APPENDIX C

2025 Retail Demand Model and Projections Technical Memorandum

2025 URBAN WATER MANAGEMENT PLAN
for the City and County of San Francisco

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Water Demand Projections for the City and County of San Francisco

2025-2050

San Francisco Public Utilities Commission

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1 Executive Summary

The San Francisco Public Utilities Commission (SFPUC) commissioned Berkeley Research Group (BRG) and WestWater Research to update the project of water demand within the SFPUC's in-City retail service area, encompassing the City and County of San Francisco (CCSF). Previously, Brattle Research Group prepared projections to support the preparation of SFPUC's 2015 and 2020 Urban Water Management Plans, as well as in 2023 to align with San Francisco's Housing Element 2022 Update. We project demands for the following three types of accounts within the in-City retail service area:

- Single Family Residential,
- Multi-Family Residential, and
- Commercial and Industrial.

To project future water demands, we obtained data on monthly water consumption and billing for each account of the above types in the City and County of San Francisco. We merged this data with property characteristics held by the Office of the Assessor-Recorder, demographic characteristics from the American Community Survey (ACS) at the census block-group level, and historical climate data from the PRISM dataset.

We project account-level water demand based on each household's or business's historical average water consumption between 2010 and 2025 and statistical relationships between each household's water consumption and demand drivers such as water rates, weather, and other factors such as drought and the COVID-19 pandemic (2020-2022). For each account, we estimate the relationship between water use and these demand factors using a multiple regression analysis. In a regression analysis, changes in the demand variable, namely account-level water use, are explained by the control variables such as rates, climate, and macro-economic factors. The statistical estimates are not based on differences in the average level of water use between accounts, which we adjust for using a statistical technique called 'fixed-effects'. Rather, our estimates are based on the different trends in how each account's water use changes in response to changes in rates, climate, and macro-economic factors.

The results of our statistical model are a set of "demand elasticities" with respect to water rates, average monthly temperature, and monthly precipitation. These elasticities describe the percentage change in water consumption predicted in response to a one-percentage change in each of these control variables.

For each account, future demand from 2025 to 2050 is based on historical aggregate water use, expected future changes in rates and climate, and revised growth assumptions. The 2050 planning horizon aligns with the planning period for the SFPUC's 2025 Urban Water Management Plan (UWMP). The assumptions for future rates and climate were developed in consultation with SFPUC. The projections assume that by 2050 total water rates (including wastewater) increase by almost 100% in real terms (after inflation), average temperatures in San Francisco increase by 0.7°C relative to 2025, and average precipitation will increase by 3.4 mm per month.

San Francisco Planning Department (SF Planning) provides both the housing (units) and employment growth projections to the SFPUC. For each type of account, the SFPUC uses an econometric model that estimates the relationship between water consumption and demand factors (e.g., rates, temperature, precipitation) using multiple regression analysis with account-level fixed effects. These models generate monthly consumption projections for each individual account, which incorporate the projected housing and employment growth along with anticipated changes in rates and weather patterns. Total demand for the in-City retail service area is calculated by aggregating the monthly account-level projections by sector.

Table 1-1 summarizes our projections. Single family residential consumption assumes no increase in housing units and is projected to increase from 12.6 million gallons per day (MGD) in FY 2024-25 to 13.0 MGD in FY 2049-50; multi-family residential consumption assumes a 44% increase in housing units and is projected to grow from 22.2 MGD in FY 2024-25 to 32.2 MGD in FY 2049-50; and commercial and industrial consumption assumes a 28% increase in jobs but demands will slightly decline from 12.3 MGD in FY 2024-25 to 12.2 MGD in FY 2049-50. These projections account for all single family, multi-family, and commercial/industrial water use in the SFPUC retail service area. These projections are then combined with estimates of future demands for dedicated irrigation, municipal, and suburban retail accounts, which are assumed to be equal to the last fiscal year's consumption (i.e., FY 2024-25). For water losses and unbilled consumption, the SFPUC projects these demands to be equal to the latest three-year average (i.e., FY 2022-23 through FY 2024-25). Total water demand is projected to change from 62.5 MGD in FY 2024-25 to 73.4 MGD in FY 2049-50.

This projection uses the same methodology as the demand projection produced as part of the 2020 UWMP process by the same authors. This report estimates the parameters of the econometric model after incorporating additional data from 2020-2024 into our dataset and updates the projection using the new econometric model parameters and updated projections for household and employment growth.

