

Threshold Determination
Data on Past Presence of the HR2W list was available for all 2,850 water systems. 2,393 water systems (82%) have zero HR2W list occurrences over the past three years. There are 457 (16%) water systems with one or more occurrence in the past three years. Of these systems the minimum occurrence was once, the maximum was 3. Peer-reviewed studies suggest that past presence of drinking water quality violations is associated with subsequent present-day violations.[192] Therefore tiered thresholds were developed, where more occurrences on the HR2W list is associated with greater risk.

Risk Indicator Scoring & Weighting
To enable the evaluation and comparison of risk indicators, a standardized scale between 0 and 1 for risk scores has been applied to each threshold. Public feedback during with Risk Assessment methodology development process indicated that some risk indicators should be weighted higher than others because they may be more "critical" as they relate to a water system's ability to stay in compliance. Risk indicator weights between 1 and 3 were applied to individual risk indicators. Based on feedback from the State Water Board's engineers, the maximum weight of 2 is applied to the "Past Presence on the HR2W List" risk indicator. Therefore, the minimum risk score is 0 and the maximum risk score is 2. Table A12 summarizes the thresholds, scores, and weight for this risk indicator.

Table A12: "Past Presence on the HR2W List" Thresholds & Scores

Threshold Number	Threshold	Score	Weight
0	**0** HR2W list occurrence over the last three years.	0	N/A
1	**1** HR2W list occurrence over the last three years.	0.5	2
2	**2** or more HR2W list occurrences over the last three years.	1	2

Figure A15 shows 2,364 water systems (85%) had no HR2W list occurrences in the last 3 years. 415 water systems (15%) had at least 1 HR2W list occurrence in the last 3 years. Among these systems, 370 (13% of the total) meet Threshold 1 with only one occurrence in the last three years, whereas 45 water systems (23%) meet Threshold 2 having two or more occurrences in the last three years.

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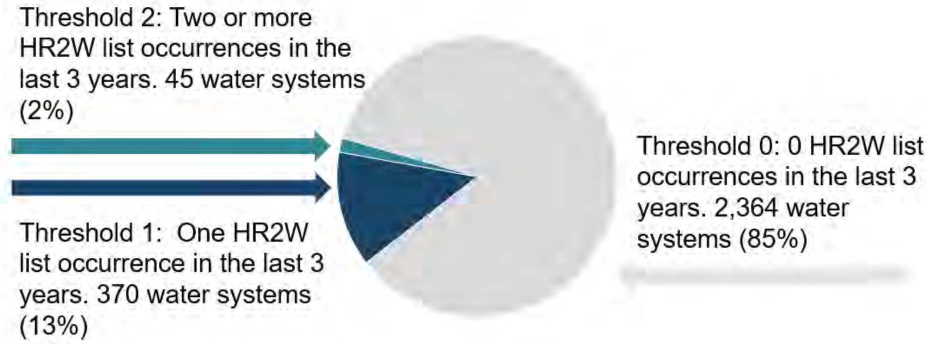
[191] Human Right to Water | California State Water Resources Control Board
https://www.waterboards.ca.gov/water_issues/programs/hr2w/

[192] See McDonald, Yolanda J., and Nicole E. Jones. "Drinking water violations and environmental justice in the United States, 2011–2015." *American journal of public health* 108.10 (2018): 1401-1407.

Figure A15: Past Presence on the HR2W List over the Last 3 Years (n=2,779)



MAXIMUM DURATION OF HIGH POTENTIAL EXPOSURE (HPE)

Maximum Duration of HPE is developed and utilized by OEHHA in their HR2W Tool.[193] This indicator first measures the duration of HPE for each of 19 analyzed contaminants and selects the maximum duration across all contaminants. This indicator focuses on the recurring nature of contamination. Accordingly, it highlights systems that experience an ongoing contamination problem. Capturing this recurring exposure may be important, especially when such exposure involves contaminants whose health effects are associated with chronic exposure. A long duration of high potential exposure can also signal that a system may need additional resources or support to remedy contamination.

Calculation Methodology
Required Risk Indicator Data Points & Sources:

- Water Quality Monitoring database (WQM) between 2011 and 2019: Water quality sampling data for the list of chemicals housed in WQIr chemical table (see below).
- MCL violations Total Coliform Rule (TCR) and Revised Total Coliform Rule (RTCR) from SDWIS.
- Lead Sampling Analyte results from SDWIS.[194]

Table A13: Contaminants Utilized by OEHHA for HPE*

Analyte Name	Analyte Number (in WQIr)
Arsenic	01002
Barium	01007

[193] Human Right to Water Data Tool
https://oehha.maps.arcgis.com/apps/MapSeries/index.html?appid=a09e31351744457d9b13072af8b68fa5

Achieving the Human Right to Water in California: An Assessment of the State's Community Water Systems January 2021
https://oehha.ca.gov/media/downloads/water/report/hrtwachievinghrtw2021f.pdf

[194] Action Level (0.015 mg/L) exceedance at "90th percentile" lead level.

Analyte Name	Analyte Number (in WQIr)
Benzene	34030
Cadmium	01027
Carbon Tetrachloride	32102
Mercury	71900
Methyl Tertiary Butyl Ether (MTBE)	46491 (A-030)
1,2,3-trichloropropane (1,2,3-TCP)	77443/7744x
Nitrate as Nitrogen	00618
Perchloroethylene (PCE)	34475
Perchlorate	A-031
Trichloroethylene (TCE)	39180
Toluene	34010
Xylene	81551
1,2-dibromo-3-chloropropane (DBCP)	38761
Total trihalomethanes (TTHM)	82080
Gross Alpha	01501

* Lead and TCR/RTCR are excluded from this table

Risk Indicator Calculation Methodology

To create the indicator OEHHA:[195]

- Used the average annual concentration for each contaminant (except for Total Coliform/E.coli).
- Summed the number of years (within 9-year compliance cycle) for which any contaminant's annual average concentrations was greater than the MCL (or Action Level for lead) for each contaminant and summed the total years of TCR/RTCR MCL violations.
- Selected the maximum duration of high potential exposure across the 19 contaminants.

Threshold Determination

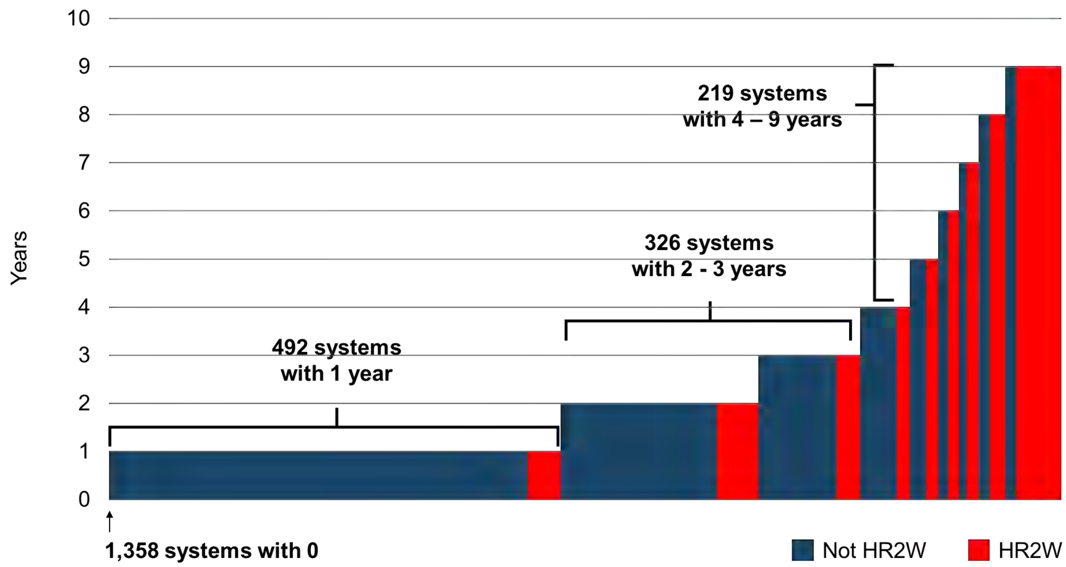
Data coverage for Maximum Duration of HPE is 86% with data available for 2,395 water systems. The minimum years of HPE in the data set is 0 years, the maximum is 9 years, and the average is 1.12 years. 1,358 water systems (49%) had zero years HPE.

100% data coverage was not available because the inventory of water systems assessed by OEHHA for HPE only includes community water systems. The inventory of systems assessed

[195] From Page 25 in OEHHA's *Achieving the Human Right to Water in California: An Assessment of the State's Community Water Systems January 2021*: https://oehha.ca.gov/media/downloads/water/report/hrtwachievinghrtw2021f.pdf

by the State Water Board's Risk Assessment also includes non-transient, non-community systems, specifically schools K-12. HPE data is not available for these systems.

Figure A16: Water Systems' Max Duration of HPE over the Last 9 Years (n=2,395)



As described above, the Maximum Duration of HPE is developed and utilized by OEHHA in their HR2W Tool. OEHHA set different thresholds of concern for HPE at each of 0, 1, 2 to 3, 4 to 5, and 6+ years with score values ranging from 0 to 4. The State Water Board adapted this range of thresholds in coordination with OEHHA to align with the Risk Assessment's maximum range of three thresholds.

Risk Indicator Scoring & Weighting

To enable the evaluation and comparison of risk indicators, a standardized scale between 0 and 1 for risk scores has been applied to each threshold. Public feedback during with Risk Assessment methodology development process indicated that some risk indicators should be weighted higher than others because they may be more "critical" as they relate to a water system's ability to stay in compliance. Risk indicator weights between 1 and 3 were applied to individual risk indicators. Based on feedback from the State Water Board's engineers, the maximum weight of 3 is applied to the "Maximum Duration of HPE" risk indicator. Therefore, the minimum risk score is 0 and the maximum risk score is 3. Table A14 summarizes the thresholds, scores, and weight for this risk indicator.

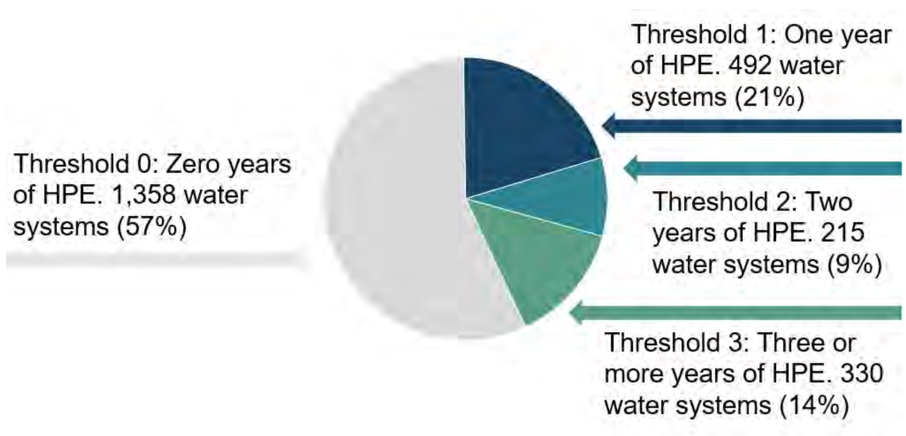
Table A14: "Maximum Duration of HPE" Thresholds & Scores

Threshold Number	Threshold	Score	Weight
0	**0** year of HPE over the last nine years.	0	N/A
1	**1** year of HPE over the last nine years.	0.25	3

Threshold Number	Threshold	Score	Weight
2	**2** years of HPE over the last nine years.	0.5	3
3	**3 or more** years of HPE over the last nine years.	1	3

Figure A17 shows 1,358 water systems (57%) have zero years of HPE. 492 water systems (21%) meet Threshold 1 having one-year HPE, compared to 215 water systems (9%) which meet Threshold 2 having two years of HPE. Finally, 330 water systems (14%) meet Threshold 3 having three or more years of HPE.

Figure A17: Maximum Duration of High Potential Exposure (HPE) (n=2,395)



PERCENTAGE OF SOURCES EXCEEDING AN MCL

Percent of the number of sources that exceed any MCL in the table below. The number includes water systems sources with an exceedance of any primary chemical contaminant within the past three years. This indicator assumes that the water system is not in violation overall.

Calculation Methodology
Required Risk Indicator Data Points & Sources:

- Water source facility type from SDWIS:
    - CC – Consecutive Connection
    - IG – Infiltration Gallery
    - IN – Intake
    - RC – Roof Catchment
    - SP – Spring
    - WL – Well
- WQIr chemical table:

Table A15: Analytes in WQIr Chemical Table

Analyte Name	Analyte Number (in WQIr)
1,1,1-Trichloroethane	34506
1,1,2,2-Tetrachloroethane	34516
Trichlorotrifluoroethane	81611
1,1,2-Trichloroethane	34511
1,1-Dichloroethane	34496
1,1-Dichloroethylene	34501
1,2,3-Trichloropropane (1,2,3-TCP)	77443
1,2,4-Trichlorobenzene	34551
1,2-Dichlorobenzene	34536
1,2-Dichloroethane	34531
1,2-Dichloropropane	34541
1,3-Dichloropropane (TOTAL)	34561
1,4-Dichlorobenzene	34571
2,3,7,8-TCDD (Dioxin)	34676
2,4,5-TP (Silvex)	39045
2,4-D	39730
Alachlor	77825
Aluminum	01105
Antimony	01097
Arsenic	01002
Asbestos	81855
Atrazine	39033
Barium	01007
Bentazon	38710
Benzene	34030
Benzo (A) Pyrene	34247
Beryllium	01012
Bromate	A-027
Cadmium	01027
Carbofuran	81405
Carbon Tetrachloride	32102
Chlordane	39350
Chlorite	50074
Chromium (Total)	01034
CIS-1,2-Dichloroethylene	77093
CIS-1,3-Dichloropropene	34704
Combined RA 226 + RA 228	11503
Cyanide	01291
Dalapon	38432
Di(2-Ethylhexyl)Phthalate	39100
Dibromochloropropane (DBCP)	38761

Analyte Name	Analyte Number (in WQIr)
Dichloromethane	34423
Dinoseb	81287
Diquat	78885
Endothall	38926
Endrin	39390
Ethylbenzene	34371
Ethylene Dibromide (EDB)	77651
Fluoride (F) (Natural-Source)	00951
Glyphosate	79743
Gross Alpha	01501
Gross Beta	03501
Haloacetic Acids (5) (HAA5)	A-049
Heptachlor	39410
Heptachlor Epoxide	39420
Hexachlororobenzene	39700
Hexachlorocyclopentadiene	34386
Lindane	39340
Manganese, Dissolved	01056
Mercury	71900
Methoxychlor	39480
Methyl Tertiary Butyl Ether (MTBE)	46491
Molinate	82199
Monochlorobenzene	34301
Nickel	01067
Nitrate as Nitrogen	00618
Nitrate + Nitrite (As N)	A-029
Nitrite (As N)	00620
Oxamyl	38865
Pentachlorophenol	390032
Perchlorate	A-031
Picloram	39720
Polychlorinated Biphenyls, Total, As DCB	39516
Selenium	01147
Simazine	39055
Strontium-90	13501
Styrene	77128
Tetrachloroethylene	34475
Thallium	01059
Thiobencarb	A-001
Toluene	34010
Total Trihalomethanes	82080

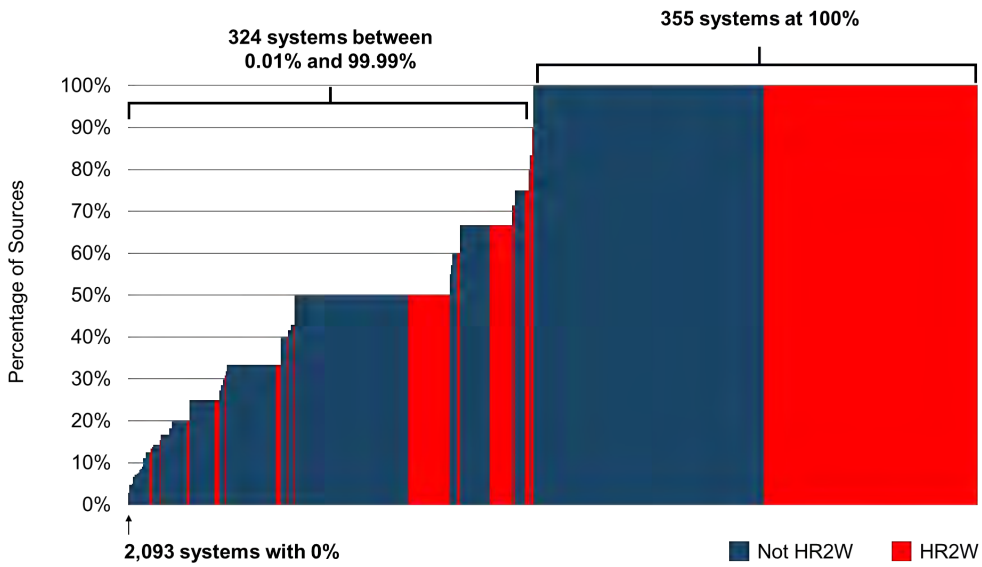
Analyte Name	Analyte Number (in WQIr)
Toxaphene	39400
Trans-1,2-Dichloroethylene	34545
Trans-1,2-Dicholropropene	34546
Tricholoroethylene	39180
Trichlorofluoromethane Freon 11	34488
Tritium	07000
Uranium (PCI/L)	28012
Vinyl Chloride	39175
Xylene (Total)	81551

Risk Indicator Calculation Methodology:

- Prepare SDWIS data
    - Combine two SDWIS tables (the Water System table and Water System Facility table).
    - Apply filters to prepared data and get counts of the total number of Water System Facilities for each Water System.
        - Filters applied
            - Active Water Systems Only
            - Active Water System Facilities Only
            - Water System Facilities with a facility type of CC, IG, IN, RC, SP, and WL
- Prepare WQI data
    - Combine three WQI tables (the Findings, Chemicals (Storets), and Chemical Levels).
    - Apply filters to prepared data and get counts of MCL exceedances for each source
        - Filters applied:
            - Primary contaminants only
            - Primary contaminants with an MCL exceedance
- Combine filtered SDWIS and WQI data
- Calculate the percentage of impaired sources by dividing the total number of sources with MCL exceedances (From WQI) by the total number of sources (From SDWIS) and then multiply that number by 100.

Threshold Determination
Data for 2,772 water systems was available to analyze the Percentage of Sources Exceeding MCL indicator. The minimum percentage found is zero, the maximum percentage found is 100%, and the average percentage found is 18%.

Figure A18: Water Systems' Percentage of Sources Exceeding an MCL (n=2,772)



The percentage of sources exceeding an MCL, as defined here or a similar measure, has not been assessed in other previous studies as related to water system failure or employed by other regulatory agencies or stakeholders as a threshold of concern. However, this lack of precedent likely reflects that this indicator threshold is hard to obtain and analyze without significant expertise and experience with source water quality data and data processing capability. The State Water Board's workgroup of district engineers determined the draft tiered thresholds for this risk indicator based on their experience working with water systems throughout the state. These draft thresholds were shared with the public and ultimately incorporated into the Risk Assessment.

Risk Indicator Scoring & Weighting

To enable the evaluation and comparison of risk indicators, a standardized scale between 0 and 1 for risk scores has been applied to each threshold. Public feedback during with Risk Assessment methodology development process indicated that some risk indicators should be weighted higher than others because they may be more "critical" as they relate to a water system's ability to stay in compliance. Risk indicator weights between 1 and 3 were applied to individual risk indicators. Based on feedback from the State Water Board's engineers, the maximum weight of 3 is applied to the "Percentage of Sources Exceeding MCL" risk indicator. Therefore, the minimum risk score is 0 and the maximum risk score is 3. Table A16 summarizes the thresholds, scores, and weight for this risk indicator.

Table A16: "Percentage of Sources Exceeding MCL" Thresholds & Scores

Threshold Number	Threshold	Score	Weight
0	**less than 49.9%** of sources exceed an MCL.	0	N/A
1	**greater than 49.9%** or sources exceed an MCL.	1	3

Figure A19 shows 2,226 water systems (80%) have less than 49.9% of their water sources exceeding an MCL. 546 water systems (20%) meet Threshold 1 having greater than 49.9% of their water sources exceeding an MCL.

Figure A19: Percentage of Sources Exceeding an MCL (n=2,772)

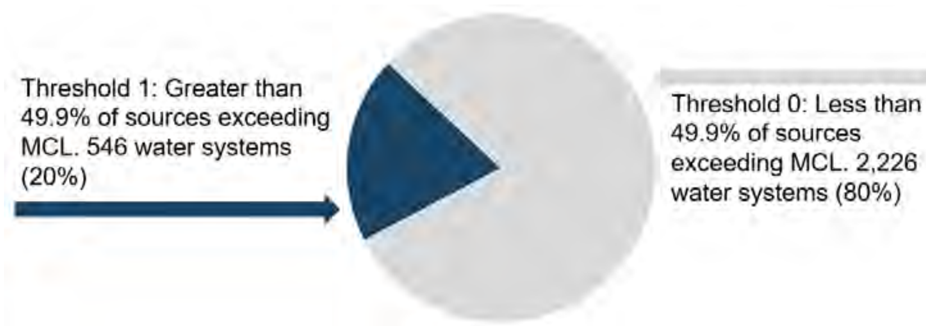
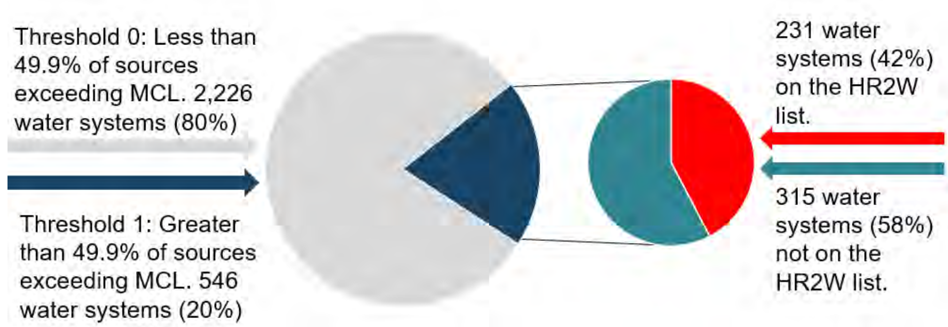


Figure A20 indicates 231 HR2W list water systems (80%) meet Threshold 1 having greater than 49.9% of their water sources exceeding an MCL. 57of HR2W list water systems (20%) have less than 49.9% of their water sources exceeding an MCL.

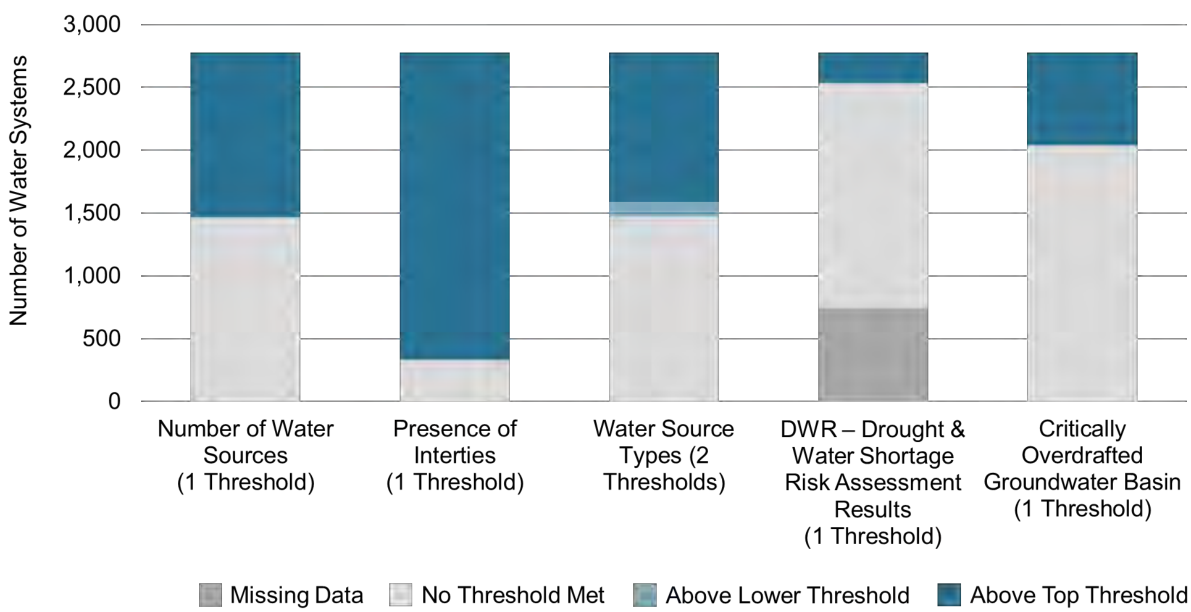
Figure A20: HR2W List System's Percentage of Sources Exceeding an MCL



ACCESSIBILITY RISK INDICATORS

This section provides full details on each Accessibility risk indicator used in the Risk Assessment. Accessibility risk indicators measure a system's ability to deliver safe, sufficient, and continuous drinking water to meet public health needs. Figure A21 illustrates the number of water systems that exceeded the risk indicator thresholds within the Accessibility category. The range of potential thresholds for each risk indicator are summarized in the respective risk indicator label and detailed below.

Figure A21: Number of Systems Exceeding Thresholds for Each Accessibility Risk Indicator



NUMBER OF SOURCES

Total number of available water sources including surface water, wells, and imported/purchased water.

Calculation Methodology

Required Risk Indicator Data Point & Source:

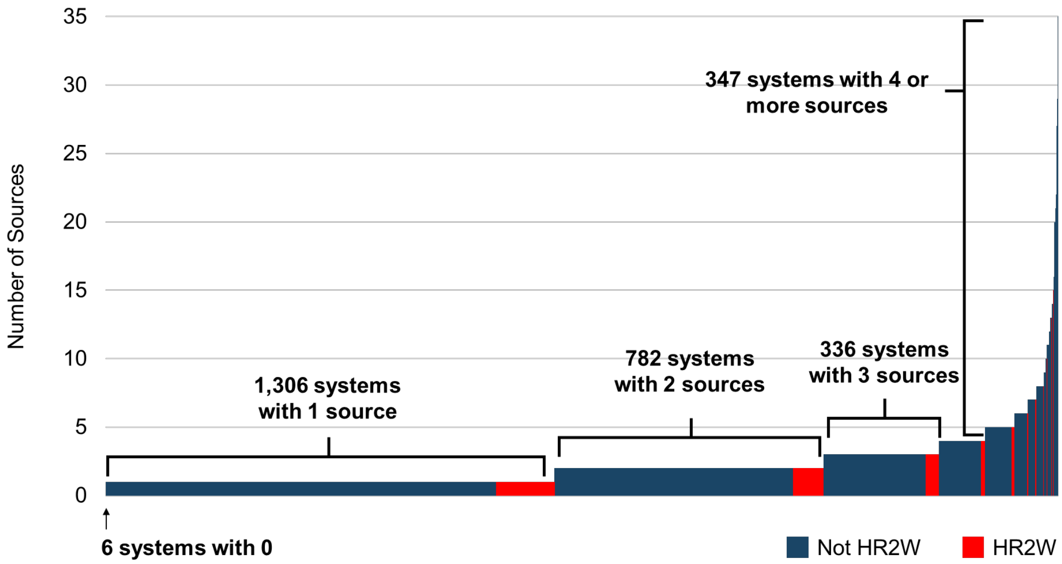
- Water Source Facility Type: SDWIS
  - CC – Consecutive Connection
  - IG – Infiltration Gallery
  - IN – Intake
  - RC – Roof Catchment
  - SP – Spring
  - WL – Well
  - ST – Storage Tank

Risk Indicator Calculation Methodology:

- Prepare data
  - Combine two SDWIS tables (the Water System table and Water System Facility table).
  - Apply filters to prepared data and get counts of the total number of Water System Facilities for each Water System.
    - Filters applied
      - Active Water Systems Only
      - Active Water System Facilities Only
      - Water System Facilities with a facility type of CC, IG, IN, RC, SP, and WL

Threshold Determination
Data on the number of water sources is available for 2,779 water systems. The minimum number of sources found was 0, the maximum number of sources found was 35, and the average number of sources found was 2.2.

Figure A22: Number of Sources (n=2,779)



The threshold developed for the number of sources risk indicator mostly aligns with the thresholds used by DWR's Drought & Water Shortage Risk Assessment. Peer-reviewed studies also suggest that single source reliance is associated with water system failure.[196] Moreover, Section 64554(c) of the California Code of Regulations (CCR) requires new community water systems using only groundwater sources to have a minimum of two

[196] See Mullin, M. (2020). The effects of drinking water service fragmentation on drought-related water security. *Science, 368*(6488), 274-277.

approved sources capable each capable to meet the maximum day demand of the water system.

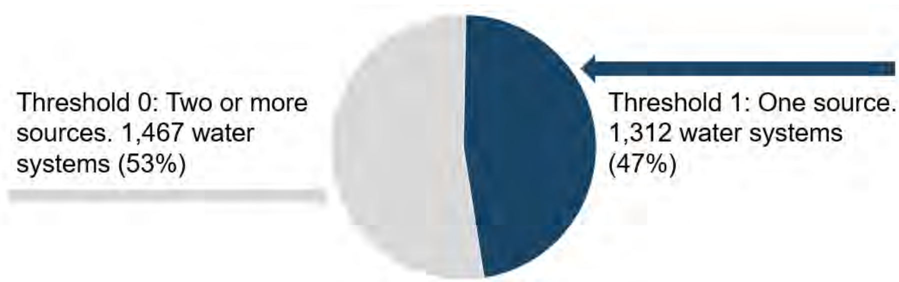
Risk Indicator Scoring & Weighting
To enable the evaluation and comparison of risk indicators, a standardized scale between 0 and 1 for risk scores has been applied to each threshold. Public feedback during with Risk Assessment methodology development process indicated that some risk indicators should be weighted higher than others because they may be more "critical" as they relate to a water system's ability to stay in compliance. Risk indicator weights between 1 and 3 were applied to individual risk indicators. Based on feedback from the State Water Board's engineers, the maximum weight of 3 is applied to the "Number of Sources" risk indicator. Therefore, the minimum risk score is 0 and the maximum risk score is 3. Table A17 summarizes the thresholds, scores, and weight for this risk indicator.

Table A17: "Number of Sources" Thresholds & Scores

Threshold Number	Threshold	Score	Weight
X	**0** source (automatically At-Risk).	N/A	N/A
0	**2 or more** sources.	0	N/A
1	**1** source.	1	3

Figure A23 shows 6 water systems have 0 water sources and are considered automatically "At-Risk". 1,467 water systems (53%) meet Threshold 0 of having two or more water sources. 1,312 water systems (47%) meet Threshold 1 of having only one water source.

Figure A23: Number of Sources (n=2,779)



ABSENCE OF INTERTIES

An intertie or interconnection is a connection between one or more water systems where systems can either supply or receive water from each other. Presence of interties is assumed to reduce the risk of a water outage by allowing water systems to switch sources and even governance structure support, if needed.

Calculation Methodology

Required Risk Indicator Data Points & Source:

In SDWIS, this type of data is stored as a water system facility with a consecutive connection designation. Additionally, these types of water system facilities can be described in terms of their availability of use. According to internal SDWIS procedure documents, only the receiving facility should have a CC water system facility represented in SDWIS. The procedure document does not indicate whether emergency or seasonal CCs should be entered. The purpose of this metric is to capture the number of interties per water system entered in SDWIS, regardless of availability.

- Water source facility type and availability: SDWIS
  - CC – Consecutive Connection
  - Availability:
    - I – Interim
    - E – Emergency
    - O – Other
    - P – Permanent
    - S – Seasonal

Risk Indicator Calculation Methodology:

- Prepare data:
  - Combine two SDWIS tables (the Water System table and Water System Facility table).
- Apply filters to prepared data and get counts for each Water Source Type per Water System.
  - Filters applied:
    - Active Water Systems Only
    - Active Water System Facilities Only
    - Water System Facilities with a facility type of CC

Threshold Determination

Absence of Intertie data is available for all 2,850 water systems. The minimum number of interties found is zero and the maximum presence of interties is 1. The developed threshold aligns with DWR's Drought & Water Shortage Risk Assessment.[197]

Risk Indicator Scoring & Weighting

To enable the evaluation and comparison of risk indicators, a standardized scale between 0 and 1 for risk scores has been applied to each threshold. Public feedback during with Risk Assessment methodology development process indicated that some risk indicators should be weighted higher than others because they may be more "critical" as they relate to a water system's ability to stay in compliance. Risk indicator weights between 1 and 3 were applied to individual risk indicators. Based on feedback from the State Water Board's engineers, the

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[197] Countywide Drought and Water Shortage Contingency Plans | DWR https://water.ca.gov/Programs/Water-Use-And-Efficiency/Making-Conservation-a-California-Way-of-Life/CountyDrought-Planning

maximum weight of 1 is applied to the "Absence of Interties" risk indicator. Therefore, the minimum risk score is 0 and the maximum risk score is 1. Table A18 summarizes the thresholds, scores, and weight for this risk indicator.

Table A18: "Absence of Interties" Thresholds & Scores

Threshold Number	Threshold	Score	Weight
0	**1 or more** interties.	0	N/A
1	**0** interties.	1	1

Figure A24 shows 338 water systems (12%) have one or more interties. 2,441 water systems (88%) meet Threshold 1 of having zero interties.

Figure A24: Absence of Interties (n=2,779)

WATER SOURCE TYPES

Total number of water source types utilized by the water system. Water source types include groundwater, surface water, and purchased water.

Calculation Methodology
Required Risk Indicator Data Points & Sources:

Both of the following data points for this indicator are required and collected through the initial water system permitting process and entered into SDWIS by State Water Board staff. This data is verified through Sanitary Surveys and necessary updates are made in SDWIS.

- Water Source Facility Type: SDWIS
  - CC – Consecutive Connection
  - IG – Infiltration Gallery
  - IN – Intake
  - RC – Roof Catchment
  - SP – Spring
  - WL – Well

- ST – Storage Tank

- Water Source Facility Water Type Code: SDWIS
  - GW – Groundwater
  - GU – Ground water under direct influence of surface water (Consider to be ground water)
  - SW – Surface Water
  - Both – GW and SW

Risk Indicator Calculation Methodology:

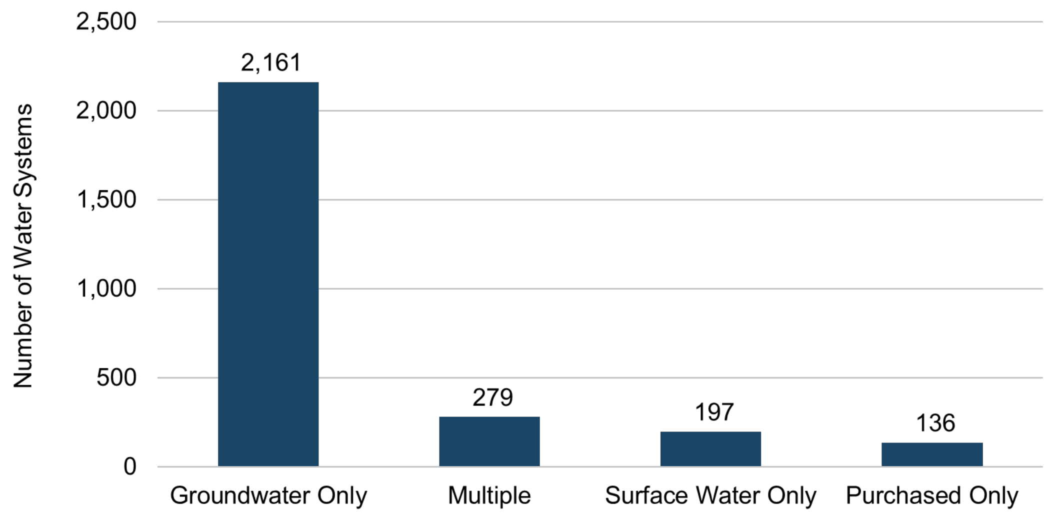
- Prepare data
  - Combine two SDWIS tables (the Water System table and Water system Facility table)

- Apply filters to prepared data and get counts for each Water Source Type per Water System
  - Filters applied for Groundwater Counts:
    - Active Water Systems Only
    - Active Water System Facilities Only
    - Water System Facilities with a facility type of IG, RS, RC, SP, or WL
    - Water System Facilities with a Water Type Code of GW or GU
  - Filters applied for Purchased Water Counts:
    - Active Water Systems Only
    - Active Water System Facilities Only
    - Water System Facilities with a facility type of CC
  - Filters applied for Surface Water Counts:
    - Active Water Systems Only
    - Active Water System Facilities Only
    - Water System Facilities with a facility type of IG, IN, RC, or SP
    - Water System Facilities with a Water Type Code of SW

Threshold Determination

Water Source Type data is available for all 2,779 water systems. 279 water systems had multiple water sources. 2,161 had groundwater only, 197 had surface water only, and 136 had purchased only.

Figure A25: Water Source Types (n=2,779)



Peer-reviewed studies suggest that water source type, particularly single-source groundwater reliance, is associated with water system failure.[198] The developed threshold for the type of sources risk indicator is similar to that used in DWR's Drought & Water Shortage Risk Assessment.

Risk Indicator Scoring & Weighting
To enable the evaluation and comparison of risk indicators, a standardized scale between 0 and 1 for risk scores has been applied to each threshold. Public feedback during with Risk Assessment methodology development process indicated that some risk indicators should be weighted higher than others because they may be more "critical" as they relate to a water system's ability to stay in compliance. Risk indicator weights between 1 and 3 were applied to individual risk indicators. Based on feedback from the State Water Board's engineers, the maximum weight of 1 is applied to the "Water Source Types" risk indicator. Therefore, the minimum risk score is 0 and the maximum risk score is 1. Table A19 summarizes the thresholds, scores, and weight for this risk indicator.

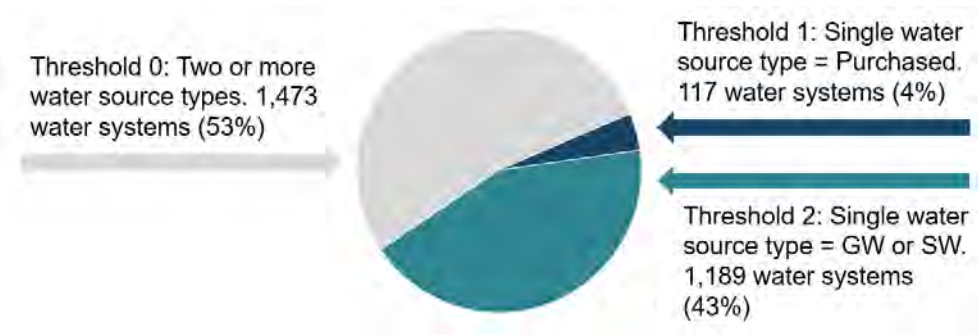
Table A19: "Water Source Types" Thresholds & Scores

Threshold Number	Threshold	Score	Weight
0	**2 or more** water source types.	0	N/A
1	**1** water source type and that source is **purchased** water.	0.5	1
2	**1** water source types and that source is either **groundwater** or **surface water**.	1	1

[198] See Pennino, M. J., Compton, J. E., & Leibowitz, S. G. (2017). Trends in drinking water nitrate violations across the United States. *Environmental science & technology, 51*(22), 13450-13460.

Figure A26 shows there are 1,473 water systems (53%) with two or more water source types, meeting Threshold 0. There are 1,306 water systems (47%) with a single water source type. Of these water systems, 117 (4%) meet Threshold 1 with "Purchased" as their source type. The remaining 1,189 water systems (43%) meet Threshold 2 with a groundwater or surface water source type.

Figure A26: Water Source Types (n=2,779)



DWR – DROUGHT & WATER SHORTAGE RISK ASSESSMENT RESULTS

This indicator utilizes DWR's Drought and Water Shortage Risk Scoring Tool[199] results which identifies small water suppliers and rural communities (defined as *Self-Supplied Communities* in the tool) that are potentially at-risk of drought and vulnerable to water shortages. For this tool, small water suppliers are considered publicly regulated systems with fewer than 3,000 service connections and using fewer than 3,000 acre-feet per year. Self-supplied communities are water systems with fewer than 15 service connections, which covers state small water systems (5 to 14 connections), local small water systems (2 to 4 connections), and domestic wells. This tool creates an aggregated, comparative risk score for each water system and community derived from a set of indicators that capture different dimensions of exposure to hazards, physical/social vulnerability, and observed supply shortages (29 indicators for small water suppliers and 29 indicators for self-supplied communities).

Calculation Methodology

For the *small water suppliers*, the 29 risk indicators utilized by DWR were categorized and scored according to three components:

- Exposure:
  - Climate change impacts (weighted: 0.25)
  - Recent or current hazardous conditions and events (weighted: 0.75)
- Vulnerability:
  - Infrastructure vulnerability (system connectivity and other factors) (weighted: 4 connectivity indicators at 0.67 plus 4 other factor indicators at 0.33)

[199] Drought and Water Shortage Risk Explorer Tool for Small Water Suppliers and Rural Communities https://dwr.maps.arcgis.com/apps/MapSeries/index.html?appid=3353b370f7844f468ca16b8316fa3c7b

    - Organizational vulnerability (demographic and socioeconomic characteristics) (weighted: 0.33)
- Observed Water Shortage:
    - Experienced drought impacts or shortage records (weighted: 0.33)

For *self-supplied communities*, the 29 similar risk indicators were categorized and scored according to the same three components:

- Exposure:
    - Climate change impacts (weighted: 0.25)
    - Recent or current hazardous conditions and events (weighted: 1.0)
- Vulnerability
    - Physical vulnerability (weighted: 0.25)
    - Socioeconomic vulnerability (weighted: 0.75)
- Observed Water Shortage
    - Water outage records (weighted: 0.5)

For both the *small water suppliers* and *self-supplied communities* scoring, the risk indicator variables were all rescaled 0-1 numbers (1 is high and 0 is low) and combined with the other variables in their respective component. A simple calculation that weights each variable (noted above) within its given component was applied, and then the weighted component scores were aggregated.

Each group of variables is then combined with the other group scores for each component (Exposure, Vulnerability, and Observed Water Shortage). Finally, the raw risk score from each component is summed and rescaled from 0 to 100 using a min-max scaling technique to calculate the final risk score.

The draft drought scoring for the small water suppliers and self-supplied communities can be found in the Drought and Water Shortage Risk Explorer Tool for Small Water Suppliers and Rural Communities.[200]

Additional information is available on the DWR Countywide Drought and Water Shortage Contingency Plans website.[201]

Threshold Determination

DWR Assessment Results were available for 2,420 water systems. The minimum score found was 0.2, the maximum score found was 100.3, and the average score was 54. The proposed thresholds for this indicator (the top 10% and 25% of systems analyzed) are based on the illustrative cutoff provided by DWR in its presentation of Drought & Water Shortage Risk Assessment Results.

