Domestic Well Communities Version 1.0

Created by the Water Equity Science Shop (WESS)

Shared with CWC – February 3, 2020

Metadata: DomesticWellCommunities_v1.shp

Data Type:	Shapefile Feature Class
Shapefile:	DomesticWellCommunities_v1.shp
Geometry Type:	Polygon
Coordinates have Z values:	No
Coordinates have measures:	No
Projected Coordinate System:	NAD_1983_California_Teale_Albers
Projection:	Albers
False_Easting:	0.00000000
False_Northing:	-4000000.00000000
Central_Meridian:	-120.00000000
Standard_Parallel_1:	34.00000000
Standard_Parallel_2:	40.50000000
Latitude_Of_Origin:	0.00000000
Linear Unit:	Meter
Geographic Coordinate System:	GCS_North_American_1983
Datum:	D_North_American_1983
Prime Meridian:	Greenwich
Angular Unit:	Degree

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UC Berkeley Water Equity Science Shop domestic well communities version 1.0, 2019.
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Methodology

This shapefile contains a feature class, a file that contains 82,391 polygons that represent Public Land Survey System (PLSS) sections (approximately 1x1 mile grid squares) in the state of California representing domestic well communities. This shapefile was generated by the Water Equity Science Shop (WESS) of the Berkeley Superfund Research Center. The WESS is a community-academic partnership between UC Berkeley, San Francisco State University (SFSU), Cal EPA's Office of Environmental Health Hazard Assessment (OEHHA) and the Community Water Center (CWC).

The WESS defined the geography of domestic well communities in California. We used the PLSS section grid (https://catalog.data.gov/dataset/blm-national-public-land-survey-system-polygons) as the underlying geographic unit to define areas served by domestic wells. We removed areas served by community water systems (CWS) based on CWS service area boundaries accessed through the Water Boundary Tool (http://www.cehtp.org/water/) now known as the Tracking California Water System Service Areas tool. Next we cleaned the file by dissolving slivers into adjoining CWS polygons. Slivers were defined as sections with an area < 10% of the total area of the section. The resulting layer comprises the geographical basis of the domestic well layer. We next applied a series of filters to define "likely" and "potential" domestic well areas.

Filter 1: We assigned domestic wells from the Online System for Well Completion Reports (OSWCR) (https://data.ca.gov/dataset/well-completion-reports) dataset to PLSS sections in the domestic well layer and categorized sections based on whether or not they contained a domestic well. (See metadata for All Private domestic well locations for details on data processing and cleaning).

Filter 2: We assigned population to each section by aerially apportioning the population from 2010 census blocks (https://www.census.gov/geo/maps-data/data/tiger-data.html) to PLSS sections. We categorized sections by whether or not they contained at least 1 person.

Filter 3: We intersected the domestic well layer with a separate layer we created containing residential parcels in California and categorized the domestic well sections by whether or not they intersected with at least 1 residential parcel.

Based on these three filters, we categorized PLSS sections into the following categories: **Likely DWAs** and **Potential DWAs**. Likely DWAs have a greater degree of certainty compared to potential DWAs.

Likely Domestic Well Area (DWA):

A section that meets all of the following criteria is defined as a **likely DWA:**

1) Section is in a populated census block.

2) Section is not served by a CWS.

3) Section contains at least one domestic well.

4) Section contains a population of at least one person according to the results of our aerial apportionment method.

5) Section intersect with at least one residential parcel.

Potential Domestic Well Area (DWA):

A section that meets any of the following criteria is defined as a **potential DWA:**

1) Section is in a populated census block, not served by a CWS, but does not contain a domestic wells (screened out by filter 1).

2) Section is in a populated census block, not served by a CWS, contains a domestic well, but has an estimated population < 1 person (screened out by filter 2).
3) Section is in a populated census block, not served by a CWS, contains a domestic well, has an estimated population ≥ 1 person, but does not intersect with any part of a residential parcel (screened out by filter 3).

In the online Drinking Water Tool, data is available for Likely DWA

Assigning Water Quality Values to PLSS sections:

The WESS used water quality values provided by OEHHA and developed for CalEnviroScreen (CES) 3.0 (https://oehha.ca.gov/media/downloads/calenviroscreen/report/ces3dwmethodology.pdf), along with water quality values provided by Sacramento State's Office of Water Program's (OWP) and developed for the Groundwater Risk Index (GRID) tool. These datasets were used to assign contaminant concentrations for arsenic (As), nitrate as nitrogen (N), 1,2,3-trichloropropane (1,2,3-TCP), and hexavalent chromium (Cr6) to all domestic well areas. These contaminants were selected because of their acute or carcinogenic effects. Future versions of this layer will expand this list to include additional high priority contaminants. Both the CES 3.0 and GRID datasets utilized data downloaded from the State Water Resources Control Board's (SWRCB's) Groundwater Ambient Monitoring & Assessment (GAMA) dataset, a groundwater information system that integrates water quality data from various sources.