Compared to the 2020 water demand projections, the 2025 projections made the following key updates:

- It recalibrates the baseline year from FY 2019-20 to FY 2023-24.
- It applies updated housing and employment to projections.
- This report also introduces two new demand scenarios (Appendix A) that reflect uncertainty in the long-term housing and employment growth rates within the City.

Table 1-1: Summary of Demand Projections by Sector (MGD)

		FY 2024-25 (Actual)	FY 2029-30	FY 2034-35	FY 2039-40	FY 2044-45	FY 2049-50
				(millions of gallons per day)			
Single Family Residential							
Raw Prediction		12.6	13.4	13.1	13.1	13.1	13.1
Conservation:	*Active*	0.0	-0.1	-0.1	-0.1	-0.1	-0.1
	Total	*12.6*	*13.3*	*13.0*	*13.0*	*13.0*	*13.0*
Multi-Family Residential							
Raw Prediction		22.2	26.3	27.3	29.0	30.6	32.4
Conservation:	*Active*	0.0	-0.1	-0.1	-0.1	-0.1	-0.1
	Non-Potable / Onsite Reuse	0.0	-0.1	-0.2	-0.2	-0.2	-0.2
	Total	*22.2*	*26.2*	*27.1*	*28.7*	*30.4*	*32.2*
Commercial and Industrial							
Raw Prediction		12.6	12.9	12.4	12.9	13.3	14.0
Conservation:	*Active*	0.0	-0.4	-0.5	-0.4	-0.4	-0.4
	Non-Potable / Onsite Reuse	-0.2	-0.5	-1.3	-1.4	-1.4	-1.4
	Total	*12.4*	*12.0*	*10.7*	*11.1*	*11.5*	*12.2*
Others							
Estimations	*Irrigation*	1.5	1.5	1.5	1.5	1.5	1.5
	Municipal	2.2	2.2	2.2	2.2	2.2	2.2
	Suburban Retail	4.0	4.1	4.2	4.3	4.4	4.5
	Water Loss and Other[a]	7.6	7.8	7.8	7.8	7.8	7.8
	Total	*15.3*	*15.6*	*15.7*	*15.8*	*15.9*	*16.0*
Grand Total							
		62.5	***67.0***	***66.5***	***68.6***	***70.7***	***73.4***

Notes: *Raw predictions in each sector include both standard accounts and combination-fire accounts.*
Minor 'inconsistencies' in subtotal are result of rounding significant figures.
[a] *Other uses include authorized, unbilled, unmetered consumption or water that is used in activities such as firefighting, water or sewer main flushing, street cleaning, etc.*

2 Methodology

Our estimation process has several steps that we discuss in the respective subsections below. The first subsection discusses the raw data that we collect and how we pre-adjust our raw data to remove the impact of the SFPUC's active water conservation programs, which we account for separately after projecting future demand. The second subsection discusses the econometric model that we built. The third subsection discusses the assumptions and calculations that we use to produce both individual-level and aggregate demand estimates from the econometric model.

2.1. Data

2.1.1 Data Sources and Construction

Our estimates rely on account-level data from the SFPUC's in-City retail service area, matched with data on parcel characteristics, and local weather fluctuations. We matched the SFPUC's monthly billing data from FY 2009 -10 through FY 2023-24[1] to publicly available data on land use and building characteristics based on addresses provided in San Francisco's 2023 Tax Assessor roll[2] and 2022 Land Use inventory.[3] We then used these parcels to add characteristics about each water meter from the CCSF Assessor-Recorder Department and land use data, as well as historical weather data from the Oregon State University's PRISM dataset, US Census block-group characteristics and tract characteristics from the 2019-2023 ACS five-year estimates, and employment and household projections provided by SF Planning.

San Francisco's public agencies do not keep a data key that links information between the parcel identifiers in the Tax Assessor's records and the account numbers used in the SFPUC's records. Therefore, to merge assessor information into our dataset, we matched accounts based on their reported addresses. Due to inconsistencies in address reporting between the two datasets, we could not match all records; however, we managed to match over 95% of all accounts. Based on a comparison of summary statistics between all accounts and only matched summary statistics, these accounts appear to be a representative sample, and therefore, we are confident using these data as the basis for our projection model.