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[200] Drought and Water Shortage Risk Explorer Tool for Small Water Suppliers and Rural Communities https://dwr.maps.arcgis.com/apps/MapSeries/index.html?appid=3353b370f7844f468ca16b8316fa3c7b

[201] Countywide Drought and Water Shortage Contingency Plans | DWR https://water.ca.gov/Programs/Water-Use-And-Efficiency/2018-Water-Conservation-Legislation/County-Drought-Planning

Risk Indicator Scoring & Weighting
To enable the evaluation and comparison of risk indicators, a standardized scale between 0 and 1 for risk scores has been applied to each threshold. Public feedback during with Risk Assessment methodology development process indicated that some risk indicators should be weighted higher than others because they may be more "critical" as they relate to a water system's ability to stay in compliance. Risk indicator weights between 1 and 3 were applied to individual risk indicators. Based on feedback from the State Water Board's engineers, the maximum weight of 2 is applied to the "DWR Assessment Results" risk indicator. Therefore, the minimum risk score is 0 and the maximum risk score is 2. Table A20 summarizes the thresholds, scores, and weight for this risk indicator.

Table A20: "DWR Assessment Results" Thresholds & Scores

Threshold Number	Threshold	Score	Weight
0	**Below top 25%** of systems most at risk of drought and water shortage.	0	N/A
1	**Top 25%** of systems most at risk of drought and water shortage.	0.25	2
2	**Top 10%** of systems most at risk of drought and water shortage.	1	2

Figure A27 shows 1,797 water systems (75%) scored below the top 25% in the DWR assessment. 359 water systems (15%) meet Threshold 1, as they fall within the top 10% - 25% of the DWR assessment. 241 water systems (10%) meet Threshold 2, as they fall within the top 10% of the DWR assessment.

Figure A27: Water System DWR Assessment Results (n=2,397)

CRITICALLY OVERDRAFTED GROUNDWATER BASIN

Water systems in basins considered to be in Critical Overdraft per DWR's Bulletin 118. A basin is subject to critical conditions of overdraft when continuation of current water management practices would probably result in significant adverse overdraft-related environmental, social, or economic impacts.

Calculation Methodology

Required Risk Indicator Data Points & Sources:

- SGMA Basin Prioritization Statewide Summary Table[202]: DWR
- Water System Boundaries: State Water Board Service Area Boundary Layer (SABL)
- Water Type Code: SDWIS
    - GW – Groundwater
    - SW – Surface Water
    - Both – GW and SW

Risk Indicator Methodology:

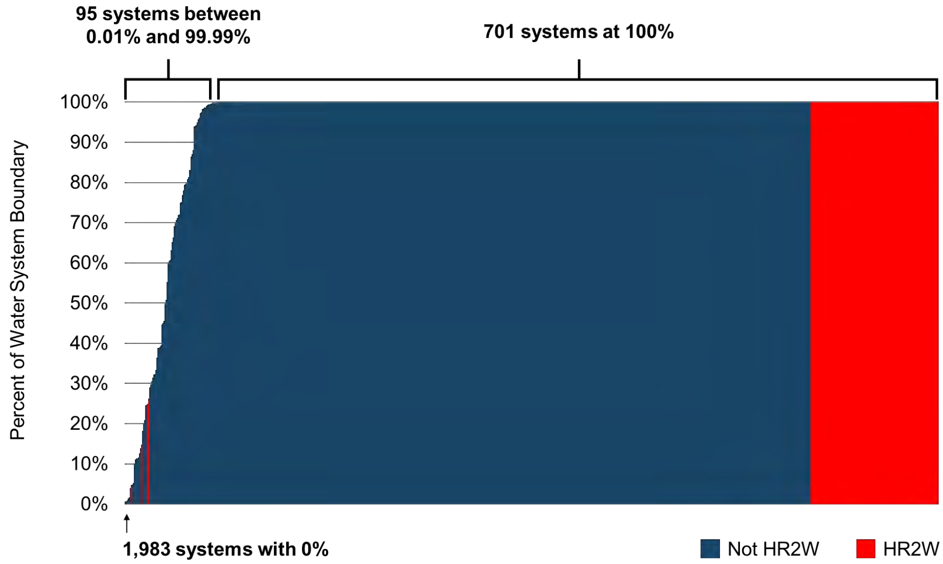
- Water System Boundaries – SABL – Water systems boundaries are overlaid with the critically overdrafted groundwater basins.
- Water System Source Water Identification – SDWIS – Water systems screened for source water (groundwater/surface water) to determine reliance on groundwater.

Threshold Determination

Data on the location of water systems in critically overdrafted groundwater basins is available for all 2,779 water systems. The minimum percentage of service area within a critically overdrafted groundwater basin is 0%, the maximum percentage is 100%, and the average percentage is 27%.

202 SGMA Basin Prioritization Statewide Summary Table https://data.cnra.ca.gov/dataset/13ebd2d3-4e62-4fee-9342-d7c3ef3e0079/resource/6347629e-340d-4faf-ae7f-159efbfbcdc9/download/final-515-table.xlsx

Figure A28: Percent of Water System Boundary within an Overdrafted Groundwater Basin (n=2,779)



The percentage of a water system's boundary overlapping with a critically over-drafted groundwater basin, as defined here or a similar measure, has only been assessed in DWR Assessment Results as a binary factor, likely reflecting the relatively recent nature of SGMA. Moreover, the determination of a numerical threshold between 1-100% (as opposed to 0%) leads to little difference in the number of systems deemed as above the threshold for this indicator.

Risk Indicator Scoring & Weighting

To enable the evaluation and comparison of risk indicators, a standardized scale between 0 and 1 for risk scores has been applied to each threshold. Public feedback during with Risk Assessment methodology development process indicated that some risk indicators should be weighted higher than others because they may be more "critical" as they relate to a water system's ability to stay in compliance. Risk indicator weights between 1 and 3 were applied to individual risk indicators. Based on feedback from the State Water Board's engineers, the maximum weight of 2 is applied to the "Critically Overdrafted Groundwater Basin" risk indicator. Therefore, the minimum risk score is 0 and the maximum risk score is 2. Table A21 summarizes the thresholds, scores, and weight for this risk indicator.

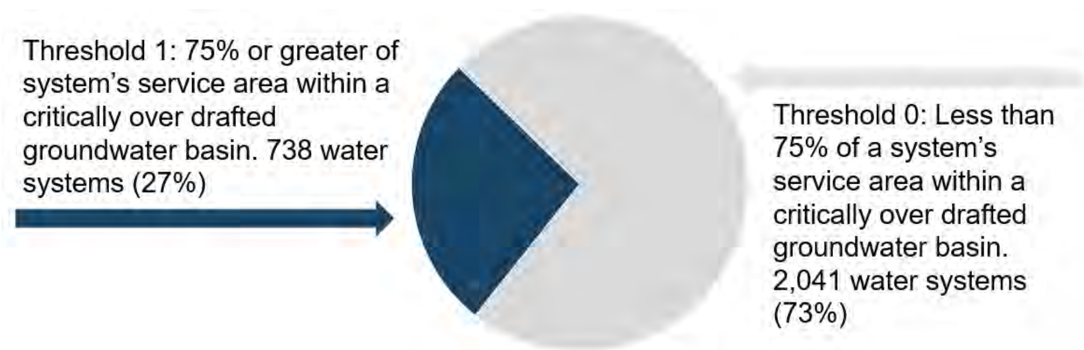
Table A21: "Critically Overdrafted Groundwater Basin" Thresholds & Scores

Threshold Number	Threshold	Score	Weight
0	**Less than 75%** of system's service area boundary is within a critically overdrafted basin.	0	N/A

Threshold Number	Threshold	Score	Weight
1	**75% or greater** of systems service area boundary is within a critically overdrafted basin.	1	2

Figure A29 shows 2,041 water systems (73%) have less than 75% of their service area within a critically endangered overdrafted groundwater basin. 738 water systems (27%) meet Threshold 1 with 75% or greater of their service area within a critically overdrafted groundwater basin.

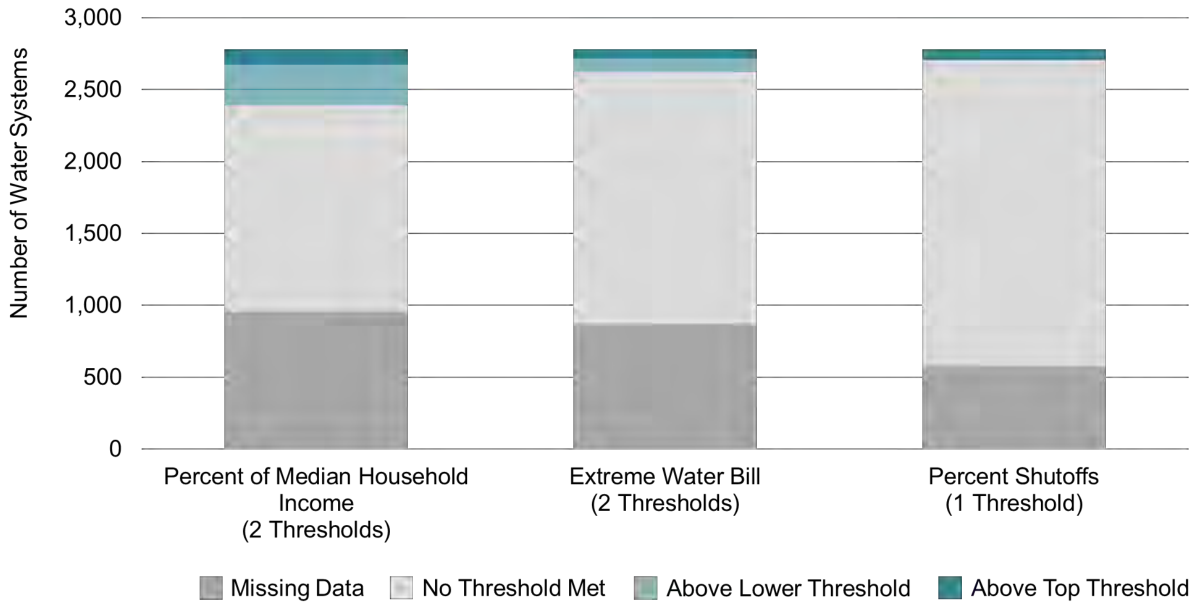
Figure A29: Water Systems in Critically Overdrafted Groundwater Basins (n=2,779)



AFFORDABILITY RISK INDICATORS

This section provides full details on each Affordability risk indicator used in the Risk Assessment. Affordability risk indicators measure the capacity of households and the customer base as a whole to supply the revenue necessary for a water system to pay for necessary capital, operations, and maintenance expenses. Figure A30 illustrates the number of water systems that exceeded the risk indicator thresholds within the Affordability category. The range of potential thresholds for each risk indicator are summarized in the respective risk indicator label and detailed below.

Figure A30: Number of Systems Exceeding Thresholds for Each Affordability Risk Indicator



PERCENT OF MEDIAN HOUSEHOLD INCOME (%MHI)

This indicator measures the annual system-wide average residential water bill for 6 Hundred Cubic Feet (HCF) per month relative to the annual Median Household Income (MHI) within a water system's service area.

Calculation Methodology

Required Risk Indicator Data Points & Sources:

- Water system service area boundaries: SABL
- Block group-Income in the Past 12 Months: U.S. Census Bureau's American Community Survey
- Drinking Water Customer Charges: Electronic Annual Report (EAR)
- Other Customer Charges: EAR

Average monthly drinking water customer charges is collected through the EAR. However, this data has historically not been required for reporting. Therefore, the 2019 EAR data had coverage and accuracy issues. The State Water Board attempted to validate and supplement this dataset through a water rate survey conducted in November 2020. Additionally, customer charges data was collected through the UNC EFC's development of the Small Water System's Rates Dashboard. This data was used when available and applicable. It is anticipated that the coverage and accuracy of drinking water customer charges data will improve with the revisions made to the 2020 reporting year EAR.

Risk Indicator Calculation Methodology:

Median household income (MHI) is determined for a water system using American Community Survey data for household income. Community Water System boundaries typically do not align with census boundaries where per capita income data is regularly collected. In order to assign an average median household income to a community water system spatially weighted income data is aggregated by census block group within the water system service area.

The methodology for this indicator was based on the Division of Financial Assistance (DFA) MHI methodology. While the MHI calculation methodology for the Affordability Assessment generally aligns with the Division of Financial Assistance's (DFA) MHI determination methodologies, there are slight differences. The differences found in the calculation of MHI's for cities and census designated places and in the application of the Margin of Error (MOE).

The DFA methodology dictates that when it is determined that a system boundary exactly matches city boundaries or closely matches a census designated place boundary, the MHI for the entire city or census designated place should be directly applied to the system rather than using areally-interpolated block group data. This likely leads to more accurate MHI estimation in these cases. However, this method was not used in the Needs Assessment given that a case by case determination of matching of cities and census designated places to system boundaries was not feasible for the entire state. The MHI for each water system is a population-weighted MHI, using census block group area and population data. A population factor is generated based on the area of each census block group that falls within the water system boundary. The water system MHI is then calculated using population-adjusted MHIs for each census block group that falls within the water system boundary using the formula below:

$$\sum \frac{(Block\ Group\ MHI) \times (Adjusted\ Block\ Group\ Population)}{(Total\ Adjusted\ Block\ Groups\ Population)}$$

MOE for MHI American Community Survey data is also included in the MHI calculation. A population adjusted MOE is found using the same methodology described for MHI. The lower range of the MOE will be applied to a community's estimated MHI up to a maximum MOE value of $7,500 for communities with more than 500 people and $15,000 for communities with 500 or fewer people. The MOE will be subtracted from the estimated MHI.

The DFA methodology uses a lower bound MHI by subtracting the block group MOE from the block group MHI, with limits based on community size prior to applying the population factor to

MHI and MOE. The methodology applied in the Needs Assessment set margin of error limits and then applied them to population adjusted MHI figures, resulting in slightly different community water system MHI calculations than the DAF methodology.

As a result of these slight variations and the changing nature of household income, all funding related financial assessments must be completed by the DFA as their assessments are water system specific as opposed to the aggregated analysis done for the purposes of the Needs Assessment.

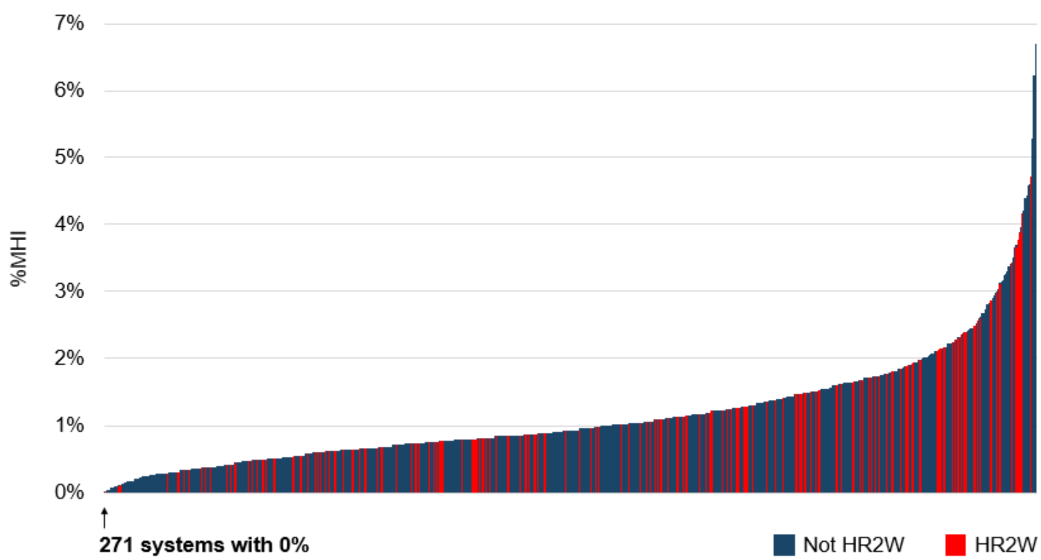
Average monthly drinking water customer charges are calculated using:

- Drinking water service costs estimated at 6 Hundred Cubic Feet per month. This level of consumption is in line with statewide conservation goals of 55 gallons per capita per day, in an average 3-person household.
- When data becomes available, additional approximated customer charges (not collected through a customer's bill) will be added to this figure to calculate Total Drinking Water Customer Charges.

%MHI = [Average Monthly Drinking Water Changes] / [MHI]

Threshold Determination
Data on %MHI is available for 1,822 of the water systems in the data set. The minimum %MHI found was 0%, the maximum %MHI found was 46.3%, and the average %MHI found was 1%. The State Water Board recognizes that customer charges data collected through the EAR may have data quality issues. The Needs Analysis Unit directly contacted some water systems to confirm their water rates and charges data submitted through the 2019 EAR.

Figure A31: %MHI Distribution, Excluding 6 Systems with %MHI > 10% (n=1,876)



%MHI is commonly used by state and Federal regulatory agencies and by water industry stakeholders for assessing community-wide water charges affordability for decades. %MHI is utilized by the State Water Board (at 1.5% threshold) and the U.S. EPA (at 2.5% threshold) for assessing affordability. The State Water Board and DWR use %MHI to determine Disadvantaged Community (DAC) status, among other income-related metrics. DAC status is often used to inform funding eligibilities for different financial programs offered by the State and other agencies. OEHHA's Human Right to Water (HR2W) Tool also utilizes[203] the thresholds determined by the State Water Board for this indicator.[204] Other states, including and North Carolina,[205] presently or have recently used 1.5% of MHI spent on water and sewer costs as a threshold for water system funding decisions.

Risk Indicator Scoring & Weighting

To enable the evaluation and comparison of risk indicators, a standardized scale between 0 and 1 for risk scores has been applied to each threshold. Public feedback during with Risk Assessment methodology development process indicated that some risk indicators should be weighted higher than others because they may be more "critical" as they relate to a water system's ability to stay in compliance. Risk indicator weights between 1 and 3 were applied to individual risk indicators. Based on feedback from the State Water Board's engineers, the maximum weight of 3 is applied to the "Percent Median Household Income" risk indicator. Therefore, the minimum risk score is 0 and the maximum risk score is 3. Table A22 summarizes the thresholds, scores, and weight for this risk indicator.

Table A22: "Percent Median Household Income" Thresholds & Scores

Threshold Number	Threshold	Score	Weight
0	**Less than 1.5%**	0	N/A
1	**1.5% or greater**	0.75	3
2	**2.5% or greater**	1	3

Figure A32 shows 1,442 water systems (79% of those with available data) have an average water charge less than 1.5% MHI. 273 water systems (15%) meet Threshold 1 having an average water charge at 1.5% MHI or greater, whereas 107 water systems (6%) meet Threshold 2 having an average water charge at 2.5% MHI or greater.

[203] There has been criticism of this metric by academics, water system associations, and the broader water sector mostly around its accuracy in measuring household affordability for those truly in need and the setting of arbitrary %MHI thresholds, limitations which the U.S. EPA has recently acknowledged.

[204] Arkansas Natural Resources Commission (2020). Safe Drinking Water Fund Intended Use Plan SFY 2019: https://www.agriculture.arkansas.gov/wp-content/uploads/2020/05/0_-_2019_DWSRF_IUP_-_AMENDED_January_2019_01082019_1156hrs.pdf

[205] North Carolina Department of Environmental Quality, Joint Legislative Economic Development and Global Engagement Oversight Committee (March 17, 2016) https://www.ncleg.gov/DocumentSites/Committees/JLEDGEOC/2015-2016/Meeting%20Documents/3%20-%20March%2017,%202016/2%20%20DEQ_Kim%20Colson%20Water%20Infrastructure%20JLOC%20EDGE%2020160317.pdf

Figure A32: Percent of Median Household Income (%MHI) (N=1,822)

EXTREME WATER BILL

This indicator measures drinking water customer charges that meet or exceed 150% of statewide average drinking water customer charges at the 6 Hundred Cubic Feet (HCF) level of consumption.

Calculation Methodology
Required Risk Indicator Data Points & Sources:

- Drinking Water Customer Charges: EAR
- Other Customer Charges: EAR

Risk Indicator Calculation Methodology:

Extreme Water Bill for a water system is determined using Average Monthly 6 HCF Drinking Water Customer Charges and Other Customer Charges divided by the State's Monthly Average Drinking Water Charges. The Risk Assessment is applied to water systems with less than 3,300 service connections; however, this methodology utilizes the statewide average customer charges to calculate extreme water bill, which includes systems with greater than 3,300 connections.

Threshold Determination
Data on Extreme Water Bill is available for 1,907 water systems. 1,616 water systems (85%) had an average monthly water bill greater than $0. The minimum average monthly water bill found was $0.00, the maximum average monthly water bill found was $350.00, and the average water bill found was $51.03.

Figure A33: Average Monthly Water Bill (n=1,907)

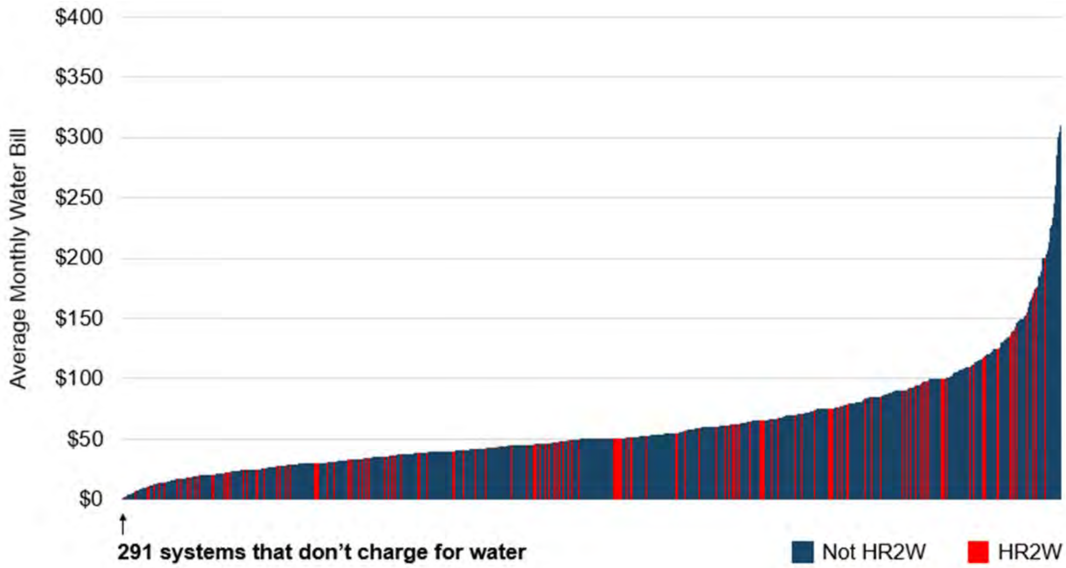
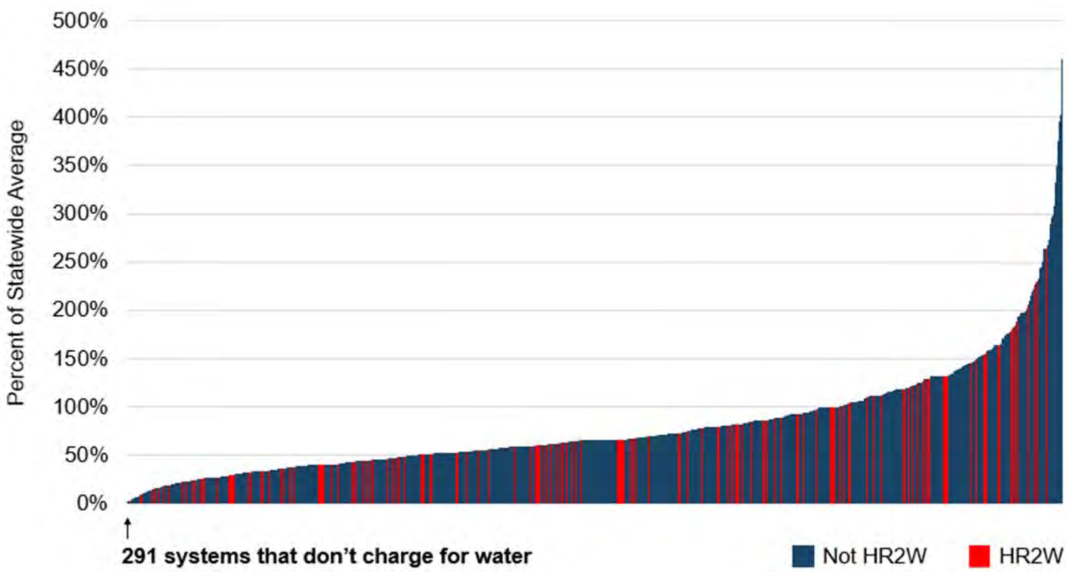


Figure A34: Average Monthly Water Bill as a Percent of the Statewide Average ($75.95) (n=1,907)



The State Water Board's AB 401 report[206] recommended statewide low-income rate assistance program elements utilize the two recommended tiered indicator thresholds of 150% and 200% of the state average drinking water bill for 6 HCF.

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[206] AB 401 Final Report:
Recommendations for Implementation of a Statewide Low-Income Water Rate Assistance Program
https://www.waterboards.ca.gov/water_issues/programs/conservation_portal/assistance/docs/ab401_report.pdf

Risk Indicator Scoring & Weighting
To enable the evaluation and comparison of risk indicators, a standardized scale between 0 and 1 for risk scores has been applied to each threshold. Public feedback during with Risk Assessment methodology development process indicated that some risk indicators should be weighted higher than others because they may be more "critical" as they relate to a water system's ability to stay in compliance. Risk indicator weights between 1 and 3 were applied to individual risk indicators. Based on feedback from the State Water Board's engineers, the maximum weight of 1 is applied to the "Extreme Water Bill" risk indicator. Therefore, the minimum risk score is 0 and the maximum risk score is 1. Table A23 summarizes the thresholds, scores, and weight for this risk indicator.

Table A23: "Extreme Water Bill" Thresholds & Scores

Threshold Number	Threshold	Score	Weight
0	**Below 150%** of the statewide average.	0	N/A
1	**Greater than 150%** of the statewide average.	0.5	1
2	**Greater than 200%** of the statewide average.	1	1

Figure A35 shows 1,759 water systems (92%) have an average water bill below 150% of the statewide average. 85 water systems (4%) meet Threshold 1 with an average water bill greater than 150% of the statewide average, whereas 63 water systems meet Threshold 2 with an average water bill greater than 200% the statewide average.

Figure A35: Extreme Water Bill (n=1,907)

% SHUT-OFFS

Percentage of residential customer base with service shut-offs due to non-payment in a given year.

Calculation Methodology

Required Risk Indicator Data Points & Sources:

- Number of residential service connections with water shut-off more than once due to failure to pay: EAR
    - Total Single-Family Shut-offs
    - Total Multi-Family Shut-offs
- Total Number of Service Connections: EAR

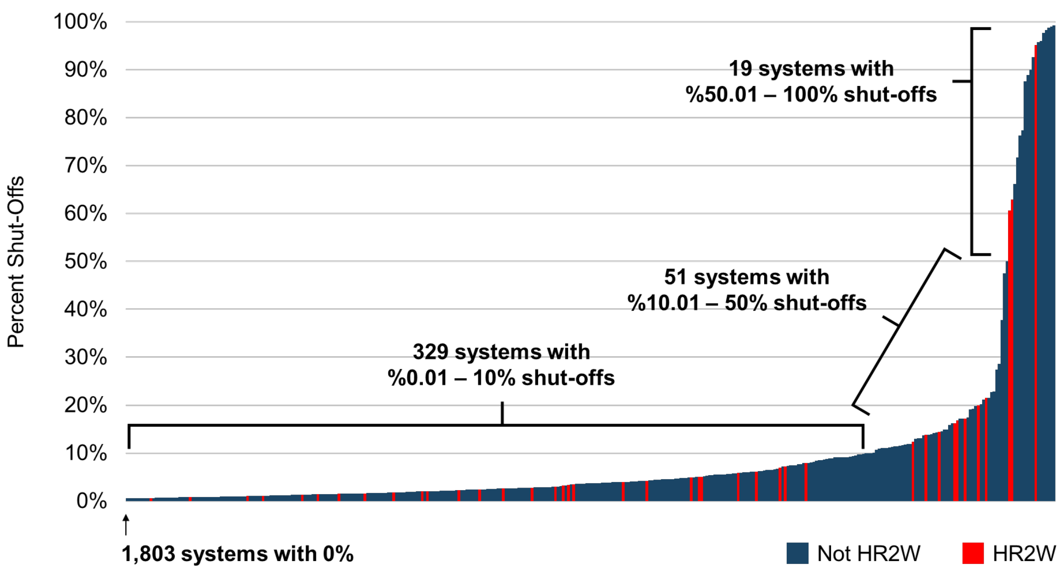
Risk Indicator Calculation Methodology:

- % Shut-Offs = ([Total Single-Family Shut-offs + Total Multi-Family Shut-offs] / Total Number of Service Connections) x 100

Threshold Determination

Data on the percent of customer accounts shut-off is available for 2,201 water systems. The minimum percentage of customer accounts shut-off was 0%, the maximum was 99%, and the average was 1.6%.

Figure A36: Percent Shut-Offs (n=2,201)



An indicator threshold for the percent of residential service connections shut-off due to non-payment, as defined here or a similar measure, has not to the State Water Board's knowledge been assessed in other previous studies as related to water system failure. However, a standard of zero has been employed by the State,[207] other regulatory agencies and stakeholders as a threshold of concern particularly during the COVID-19 pandemic. In addition to affordability concerns, high percentages of shut-offs may also negatively impact a water system's financial capacity.

Risk Indicator Scoring & Weighting

To enable the evaluation and comparison of risk indicators, a standardized scale between 0 and 1 for risk scores has been applied to each threshold. Public feedback during with Risk Assessment methodology development process indicated that some risk indicators should be weighted higher than others because they may be more "critical" as they relate to a water system's ability to stay in compliance. Risk indicator weights between 1 and 3 were applied to individual risk indicators. Based on feedback from the State Water Board's engineers, the maximum weight of 2 is applied to the "Percent Shut-Offs" risk indicator. Therefore, the minimum risk score is 0 and the maximum risk score is 2. Table A24 summarizes the thresholds, scores, and weight for this risk indicator.

Table A24: "Percent Shut-Offs" Thresholds & Scores

Threshold Number	Threshold	Score	Weight
0	**less than 10%** customer shut-offs over the last calendar year.	0	N/A
1	**10% or greater** customer shut-offs over the last calendar year.	1	2

Figure A37 shows 2,131 water systems (97%) had less than 10% of their customer account shut-off due to non-payment. 70 water systems (3%) meet Threshold 1 with 10% or greater customer accounts experiencing a shut-off due to non-payment.

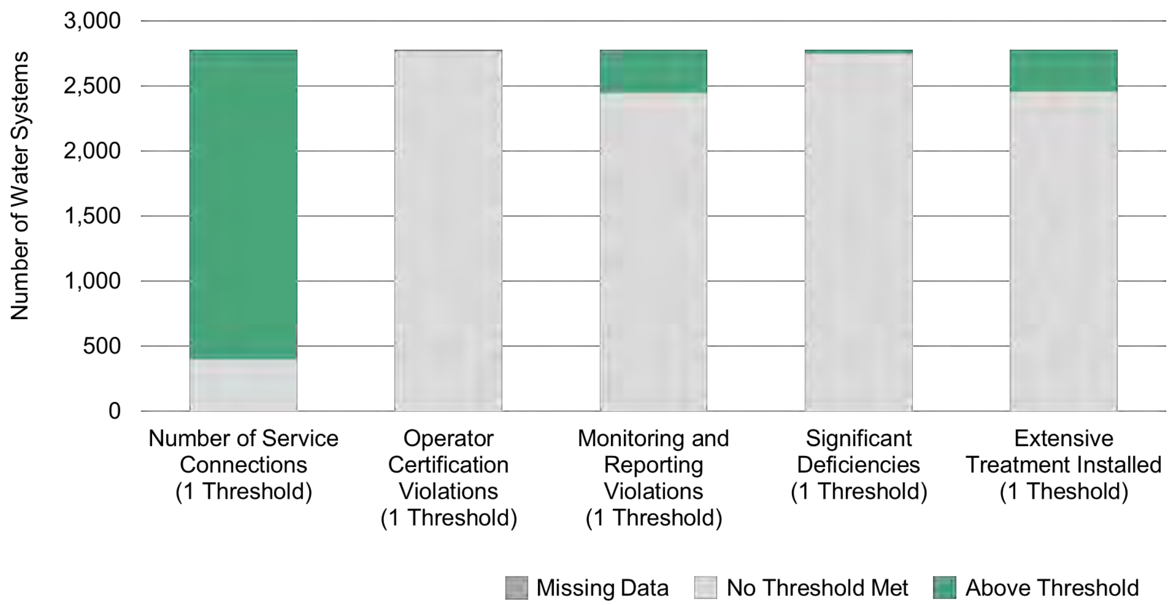
Figure A37: 2019 Percent Shut-Offs (n=2,201)

[207] Executive Order N-42-20
https://www.gov.ca.gov/wp-content/uploads/2020/04/4.2.20-EO-N-42-20-text.pdf

TMF CAPACITY RISK INDICATORS

This section provides full details on each TMF Capacity risk indicator used in the Risk Assessment. TMF Capacity risk indicators measure a system's technical, managerial and financial (TMF) capacity to plan for, achieve, and maintain long term compliance with drinking water standards, thereby ensuring the quality and adequacy of the water supply. Figure A38 illustrates the number of water systems that exceeded the risk indicator thresholds within the TMF Capacity category. The range of potential thresholds for each risk indicator are summarized in the respective risk indicator label and detailed below.

Figure A38: Number of Systems Exceeding Thresholds for Each TMF Capacity Risk Indicator



NUMBER OF SERVICE CONNECTIONS

This indicator measures the total number of customer service connections of the water system. Number of service connections may be used as a proxy to assess whether a water system has adequate financial capacity to support staff and budget.

Calculation Methodology
Required Risk Indicator Data Point & Source:

- Water System Details – Service Connection Count: SDWIS

Threshold Determination
Data for all 2,779 water systems was available to analyze Number of Service Connections. The minimum number of service connections found was one, the maximum number of service connections found was 3,300, and the average number of service connections found was

285.4. Several peer-reviewed studies suggest that a threshold of 500 connections for system connections is associated with water system failure.[208]

Figure A39: Number of Service Connections (n=2,779)

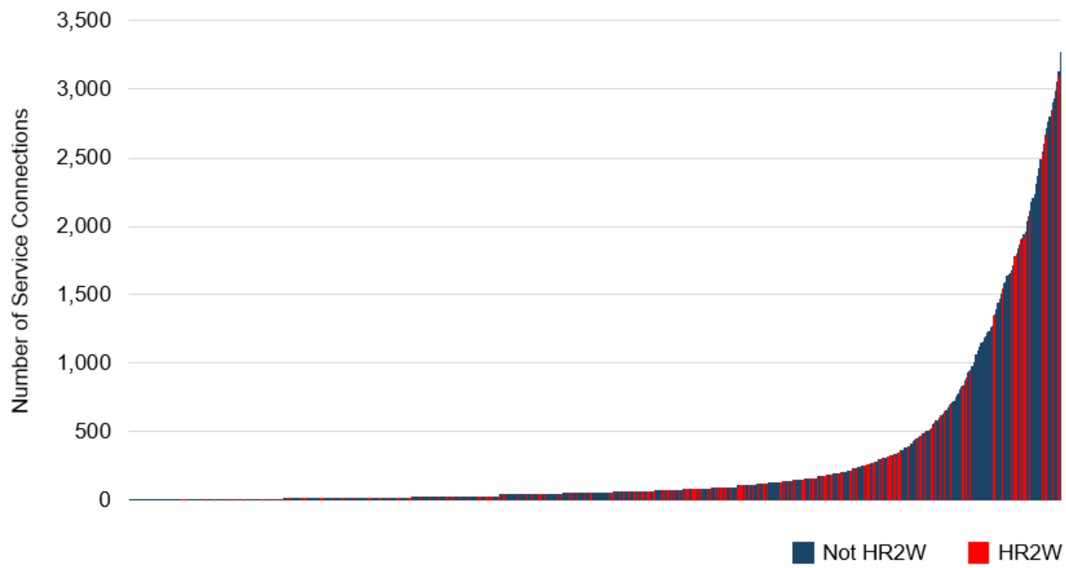
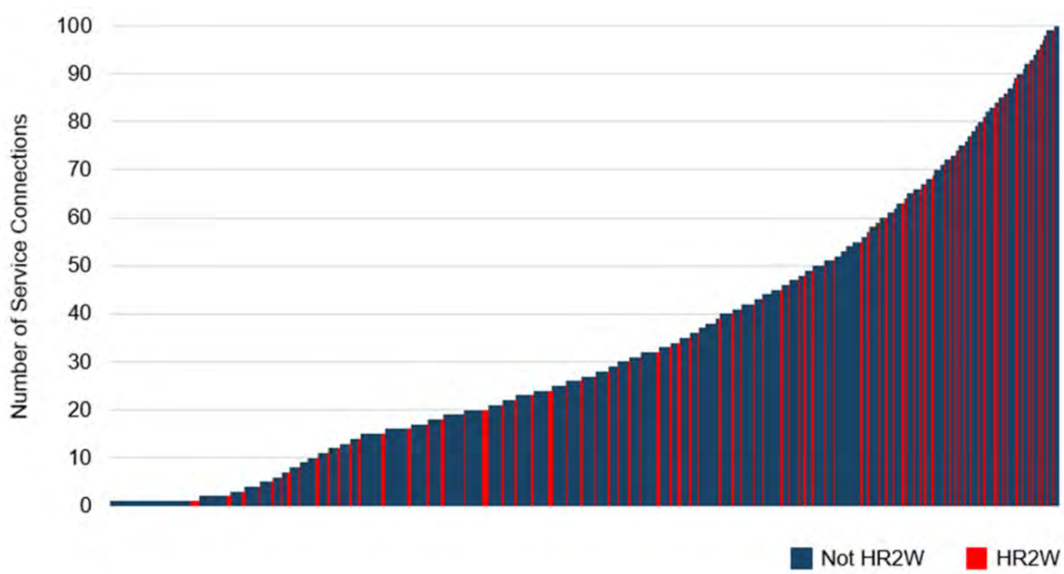


Figure A40: Number of Service Connections (0 – 100) (n=1,803)



[208] See Michielssen, S., Vedrin, M. C., & Guikema, S. D. (2020). Trends in microbiological drinking water quality violations across the United States. *Environmental Science: Water Research & Technology, 6*(11), 3091-3105; Oxenford, J. L., & Barrett, J. M. (2016). Understanding small water system violations and deficiencies. *Journal-American Water Works Association, 108*(3), 31-37.

Figure A41: Number of Service Connections (100 – 1,000) (n=713)

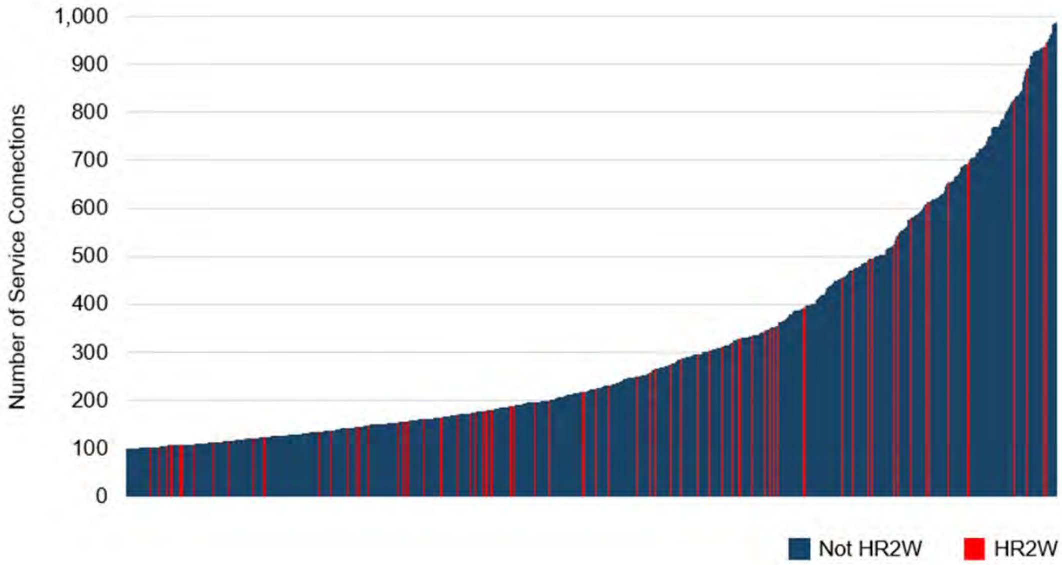
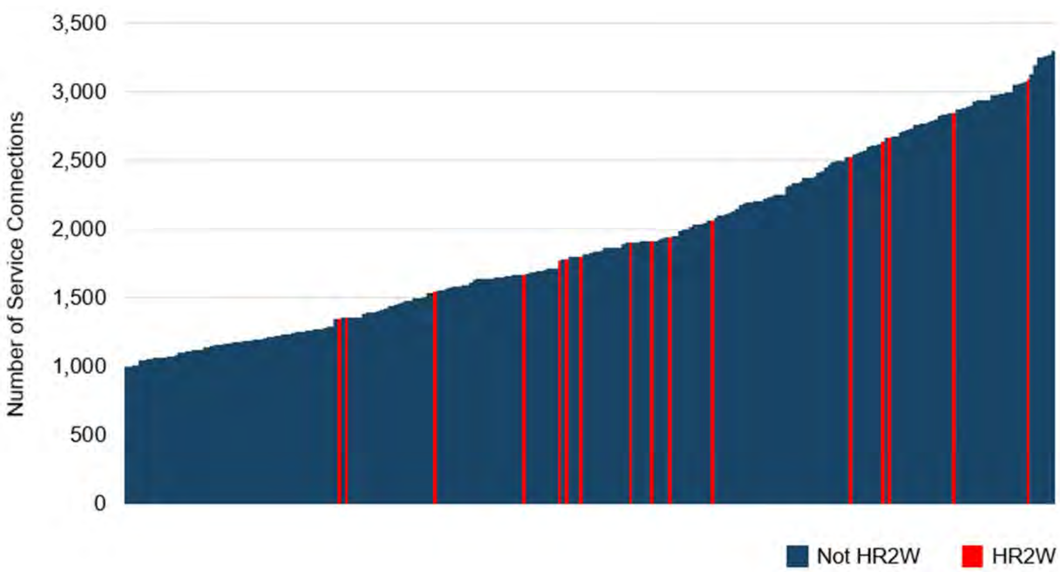


Figure A42: Number of Service Connections (1,000 – 3,300) (n=263)



Risk Indicator Scoring & Weighting

To enable the evaluation and comparison of risk indicators, a standardized scale between 0 and 1 for risk scores has been applied to each threshold. Public feedback during with Risk Assessment methodology development process indicated that some risk indicators should be weighted higher than others because they may be more "critical" as they relate to a water system's ability to stay in compliance. Risk indicator weights between 1 and 3 were applied to individual risk indicators. Based on feedback from the State Water Board's engineers, the maximum weight of 1 is applied to the "Number of Service Connections" risk indicator. Therefore, the minimum risk score is 0 and the maximum risk score is 1. Table A25 summarizes the thresholds, scores, and weight for this risk indicator.

