Interactive Groundwater Sustainability Agency Boundaries

Updated interactive Groundwater Sustainability Agency (GSA) layer for the Drinking Water Tool (2025). Data processed and joined by Clare Pace and Ari Libenson, Water Equity Science Shop, UC Berkeley. Contact: cpace@berkeley.edu

File name: GSA_interactive_final_050625.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 shapefile contains a feature class with polygons that represent 353 Groundwater Sustainability Agencies (GSA) formed under the Sustainable Groundwater Management Act (SGMA). The GSA boundaries were downloaded from the Department of Water Resources (August 7, 2023). To estimate a count of each entity per GSA, the following fields were spatially joined to the GSA boundaries: domestic wells locations, Groundwater Sustainability Agencies, public supply well locations, water system boundaries, severely disadvantaged and disadvantaged census places, drinking water threats, results for the Central Valley Drought Analysis, and drinking water affordability data.

Methods:

Updating GSA layer attributes

1. Spatially joined public supply wells[1] to GSA polygons[2] in ArcGIS Pro, using the "Completely Contained" argument.
    a. Created a new field, Num_MunPub, populated with the sum of wells per GSA.
2. Spatially joined domestic well points[3] to GSA polygons, using the "Completely Contained" argument.
    a. Created a new field, Count, populated with the count of wells per GSA.
    b. Selected all domestic wells with completed depth > 0 ft. Used summarize within function to calculate average and standard deviation of completed well depth.

3. Performed a pairwise intersection to identify overlaps between water system boundaries[4] and GSAs.
    a. Slivers were identified and excluded.
    b. Dissolved by GSA ID and calculated the sum of systems per GSA.
4. Joined updated contact information for GSAs shared by the CA Department of Water Resources on August 7, 2023.
5. Calculated population served by domestic wells[3] and population served by water system (Pace et al., 2023) for each GSA.
    a. Used geoprocessing tool "make feature layer" and selected the option for "use ratio policy" for population field.
    b. Intersected layer with GSA boundaries.
    c. Dissolved by GSA ID and calculated sum of population.
6. Calculated number of disadvantaged communities (DAC) and severely disadvantaged communities (SDAC) census designated places[5] in each GSA.
    a. Intersected 2021 census designated places and GSA boundaries.
    b. Selected by DAC and dissolved by GSA.
    c. Selected by SDAC and dissolved by GSA.
7. Spatially joined with point data for the following drinking water threats layers:
    a. Drinking water wells with PFAS detections,[6] wastewater treatment facilities,[7] landfills,[7] refineries and terminals,[7] chrome plating facilities,[7] active oil and gas wells,[8] sites permitted to discharge animal waste discharge.[9]
    b. Used the geoprocessing tool "summarize within" function to count the number of each threat by GSA.
    c. Calculated the percent of drinking water wells that had at least one sample that exceeded the detection limit.
    d. Calculated the percent of drinking water wells that had at least one sample that exceeded one or more PFAS maximum contaminant level (MCL).
8. Merged drinking water threat polygons representing superfund sites;[10] military installations, ranges, and training areas;[11] and airports permitted to use aqueous film-forming foam (AFFF)[12] into a single shapefile.
    a. Removed duplicates, dummy coded polygons based on which dataset (or combination of datasets) it came from.
    b. Intersected polygons with GSAs and added the number of each type of facility by GSA.
9. Spatially intersected polygons representing biosolid application areas[13] with districts to calculate the number of sites per district.
10. Calculated total pesticide application (pounds) for each district.
    a. Calculated the total application of pesticide active ingredients that are classified as groundwater threats (2011-2019)[14] and as PFAS chemicals (2019-2022).[15]
    b. Used geoprocessing tool "make feature layer" and selected the option for "use ratio policy" for pesticide sum.
    c. Intersected layer with county boundaries.
    d. Dissolved by county ID and calculated sum of pesticides.