We use climate data from California's Fourth Climate Change Assessment (data retrieved from Cal-Adapt, a climate adaptation planning tool developed by UC Berkeley with support from the California

[1] In FY 2023-24, a technical problem led to some customers not receiving a water and sewer bill for several months. The problem was caused by certain transponders on water meters. The water meters were accurately reading the water usage, but the transponders were not sending that data electronically to the SFPUC's billing system. As a result, while these customers continued to receive water and sewer service, they did not receive bills for a period of time. This caused raw billing consumption data for FY 2023-24 to be artificially lower (by about 0.4 mgd) than actual demands. To correct this error, the SFPUC has manually added the delayed consumption to the FY 2023-24 billing data to more accurately reflect usage during this period.

[2] Property assessment data. SF.gov. https://www.sf.gov/resource--2024--secured-property-tax-data

[3] 2022 San Francisco Housing Inventory. https://sfplanning.org/sites/default/files/documents/reports/2022_Housing_Inventory.pdf

Energy Commission).[4,5] This dataset gathers climate observations from a wide range of monitoring networks, applies sophisticated quality control measures, and develops spatial climate datasets to reveal short- and long-term climate patterns. Climate data uses Representative Concentration Pathway 4.5, which is "a 'medium' emissions scenario that models a future where societies attempt to reduce greenhouse gas emissions" (Pierce et. al). We use a dataset of monthly average temperature and precipitation at a resolution of 1/16° (about 6 km, or 3.7 miles) . These dataset's spatial resolution allow us to identify microclimates at a high spatial resolution within San Francisco and identify how these microclimates affect water use.

From the assessor's parcel data, we can match each account with the land use category of the property on which it lies. The San Francisco Assessor's dataset includes land use classifications and the North American Industry Classification System (NAICS) codes used for business and tax registration. We aggregate these NAICS codes into five broader categories— Office/Professional, Health/Education/Recreation, Manufacturing/Wholesale, Retail, and Other. These aggregated categories can then be linked to local employment projections produced by ABAG to support projections of future water demand by sector.

Consumption data is also matched with past water rate data (FY 2023-24) and projected rate increases out to 2050, which were provided by the SFPUC Financial Services.[6] Rate data used in our analysis are adjusted for inflation to 2025 dollars using consumer price index (CPI) data from the St. Louis Federal Reserve's Economic Data (FRED).[7]

2.1.2 Remove Water Conservation Policy from Raw Data

In addition to the fundamental determinants, we also explicitly adjust the projected demand based on expected future water conservation from active water conservation programs and non-potable onsite water reuse programs administered by the SFPUC. This approach of explicitly accounting for active conservation programs in demand projections has been advocated as best practice by local researchers and advocacy groups.[8] However, explicitly adjusting for water conservation introduces

[4] https://cal-adapt.org/

[5] Pierce et al. (2018). Climate, drought, and sea level rise scenarios for California's fourth climate change assessment. California's Fourth Climate Change Assessment, California Energy Commission. Publication Number: CNRA-CEC-2018-006.

[6] The price elasticity estimates in this report are based on historical *marginal volumetric water rates* only. For each account and billing period, the econometric model identifies the applicable marginal Tier 1 or Tier 2 water rate corresponding to the customer's actual consumption. Consistent with the methodology adopted in the previous demand projection study, the historical price variable did not incorporate wastewater, nor did it include fixed service charges. However, during the review process, SFPUC highlighted that future wastewater and stormwater rate increases are expected to diverge materially from water-only increases (particularly given the phased introduction of the stormwater charge through FY 2029-30). Although the historical price elasticity was estimated using water-only marginal rates, the projection component of this study incorporates the updated water, wastewater and increases from the FYE 2026 Financial Plan, applying only the volumetric wastewater rate changes (SIC Group 4) and excluding fixed stormwater charges. This adjustment ensures that projected average customer bills reflect the anticipated relative growth in wastewater rates while maintaining consistency with the historical estimation framework based on marginal volumetric water prices.

[7] U.S. Bureau of Labor Statistics, *Consumer Price Index for All Urban Consumers: All Items (CPI-U)* [CPIAUCSL], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/CPIEALL, October 15, 2025.