Table A25: "Number of Service Connections" Thresholds & Scores

Threshold Number	Threshold	Score	Weight
0	**greater than 500** service connections.	0	N/A
1	**500 or less** service connections.	1	1

Figure A43 shows 402 water systems (14%) meet Threshold 0 of having 500 or more service connections. 2,377 water systems (86%) meet Threshold 1 of having 500 or fewer service connections.

Figure A43: Number of Service Connections (n=2,779)

OPERATOR CERTIFICATION VIOLATIONS

Failure to have an appropriately certified water treatment or distribution operator. A lack of adequately trained water treatment or distribution operators may be indicative of larger technical and managerial risks borne by the system. Research shows that poorly trained staff and managers working on water systems can result in avoidable waterborne disease outbreaks. Chief and shift operators must possess valid operator certificates pursuant to CCR Sections 63765 and 63770.

Calculation Methodology

Required Risk Indicator Data Point & Source:

- Operator Certification Violations: SDWIS Violation Codes:
  - 12
  - OP

Risk Indicator Methodology:

- Determine which systems have had an Operator Certification Violation within the last three years.
    - Systems that are currently out of compliance or have returned to compliance are included.

Threshold Determination

Data on operator certification violations is available for 2,850 water systems. An analysis of the counts of operator certification violations over the last three years finds no violations when an open enforcement action. The systems that have had an operator certification violation over the last three years have only had one violation each during this time period.

Peer-reviewed studies suggest that the absence of a certified operator is associated with water system failure.[209] Moreover, operator certification violations are an established threshold for additional regulatory oversight by states such as Illinois.[210] Therefore a threshold of 1 or more operator certification violations over the last three years was determined.

Risk Indicator Scoring & Weighting

To enable the evaluation and comparison of risk indicators, a standardized scale between 0 and 1 for risk scores has been applied to each threshold. Public feedback during with Risk Assessment methodology development process indicated that some risk indicators should be weighted higher than others because they may be more "critical" as they relate to a water system's ability to stay in compliance. Risk indicator weights between 1 and 3 were applied to individual risk indicators. Based on feedback from the State Water Board's engineers, the maximum weight of 3 is applied to the "Operator Certification Violations" risk indicator. Therefore, the minimum risk score is 0 and the maximum risk score is 3. Table A26 summarizes the thresholds, scores, and weight for this risk indicator.

Table A26: "Operator Certification Violations" Thresholds & Scores

Threshold Number	Threshold	Score	Weight
0	**0** Operator Certification violations over the last three years.	0	N/A
1	**1 or more** Operator Certification violations over the last three years.	1	3

Figure A26 shows there are 2,767 water systems (>99%) which have had 0 operator certification violations over the last three years. There are 12 water systems (<1%) that meet Threshold 1 for having one or more violations in the last three years.

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[209] See Oxenford, J. L., & Barrett, J. M. (2016). Understanding small water system violations and deficiencies. *Journal-American Water Works Association, 108*(3), 31-37.

[210] Office of the Illinois State Fire Marshal (2012.). "Notification of New NOV for Operator Certification Violations." Retrieved from: https://www2.illinois.gov/sites/sfm/SFMDocuments/Documents/NoticeRedTagOperators.pdf

Figure A44: Operator Certification Violations (n=2,779)

MONITORING & REPORTING VIOLATIONS

A water system is required to monitor and verify that the levels of contaminants present in the drinking water supplies do not exceed an MCL. A monitoring violation occurs when a water system fails to have its water tested as required within the required time frame. A water system that fails to perform required monitoring for a group of chemicals (such as synthetic organic chemicals or volatile organic chemicals) would incur a monitoring violation for each of the individual chemicals within the group.

A reporting violation occurs when a water system fails to report test results in a timely manner to the regulatory agency or fails to provide certification that mandated information was provided to the public, such as through the issuance of a public notice or the annual Consumer Confidence Report. A system may also receive a reporting violation for not submitting an Annual Report the State Water Board.

This indicator measures the total number of monitoring and reporting violations during a 3-year compliance cycle.

Calculation Methodology
Required Risk Indicator Data Point & Source:

- Monitoring and Reporting violations: SDWIS

Table A27: Monitoring & Reporting Violation Codes

Violation Type Code	SDWIS Violation Name
03	Monitoring, Regular
04	Monitoring, check, repeat, or confirmation
19	Failure to Conduct Assessment Monitoring
23	Monitoring, Routine Major (TCR)
24	Monitoring, Routine Minor (TCR)
25	Monitoring, Repeat Major (TCR)
26	Monitoring, Repeat Minor (TCR)

Violation Type Code	SDWIS Violation Name
27	Monitoring, Routine (DBP)
29	Failure Submit Filter Profile/CPE Report
30	Monitoring, Routine (IDSE)
31	Monitoring of Treatment (SWTR-Unfilt/GWR)
32	Monitoring, Source Water (LT2)
34	Monitoring, Source Water (GWR)
35	Failure Submit IDSE/Subpart V Plan Rpt
36	Monitoring of Treatment (SWTR-Filter)
38	Monitoring, Turbidity (Enhanced SWTR)
39	Monitoring and Reporting (FBRR)
51	Initial Tap Sampling for Pb and CU
52	Follow-Up or Routine LCR Tap M/R
53	Water Quality Parameter M/R
56	Initial, Follow-Up, or Routine SOWT M/R
66	Lead Consumer Notification
3A	Routine Monitoring
3B	Additional Routine Monitoring
3C	TC Samples (triggered by turbidity exceedance) Monitoring
3D	Monitoring, Lab Cert/Method Errors
4A	Assessment Forms Reporting
4B	Sample Result/Fail to Monitor Reporting
4C	Start-up Procedures Certification Form Reporting
4D	EC+ Notification Reporting
4E	E. coli MCL Reporting
4F	L1/L2 TT Vio or Correct Action Reporting
S1	State Violation-M&R (Major)
AR	Failure to Complete an Annual Report
RR	State Reporting Requirement Violation (review in one year for lead service line replacement)

Risk Indicator Methodology:

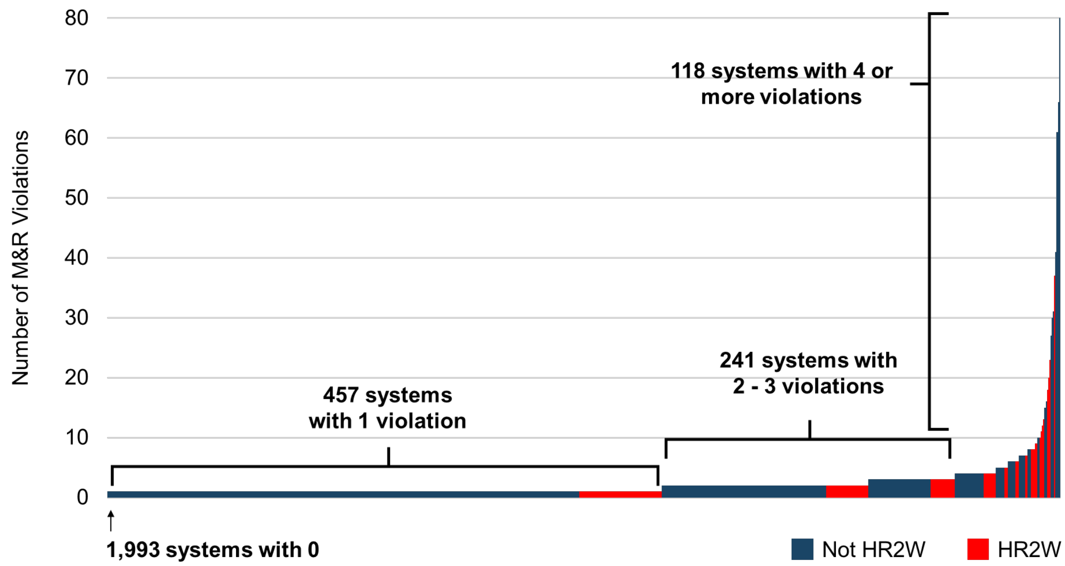
- Determine which systems have had Monitoring & Reporting violations over the last 3-year compliance period using the Monitoring & Reporting violation codes in Table B24. This excludes MCL and TT related Monitoring & Reporting violations described below that are included in the expanded HR2W list criteria:

- System that have three or more Monitoring and Reporting violations within the last three years where at least one violation has an Enforcement Action that has been open for 15 months or greater.

Threshold Determination

Data on Monitoring and Reporting violations is available for 2,779 water systems. An analysis of the counts of Monitoring & Reporting violations over the last three years finds the minimum number of Monitoring & Reporting violations as 0, the maximum as 85, and the average of 0.7 per system.

Figure A45: Monitoring & Reporting Violations Over the Last 3 Years (n=2,779)



The State Water Board has developed a threshold for Monitoring & Reporting violations (related to an MCL or Treatment Technique) as criteria for the HR2W list. The HR2W list criteria threshold is three or more MCL/TT-related Monitoring & Reporting violations within the last three years where at least one violation has an open enforcement action greater than 15 months. For the Risk Assessment, the State Water Board and UCLA developed a slightly modified version of the HR2W list criteria threshold. Systems that have had two or more Monitoring & Reporting violations over the last three years are more at-risk.[211]

Moreover, correlation and regression analysis between the indicator threshold and water system failure definition employed in Risk Assessment 1.0 shows a statistically significant relationship.

Risk Indicator Scoring & Weighting

To enable the evaluation and comparison of risk indicators, a standardized scale between 0 and 1 for risk scores has been applied to each threshold. Public feedback during with Risk Assessment methodology development process indicated that some risk indicators should be weighted higher than others because they may be more "critical" as they relate to a water

[211] Systems that meet the HR2W criteria will not be included in the Risk Assessment.

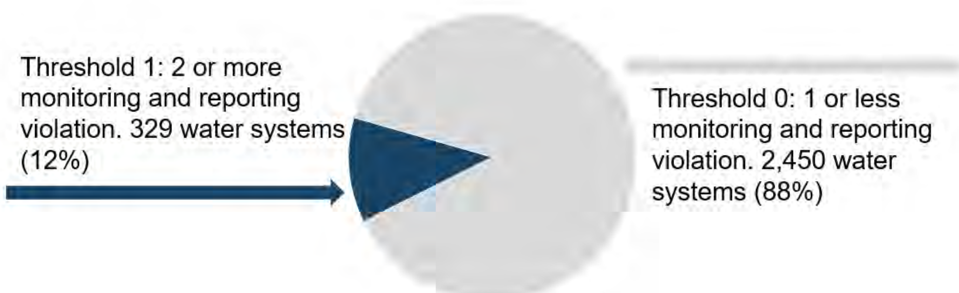
system's ability to stay in compliance. Risk indicator weights between 1 and 3 were applied to individual risk indicators. Based on feedback from the State Water Board's engineers, the maximum weight of 2 is applied to the "Monitoring and Reporting Violations" risk indicator. Therefore, the minimum risk score is 0 and the maximum risk score is 2. Table A28 summarizes the thresholds, scores, and weight for this risk indicator.

Table A28: "Monitoring and Reporting Violations" Thresholds & Scores

Threshold Number	Threshold	Score	Weight
0	**1 or less** Monitoring & Reporting violations over the last three years.	0	N/A
1	**2 or more** Monitoring & Reporting violations over the last three years.	1	2

Figure A46 shows 2,450 water systems (88%) have had 1 or fewer Monitoring & Reporting violations. 329 water systems (12%) meet Threshold 1 of having 2 or more Monitoring & Reporting violations.

Figure A46: Monitoring and Reporting Violations (n=2,779)



SIGNIFICANT DEFICIENCIES

Significant Deficiencies are identified by State Water Board staff or a Local Primacy Agency (LPA) 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. Significant Deficiencies can be identified for both groundwater and surface water systems, although the compliance deadlines and requirements differ depending on the applicable rule (Groundwater Rule vs. Long Term 2 Enhanced Surface Water Treatment [LT2] Rule).

State Water Board and LPA staff must enter these deficiencies into SDWIS and must follow-up on the addressing actions taken by the water system to correct the deficiencies. The State

Water Board and LPA must provide written notification of a Significant Deficiency within 30 days and require the water system to respond within 30 days with a correction action plan. Scheduled return to compliance dates should be noted in the plan and approved by the State Water Board or LPA. The water system must implement the appropriate corrective action within 120 days of notification or be in compliance with a State-approved plan for correcting the deficiency at the end of the same 120-day period. The State Water Board and LPAs must then confirm that the deficiency has been addressed within 30 days after the scheduled date of correction.

A water system can incur a violation for failing to respond to or correct a Significant Deficiency (Title 22 CCR § 64430 and 40 CFR § 141.404 (s) for systems subject to the Groundwater Rule, or Title 22 CCR § 64650(f) and 40 CFR § 141.723 having for systems subject to LT2 Rule). The State Water Board and LPAs may take additional enforcement action as necessary to correct the deficiency.

Calculation Methodology
Required Risk Indicator Data Point & Source:

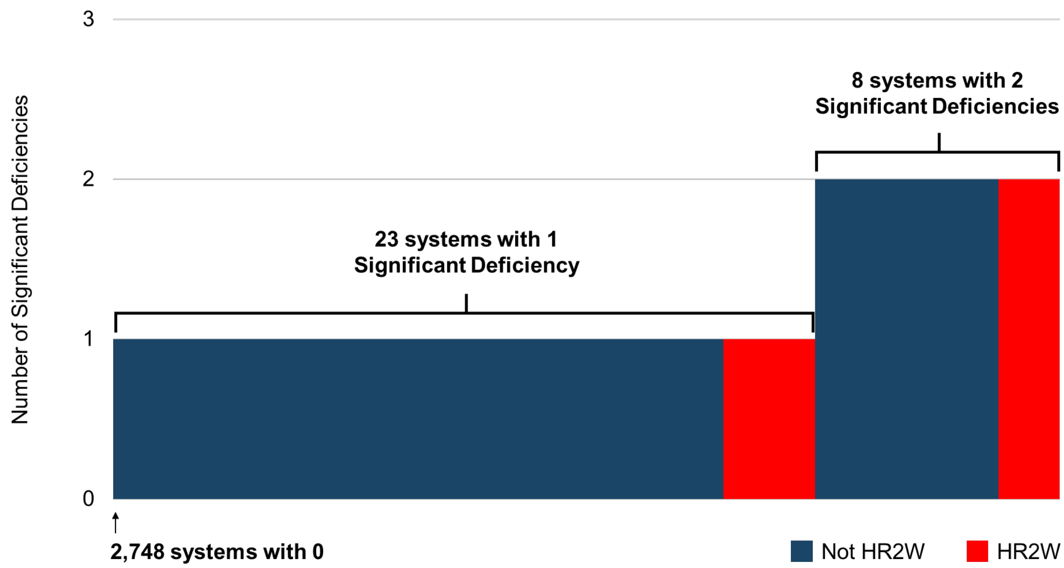
- Significant Deficiencies: Table in SDWIS with a SIG (Significant) severity designation

Risk Indicator Calculation Methodology:

- Determine which systems have had a Significant Deficiency **within the last three years** using the visit date in SDWIS (date the State Water Board became aware of the Significant Deficiency).
    - Systems that are currently out of compliance or have returned to compliance are included.

Threshold Determination
Data on Significant Deficiencies is available for 2,779 water systems. The minimum number of Significant Deficiencies found is 0, the maximum number found is 2, and the average number of Significant Deficiencies found is 0.01. 23 water systems had 1 significant deficiency and 8 water systems had 2 significant deficiencies.

Figure A47: Significant Deficiencies Within the Last 3 Years (n=2,779)



As described above, the presence of Significant Deficiencies has already been defined as a threshold for State Water Board action. Moreover, peer-reviewed studies suggest that the presence of Significant Deficiencies is associated with water system failure.[212] Finally, similar measures of significant deficiencies are used as an established threshold of concern by states such as Alaska and Nevada,[213] Connecticut,[214] and New Mexico,[215] among others. Therefore, the threshold of one or more Significant Deficiencies within the last three years has been determined to be an appropriate threshold for risk.

Risk Indicator Scoring & Weighting

To enable the evaluation and comparison of risk indicators, a standardized scale between 0 and 1 for risk scores has been applied to each threshold. Public feedback during with Risk Assessment methodology development process indicated that some risk indicators should be weighted higher than others because they may be more "critical" as they relate to a water system's ability to stay in compliance. Risk indicator weights between 1 and 3 were applied to individual risk indicators. Based on feedback from the State Water Board's engineers, the

[212] See Oxenford, J. L., & Barrett, J. M. (2016). Understanding small water system violations and deficiencies. Journal-American Water Works Association, 108(3), 31-37.

[213] State Strategies to Assist Public Water Systems in Acquiring and Maintaining Technical, Managerial, and Financial Capacity." Retrieved from: https://books.google.com/books?id=MK64VtYz-SsC&printsec=frontcover&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false

[214] Systems that meet the HR2W criteria will not be included in the Risk Assessment. McPhee, Eric (n.d.). "Significant Deficiencies." Connecticut Department of Public Health: Drinking Water Division. Retrieved from: https://portal.ct.gov/-/media/Departments-and-Agencies/DPH/dph/drinking_water/pdf/CTAWWAGWRTraining2009SigDefpdf.pdf?la=en

[215] New Mexico Environment Department: Drinking Water Bureau (2016). "Surface Water Rule and Interim Enhanced Surface Water Treatment Rule: Significant Deficiency Policy." Retrieved from: https://www.env.nm.gov/wp-content/uploads/sites/5/2018/11/RE_Surface-Water-Rule-Significant-Deficiency_Policy_020816.pdf

maximum weight of 3 is applied to the “Significant Deficiencies” risk indicator. Therefore, the minimum risk score is 0 and the maximum risk score is 3. Table A29 summarizes the thresholds, scores, and weight for this risk indicator.

Table A29: “Significant Deficiencies” Thresholds & Scores

Threshold Number	Threshold	Score	Weight
0	**0** Significant Deficiencies over the last three years.	0	N/A
1	**1** or more Significant Deficiencies over the last three years.	1	3

Figure A48 shows 2,748 water systems (99%) have had no Significant Deficiencies in the last three years. 31 water systems (1%) meet Threshold 1 of having 1 or more Significant Deficiency in the last three years.

Figure A48: Significant Deficiencies (n=2,779)

EXTENSIVE TREATMENT INSTALLED

Extensive Treatment Installed is when one or more of the following conditions are met:

- Groundwater source(s) necessitating the use of a treatment plant that has a treatment facility classification of T3 or higher.
- Surface water quality necessitating a surface water treatment plant.

In accordance with CCR Section 64413.1, water treatment facility operator certification grades are based on a classification of system that stresses influent water quality (e.g. influent turbidity, microbial quality and MCL compliance), treatment complexity, and the population supplied by the treatment plant based on facility flows greater than 2 million gallons per day. Water systems serving less than 3,300 connections are unlikely to have water treatment plants that exceed 2 million gallons per day. Therefore, facility certification level at this size range focuses on the risks associated with poor raw water quality and treatment complexity. Water treatment facilities with operator certification grades T3, T4, and T5 are also relatively expensive compared to lower certification facilities, particularly when there is a small rate base to distribute the cost of treatment. Furthermore, the threat to customers if failure occurs is greater if the source water is significantly impaired and required extensive treatment.

Calculation Methodology

Required Risk Indicator Data Points & Sources:

- Federal Primary Source Type: SDWIS
  - GW – Groundwater
  - GU – Ground water under direct influence of surface water (Consider to be ground water)
  - GWP – Purchased Ground water under direct influence of surface water (Consider to be ground water)
  - SW – Surface Water
  - SWP – Purchased Surface Water

- Operating Category Code: SDWIS
  - T3: Treatment plants requiring a Treatment Operator Certification Grade 3
  - T4: Treatment plants requiring a Treatment Operator Certification Grade 4
  - T5: Treatment plants requiring a Treatment Operator Certification Grade 5

Risk Indicator Calculation Methodology:

- Water Systems where split into two groups based on their Federal Primary Source Type:
  - Group 1 – Groundwater systems – included the following SDWIS categories: GU, GW, and GWP.
  - Group 2 – Surface water systems – included the following SDWIS categories: SW and SWP.

- For groundwater systems, the maximum treatment classification was identified and any systems with T3, T4, or T5 treatment plants were considered as having extensive treatment.
  - There were also 14 systems that were found to have missing treatment classifications associated with their treatment plants and a system represented was contacted to get those missing classifications. In the end only one additional system was identified as having a level T3 treatment plant.

- For surface water systems, several methods were implored to determine if the systems had extensive treatment installed.
  - Surface water systems with intakes were considered to have extensive treatment installed.
  - Surface water systems that had no intakes but received raw surface water from an intertie were identified and considered to have extensive treatment installed. Some interties were incorrectly identified as not receiving treatment, but after further review were found to have extensive treatment installed.

Threshold Determination

Data on extensive treatment installed is available for 2,850 water systems. There is a minimum of 0 extensive treatment installed, a maximum of 1 extensive treatment installed, and an average of 0 across the data set.

Risk Indicator Scoring & Weighting

To enable the evaluation and comparison of risk indicators, a standardized scale between 0 and 1 for risk scores has been applied to each threshold. Public feedback during with Risk Assessment methodology development process indicated that some risk indicators should be weighted higher than others because they may be more “critical” as they relate to a water system’s ability to stay in compliance. Risk indicator weights between 1 and 3 were applied to individual risk indicators. Based on feedback from the State Water Board’s engineers, the maximum weight of 2 is applied to the “Extensive Treatment Installed” risk indicator. Therefore, the minimum risk score is 0 and the maximum risk score is 2. Table A30 summarizes the thresholds, scores, and weight for this risk indicator.

Table A30: “Extensive Treatment Installed” Thresholds & Scores

Threshold Number	Threshold	Score	Weight
0	**No** extensive treatment installed.	0	N/A
1	**Yes,** extensive treatment is installed.	1	2

Figure 49 shows 2,456 water systems (88%) have no extensive treatment installed, whereas 323 water systems (12%) meet Threshold 1 of having extensive treatment installed.

Figure A49: Extensive Treatment Installed (n=2,779)

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

INTRODUCTION

The aquifer risk map was developed to fulfill requirements of Senate Bill (SB 200, Monning, 2019), and is a component of California's Safe and Affordable Fund for Equity and Resilience (SAFER) Program. The aquifer risk map is intended to help prioritize areas where domestic wells and state small water systems may be accessing groundwater that does not meet primary drinking water standards (maximum contaminant level or MCL). In accordance with SB 200, the risk map is available to the public and is to be updated annually starting January 1, 2021. SB 200 also requires that a Fund Expenditure Plan be developed annually. The Fund Expenditure Plan states that the risk map will be used by Water Board staff to help prioritize areas for available SAFER funding.

The aquifer risk map contains several data layers. The **water quality risk layer** compiles available de-clustered, depth-filtered water quality results, applies risk factors to those data, and ranks, by percentile, the relative risk of groundwater in an area not meeting primary drinking water standards. The **domestic well density layer** plots the density of domestic wells based on available well record data.[216] The **state small water system layer** shows the locations of state small water systems, based on data provided by counties and other oversight agencies.[217] The **combined risk layer** combines the water quality risk ranking with the domestic well and state small system density of an area to calculate the overall risk to domestic well and state small systems. By combining these two data elements, areas with a relatively high density of reported domestic wells or state small water systems, and a high relative risk to water quality, are assigned the highest combined risk. Other **reference layers** that can be overlaid on the map for reference include boundaries of priority areas in the Central Valley CV-SALTS program, Groundwater Sustainability Agency boundaries, and Disadvantaged Community status data.

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[216] The well record information is from the Department of Water Resources Online System for Well Completion Reports.
https://dwr.maps.arcgis.com/apps/webappviewer/index.html?id=181078580a214c0986e2da28f8623b37

[217] The small water system location data may not represent the actual location of the well head or of the service boundaries. Due to constraints in locating small water systems, the location may represent the administrative address, or another location associated with the system. Additionally, the locations for Monterey County were provided for all systems with 2 – 14 connections. To isolate the systems in Monterey County that fit the definition of state small water systems (5 – 14 connections) only systems that serve four or more APNs were included in this analysis (totaling 268 systems in Monterey County).

RISK ASSESSMENT METHODOLOGY DEVELOPMENT PROCESS

Three public webinars were held by the State Water Board over the course of 2020 to solicit public feedback on the development of the aquifer risk map. The first webinar on April 17, 2021 involved the presentation of available data, previous work, and information about the initial map development. The second webinar on July 22, 2020 presented several draft methodologies and the initial results. The third webinar on October 9, 2020 presented the final draft methodology. All three webinars were held remotely over Zoom and included opportunities for public participants to ask questions directly during the meeting or to submit questions via email during or after the meeting.

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 on January 18, 2019.

INTENDED USE OF THIS ANALYSIS

The water quality risk ranking 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 to inform additional investigation and sampling efforts. The current lack of available domestic well and state small system water quality data makes it impossible to characterize the water quality for individual domestic wells and state small systems. The analysis described here thus represents a best effort at using the available data to estimate water quality risk for domestic wells and state small systems.

METHODOLOGY

DATA PROCESSING

Water quality results from 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, and the Irrigated Lands Regulatory Program (AGLAND) were included in this analysis. Water quality data from most regulated clean-up and monitoring sites (Geotracker) were not included in this analysis as these data were not considered to be representative of groundwater typically accessed by domestic wells. Results were only included if the well met the depth-filtering criteria developed in the Domestic Well Needs Assessment project. 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[218]. Water quality results were converted to an MCL Index[219] to allow comparison between chemical constituents (see Table B1 for chemical constituent codes and MCL values). A more detailed presentation of data collection, data standardization, and data filtering are outlined in the Needs Assessment Domestic Well Water Quality Tool White Paper.[220] The R script used to download, process, and filter the water quality data is available on GitHub.[221]

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)	UG/L	70	MCL
AL	Aluminum	UG/L	1000	MCL
ALACL	Alachlor	UG/L	2	MCL
ALPHA	Gross Alpha radioactivity	pCi/L	15	MCL
AS	Arsenic	UG/L	10	MCL
ATRAZINE	Atrazine	UG/L	1	MCL
BA	Barium	MG/L	1	MCL
BDCME	Bromodichloromethane (THM)	UG/L	80	MCL
BE	Beryllium	UG/L	4	MCL
BETA	Gross beta	pCi/L	50	MCL
BHCGAMMA	Lindane (Gamma-BHC)	UG/L	0.2	MCL
BIS2EHP	Di(2-ethylhexyl)phthalate (DEHP)	UG/L	4	MCL
BRO3	Bromate	UG/L	10	MCL
BTZ	Bentazon	UG/L	18	MCL
BZ	Benzene	UG/L	1	MCL
BZAP	Benzo(a)pyrene	UG/L	0.2	MCL

218 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.

219 See page 5 of the Domestic Well Needs Assessment White Paper. 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.

220 GAMA Needs Assessment White Paper-Draft
https://gispublic.waterboards.ca.gov/portal/home/item.html?id=70feb9f4b00f4b3384a9a0bf89f9f18a

221 Methodology script (GitHub)

https://github.com/EmilyHoulihan/Aquifer_Risk_Map

Chemical Abbreviation (Web Tool)	Chemical Name	Units	Comparison Concentration Value	Comparison Concentration Type
BZME	Toluene	UG/L	150	MCL
CD	Cadmium	UG/L	5	MCL
CHLORDANE	Chlordane	UG/L	0.1	MCL
CHLORITE	Chlorite	MG/L	1	MCL
CLBZ	Chlorobenzene	UG/L	70	MCL
CN	Cyanide (CN)	UG/L	150	MCL
CR	Chromium	UG/L	50	MCL
CR6	Chromium, Hexavalent (Cr6)	UG/L	10	Temporary comparison level*
CRBFN	Carbofuran	UG/L	18	MCL
CTCL	Carbon Tetrachloride	UG/L	0.5	MCL
CU	Copper	MG/L	1.3	Action Level
DALAPON	Dalapon	UG/L	200	MCL
DBCME	Dibromochloromethane (THM)	UG/L	80	MCL
DBCP	1,2-Dibromo-3-chloropropane (DBCP)	UG/L	0.2	MCL
DCA11	1,1-Dichloroethane (1,1 DCA)	UG/L	5	MCL
DCA12	1,2 Dichloroethane (1,2 DCA)	UG/L	0.5	MCL
DCBZ12	1,2 Dichlorobenzene (1,2-DCB)	UG/L	600	MCL
DCBZ14	1,4-Dichlorobenzene (p-DCB)	UG/L	5	MCL
DCE11	1,1 Dichloroethylene (1,1 DCE)	UG/L	6	MCL
DCE12C	cis-1,2 Dichloroethylene	UG/L	6	MCL
DCE12T	trans-1,2, Dichloroethylene	UG/L	10	MCL
DCMA	Dichloromethane (Methylene Chloride)	UG/L	5	MCL
DCP13	1,3 Dichloropropene	UG/L	0.5	MCL
DCPA12	1,2 Dichloropropane (1,2 DCP)	UG/L	5	MCL
DINOSEB	Dinoseb	UG/L	7	MCL
DIQUAT	Diquat	UG/L	20	MCL

Chemical Abbreviation (Web Tool)	Chemical Name	Units	Comparison Concentration Value	Comparison Concentration Type
DOA	Di(2-ethylhexyl)adipate	MG/L	0.4	MCL
EBZ	Ethylbenzene	UG/L	300	MCL
EDB	1,2 Dibromoethane (EDB)	UG/L	0.05	MCL
ENDOTHAL	Endothall	UG/L	100	MCL
ENDRIN	Endrin	UG/L	2	MCL
F	Fluoride	MG/L	2	MCL
FC11	Trichlorofluoromethane (Freon 11)	UG/L	150	MCL
FC113	1,1,2-Trichloro-1,2,2-Trifluoroethane (Freon 113)	MG/L	1.2	MCL
GLYP	Glyphosate (Round-up)	UG/L	700	MCL
H-3	Tritium	pCi/L	20000	MCL
HCCP	Hexachlorocyclopentadiene	UG/L	50	MCL
HCLBZ	Hexachlorobenzene (HCB)	UG/L	1	MCL
HEPTACHLOR	Heptachlor	UG/L	0.01	MCL
HEPT-EPOX	Heptachlor Epoxide	UG/L	0.01	MCL
HG	Mercury	UG/L	2	MCL
MOLINATE	Molinate	UG/L	20	MCL
MTBE	MTBE (Methyl-tert-butyl ether)	UG/L	13	MCL
MTXYCL	Methoxychlor	UG/L	30	MCL
NI	Nickel	UG/L	100	MCL
NNSM	N-Nitrosodimethylamine (NDMA)	UG/L	0.01	NL
NO2	Nitrite as N	MG/L	1	MCL
NO3N	Nitrate as N	MG/L	10	MCL
OXAMYL	Oxamyl	UG/L	50	MCL
PB	Lead	UG/L	15	Action Level
PCA	1,1,2,2 Tetrachloroethane (PCA)	UG/L	1	MCL
PCATE	Perchlorate	UG/L	6	MCL
PCB1016	Polychlorinated Biphenyls (PCBs)	UG/L	0.5	MCL
PCE	Tetrachloroethene (PCE)	UG/L	5	MCL
PCP	Pentachlorophenol (PCP)	UG/L	1	MCL

Chemical Abbreviation (Web Tool)	Chemical Name	Units	Comparison Concentration Value	Comparison Concentration Type
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	UG/L	6	MCL
SE	Selenium	UG/L	50	MCL
SILVEX	2,4,5-TP (Silvex)	UG/L	50	MCL
SIMAZINE	Simazine	UG/L	4	MCL
SR-90	Strontium 90	pCi/L	8	MCL
STY	Styrene	UG/L	100	MCL
TBME	Bromoform (THM)	UG/L	80	MCL
TCA111	1,1,1-Trichloroethane	UG/L	200	MCL
TCA112	1,1,2-Trichloroethane	UG/L	5	MCL
TCB124	1,2,4- Trichlorobenzene (1,2,4 TCB)	UG/L	5	MCL
TCDD2378**	2,3,7,8-Tetrachlorodibenzodioxin (Dioxin)	UG/L	3.00E-05	MCL
TCE	Trichloroethene (TCE)	UG/L	5	MCL
TCLME	Chloroform (THM)	UG/L	80	MCL
TCPR123	1,2,3-Trichloropropane (1,2,3 TCP)	UG/L	0.005	MCL
THIOBENCARB	Thiobencarb	UG/L	70	MCL
THM	Total Trihalomethanes	UG/L	80	MCL
TL	Thallium	UG/L	2	MCL
TOXAP	Toxaphene	UG/L	3	MCL
U	Uranium	pCi/L	20	MCL
VC	Vinyl Chloride	UG/L	0.5	MCL
XYLENES	Xylenes (total)	UG/L	1750	MCL

* Since there is currently no MCL for Hexavalent Chromium (CR6), 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[222] based on Total Completed Depth statistics from the 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 1). 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.[223]

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[222] This project uses Groundwater Units as areas of analysis. Groundwater Units consist of groundwater basins as defined by DWR Bulletin 118, and the connecting upland areas associated with each of these basins as delineated by the USGS. 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.
https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Bulletin-118/Files/B118-Interim-Update-2016.pdf
https://www.sciencedirect.com/science/article/pii/S2214581814000305?via%3Dihub

[223] 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 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.

Figure B1: Numeric Depth Filter

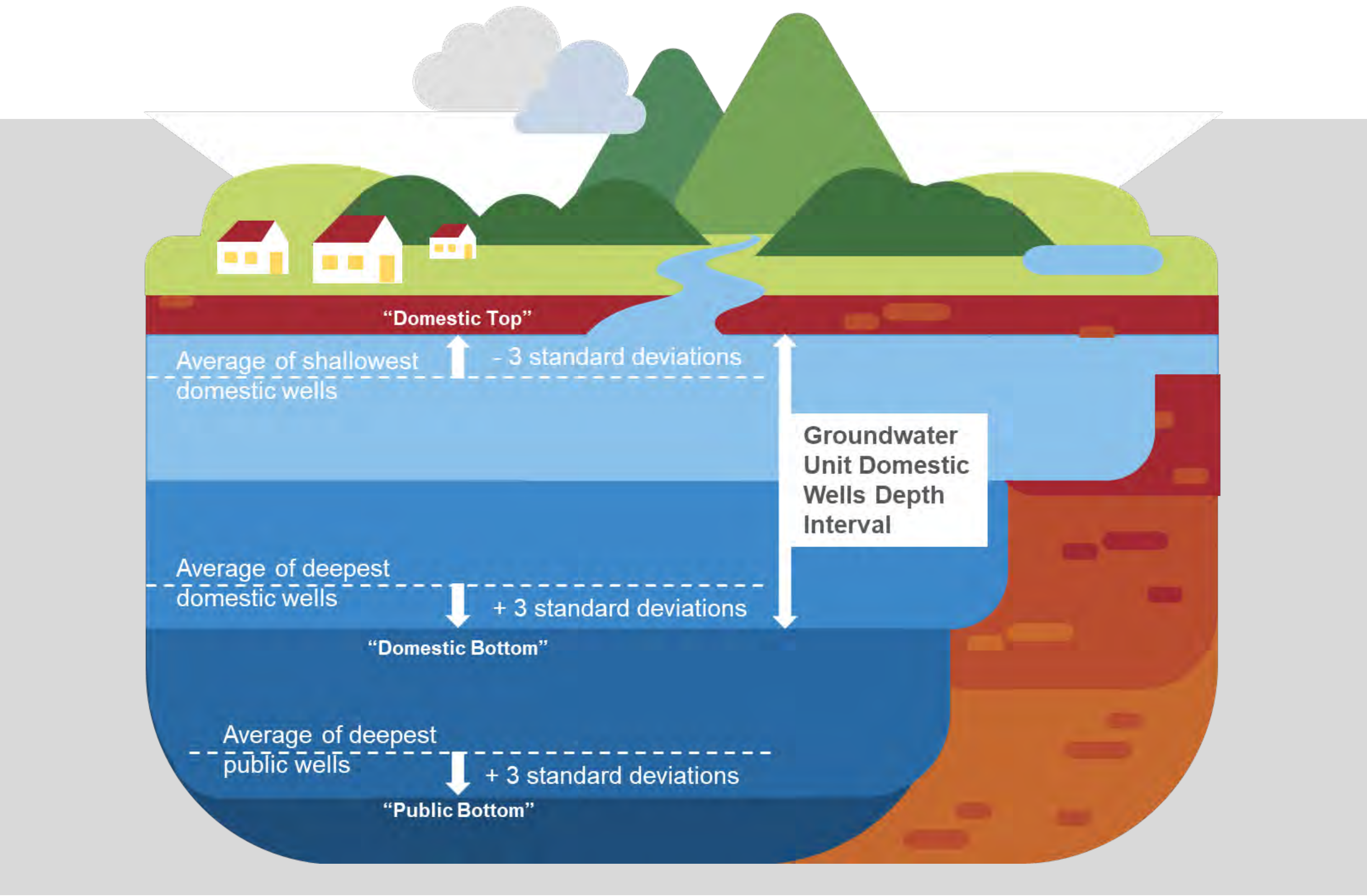
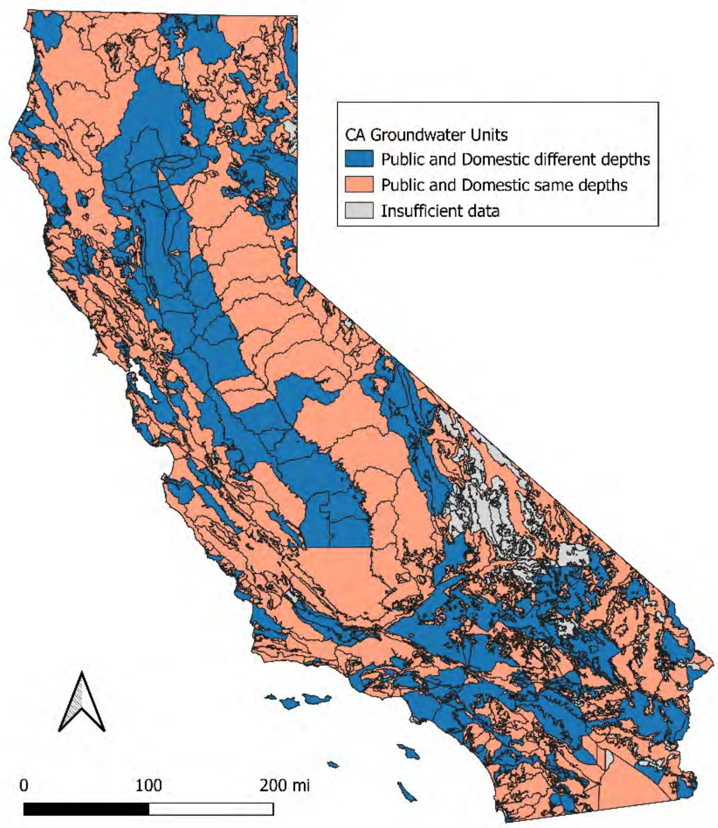


Figure B2 illustrates the depth filter by well type (for wells with unknown depth) in California. This map shows basins where domestic wells and public wells may be accessing similar groundwater depths (pink) and basins where domestic wells and public wells are accessing different groundwater depths (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[224] and “Domestic Top” depth[225]. For Group 1 wells, if the given depth of the well fell between the “Domestic Top”

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

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

depth and the “Domestic Bottom” depth, water quality data from that well was included in the analysis.

WELLS WITH UNKNOWN NUMERIC DEPTHS

Staff used OSWCR well depth information to compare “Domestic Bottom” depth (defined above) to “Public Bottom” depth[226] (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[227]) average and all recent results (within 2 years[228]). The temporal and spatial de-clustering methodology for each metric is outlined below and is further described in the Domestic Well Needs Assessment White Paper.[229]

LONG-TERM AVERAGE

1. Water quality results from each well for each chemical constituent are averaged per year (for the past 20 years).
2. The results from step one are averaged per well.
3. The results from step two are averaged for all the wells that lie within a section.

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

[227] To calculate the 20-year average, water quality results with sample collection dates between January 1, 2000 and January 1, 2020 were used.

[228] To calculate results within the last two years, water quality results with sample collection dates between January 1, 2018 and January 1, 2020 were used.

[229] For this map, on the “source” and “neighbor” sections described in the Domestic Well Needs Assessment White Paper are used. The Domestic Well Needs Assessment White Paper also describes the calculations for “groundwater unit” sections, which are not included in this map.

4. 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

1. All recent (within the past 2 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).
2. The count of recent results in each category are summarized per square mile section for each constituent.
3. 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.

UNIT OF ANALYSIS

Groundwater quality risk is summarized by census block group. This allows the water quality risk to be combined with existing census information, such as disadvantaged community status and other demographic information. This also allows the data to be combined with the results of the Department of Water Resources Drought and Water Shortage Risk mapping, which identifies water accessibility risk throughout the state. Water quality data can also be viewed as individual well points and compiled into square mile public land survey sections. The well point and section-level data allow the user to better understand the potential distribution of available water quality data within a census block that contributed to the overall risk ranking for that block. State small system location data is available as point locations, and domestic well density information is available as both count per square mile and as count per census block group.

RISK FACTORS

WATER QUALITY RISK (“HAZARD”)

Water quality data for census block groups are calculated using data from all sections within the census block group. Prioritization of census block groups is based on five water quality risk factors that capture different aspects of water quality risk based on the available data. Several additional informational fields are included for reference.

Table B2: Water Quality Risk Factors for Domestic Wells and State Small Water Systems (For Each Census Block Group)

Risk Factor	Notification	Description
Count of chemical constituents above MCL	CRF1	Number of individual chemical constituents which have a long-term (20 year) average or recent result (within the past 2 years) above the MCL.

Risk Factor	Notification	Description
Count of chemical constituents within 80 percent of MCL	CRF2	Number of chemical constituents with a long-term average or recent result within 80 percent and 100 percent of the MCL.
Average MCL Index (for results above MCL)	CRF3	Magnitude of the average result for chemical constituents with a long-term average or recent result above the MCL.
Percent of high risk sections	CRF4	Percentage of square mile sections in the census block group that contain at least one constituent with a long-term average or recent result above the MCL (i.e., “high risk”).
Percent of medium risk sections	CRF5	Percentage of square mile sections in the census block group that contain at least one constituent with a long-term average or recent result within 80 percent – 100 percent of the MCL (i.e., “medium risk”).

