Water System Boundaries Version 2.0

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File name: WS_full_final_081024.shp; WS_downloadable_final_081024.shp*

Spatial Reference

Geographic Coordinate System	NAD 1983	Projected Coordinate System	NAD 1983 (Teale) Albers (Meters)
WKID	4269	Projection	3310
Authority	EPSG	Authority	EPSG
Angular Unit	Degree (0.0174532925199433)	Linear Unit	Meters (1.0)
Prime Meridian	Greenwich (0.0)	False Easting	0.00
Datum	D North American 1983	False Northing	-4000000.0
Spheroid	GRS 1980	Central Meridian	-120.0
Semimajor Axis	6378137.0	Standard Parallel 1	34.0
Semiminor Axis	6356752.314140356	Standard Parallel 2	40.5
Inverse Flattening	298.257222101	Latitude of Origin	0.0

Description

This file contains spatial geography for 4,035 water systems in California; 2,917 boundaries maintained by the California State Water Resources Control Board (State Water Board) and processed by California Environmental Protection Agency Office of Environmental Health Hazard Assessment (OEHHA) for CalEnviroscreen 4.0 (CES4.0)[1], and 1,271 boundaries from the Monterey County Department of Public Health.[2] Statewide boundaries originating from the State Water Board include community water systems (CWS) – systems with 15 or more service connections or serving 25 or more people at least 6-months out of the year, and State Small Water Systems (SSWS) – systems with 5-14 service connections. Limited statewide boundaries were available for SSWS (less than 10% of estimated SSWS have polygon boundaries). We integrated regional water system boundaries provided by Monterey County, a dataset unique to Monterey County that includes State Small Water Systems (SSWS); Local Small Water Systems (LSWS) – 2-4 service connections; Transient non-community (TNC) and Non-transient non-community (NTNC) (i.e., parks and schools, respectively) and boundaries for public water systems that are monitored by Monterey County and Local Primacy Agency (LPA). Boundaries were cleaned and integrated into a single layer. Statewide, we estimate that 37.6 million people are served by a water system included in this dataset. Appendix A provides a breakdown of water systems by type. NTNC and TNC systems were excluded in the statewide dataset but retained in Monterey County.

Water systems were assigned a number of water system service connections and activity status from the Safe Drinking Water Information System (SDWIS), as of August 5, 2024.[3] Inactive systems (N=180) were flagged and will be removed during the next round of updates to this layer.

Water quality estimates for arsenic, nitrate, hexavalent chromium (Cr[VI]) and 123-trichloropropane (123-TCP) originate from two sources. Water systems in CES4.0 received a water quality estimate representing the 9-year system average for water delivered to the customer.[4] Water systems from the Monterey County Department of Public Health received annual maximum measured water quality for each year from 2015-2020, and the overall maximum measured concentration from 2015-2020.[5]

Each water system includes demographic data from the US Census Bureau's American Community Survey 2017-2021 5-year estimates for race/ethnicity, median household income, and disadvantaged community (DAC) status.[6,7] Demographic data was originally downloaded at the block group level and aggregated to water systems using areal apportionment.

Water systems were assigned an affordability burden level, based on results from the State Water Board's 2024 Affordability Assessment.[8] The affordability burden was determined by evaluating each system against three affordability indicators:

- Percent of median household income (%MHI): compares the average annual residential water bill (for six hundred cubic feet [HCF] per month) to the annual MHI of the service area;
- Extreme water bill: assesses drinking water customer charges that are at least 150% of the statewide average drinking water charges for six HCF per month; and
- Household socioeconomic burden: a composite measure identifying systems serving communities with high poverty and high housing costs for low-income households.

The total number of affordability indicator thresholds a system met or exceeded determined its overall affordability burden. Systems exceeding more indicators were determined to face greater affordability challenges.

Methods

Cleaning state small water system (SSWS), local small water system (LSWS), and Local Primacy Agency (LPA) boundaries.