[8] See, for example: Sarah E. Diringer, Heather Cooley, Matthew Heberger, Rapichan Phurisamban, Andrea Turner, John McKibbin, and Mary Ann Dickinson, "Integrating Water Efficiency Standards and Codes into Long-Term Demand Forecasting," *Water Research Foundation* (2018); Sonali Abraham, Sarah Diringer, and Heather Cooley, *An Assessment of Water Demand Forecasts in California*, 2020 (Oakland, California: Pacific Institute).

some challenges into the demand estimation process. Specifically, care needs to be taken not to double-count savings from conservation programs with consumers' responses to rates, drought, and climate. To do this, we adjust our historical data by adding back in the savings that the SFPUC estimates have been generated as a result of their active conservation programs. These savings are calculated using SFPUC's customized version of the Alliance for Water Efficiency Conservation Tracking Tool. Savings for water conservation are calculated at an aggregate level by sector, but we split these savings down to the household level by calculating the share of conservation attributable to each household and adding these savings back onto each household's daily water use.[9]

After adding these savings back in, we derive an estimate of "pre-conservation" demand, which describes what demand would have been but-for the SFPUC's conservation programs. We estimate our statistical demand model and predict demand based on this "pre-conservation" data.

Future demand reductions from onsite water reuse programs are also incorporated into the multi-family and commercial sector models. Estimates of savings from onsite water reuse programs were provided by the SFPUC staff and are subtracted from the raw demand projections.

In the last step of our analysis, we add back in the active conservation savings and savings from non-potable onsite water reuse programs to generate the final demand estimate.

2.2. Econometric Model

For consistency, the methodology employed in this update remains the same as that used in the previous demand projection report included in the 2020 UWMP.

To predict how water demand in the SFPUC's retail service area will change over time, it is necessary to estimate a relationship between water use and the demand factors used in this analysis (e.g., rates and climate). Generally, water use and water price are negatively correlated. In other words, as water becomes more expensive, users will reduce their demands to offset the higher costs. As temperature increases or precipitation decreases, water demand is expected to increase.

For each account, we estimate the relationship between water use and these demand factors using a regression analysis with account-level fixed effects. In a regression analysis, changes in the explanatory variable, customer water use, are explained by the dependent variables, such as rates, climate, and macro-economic factors. In a regression with account-level fixed effects, we also control for the average level of water consumption for every premise in the in-City retail service area. All explanatory variables in our empirical model are estimated in natural logarithms, which allows us to interpret their corresponding regression coefficients as elasticities.

[9] Although we make explicit adjustments for active water conservation programs, demand for which is driven by SFPUC outreach, we do not make a similar adjustment for passive water saving. Passive water savings are primarily driven by consumers taking water-saving actions in response to changes in rates and so are implicitly accounted for in our demand elasticity estimates. Including an explicit adjustment for these savings would risk double-counting and underestimating future water use.

An elasticity is the relationship between a variable, such as price, and water demand, which is calculated and interpreted as the percent change in water demand for a given percent change in the variable, water price. For example, a price elasticity of -0.2 implies that users reduce water demand by 0.2% for each 1% increase in price. We estimate similar elasticities with respect to elements of climate such as temperature and precipitation. These elasticities can be used to estimate the impact of anticipated future climate change.

To estimate demand for single family and multi-family water use, we estimate the following equation,

$$\ln(q_{it}) = \ln(rate_t)\,\beta^{rate} + \ln(temp_t)\,\beta^{temp} + \ln(ppt_{it})\,\beta^{ppt} + \gamma^{COVID} + \gamma^{drght} + \gamma_i + \varepsilon_{it}$$

Where, the dependent variable, $\ln(q_{it})$, is the natural logarithm of household i's pre-conservation water consumption in month t. Dependent Variables:

- Monthly Rate $rate_t$: The volumetric rate paid by households in each month. Rates are expressed as a Real Rate Index (year 2023 = 100), which adjusts nominal rates for inflation to enable consistent comparisons over time. An index value of 100 represents the average 2023 rates; values below 100 indicate lower inflation-adjusted rates, while values above 100 indicate higher inflation-adjusted rates.

- Weather $temp_t$ and ppt_{it} : We obtain panel of modelled climate characteristics of 1/16° (about 6 km, or 3.7 miles) from Cal-Adapt. We control each month's average precipitation and mean temperature.

- Drought[10] and COVID-19 Emergencies[11] γ^{drght} and γ^{COVID}: We include fixed-effect dummy variables that take a value of 1 during periods of declared drought or COVID-19 emergency, and 0 otherwise. These variables capture temporary impacts on demand during those events. Both factors are not included in the projection period, as the projection assumes normal (non-emergency) conditions.

- Individual Fixed Effects γ_i: Using this high-resolution data, we can control the average level of water use for each account in our data. Adjusting the average level of our water use within each household allows us to estimate how an individual account responds to changes in rates, precipitation, and temperature, rather than basing the estimates on differences in average water use across accounts at a point in time.