Table B3: Additional Reference Information for Water Quality Risk Factors for Domestic Well and State Small Water Systems (For Each Census Block Group)

Reference Data	Description
List of chemical constituents above MCL	List of chemical constituents with a long-term or recent result above the MCL
List of chemical constituents within 80 percent of MCL	List of chemical constituents with a long-term or recent result within 80 percent – 100 percent of MCL.
Percent area with water quality data	The percentage of sections in the census block group that contain water quality data.

These water quality risk factors are aggregated into a final water quality score, calculated as:

$$Water\ Quality\ Score = \left(CRF1 + \frac{CRF2}{2} + \frac{CRF3}{10}\right) * (CRF4 + \frac{CRF5}{2})$$

The water quality scores for all census block groups are converted into percentiles to normalize the scores. Higher scores and high percentiles indicate areas that are at relatively higher risk for water quality issues in domestic wells and state small water systems. Census block groups with a score of zero (no constituents above or close to the MCL) are automatically assigned to the 0th percentile and are not included in the percentile calculation. Approximately 33 percent of census block groups fall into this category. It is important to note that because of the data filtering and de-clustering involved in these calculations, a risk percentile of zero does not necessarily mean there is no water quality risk in an area (see discussion on areas with sparse/no available data, below).

In addition to the census block group percentiles, detailed data layers show water quality data summarized at the square mile section level and at the point (well) level. These layers display similar risk factors for sections and well points:

Table B4: Water Quality Data for Domestic Wells and State Small Water Systems (For Each Square Mile Section)

Section Data Risk Information	Description
Section Risk Category	Categorizes sections as being “high”, “medium”, or “low” water quality risk. “High”: contains at least one constituent with a long-term average or recent result above the MCL “Medium”: contains at least one constituent with a long-term average or recent result within 80 percent – 100 percent of the MCL “Low”: contains no constituents with a long-term average or recent result greater than 80 percent of the MCL
Count of chemical constituents above MCL	Number of chemical constituents in the section that have a long-term (20 year) average or recent result (within the past 2 years) above the MCL.
Count of chemical constituents within 80 percent of MCL	Number of chemical constituents in the section that have a long-term (20 year) average or recent result (within the past 2 years) within 80 percent and 100 percent of the MCL.
Average MCL Index (for results above MCL)	Average magnitude of chemical constituents that are above the MCL in the section.
List of chemical constituents above MCL	List of chemical constituents with a long-term or recent result above the MCL in the section
List of chemical constituents close to MCL	List of chemical constituents with a long-term or recent result within 80 percent – 100 percent of MCL in the section

Table B5: Water Quality Data for Domestic Wells and State Small Water Systems (For Each Well)

Point Data Risk Information	Description
Well Risk Category	Categorizes wells as being in a section that has a "high", "medium", or "low" water quality risk: "High": contains at least one constituent with a long-term average or recent result above the MCL "Medium": contains at least one constituent with a long-term average or recent result within 80 percent – 100 percent of the MCL "Low": contains no constituents with a long-term average or recent result greater than 80 percent of the MCL
Count of chemical constituents above MCL	Number of chemical constituents in the well that have a long-term (20 year) average or recent result (within the past 2 years) above the MCL.
Count of chemical constituents within 80 percent of MCL	Count of chemical constituents in the well that have a long-term (20 year) average or recent result (within the past 2 years) within 80 percent and 100 percent of the MCL.
Average MCL Index (for results above MCL)	Average magnitude of chemical constituents that are above the MCL in the well.
List of chemical constituents above MCL	List of chemical constituents with a long-term or recent result above the MCL in the well.
List of chemical constituents close to MCL	List of chemical constituents with a long-term or recent result within 80 percent – 100 percent of MCL in the well.

Areas with No Available Water Quality Data

Out of 23,212 census block groups, approximately 5,183 (22%) do not contain water quality data for any of the chemical constituents.

Most (3,250, or 63%) of these "no data" block groups are in the most densely populated areas of the state (i.e., Los Angeles and San Francisco Bay metropolitan areas), where census block groups are very small (less than 1 square mile) and do not overlap a square mile section with a well with water quality data. These areas are predominantly served by municipal water systems and are less likely to have a significant population reliant on domestic wells. However, there are several block groups with no data in Imperial County and parts of Humboldt, Trinity, and Shasta Counties, where there are likely populations of domestic well users. Currently, block groups with no water quality data are not included in the percentile ranking process and are assigned a water quality risk percentile of zero. Due to the data filtering and de-clustering involved in these calculations, a risk percentile score of “zero” does not mean there is not a water quality risk in each area.

Areas with Sparse Available Water Quality Data

Additionally, there are 118 census block groups that contain sparse (less than 10%) data coverage. While these block groups are included in the percentile ranking, they are flagged on the tool with the hatch marks to alert the user to this concern.

Individual Chemical Constituents

Single-chemical constituent layers are available as square mile section data for Nitrate, Arsenic, 1,2,3-Trichloropropane, Hexavalent Chromium, and Uranium. These layers display the long-term average and the count of recent results over, close to, and under the MCL per square mile section for a single chemical constituent.

DOMESTIC WELL AND STATE SMALL SYSTEM DENSITY (“EXPOSURE”)

This layer identifies areas where available data indicates a relatively high density of domestic wells and state small systems. The density of domestic wells is calculated from the count of domestic well records per mile in the California Department of Water Resources Online System for Well Completion Reports (OSWCR). OSWCR records with a completion date prior to 1970 were not included in this assessment to avoid including wells that may no longer be in use. Exposure risk is based on the number of domestic wells and state small water systems per square mile in the census block group (density). The “exposure risk” is calculated by normalizing the density to percentiles for all census block groups.

COMBINED RISK (WATER QUALITY AND DOMESTIC WELL/STATE SMALL RELIANT POPULATION)

The combined risk layer combines the water quality risk (“hazard”) with the domestic well and state small density (“exposure”) using the following equation:

$$\textit{Combined Risk} = \textit{Water Quality Risk Percentile} + \textit{Domestic Well and State Small System Density Percentile}$$

To avoid under-representing the risk of areas with little to no data, the final equation to calculate combined risk is additive (instead of multiplicative) because areas with a water quality risk or domestic well and state small system density of “zero” might just have low or no available data. A “zero” does not necessarily indicate no risk to water quality or no domestic well/state small system users because of the uncertainty in both individual risk layers. The final combined risk value is then re-normalized to a percentile.

The metadata for this layer includes the following fields:

Table B6: Risk Factors for Domestic Wells and State Small Water Systems (For Each Census Block Group)

Combined Risk Factor	Description
Water quality risk percentile	See above section "Water Quality Risk (Hazard)"
Domestic well and state small system density percentile	See above section "Domestic Well and State Small System Density (Exposure)"

Table B7: Additional Reference Information for Domestic Wells and State Small Water Systems (For Each Census Block Group)

Reference Data	Description
Count of domestic wells in census block group	Count of domestic wells from OSWCR, excluding those drilled prior to 1970.
Count of state small water systems in census block group	Count of state small water systems from RCAC.
Disadvantaged community status of census block group	From the Department of Water Resources (2018), this indicates if a census block group is disadvantaged (Median Household Income (MHI) is less than $56,982, or 80% of California MHI) or severely disadvantaged (MHI is less than $42,737, or 60% of California MHI). MHI information is not available for some areas.

APPENDIX C:
COST ASSESSMENT METHODOLOGY

INTRODUCTION

The Cost Assessment methodology utilizes a model to estimate the financial costs of both necessary interim measures and longer-term solutions to bring HR2W list systems into compliance, address the challenges faced by At-Risk systems and domestic well as identified via the Risk Assessment. The goal of the Cost Assessment is to inform the prioritization of the spending of existing funding sources, particularly via the SB 200-mandated annual Safe and Affordable Drinking Water Fund Expenditure Plan, as well as to identify potential additional funding sources to leverage, and to estimate the size of the current funding gap to continue to advance the HR2W for all Californians.

COST ASSESSMENT METHODOLOGY DEVELOPMENT PROCESS

The development process of the Cost Assessment was designed to encourage public and stakeholder participation, providing opportunities for feedback and recommendations throughout the methodology development process. Figure C1 provides an overview of the Cost Assessment development phases. Each of these development phases were detailed in publicly available white papers, presented at public webinars, and the public feedback received was incorporated into the final Cost Assessment methodology and results.

The initial draft Cost Assessment methodology was developed by Corona Environmental, and the State Water Board, with support from UCLA and OWP at Sacramento State, from September 2019 to August 2020. Details on the initial draft Cost Assessment methodology were provided in the August 28, 2020 white paper *Long Term Solutions Cost Methodology for Public Water Systems and Domestic Wells*[230] and public webinar *Cost Estimate: Overview of Approach and Update.*[231]

Corona Environmental, the State Water Board, OWP at Sacramento State and UCLA refined the initial draft Cost Assessment methodology through multiple stages of development between August 2020 and March 2021. An updated Cost Assessment white paper titled *Long Term Solutions Cost Methodology for Public Water Systems and Domestic Wells*[232] was published on November 20, 2020 and a public webinar was hosted on November 20, 2020 to

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230 Draft White Paper: Long Term Solutions Cost Methodology for Public Water Systems and Domestic Wells https://www.waterboards.ca.gov/safer/docs/draft_whitepaper_lt_solutions_cost_meth_pws_dom_wells_updated.pdf

231 August 28, 2020 Webinar Recording https://www.youtube.com/embed/ndsVqRS_-s8?modestbranding=1&rel=0&autoplay=1

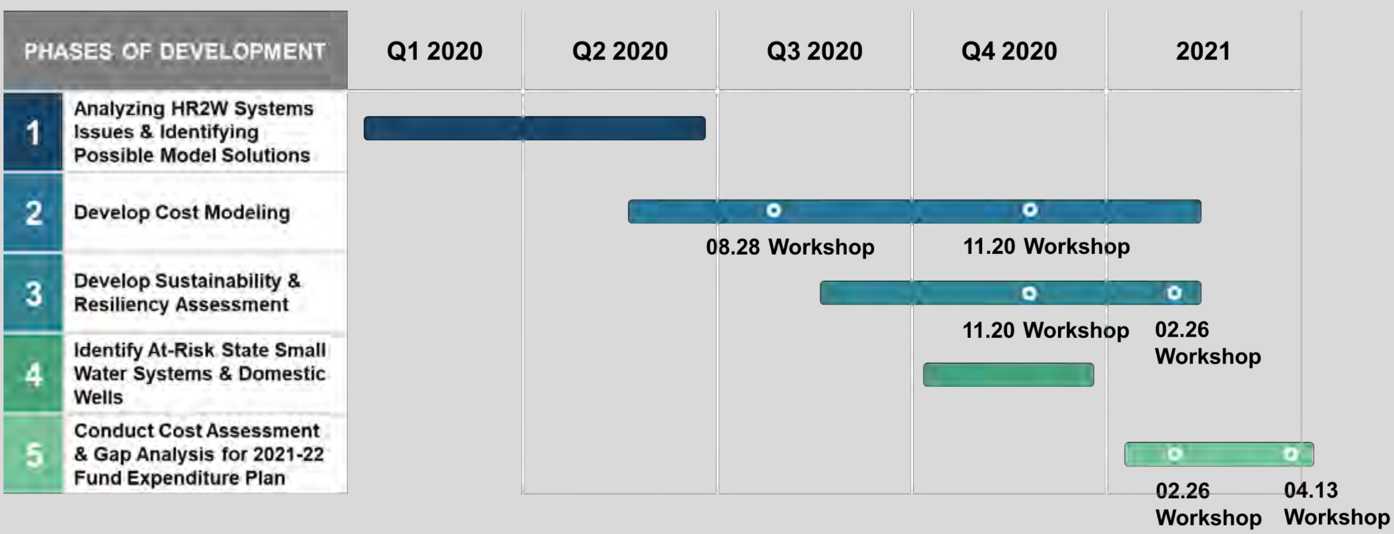
232 White Paper: Long Term Solutions Cost Methodology for Public Water Systems and Domestic Wells https://www.waterboards.ca.gov/safer/docs/draft_whitepaper_lt_solutions_cost_methd_pws_dom_wells.pdf

solicit feedback on the Model for estimating costs associated with implementing interim and long-term solutions for failing HR2W list and At-Risk systems.

The third, and final, webinar workshop *Cost Assessment Model Preliminary Results and Gap Analysis*[233] was hosted on February 26, 2021 to seek public feedback on the revisions to the Cost Assessment of long-term solutions for HR2W list and At-Risk systems, and proposed methodology for the funding Gap Analysis. Details on the preliminary results from the Cost Assessment model and Gap Analysis were provided in the February 25, 2021 white paper *Gap Analysis for Funding Solutions for Human Right to Water and At-Risk Drinking Water Systems.*[234]

A handful of comment letters were received throughout this effort and some adjustments to the Cost Methodology have been made as a result. Additional details that were requested in the comment letters have been added to this Cost Assessment Methodology Appendix.

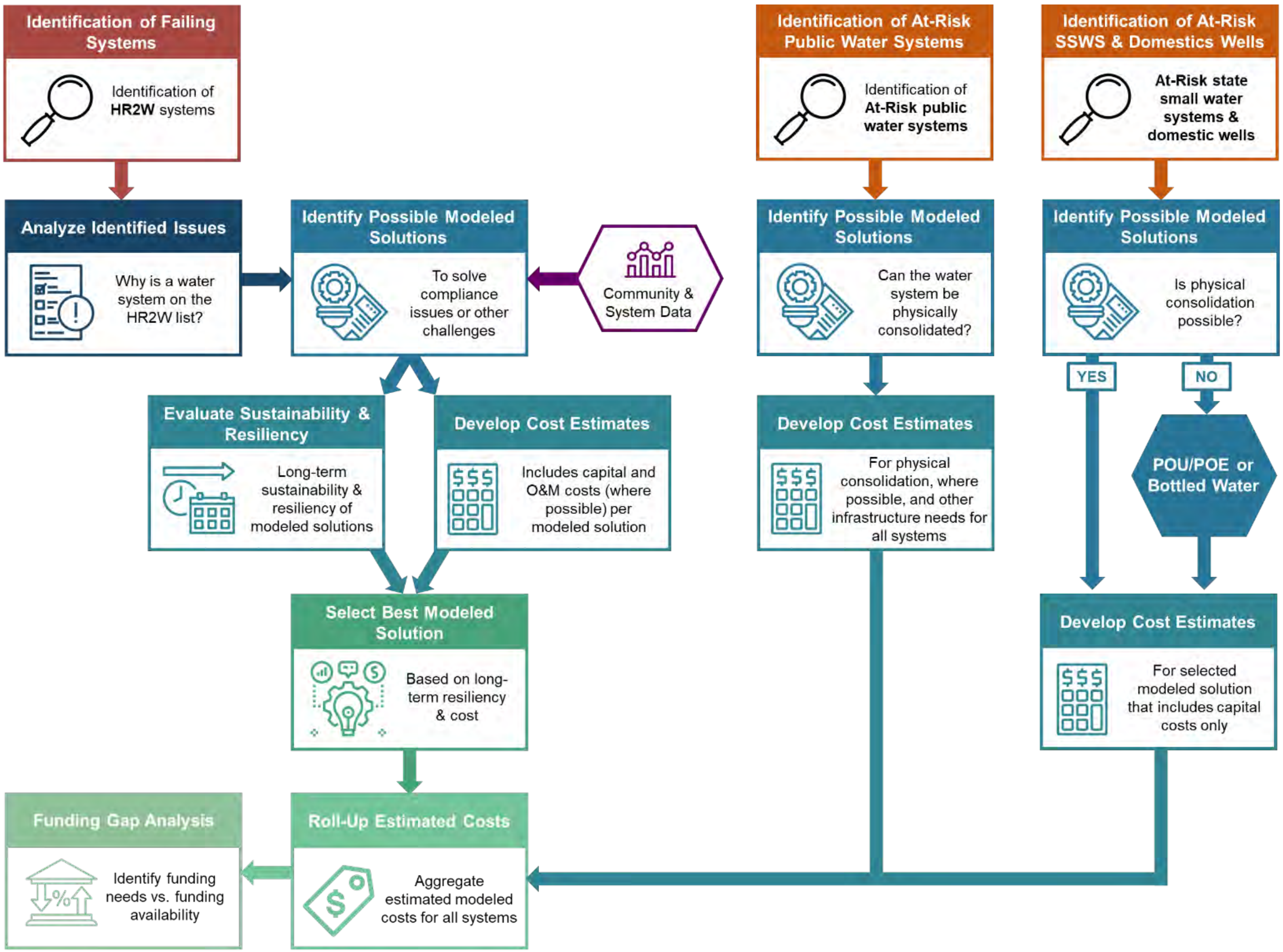
Figure C1: 2020-21 Public Engagement for the Development of the Cost Assessment



[233] Webinar recording can be found at the Needs Assessment website: [Needs Assessment | California State Water Resources Control Board](https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/needs.html)
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/needs.html

[234] White Paper: Gap Analysis for Funding Solutions for Human Right to Water and At-Risk Drinking Water Systems
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/docs/Draft_White_Paper_Needs_Assessment_Gap_Analysis_FINAL.pdf

Figure C2: Cost Assessment Model Methodology



COST ASSESSMENT METHODOLOGY

The goal of the Cost Assessment was to estimate the potential costs of addressing issues in water systems currently in violation (HR2W list systems) and those at risk of future violations (At-Risk PWS). Additionally, the Cost Assessment identified costs for state small water systems and domestic wells that may be at-risk of having water quality issues. The process is summarized in Figure C2. **The Cost Assessment was not intended to identify actual solutions that should be implemented for a given system. An evaluation of each system will be needed to identify and cost a range of solutions.** As the State Water Board's data improves, the Cost Assessment will improve over time.

IDENTIFICATION OF WATER SYSTEMS AND DOMESTIC WELLS

The purpose of the Cost Assessment Model is to estimate the potential cost of implementing solutions for failing HR2W list systems, At-Risk water systems, At-Risk state small water systems and At-Risk domestic wells. Therefore, the first critical dataset the model requires is the list of HR2W list systems and At-Risk water systems and domestic wells.

HR2W List Systems: The identification of HR2W list systems is conducted on a regular basis by the State Water Board utilizing enforcement and compliance data. The list of current HR2W list systems is maintained on the State Water Board website.[235] The list of HR2W list systems utilized for the 2021 Cost Assessment was based on the list of systems as of December 1, 2020, which contained 305 public water systems.

At-Risk Public Water Systems: The State Water Board and UCLA developed a methodology for determining At-Risk public water systems (Appendix A). The initial results of the Risk Assessment methodology identified 630 At-Risk public water systems. This initial list was incorporated into the 2021 Cost Assessment. Modifications were made to the initial Risk Assessment results, therefore the list of the At-Risk systems summarized inn the Risk Assessment Results for public water systems section above and in Appendix A differ slightly from the list used in the Cost Assessment.

At-Risk State Small Water Systems and Domestic Wells: The State Water Board's DWQ's Groundwater Ambient Monitoring and Assessment Program (GAMA) Unit developed the Risk Assessment methodology for state small water systems and domestic wells, which is focused on groundwater quality. This effort was accomplished through the mapping of aquifers that are used as a source of drinking water that are at high risk of containing contaminants that exceed primary drinking water standards. The Cost Assessment Model used the GAMA modeled data to determine which state small water systems and domestic wells may be at risk of water quality issues. The number of At-Risk state small water systems and domestic wells in the long-term solutions cost analysis is different than the number in the Risk Assessment results and the interim solutions cost analysis because the data for long term cost estimated was based on the

[235] Human Right to Water | California State Water Resources Control Board
https://www.waterboards.ca.gov/water_issues/programs/hr2w/

GAMA model for the six contaminants that were available at the time the data was used. The interim solutions cost model was based on a later Aquifer Risk Map that contains all contaminants with an MCL. Please refer to Appendix B to learn more about this Risk Assessment methodology and Attachment C1 for more information on how the Cost Assessment incorporated this information into the analysis.[236]

HR2W List and At-Risk Equivalent Tribal Water Systems: The State Water Board's Needs Analysis Unit and Office of Public Participation are working to collect data and develop a Risk Assessment methodology for Federally recognized tribal water systems located in California. The State Water Board has developed high level cost estimates based on the known number of Federally recognized tribal water systems, violation trends across USEPA Region 9, and typical costs for California water systems (Appendix F). State tribal water systems are under the regulatory jurisdiction of the State Water Board and are therefore incorporated within this Cost Assessment.

The Cost Assessment Model also utilizes location data of public water systems, state small water systems, and domestic wells that are not on the HR2W list or deemed At-Risk in order to identify possible physical consolidation and regional solutions. Detailed information on the datasets used to gather locational information on water systems and domestic wells, including water quality, is provided in Attachment C1.[237]

This model does not capture all needs for water systems and domestic wells throughout the state. It is important to note that the possible modeled solutions utilized in the Cost Assessment Model were only intended to provide a statewide cost estimate for implementing solutions for HR2W list systems, At-Risk systems, and domestic wells. Solutions modeled for individual systems in the Cost Assessment Model will not be utilized by the State Water Board to directly make technical, funding or technical assistance decisions. The State Water Board recognizes that HR2W list systems and At-Risk systems will require a site-specific, detailed evaluation conducted by a qualified engineer, or technical assistance provider, or other specialized firm, to identify implementable solutions for communities.

ANALYZE IDENTIFIED ISSUES

To estimate the cost of providing solutions to HR2W list systems and At-Risk PWS, the Model needed to incorporate and analyze the challenges and issues these systems are struggling with to provide sustained safe and accessible drinking water.

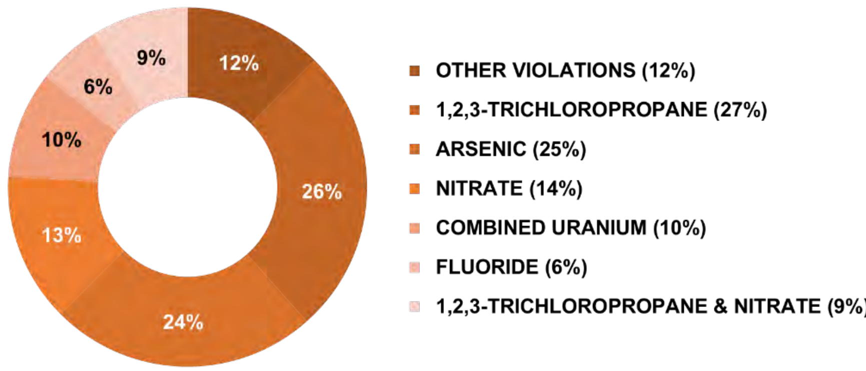
Corona Environmental conducted a case study of the HR2W list systems in Kern County to identify and refine the possible challenges the Cost Assessment Model needed to address. Kern County was selected for initial analysis because it had 61 of the state's 311 HR2W list

[236] Attachment C1: Geographic Information System and Database Methodologies https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/c1.pdf

[237] Attachment C1: Geographic Information System and Database Methodologies https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/c1.pdf

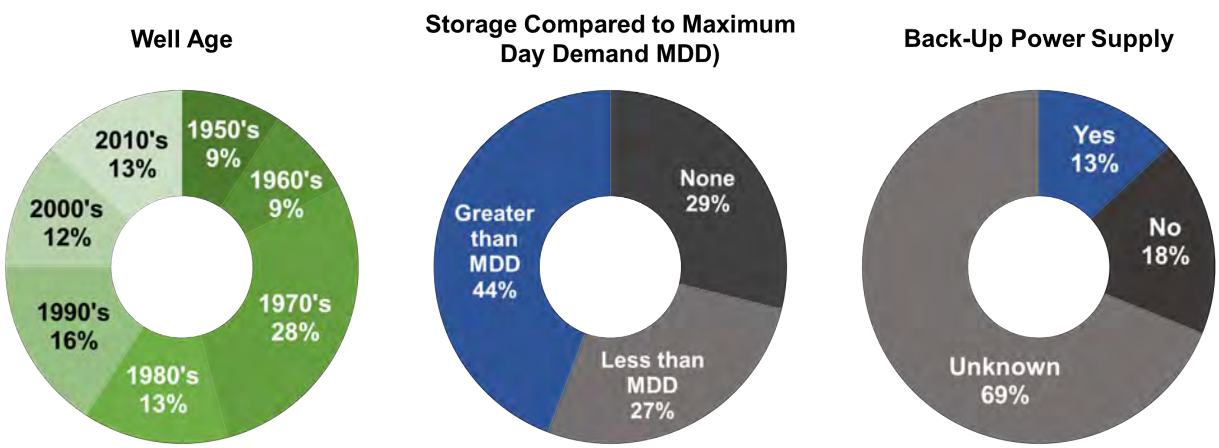
systems as of the spring of 2020. Figure C3 summarizes the different water quality violations in Kern County.

Figure C3: Kern County HR2W List Systems' Water Quality Violations



To examine contributing factors drivers of these challenges with more data, sanitary surveys[238] for 60 of the HR2W list systems in Kern County were analyzed to look at source age, source capacity, and storage capacity of the systems. Figure C4 summarizes the proportion of systems that may have additional infrastructure needs based on this review.

Figure C4: Additional Issues Identified for Kern County HR2W List Systems



The Kern County case study identified several challenges that are anticipated to be applicable

[238] The most recent Sanitary Surveys for Kern County Human Right to Water systems were provided by the State Water Board in PDF format.

across the state and utilized this information to develop more nuanced assumptions in the Model. These findings are summarized below and further discussed in Attachment C2.[239]

- In Kern County, 75% of the water systems served fewer than 200 connections. Small water systems having fewer technical, managerial and financial resources to leverage may need additional technical assistance or managerial support to achieve interim and long-term compliance.

- Approximately 48% of the water systems reviewed in the Kern County case study had only one well and thus lacked the water supply redundancy to meet current standards. These water systems frequently also had inadequate storage and no backup power. Therefore, water systems that are not consolidated may need additional water infrastructure redundancy to remain out of the At-Risk or Potentially At-Risk category.

- Only 25% of the wells were constructed within the past twenty years, indicating that at least some of the water system infrastructure is likely beyond its useful life. Aging infrastructure effects many of the water systems in Kern County. This is expected to impact the cost of consolidation/regionalization projects if receiving entities are hesitant to combine with water systems having poor existing infrastructure and/or increase the need for funding for infrastructure replacement.

The study also identified a high prevalence of 1,2,3-Trichloropropane (1,2,3-TCP) violations, which are likely in part a result of the relatively recent implementation of the maximum contaminant level, effective in December 2017. It was also observed that there was significant co-occurring contamination across Kern County with nitrate and that the presence of multiple contaminants will significantly increase treatment costs and complexity.

At the time, water quality information was not available for all state small water systems and domestic wells. Future iterations of the Cost Assessment Model would benefit from more specific information about these water sources and associated infrastructure. Regional water quality maps for selected constituents have been developed statewide by the State Water Board's Groundwater Ambient Monitoring and Assessment (GAMA) program.[240] Any domestic wells in areas of the state that were labeled as at risk of having source water quality issues mapped in the GAMA project were assumed to have those water quality issues. At the time of use in the long-term Cost Assessment, the GAMA model included the following constituents: arsenic, hexavalent chromium, nitrate, perchlorate, uranium, and 1,2,3-Trichloropropane. For the purpose of the Cost Assessment hexavalent chromium was not included, since there is no current regulation. State small water systems and domestic wells were considered "At-Risk" if they mapped into a grade 4, 5, or 6 area. Those grades indicated that the constituent had been found at or over the regulatory limit in the area. For state small water systems and local small water systems in Monterey County, actual water quality results were used for the Cost

[239] Attachment C2: Kern County Case Study
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/c2.pdf

[240] State Water Resources Control Board. 2020. Needs Analysis Groundwater Ambient Monitoring and Assessment (GAMA) Tool | GAMA Program.
https://gispublic.waterboards.ca.gov/portal/apps/webappviewer/index.html?id=292dd4434c9c4c1ab8291b94a91cee85

Assessment. Details about this part of the methodology are in Attachment C1.[241]

IDENTIFYING POSSIBLE MODELED SOLUTIONS: ISSUES MAPPING TO POSSIBLE SOLUTIONS

For each category of issues identified, a range of potential solutions were considered in the Model. Tables C1 and C2 summarizes the issues and potential modeled solutions for the HR2W list and At-Risk PWS, and Table C3 identifies the issues and potential solutions for state small water systems and domestic wells. As more information becomes available for state small water systems, other potential modeled solutions can be added.

Table C1: Identified Issues and Potential Solutions for HR2W List Systems

Identified Issues	Potential Modeled Solutions
Water Quality	• Physical Consolidation • Centralized Treatment techniques • Point-of-Use or Point-of-Entry Treatment (less than 200 service connections).

• **Single Source**
• **Source Over 40-Years Old**
• **Insufficient Storage**
• **No Back-Up Generator**
• **Mains Over 40-Years Old**
• **No Meters**
	• "Other essential infrastructure" needed:
	  ○ New wells
	  ○ Storage tanks
	  ○ Booster pumps,
	  ○ Back-up generators
	  ○ Main replacement
	  ○ SCADA systems
	  ○ Meters

Insufficient TMF (Technical, Managerial, Financial) Capacity	• Technical Assistance (managerial support)

Table C2: Identified Issues and Potential Solutions for At-Risk PWS

Identified Issues	Potential Modeled Solutions
At-Risk due to Water Quality Accessibility, Affordability, and TMF Capacity	• Physical Consolidation

241 Attachment C1: Geographic Information System and Database Methodologies https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/c1.pdf

Identified Issues	Potential Modeled Solutions

• **Single Source**
• **Source Over 40-Years Old**
• **Insufficient Storage**
• **No Back-Up Generator**
• **Mains Over 40-Years Old**
• **No Meters**
	• "Other essential infrastructure" needed:
	  ○ New wells
	  ○ Storage tanks
	  ○ Booster pumps,
	  ○ Back-up generators
	  ○ Main replacement
	  ○ SCADA systems
	  ○ Meters

Insufficient TMF (Technical, Managerial, Financial) Capacity	• Technical Assistance (managerial support)

Table C3: Identified Issues and Potential Solutions for <u>At-Risk State Small Water Systems</u> and <u>Domestic Wells</u>

Identified Issues	Potential Modeled Solutions
Water Quality	• Physical Consolidation • Point-of-Use or Point-of-Entry Treatment • Bottled Water where point-of-use or point-of-entry treatment is not a technically viable solution (e.g. high nitrate concentrations)

The following sections of this paper explain in greater detail the potential modeled solutions incorporated into the Model. Several additional potential modeled solutions were considered, but ultimately not included, because of a lack of information or due to uncertainty around the solutions ability to permanently address a water quality issue. Excluded modeled solutions include blending, managerial consolidation, and new wells in lieu of treatment. Additional information on these explored modeled solutions that were excluded can be found in white paper *Long Term Solutions Cost Methodology for Public Water Systems and Domestic Wells*.[242] In future iterations of the Cost Assessment, it may be beneficial to include these options if sufficient information becomes available.

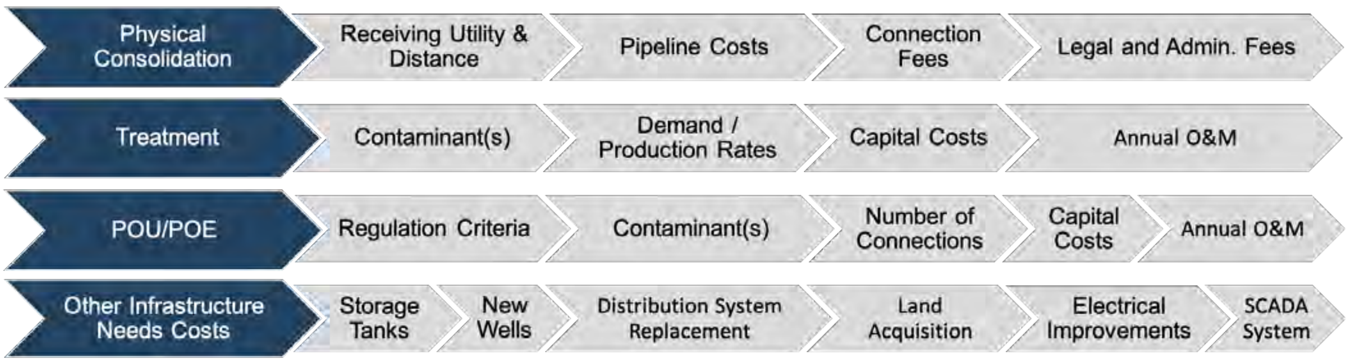
MODELED SOLUTIONS

The Cost Assessment methodology considers a range of regional and individual system-based model solutions for water systems and domestic wells as illustrated in Figure C5, along with additional considerations that are important to each potential modeled solution. The following

[242] White Paper: Long Term Solutions Cost Methodology for Public Water Systems and Domestic Wells https://www.waterboards.ca.gov/safer/docs/draft_whitepaper_lt_solutions_cost_methd_pws_dom_wells.pdf

section describes the range of modeled solutions in more detail. In some cases, multiple modeled solutions were considered to address a water system's challenges.

Figure C5: Modeled Long-Term Solutions and Considerations Appraised



Interim Solutions

The State Water Board is committed to providing interim drinking water solutions in order to ensure a reliable and potable water source while longer-term solutions are being determined and implemented. Using historical cost data provided by the State Water Board, UCLA initially assessed the cost and feasibility of four interim measures: bottled water, POU or POE treatment, hauled water, and filling stations. Each of these considered interim measures had been deployed in previous or ongoing regional and statewide programs to provide emergency or interim drinking water access to communities in need.

For instance, during the 2012 – 2016 drought, dozens of water systems across the state struggled to provide drinking water to customers due to decreased water supply and increased concentrations of contaminants in diminishing water tables. The State Water Board deployed all four interim solutions evaluated in this analysis when it operated the Cleanup and Abatement Account (CAA) that funded interim emergency drinking water projects to address urgent needs in communities and schools. Projects eligible for the emergency interim drinking water funding included bottled water, vending machines, hauled water, and POU and POE treatment filtration devices. Data from these funded projects provided most of the real cost data used in this analysis.

However, relatively robust historical data to project interim solutions cost was only available for bottled water and POU and POE treatment, as opposed to hauled water (n=11 projects),[243] and communal filling stations (n=2 projects).[244] While communal access models for interim

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[243] Hauled water is typically used to supply locations with storage tanks (domestic well owners, schools, state smalls). Current allocations allow 50 gallons per person, per day for hauled water programs. A community-access model with common tanks had an average cost the cost per gallon to approximately $0.11 and allows communities without household storage tanks to benefit.

[244] At the time of data collection for this project, only two examples of state funded filling stations or vending machine programs exist, one of which charges customers $0.30 per gallon for water; the other provides 10-

water showed promise in terms of per unit cost and feasibility of administration, their cost across the state could not be estimated until more data is collected. Accordingly, only bottled water and POU and POE treatment interim measures were applied to estimate the cost of interim supply to populations served by HR2W list systems and At-Risk state small water systems and domestic wells.

DAC status was assigned to HR2W list systems as detailed in the description of the %MHI indicator found in Appendix A. DAC status was assigned to At-Risk state small water systems and domestic wells based on the ACS block group data, also described in Appendix A, in which these water sources were found.

Bottled Water
For the purpose of this analysis, bottled water is defined as an "any water that is placed in a sealed container at a water-bottling plant to be used for drinking, culinary, or other purposes involving a likelihood of the water being ingested by humans."[245] The majority of literature on the cost of bottled water focuses on costs of locally purchased bottled water by residential consumers. State and Federal emergency preparedness plans include bottled water as an emergency water source when traditional water sources are unusable or inaccessible.[246] Types of bottled water provided by the State Water Board are typically either 1-gallon or 5-gallon bottles.

Point-of-Use (POU) or Point-of-Entry (POE) Treatment
Providing POU/POE treatment to customers served by affected water systems with less than 200 connections or domestic wells may be a viable interim and/or a necessary long-term solution option to address contaminants that exceed water quality standards. POU treatment was considered for most commonly occurring inorganic contaminants (for example nitrate or arsenic) and was not recommended when bacteriological contaminants exist.

POE treatment must be considered in the case of 1,2,3-TCP, or other volatile organic compounds, to address health impacts of inhaling the compounds during exposure in the shower for example. POU treatment is not acceptable for any contaminant that has a risk pathway beyond ingestion. Table C4 lists the contaminants that require treatment of this type, as determined in consultation with State Water Board staff. In communities where Nitrate levels exceed 25 mg/L filtration is no longer an effective option and bottled water must be provided as the interim solution.

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gallons at no charge to each household. Limited data on this option hinder the ability to conduct further analysis for the 2021 Needs Assessment.

[245] California Health and Safety Code Section 111070

[246] United States Environmental Protection Agency, "Planning for an Emergency Drinking Water Supply." (2011); California Governor's Office of Emergency Services, "Emergency Drinking Water Procurement & Distribution Guidance." (2014)

Table C4: Contaminants Treated by POU and POE

Point of Use (POU) Filtration	Point of Entry (POE) Filtration
Aluminum	1, 2 Dibromoethane (EDB)
Arsenic	1, 2-Dibromo-3-chloropropane (DBCP)
Antimony	1,2,3-Trichloropropane
Barium	Benzene
Cadmium	Benzo(a)pyrene
Chromium	Carbon Tetrachloride
Chromium Hexavalent	Chloroform
Copper	Di(2-ethylhexyl)phthalate (DEHP)
Fluoride	Dichloromethane (Methylene Chloride)
Gross Alpha radioactivity	MTBR (Methyl-tert-butyl ether)
Gross Beta radioactivity	N-Nitrosodimethylamine
Lead	Pentachlorophenol
Mercury	Tetrachloroethene
Nickel	Total Trihalomethanes
Nitrate	Trichloroethene
Nitrite	Vinyl Chloride
Perchlorate	
Radium 228	
Thallium	
Uranium	

Physical Consolidation

The challenges that water systems experience are often regional issues that stem from degraded source water quality, inconsistent source water availability, or the economic capacity of certain communities. Once challenges are identified at a regional and individual water system level, potential long-term solutions can be considered to eliminate current water quality violations and ensure long-term water quantity and water quality sustainability.

This methodology includes a regional component to identify opportunities where water systems and communities can work together to solve common issues. Some of the solutions evaluated that are aimed at resolving regional issues include:

Physical consolidation of two or more water suppliers that are geographically close together. Please refer to Attachment C1 for more information on the GIS methodology developed for this evaluation.[247]

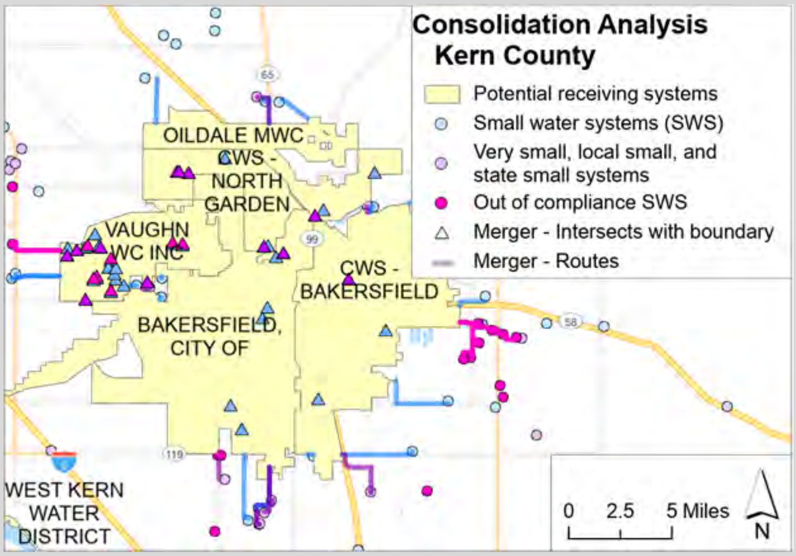
Physical consolidation is the joining of two or more water systems. For example, a small mobile home park that operates its own water system may be near or within a city (i.e. receiving system) and decides it no longer wishes to be responsible for providing drinking water. The city can begin providing water to the mobile home park through a master meter or other type of connection. Some of the benefits of physical consolidation include:

- The receiving water system may already have adequate treatment or the ability to construct water treatment that is designed to address the water quality challenges that impact area water supplies.
- The receiving water system may offer a diversified water supply portfolio affording optimization of available area water supplies to ensure that its population will not be faced with shortages. This alleviates small systems' issues with a lack of storage, inadequate pumping capacity, or inadequate individual well productivity.
- Consolidation of treatment and operations can improve water rate affordability by spreading costs over a larger customer base, decreasing redundant efforts and decreasing treatment costs through larger bulk purchases.
- Some physical consolidation projects may be in proximity to and thus allow for integration of small water systems, households served by domestic wells, and other At-Risk water systems, in addition to the targeted joining system. The physical consolidation analyses conducted as part of this methodology have determined the expected cost range of a given project.

Figure C6 shows an example physical consolidation analysis map. This methodology identified potential physical consolidation projects and even larger scale regional projects. While engineering and cost-modeling play a large role in consolidation and regionalization, the actual solution that will be implemented may be highly variable depending on other factors such as political boundaries, water rights boundaries, community interests, and other factors.

[247] Attachment C1: Geographic Information System and Database Methodologies
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/c1.pdf

Figure C6: Example Physical Consolidation Analysis Map



Centralized Treatment

Treatment of groundwater or surface water to address contaminants that exceed water quality standards. Many of the water systems that were under evaluation, in particular those that were added to the HR2W list for recurring water quality violations, may require new or additional treatment. Some of the contaminants that have resulted in water quality violations in the systems under evaluation include:

- Arsenic
- Nitrate
- 1,2,3-TCP
- Disinfection byproducts - trihalomethanes (THM) and haloacetic acids (HAA)
- Perchlorate
- Uranium
- Surface Water Treatment and/or extensive bacteriological failures

In some cases, there were multiple treatment options that may effectively remove a contaminant. In other cases, there may only be a single treatment option that is currently available to treat a contaminant. And in yet other cases, there may be multiple contaminants that a water system needs treatment for. These realities ultimately impact the type of treatment required.

Other Needed Infrastructure

In addition to water quality challenges, many identified systems had additional infrastructure needs to address reliability and basic system operation. Examples of these items include storage tanks and booster pumps, second wells, replacement well(s), back-up generators, main replacement, etc.

Solution Options for State Small WATER SYSTEMS AND DOMESTIC WELLS

Physical consolidation and POU or POE treatment were considered in the model as the primary potential solution for State Small Water Systems and Domestic Wells. However, bottled water was also considered for those domestic wells that are believed to have nitrate levels exceeding 25 mg/L[248] as nitrogen because POU devices do not work at these levels.