1. Identified duplicate systems with the same system ID. Several systems were in the dataset twice because they are monitored by LPA and county SWS program. In the case of duplicates, we retained boundaries from SWS under recommendation from the Community Water Center (CWC) based on local knowledge.
2. Identified overlapping geography by intersecting systems monitored by LPA and SWS. Overlapping geography was assigned to the smaller system (typically the SWS).
3. Manually cleaned boundaries for Visalia to match the CalWater[9] service area map, available online.

4. Manually cleaned boundaries for Porterville water system at request of CWC (Porterville consolidated the Central Mutual Water Co. several years ago but the updated boundary was not reflected in CES4.0).
5. Manually removed slivers (i.e. small polygons created by merging geography from different polygons) from CA4810001 (Elmira system in Vacaville, CA).

Combining SWS and Public water system (PWS) boundaries and removing slivers

1. Removed overlaps in PWS boundaries (assigned overlaps to smaller systems).
2. Removed overlaps between Monterey County system boundaries and Statewide PWS (assigned overlaps to smaller systems).
3. Combined Monterey and Statewide systems into a single shapefile.
4. Identified slivers (small polygons) created in step 4; New slivers of 5 meters or less were merged with the water system sharing the longest border.
5. Manually fixed boundary for Maywood systems 1, 2, 3 based on the Luskin[10] Water Systems Governance Map.

Assigning Service Connections and Activity Status

1. Data for service connections and activity status were downloaded from Safe Drinking Water Information System (SDWIS) and joined to water systems based on system ID.
2. A new field was created in the attribute table called "qualifier."
    a. State Small Water Systems (SSWSs; by definition have between 5-14 service connections) were assigned a qualifier of "<=" and a service connection value of 14 (i.e. <=14 service connections).
3. Service Connections:
    a. 852 systems missing service connections.
    b. 191 of the 852 were classified as SSWSs.
    c. 661 of the 852 had missing value for service connections.
        i. 660 were "Local Small Water Systems."
        ii. 1 was "transient non-community."
    d. 112 had "0" service connections.
        i. 110 of them were "Inactive."
        ii. The system IDs for the other two are CA2701824 (11 service connections according to the State Water Board 2023 State Small Risk Assessment) and CA5000066 (system undergoing voluntary consolidation).
4. Activity status:
    a. 2,894 systems "active."
    b. 109 changed from public to non-public (these are also active).
    c. 180 "inactive" (to be addressed in the next update).
    d. 852 unknown (these are the same systems that were missing data on service connections).

Assigning Water Quality

1. Assigned time weighted 9-year estimates for delivered water quality for nitrate as N, arsenic, hexavalent chromium, and 123-TCP. Data was processed and shared by OEHHA and originally developed for CES4.0.
   - 2,930 joined by system ID
   - 2,812 received water quality data for one or more contaminant
   - 115 (3.92%) were missing water quality data
   - 13% received a concentration of "0", indicating that all measurement were below the detection limit

2. Assigned 1-year maximum measured water quality for nitrate as N, arsenic, and chromium [VI]. Data was shared by Monterey County and processed by Ananya Subramanian and Clare Pace. Most systems in this dataset were sampled once every year or once every two years.
   - 1,271 systems joined by system ID
   - 956 received water quality data for at least one contaminant for at least one year.
   - One system (CA2700802) received water quality data for nitrate from both CES4.0 and Monterey County:
     - CES4.0: 9-year avg Nitrate = 6.55
     - Monterey County: Max Nitrate 2015-2020: NA; 6.5; 6.8, 6.8; 6.5; 6.5