11. Spatially joined the Sustainable Management Criteria (SMC) Drought Analysis[16] results to GSA polygons, using the "Completely Contained" argument.
    i. Calculated the count of domestic wells included in the drought analysis.
    ii. Calculated the count of domestic wells fully dewatered and partially dewatered under both the Measurable Objective and Minimum Threshold conditions.
    iii. Calculated the percent of domestic wells fully dewatered and partially dewatered under both the Measurable Objective and Minimum Threshold conditions.
12. Spatially joined Water System Affordability data[17] to GSA using the pairwise intersect and pairwise dissolve functions.
    a. Performed a pairwise intersection to identify overlaps between water system boundaries and GSAs.
        i. Slivers were identified and excluded.
    b. Dissolved by GSA ID
        i. Calculated the sum of systems assessed for: affordability, percent median household income (%MHI), extreme water bill, and household socioeconomic burden.
        ii. Calculated the sum of systems that have a high affordability burden and thresholds exceeded for %MHI, extreme water bill, and household socioeconomic burden.
        iii. Calculated the percent of systems assessed that have a high affordability burden and thresholds exceeded for %MHI, extreme water bill, and household socioeconomic burden.

Attribute Table

Field Heading	Field type	Field Description	Source
GSA_ID	Long	GSA ID	DWR
GSA_Name	Text	GSA name	DWR
GSA_URL_1	Text	URL	DWR
POC_Name_1	Text	Person of contact name	CWC
POC_Email_	Text	Person of contact email	CWC
POC_Phone_	Text	Person of contact phone number	CWC
Local_ID	Text	Local ID	DWR

Posted_DT	Date	Date GSA posted to DWR database	DWR
Av_depth	Double	Average total completed depth of wells	WESS
SD_depth	Double	Standard deviation of total completed depth for wells	WESS
Count	Long	Count of domestic wells	WESS
Num_MunPub	Long	Count of public supply wells	WESS
Basin_Numb	Text	Basin Number (B118)	DWR, B118
Basin_Subb	Text	Sub-Basin Number (B118)	DWR, B118
Basin_Name	Text	Basin Name (B118)	DWR, B118
Basin_Su_1	Text	Sub-Basin Name (B118)	DWR, B118
Basin_1	Text	Sub-Basin Number (B118)	DWR, B118
Region_Off	text		
Hydrologic	Text	Hyrologic Region (DWR)	DWR, CASGEM
DWR_Projec	Long	DWR CASGEM Project Phase	DWR, CASGEM
Adjud_C8c	Long	Adjudicated Basin [True / False]	DWR, CASGEM
CritOvrdrft	Long	Critically Overdrafted Basin [True / False]	DWR, CASGEM
PriorityCh	Text	Change in CASGEM Priority between 2014	DWR, CASGEM

		and 2018	
CASGEMPhas	Text	CASGEM Priority Ranking (Phase 2)	DWR, CASGEM
WS_count	Long	Count of water systems	WESS
CWS_pop_fi	Double	Population served by water systems	WESS
DWA_pop_To	Double	Population served by domestic wells	WESS
Num_DAC	Double	Count of disadvantaged communities	WESS
Num_SDAC	Double	Count of severely disadvantaged communities	WESS
WWTFs	Double	Count of wastewater treatment facilities (WWTFs)	WESS
Excd_MCL	Float	Count of wells with at least one water sample with PFAS measured above any EPA Maximum Contaminant Level (MCL)	WESS
Excd_DL	Float	Count of wells with at least one water sample with PFAS measured above the detection limit but below any EPA Maximum Contaminant Level (MCL)	WESS

n_PFAS_sam	Float	Count of wells that were sampled and tested for PFAS.	WESS
p_excd_MCL	Float	Percent of wells sampled with at least one water sample with PFAS measured above any EPA MCL.	WESS
p_excd_DL	Float	Percent of wells sampled with at least one water sample with PFAS detected above the detection limit but below any EPA MCL.	WESS
RefsTerms	Double	Count of refineries and bulk terminals	WESS
Landfills	Double	Count of municipal landfills in GSA	WESS
ChromePlat	Double	Count of chrome-plating facilities in GSA	WESS
Num_OG	Double	Count of oil and gas wells in GSA	WESS
Total_pest	Double	Total pounds of pesticide active	WESS