No detailed information about the water quality of individual domestic wells was available and therefore several assumptions were required to be made. Locations of domestic wells were available as a count of wells in a square mile area. The status of the wells was unknown. Given the limitations of the existing data, this methodology assumed that all locations with domestic wells along a possible physical consolidation route could be connected to a public water system. Regional water quality maps for selected constituents were developed statewide by the State Water Board's Groundwater Ambient Monitoring and Assessment (GAMA) program.[249] As appropriate, POU or POE treatment was budgeted (or bottled water for some high nitrate levels) for any domestic wells in areas of the state that are expected to have the water quality issues mapped in the GAMA project and were not along a potential physical consolidation route. It is important to note that bacteriological water quality in domestic wells may also significantly alter the ability to use POU or POE but could not be modeled due to its site specific and changing nature.

DEVELOP COST ESTIMATES FOR MODELED SOLUTIONS

The Model methodology developed high-level cost estimates for the solutions that were identified as viable options to address water system challenges. The generalized costs developed did not include some site-specific details that will significantly impact total project costs. The estimates should thus be considered as planning numbers on a statewide level rather than a decision-making tool for a specific system. The following sections provide a summary of the potential modeled solutions considered and how the solution costs were developed.

COST ESTIMATION LEVEL OF ACCURACY

The methodology described above corresponds with a Class 5 cost estimate as defined by AACE International. Class 5 cost estimates are considered appropriate for screening level efforts and have a level of accuracy ranging from -20% to -50% on the low end and +30% to

[248] NSF/ANSI 58 – 2018, *Reverse Osmosis Drinking Water Treatment Systems*. Lists an influent nitrate concentration of 30 mg/L-N to achieve a treated water of 10 mg/L-N in the treated water. A safety factor has been applied to keep the treated water below 10 mg/L-N.

[249] State Water Resources Control Board. 2020. Needs Analysis Groundwater Ambient Monitoring and Assessment (GAMA) Tool GAMA Program. https://gispublic.waterboards.ca.gov/portal/apps/webappviewer/index.html?id=292dd4434c9c4c1ab8291b94a91cee85

+100% for an encompassing range of -50% to +100%. For the developed costs, the central tendency of the cost estimates is shown; however, it is important that the reader view each value with the accuracy in mind. For example, if a cost of $100 is presented, the corresponding range of anticipated costs is $50 to $200.

COST ESCALATION

Cost escalation has been accounted for using construction cost indices published by Engineering News-Record[250]. Capital and O&M costs have been adjusted as appropriate to January 2021 values. This approach will be replicated as future iterations of the model are executed to provide a reflection of current day costs.

NET PRESENT WORTH DEVELOPMENT

Lifecycle costs of selected alternative are presented in net present worth terms. All net present worth costs are developed using a 20-year period and 4% annual discount rate.

REGIONAL COST ADJUSTMENT

To adjust the cost estimates presented in the subsequent sections for regional cost variance, the Model applied an RSMeans[251] City Cost Index (CCI). RSMeans catalogs a database of material, labor and equipment costs across the United States and creates an RSMeans CCI number for selected cities. This CCI was used to compare or adjust costs between locations and the national average. For 2019, the most recent data publicly available, the national average CCI is 3.0. Not all cities have a CCI assigned, in which cases relatively similar CCI were selected by county based upon urban and rural considerations.

Cost estimates for treatment equipment and general civil site work were assigned the national average CCI of 3.0. The California CCI shown in Table C5 was then applied to adjust modeled capital costs based on each water system's location.

Table C5: RSMeans CCI Selected for Locational Cost Estimating

RSMeans City	Generalized Model Location	RSMeans CCI	Percent Adjustment
National Average	**Rural**	+3.0	0%
Oakland	**Urban**	+3.97	+32%
San Jose	**Suburban**	+3.89	+30%

[250] https://www.enr.com/economics
[251] RSMeans City Cost Index
https://www.rsmeans.com/rsmeans-city-cost-index

The categorization of counties by the generalized location for applying a CCI is shown in Table C6.

Table C6: California Counties Categorized by Generalized Model Location

Generalized Model Location	Counties
Rural	Alpine, Amador, Butte, Calaveras, Colusa, Del Norte, Fresno, Glenn, Humboldt, Imperial, Inyo, Kern, Kings, Lake, Lassen, Madera, Mariposa, Mendocino, Merced, Modoc, Mono, Nevada, Placer, Plumas, San Joaquin, Shasta, Sierra, Siskiyou, Stanislaus, Sutter, Tehama, Trinity, Tulare, Tuolumne, Yolo, Yuba
Suburban	Alameda, Contra Costa, El Dorado, Marin, Monterey, Napa, Orange, San Benito, San Bernardino, San Luis Obispo, Santa Barbara, Santa Cruz, Solano, Sonoma
Urban	Los Angeles, Riverside, Sacramento, San Diego, San Francisco, San Mateo, Santa Clara, Ventura

INTERIM SOLUTION COSTS

The evaluation of interim solutions primarily used data provided by the Division of Financial Assistance (DFA) regarding previous and currently funded interim drinking water projects, as well as knowledge on solution operation derived from conversations with multiple DFA staff. In addition to the data provided by the DFA, Interim Emergency Drinking Water and Drought Related funding applications publicly available on the Water Board's Financial Assistance Application Submittal Tool (FAAST) were reviewed. In some instances, the FAAST applications provided supplementary documents such as Scopes of Work, Project Timelines, and Itemized Budgets.

For a better understanding of how interim solutions are deployed in the field, interviews were also conducted with professional staff at organizations administering interim solutions and with staff of private companies providing the interim solutions. Secondary sources such as media stories with interim solution providers and emergency water recipients also provided corroborative insight into the costs of providing and maintaining interim drinking water solutions. When necessary, cost estimates derived from literature or other publicly available documents were used to supplement the cost data from the Water Board.

Interim solutions costs were only estimated for populations served by public water systems on the HR2W list and for At-Risk state small water systems and domestic wells, with a sub-analysis focusing only on the populations that also live in DACs. Based on board staff input, the term of interim water provision estimated was 6 years for HR2W list systems and 9 years for At-Risk state small water systems and domestic wells. Each domestic well was considered an individual connection. As in the long-term solution cost model, state small water systems are assumed to have 8 connections when connection data is not available for them.

In terms of deciding between bottled water versus POU or POE as an interim solution, POU or POE was assigned in every case where it was feasible given that it also has potential as a longer-term solution. That is, POU or POE was assigned in every case where either of these treatment technologies would address the underlying water quality issue(s) causing the water system, state small water systems, or domestic well to be on the HR2W list or At-Risk. Also, POU and POE were only assigned for systems serving 200 connections or less, as noted above.

Bottled Water Costs

To determine a cost per gallon figure, this analysis reviewed data on projects previously funded by the Water Board for 67 public water systems and 18 school systems. These findings were compared with estimated costs per gallon found in 48 applications for emergency bottled water projects in the FAAST database. The analysis considers the costs derived from FAAST applications but uses only costs from the funded projects and DFA analysis where there is confidence in actual spending amounts. DFA guidelines allocate a quantity 60 gallons of bottled water per month per connection for public water systems and 0.25 gallons per school day per person for school populations.

For the bottled water projects funded by the Water Board for 67 public water systems, the median cost of bottled water was $0.98 per gallon and the mean was $1.18 per gallon. In the funded school-system projects (at 18 school systems), the median cost of providing bottled water to school systems was $1.24 per gallon and the mean cost was $1.56 per gallon. Analysis provided by DFA of the cost per gallon for bottled water in school systems finds the cost per gallon to be $1.20 applied over a 180 day “school year”. The DFA figure is used in the analysis due to the small size of the school system data set.

This analysis attempted to explore potential factors driving variation in the average across systems: system size, duration of interim supply, system governance type, and location in the state. Due to the small sample size of past projects, however, the analysis could not confidently use these factors to model variation in cost per gallon of bottled water delivery for HR2W list systems.

The California Office of Emergency Services Emergency Drinking Water Procurement & Distribution Planning Guidance also contains a standing contract that the California Office of General Services Procurement Division entered into in 2014 and reports similar costs per gallon. This allows state and local governments to purchase emergency bottled water directly through the state contract. A half truckload of bottled water ranges from $0.98 - $1.58 per gallon per pallet while a full truckload costs $0.97 - $1.56 per gallon per pallet.[252]

Overall, these costs were in line with common bulk retail costs for bottled water, so there do not appear to be any apparent economies of scale advantage at play in the Board’s procurement and distribution process. This analysis tried to identify evidence of cost savings through economies of scale. As of yet, there is no evidence that the state benefits from bulk

[252] California Governor’s Office of Emergency Services, “Emergency Drinking Water Procurement & Distribution Guidance.” (2014)

bottled water agreements. There is anecdotal evidence that suggests in some school districts achieved cost savings in competitive bids or bulk purchasing but these costs savings cannot be confirmed or applied across the state.

There is also anecdotal evidence of project specific cost savings with local bottled water vendors or distributors offering reduced rates for bulk purchases or bidding a lower per-gallon rate in order to secure a purchase. However, there was no evidence to support that this would scale to a statewide level, due to the local conditions that play a part in these cost savings. Without cost savings the costs of providing bottled water can quickly add up when meeting daily consumption needs.

POU/POE

The Cost Assessment Model utilizes the same POU/POE costs for both long-term solutions and interim POU/POE solutions because many of the requirements related to POU/POE apply in both cases, e.g. pilot studies, water quality monitoring, etc. In some cases, fewer POU/POE units may be allowed for interim solutions as opposed to longer-term solutions. As the number of POU/POE units are determined on a case by case basis and current regulations require long-term POU/POE installations to be re-assessed every three years, the same cost assumptions are applied. Therefore, additional detailed cost information can be found below on POU/POE in the long-term solutions section.

PHYSICAL CONSOLIDATION COSTS

Capital Costs

The cost methodology for physical consolidation was based on previous work, entitled Cost Analysis of California Drinking Water System Mergers[253], which was completed by Corona for the Water Foundation. For the Needs Assessment, the cost details were updated. The approach was initially based on the method developed through a project at the UC Davis Center for Regional Change.[254] The costs accounted for in the physical consolidation of systems include:

- The capital costs of pipeline[255] needed to connect systems.
- Connection fees[256] charged by the receiving water system.
- Legal and administrative costs[257] to develop necessary agreements between connecting systems.

[253] https://waterfdn.org/wp-content/uploads/2019/08/COSTAN1.pdf

[254] London, J.; Fencl, A.; Watterson, S.; Jarin, J.; Aranda, A.; King, A.; Pannu, C.; Seaton, P.; Firestone, L.; Dawson, M.; & Nguyen, P., 2018. The Struggle for Water Justice in California's San Joaquin Valley: A Focus on Disadvantaged Unincorporated Communities. UC Davis Center for Regional Change.

[255] Provided by QK, Incorporated, which is an engineering design firm in the Central Valley.

[256] Based on the connection fees of 42 water systems reviewed.

[257] The legal and administrative cost assumption is based on information from an Investor Owned Utility for recent acquisitions in California. No other data or case studies are available.

- Service lines for systems already within the service area of another system (intersecting systems)
- A 20% contingency addition on the total.

Upgrades, such as back flow prevention, tanks, and metering required by receiving water system were addressed in the OEI needs section. The State Water Board recognizes that further analysis of corrosion control issues, disinfection byproduct formation, and residual degradation will need to be considered on a case-by-case basis but that it is highly location dependent and thus is out of the scope for this cost model.

The cost of physically consolidating systems can vary widely depending on several factors. High-level cost estimates were developed for this methodology which leverage existing California case studies from systems that have accomplished physical consolidation.

The distance along roadways from a joining system to a receiving system was determined using the methodology described in Attachment C1.[258] Physical consolidation costs were calculated as the sum of pipeline costs, service line costs, connection fees, and legal and administrative costs for system acquisition, with a 20% contingency. Cost assumptions are shown in Table C7. For domestic well pickups, $15,000 was also added for well destruction.

Table C7: Physical Consolidation Costs

Item	Cost Assumption
Pipeline Cost[259]	$155 per linear foot
Service Line Cost	$5,000
Connection Fees[260]	$6,600 per connection[261]
Legal and Administrative Costs for System Acquisition[262]	$200,000
CEQA	$85,000
Contingency	20% applied to total

[258] Attachment C1: Geographic Information System and Database Methodologies
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/c1.pdf

[259] Provided by QK, Incorporated, which is an engineering design firm in the Central Valley. 12” C-900 PVC main was selected in order to achieve 1,500 gpm flow to accommodate fire flow.

[260] Based on the connection fees of 42 water systems reviewed.

[261] For some systems (many state small water systems (SSWS)) population and connection information was not available; for these systems the number of connections was set to eight. The connection fee is based on the average connection fee reported in the 2018 Electronic Annual Report for large systems (3,000 connections or more), excluding connection fees of $500 or less. This resulted in data from 180 systems being included in the average.

[262] The legal and administrative cost assumption is based on information from an Investor Owned Utility for recent acquisitions in California. No other data or case studies are available. CEQA costs are included in this cost assumption.

In the case of elevation changes, due to physical consolidation, that would result in a pressure loss over 10 psi, two booster stations were budgeted: one for fire flow, and another capable of meeting Maximum Day Demand (MDD). Property cost was assumed to be $150,000 for a 100-foot by 100-foot lot. The booster station cost is discussed in the OEI Needs section.

Operational Costs

Physical consolidation can result in additional electrical costs due to the need to pump water to overcome head loss due to pipeline friction and elevation changes. The elevation changes along pipeline routes were determined, along with the pipeline length. These were used to estimate the additional electrical costs.

WELL HEAD TREATMENT COSTS

Treatment costs relied on three components: (1) estimating water demand, design and average flow rates, (2) determining the appropriate treatment solution, and (3) developing capital and operational cost details. The following sub-sections describe the methodology for each. Additional details about the cost methodology for treatment are available in Attachment C3.[263]

Estimating Water Demand, Design, and Average Flow Rates

The development of suitable water demand approximations for each drinking water system was required for the selection of a successful treatment or non-treatment option. Water demand approximations were especially important when developing capital costs and ongoing operations and maintenance costs. As there was no site-specific information for the systems included on the HR2W list and At-Risk lists, system water demands were calculated based on the methodology outlined in the *1,2,3-Trichloropropane Maximum Contaminant Level Regulations Initial Statement of Reasons.*[264]

An average daily demand (ADD) of 150 gallons/person/day was applied to the system population obtained from the SDWIS database. This ADD was based on the water usage provided to the State Water Board by 386 California urban water suppliers in June 2014 with an additional 10% demand. This value can be adjusted in the future to better reflect the water usage at that time. A peaking factor of 1.5 was applied to the ADD to calculate the MDD as stated in the *1,2,3-Trichloropropane Maximum Contaminant Level Regulations Initial Statement of Reasons* and in the California Code of Regulations title 22, division 4, chapter 16, section 64454.

[263] Attachment C3: Treatment Cost Methodology Details
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/c3.pdf

[264] California Water Boards. (2017). Initial Statement of Reasons 1,2,3-Trichloropropane Maximum Contaminant Level Regulations. Title 22, California Code of Regulations:
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/123-tcp/sbddw17_001/isor.pdf

To ensure that the proposed treatment capacity was conservative and to recognize that it was unrealistic to assume a source continuously operates 24 hours per day, treatment capacity was instead calculated by assuming the MDD must be produced during 16 hours a day, resulting in a 33% increase in capacity for treatment units and back-up wells.

Identifying Appropriate Treatment Solutions

HR2W list system violation types were identified, and only approaches listed as Best Available Technologies (BAT) in Title 22[265] were considered for treatment. A summary of the BATs for many of the violation types found in the HR2W list data are summarized in Table C8 below. Although adsorption was not listed as a BAT for arsenic removal, it was considered for small systems because of demonstrated performance and ease of operation.

Table C8: Summary of Drinking Water Best Available Technologies (BATs) for Common Groundwater Violations

Violation Type	Regulatory Limit (MCL)	Chemical Class	Best Available Technology (BAT)
Arsenic[266]	10 µg/L	Inorganic	Activated Alumina, **Coagulation/Filtration**,[267] Lime Softening,[268] Reverse Osmosis, Electrodialysis, Oxidation Filtration
1,2,3-TCP	5 ng/L	Organic	Granular Activated Carbon (GAC)
Nitrate	10 mg/L as NO_3	Inorganic	**Ion Exchange**, Reverse Osmosis, Electrodialysis
Uranium (Combined)	20 pCi/L	Radionuclides	**Ion Exchange**, Reverse Osmosis, Lime Softening,[269] Coagulation/Filtration
Fluoride	2 mg/L	Inorganic	Activated Alumina

With the exception of 1,2,3-TCP and fluoride, each of the violation types shown in the table had multiple BATs. For this methodology, treatment approaches were limited based on the assumption that liquid stream residuals disposal is not available on-site at impacted systems. This assumption eliminated processes like reverse osmosis and electrodialysis because the residuals volume requiring disposal would be physically and cost- prohibitive. Further, while processes like lime softening may be effective for some contaminants, they are rarely implemented for impacted systems. Capital and operational costs were developed for the

[265] State of California Drinking Water-Related Regulations
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/Lawbook.html

[266] Adsorption technology, although not listed as a BAT, was considered for arsenic treatment in small systems because of demonstrated experience and ease of operation

[267] Not considered BAT for systems <500 service connections

[268] Not considered BAT for systems <500 service connections

[269] Not considered BAT for systems <500 service connections

technologies in bold in Table C8, with the exception of arsenic where adsorption was assumed for systems of with less than 500 service connections due the relatively simple operations when compared to coagulation/filtration.

Estimating Water Treatment System Capital Costs

Potential water treatment solutions can vary considerably based upon site-specific considerations. In some cases, water systems that have multiple wells install water treatment systems on only the wells that were impacted by contaminants that pose a threat to human health. In other cases, if multiple wells in a water system were impacted by the same contaminant(s), pumping the impacted groundwater to a centralized treatment facility may be more cost effective. Due to the lack of individual well location data, this methodology did not develop such ancillary costs associated with centralized treatment.

The methodology of the cost model did consider the fact that treatment costs were generally non-linear as a function of source capacity where the unit cost of water produced tends to increase as production capacity decreases.

Some of the other factors that may influence the capital cost associated with installing new treatment systems include:

- Land that may need to be purchased to accommodate treatment system facilities
- The availability of pre-constructed treatment systems vs. the need to construct customized treatment
- Treatment system capacity requirements
- Complexity of system, if treating multiple contaminants
- Electrical improvements for system operation
- Wellhead improvements to overcome additional head loss

For the methodology, treatment system capital costs were derived from a variety of sources including costs models, peer reviewed articles and manufacturer supplied information. An example of sources used is provided in Table C9 with example contaminant types.

Table C9: Data Sources Used for the Development Capital Cost Estimates

Technology	Example Contaminants	Data Source	Notes
Granular Activated Carbon (GAC)	Volatile organics and Total Organic Carbon (TTHM, HAA)	Vendor Supplied Quotes	Outputs developed over a range of system sizes, based on commercially available equipment

Technology	Example Contaminants	Data Source	Notes
Anion/Cation Exchange	Nitrate, uranium gross alpha due to uranium, radium, and perchlorate	EPA Work Breakdown Structure[270]; calibrated to recent bid costs	Calibrated to recent bid costs for small-scale treatment systems
Coagulation Filtration	Arsenic, and iron and manganese	Vendor Supplied Quotes	Regressions used to inform costs of coagulation filtration
Surface Water Package Plant	Surface Water Rule Treatment violations	Vendor Supplied Quotes	None
4-Log Virus Inactivation	Surface water and groundwater under the influence of surface water	Vendor Supplied Quotes	None
Adsorption	Arsenic and fluoride	Vendor Supplied Quotes	Regressions used to inform costs of adsorption systems

Engineering multipliers were applied to the treatment equipment capital cost estimates to develop an estimate of the installed capital costs. Due to the varied data sources providing capital cost estimates for a range of equipment with unique installation requirements, the engineering multipliers were modified for each treatment technology. Included in the multipliers were cost estimates for installation of the treatment equipment, general site work, electrical, contingency, and other planning and administrative fees. Installation costs can vary widely depending on the individual site constraints, and these multipliers were only used to provide a Class 5 estimate. Table C10 displays the engineering multipliers used for each treatment technology.

Table C10: Engineering Multipliers Applied to Treatment Technology Capital Costs

Technology	Multiplier
GAC	2.36
Anion/Cation Filtration	2.36 to 3.06[271]
Coagulation Filtration	2.36
Fluoride	3.06
Surface Water Package Plant	3.06

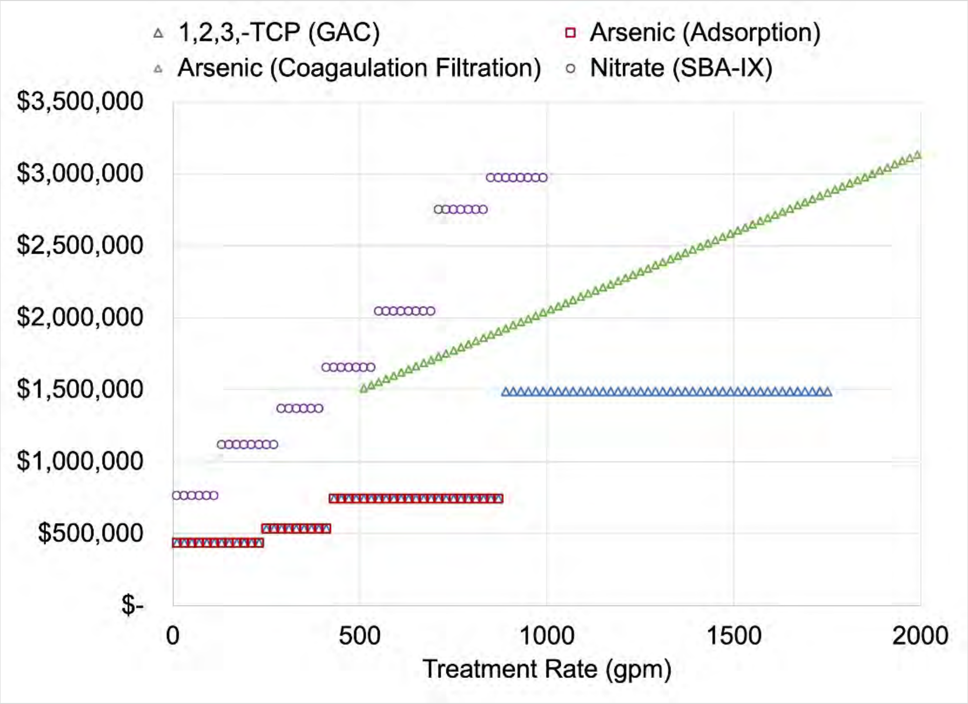
[270] Drinking Water Treatment Technology Unit Cost Models
https://www.epa.gov/sdwa/drinking-water-treatment-technology-unit-cost-models

[271] Indirect/installation costs included in the EPA Work Breakdown Structure plus 20% contingency

Technology	Multiplier
4-Log Virus Inactivation	3.06
Absorption	2.36

Attachment C3 contains the detailed methodology for each capital cost by technology.[272] An example of the resulting treatment costs for the most commonly applied treatment solutions is shown in Figure C7 as a function of flow rate. The treatment approach is shown in parenthesis following the contaminant's name. As described below, the same capital costs were applied for arsenic adsorption and GAC treatment which is illustrated by the overlap of these data series.

Figure C7: Installed Treatment Capital Cost Comparison Between Common Contaminants



Estimating Water Treatment System O&M Costs

While capital costs were an important factor to consider in the evaluation of water treatment solutions, it was just as important to have an understanding of the expected annual costs to operate and maintain a water treatment system. Operational costs for consumables were

[272] Attachment C3: Treatment Cost Methodology Details
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/c3.pdf

typically driven by the volume of water that required treatment annually and the expense of having a certified operator oversee the treatment process. Examples of operational costs considered included the following:

- Consumables
  - Chemicals
  - Media replacement: Granular activated carbon (GAC), ion exchange resin, green sand, activated alumina, other adsorbents, etc.
- Disposal of water treatment residuals: Ion exchange brine, coagulation filtration dewatered solids, spent media
- Electricity
- Additional monitoring and reporting
- Labor

Attachment C3 contains the detailed methodology of the Operational and Maintenance (O&M) cost by technology.[273] Operational costs were estimated by soliciting costs for consumables including chemicals and media. The cost of water treatment residuals disposal can be more variable. Options available for disposal may vary depending on the volume of residuals that are estimated annually. For this analysis it was conservatively assumed that sewer access was not available, and all residuals required off-site management. A 20-year operations and maintenance cost were used to develop a lifecycle cost comparison. Electrical costs were estimated based on the median cost of electricity in California ($0.1646/kWh[274]) and assuming a 10 PSI pressure loss across the system.

An example of the relative O&M costs for different treatment approaches is summarized in Figure C8. Note that the costs displayed only account for consumables and residual disposal as these components were modeled linearly as a function of water produced.

[273] Attachment C3: Treatment Cost Methodology Details
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/c3.pdf

[274] U.S. Energy Information Administration
https://www.eia.gov/electricity/monthly/epm_table_grapher.php?t=epmt_5_6_a

Figure C8: Comparison of Annual O&M Consumable & Disposal Costs by Treatment

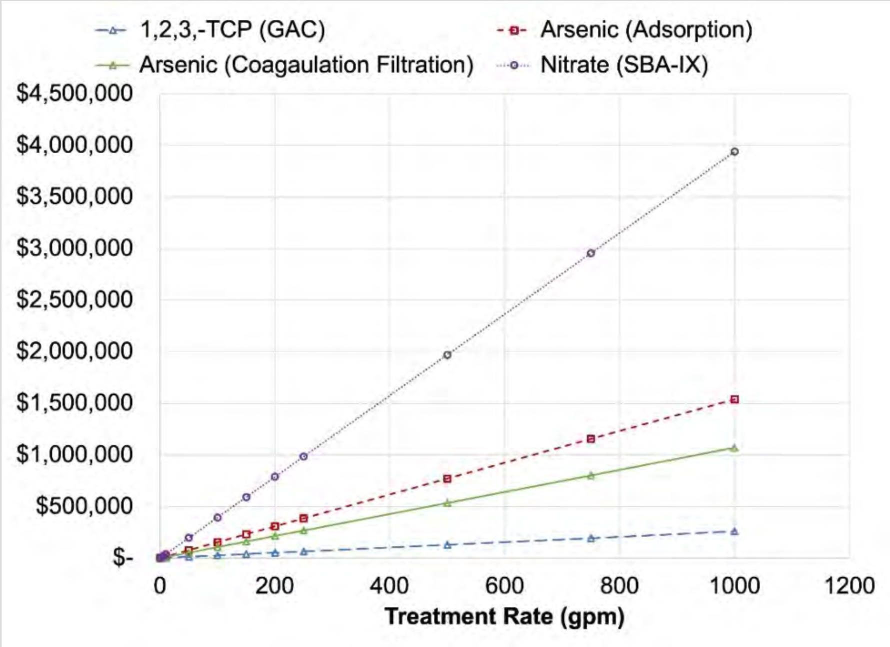


Table C11: Operator Salary and Benefits by Certification Levels[275]

Certification Level	Average of Total Pay, Including Benefits
T1	$ 97,000
T2	$ 105,000
T3	$ 132,000
T4	$ 164,000
T5	$ 181,000

Operator certification requirements were determined by the State Water Board, and for this model operator certification requirements were assumed as shown in Table C12. For budgeting purposes, operator labor cost was estimated by bins. Costs were binned by probable operator certification requirement and how much labor was required for each type of treatment. For example, both surface water treatment and nitrate treatment were considered to take 25% of a full-time operator. Surface water treatment was assumed to need a T4 operator, while nitrate treatment was assumed to need a T2 operator. Originally a T3 operator was

[275] Transparent California
https://transparentcalifornia.com/salaries/search/?page=20&y=2018&q=treatment+operator&s=-base
Base salaries and benefits from Transparent California were analyzed by Gregory Peirce at UCLA using 2018 data. Outliers were removed. Labor cost was adjusted to 2020 dollars.

specified for a water system with multiple contaminants, but the operator labor is associated with each treatment type specified, so systems with multiple contaminants have operator labor accounted for with each treatment unit, rather than one T3 operator labor rate.

Table C12: Annual Operator Labor Cost Estimate

Certification and Treatment Type	Percent of Full Time	Annual Cost
T4 Surface Water with high levels of source contamination	25%	$41,000
T2 High time intensity treatment (nitrate)	25%	$27,000
T2 Medium time intensity (U, As using CF)	20%	$22,000
T2 Low time intensity (GAC, Fe/Mn removal)	10%	$11,000

For many small systems, operator labor costs were a substantial part of annual operations and maintenance costs. Therefore, operator labor was kept as a separate line item in the operations and maintenance category for clarity.

POINT OF USE/POINT OF ENTRY TREATMENT COSTS

Point of Use or Point of Entry treatment was considered an option for public water systems with less than 200 connections and for state small water systems and domestic wells due to the complexity of monitoring and addressing units with individual residences. As previously discussed, Point of Entry Granular Activated Carbon (GAC) treatment was considered in the case of 1,2,3-TCP, or other volatile organic compounds to address health impacts of breathing the compounds during exposure in the shower. Point of Use treatment was considered for most commonly occurring inorganic contaminants (for example nitrate or arsenic). Point of Use was not recommended for nitrate over 25 mg/L[276] as nitrogen or for wells with bacteriological problems.

Limited installations of this type of treatment had been completed in California, and the costs have not always been clearly documented. The costs of POU and POE treatment were developed based on projected costs detailed in Table C13 and Table C14. The methodology assumed full replacement of the POU or POE treatment unit at 10 years. The cost for communication for POU or POE treatment is summarized in the next section.

[276] NSF/ANSI 58 – 2018, *Reverse Osmosis Drinking Water Treatment Systems*. Lists an influent nitrate concentration of 30 mg/L-N to achieve a treated water of 10 mg/L-N in the treated water. A safety factor has been applied to keep the treated water below 10 mg/L-N.

Table C13: Estimated Capital Cost for POE and POU Treatment

Treatment	Capital Cost per Connection	Installation Labor cost per Unit ($100/hr)	Admin/Project Management	Communication Cost
POE GAC Treatment	$3,700[277]	$1,000	$1,000	$300
POU Reverse Osmosis Treatment	$1,500[278]	$200	$1,000	$300

Note: For state small water systems and domestic wells an additional initial analytical budget of $500 was included because these wells rarely have water quality data.

Table C14: Estimated Annual Operations and Maintenance (O&M) for POE and POU Treatment

Treatment	Annual O&M per Connection	Operator and Communication Labor ($100/hr)	Analytical	Total
POE GAC Treatment	$410 (Prefilter and GAC Replacement 2x/year[279])	$300	$250 ($125 2x/ year[280])	$960
POU Reverse Osmosis Treatment	$100 (Prefilter and Membrane Replacement 2x/year [281])	$300	$40 - $110 (2x/year)	$440 - 510

OTHER ESSENTIAL INFRASTRUCTURE (OEI) NEEDS

Many of the HR2W list and At-Risk public water systems may have additional infrastructure needs that need to be addressed in order to make the system more sustainable. The following list of additional other essential infrastructure (OEI) needs was developed based on the Kern

[277] Based on costs of available POE treatment units in California.

[278] Vender provided costs.

[279] Based on vendor recommendations and pricing.

[280] Pricing quotes provided by BSK Analytical, in Fresno, California.

[281] Based on vendor recommendations and pricing, with freight.

County case study analysis[282] and refined based on public feedback. The Cost Assessment Model applies the percentages detailed in Table C15 to all HR2W list systems and At-Risk PWSs. The following sections detail the cost estimates derived for these OEI needs.

Table C15: Changes in OEI Needs for HR2W List and At-Risk PWSs

Infrastructure	Kern County Case Study Analysis	Cost Assessment Model Assumptions
Add a second well	All systems with one well	80% with one well
Replace well due to age	46%	26%
Replace well pump and motor	29%	9%
Upgrade electrical	29%	9%
Additional storage	56%	36%
Add back-up power	58%	38%
Replace distribution system	66%	31%
Add meters	82%	31%
Managerial assistance	All systems	80%
Land acquisition for additional storage	56%	10%
Land acquisition for adding a second well	All systems with second well	5%

New Groundwater Well(s)

Many systems needed a new well to replace aging infrastructure or provide reliable production capacity. Based on the Kern County HR2W list systems analysis, detailed in Attachment C2, the following assumptions were developed for HR2W list and At-Risk Public Water Systems:[283]

- 47% need a second well
- 26% need a replacement well due to well age

Costs, shown in Table C16, for a range of new well sizes and flow rates were developed by QK, Incorporated, a design-engineering firm located in the Central Valley. Cost for land purchase of a 100-foot by 100-foot lot was assumed to be $150,000. These costs were likely more representative of costs in the Central Valley than more expensive parts of the state.

[282] Attachment C2 contains the details of the Kern County analysis and how these assumptions were derived. Attachment C2: Kern County Case Study
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/c2.pdf

[283] Attachment C2: Kern County Case Study
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/c2.pdf

However, a CCI index adjustment was applied based on location to make the costs more locally grounded.

Additionally, 1,000-foot well depth costs were used in the cost model. In other regions across the state, well costs may be higher, but wells tend to be shallower. Also, in hard rock regions two wells may be required instead of one to achieve adequate capacity.

Test holes were assumed to be needed to understand the water quality at different depths since contamination is likely present.

In some cases, a new well could successfully be installed to avoid the local contaminant of concern and the corresponding cost of treatment. However, newly drilled wells often face the same water quality issue or a different water quality issue requiring treatment. A new well, for the purpose of this methodology, was not assumed to alleviate the need for treatment.

Table C16: New Well Drilling Costs

Depts (feet)	Test Hole Drilling & Zone Sampling (5 Zones) Cost	Production Well Drilling Cost
500	$120,000	$500,000
1,000	$140,000	$650,000
1,500	$170,000	$770,000

Assumptions:

- Test holes drilled by casing hammer method
- Production well drilling is separate from test hole drilling
- 500 foot depth for new wells at $500,000
- $150,000 added for land acquisition,[284] in addition to the tank costs
- $85,000 for CEQA, in addition to the tank costs

Table C17: New Well Development Costs

Estimated Production (gpm)	Cost
500	$120,000
1,000	$140,000
1,500	$170,000

[284] Land acquisition was assumed to be needed for each new well and tank. This is an assumption that should be further refined in the future with actual data from DFA.

Table C18: New Well Pump and Motor Costs

Motor Size (HP)	Rates Flow (gpm)	Cost
25	85	$125,000
50	170	$135,000
75	255	$155,000
100	340	$165,000
150	500	$190,000
300	1,000	$250,000

List of Well Assumptions:

- 500-foot depth
- Vertical turbine pumps
- Variable Frequency Drive (VFD) equipped
- Discharge pressure of 55 psi
- 20 feet draw down
- 800-foot static water level
- Surface mounted motor
- New power and control connection

Table C19: New Well Electrical Upgrade Costs

SCADA (cost per site)	Electrical Upgrades Cost per Site
$100,000[285]	$440,000

Assumptions:

- Main switchboard and motor control center
- Electrical conduit and wire - all equipment on a single 200' x 200' site
- Site lighting
- Transformer slab

An additional construction multiplier of 0.25 was added to account for engineering, permitting, and other construction costs, such as mobilization and demobilization. The construction multiplier was developed by QK Inc. in conjunction with their cost development. The multiplier is broken down in Table C10. An estimated cost for CEQA permitting was added along with the multiplier.

[285] Based on public feedback, SCADA costs were excluded from OEI costs.

Distribution System Replacement, Tanks, Electrical Improvements and Meters

In addition to new well construction, HR2W list systems and At-Risk PWS often have other assets that had not been properly maintained or were never installed at the time of system construction. For instance, a system may not have had enough storage to meet MDD, thereby requiring a storage tank to alleviate the problem. With this in mind, examples of needs for which high-level cost[286] estimates that have been developed and included in the cost estimate are shown in Tables C20 through C27.

Table C20: OEI Costs: Pipelines C-900 PVC

Pipeline Diameter	Cost per Foot	Rates Flow (gpm)
4"	$75	195
6"	$90	440
8"	$100	780
12"	$140	1,750

Assumptions:

- 3 feet burial, C900 pipe
- Open trenching (add $15/LF for asphalt replacement)
- Maximum velocity of 5 fps

Table C21: OEI Costs: Hydro-Pneumatic Tanks

Volume (gallons)	Cost
2,000	$35,000
4,000	$41,750
10,000	$62,100

Assumptions:

- Gross Volume (water storage volume roughly 50% of gross)
- Includes top mounted air compressor
- $150,000 added for land acquisition[287]

[286] Costs for the major capital improvements provided by QK, Incorporated, which is an engineering design firm in the Central Valley.

[287] Land acquisition was assumed to be needed for each new well and tank. This is an assumption that should be further refined in the future with actual data from DFA.

Table C22: OEI Costs: Ground Level Tanks

Volume (gallons)	Cost
50,000	$150,000
100,000	$250,000
250,000	$500,000
500,000	$875,000
1,000,000	$1,200,000

Assumptions:

- Bolted steel
- Ring wall base
- No corrosion protection
- $150,000 added for land acquisition, in addition to the tank costs
- $85,000 for CEQA, in addition to the tank costs

Table C23: OEI Costs: Booster Pump Systems (One Operational and One Standby)

Capacity (gmp)	Motor Size (HP)	Cost
100	5	$40,000
200	10	$70,000
300	15	$82,000
400	20	$100,000
500	25	$115,000
750	35	$130,000
1,000	60	$150,000

Assumptions:

- VFD Package system - skid mounted with PLC and controls
- Piping and valving between pumps included
- Electrical costs not included
- Discharge pressure of 55 psi assumed

Table C24: OEI Costs: Well Pump and Motor Replacement

Motor Size (HP)	Rate Flow (gpm)	Cost
25	85	$125,000
50	170	$135,000

Motor Size (HP)	Rate Flow (gpm)	Cost
75	255	$155,000
100	340	$165,000

Assumptions:

- 500-foot depth
- Vertical turbine pumps
- VFD equipped
- Discharge pressure of 55 psi
- 20 feet draw down
- 800-foot static water level
- Surface mounted motor
- New power and control connection

Table C25: OEI Costs: Electrical Upgrades

SCADA (cost per site)	Electrical Upgrades Cost per Site
$100,000[288]	$440,000

Assumptions:

- Main switchboard and motor control center
- Electrical conduit and wire - all equipment on a single 200' x 200' site
- Site lighting
- Transformer slab

Table C26: OEI Costs: Generators

Size (KW)	Rate Flow (gpm)	Cost
5	18	$50,000
30	110	$64,000
50	180	$80,000
75	270	$110,000
100	365	$160,000

Assumptions:

- Sized with 25% reserve

[288] Based on public feedback, SCADA costs were excluded from OEI costs.

- Based on powering well pump based on the assumptions above
- Power to booster pumps and ancillary equipment
- Diesel generators
- Automatic transfer switch

Table C27: OEI Costs: Residential Water Meters

Equipment and Software (drive by[289])	1" Meters (drive by)
$29,000[290]	$825

Assumption: Installation on an existing service

All Costs Include:

- Shoring
- Storm Water Pollution Prevention Plan
- Prevailing Wage
- Associated taxes and delivery

Costs Do Not Include:

- Permitting with PG&E or SCE
- Engineering, design, permitting
- Mobilization/demobilization

The costs that were not included above (for example CEQA, permitting, and engineering) were handled with an additional construction multiplier of 0.25. The construction multiplier was developed by QK Inc. in conjunction with their cost estimates. The multiplier is broken down in Table C28. An estimated cost for CEQA permitting was added along with the multiplier.

Table C28: Construction Multiplier Breakdown[291]

Category	Multiplier
Engineering and Design	0.15
Permitting	0.05
Mobilization / Demobilization	0.05
TOTAL MULTIPLIER:	**0.25**

[289] This type of meter allows the meter reader to drive by and take an automated reading, as opposed to a manual reading.

[290] Based on public feedback, software costs were excluded from meter costs within the OEI costs.

[291] This is a construction multiplier for OEI needs and is based on cost estimates from the Central Valley. The construction multipliers are larger for modeled treatment solutions and are detailed in the sections above.

OEI General Assumptions

The following are general assumptions around OEI needs:

- 100% of wells at schools that may use physical consolidation as a solution will be assumed to be destroyed. Some schools may decide to use the contaminated well for irrigation. There is significant cost associated with separating a potable water system from an irrigation system.
- 100% of systems identified for nitrate treatment will have SCADA.
- Many of the systems with some storage are counting small pressure tanks. The Cost Assessment Model assumed that any system needing storage will need a tank sized to meet MDD.
- For main replacement costs we are assuming a 4-inch PVC main, and that each customer connection is associated with 80 feet of main, along the property fronts.
- For residential connections, 1” meters will be assumed.

Backflow prevention assemblies were proposed in the November 2020 version of proposed Cost Assessment methodology.[292] Based on public feedback, backflow prevention assemblies were removed from the OEI needs costs.

TECHNICAL ASSISTANCE (MANAGERIAL SUPPORT)

In many cases technical assistance (TA) does not eliminate the need for other capital improvements, but it should increase the technical, managerial, and financial capacity of systems to address issues in each system. Managerial support is designed to assist water systems in developing the financial and managerial structures to ensure a sustainable water system, including asset management plans, water rate studies, fiscal policies, drought plans, etc.

Available data on the costs associated with TA (managerial support) costs are sparse. Limited case studies,[293] summarized in Table C29, were gathered to inform managerial consolidation costs. In the case of a system needing an Administrator, service was assumed to be needed for 5 years, to have adequate time to obtain funding to assist in solving the challenges and developing a long-term strategy. As more systems implement managerial consolidation, more case studies will become available and the cost model will be refined. The average one time legal and administrative costs were applied to physical consolidation. In the future, this cost could be applied for a separate Managerial Consolidation modeled solution option.

[292] White Paper: Long Term Solutions Cost Methodology for Public Water Systems and Domestic Wells https://www.waterboards.ca.gov/safer/docs/draft_whitepaper_lt_solutions_cost_methd_pws_dom_wells.pdf

[293] Two case studies of receivership costs have been provided by the State Water Board. An Investor Owned Utility has provided an average cost for the legal and administrative fees associated with system acquisition in California.