The CES 3.0 dataset includes water quality data from GAMA that was originally sampled between 2005-2013 by the SWRCB Domestic Well Project. CES 3.0 also includes samples collected Statewide by the USGS Priority Basin Project public-supply well assessment. For the aforementioned time period, samples from the USGS Priority Basin Project were comprised of approximately 75% public supply wells and 25% monitoring, irrigation, or domestic wells (personal communication with GAMA). The samples used for CES 3.0 were time weighted, averaged for each well, and aggregated for 6x6 mile township grids representing populated areas not served by a CWS. When assigning water quality values from township geography to section geography, we assumed that all sections within the township had the same water quality values. Importantly, the final water quality estimates are estimates of groundwater quality that domestic wells would rely on in particular sections; they are not actual measures of drinking water quality, but are proxies for such values. Where possible, future versions of the DWVT will be updated with more recent sampling dates.

The GRID tool is a tool developed by Sacramento State to assess the groundwater contamination risk of California's disadvantaged communities. GRID used data downloaded from GAMA's Drinking Water Information System that was collected between March of 2018 and February of 2019. These data sources include domestic and irrigation well water samples collected by the California Department of Pesticide Regulation (CDPR); multiple sample types collected by the Department of Water Resources (DWR); domestic and public supply well water samples collected by the GAMA-Priority Basin Project; samples from monitoring wells collected by the California State Water Board's regulated contaminated and remediation sites; samples from public water system wells, monitoring, irrigation, domestic, and public supply wells sampled by the National Water Information System (NWIS), and samples from local groundwater projects. These data were averaged by GRID for each well and aggregated to census block group geography. GRID data was provided in the form of a pollution index (p_i) which represents the contaminant concentration divided by the MCL. For consistency WESS converted p_i scores to contaminant concentrations.

WESS applied CES 3.0 and GRID data to the 82,391 PLSS sections representing populated areas not served by a CWS. The WESS used the two aforementioned water quality datasets in a two-step process. First, CES 3.0 data was used to characterize the majority of water quality. When a section had missing CES 3.0 data that GRID data could fill in, the GRID data was then pulled in. This approach maximizes water quality coverage, but it does include the limitation of having two separate approaches and time periods used.

Approach to assigning water quality values:

We used a tiered approach to assign individual contaminant concentrations to PLSS sections from CES 3.0 if available, and from GRID if CES 3.0 values were not available. Whenever available, CES 3.0 values were assigned using a shapefile provided by OEHHA for 4,116 townships. More information on the methods used to create the CES 3.0 layer can be found at https://oehha.ca.gov/media/downloads/calenviroscreen/report/ces3dwmethodology.pdf. We assumed that all sections within a township had the same water quality. When more than one township intersected with a single PLSS section, aerial weighting was used to assign water quality. When CES 3.0 values were not available, GRID values were assigned. When assigning GRID values, if more than one census block group intersected with a single PLSS section aerial weighting was used to assign water quality.

Concentrations below the detection limit

To address the issue of concentrations below the detection limit (the lowest concentration that can be detected) the following adjustment was made to OEHHA's CES 3.0 data. For contaminants with less than 25% of tests below detection limit the detection limit was divided by the square root of 2 (see: https://oehha.ca.gov/media/downloads/calenviroscreen/report/ces3dwmethodology.pdf). Only nitrate met this criterion. For all other contaminants, concentrations listed at or below detection limits were treated as 0.

Interpreting concentrations of "0"

A value of "0" assumes that the concentration was below the detection limit (ie: As, 123-TCP, Cr6 and N values (only applies to N values from GRID). If no measurement was available from either dataset, the section was assigned a value of (-999), indicating missing data.

Limitations to water quality data and method:

Several limitations to the water quality layer should be noted. First, in the WESS water quality layer, the majority of water samples are from untreated public water system wells with a minority of samples originating from monitoring and domestic wells. Public water system wells are likely to have better water quality than domestic wells since there is significant effort to site them in areas with high quality groundwater. In contrast, monitoring wells are placed in areas known to have poor water quality and may have a higher average water contaminant concentration than domestic wells.

Second, CES 3.0 used water quality data from 2005-2013, whereas GRID used data from 2018-2019. Due to the differences in timeframe and underlying data sources, the water quality values in GRID and CES 3.0 are not exactly comparable. Additionally in GRID and CES 3.0, different geographic units were used to aggregate water quality data. Furthermore, some of the CES 3.0 and GRID estimates were based on a small number of data points (i.e. wells).