		ingredients that are classified as groundwater threats applied between 2011-2019	
pfas_pest_	Double	Total pounds of pesticide active ingredients that are classified as PFAS applied between 2019-2022.	WESS
SRP	Double	Count of Superfund Sites	WESS
MIRTA	Double	Count of Military Installations, Ranges and Training Areas (MIRTA)	WESS
P139	Double	Count of airports permitted to use aqueous film-forming foam (contains PFAS)	WESS
MIRTA_SPR	Double	Count of sites listed as both a MIRTA and Superfund Site (SRP)	WESS
MT_fully	Float	Count of fully dewatered domestic wells based on the Minimum Threshold (MT) groundwater	EKI

		level.	
MT_partial	Float	Count of partially dewatered domestic wells based on the MT groundwater level.	EKI
MO_fully	Float	Count of fully dewatered domestic wells based on the Measurable Objective (MO) groundwater level.	EKI
MO_partial	Float	Count of partially dewatered domestic wells based on the MO groundwater level.	EKI
n_wells_sm	Float	Total number of domestic wells included in the Sustainable Management Criteria (SMC) drought analysis.	EKI
p_mt_full	Float	Percent of fully dewatered wells based on the MT groundwater level. Denominator is the total number of domestic wells included in the SMC drought analysis.	EKI
p_mt_part	Float	Percent of partially dewatered wells based on the MT groundwater level. Denominator is the total number of	EKI

		domestic wells included in the SMC drought analysis.	
p_mo_full	Float	Percent of fully dewatered wells based on the MO groundwater level. Denominator is the total number of domestic wells included in the SMC drought analysis.	EKI
p_mo_part	Float	Percent of partially dewatered wells based on the MO groundwater level. Denominator is the total number of domestic wells included in the SMC drought analysis.	EKI
afford_hig	Double	Count of water systems located partially or fully within GSA boundaries with a high affordability burden, based on the SWRCB's 2024 Affordability Assessment.	SWRCB
pMHI_yes	Double	Count of water systems located partially or fully within GSA boundaries that exceeded the threshold for percent Median Household Income (MHI), based on the SWRCB's 2024 Affordability	SWRCB

		Assessment.	
EWB_yes	Double	Count of water systems located partially or fully within GSA boundaries that exceeded the threshold for extreme water bill, based on the SWRCB's 2024 Affordability Assessment.	SWRCB
hseSES_yes	Double	Count of water systems located partially or fully within GSA boundaries that exceeded the threshold for household socioeconomic burden, based on the SWRCB's 2024 Affordability Assessment.	SWRCB
n_ws_affor	Long	Count of water systems that were included in the affordability assessment and assigned an affordability burden.	SWRCB
n_ws_pMHI	Long	Count of water systems that were included in the affordability assessment and evaluated for the percent MHI indicator.	SWRCB
n_ws_EWB	Long	Count of water systems that were included in the affordability assessment and	SWRCB

		evaluated for the extreme water bill indicator.	
n_ws_hseSE	Long	Count of water systems that were included in the affordability assessment and evaluated for the household socioeconomic burden indicator.	SWRCB
p_afford_h	Float	Percent of water systems with a high affordability burden. Denominator is the count of water systems included in the assessment.	SWRCB
p_pmhi	Float	Percent of water systems that exceeded the threshold for percent MHI. Denominator is the count of water systems evaluated for percent MHI.	SWRCB
p_ewb	Float	Percent of water systems that exceeded the threshold for extreme water bill. Denominator is the count of water systems evaluated for extreme water bill.	SWRCB
p_hseSES	Float	Percent of water systems that exceeded the threshold for	SWRCB

		household socioeconomic burden. Denominator is the count of water systems evaluated for household socioeconomic burden.	
Num_biosol	Float	Number of sites historically and actively permitted to apply biosolids to land.	WESS
an_wst_dis	Float	Number of sites historically and actively permitted to discharge animal waste.	SWRCB/CIWQS