Table C29: Managerial Costs

Annual Cost for TA for a Lower Need System	Annual Cost for TA for a Higher Need System
$12,000 ($60,000 for 5 years)	$60,000 ($300,000 for 5 years)

Assumptions for HR2W List and At-Risk Public Water Systems
HR2W list and At-Risk PWSs were expected to have a variety of technical, managerial, and financial capacity issues in addition to significant infrastructure needs. Technical assistance in the form of managerial support was assumed for all the HR2W list and At-Risk PWS. As shown in Table C29, the "Annual Cost for TA (Managerial Support)" t was set at $12,000 per year for 5 years ($60,000 total), likely representing a TA cost for a lower-need water system.

A combination of updated infrastructure and proactive long-term managerial and fiscal policies can help address affordability issues and preventatively meet the needs of these water systems before expensive emergency responses are necessary. Implementation of rate structures and fiscal policies to ensure repair and replacement of any installed infrastructure upgrades, funded by State grants, is anticipated to be a funding eligibility requirement for TA assistance.

SUSTAINABILITY AND RESILIENCY ASSESSMENT

For many systems, several solutions were identified via modeling as possible for HR2W list systems. The State Water Board recognizes that the lowest-cost modeled solution may not be the best long-term solution of a system or community. The Cost Assessment Model therefore incorporates the SRA to compare each HR2W list system's potential modeled solutions and select a single selected solution for the Cost Assessment. The SRA was developed and executed by OWP at Sacramento State and the State Water Board, in collaboration with UCLA, Corona, and the Pacific Institute.

The SRA uses four sustainability metrics to rank the potential modeled solutions for each system.[294] The metrics were selected based on a literature review of four primary categories of sustainability and resiliency: technical performance, economic viability, environmental sustainability and social acceptability. The identified metrics were then screened through internal consultation with project collaborators. The metrics remaining after the screening process were then evaluated based on their applicability and their data properties (i.e., data availability, quality, and site-specific requirements) to select a list of final metrics for inclusion for the SRA. Table C30 lists the final selected metrics and their definitions.

[294] Previous white papers published by the State Water Board associated with the development of the Cost Assessment included additional SRA metrics that were ultimately excluded from the Cost Assessment model.

Table C30: SRA Metrics and Definitions

SRA Metric	Definition
O&M Cost/Connection	O&M cost estimates of a potential solution divided by the # connections in a water system
Relative Operational Difficulty	Technical complexity of treating water to comply with water quality standards. Dependent on number and complexity of treatment processes
Operator Training Requirements	Grade-level certification required to operate a treatment and distribution system. Dependent on contaminant type and associated treatment processes
Waste Stream Generation	Difficulty of managing residuals created by a treatment solution. Dependent on whether a waste stream is generated, type of waste stream (solid vs. liquid), and residual properties (e.g. hazardous, special disposal required)

A scoring system was then developed to assign points to each metric based on the general characteristics of the various modeled solution types. The four metrics were each allotted a maximum of five points (where 5 is the most sustainable), so the maximum total SRA score after summing those from all metrics was 20 points. No weighting was used. To determine the actual score for each metric, matrices were developed that assign scores based on specific characteristics of the various possible modeled solutions.

For example, a modeled solution with a low O&M Cost per Connection, no waste stream generation and relatively high ease of operation would score higher (i.e., more indicative of being sustainable) than an alternative with a higher O&M Cost per Connection, a generated waste stream and a highly complex treatment process.

Figure C9 provides partial examples for the Relative Operational Difficulty and Waste Stream Generation metrics.

Figure C9: Example Matrices for SRA Scoring

Relative Operational Difficulty SRA Scoring

Model Solutions	*Requires Media Regeneration?*	*Requires Filter Backwash?*	*Requires Access to Home?*	*Requires Travel to Operate?*	Ordinal Score (1-5)
Physical Consolidation	No	No	No	No	5
Uranium Wellhead Treatment	No	No	No	No	4
POE	No	No	No	Yes	3
… See Attachment C4 for full list of solutions					

Waste Stream Generation SRA Scoring

Model Solutions	Ordinal Score (1-5)	Score Justification
Physical Consolidation	5	**5** = No waste stream generated
Arsenic Wellhead Treatment	4	**4** = Treatment produces a waste stream that is hazardous **AND** has special disposal considerations
Nitrate Wellhead Treatment	2	
Uranium Wellhead Treatment	3	**3** = Treatment produces a waste stream that is hazardous **OR** has special disposal considerations
Perchlorate Wellhead Treatment	3	
Fluoride Wellhead Treatment	4	**2** = Treatment technology produces non-hazardous waste stream with **no** special disposal considerations
POU	2	
… See Attachment C4 for full list of solutions		**1**= Multiple treatment technologies producing waste streams

For the Relative Operational Difficulty metric, scores were based on the answers to following questions for each potential modeled solution:

- Does the solution require media regeneration?
- Does the solution require filter backwash?
- Does the solution require access to homes?
- Does the solution require an operator to travel to operate?

For physical consolidation solutions, the answer to all these questions is no, indicating a low level of relative operational difficulty. Physical consolidation was therefore assigned a maximum score of five. This is because it is assumed that with consolidation, operations will be taken over by another entity. which has the capacity to address the HR2W list systems' water quality needs.

For uranium wellhead treatment, all answers were also no, but the score assigned was four, just lower than physical consolidation. Systems using uranium wellhead treatment will require a system operator. For POE, the answers to the first three questions are no, but the last answer is yes. POE was assigned a score of three, assuming a moderate operational difficulty since maintenance requires scheduling with households to replace GAC to prevent

VOC/DBP/TCP breakthrough. Scores for other modeled solutions were assigned based on a similar question-by-question exercises.

Scoring assignments for the Waste Stream Generation metric were simpler. Ordinal scores of one through five were defined as shown in Table C31. Scores for each type of modeled solution were then assigned based on these definitions.

Table C31: Waste Stream Generation Score Definitions for SRA Scoring

Ordinal Score	Definition
5	No waste stream generated
4	Treatment produces non-hazardous waste stream with no special disposal considerations
3	Treatment produces a waste stream that is hazardous OR has special disposal considerations
2	Treatment produces a waste stream that is hazardous AND has special disposal considerations
1	Multiple treatment technologies producing waste streams

Scores were assigned to each modeled solution type for the Operator Training Requirements and O&M Cost per Connection metrics following similar processes that take solution characteristics into consideration. The Operator Training Requirements metric scoring was based on the requirements stated in California Code of Regulations Section 64413.1, Classification of Water Treatment Facilities. The O&M Cost per Connection metric scoring involved establishing tiers of numeric ranges, with a score between one and five assigned to each tier.

Attachment C4 provides the detailed scoring methodology for all metrics.[295] The SRA scores were then used with each potential modeled solution's costs to select a final modeled solution for each system. The aggregated costs of selected modeled solutions are what is summarized in the Needs Assessment report.

SELECT MODELED SOLUTION FOR EACH SYSTEM

HR2W LIST SYSTEMS

After estimating the costs and determining SRA scores for each system's potential modeled solutions, the SRA scores and cost estimates were compared to select a final modeled solution for each system. Then the costs of the selected modeled solution for each system were used to report the summaries presented in the Needs Assessment report. This selected modeled solution is only for the purpose of estimating an overall projected budget need for the

[295] Attachment C4: Sustainability and Resiliency Assessment
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/c4.pdf

State and does not dictate the solution that a system must select to achieve compliance and long-term resiliency. The ultimate solution that will be implemented will involve more detailed investigation of each water system and should include the input of the community and other stakeholders.

Selection of the final modeled solution followed a step wise process, as demonstrated in the decision tree in Figure C10. The selection process starts by examining whether a HR2W list system has more than one modeled solution. If only one solution is available, this solution is selected. However, if there are more than one modeled solution, the top two modeled solutions with the highest long-term sustainability and resiliency scores are selected.

After selecting the two modeled solutions with the highest sustainability and resiliency scores (the “top two selected modeled solutions”), the decision-making process becomes contingent on whether physical consolidation is one of the top two selected modeled solutions. If physical consolidation is not one of the two selected solutions, then the non-physical consolidation solution with the lowest 20-Year NPW is selected. However, if physical consolidation is one of the top two selected solutions, the process proceeds to examine whether it meets either of the following criteria: (1) Total capital costs less than $500k; or (2) Capital costs/connection less than $60k.

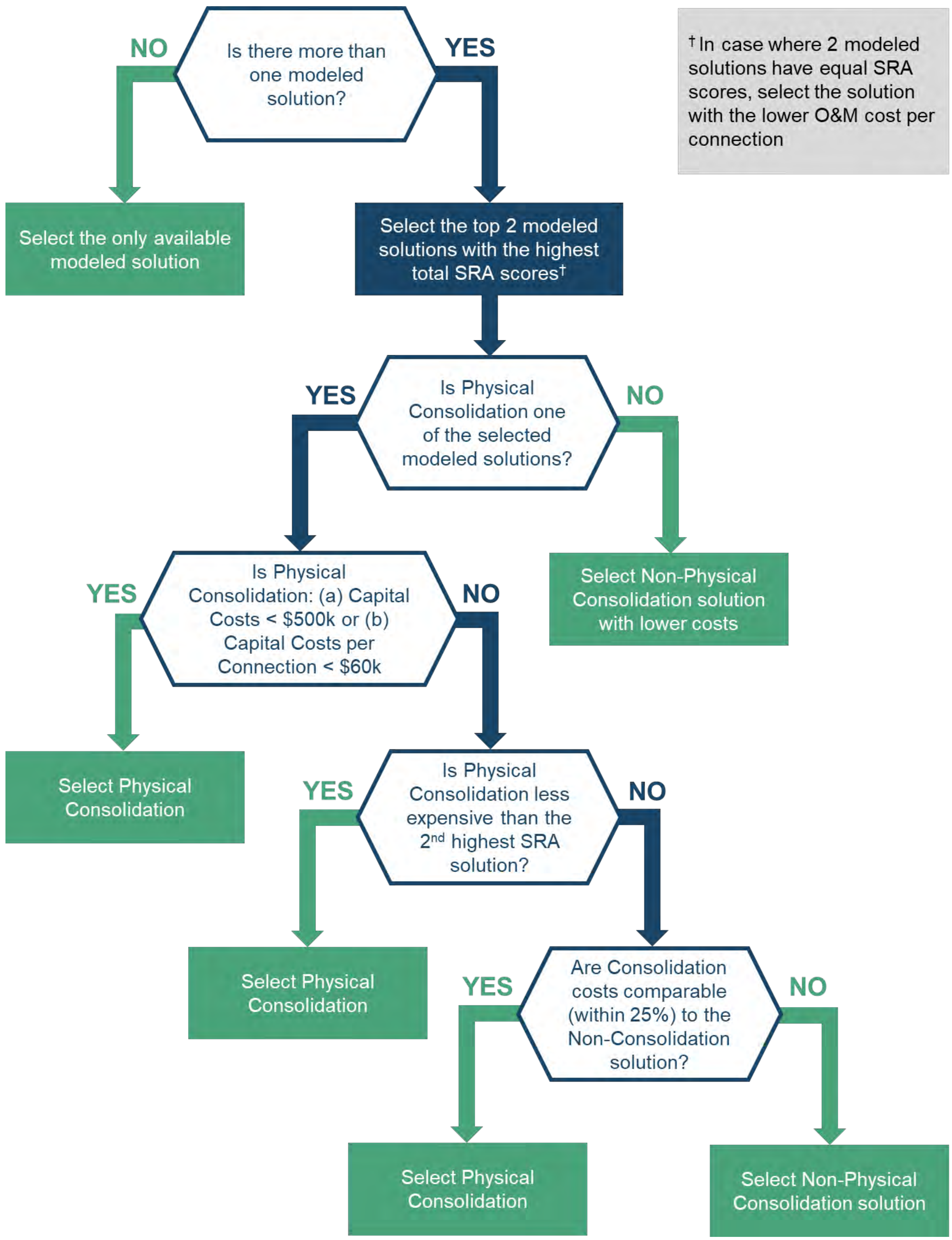
If physical consolidation meets either of these criteria, then it is chosen as the final selected modeled solution. However, if physical consolidation does not meet either criteria, then the process advances to check if physical consolidation has lower capital costs than the second selected solution.

If physical consolidation has a lower capital cost than the second selected modeled solution, then it is selected as the final modeled solution. Otherwise, if physical consolidation’s capital costs exceed those of the second modeled solution, the model examines whether the capital cost of physical consolidation is comparable to those of the second modeled solution.

If the capital cost of physical consolidation is comparable to the alternative solution’s capital costs, then physical consolidation is selected as a final modeled solution. Otherwise, the alternative non-physical consolidation solution is selected.

Note that for these latter decision steps, “comparable” is considered to be within 25% of each other. The 25% threshold was selected by the State Water Board as a reasonable cost differential margin within which to select physical consolidation despite its costs being higher and is used only for purposes of the Cost Assessment effort. This assumption does not guide State Water Board funding decisions.

Figure C10: Decision Tree for Selecting Final Modeled Solution Used for Cost Estimate Results for HR2W List Systems



AT-RISK PUBLIC WATER SYSTEMS

At-Risk PWSs were evaluated for physical consolidation as a possible modeled solution. Where physical consolidation was $60,000 per connection or less, this solution was assigned as the selected modeled solution. Where costs were greater than $60,000 per connection, physical consolidation was removed as a possible modeled solution. Further evaluation is needed to determine which of these physical consolidations could be part of a larger regional project. All At-Risk PWSs had OEI needs costs applied, as well as Technical Assistance for managerial support costs. No treatment or POU/POE treatment was considered for At-Risk PWSs.

AT-RISK STATE SMALL WATER SYSTEMS AND DOMESTIC WELLS

At-Risk state small water systems and domestic wells were evaluated for physical consolidation potential, POU and POE, as well as for interim solution costs. Physical consolidation was only considered a viable option if it was part of larger regional consolidation project and was cost effective. Cost effectiveness was defined as a per connection cost less than or equal to $60,000. For At-Risk SSWS and domestic wells where physical consolidation was not viable, POU and POE treatment was budgeted as a long-term solution. For some, as noted above, there was no viable solution besides bottled water because POU treatment cannot be effectively used for nitrate concentrations over 25 mg/L-N.

ROLL-UP OF ESTIMATED COSTS

The estimated costs of the selected solutions for HR2W list systems, At-Risk public water systems, state small water systems, and domestic wells were aggregated into a statewide cost estimate. This cumulative statewide cost estimate was meant to provide a broad overview of the potential projected demand for the Safe and Affordable Drinking Water Fund. The aggregated cost estimate will be conducted annually and will be included in the Fund Expenditure Plan.

IDENTIFY FUNDING NEEDS AND FUNDING GAP

The Pacific Institute, a subcontractor to the Needs Assessment team led by UCLA, developed an approach to (1) evaluate the funding alternatives available for both interim and long-term solutions identified by the Cost Assessment Model and (2) estimate the gap between the funding potentially available and the amount needed over time. Appendix D below provides full details of the Gap Analysis methodology.

APPENDIX D:
GAP ANALYSIS METHODOLOGY

INTRODUCTION

The Cost Assessment Model was developed to estimate the costs related to the implementation of interim and/or emergency measures and longer-term solutions for HR2W list and At-Risk systems. The Gap Analysis is the final step within the Cost Assessment Model.

The Pacific Institute, a subcontractor to the UCLA Needs Assessment contract, developed an approach to (1) estimate the funding needed for solutions for HR2W list and At-Risk systems and (2) estimate the gap between the funding and financing potentially available and the amount needed over one year and five year time periods into the future. These estimates will help the State Water Board inform future SADWF Fund Expenditure Plans (FEPs) and be used to communicate the SAFER Program's funding needs to decision makers and stakeholders. This statewide analysis was the final step of the Cost Assessment and was not intended to inform funding decisions nor local decisions for drinking water systems.

GAP ANALYSIS METHODOLOGY DEVELOPMENT PROCESS

The State Water Board and the Pacific Institute worked together to develop the funding and financing Gap Analysis methodology. The Gap Analysis development process was embedded in the development of the Cost Assessment. Both efforts were designed to encourage public and stakeholder participation, providing opportunities for feedback and recommendations throughout. The Gap Analysis methodology was also dependent on significant guidance from the State Water Board's Division of Financial Assistance (DFA). DFA provided insight on State Water Board funding availability, funding program eligibilities, and recommendations on how to assess potential funding and financing gaps.

The State Water Board and the Pacific Institute hosted a webinar workshop *Cost Assessment Model Preliminary Results and Gap Analysis*[296] on February 26, 2021 to seek public feedback on the proposed methodology for the funding and financing Gap Analysis. Details on the proposed methodology were provided in the February 25, 2021 white paper *Gap Analysis for Funding Solutions for Human Right to Water and At-Risk Drinking Water Systems*.[297]

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[296] Webinar recording can be found at the Needs Assessment website: Needs Assessment | California State Water Resources Control Board https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/needs.html

[297] White Paper: Gap Analysis for Funding Solutions for Human Right to Water and At-Risk Drinking Water Systems https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/docs/Draft_White_Paper_Needs_Assessment_Gap_Analysis_FINAL.pdf

Adjustments to the Gap Analysis methodology were made based on feedback during the webinar and comment letters that were received following the webinar. Additional details that were requested in the comment letters have been added to this Gap Analysis Methodology Appendix.

GAP ANALYSIS METHODOLOGY

The Gap Analysis is the final step of the Cost Assessment (Figure D2) and its methodology is composed of three main steps. The first step focuses on refining the funding needs, modeled by the Cost Assessment, for implementation of interim and long-term solutions for current HR2W list and At-Risk systems. The second step concentrates on identifying State Water Board funding sources and external funding sources that can be leveraged to support the identified funding needs based on project and borrower eligibilities. DAC status and other system-level characteristics were utilized to refine this analysis. The third and final step uses the State Water Board's SAFER Program funding priorities to determine the funding and financing gap for the refined estimated funding need. This third step also estimates how many years it may take to meet all identified and projected funding needs. Together, these steps provide an estimate of how much it may cost and how long it may take to achieve the HR2W with existing funding sources. However, it is important to highlight that other State, Federal, and private funding and financing may be available to meet some of these needs, and that large regionalization projects may reduce cost needs.

Figure D1: Gap Analysis Methodology

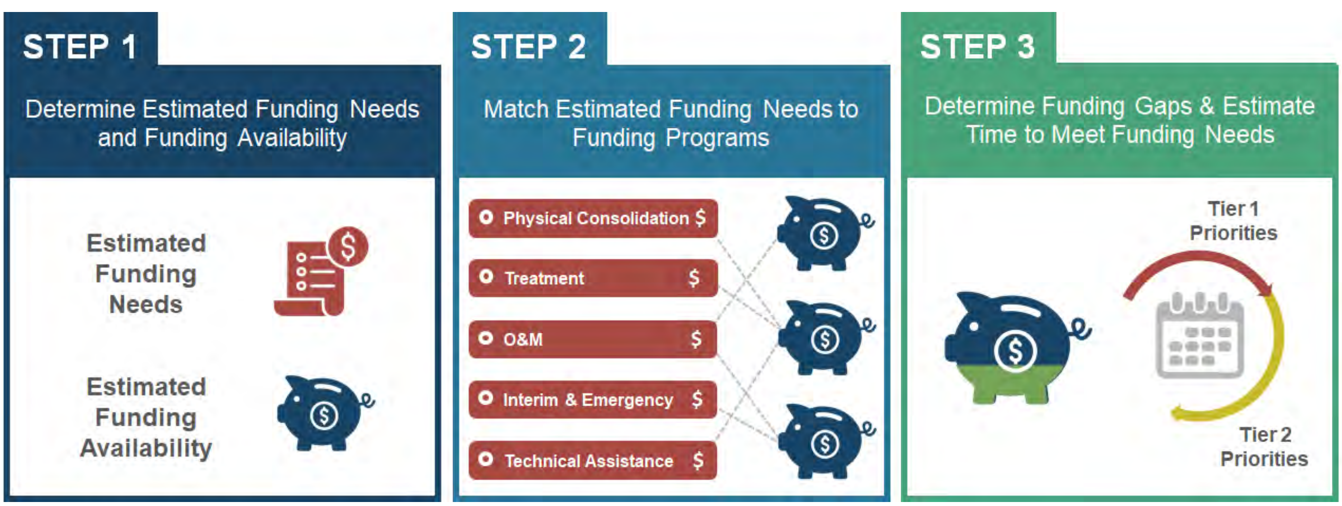
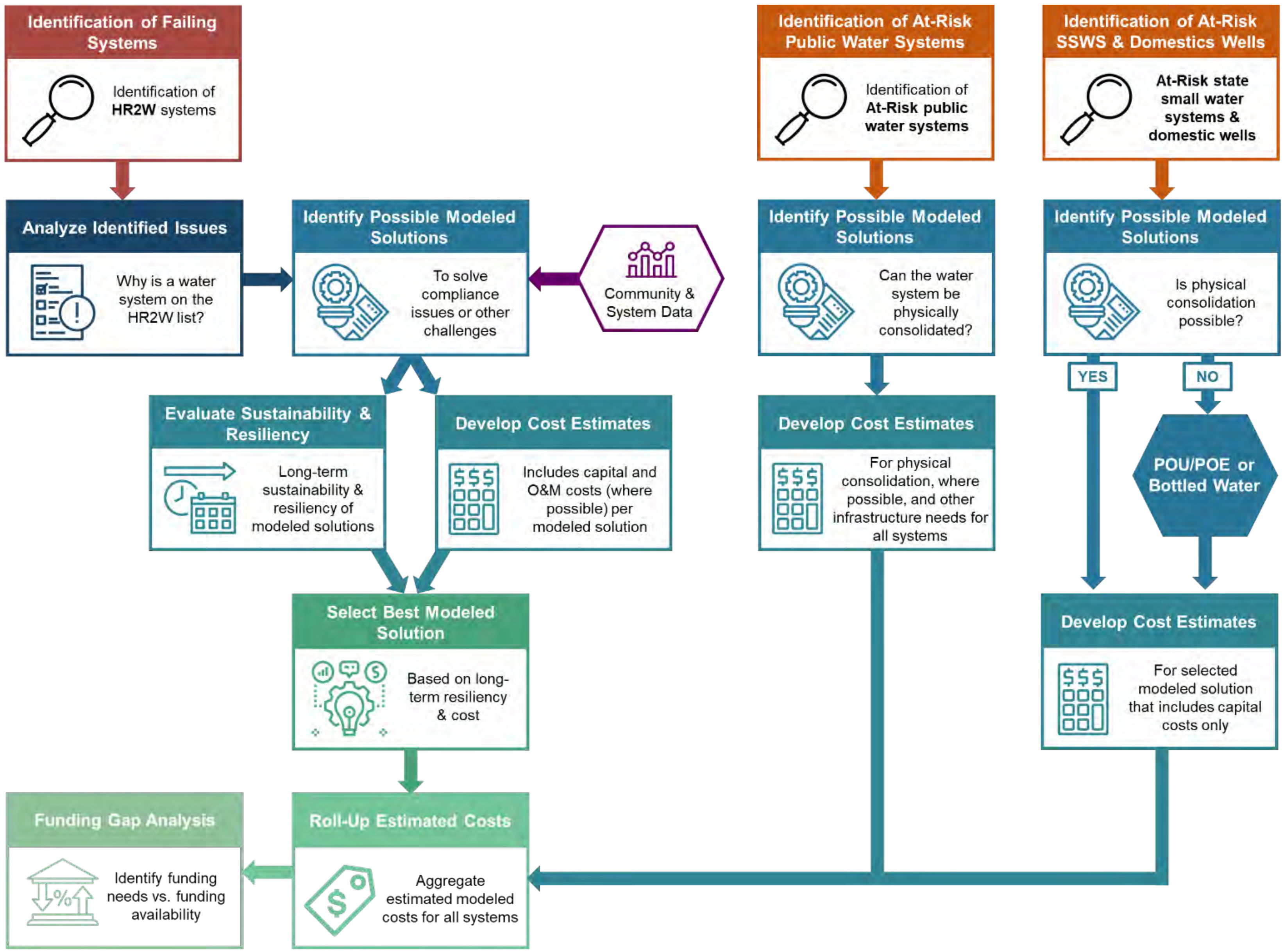


Figure D2: Cost Assessment Model Process

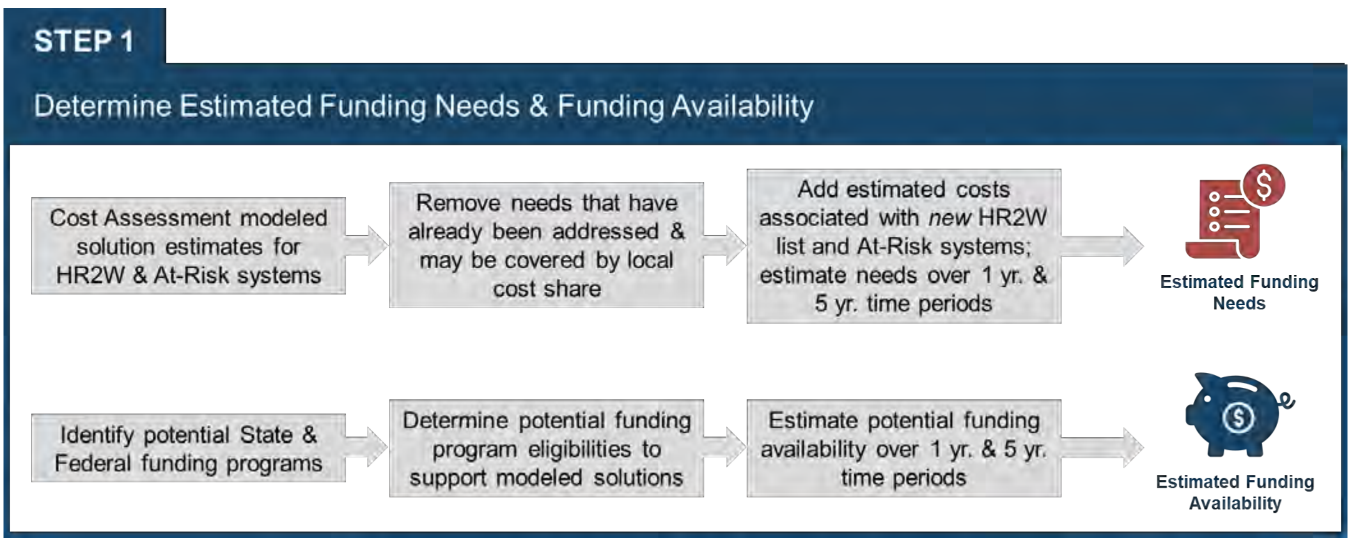


STEP 1: ESTIMATING FUNDING NEEDS AND FUNDING AVAILABILITY

The Gap Analysis methodology refined the modeled interim and long-term solution cost estimates produced by the Cost Assessment by: (1) removing the estimated costs for systems that have already received funding assistance; (2) removing a proportion of estimated costs that would be met by communities through local cost share; and (3) adding estimated new costs associated with new HR2W list water systems and At-Risk water systems each year for up to 5 years. Together, these three refinement steps produce the estimated funding need utilized in the Gap Analysis. Furthermore, the funding need for the modeled solutions for HR2W and At-Risk systems was estimated both for this current year ("Year 1") and for five years into the future ("Year 5"). This multi-pronged approach provides a short-term and longer-term understanding of the estimated funding need over time.

Available funding was determined by analyzing existing State Water Board funding programs. The Gap Analysis focused on the gap that may exist after State Water Board funding sources are exhausted; however, the Gap Analysis also highlighted opportunities where additional non-State Water Board state funding and Federal funding programs may be leveraged to expand the potential impact of the agency's available funding programs in the future.

Figure D3: Step 1 of the Gap Analysis Methodology



ESTIMATING FUNDING NEEDS

Cost Assessment Model Estimates

Earlier steps in the Cost Assessment Model identified and estimated the capital, operations and maintenance (O&M), and 20-year Net Present Value (NPV) costs for long-term modeled solutions for 305 HR2W list systems and approximately 620 At-Risk public water systems (PWS).[298] The Cost Assessment Model also generated cost estimates for At-Risk state small

[298] The information generated by this model will not be used to inform system or community-level decisions around solution selection, implementation, or funding allocations.

water systems (SSWS) and domestic wells. In addition, interim solution costs were modeled for HR2W list water systems, At-Risk PWS, SSWS, and domestic wells.

The number of systems modeled differs between the interim and long-term solution cost efforts. Table D1 shows the number of systems from the long-term and interim solutions data sets, with the total number of unique systems included in the first year of the Gap Analysis. Note that for Year 1 of the Gap Analysis, 47 new HR2W list systems and 95 new At-Risk PWS were added to the Gap Analysis, described further below. For SSWS, 455 systems were included in the cost model for long-term solutions, while 611 systems were included in the cost model for interim solutions. This difference is due to the risk status of the systems, with SSWS deemed at-risk receiving estimated interim solutions. For domestic wells, about 63,000 systems were included in the cost model for long-term solutions while about 78,000 systems were included in the cost model for interim solutions because different datasets were used in different elements of the cost model.

Table D1: Total Count of HR2W list systems, At-Risk PWS, At-Risk SSWS, and domestic wells in Year 1 of the Gap Analysis

System Type	# of Systems with Long-Term Solutions	# of Systems with Interim Solutions	# of Unique Systems in Yr. 1 of the Gap Analysis
HR2W list	305	305	352
At-Risk PWS	630	40	725
At-Risk SSWS	455	611	830
At-Risk Domestic Wells	62,607	77,567	98,315

Potential modeled solutions are listed and described in Table D2.

Table D2: Modeled Potential Solutions for HR2W List Systems, At-Risk PWS, At-Risk State Small Water Systems (SSWS), and At-Risk Domestic Wells[299]

Modeled Solution	Description	Modeled For
Physical Consolidation	The joining of infrastructure of two or more water systems that are geographically close.	HR2W, At-Risk PWS, At-Risk SSWS, At-Risk Domestic Wells
Treatment	Treatment solutions are used to address contaminants that exceed water quality	HR2W

[299] Details on how the Gap Analysis will differentiate between local cost share and State Water Board support is provided in Tables 2 and 3.

Modeled Solution	Description	Modeled For
	standards. For a full list of treatment solutions considered, see "Long Term Solutions Cost Methodology for Public Water Systems and Domestic Wells, Version 2".[300]	
POU/POE	Point-of-use (POU) or point-of-entry (POE) treatment are used to address contaminants that exceed water quality standards, when other solutions are infeasible.	HR2W systems with less than 200 connections, At-Risk SSWS, At-Risk Domestic Wells where other options are infeasible
Other Essential Infrastructure (OEI)	A broad category that includes storage tanks, new wells, well replacement, upgrade electrical, add backup power, replace distribution system, add meters, and land acquisition.	HR2W, At-Risk PWS
Operations & Maintenance (O&M)	Ongoing, day-to-day operations and maintenance of a water system.	HR2W
Interim Solutions	POU/POE and bottled water, including the O&M costs for maintaining a temporary installment of POU/POE systems.	HR2W
Technical Assistance	A broad category of support to assist water system operators and managers with planning, construction projects, financial management, and O&M tasks.	HR2W, At-Risk PWS

After all feasible modeled solutions were identified, the Sustainability and Resilience Assessment (step 4a in the Cost Assessment Model for HR2W list systems) helped further refine the results of the Model by identifying the top two most sustainable and resilient modeled solutions for each HR2W list system. The Cost Assessment Model then applied a set of criteria to identify which of the two modeled potential solutions should be selected for the aggregated cost estimate. For details on the methods used for these steps in the Cost Assessment Model, refer to Appendix C.

[300] Long Term Solutions Cost Methodology for Public Water Systems and Domestic Wells
https://www.waterboards.ca.gov/safer/docs/draft_whitepaper_lt_solutions_cost_methd_pws_dom_wells.pdf

Removing Costs for Systems with Funding Agreements

The first step of refining the Cost Assessment's estimated funding need is to remove the estimated interim and long-term solution costs associated with systems that already have funding agreements with the State Water Board. The funding agreements included were based on information from DFA from February 18, 2021 for HR2W list systems and from March 4, 2021 for At-Risk PWS.[301] This resulted in the removal of 21 HR2W list and 10 At-Risk systems with existing funding agreements for an interim solution, 52 HR2W list and 20 At-Risk systems with funding agreements for a long-term solution, and 19 HR2W list and 3 At-Risk systems with funding agreements for both an interim and a long-term solution.

Estimating and Removing Local Cost Share

To refine the estimated funding need, the Gap Analysis methodology assumed that a portion of the Cost Assessment for modeled solutions would be shared by water systems, communities, or well owners, as applicable, and not fully borne by the State Water Board. The local cost share for the Gap Analysis was based on four types of qualifications: disadvantaged (DAC) and severely disadvantaged (SDAC) status, water rates as percent of MHI, water system size, and water system type. Where water rate, MHI, and/or DAC status data was not available for a water system, the entity was assigned either DAC, SDAC, or non-DAC status based on spatial averages of the county where the system operated, calculated in association with the Cost Assessment Model. A status of non-DAC was assigned to all domestic wells without MHI or DAC status data. Once calculated, the percent local cost share was separated from the estimated need for the purposes of the Gap Analysis.[302]

The specific requirements used to calculate local cost share obligations for HR2W list, At-Risk PWSs, and At-Risk SSWSs were generally adapted from the Drinking Water State Revolving Loan Fund (DWSRF) Intended Use Plan (IUP) from FY 2020-2021 in Appendix E.[303] The specific percent of local cost share assumed for the Gap Analysis is presented in Table D3 (for grant/principal forgiveness) and Table D4 (for loans/repayable financing).[304]

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[301] Data on funding for HR2W systems and some At-Risk systems can be found on the SAFER website: https://www.waterboards.ca.gov/safer/dw_systems_violations_tool.html

[302] Assignment of local cost share does not consider individual systems' ability to accept grant funds, which may vary according to the type of PWS entity or other factors. However, future gap analyses may address these differences.

[303] Drinking Water State Revolving Fund Intended Use Plan https://www.waterboards.ca.gov/drinking_water/services/funding/documents/dwsrf_iup_sfy2020_21_final.pdf

[304] The Gap Analysis assumed that all domestic well owners that are DAC and SDAC would receive grant funding from the State Water Board covering 100% of modeled interim and long-term solution costs, and all domestic well owners that are Non-DAC would bare 100% of modeled costs as local cost share.

Table D3: Criteria for Local Cost Share for Grant/Principal Forgiveness

Type of Community	Water Rate as % of MHI[305]	Local Cost Share (%)	Max. Amount Per Conn.
A-C Category Projects[306]			
Small DAC/SDAC,[307] Public K-12 Schools	N/A	0%	$60,000
Small Non-DAC, Expanded Small DAC/SDAC[308]	N/A	25%	$60,000
Large DAC,[309] Non-DAC systems	N/A	Not eligible for grant/principal forgiveness	N/A
D-F Category Projects[310]			
Small SDAC, Public K-12 Schools that serve a small DAC	N/A	10%	$45,000
Small DAC	>=1.5%	25%	$45,000
Expanded Small SDAC	>=1.5%	50%	$45,000
Expanded Small DAC	>=1.5%	75%	$45,000
Small DAC, Expanded Small DAC/SDAC	<1.5%	Not eligible for grant/principal forgiveness	NA
Large DAC, Non-DAC	NA	Not eligible for grant/principal forgiveness	NA

[305] The water rate as percent of MHI was obtained from the affordability assessment results on a system-by-system basis. For 333 of the 558 PWS that qualify as D-F projects, the water rate as percent of MHI was not available. For these systems, the cost share was estimated based on the average local proportion for systems with a similar number of connections according to the following system size bins: 1-100 connections, 101-500, 501-1000, 1001-3300, 1001-3300, and 3301 and above.

[306] A-C Category Projects are generally defined as follows: A = Immediate Health Risk; B = Untreated or At-Risk Sources; C = Compliance or Shortage Problems. For complete definitions see the "Policy for Implementing the Drinking Water State Revolving Fund.

Drinking Water State Revolving Fund Program
https://www.waterboards.ca.gov/drinking_water/services/funding/DWSRF_Policy.html

[307] "Small" refers to a community water system that serves no more than 3,300 service connections or a year-round population of no more than 10,000.

[308] "Expanded Small" refers to a community water system that serves no more than 6,600 service connections or a year-round population of no more than 20,000.

[309] 3,300 connections and/or more than 20,000 people

[310] D-F Category Projects are generally defined as follows: D = Inadequate Reliability; E = Secondary Risks; F = Other Projects. For complete definitions see the "Policy for Implementing the Drinking Water State Revolving Fund."

For all HR2W list and At-Risk systems the maximum eligible percentage of total modeled project cost was used, up to the maximum amount per connection.[311] For all costs that exceeded the maximum amount per connection for a given system, they were allocated 100% to local cost share. Where there are exceptions in practice to percentages listed in the IUP, the standard amount detailed in the IUP was used for the Gap Analysis.[312]

Table D4: Criteria for Local Cost Share for Loans/Repayable Financing

Type of Community	Interest Rate	Maximum Financing Term	Local Cost Share (%)
Small DAC, Small non-DAC, Expanded Small DAC/SDAC	0%	20 Years	100% of remaining portion, may be State Water Board loans
Large DAC, Non-DAC	2% for SWB (4% for private)	20 Years	100%, may be State Water Board loans[313] or other private funding

Estimating Need for Grants vs. Loans

The percentage of each HR2W list, At-Risk PWS, or At-Risk SSWS water system's modeled interim and long-term solution costs was assumed to be eligible for State Water Board grants as detailed in Table D3 based on eligibility requirements. For HR2W list and At-Risk PWS water systems not eligible for 100% grant coverage of their modeled solution capital cost, it was assumed that the remaining costs would be covered by local cost share through a State Water Board loan with either a 0% or 2% interest rate, detailed in Table D4. For At-Risk SSWS modeled costs that were not eligible for 100% grant coverage, it was assumed that the remaining costs would be covered by local cost share through a private loan at a 4% interest rate. For domestic wells, the Gap Analysis assumed that 100% of interim and long-term modeled solution costs for DAC/SDAC wells were grant eligible. Domestic well owners are not currently eligible for State Water Board loans and therefore, all local cost share for capital costs for domestic wells is assumed to need a private loan at a 4% interest rate.

Estimated O&M costs for long-term solutions for DAC/SDAC HR2W list and At-Risk PWS were considered grant-eligible and included in the estimated refined grant needs. Modeled O&M costs for long-term solutions for At-Risk SSWS and domestic wells were used to calculate the total, unrefined need, but then were not incorporated into the total estimated grant funding

[311] Maximum amount per connection was calculated for each system as the proportion of the total grant-eligible project cost divided by the number of connections. If the water system was a public school, the number of connections was calculated as 3.43*population to account for the very low connection count at schools.

[312] For example, it states in the DWSRF FY 2020-21 IUP: "The Deputy Director of DFA may approve up to 100% grant for capital costs required to complete a mandatory or voluntary consolidation."

[313] The Drinking Water SRF Policy states the financing term is the shorter of 30 years or useful life for public water systems not serving a DAC/SDAC and 40 years or useful life for public water systems serving a DAC/SDAC. For purposes of the Cost Assessment and Gap Analysis it is assumed that solutions have a 20-year useful life. https://www.waterboards.ca.gov/drinking_water/services/funding/documents/srf/dwsrf_policy/dwsrf_policy_final.pdf

need for the Gap Analysis. Any O&M cost for systems not met by a State Water Board grant was included in the calculation of local cost share. The Gap Analysis assumed no public or private financing is available to cover ongoing O&M cost needs.

Estimating Need Over Time

The funding need for modeled solutions for HR2W list and At-Risk systems was estimated both for this current year ("Year 1") and for five years into the future ("Year 5"). This provided a short-term and longer-term understanding of the funding need.

The State Water Board estimates that approximately 47 unique HR2W list systems will be added to the list each year based on the historical number of new systems added annually from 2017-2019 based on the expanded HR2W list criteria. This estimated number of new HR2W list systems was based on historical HR2W list data from 2017-2019. No historical data exists for the number of systems and domestic wells added to the At-Risk list annually since this is the first year of the Risk Assessment. Therefore, the Gap Analysis assumed the same proportion (approximately 15%) of systems will be added to the At-Risk list as the HR2W list. The total number of new At-Risk PWS added per year was 95.

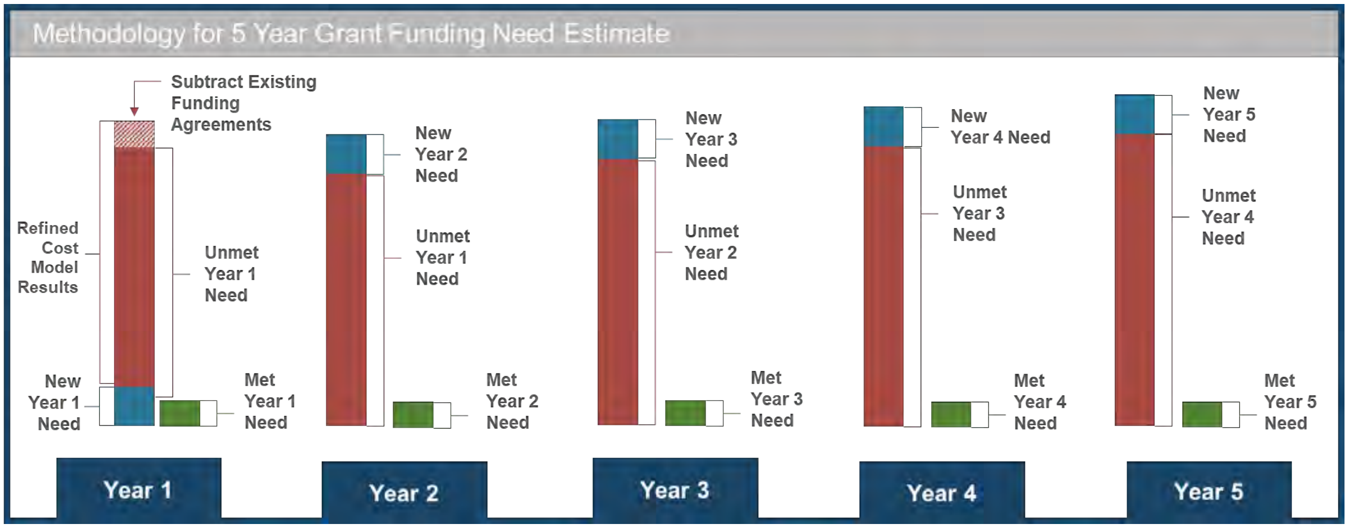
The Gap Analysis took the average costs per solution type (i.e., interim, long-term, and O&M) for HR2W list and At-Risk PWS systems, binned by connection size categories and by DAC status, as estimated by the Cost Assessment Model, and attributed those average costs proportionally to each of the 47 new HR2W list and 95 new At-Risk systems per year, out to Year 5.[314]

In addition to the anticipated increase in need annually over the next five years, any grant-eligible need from the previous year not funded was added to the next year's need (Figure D4). For long-term O&M need, the unfunded portion was not added to the next year's need, but instead was appropriated to local cost share. This was done to more closely match real-world scenarios where un-funded O&M would not be possible to carry forward, but would, by necessity, be borne by the community. This process is explained in more detail in Step 3: Estimating the Annual Funding Gap.