Another potential issue is related to taking water quality values estimated for a larger geographic unit and assigning them to a smaller geographic unit: we applied CES 3.0 estimates developed for townships (approximately 6x6 mile grid squares) and GRID estimates developed for census block groups (variable size) to PLSS sections (approximately 1x1 mile grid squares), which suggests greater spatial accuracy than that of the underlying data.

Attribute table

Field Heading	Type	Description
FID	Numeric/Long Integer/Precision 10	GIS system generated field
Shape	Geometry	Stored geometry type: Polygon

MTRS	String/Length 9	PLSS section identifier; Meridian (M), Township (T), Range (R), Section (S)
N_Dom_Well	Numeric/Double/Precision 0/Scale 0	Number of domestic wells in section
DDLong	Numeric/Double/Precision 0/Scale 0	Longitude for centroid of section in decimal degrees
DDLat	Numeric/Double/Precision 0/Scale 0	Latitude for centroid of section in decimal degrees
N_mgL(*)	Numeric/Double/Precision 0/Scale 0	Nitrate as N water quality concentration in mg/L (MCL=10 mg/L) Values below the detection limit for nitrate in GRID dataset received a value of 0; values below the detection limit for nitrate in CES 3.0 dataset received a value of 0.318519 representing (1/sqrt(2))*(lower limit of detection for nitrate as NO3)*(conversion factor to transform NO3 to N)
N_Source(*)	Short Integer	Source of water quality value for nitrate 1=CES 3.0 2=GRID 3= no water quality value available
As_ugL(*)	Numeric/Double/Precision 0/Scale 0	Arsenic water quality concentration in ug/L (MCL=10 ug/L)
As_Source(*)	Short Integer	Source of water quality value for arsenic 1=CES 3.0 2=GRID 3= no water quality value available
Cr6_ugL(*)	Numeric/Double/Precision 0/Scale 0	Chromium 6 water quality value in ug/L (Former MCL=10ug/L)
Cr6_Source(*)	Short Integer	Source of water quality value for Cr6 1=CES 3.0 2=GRID 3= no water quality value available
TCP_ugL(*)	Numeric/Double/Precision 0/Scale 0	123-Trichloropropane(123-TCP) water quality value in ug/L (MCL=.005 ug/L)
TCP_Source(*)	Short Integer	Source of water quality value for 123-TCP 1=CES 3.0 2=GRID 3= no water quality value available
Av_depth	Numeric/Double/Precision 0/Scale 0	Average total completed depth of wells in section (0-2,440 ft.)

SD_depth	Numeric/Double/Precision 0/Scale 0	Standard deviation of total completed depth for wells in section (0-2,990.74 ft.)
DWA_code	Numeric/Long Integer/Precision 5	1= section is a likely domestic well area 2= section is a potential domestic well area
POP_WESS	Numeric/Double/Precision 0/Scale 0	Population in section according to aerial apportionment method
HOUSE_WESS	Numeric/Double/Precision 0/Scale 0	Number of housing units in section according to aerial apportionment method

(*) this data is not currently available for download but can be visualized on the interactive webmap viewer.

Data Sources

1. CalEnviroscreen 3.0 report (https://oehha.ca.gov/calenviroscreen/report/calenviroscreen-30).
2. CalEnviroscreen 3.0 technical documentation (https://oehha.ca.gov/media/downloads/calenviroscreen/report/ces3dwmethodology.pdf).
3. California State Water Boards (https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/Chemicalcontaminants).
4. California State Water Boards. Interconverting Nitrate-N and Nitrate-NO3 (https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/drinkingwaterlabs/InterconvertingNitrate-NandNitrate-NO3.pdf
5. Geotracker GAMA. (https://gamagroundwater.waterboards.ca.gov/gama/gamamap/public/Default.asp)
6. GRID. (2019) Assessing groundwater contamination risk in California's disadvantaged communities**.** http://www.owp.csus.edu/grid/
7. OSWCR. (https://data.ca.gov/dataset/well-completion-reports). Accessed September 19, 2018
8. PLSS Sections (https://catalog.data.gov/dataset/blm-national-public-land-survey-system-polygons). Accessed October 12, 2018.
9. Water Boundary Tool: (http://www.cehtp.org/water/; https://trackingcalifornia.org/water/map-viewer). Accessed January 8, 2019.
10. US Census Bureau (https://factfinder.census.gov/faces/nav/jsf/pages/download_center.xhtml).
11. US Census Bureau (https://www.census.gov/geo/maps-data/data/tiger-data.html)
12. SWRCB Water Quality Monitoring (http://www.cdph.ca.gov/certlic/drinkingwater/pages/EDTlibrary.aspx)

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UC Berkeley Water Equity Science Shop domestic well community boundaries version 1.0, 2019.

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