- Idiosyncratic error term ε_{it}: This term is standard in statistical regression analysis and is used to rationalize unexplained variation in the model. The model coefficients β are chosen to minimize idiosyncratic errors. The variance of ε_{it} is a key factor that is used to calculate the 95% confidence interval that characterizes the uncertainty associated with the model's

[10] The drought variable in the model was defined based on the SFPUC's Drought Emergency Declarations, covering February 2014 to April 2017 and November 2021 to April 2023.

[11] The COVID variable in the model was defined based on San Francisco's municipal COVID-19 restrictions, which were in effect between March 2020 and December 2022.

parameters estimates β. We adopt two-way cluster-robust method, clustered at the census block-group and year level to account for unexplained correlations in water use either within years or within neighborhoods.

To estimate demand for commercial and industrial accounts, we use the following equation:

$$\ln(q_{ijt}) = \ln(rate_t)\,\beta_j^{rate} + \ln(temp_{it})\,\beta^{temp} + \ln(ppt_{it})\,\beta^{ppt} + \gamma_j^{COVID} + \gamma^{drght} + \gamma_i + \varepsilon_{it}$$

This specification is the same as for the residential model, except the key differences is that the parameter estimates for rates β_j^{rate} and for COVID-19 γ_j^{COVID} are allowed to vary by land use with a different parameter being chosen in each different type of land use in the commercial and industrial sector.

2.3. Projection Data

2.3.1 Projection Assumptions

Table 2-1 and Table 2-2 summarize the assumptions that we adopt in our projections. Assumptions about growth in the number of single family and multi-family units come from SF Planning.[12] Note that all future residential growth is expected to be in the multi-family sector, with no growth expected for single family units. Assumptions for the number of employees by sector are from the UWMP out to the year 2050. Assumptions about future climate are based on the average of outcomes across multiple climate models.

[12] 2023 San Francisco Housing Inventory, SF Planning. https://sfplanning.org/sites/default/files/resources/2024-04/2023_Housing_Inventory.pdf

Table 2-1: Demand Projection Assumptions – Housing Unit and Employment Growth

		FY 2024-25 (Actual)	FY 2029-30	FY 2034-35	FY 2039-40	FY 2044-45	FY 2049-50
No. Housing Units	*Single Family Residential*	95,071	95,071	95,071	95,071	95,071	95,071
	Multi-Family Residential	322,753	363,262	388,529	413,929	438,929	463,929
	Total	***432,667***	***458,333***	***483,600***	***509,000***	***534,000***	***559,000***
No. Employees	*Office/Professional*	155,250	171,672	174,515	182,850	188,458	198,470
	Health/Education/Recreation	306,304	338,704	344,313	360,758	371,822	391,575
	Manufacturing/Wholesale	34,766	38,444	39,081	40,947	42,203	44,445
	Retail	25,775	28,502	28,974	30,357	31,288	32,951
	Other	203,204	224,698	228,419	239,329	246,668	259,773
	Total	***725,300***	***802,020***	***815,302***	***854,241***	***880,439***	***927,214***

Table 2-2: Demand Projection Assumptions- Covariates

	FY 2024-25 (Actual)	FY 2029-30	FY 2034-35	FY 2039-40	FY 2044-45	FY 2049-50
Real Rate Index *(2023 = 100)*	100	143	189	199	205	204
Monthly Average Temperature *(°C)*	14.7	14.8	15.0	15.1	15.2	15.4
Monthly Average Precipitation *(mm)*	46.0	46.9	48.3	46.8	47.8	49.4
COVID-19	0.0	0.0	0.0	0.0	0.0	0.0
Drought	0.0	0.0	0.0	0.0	0.0	0.0

2.3.2 Econometric Projections

The econometric model that we use in the single family and multi-family sectors is estimated on a per-unit basis, and our projections are also on a per-unit basis. Characteristics and fixed-effects for existing accounts are estimated from our data. For new multi-family residential and commercial and industrial accounts, we simulate firm fixed-effects. Based on these individual effects, we estimate individual level demand using the following equation:

$$\widehat{q_{it}} = e^{\ln(rate_t)\beta^{rate}+\ln(temp_{it})\beta^{\widehat{temp}}+\ln(ppt_{it})\beta^{\widehat{ppt}}+\gamma^{\widehat{COVID}}+\gamma^{\widehat{drght}}+\gamma_i}$$