Most drinking water projects are funded on a multi-year basis, but for the Gap Analysis it is assumed that all projects receive their full funding in the first year, as funding is available. For the modeled interim solutions, the analysis assumed that the cost of the interim solution must still be applied during the first year that a long-term solution is funded.

[314] Bin sizes by connection were: 1-100, 101-500, 501-1,000, 1,001-3,300, 3,301+.

Figure D4: Estimating Need Over Time



ESTIMATING FUNDING AVAILABILITY

State Water Board Funds

While the SADWF is a unique fund that is wholly available to the SAFER Program, the State Water Board has additional funding programs that can be utilized to advance the SAFER Program's objectives. This analysis considered the SADWF along with other sources administered by DFA as one scenario and the SADWF as a standalone funding source as a separate scenario. Table D5 provides a complete list of all State Water Board funds that are available to help meet SAFER Program funding objectives.

Table D5: State Water Board Funding Programs[315]

Fund	Fund Size (as of 2/9/2021)	Projected Future Annual Allocation or Final Disbursement Date by Fund Source	Eligible Applicants	Eligible Projects
Safe and Affordable Drinking Water Fund (SADWF)	$152,505,586[316]	Up to $130 million per year through FY 2029-2030[317]	Public agencies, nonprofits, public utilities, mutual water companies, CA Native American tribes, Administrators, GW sustainability agencies, and public utilities regulated by PUC (so long as the project will benefit customers and not investors), state small water systems and domestic well owners	Provision of interim replacement water, planning or design, Construction, Consolidation (physical or managerial), Administrator funding, O&M, Technical Assistance
Drinking Water State Revolving Fund (DWSRF)	$119,840,349 for principal forgiveness	$50,000,000 expected annual funding capacity for grant/principal forgiveness, $300,000,000 expected annual funding capacity for loan/repayable financing	Privately-owned and publicly-owned CWSs or nonprofit non-CWSs, CWSs created by the project, Systems referred to in Section 1401(4)(B) of the SDWA for the purposes of point of entry or central treatment under Section 1401(4)(B)(i)(III)	Planning and design or construction of drinking water infrastructure, including treatment systems, distribution systems, interconnections, consolidations, pipeline extensions, water sources, water meters, water storages

[315] Summary information only. For full descriptions, please review fund expenditure plans.

[316] The Fund Size reported here is the total for Year 1 of the Gap Analysis, before removal of staff and Administrator costs. In Year 1 of the Gap Analysis that total funding available is reduced by $16 million to account for staff and Administrator costs, and therefore equals $136,505,586.

[317] For Year 2-5 of the Gap Analysis, $16 million is removed annually from the SADWF to account for staff and Administrator costs, leaving an annual fund availability of $114 million.

Fund	Fund Size (as of 2/9/2021)	Projected Future Annual Allocation or Final Disbursement Date by Fund Source	Eligible Applicants	Eligible Projects
Small Community Drinking Water Funding Program	$275,253,116	Final disbursement: June 2023 for Prop 1 and Prop 68 Groundwater funds, June 2024 for Prop 68 Drinking Water funds	Publicly-owned community water systems, Privately-owned community water systems, Community water systems created by the projects, non-profit or publicly owned non-community water systems, <10,000 pop served; MHI less than 80% statewide avg	Planning/design & construction of DW infrastructure: treatment systems; distribution systems; interconnections; consolidations; pipeline extensions; water sources; water meters; water storages
Emergency Drinking Water/Cleanup & Abatement Account Programs – Urgent Drinking Water Need Projects	$9,007,065	Final disbursement: June 2024 for AB 72 and AB 74 Funds	Public agencies, nonprofits, community water systems, tribal governments (on the CA Tribal Consultation List)	Provision of interim alternative water supplies, emergency improvements or repairs as necessary to provide an adequate supply of domestic water
Water Board Household & Small Water System Drought Assistance Program; CAA – DW Well Replacement Program	$860,646	Final disbursement: June 2024 for SB 108 and AB 72 funds	Individual households (homeowners) that qualify as "disadvantaged", Small Water Systems (serving less than 15 connections)	New well construction, design costs of necessary infrastructure, permit and connection fees, well rehabilitation/repair (including extending wells to deeper aquifers), distribution/conveyance pipelines (up to point of entry of household), limited consolidation efforts (i.e. laterals, above-ground interties), all necessary appurtenances, etc.

Fund	Fund Size (as of 2/9/2021)	Projected Future Annual Allocation or Final Disbursement Date by Fund Source	Eligible Applicants	Eligible Projects
Water System Administrator Program[318]	$8,159,143	Final disbursement: June 2024 for AB 72 funds	An Administrator can be an individual or an entity with the necessary qualifications to carry out the responsibilities required for a specific designated water system.	Administrative, technical, operational, legal, or managerial services, or any combination of those services (limited-scope administrator), as well as full management and control of all aspects to a designated water system (full-scope Administrator).

[318] Currently, there is limited cost data to support the inclusion of the Administrator funding program into the Gap Analysis for the 2021 Needs Assessment. Future iterations will be able to assess the gap for Administrators when data becomes available.

Funding Availability Over Time

For the Gap Analysis, it is assumed that the SADWF will receive the maximum potential allocation of $130 million per year through FY 2029-30 from the Greenhouse Gas Reduction Fund and that the DWSRF will have a $350 million funding capacity each year ($50,000,000 for grant/principal forgiveness and $300,000,000 for loan/repayable financing). No other funding sources were assumed to have additional allocations beyond the current available amounts.

Funding availability for the SADWF, for purposes of the Gap Analysis, is reduced by $16 million per year to account for staff costs and Administrator funding, based on the estimated costs in the SADWF FY 2020-21 FEP. Additionally, due to carry over from the previous year, for Year 1 of the Gap Analysis, the SADWF is assumed to have $152 million available, before staff costs and other program needs are removed. Funding availability for all other State Water Board funds already account for staff costs in the figure presented above.

NON-STATE WATER BOARD FUNDS

In addition to State Water Board funds, there are other loan and grant programs that may eventually be leveraged to support the implementation of solutions for HR2W list and At-Risk drinking water systems in California (Table D6). These funds were not incorporated into the Gap Analysis at this time and are only presented here for informational purposes. Future iterations of the Gap Analysis will consider the availability of these funding sources as more information is developed on the typical breakdown allocated to drinking water projects in California.

In order to identify a list of potential non-State Water Board funds, the Pacific Institute project team conducted desktop research and outreach to state, Federal, and private loan and grant programs designed to address drinking water system issues. Research and outreach sought to assess the likelihood that the funding source would remain active at least through 2022, the earliest year in which the SAFER Needs Assessment process will be positioned to consider leveraging outside funds. The research process also gathered key information regarding each fund, such as special application criteria, any matching requirements, and any information affecting the eligibility of small and DAC systems. Where available, historical award amounts to California entities were collected from the most recent fiscal year for which funding allocation data was available. These data were used to provide a rough estimate of the aggregate, non-State Water Board funds leverage potential in the future. Additional drinking water infrastructure funding and financing programs can be found in U.S. EPA's Water Finance Clearinghouse.[319]

[319] U.S. EPA Water Finance Clearinghouse
https://www.epa.gov/waterdata/water-finance-clearinghouse

Table D6: Additional Funding Resources[320]

Fund	Source Agency	Fund size (Number of awards to CA entities)	Eligible Applicants	Eligible Projects
DWR Integrated Regional Water Management Implementation Grants, Round 2	California DWR	To be announced ($181,000,000 expected)	Public agencies, non-profit organizations, public utilities, Federally recognized Indian tribes, state Indian tribes listed on the Native American Heritage Commission's Tribal Consultation list, mutual water companies. (Note: list from Round 1 Grant Program Guidelines.)	Water reuse and recycling, water-use efficiency and water conservation, water storage, regional water conveyance facilities, watershed protection, stormwater management, conjunctive use, water desalination, water supply decision support tools, and water quality improvement for drinking water treatment and distribution and other purposes. (Note: list from Round 1 Grant Program Guidelines.)
Household Water Well System Loan Program	USDA Rural Development Program[321]	FY20: $0 FY19: $225,000 (1 award) FY18: $308,000 (1)	Homeowners with a household income under $62,883 living in a rural area, town, or community with a population of fewer than 50,000 people.	Refurbishment, replacement, or construction of a household water well system.
Water & Waste Disposal Loan & Grant Program in California	USDA Rural Development Program	FY20: $13.8 million (7) FY19: $10.3m (10) FY18: $24.6m (26)	State and local government entities, private nonprofits, Federal tribes in rural areas with a population of less than 50,000	Acquisition, construction, or improvement of drinking water sourcing, treatment, storage, and distribution, in

[320] Summary information only. For full descriptions, please review fund expenditure plans.

[321] Rural Community Assistance Corporation (RCAC), Self-Help Enterprises (SHE)

Fund	Source Agency	Fund size (Number of awards to CA entities)	Eligible Applicants	Eligible Projects
			people, rural tribal lands, and colonias.	addition to other project eligibility such as waste disposal. Some funds for TA, training, and predevelopment planning.
Water & Waste Predevelopment Planning Grants	USDA Rural Development Program	FY20: $0 FY19: $139,820 (1) FY18: $0	State and local government entities, private nonprofits, Federal tribes in rural areas with a population of less than 10,000 people, rural tribal lands, and colonias. Median household income (MHI) must be below poverty line or less than 80% of statewide non-metropolitan MHI.	Pre-planning and development of applications for USDA Rural Development Water loans and grants.
SEARCH - Special Evaluation Assistance for Rural Communities & Households (grant)	USDA Rural Development Program	FY20: $90,000 (3) FY19: $288,620 (5) FY18: $56,000 (2)	State and local government entities, nonprofit organizations, Federally recognized tribes in rural areas with population of 2500 or less with MHI below poverty line or less than 80% of statewide non-metropolitan MHI.	Constructing, enlarging, extending or improving rural water, sanitary sewage, solid waste disposal and stormwater facilities.
Emergency Community Water Assistance Grants	USDA Rural Development Program	FY20: $390,154 (2) FY19: $1.5m (2) FY18: $1.1m (2)	State and local government entities, nonprofit organizations, Federally recognized tribes in rural areas and towns with populations of 10,000 or less and with an MHI less than state's MHI for non-metro areas facing a qualified emergency.	Projects to address drought, flood, earthquake, tornado, hurricane, disease outbreak, chemical spill, or other qualified emergency. Federal disaster designation is not required.

Fund	Source Agency	Fund size (Number of awards to CA entities)	Eligible Applicants	Eligible Projects
Environmental infrastructure loans (USDA bridge loans)	Rural Community Assistance Corp (RCAC)	Typically 8-10 CA loans annually. FY20: approximately $3.3m (10)	Rural areas with population of 50,000 or less or 10,000 or less for USDA long-term loans.	Water and waste facility projects for small, rural communities.
Circuit Rider Program - Technical Assistance for Rural Water Systems	USDA, U.S. EPA	FY21: $19m nationally. CA: $0 over last 3 years.	Rural water, wastewater, and solid waste systems; nonprofit water systems, municipal water systems.	Day-to-day operational issues, financial issues, management issues, energy audits.
Community Facilities Direct Loan and Grant Program	USDA Rural Development Program	FY20: Grants $4.4m (52) FY19: Grants $887,800 (26) FY18: $1.8m (29)	Systems serving fewer than 20,000 people, with a focus on systems serving fewer than 5,000 people.	Purchase, construct, and/or improve essential community facilities, purchase equipment and pay related project expenses.
306C Water and Waste Grants	USDA Rural Development Program	FY19: $2m (2)	Federally recognized tribes, colonias designated before October 1, 1989, and rural areas and towns with populations of fewer than 10,000 people.	Basic drinking water and waste disposal systems, including storm drainage.
Assistance for Small and Disadvantaged Communities Drinking Water Grant	U.S. EPA	FY19-20: $3.8m to SRF	Public water systems, existing privately-owned and publicly owned community water systems, and non-profit non-community water systems, including system utilizing POE or residential central treatment.	Investments necessary for public water systems to comply with the Safe Drinking Water Act (see Section 1459A of the SDWA).

Fund	Source Agency	Fund size (Number of awards to CA entities)	Eligible Applicants	Eligible Projects
Water Infrastructure Finance and Innovation (loan)	U.S. EPA	FY20: $1.7B (11)	Local, state, tribal, and Federal government entities; partnerships and joint ventures; corporations and trusts; CWSRF and DWSRF programs. Total Federal assistance may not exceed 80% of projects eligible costs. Minimum project costs of $20m for communities of more than 25,000 people, $5m for communities of 25,000 people or less.	CWSRF and DWSRF projects, enhanced energy efficiency at drinking water and wastewater facilities, desalination, aquifer recharge, alternative water supply, water recycling, drought prevention and reduction or mitigation, property acquisition if necessary. Planning and construction projects both eligible.
WaterSMART Water and Energy Efficiency Grants	U.S. Bureau of Reclamation (USBR)	FY19: $9.5m (12)	State, tribe, irrigation district, water district, or other organization with water or power delivery authority.	50-50 cost share projects addressing water conservation and efficiency, hydropower, conflict risk, and water supply reliability.
Small-Scale Water Efficiency Projects (grant)	USBR	FY20: $862,000 (14)	State, tribe, irrigation district, water district, or other organization with water or power delivery authority.	50-50 cost share projects addressing canal lining/piping, municipal metering, irrigation flow measurement, Supervisory Control and Data Acquisition and Automation (SCADA), irrigation measures, and other projects.

Fund	Source Agency	Fund size (Number of awards to CA entities)	Eligible Applicants	Eligible Projects
Native American Affairs (NAA) Technical Assistance Program (TAP)	USBR	FY20: $200,000 (1)	Federally recognized Indian Tribes.	Projects concerning management, protection, or development of water and related resources.
Rural Water and Wastewater Lending	CoBank	Historically $2.2B to 300 borrowers nationwide	Water cooperatives, water companies, and non-profit water systems.	Not specified.
Rural Water Loan Fund	National Rural Water Association	FY20: 15 loans nationally (average loan size $67,000). No loans to CA in 2020, but 10 loans have been made to CA since the program's inception.	Public entities including municipalities, counties, special purpose districts, Native American tribes, nonprofit corporations, and cooperatives serving rural areas or communities of 10,000 people or less.	Pre-development (planning) costs for infrastructure projects; replacement equipment, system upgrades, maintenance and small capital projects; energy efficiency projects to lower costs and improve system sustainability; and disaster recovery or other emergency loans.
Public Works (grant)	Economic Development Administration (EDA), US Department of Commerce	FY18: $17.8m (6)	District organizations; Indian tribes; states; county, or city, or other political subdivision of a state; institutions of higher education; public or private non-profits.	Competitive national fund to address EDA's investment priorities meeting economic distress criteria. Amount of EDA award may not exceed 50% of project costs.

Fund	Source Agency	Fund size (Number of awards to CA entities)	Eligible Applicants	Eligible Projects
Economic Adjustment Assistance (grant)	EDA	FY18: $5.6m (6)	District organizations; Indian tribes; states; county, or city, or other political subdivision of a state; institutions of higher education; public or private non-profits.	Competitive national fund to finance construction, non-construction, technical assistance, and revolving loan fund projects.
Community Development Block Grant (CDBG) program	Housing and Urban Development (HUD), California Department of Housing and Community Development	FY20: $413m to water & sewer projects nationally FY19: $413m to water & sewer projects nationally FY18: $395m to water & sewer projects nationally	Non-entitlement jurisdictions (cities with a population under 50,000 and counties with a population under 200,000 in unincorporated areas that do not participate in HUD CDBG entitlement program); non-Federally recognized Native American communities; colonias.	Community development projects, including water and wastewater systems.

Litigation Funds and other Contaminant Mitigation Programs

It is also recognized that treatment costs associated with certain contaminants— e.g.1,2,3-trichloropropane (1,2,3 –TCP) — may be covered through monetary damages awarded from legal settlements. Funding may also be made available from other mitigation programs for contaminants such as nitrate as part of the Central Valley Salinity Alternatives for Long-term Sustainability (CV-Salts) program. However, the extent of the availability of this type of funding tends to be site specific and is unknown currently, particularly on an aggregated Statewide basis. Therefore, this version of the Gap Analysis assumed that no necessary solution costs would be covered by litigation awards or other programs. However, it is recognized that any funding awarded through litigation should either reimburse costs that have already been met by the state and/or be utilized, to the extent possible, to expedite funding of solutions for other HR2W list or At-Risk water systems where there may otherwise be insufficient funding.

STEP 2: MATCHING FUNDING NEEDS TO FUNDING PROGRAMS

State Water Board funding sources each have specific eligibility requirements regarding applicant type and project type (Table D3, above). When estimating funding availability, the Gap Analysis used these eligibility requirements to ensure the most appropriate funds are applied to specific categories of systems and solution types (Figure D5). Table D7 shows which funds were considered for which types of systems and solutions types. In the estimation for the funding gap, each fund's total available amount was spread proportionately between all eligible solution and system types. This process was applied to the first approach to Gap Analysis described below in order to help match State Water Board fund sources to the solutions and systems identified in the Cost Assessment. For the second approach to the Gap Analysis, matching was not necessary as the approach focuses solely on the SADWF.

Figure D5: Step 2 of the Gap Analysis Methodology

Table D7: State Water Board Funds Matched to HR2W List and At-Risk Systems Modeled Solutions

State Water Board Funds	System Types	Modeled Solution Types
Safe and Affordable Drinking Water Fund (SADWF)	HR2W, At-Risk	Capital/Construction (i.e., Physical Consolidation, Treatment, OEI), O&M, Interim solutions, Technical Assistance
Drinking Water State Revolving Fund (DWSRF)	HR2W, At-Risk	Capital/Construction (i.e., Physical Consolidation, Treatment, OEI), Technical Assistance
Small Community Drinking Water Funding Program	DAC/SDAC HR2W, DAC/SDAC At-Risk	Capital/Construction (i.e., Physical Consolidation, Treatment, OEI), Technical Assistance
Emergency Drinking Water/Cleanup & Abatement Account Programs – Urgent Drinking Water Needs Projects	DAC/SDAC HR2W, DAC/SDAC At-Risk	Interim solutions, emergency supplies and repairs
Water Board Household & Small Water System Drought Assistance Program; CAA – DW Well Replacement Program	HR2W and At-Risk SSWS, Domestic Wells	Capital/Construction (i.e., Physical Consolidation, Treatment, OEI), Technical Assistance
Water System Administrator Program	HR2W, At-Risk	N/A[322]

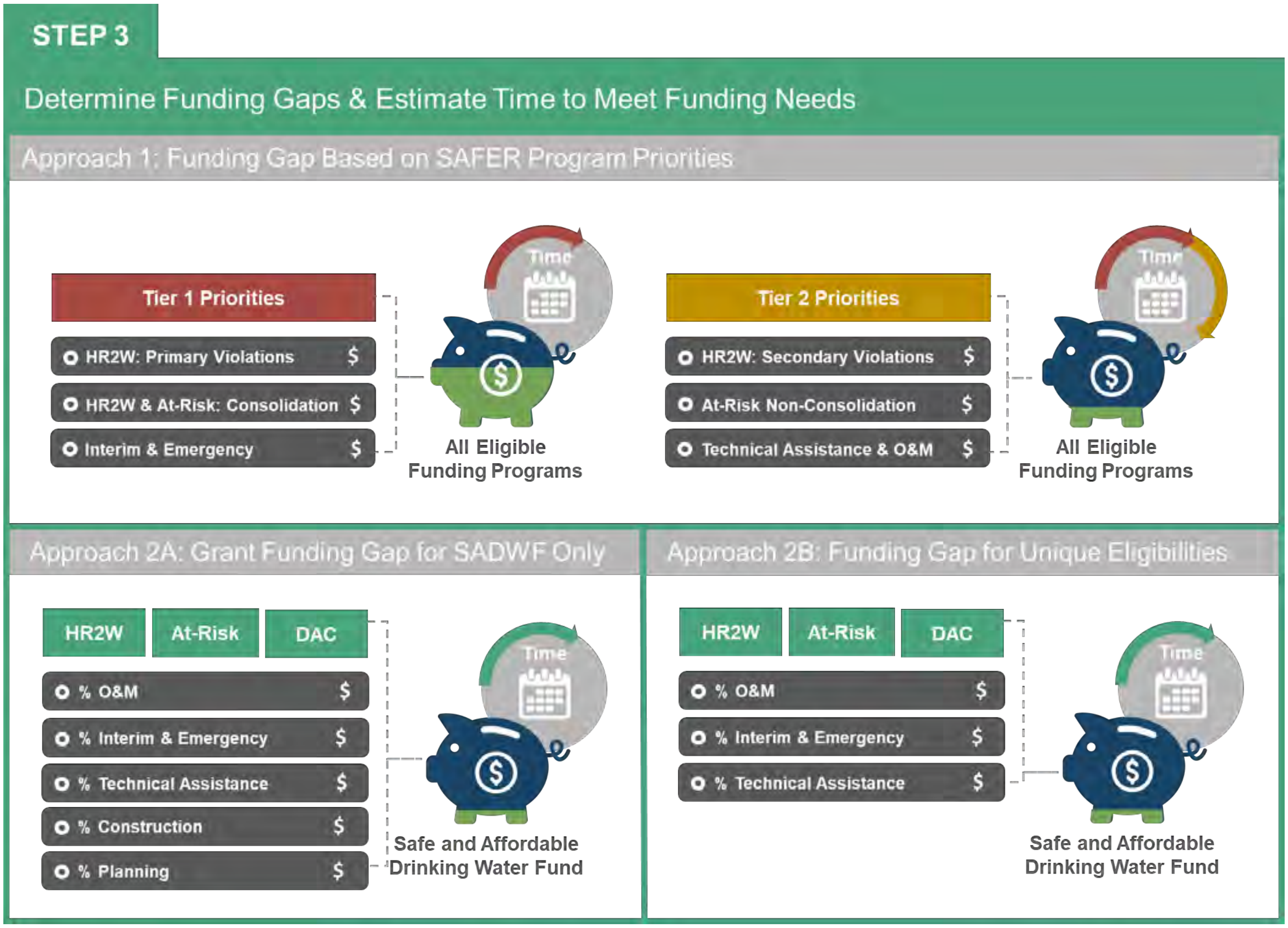
STEP 3: ESTIMATING THE FUNDING GAP

The funding gap informed an estimate of the time it will take to meet the estimated need and how much need cannot be met based on existing funding sources. Two approaches were taken to make these estimates (Figure D6). The first approach took into account a tiered prioritization of project types based on the priorities established in the SADWF FY 2020-21 FEP and applied this prioritization to all State Water Board funding programs relevant to the SAFER program. The second approach specifically analyzed the funding gap for the SADWF

[322] Currently, there is limited cost data to support the inclusion of the Administrator funding program into the Gap Analysis for the 2021 Needs Assessment. Future iterations will be able to assess the gap for Administrators when data becomes available.

by applying the fund target expenditures by solution type as presented in the SADWF FY 2020-21 FEP.

Figure D6: Step 3 of the Gap Analysis Methodology



APPROACH 1: TIERED PRIORITIZATION BASED ON SYSTEM AND MODELED SOLUTION TYPES

For the first approach to estimating the gap, the estimated grant funding need that has been matched to funding sources based on the modeled solutions was applied to the funding available in all State Water Board funding programs relevant to the SAFER Program, over time, using a two-tier prioritization. Under this approach, all available grant funding was first applied to all estimated need for Tier 1. If any funding remained after this application, then remaining funds were to be applied to Tier 2.

These priorities were used in the Gap Analysis to prioritize all State Water Board funding resources, not solely the SADWF. Even so, it was not expected that there would be sufficient funding for all estimated need to be met by State Water Board funds. The difference between the estimated grant funding available and the estimated need for both systems meeting Tier 1 and Tier 2 criteria accounts for the "gap" for calculated grant funding for each year of the estimate.

First Tier Prioritization

Tier 1 prioritization was based on the SADWF FY 2020-21 Fund Expenditure Plan's "General Funding Approach and Prioritization" (p. 12).[323] The Fund Expenditure Plan specifies that the top priorities for expenditures from the SADWF for FY 2020-21 include:

> 1) addressing any emergency or urgent funding needs, where other emergency funds are not available, and a critical water shortage or outage could occur without support from the Fund;[324]
>
> 2) addressing CWSs and school water systems out of compliance with primary drinking water standards, focusing on small DACs;[325]
>
> 3) accelerating consolidations for systems out of compliance, At-Risk systems, as well as state smalls and domestic wells, focusing on small DACs; and
>
> 4) providing interim solutions, initiating planning efforts for long-term solutions, and funding capital projects for state smalls and domestic wells with source water above a primary MCL.

Second Tier Prioritization

Tier 1 prioritization does not cover certain systems, such as those on the HR2W list solely on the basis of secondary drinking water violations or monitoring and reporting violations. Therefore, a second set of prioritization criteria was needed for the Gap Analysis. Tier 2 included:

> 1) HR2W list systems not captured in Tier 1; and
>
> 2) all other At-Risk systems not captured in Tier 1.

Any unfunded portion of long-term O&M need was not added to the next year's need, but instead was appropriated to local cost share. This was done to more closely match real-world

[323] FY 2020-21 Fund Expenditure Plan
https://www.waterboards.ca.gov/water_issues/programs/grants_loans/sustainable_water_solutions/docs/sadwfep_2020_07_07.pdf

[324] This category included interim capital and O&M costs. To account for the ongoing need for interim O&M costs in the Gap Analysis, first, the proportion of the combined interim capital and O&M costs to the total amount of those costs that were funded in the previous year, by system type (HR2W list, At-Risk PWS, At-Risk SSWS, At-Risk domestic well), was calculated. Then, this proportion was multiplied by the remaining costs in this category for that year. Finally, this amount was added to all of the following years' estimated need to ensure the ongoing interim O&M need was included.

[325] 298 out of 305 systems on the HR2W list used in this analysis were out of compliance with a primary drinking water standard. The other seven systems, which were out of compliance for secondary drinking water standards, were prioritized as Tier 2 in this analysis.

scenarios where un-funded O&M would not be possible to carry forward, but would, by necessity, be borne by the water system or domestic well owner.

Local Cost Share Gap Calculations

All project costs that were not grant eligible, as described above in Table D3, were refined into costs that were either (A) eligible for a State Water Board loan (B) eligible for a non-State State Water Board loan or (C) not eligible for a loan (i.e. O&M costs). To calculate the estimated State Water Board financing gap, the total estimated State Water Board loan eligible needs were compared to estimated annual DWSRF loan financing availability ($300 million per year). The Gap Analysis applied total annual financing availability towards Tier 1 prioritized systems first with any remaining annual financing capacity then applied to Tier 2 prioritized systems.

The Gap Analysis utilized the interest rates detailed in Table D4 to calculate the 20-yr. financing costs associated with all loan-eligible estimated capital costs. The Gap Analysis then summed the non-grant eligible capital costs, 20-year interest costs, and 20-year O&M costs, to estimate the total 20-year local cost share burden.

APPROACH 2: SADWF TARGET EXPENDITURES

The second funding Gap Analysis approach estimated a potential funding gap specifically for the SADWF with an exclusive focus on small DAC and SDAC systems. This analysis was in turn conducted two different ways (Figure D6). The first method (Approach 2A) included the majority of SADWF target expenditures. The second method (Approach 2B) removed Construction and Planning target expenditures to estimate the funding gap for the project type and recipient eligibilities uniquely covered by the SADWF. For these approaches, the estimated number of systems and associated costs of those expected to be added to the HR2W and At-Risk PWS lists was likewise limited to small DACs and SDACs. Small DAC/SDAC systems are prioritized in the 2020-21 SADWF FEP.

In both approaches, a small share of interim need was added in each year to account for the ongoing operations and maintenance need for these systems. As operations and maintenance need was calculated to be 4% of the overall refined interim need for the existing systems, an additional 4% of the interim need covered in the previous year was added to the calculated refined interim need each year, when interim need was not fully met.

Approach 2A

This approach analyzes the potential funding gap for the SADWF based on the target expenditures outlined in the 2020-21 FEP. Table D9 details the proportion of grant funding allocations employed in Approach 2A for year 1, while Table D11 details the proportions for years 2 through 5. While the percentages presented are rounded, the analysis was conducted with unrounded figures to provide the highest level of accuracy. For the purposes of the Gap Analysis, some of the percentages were re-allocated based on available modeled Cost Assessment estimates for long-term solutions. For Approach 2A and 2B, staff costs and other program needs were not allocated according to a percentage but were assumed to be $16 million in each year. This assumption was based on the FY 2020-2021 FEP Table ES-1. Accordingly, the percentages in Table D8 do not sum to 100%; the omitted portion of SADWF funds comprise the $16 million allocated towards Administrator and Staff Costs in the 2020-21 FEP and is thus not included in this analysis.

Table D8: 2020-21 SADWF Year 1 Target Expenditures as Percentages for the Gap Analysis

Water System Category	Interim Water Supplies and Emergencies	Technical Assistance	O&M Support	Construction & Planning
HR2W Systems	8.15%	5.15%	4.15%	17.15%
At-Risk PWS Systems	3.15%	14.15%	4.15%	17.15%
At-Risk SSWSs & Domestic Wells	6.15%	0%[326]	0%	10.15%

Table D9 summarizes available funding by category for the SADWF in Year 1 (fiscal year 2021-22) based on the percentages in Table D8. The Gap Analysis assumes approximately $137 million in grant funding availability in Year 1, which includes $130 million from new SADWF appropriations, reduced by $16 million for Administrator and State Water Board staff costs, and an added $23 million from fiscal year 2020-21 carryover.

Table D9: Approach 2A Estimated Year 1 SADWF Grant Funding Availability When Applying 2020-21 FEP Target Fund Expenditures as Percentages ($ Millions)

Water System Category	Emergency/Interim Assistance	Technical Assistance	O&M Support	Construction & Planning	Total 1st Yr. Funding Availability
HR2W list	$12	$8	$6	$26	**$53**
At-Risk PWS	$5	$22	$6	$26	**$59**
At-Risk SSWSs & Domestic Wells	$9	N/A	N/A	$15	**$25**
TOTAL:	**$2**	**$29**	**$13**	**$68**	**$137**

326 The 2020-21 FEP has 4% allocated towards Technical Assistance for At-Risk SSWSs and domestic wells. However, the Cost Assessment Model results did not estimate technical assistance needs for these systems. Therefore, the 4% allocation has been equally divided and applied to the Emergency/Interim and Construction/Planning categories for At-Risk SSWSs and domestic wells.

Table D10 reports a separate, slightly modified set of percentages that guide Approach 2A for years 2-5. As with Table D8, these percentages reflect the $16 million removed for staff costs and other program needs. The Year 2-5 percentages differ from the Year 1 percentages reported in Table D8 because the $16 million figure is assumed to remain constant while the overall funding is lower as there are assumed to be no carryover costs for years 2 through 5.

While this analysis assumed that the percentages do not change from Year 2 onward, however, for future Fund Expenditure Plans, all target expenditures will be reviewed and adjusted annually based on actual need, public input, and the SAFER Advisory Group recommendations.

Table D10: 2020-21 SADWF Year 2-5 Target Expenditures as Percentages for the Gap Analysis

Water System Category	Interim Water Supplies and Emergencies	Technical Assistance	O&M Support	Construction & Planning
HR2W Systems	7.97%	4.97%	3.97%	16.97%
At-Risk PWS Systems	2.97%	13.97%	3.97%	16.97%
At-Risk SSWSs & Domestic Wells	5.97%	0%[327]	0%	9.97%

While total available funding of the SADWF in Year 1 of the analysis includes uncommitted funds from the previous fiscal year, the Gap Analysis assumes full commitment each year. Therefore, from Year 2 through Year 5 the total annual SADWF funding availability drops to $114 million (the full $130 million appropriation less $16 million for staff and Administrator costs). Table D11 summarizes the total available SADWF funding in Years 2 through 5 utilized in the Gap Analysis.

[327] The 2020-21 FEP has 4% allocated towards Technical Assistance for At-Risk SSWSs and domestic wells. However, the Cost Assessment Model results did not estimate technical assistance needs for these systems. Therefore, the 4% allocation has been equally divided and applied to the Emergency/Interim and Construction/Planning categories for At-Risk SSWSs and domestic wells.

Table D11: Approach 2A Estimated Annual SADWF Grant Funding Availability (Years 2 through 5) When Applying 2020-21 FEP Target Fund Expenditures as Percentages ($ Millions)

Water System Category	Emergency/Interim Assistance	Technical Assistance	O&M Support	Construction & Planning	Total Annual Funding Availability
HR2W list	$10	$6	$5	$22	**$44**
At-Risk PWS	$4	$18	$5	$22	**$49**
At-Risk SSWSs & Domestic Wells	$8	N/A	N/A	$13	**$21**
TOTAL:	**$22**	**$24**	**$10**	**$57**	**$114**

For Approach 2A, if the funding available based on the allocations described above was more than the estimated refined need for a specific solution within a water system category (e.g., if there was less than $18 million of Technical Assistance need for At-Risk PWS in year 2-5), then the surplus funds were re-allocated equally across the other solutions within that same water system category. The one exception was if the funding available for At-Risk PWS O&M support was more than the need, then the surplus funds from this category were re-allocated to the HR2W list O&M support need category.

Approach 2B

The purpose of Approach 2B is to assess the potential funding gap for the SADWF that specifically focuses on the fund's unique funding eligibilities. For this approach, all refined estimated construction and planning needs that are associated with HR2W list and At-Risk PWS systems were removed, as these costs may be covered by other State Water Board funding programs. The SADWF fiscal year 2020-21 FEP construction and planning target expenditure percentages were equally redistributed into the other solutions within each water system category, either HR2W list or At-Risk PWS, detailed in Table D12.

As under Approach 2A, staff costs and other program needs were not allocated according to a percentage but were assumed to be $16 million each year. This assumption was based on the FY 2020-2021 FEP Table ES-1. Accordingly, the percentages in these tables do not sum to 100%; the omitted portion of SADWF funds comprise the $16 million allocated towards Administrator and Staff Costs in the 2020-21 FEP. As under Approach 2A, these percentages are presented as rounded figures, however the analysis was conducted with the unrounded percentages for greater accuracy.

Table D12: 2020-21 SADWF Year 1 Target Expenditures as Percentages for the Gap Analysis with Construction and Planning Removed for PWSs

Water System Category	Interim Water Supplies and Emergencies	Technical Assistance	Direct O&M Support	Construction & Planning
HR2W Systems	13.67%	10.67%	9.67%	0%
At-Risk PWS Systems	8.67%	19.67%	9.67%	0%
State Small Systems & Domestic Wells	6%	0%	0%	10%

The redistribution of target fund expenditures shifts the annual estimated need that can be met by the SADWF. Mirroring Approach 2A, these estimates assume approximately $137 million grant funding availability in Year 1, which includes $130 million from new SADWF appropriations, reduced by $16 million for Administrator and State Water Board staff costs, and $27 million from fiscal year 2020-21 carryover. Table D13 details how the $137 million available in Year 1 of the analysis was distributed based on the target expenditure percentages in Table D12.

Table D13: Approach 2B Estimated Year 1 SADWF Grant Funding Availability When Applying 2020-21 FEP Target Fund Expenditures as Percentages from Table D12

Water System Category	Emergency/Interim Assistance	Technical Assistance	O&M Support	Construction & Planning	Total 1st Yr. Funding Availability
HR2W list	$21	$17	$15	N/A	**$53**
At-Risk PWS	$14	$30	$15	N/A	**$59**
At-Risk SSWSs & Domestic Wells	$9	N/A	N/A	$16	**$25**
TOTAL:	**$44**	**$47**	**$30**	**$16**	**$137**

Table D14 shows the Year 2-5 percentages.

Table D14: 2020-21 SADWF Year 2-5 Target Expenditures as Percentages for the Gap Analysis with Construction and Planning Removed for PWSs[328]

Water System Category	Interim Water Supplies and Emergencies	Technical Assistance	Direct O&M Support	Construction & Planning
HR2W Systems	13.86%	10.86%	9.86%	0%
At-Risk PWS Systems	8.86%	19.86%	9.86%	0%
State Small Systems & Domestic Wells	6.19%	0%	0%	10.19%

As with Approach 2A, in Year 2 through Year 5 the total annual SADWF funding availability drops to $116 million (the full $130 million appropriation less $16 million for staff costs). Table D15 summarizes the total available SADWF funding in Years 2 through 5 applied following 2020-21 FEB target fund expenditures.

Table D15: Approach 2B Estimated Years 2-5 Annual SADWF Grant Funding Availability When Applying 2020-21 FEP Target Fund Expenditures as Percentages from Table D14

Water System Category	Emergency/Interim Assistance	Technical Assistance	O&M Support	Construction & Planning	Total Annual Funding Availability
HR2W list	$18	$14	$13	N/A	**$45**
At-Risk PWS	$11	$26	$13	N/A	**$50**
At-Risk SSWSs & Domestic Wells	$8	N/A	N/A	$13	**$21**
TOTAL:	**$37**	**$40**	**$26**	**$13**	**$116**

328 Note that percentages in Table D14 do not add up to 100% as this table only includes solutions types modeled by the Cost Assessment, and therefore, Administrator solutions and other program needs are not included in the Gap Analysis at this time. Furthermore, Table D14 does not include staff costs associated with implementing the SAFER Program, which are anticipated to increase over time.

Reallocation of funds for the Approach 2B gap estimate followed the same methods as described for Approach 2A. However, for Approach 2B, it was necessary to reallocate funds across water system categories, with surplus funds first being reallocated from the At-Risk PWS category to the HR2W list category, and then, if surplus were still available, it was applied to the At-Risk SSWS and domestic well category.

The results of Gap Analysis Approaches 2A and 2B are summarized in Attachment D1.[329]

[329] Attachment D1: Supplemental Gap Analysis for the Safe and Affordable Drinking Water Fund https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/d1.pdf

APPENDIX E:
AFFORDABILITY ASSESSMENT METHODOLOGY

INTRODUCTION

The purpose of the Affordability Assessment is to identify disadvantaged community (DAC) and severely disadvantages community (SDAC) water systems, that have instituted customer charges that exceed the "Affordability Threshold" established by the State Water Board in order to provide drinking water that meets State and Federal standards.[330]

The Affordability Assessment is conducted annually for all Californian community water systems. It is worth noting that, while there is some overlap, the systems included in the Affordability Assessment differ from the list of water systems analyzed in the Risk Assessment for public water systems. The Affordability Assessment includes large and small community water systems but excludes non-transient, non-community water systems, like schools. The Risk Assessment, on the other hand, analyzed smaller public water systems with 3,300 service connections or less and non-transient, non-community K-12 schools are included. Both assessments exclude all transient water systems, state small water systems and domestic wells. Table E1 provides an overview of the systems included in the Affordability Assessment.

Table E1: Systems Included in the Affordability Assessment

SAFER Program Status	Risk Assessment	Affordability Assessment
HR2W List Systems	**326**	**276**
At-Risk Systems	**617**	**467**
Not HR2W or At-Risk System	**1,836**	**2,134**
TOTAL:	**2,779**	**2,877**

The difference in the number of HR2W list systems and At-Risk systems between the Risk Assessment and Affordability Assessment in Table E1 demonstrates the impact of the type of systems analyzed. For example, schools on the HR2W list were not assessed for affordability and make up a large portion of the change in numbers assessed between the two pieces of the Needs Assessment.

[330] California Health and Safety Code, § 116769, subd. (a)(2)(B)

AFFORDABILITY ASSESSMENT METHODOLOGY DEVELOPMENT PROCESS

From April through October 2020, the State Water Board and UCLA conducted extensive research and public engagement to identify potential affordability indicators that could be used to assess affordability challenges in both the Risk Assessment and Affordability Assessment. This effort identified 23 potential affordability indicators (white paper, Table 10) [331] and six were ultimately recommended (Table E2). Three of the recommended affordability indicators were not used in either the 2021 Risk Assessment or the Affordability Assessment because the State Water Board did not have sufficient time to conduct the proper research and stakeholder engagement needed to develop appropriate affordability thresholds for the 2021 Needs Assessment. The State Water Board will begin conducting the proper research and stakeholder engagement needed to develop the appropriate affordability thresholds necessary for inclusion in the Risk Assessment and potentially the Affordability Assessment as well.

Table E2: Recommended Affordability Indicators

Affordability Indicator	Affordability Assessment
Percent of Median Household Income (%MHI)	2020, 2021
Extreme Water Bill	2021
% Shut-Offs	2021
Household Burden Indicator (HBI)	*Future*
Poverty Prevalence Indicator (PPI)	*Future*
Housing Burden	*Future*

AFFORDABILITY ASSESSMENT METHODOLOGY

In 2020, the State Water Board conducted an Affordability Assessment for community water systems, which analyzed one affordability indicator, water charges as a percent of median household income (%MHI), for the FY 2020-21 Safe and Affordable Drinking Water Fund Expenditure Plan. The Fund Expenditure Plan used an affordability threshold of 1.5% MHI to identify DAC water systems that may have customer charges that are unaffordable.[332]

For the 2021 Needs Assessment, the State Water Board explored additional affordability indicators to identify DACs and SDACs that may be experiencing affordability challenges.

[331] White Paper: Evaluation of Potential Indicators and Recommendations for Risk Assessment 2.0 for Public Water Systems https://www.waterboards.ca.gov/safer/docs/e_p_i_recommendations_risk_assessment_2_public_water_systems.pdf

[332] FY 2020-21 Fund Expenditure Plan https://www.waterboards.ca.gov/water_issues/programs/grants_loans/sustainable_water_solutions/docs/sadwfep_2020_07_07.pdf

Ultimately, the affordability indicators “Extreme Water Bill” and “% Shut-Offs” were included in the 2021 Risk Assessment and Affordability Assessment alongside %MHI. The State Water Board analyzed all three affordability indicators for the Affordability Assessment and applied the same thresholds as utilized in the Risk Assessment (summarized in the sections below).

Additional analysis was conducted to identify the DAC and SDAC water systems, HR2W list systems, and At-Risk water systems that met more than one affordability indicator threshold. Scores of 0 (no threshold met), 1 (lower “minimum” threshold met), and 1.5 (higher “maximum” threshold met) were applied to each affordability indicator threshold and tallied across the three indicators for each system to identify which systems may be facing the greatest affordability challenges.

DAC & SDAC DETERMINATION

SB 200 requires the identification of DAC systems that meet the Affordability Threshold. For the purposes of the Affordability Assessment, the State Water Board determined DAC and SDAC economic status for water systems using available data.

> **Disadvantaged Community** or DAC mean the entire service area of a community water system, or a community therein, in which the MHI is less than 80% of the statewide annual MHI level.
>
> **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 MHI.