Assigning population estimates to water systems

1. First, assigned population by areal apportionment using Depsky, 2020 population grid.[11]
2. If resulting population was considered implausible (less than 25 people for CWS (n=1,542); less than 8 people for SSWS; and less than 2 people for local small water system (LSWS), then we used the following steps to estimate the population:
   a. Used the Safe Drinking Water Information System (SDWIS)[12] population estimate if the SDWIS population was greater than or equal to the above cutoff.
   b. If the population estimate from SDWIS was below the cutoff, we followed an approach developed by the State Water Board and multiplied the number of service connections reported in SDWIS by 3 to get a new population (n=655).
      i. There are an estimated 3 people per household and we assumed each connection serves one household.
   c. Manually checked all remaining systems with low population. All were plausible: remaining systems with low population were categorized as 'non-community' type systems "NTNC" or "TNC." These include 14 systems have 0 pop; 152 have a population under 25).
3. Adjusted for potential well users
   a. Summed domestic wells in overlapping water system/DWA areas.[13]
   b. Explored a matrix of options for calculating the number of people served by each well across the state. Factors that we considered were the number of wells that are active/in use (i.e. activity weight), the number of wells that may be missing from the Online

System of Well Completion Reports (OSWCR) dataset (i.e., completeness weight), and the number of people in each household (i.e., population weight).

c. Subtracted potential (low, moderate, high) estimated well populations in PWS areas from the respective water system and evaluated for plausibility (i.e. determined how many "adjusted" water system populations would be below population limits established in step 2.
d. Based on our results and consultation with our technical advisory committee, we assigned a weight of 1 person to each domestic well. Under these conditions only 14 systems received implausible population estimates.
e. For the 14 systems flagged in step 3d, we made a final adjustment: assumed that the corresponding wells are not active and we did not adjust the final population estimates by shifting these people from water system population to DWA population. This impacted 558 people statewide.
f. In all, shifted a total of 58,898 people from water system areas and added them to their respective domestic well areas (DWAs).

Assigning water system demographics

1. Calculated areal weights
    a. Calculated the area in km^2 of California block group (BG) geography
        i. Created a feature layer, setting use ratio policy for the area field
    b. Calculated the area in km^2 for the water system boundaries
    c. Performed spatial intersect between the water systems layer (rank 1) and the block group feature layer (rank 2)
    d. Calculated areal weights by dividing the intersected block group area by the total area of the water system
2. Assigned block group level 2021 American Community Survey (ACS) of the US Census 5-year data to water system boundaries
    a. Joined ACS data to the intersected water system/BG layer by GEOID
    b. Multiplied race/ethnicity proportions by the areal weights
    c. Multiplied median household income (MHI) by the areal weights
3. Assigned missing MHI data to water systems
    a. Selected the 2,325 block group sections missing MHI data
        i. Assigned the missing block group sections MHI data at the census tract level
    b. Selected the 430 block group sections still missing MHI data
        i. Assigned the missing block group sections MHI data at the county subdivision level
        ii. *Note*: Because county subdivisions do *not* share a GEOID with block groups, county subdivision data was spatially joined to the intersected water system/BG layer by centroid
    c. Repeated step 2c.
4. Summed demographic data by water system
    a. Dissolved the intersected water system/BG layer by system ID

b. Calculated the sum of race/ethnicity proportions and MHI per water system
c. Identified and created new binary variables for disadvantaged community (DAC) and severely disadvantaged community (SDAC) communities (1=yes, 0=no)
    i. A DAC has MHI of less than 80% of California's overall MHI. A SDAC has an average MHI of less than 60% of California's overall MHI. Note that the MHI changes each year; In 2021, the statewide MHI was $84,097. The calculated DAC threshold is $67,278 and the calculated SDAC threshold is $50,458. Census geographies with MHIs below $67,278 are labeled DACs and MHIs below $50,458 are labeled SDACs.

Assigning water system affordability burden:

1. Assigned overall affordability burden and individual affordability indicator thresholds to water systems using data from the State Water Board's 2024 Affordability Assessment.
2. Water systems included in the Affordability Assessment (n=3,202) received a value of high, medium, low, or none for the affordability burden and a binary value (Yes or No) indicating whether any of the affordability indicator thresholds were exceeded (see Tables 1&2 for a breakdown of the burden levels and indicator thresholds).
3. The Affordability data was joined to the Drinking Water Tool (DWT) Water System Boundaries layer by water system ID, and matched 2,767 systems.
    a. The remaining 1,268 DWT systems without affordability data were assigned "Missing" values. The unmatched systems were majority LSWSs and SSWSs (83%).
    b. The 439 systems in the Affordability dataset that are not included in the DWT were majority NTNC water systems (K-12 Schools, 80%). The remaining 20% were small CWSs.