Once we have calculated individual-level demand for each account, we calculate total demand by aggregating each of the individual estimates in our data:

$$\widehat{Q_{it}}^{Raw} = \sum_i q_{it}$$

2.3.3 Reincorporating Conservation Estimates and Other Demand Adjustments

The final steps of the projection process are to (1) subtract the estimated savings from active conservation programs and non-potable onsite reuse programs, as well as (2) add the additional residential and commercial/industrial demands not covered in our model. Specifically, this includes residential and non-residential fire accounts, docks and ships accounts, and builder/contractor accounts. The projections for these accounts are outside of our model and were developed by the SFPUC. Note that this econometric model does not project other sectors of water use, including water losses, dedicated irrigation accounts, municipal accounts, and suburban retail accounts.

$$\widehat{Q_t}^{Final} = \widehat{Q_t}^{Raw} - Q^{Conservation} + Q^{Other}$$

3 Single Family Residential Projection

3.1. Model Estimates

Table 3-1 summarizes the estimates of the demand model for the single family residential sector. The model fits the data well due to account-level fixed effects that adjust for the average level of water use of every household. Specifically, the model has an R-squared value of 0.67, implying that our estimate explains 67% of the total variation in demand. This represents a strong model fit and is consistent with the R-squared value reported in the 2020 analysis.

Across all units in the sample, we estimate a price-elasticity of demand of -0.12. This elasticity implies that a 10% increase in water rates will lead to a 1.2% reduction in demand. This estimate is statistically significant and has a confidence interval from -0.17 to -0.08. Note that the SFPUC charges two tiers of variable rates and a fixed rate. The demand elasticity estimate is with respect to the two tiers of variable rates, but not the fixed rate.

We estimate an elasticity of demand with respect to temperature of 0.10 and with respect to precipitation of -0.0067. This estimate implies that a 10% increase in average temperature will lead to a 1.0% increase in demand, and that a 10% increase in precipitation will lead to a 0.067% decrease in demand. These estimates are also both statistically significant. The difference between these coefficients and those estimated in the 2020 report is not statistically significant.

During COVID-19 restrictions (2020-2022), single family residential water demand is estimated to be 2.6% lower; however, this effect is not statistically significant.[13] Based on the patterns of water use in our data, we predict that during periods of drought single family residential water demand is 8.3% lower and this effect is statistically significant.[14] Following the COVID-19 pandemic, water sales declined more rapidly than population and did not rebound following the end of the 2021-23 drought, suggesting a secular decline in water use due to more efficient consumption incentivized by both the drought and other conservation programs).

Table 3-1: Model Estimates – Single Family Residential Sector

	Coefficient	95% Confidence Interval	Change in Consumption from 10% Predictor Change
log(Marginal Rates)	-0.12	[-0.17, -0.08]	-1.2%
log(Temperature)	0.10	[0.02, 0.18]	1.0%
log(Precipitation)	-0.007	[-0.012, -0.001]	-0.07%
			Change in Consumption from Predictor Event
COVID-19	-0.026	[-0.06, 0.01]	-2.6%
Drought	-0.09	[-0.11, -0.06]	-8.3%
Account Fixed-Effects	Yes		
R-squared	0.67		

3.2. Demand Projection

[13] The estimate COVID-19 coefficient differs from that estimated in our 2020 demand projections, which estimated a 9.3% increase in single family residential water use during COVID-19. The earlier report was based on data through July 2020 and reflected increased consumption during initial stay-at-home orders. The current coefficient captures the average effect across the entire pandemic (2020-2022), including both the initial increase and subsequent decline as San Francisco experienced significant population outmigration.

[14] In the model drought periods are defined based on SFPUC drought declarations, which occurred from February 2014 to April 2017 and from November 2021 to April 2023. This model estimates a smaller drought coefficient than the previous report (-0.03 in 2025 compared to -0.13 in 2020). The reason for this is that water consumption showed little rebound following the end of the drought in April 2023, suggesting that the observed declines in water use represent secular reductions in average consumption rather than temporary drought-related impacts.

Table 3-2 summarizes our demand projection for the single family residential sector. The SF Planning Department does not anticipate any growth in San Francisco's single family housing stock through FY 2049-50, keeping the inventory constant at 95,071 units. The projection is calibrated to FY 2024-25 consumption levels, where total demand was 12.6 MGD or 145.1 gallons per occupied unit per day and incorporates an 8.6% vacancy rate based on the latest estimate from the California Department of Finance. SFPUC's conservation model indicates that active conservation programs will reduce single family demand by approximately 0.1 MGD by 2050. After accounting for these savings, total single family demand is projected to rise by 3.2% or to 13.0 MGD due to full occupancy of all units. On a per unit basis, however, average consumption is expected to decline by 5.7% or to 136.8 gallons per day by FY 2049-50.