The State Water Board used the methodology detailed below to estimate MHI. **It is important to note that the estimated designation of community economic status is for the purposes of the Affordability Assessment only and will not be used by the State Water Board’s Division of Financial Assistance (DFA) to make funding decisions.** Further MHI analysis on a per system basis will be conducted by DFA when a system seeks State Water Board assistance.

Table E3: Water System Community Economic Status for the Affordability Assessment

Community Economic Status	Total Systems	HR2W List Systems	At-Risk Systems
DAC	578	45	103
SDAC	993	142	189
Non-DAC	1,210	76	161
Missing DAC Status	96	13	14
TOTAL:	**2,877**	**276**	**467**

AFFORDABILITY INDICATORS

% MEDIAN HOUSEHOLD INCOME

This indicator measures the annual system-wide average residential water bill for 6 Hundred Cubic Feet (HCF) per month relative to the annual Median Household Income (MHI) within a water system's service area. To calculate %MHI for individual water systems, MHI must be determined for the water service area and customer charges are needed. The following section provides an overview of how the State Water Board determined these two datapoints and calculated %MHI.

Calculation *Methodology*

Required Risk Indicator Data Points & Sources:

- Water system service area boundaries: System Area Boundary Layer (SABL).[333]
- 2015-2019 block group-Income: U.S. Census Bureau's American Community Survey.
- Drinking Water Customer Charges: Electronic Annual Report (EAR).

Average monthly drinking water customer charges is collected through the EAR. However, this data has historically not been required for reporting. Therefore, the 2019 EAR data had coverage and accuracy issues. The State Water Board attempted to validate and supplement this dataset through a water rate survey conducted in November 2020. Additionally, customer charges data was collected through the UNC EFC's development of the Small Water System's Rates Dashboard. This data was used when available and applicable. It is anticipated that the coverage and accuracy of drinking water customer charges data will improve with the revisions made to the 2020 reporting year EAR.

Risk Indicator Calculation Methodology:

Median household income (MHI) is determined for a water system using American Community Survey data for household income. Community Water System boundaries typically do not align with census boundaries where per capita income data is regularly collected. In order to assign an average median household income to a community water system spatially weighted income data is aggregated by census block group within the water system service area.

The methodology for this indicator was based on the Division of Financial Assistance (DFA) MHI methodology. While the MHI calculation methodology for the Affordability Assessment generally aligns with the DFA MHI determination methodologies, there are slight differences. The differences found in the calculation of MHI's for cities and census designated places and in the application of the Margin of Error (MOE).

The DFA methodology dictates that when it is determined that a system boundary exactly matches city boundaries or closely matches a census designated place boundary, the MHI for

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[333] State Water Board System Area Boundary Layer (SABL) https://gispublic.waterboards.ca.gov/portal/apps/webappviewer/index.html?id=272351aa7db14435989647a86e6d3ad8

the entire city or census designated place should be directly applied to the system rather than using areally-interpolated block group data. This likely leads to more accurate MHI estimation in these cases. However, this method was not used in the Affordability Assessment given that a case by case determination of matching of cities and census designated places to system boundaries was not feasible for the entire state. The MHI for each water system is a population-weighted MHI, using census block group area and population data. A population factor is generated based on the area of each census block group that falls within the water system boundary. The water system MHI is then calculated using population-adjusted MHIs for each census block group that falls within the water system boundary using the formula below:

$$\sum \frac{(Block\ Group\ MHI) \times (Adjusted\ Block\ Group\ Population)}{(Total\ Adjusted\ Block\ Groups\ Population)}$$

MOE for MHI American Community Survey data is also included in the MHI calculation. A population adjusted MOE is found using the same methodology described for MHI. The lower range of the MOE will be applied to a community’s estimated MHI up to a maximum MOE value of $7,500 for communities with more than 500 people and $15,000 for communities with 500 or fewer people. The MOE will be subtracted from the estimated MHI.

The DFA methodology uses a lower bound MHI by subtracting the block group MOE from the block group MHI, with limits based on community size prior to applying the population factor to MHI and MOE. The methodology applied in the Needs Assessment set margin of error limits and then applied them to population adjusted MHI figures, resulting in slightly different community water system MHI calculations than the DAF methodology.

As a result of these slight variations and the changing nature of household income, all funding related financial assessments must be completed by the DFA as their assessments are water system specific as opposed to the aggregated analysis done for the purposes of the Needs Assessment.

Average monthly drinking water customer charges are calculated using:

- Drinking water service costs estimated at 6 Hundred Cubic Feet per month. This level of consumption is in line with statewide conservation goals of 55 gallons per capita per day, in an average 3-person household.
- When data becomes available, additional approximated customer charges (not collected through a customer’s bill) will be added to this figure to calculate Total Drinking Water Customer Charges.

%MHI = [Average Monthly Drinking Water Changes] / [MHI]

Threshold Determination
%MHI is commonly used by state and Federal regulatory agencies and by water industry stakeholders for assessing community-wide water charges affordability for decades. %MHI is utilized by the State Water Board (at 1.5% threshold) and the U.S. EPA (at 2.5% threshold) for assessing affordability. The State Water Board and DWR use %MHI to determine

Disadvantaged Community (DAC) status, among other income-related metrics. DAC status is often used to inform funding eligibilities for different financial programs offered by the State and other agencies. OEHHA's Human Right to Water (HR2W) tool also utilizes[334] the thresholds determined by the State Water Board for this indicator.[335] Other states, including North Carolina,[336] presently or have recently used 1.5% of MHI spent on water and sewer costs as a threshold for water system funding decisions.

Table E4: % MHI Affordability Thresholds

Threshold Number	Threshold	Score
0	**Below 1.5%** MHI	0
1	**1.5% to 2.49%** MHI	1
2	**2.5% MHI or greater**	1.5

Indicator Analysis

State Water Board staff analyzed 2,877 community water systems, of which approximately 118 CWSs lacked the data necessary to estimate water rates and 83 water systems lacked the data to estimate MHI. Of the 2,676 water systems with sufficient data, staff identified 592 water systems that exceeded the 1.5% MHI affordability threshold, 222 of which exceeded 2.5% MHI. Of those, 121 systems were identified that serve DACs and 313 systems that serve SDACs. Tables E5 and E6 summarize the full results of this indicator analysis. The tables of the full results from the affordability threshold calculations are included in Attachment E1.[337]

Table E5: % MHI Assessment Results by Community Status

Community Status	Total Systems	Threshold Not Met	Threshold 1 Met (1.5%)	Threshold 2 Met (2.5%)
DAC	570	449 (79%)	89 (15%)	32 (6%)
SDAC	902	589 (65%)	161 (18%)	152 (17%)
Non-DAC	1,204	1,046 (87%)	120 (10%)	38 (3%)

[334] On the other hand, there has been criticism of this metric by academics, water system associations, and the broader water sector mostly around its accuracy in measuring household affordability for those truly in need and the setting of arbitrary %MHI thresholds, limitations which the U.S. EPA has recently acknowledged.

[335] Arkansas Natural Resources Commission (2020). Safe Drinking Water Fund Intended Use Plan SFY 2019: https://www.agriculture.arkansas.gov/wp-content/uploads/2020/05/0_-_2019_DWSRF_IUP_-_AMENDED_January_2019_01082019_1156hrs.pdf

[336] North Carolina Department of Environmental Quality, Joint Legislative Economic Development and Global Engagement Oversight Committee (March 17, 2016): https://www.ncleg.gov/DocumentSites/Committees/JLEDGEOC/2015-2016/Meeting%20Documents/3%20-%20March%2017,%202016/2%20%20DEQ_Kim%20Colson%20Water%20Infrastructure%20JLOC%20EDGE%2020160317.pdf

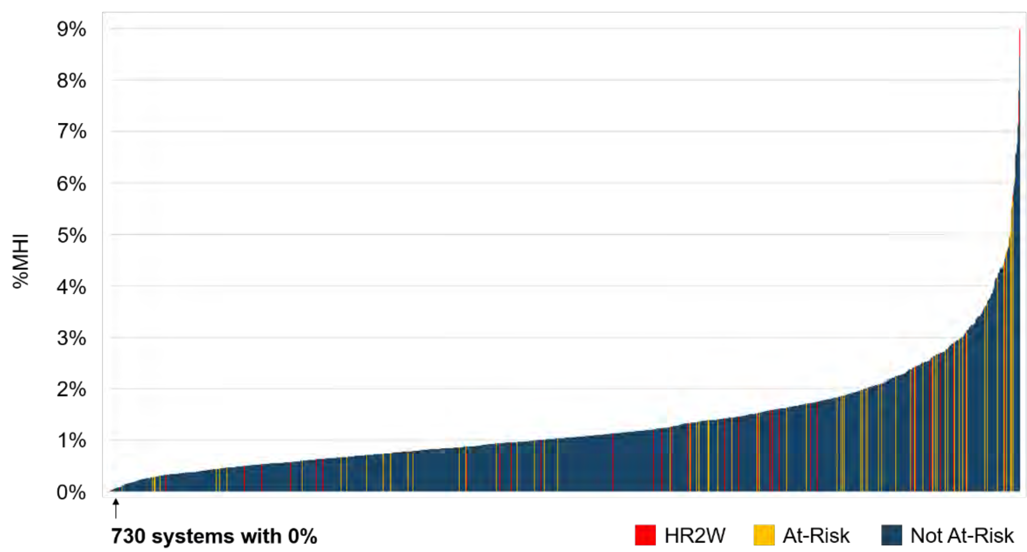
[337] Attachment E1: 2021 Affordability Assessment Data https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/docs/e1.xlsx

Community Status	Total Systems	Threshold Not Met	Threshold 1 Met (1.5%)	Threshold 2 Met (2.5%)
TOTAL:	**2,676**	**2,084 (78%)**	**370 (14%)**	**222 (8%)**
Missing Data	*201*			

Table E6: %MHI Assessment Results by Water System SAFER Program Status

SAFER Program Status	Total Systems	Threshold Not Met	Threshold 1 Met (1.5%)	Threshold 2 Met (2.5%)
HR2W Systems	**256**	**179 (70%)**	**45 (18%)**	**32 (12%)**
HR2W DAC	43	33	5	5
HR2W SDAC	137	81	33	23
At-Risk Systems	**434**	**315 (73%)**	**64 (15%)**	**55 (13%)**
At-Risk DAC	103	83	15	5
At-Risk SDAC	172	109	23	40
Not HR2W or At-Risk System	**1,986**	**1,590 (80%)**	**261 (13%)**	**135 (7%)**
DAC	424	333	69	22
SDAC	593	399	105	89
TOTAL:	**2,676**	**2,084 (78%)**	**370 (14%)**	**222 (8%)**
Missing Data	*201*			

Figure E1: Distribution of %MHI, Excluding 12 Systems Above 10% (n=2,664)



EXTREME WATER BILL

This indicator measures drinking water customer charges that meet or exceed 150% of statewide average drinking water customer charges at the 6 Hundred Cubic Feet (HCF) level of consumption.

Calculation Methodology

Required Risk Indicator Data Points & Sources:

- Drinking Water Customer Charges: EAR
- Other Customer Charges: EAR

Average monthly drinking water customer charges is collected through the EAR. However, this data has historically not been required for reporting. Therefore, the 2019 EAR data had coverage and accuracy issues. The State Water Board attempted to validate and supplement this dataset through a water rate survey conducted in November 2020. Additionally, customer charges data was collected through the UNC EFC's development of the Small Water System's Rates Dashboard. This data was used when available and applicable. It is anticipated that the coverage and accuracy of drinking water customer charges data will improve with the revisions made to the 2020 reporting year EAR.

Risk Indicator Calculation Methodology:

Extreme Water Bill for a water system is determined using Average Monthly 6 HCF Drinking Water Customer Charges and Other Customer Charges divided by the State's Monthly Average Drinking Water Charges. The Risk Assessment is applied to water systems with less than 3,300 service connections, however, this methodology utilizes the statewide average customer charges to calculate extreme water bill, which includes systems with greater than 3,300 connections.

Threshold Determination

The State Water Board's AB 401 report[338] recommended statewide low-income rate assistance program elements utilize the two recommended tiered indicator thresholds of 150% and 200% of the state average drinking water bill for 6 CCF of service.

Table E7: Extreme Water Bill Affordability Thresholds

Threshold Number	Threshold	Score
0	**Below 150%** of the statewide average.	0
1	**Greater than 150%** of the statewide average.	1
2	**Greater than 200%** of the statewide average.	1.5

[338] AB 401 Final Report "Recommendations for Implementation of a Statewide Low-Income Water Rate Assistance Program."
https://www.waterboards.ca.gov/water_issues/programs/conservation_portal/assistance/docs/ab401_report.pdf

Indicator Analysis
State Water Board staff analyzed 2,877 community water systems, of which approximately 118 water systems lacked the data necessary to estimate water rates. Of the 2,759 water systems with sufficient data, staff identified 628 systems that exceeded the 150% statewide MHI affordability threshold and 365 of those systems exceeded the 200% statewide MHI threshold. Of those that exceeded the 150% MHI affordability threshold, 113 systems were identified that serve DACs and 122 that serve SDACs. Tables E8 and E9 summarize the full results of this indicator analysis. The tables of the full results from the affordability threshold calculations are included in Attachment E1.[339]

Table E8: Extreme Water Bill Assessment Results by Community Status

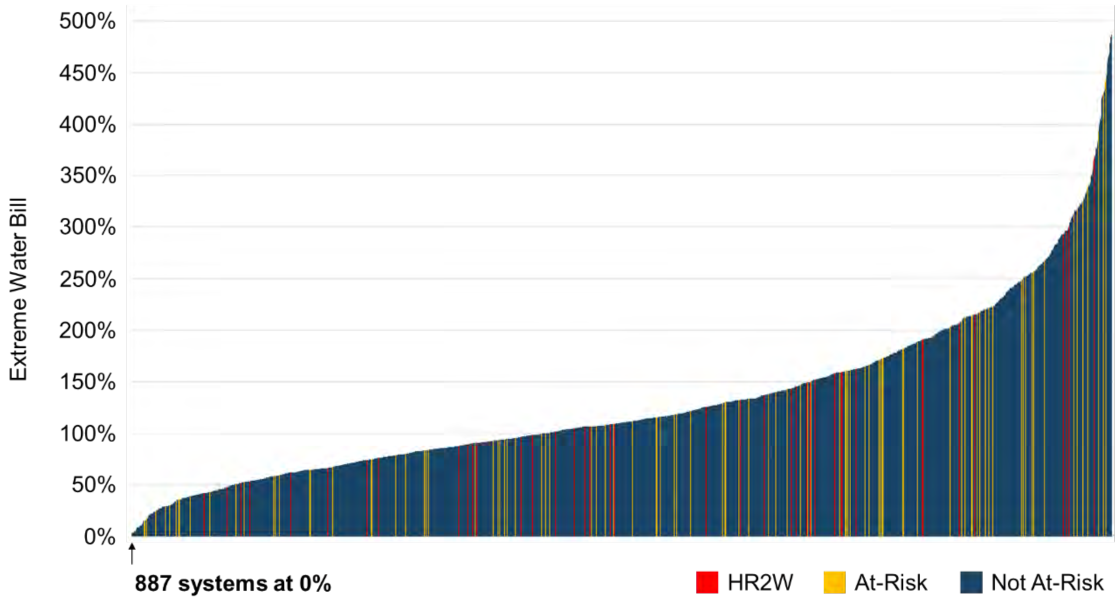
Community Status	Total Systems	Threshold Not Met	Threshold 1 Met (150%)	Threshold 2 Met (250%)
DAC	570	457 (80%)	57 (10%)	56 (10%)
SDAC	985	863 (88%)	60 (6%)	62 (6%)
Non-DAC	1,204	811 (67%)	146 (12%)	247 (21%)
TOTAL:	**2,759**	**2,131 (77%)**	**263 (10%)**	**365 (13%)**
Missing Data	*118*			

Table E9: Extreme Water Bill Assessment Results by Water System SAFER Program Status

SAFER Program Status	Total Systems	Threshold Not Met	Threshold 1 Met (150%)	Threshold 2 Met (250%)
HR2W Systems	**259**	**205 (79%)**	**25 (10%)**	**29 (11%)**
HR2W DAC	43	33	4	6
HR2W SDAC	140	120	12	8
At-Risk Systems	**449**	**343 (76%)**	**39 (9%)**	**67 (15%)**
At-Risk DAC	103	84	10	9
At-Risk SDAC	187	154	16	17
Not HR2W or At-Risk System	**2,051**	**1,583 (77%)**	**199 (10%)**	**269 (13%)**
DAC	658	340	43	41
SDAC	424	589	32	37
TOTAL:	**2,759**	**2,131 (77%)**	**263 (10%)**	**365 (13%)**
Missing Data	*118*			

[339] Attachment E1: 2021 Affordability Assessment Data
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/docs/e1.xlsx

Figure E2: Distribution of Extreme Water Bill, Excluding 23 Systems Above 500% (n=2,736)



% SHUT-OFFS

Percentage of residential customer base with service shut-offs due to non-payment in a given year.

Calculation Methodology

Required Risk Indicator Data Points & Sources:

- Number of residential service connections with water shut-off more than once due to failure to pay: EAR
    - Total Single-Family Shut-offs
    - Total Multi-Family Shut-offs
- Total Number of Service Connections: EAR

Risk Indicator Calculation Methodology:

% Shut-Offs = ([Total Single-Family Shut-offs + Total Multi-Family Shut-offs] / Total Number of Service Connections) X 100

Threshold Determination

An indicator threshold for the percent of residential service connections shut-off due to non-payment, as defined here or a similar measure, has not to the State Water Board's knowledge been assessed in other previous studies as related to water system failure or to determine affordability challenges. However, a standard of zero has been employed by the State,[340] other regulatory agencies and stakeholders as a threshold of concern particularly during the COVID-19 pandemic. For the purposes of the State Water Board's Needs Assessment a threshold of 10% or greater customer shut-offs over the last calendar year for non-payment was utilized.

Table E10: % Shut-Offs Affordability Thresholds

Threshold Number	Threshold	Score
0	**Below 10%** customer shut-offs	0
1	**Greater 10% or greater** customer shut-offs.	1

Indicator Analysis
State Water Board staff analyzed 2,877 community water systems, of which approximately 49 water systems lacked the data necessary estimate the percent of customers who had their services shut-off due to non-payment. Of the 2,828 water systems with sufficient data, staff identified 139 systems that exceeded the 10% or greater shut-offs for non-payment affordability threshold. Of those, 35 systems were identified that serve DACs and 62 that serve SDACs. Tables E11 and E12 summarize the full results of this indicator analysis. The tables of the full results from the affordability threshold calculations are included in Attachment E1.[341]

Table E11: % Shut-Offs Assessment Results by Community Status

Community Status	Total Systems	Threshold Not Met	Threshold Met (10% or more)
DAC	569	534 (94%)	35 (6%)
SDAC	974	912 (94%)	62 (6%)
Non-DAC	1,199	1,159 (97%)	40 (3%)
Missing DAC Status	86	84 (98%)	2 (2%)
TOTAL:	**2,828**	**2,689 (95%)**	**139 (5%)**
Missing Data	*49*		

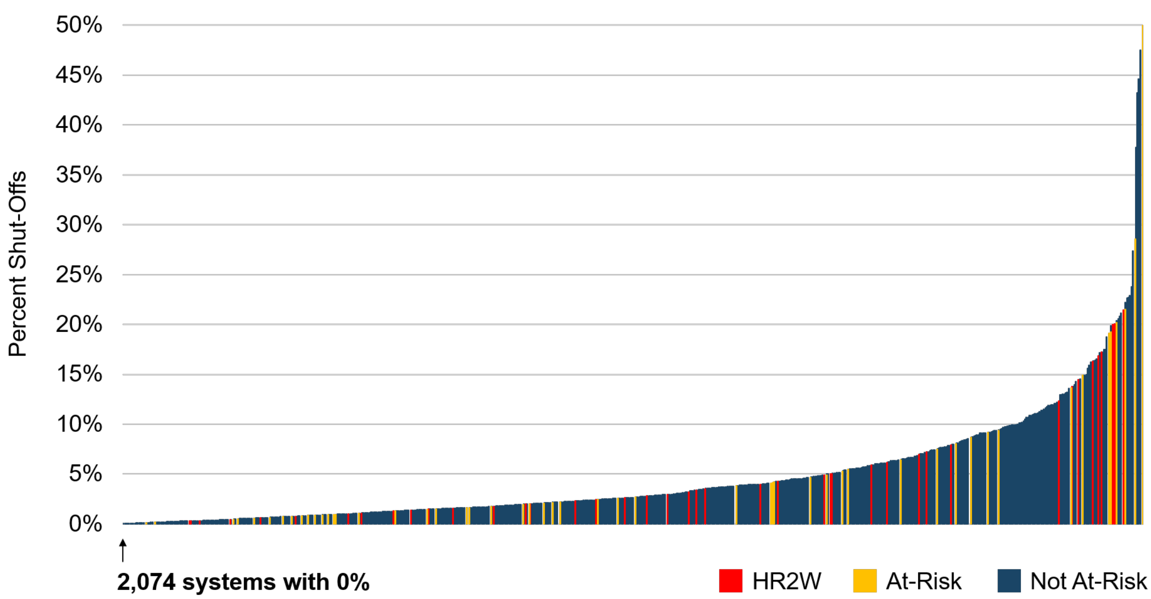
340 Executive Order N-42-20
https://www.gov.ca.gov/wp-content/uploads/2020/04/4.2.20-EO-N-42-20-text.pdf

341 Attachment E1: 2021 Affordability Assessment Data
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/docs/e1.xlsx

Table E12: % Shut-Offs Assessment Results by Water System SAFER Program Status

SAFER Program Status	Total Systems	Threshold Not Met	Threshold Met (10% or more)
HR2W Systems	**271**	**250 (92%)**	**21 (8%)**
HR2W DAC	43	39	4
HR2W SDAC	139	126	13
At-Risk Systems	**457**	**440 (96%)**	**17 (4%)**
At-Risk DAC	102	100	2
At-Risk SDAC	186	174	12
Not HR2W or At-Risk System	**2,100**	**1,999 (95%)**	**101 (5%)**
DAC	424	612	29
SDAC	649	395	37
TOTAL:	**2,828**	**2,689 (95%)**	**139 (5%)**
Missing Data	*49*		

Figure E3: Distribution of % Shut-Off, Excluding 54 systems with Shut-Offs above 50% (n=2,774)



APPENDIX F:
NEEDS ASSESSMENT FOR TRIBAL WATER SYSTEMS

INTRODUCTION

The State Water Board is currently organizing outreach to tribal leaders and coordinating with Indian Health Services, U.S. EPA, and other partners to identify needs and potential solutions for water systems serving Federally recognized California Native American tribes and non-Federally recognized Native American tribes.[342] These outreach efforts are also intended to ensure these communities are informed of, and have the opportunity to engage with, all aspects of the SAFER Program. The State Water Board recognizes the unique sovereign status of tribal governments and that actual participation in any aspect of the SAFER Program would be voluntary on the part of each individual tribe.

Tribal water systems that are not Federally recognized are currently regulated by the State Water Board's Division of Drinking Water and therefore are included within the Needs Assessment of public water systems (PWSs), state small water systems (SSWSs), and domestic wells. Thus, the methodology provided in this section is only applicable to Federally regulated California tribal water systems. This methodology is designed to ensure that Federally regulated California tribal water systems are incorporated in the 2021 Needs Assessment while public outreach is ongoing. Throughout this report, the term "tribal water systems" refers to Federally regulated Tribally owned or operated public water systems.

NEEDS ASSESSMENT FOR TRIBAL WATER SYSTEMS

Due to data limitations, the State Water Board was unable to assess the needs of tribal water systems in the 2021 Needs Assessment using the same methodology employed for evaluation of public water systems, state small water systems, and domestic wells. Therefore, the State Water Board developed an alternative approach for conducting a tribal water system Needs Assessment which relies upon approximating of HR2W list equivalent and At-Risk equivalent water systems. The approximation of HR2W list and At-Risk equivalent water systems is necessary because the SAFER Program's prioritization of funding and technical assistance for the Safer and Affordability Drinking Water Fund generally relies on the results of the Needs Assessment for these systems. The following sections provide an overview of the alternative approach utilized for tribal water systems.

[342] Tribal contact list maintained by the Native American Heritage Commission.

HR2W LIST EQUIVALENT TRIBAL WATER SYSTEMS

The State Water Board assesses water systems that fail to meet the goals of the HR2W and maintains a list and map of these systems on its website. Systems that are on the HR2W list are those 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 (CWSs) and Non-Community Water Systems (NCWSs) that serve schools and daycares. The HR2W list criteria was expanded in April 2021 to align with statutory definitions of what it means for a water system to "consistently fail" to meet primary drinking water standards.[343] Table F1 summarizes the new expanded criteria.

Table F1: Failing Water Systems, HR2W List Criteria

Criteria
Primary MCL Violation with an open Enforcement Action
Secondary MCL Violation with an open Enforcement Action
E. coli Violation with an open Enforcement Action
Treatment Technique Violations (in lieu of an MCL): • One or more Treatment Technique violations (in lieu of an MCL), related to a primary contaminant, with an open enforcement action; and/or • Three or more Treatment Technique violations (in lieu of an MCL), related to a primary contaminant, within the last three years.
Monitoring and Reporting Violations (related to an MCL or Treatment Technique): • Three Monitoring and Reporting violations (related to an MCL) within the last three years where at least one violation has been open for 15 months or greater.

TRIBAL WATER SYSTEM WATER QUALITY VIOLATIONS

U.S. EPA Region 9 and Navajo Nation EPA, which together encompass multiple southwestern states, regulate approximately 365 tribal community water systems and 115 non-community water systems. As illustrated in Figure F1, there were 56 (12%) tribal water systems with serious health-based violations across U.S. EPA Region 9 in 2020. Federally regulated tribal water systems are not required to sample all contaminants regulated in California, therefore, it is expected that there may also be tribal water systems with California specific contaminant violations that are not captured in this list.

In California, there are approximately 90 Federally recognized tribal community water systems, 23 non-transient non-community water systems, and 15 transient water systems. Information

[343] California Health and Safety Code Section 116275(c)

on the compliance status of individual tribal public water system can be found on U.S. EPA's Envirofacts: Safe Drinking Water Search for Tribes in EPA Region 9 website.[344]

Figure F1: Tribal Lands in U.S. EPA Region 9[345]

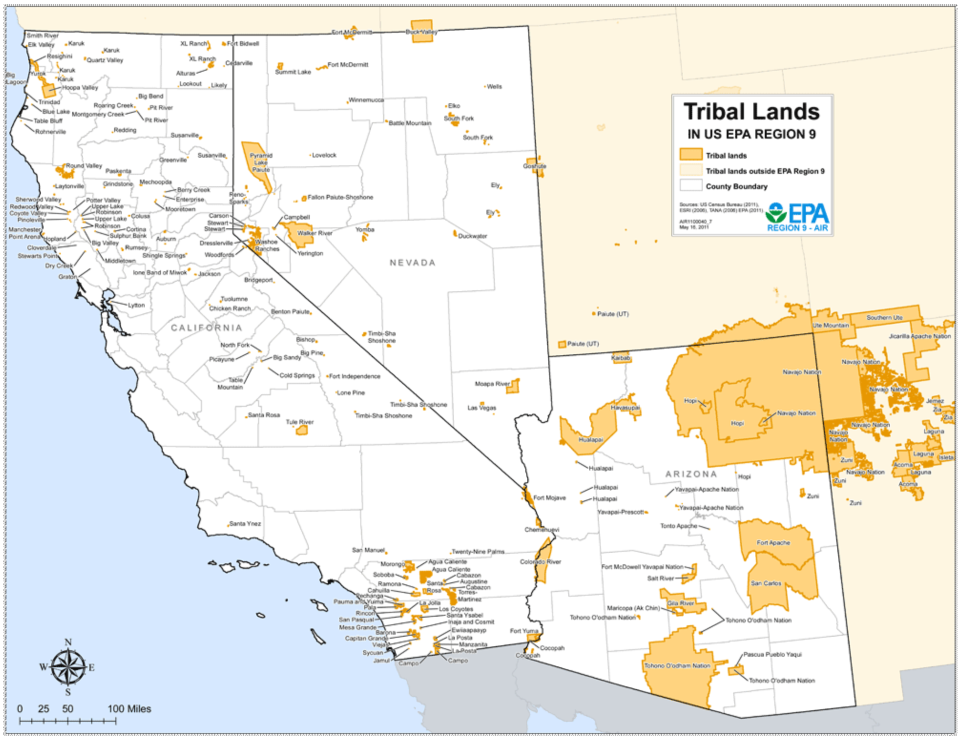
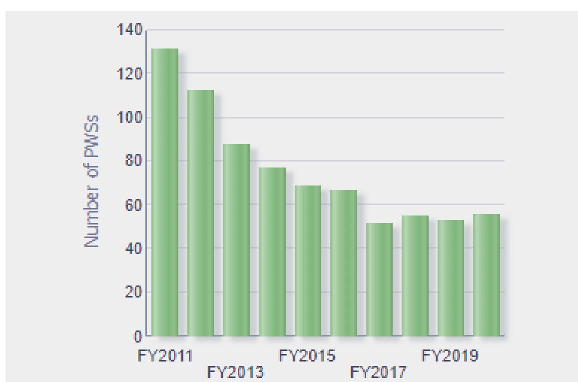


Figure F2: Tribal PWSs with Health-Based Violations in Region 9[346]



[344] [Safe Drinking Water Search for Tribes in EPA Region 09](https://enviro.epa.gov/enviro/sdw_form_v3.create_page?state_abbr=09)
https://enviro.epa.gov/enviro/sdw_form_v3.create_page?state_abbr=09

[345] [Tribal Lands in US EPA Region 9](https://19january2017snapshot.epa.gov/sites/production/files/2015-07/documents/r9tribes.pdf)

https://19january2017snapshot.epa.gov/sites/production/files/2015-07/documents/r9tribes.pdf

[346] [Analyze Trends: State Water Dashboard | ECHO | US EPA](https://echo.epa.gov/trends/comparative-maps-dashboards/state-water-dashboard?region=09&view=activity)
https://echo.epa.gov/trends/comparative-maps-dashboards/state-water-dashboard?region=09&view=activity

METHODOLOGY FOR IDENTIFYING HR2W LIST EQUIVALENT TRIBAL WATER SYSTEMS

State Water Board staff worked with U.S. EPA tribal drinking water staff to calibrate their assumptions on the number of tribal equivalent HR2W list systems. Using the same SDWIS enforcement codes for the State Water Board's expanded HR2W list criteria, U.S. EPA identified 13 tribal community water systems that met the criteria. Of these 13 tribal community water systems, three had primary MCL enforcement actions while the other 10 were related to treatment technique violations, which includes failure to address a significant deficiency under the groundwater rule as defined by U.S.EPA. Two of these systems also had significant monitoring and reporting violations. All the tribal HR2W list equivalent water systems had fewer than 400 connections and only two systems had greater than 100 connections.

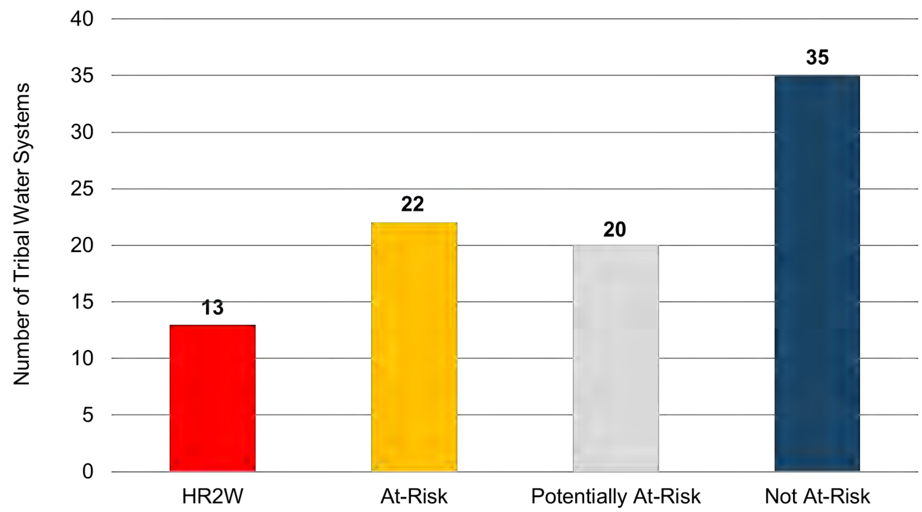
Using U.S. EPA's health-based violation numbers for Region 9, a proportional estimate assumes that 12% of the 90 California tribal public water systems, or approximately 11 water systems, would be on an equivalent HR2W list based on Federal violations. The statewide percentage of community water systems and schools on the California HR2W list is also approximately 12% showing some similarities between the Federally recognized tribal water systems and those water systems regulated by the State Water Board. The two percentages are not directly comparable however because the U.S. EPA model includes all non-community water systems, while the California model excludes non-community water systems except for K-12 schools. On the other hand, the U.S. EPA serious violation numbers do not include contaminants only regulated in California, e.g. 1,2,3-TCP.

For the purposes of the tribal Needs Assessment, the State Water Board used the U.S. EPA provided HR2W list of 13 tribal water systems. However, the State Water Board utilized the 11 modeled HR2W tribal equivalent systems and the 13 actual HR2W tribal equivalent systems to calculate an adjustment ratio (15%) to calibrate the approximation of At-Risk equivalent tribal water systems.

AT-RISK LIST EQUIVALENT TRIBAL WATER SYSTEMS

After removing HR2W list systems, the Risk Assessment results from the analysis of 2,779 Californian public water systems (with service connections fewer than 3,300) and K-12 schools identified 25% as At-Risk and 23% as Potentially At-Risk water systems. These California statewide percentages were utilized to approximate the number of equivalent tribal At-Risk water systems combined with a +15% adjustment ratio, based on the analysis of HR2W list equivalent tribal systems discussed in the previous section. Using this methodology, the estimated numbers of tribal equivalent At-Risk and Potentially At-Risk water systems are 22 and 20, respectively. Figure F3 shows the summary results of the tribal Risk Assessment.

Figure F3: Estimated Tribal HR2W List and At-Risk Water Equivalent Systems



The State Water Board recognizes that Indian Health Services (IHS), Division of Environmental Health Services prioritizes access to safe drinking water as a major component of its effort to decrease waterborne illness in tribal communities nationwide. They have developed several strategies, objectives, indicators and performance measures that provide a foundation for their work. A summary of the Division's measures can be found on its website.[347] Further outreach to advance these existing efforts and collaboration with IHS will be undertaken as the State Water Board's Needs Assessment evolves.

COST ASSESSMENT FOR TRIBAL WATER SYSTEMS

The Cost Assessment methodology for tribal water systems generally follows the statewide methodology (Appendix C). However, two significant changes were made: 1) physical consolidation was not considered as a modeled solution and 2) the sustainability and resiliency analysis for potential modeled solutions was not performed for tribal water systems due to inadequate data availability. For the purposes of this assessment, it was generally assumed that consolidation would not be a preferred option based on the special sovereign status of Federally recognized tribal water systems and previous input from tribal members. As with the statewide Cost Assessment, these modeled solutions are utilized for broad policy efforts and are not a substitute for individual evaluations and outreach for the actual solution implementation at each water system.

Statewide cost estimates utilized for the tribal Cost Assessment were based on estimated California infrastructure costs derived for HR2W list and At-Risk PWSs. This also included operations and maintenance (O&M) costs for HR2W list systems only. These costs were based on specific system-level information, particularly contaminant information for HR2W list

[347] Safe Drinking Water | Indian Health Services, Division of Environmental Health Services https://www.ihs.gov/sites/dehs/themes/responsive2017/display_objects/documents/priorities/SafeDrinkingWater.pdf

systems. However, due to the lack of specificity around the issues tribal water systems may be facing, the average statewide long-term solution cost (excluding consolidation costs) generated for Californian PWSs was applied to the tribal HR2W list and At-Risk equivalent water systems. The actual number of connections was directly utilized for tribal HR2W list equivalent systems, while estimates were utilized for the tribal equivalent At-Risk systems.

Of the 22 tribal At-Risk equivalent water systems, it is estimated that 17 systems have equal to or less than 100 connections and five systems have between 101 and 500 connections. The average number of connections among those with less than or equal to 100 connections is assumed to be the midpoint (50). Likewise, the average number of connections in the between 101 to 500 connections is assumed to be 300. Tables F2 and F3, below provide a summary of the cost estimates for HR2W list and At-Risk equivalents tribal water systems.

Table F2: Cost Estimates for Tribal HR2W Equivalent Systems

Criteria	# of Systems	Avg. Treat. Costs per System	Other Infra. Cost per Connection	Capital Costs Subtotal	Annual O&M per System	20-Yr. NPW[348] O&M per System	20-Yr. NPW Subtotal Costs[349]
< 100 connections w/ MCL violation	2	$1,025,000	$69,000	$5,500,000	$42,000	$1,597,000	$8,700,000
< 100 connections	9	N/A	$69,000	$31,000,000	N/A	N/A	$31,000,000
101 – 500 connections with MCL violation	1	$1,178,000	$9,000	$4,700,000	$68,000	$2,101,000	$6,800,000
101 – 500 connections	1	N/A	$9,000	$2,300,000	N/A	N/A	$2,300,000
Total				**$43,500,000**			**$48,800,000**

[348] The Net Present Worth (NPW) estimates the total sum of funds that need to be set aside today to cover all the expenses (capital, including OEI costs, and annual O&M) during the potential useful life of the infrastructure investment, which is conservatively estimated at 20-years.

[349] Cost includes treatment, OEI, and 20-year O&M, for systems with MCL violations.

As discussed in other sections of the Needs Assessment, it is important to note that the long-term Cost Assessment results summarized below correspond with a Class 5 cost estimate as defined by Association for the Advancement of Cost Engineering (AACE) International. The full range of estimate is thus -50% to +100%. A more site specific and detailed assessment will be needed to refine the costs and select a local solution that is most appropriate. Therefore, the range of capital cost estimates for equivalent HR2W list tribal systems extends from $21.7 million to $87 million. The range of 20-Year NPW costs, including capital costs and 20-years of O&M, for these systems range from $24.4 million to $97.6 million.

Table F3: Cost Estimates for Tribal At-Risk List Equivalent Systems

Criteria	# of Systems	Assumed # of Connections	Other Infra. Costs and TA per Conn	Subtotal Costs
< 100 connections	17	50	$48,000	$40,800,000
101 – 500 connections	5	300	$9,300	$14,000,000
	Total At-Risk Equivalent Tribal Estimated Costs:			**$54,800,000**

Total Estimated Capital Costs for both HR2W List and At-Risk Equivalent Tribal Water Systems:	**$98,300,000**

Thus, the total estimated capital needs to address both the tribal equivalent HR2W list and At-Risk cost is $98.3 million, with a Class 5 estimate range of $49.1 million to 196.6 million. For the three tribal water systems with a primary MCL violation, the estimated O&M cost associated with a treatment solution is $152,000 per year or $10 million dollars for 20 years. With a Class 5 estimate range, this is approximately $76,000 to $304,000 per year, or $5 million to $20 million for 20 years.

Interim costs were also estimated for tribal HR2W list equivalent water systems. The costs assumed that POE/POU devices were supplied to the three water systems with primary MCL violations and bottled water to the remaining 10 HR2W list equivalent systems. It was assumed that either POE/POU or bottled water would be supplied for at least 6 years to ensure that the water system had adequate time to obtain financing and come into compliance. The underlying estimates were completed using similar average unit costs and other assumptions employed in the Cost Assessment for Californian PWSs. The estimated 6-year tribal emergency/interim equivalent estimated costs were $6.7 million.

TRIBAL METHODOLOGY FOR GAP ANALYSIS

Tribal costs were not included in the Cost Assessment's Gap Analysis for the 2021 Needs Assessment. This decision was influenced by two factors. First, tribal water systems are eligible for Federal funding sources that are not currently captured in the Gap Analysis. For instance, grant funding for tribal water system planning and construction can be obtained from the Federal U.S. EPA Drinking Water Tribal Set Aside Program.[350] Second, there is uncertainty surrounding tribal interest in participating in the SAFER Program. However, it is worth noting, that based on early outreach to tribal systems by SAFER Program staff, operations and maintenance support is of interest to some tribal communities. Estimated tribal system solution costs will be a topic of discussion for the SAFER Program's Advisory Group members for the 2021-22 Fund Expenditure Plan.

TRIBAL METHODOLOGY FOR THE AFFORDABILITY ASSESSMENT

Unfortunately, the State Water Board does not have access to the data necessary to conduct an Affordability Assessment for tribal water systems. The State Water Board, in coordination with IHS, U.S. EPA, and other partners, will be reaching out to tribal water systems and tribal leaders to explore interest in data sharing which may enable a tribal water system Affordability Assessment in the future.

TRIBAL NEEDS ASSESSMENT LIMITATIONS & OPPORTUNITIES

LIMITATIONS

Non-Federally recognized tribal water systems are under the jurisdiction of the State Water Board and are included as part of the broader Needs Assessment effort. Federally regulated California tribal water systems are not regulated by the State Water Board and therefore significant data limitations hamper the State Water Board's current ability to conduct a Needs Assessment for tribal water systems. These data limitations require the Needs Assessment to extrapolate data, particularly around identification of At-Risk equivalent water systems and tribal cost estimates.

Another unique data limitation is related to the identification of HR2W list equivalent tribal water systems. There are some contaminants, e.g. 1,2,3-trichloropropane, that are specifically regulated by the State and not U.S. EPA. Thus, many tribal water systems do not sample and test for these contaminants, even though some tribal water system sources may be exceeding California specific MCLs. Therefore, these systems would not be captured on the HR2W list. The SAFER Program has resources that may support projects associated with these types of contaminants, which are not typically funded through Federal programs.

OPPORTUNITIES

The Needs Assessment is an iterative process and tribal community inclusion is a fundamental principle of the SAFER Program. The State Water Board recognizes tribal governments as sovereign nations within California's boundaries. In June 2021, the State Water Board's Office of Public Participation anticipates conducting outreach to tribal leaders and members to inform them of the SAFER Program to ensure they can fully participate, if desired. Tribal representatives and Federal partners are part of the SAFER Advisory Group and help provide additional specialized expertise on tribal outreach and inclusion.

In addition to tribal outreach, the State Water Board is in discussions with U.S. EPA and IHS to investigate alternative approaches to determining At-Risk equivalent tribal water systems that wish to participate in the SAFER Needs Assessment process. The State Water Board is also exploring how tribal privacy and sovereignty concerns can be addressed. Future iterations of the Needs Assessment will continue to seek to expand incorporation of tribal interests to the maximum extent possible, including further research into which funding sources may be applicable to tribal water systems for the foundations of a funding Gap Analysis.