Table 1. Affordability Burden Levels.

Level	Affordability Risk
High	3 Affordability indicator thresholds exceeded
Medium	2 Affordability indicator thresholds exceeded
Low	1 Affordability indicator thresholds exceeded
None	0 Affordability indicator thresholds exceeded

Table 2. Affordability Indicator Thresholds.

Threshold Met	% MHI	Extreme Water Bill	Household Socioeconomic Burden
Yes	1.5% or greater	Equal to or greater than 150%	Combined score of 0.25 - 1
No	Less than 1.5%	Below 150% of the	Combined score of 0 -

		statewide average.	0.125

Attribute Table

	Field Heading	**Field Description**	**Source**
	FID	Field ID	ESRI generated
	Shape	Polygon ZM	ESRI generated
Water System Information	Sys_ID	Water system ID	CalEnviroscreen 4.0 (CES)[1] /Monterey County dataset[2]
	Name	Water System name	CES/Monterey County
	TYPE	COMMUNITY ● 15 or more service connections or serving 25 or more residential customers at least 60 days of the year NTNC ● Non-Transient non-community (i.e. school or business) TNC ● transient non-community (i.e. park or motel) STATE SMALL WS ● 5-14 service connections LOCAL SMALL WS ● 2-4 service connections serving households OTHER	CES/Monterey County
	REG_TYPE	Regulatory type PUBLIC = public water system SSWS = small water system (regulated by county)	CES/Monterey County

		LSWS = local small water system (no federal requirements to monitor) NP = Non-public	
	qualifier	Qualifier for the service connections field (i.e. "=" , "<=")	WESS
	Service_co	Number of connections served.	SDWIS
	Activity_S	Active or Inactive according to most recent Safe Drinking Water Information System (SDWIS) data.	SDWIS
	Geog	Geography source OEHHA (statewide): ● **OEHHA** = boundary developed/modified by Cal EPA OEHHA for CES 4.0 ● **LADWP boundary** = shared by LA Department of Water Projects, used in CES 4.0 ● **WBT** = boundary from water boundary tool , used in CES 4.0 ● **WESS** = from WBT, modified by WESS ● LADWP - WESS = shared by LA DWP, modified by WESS EJCW (Monterey county only) ● **EJCW - shared by Monterey county** ● **EJCW - LPA** shared by Monterey County, originating from a subset of Monterey systems monitored by local primacy agency	CES/Monterey County/WESS
	In_CES4	YES – boundary included in CalEnviroscreen 4.0 NO – not included	WESS
	In_EJCW	YES – boundary included in Monterey county tool developed by Environmental Justice Coalition for Water (EJCW)	WESS

		NO-not included	
	primary_wa	Primary water source: Groundwater, Purchased Groundwater, Surface Water, Purchased Surface Water	SWRCB/WESS
	Dwell_CWS	Count of domestic wells within the water system boundary	WESS
Water Quality*	WQ_CES4	Yes No	WESS
	As_ugL_9y	Average arsenic (ug/L) shared by OEHHA, CES4.0 2011-2019 (MCL = 10 µg/L) -999 = no data	CES
	N_mgL_9y	Average nitrate as N (mg/L) 2011-2019, shared by OEHHA, CES4.0 (MCL = 10 mg/L) -999 = no data	CES
	CR_ugL_9y	Average hexavalent chromium shared by OEHHA, CES4.0 Former MCL = 10 µg/L) -999 = no data	CES
	TCP_ugL9y	Average 1,2,3-trichloropropane (TCP) (ug/L) shared by OEHHA, CES4.0 2011-2019 (MCL = .005 µg/L) -999 = no data	CES
	WQ_EJCW	Yes/No – indicates whether water quality data is available from Monterey county dataset	Monterey County
	N_15_max	Maximum nitrate (mg/L) 2015	Monterey County
	N_16_max	Maximum nitrate (mg/L) 2016	Monterey County