References

1. Municipal Wells Dataset (2025). California State Water Resources Control Board, Groundwater Ambient Monitoring and Assessment (GAMA), Groundwater Information System. Available from https://gamagroundwater.waterboards.ca.gov/gama/gamamap/public/. Accessed February 5, 2025.
2. Dept. of Water Resources (2023). i03 Groundwater Sustainability Agencies MapService. Available from https://data.ca.gov/dataset/i03-groundwater-sustainability-agencies-mapservice. Accessed August 7, 2023.
3. Rempel, J., Pace, C., Cushing, L., Morello-Frosch, R. (2023). Domestic Well Areas Version 2.0, Drinking Water Tool metadata, prepared by the Water Equity Science Shop, UC Berkeley.
4. Pace, C., Bangia, K., Fisher, E., Cushing, L., Morello-Frosch, R. (2023). Water system boundaries version 2.0, Drinking Water Tool metadata, prepared by the Water Equity Science Shop, UC Berkeley.
5. U.S. Census Bureau. B19013: MEDIAN HOUSEHOLD INCOME IN ... - Census Bureau Table. 2017-2021 American Community Survey 5-Year Estimates. Available from https://data.census.gov/table?q=B19013
6. Karasaki, S., Pace, C., Cushing, L., Morello-Frosch, R. (2025). PFAS detections in water samples. Drinking Water Tool metadata, prepared by the Water Equity Science Shop, UC Berkeley.
7. Karasaki, S., Pace, C., Cushing, L., Morello-Frosch, R. (2023). Additional PFAS sources – landfills, chrome plating facilities, water treatment facilities, and refineries and terminals. Drinking Water Tool metadata, prepared by the Water Equity Science Shop, UC Berkeley.
8. All Wells Dataset, GIS Mapping, (2025). California Department of Conservation, California Geologic Energy Management Division (CalGEM). Available from https://www.conservation.ca.gov/calgem/maps/Pages/GISMapping2.aspx.

Accessed March 28, 2025.
9. Animal Waste Program Regulated Facilities Report, California Water Boards. Available from https://ciwqs.waterboards.ca.gov/ciwqs/readOnly/CiwqsReportServlet?inCommand=reset&reportName=RegulatedFacility. Accessed November 2024.
10. Pace, C., Karasaki, S., Cushing, L., Morello-Frosch, R. (2023). Superfund sites in California. Drinking Water Tool metadata, prepared by the Water Equity Science Shop, UC Berkeley.
11. Karasaki, S., Pace, C., Cushing, L., Morello-Frosch, R. (2023). Military installations ranges and training areas (MIRTA). Drinking Water Tool metadata, prepared by the Water Equity Science Shop, UC Berkeley.
12. Karasaki, S., Pace, C., Cushing, L., Morello-Frosch, R. (2023). Airports permitted to use aqueous film-forming foam (AFFF). Drinking Water Tool metadata, prepared by the Water Equity Science Shop, UC Berkeley.
13. Libenson, A., Pace, C., Alam, Z., Tran, T., Cushing, L.J., Morello-Frosch, R. (2024). Biosolids Land Application Sites, 1995-2024. Drinking Water Tool metadata, prepared by the Water Equity Science Shop, UC Berkeley.
14. Libenson, A., Pace, C., Cushing, L., Morello-Frosch, R. (2023). Pesticide application in California, 2011-2019. Drinking Water Tool metadata, prepared by the Water Equity Science Shop, UC Berkeley.
15. Libenson, A., Pace, C. (2024). PFAS Pesticide Application, California, 2019-2022. Drinking Water Tool metadata, prepared by the Water Equity Science Shop, UC Berkeley.
16. EKI Environment & Water, Inc. (2024). Community Water Center Drinking Water Tool 2024 Well Impact Analysis Update.
17. Affordability Assessment. California State Water Resources Control Board (2024). Available from https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/2024/2024affordabilityassessment-metodology.pdf. Accessed July 22, 2024.