Table 3-2: Demand Projection – Single Family Residential Sector

		FY 2024-25 (Actual)	FY 2029-30	FY 2034-35	FY 2039-40	FY 2044-45	FY 2049-50
Number of Units		95,071	95,071	95,071	95,071	95,071	95,071
Residents per Unit		2.2	2.2	2.2	2.2	2.2	2.2
Avg. Consumption per Unit (gal / day)							
Unadjusted Baseline Demand		145.1	141.1	138.2	137.7	137.5	137.7
Conservation	*Active*	0.0	-1.0	-1.1	-1.0	-0.9	-0.9
	Demand per Unit	***145.1***	***140.1***	***137.0***	***136.7***	***136.6***	***136.8***
Projection - Total Consumption (MGD)							
Unadjusted Baseline Demand		12.6	13.4	13.1	13.1	13.1	13.1
Conservation	*Active*	0.0	-0.1	-0.1	-0.1	-0.1	-0.1
	Total Demand	***12.6***	***13.3***	***13.0***	***13.0***	***13.0***	***13.0***

Notes: Minor 'inconsistencies' in subtotal are result of rounding significant figures.

4 Multi-Family Residential Demand Projection

4.1. Model Estimates

Table 4-1 summarizes the estimates of the demand model for the multi-family residential sector. Note that projections are made on a per-unit rather than per-account basis, this distinction is important in the multi-family residential sector, where many accounts serve multiple units. The model has good fit to the data, with an R-squared value of 0.7, implying that our estimate explains 70% of the total variation in demand.

Across all units in the sample, we estimate a price-elasticity of demand of -0.14. This elasticity implies that a 10% increase in rates will lead to a 1.4% reduction in demand. This estimate is statistically significant and has a confidence interval from -0.16 to -0.11. Note that SFPUC charges two tiers of variable rates and a fixed rate. The demand elasticity estimate is with respect to the two tiers of variable rates, but not the fixed rate.

We estimate an elasticity of demand with respect to temperature of 0.03 and with respect to precipitation of -0.0014. This estimate implies that a 10% increase in average temperature will lead to a 0.3% increase in demand, and that a 10% increase in precipitation will lead to a 0.014% decrease in demand. The difference between the temperature coefficients estimated now and in the 2020 report is statistically significant; but that of precipitation is not. The temperature elasticity has moved closer to zero, suggesting that demand has become less responsive to temperature over time, consistent with demand hardening.

During periods with COVID-19 restrictions (2020-2022), multi-family residential water demand is estimated to be 1.4% higher; however, this effect is not statistically significant. During a drought, multi-family residential water demand is estimated to be 1.9% lower, and this effect is also not statistically significant. Similarly to what’s observed in the SFR sector, water sales declined more rapidly than population following the COVID-19 pandemic, likely due to more efficient water consumption (incentivized by the 2020-2022 drought or other conservation programs).

Table 4-1: Model Estimates – Multi-Family Residential Sector

	Coefficient	95% Confidence Interval	Change in Consumption from 10% Predictor Change
log(Marginal Price)	-0.14	[-0.16, -0.11]	-1.4%
log(Temperature)	0.03	[0.01, 0.05]	0.3%
log(Precipitation)	-0.001	[-0.002, -0.001]	-0.01%
			Change in Consumption from Predictor Event
COVID-19	0.01	[-0.01, 0.04]	1.4%
Drought	-0.02	[-0.03, -0.01]	-1.9%
Account Fixed-Effects	Yes		
R-squared	0.70		

4.2. Demand Projection

Table 4-2 summarizes the multi-family residential demand projection. The SF Planning Department expects growth in the stock of multi-family residential units to increase by 43.7% or from 322,753 units in FY 2024-25 to 463,929 units in FY 2049-50.[15] The projection is calibrated to FY 2024-25 consumption levels, where total demand was 22.2 MGD or 75.4 gallons per occupied unit per day and incorporates an 8.6% vacancy rate based on the latest estimate from the California Department of Finance. After accounting the anticipated effects of active conservation programs and non-potable onsite reuse systems, average per-unit water demand in the multi-family sector is projected to decline from 75.4 gallons per unit per day in FY 2024-25 to 69.4 gallons per unit per day in FY 2049-50.