	N_17_max	Maximum nitrate (mg/L) 2017	Monterey County
	N_18_max	Maximum nitrate (mg/L) 2018	Monterey County
	N_19_max	Maximum nitrate (mg/L) 2019	Monterey County
	N_20_max	Maximum nitrate (mg/L) 2020	Monterey County
	NMax15_20	Maximum measured nitrate (mg/L) 2015-2020	Monterey County
	As_15_max	Maximum arsenic (µg/L) 2015	Monterey County
	As_16_max	Maximum arsenic (µg/L) 2016	Monterey County
	As_17_max	Maximum arsenic (µg/L) 2017	Monterey County
	As_18_max	Maximum arsenic (µg/L) 2018	Monterey County
	As_19_max	Maximum arsenic (µg/L) 2019	Monterey County
	As_20_max	Maximum arsenic (µg/L) 2019	Monterey County
	AsMax15_20	Maximum measured arsenic (µg/L) 2015-2020	Monterey County
	Cr6_16_max	Maximum Cr[VI] (µg/L) 2016	Monterey County
	Cr6_17_max	Maximum Cr[VI] (µg/L) 2017	Monterey County
	Cr6Max16_17	Maximum Cr[VI] (µg/l) 2016-2017 these are the only years we currently have data	Monterey County

Population	Final_pop	Estimated population of water system	WESS
Demographics	prp_nl_wht	Proportion of the population served that identifies as Non-Latinx White	ACS/WESS
	prp_latinx	Proportion of the population served that identifies as Latinx	ACS/WESS
	prp_nl_blk	Proportion of the population served that identifies as Non-Latinx Black	ACS/WESS
	prp_nl_asn	Proportion of the population served that identifies as Non-Latinx Asian	ACS/WESS
	prp_nl_pac	Proportion of the population served that identifies as Non-Latinx Pacific Islander	ACS/WESS
	prp_nl_nat	Proportion of the population served that identifies as Non-Latinx Native American	ACS/WESS
	prp_nl_oth	Proportion of the population served that identifies as Non-Latinx Other	ACS/WESS
	prp_nl_mix	Proportion of the population served that identifies as Non-Latinx Mixed/Multiple	ACS/WESS
	mhi	Median household income of the community served by a water system	ACS/WESS
	disadv	Disadvantaged community status of the community served by a water system 1 = yes; 0 = no	ACS/WESS
	sev_disadv	Severely disadvantaged community status of the community served by a water system 1 = yes 0 = no	ACS/WESS
Affordability	afford_bur	Affordability burden level (high, medium, low, or none) based on the 2024 Affordability Assessment.	SWRCB
	pMHI_met	Binary field that signifies whether the Percent of Median Household Income	SWRCB

		(%MHI) affordability indicator threshold was met (yes or no).	
	EWB_met	Binary field that signifies whether the Extreme Water Bill affordability indicator threshold was met (yes or no).	SWRCB
	hseSES_met	Binary field that signifies whether the House Socioeconomic Burden affordability indicator threshold was met (yes or no).	SWRCB
	Shape_Length	Length in meters	ESRI generated
	Shape_Area	Area in square meters	ESRI generated

*Water quality data is not currently available in the downloadable water systems shapefile but can be accessed as follows:

The drinking water contaminant data is available for download from OEHHA for public and state small water systems https://oehha.ca.gov/calenviroscreen/indicator/drinking-water-contaminants

Water quality data for public and state small water systems in Monterey, CA. https://www.co.monterey.ca.us/government/departments-a-h/health/environmental-health/drinking-water-protection

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