Because of the substantial increase in the number of multi-family units, total unadjusted baseline demand is expected to rise. Active conservation programs and the implementation of non-potable onsite reuse systems are expected to reduce water use by about 0.3 MGD by FY 2049-50. After accounting for these conservation savings, total multi-family demand is projected to increase by 45% or from 22.2 MGD in FY 2024-25 to 32.2 MGD due to full occupancy of all units. On a per unit basis, however, average consumption is expected to decline by 8.0% or to 69.4 gallons per day by FY 2049-50.

[15] SFPUC. 2023 Interim Water Demand Projections for the City and County of San Francisco. September 2023.

Table 4-2: Demand Projection – Multi-Family Residential Sector

		FY 2024-25	FY 2029-30	FY 2034-35	FY 2039-40	FY 2044-45	FY 2049-50
Number of Units	*Existing*	322,753	322,753	363,262	388,529	413,929	438,929
	New	--	40,509	25,267	25,400	25,000	25,000
	Total	***322,753***	***363,262***	***388,529***	***413,929***	***438,929***	***463,929***
Residents per Unit		2.2	2.2	2.2	2.2	2.2	2.2
Avg. Consumption per Unit (gal / day)							
Unadjusted Baseline Demand		75.4	72.5	70.4	70.0	69.8	69.8
Conservation	*Active*	0.0	-0.2	-0.2	-0.2	-0.1	-0.1
	Non-Potable / Onsite Reuse	0.0	-0.2	-0.4	-0.4	-0.4	-0.3
	Demand per Unit	***75.4***	***72.1***	***69.7***	***69.4***	***69.3***	***69.4***
Projection - Total Consumption (MGD)							
Unadjusted Baseline Demand		22.2	26.3	27.3	29.0	30.6	32.4
Conservation	*Active*	0.0	-0.1	-0.1	-0.1	-0.1	-0.1
	Non-Potable / Onsite Reuse	0.0	-0.1	-0.2	-0.2	-0.2	-0.2
	Total Demand	***22.2***	***26.2***	***27.1***	***28.7***	***30.4***	***32.2***

Notes: Minor 'inconsistencies' in subtotal are result of rounding significant figures

5 Commercial and Industrial Demand Projection

5.1. Model Estimates

Table 5-1 summarizes the estimates of the demand model for the commercial and industrial sectors. Note that we project on a per-unit account basis, but we present our results on a per-employee basis, as this is the input data into our projection model. The model has good fit to the data, with an R-squared value of 0.87, implying that our estimate explains 87% of the total variation in demand.

We estimate five price elasticities, varying from -0.16 in the Manufacturing/Wholesale sector to -0.34 in the Health/Education/Recreation sector. These elasticities imply that a 10% increase in water rates will lead to a reduction in demand between 1.6% and 3.4%, respectively. In general, unlike the residential sector, these elasticities are larger in magnitude compared to the 2020 analysis — that is, C&I sector remains more sensitive to price signals. We further estimate that these demand elasticities are statistically significant in the Office/Professional, Health/Education/Recreation, and Other sectors, but not in the Retail and Manufacturing/Wholesale sectors.[16]

We estimate an elasticity of demand with respect to temperature of 0.15 and with respect to precipitation of 0.00. This estimate implies that a 10% increase in average temperature will lead to a 1.5% increase in demand, and that changes in precipitation do not have a statistically or economically significant impact on demand.

The COVID-19 pandemic led to a statistically significant reduction in average water use among commercial and industrial customers of between 8.9% to 24.2% depending on the sector. We do not find a statistically significant impact of drought on commercial and industrial water use in San Francisco.

[16] Our estimates are deemed to be statistically significant if the estimated 95% confidence interval does not include zero. If the estimated 95% confidence interval does include zero, the estimates are considered to not be statistically significant. Note that to obtain the best-fit model, we include all variables in our projections, regardless of whether or not they are statistically significant.

Table 5-1: Model Estimates – Commercial and Industrial Sector

	Coefficient	95% Confidence Interval	Change in Consumption from 10% Predictor Change
log(Marginal Price): Office/Professional	-0.32	[-0.47, -0.18]	-3.2%
log(Marginal Price): Health/Education/Recreation	-0.34	[-0.47, -0.21]	-3.4%
log(Marginal Price): Manuf./Wholesale/Trade/Trans.	-0.16	[-0.28, -0.04]	-1.6%
log(Marginal Price): Other	-0.31	[-0.46, -0.16]	-3.1%
log(Marginal Price): Retail	-0.31	[-0.44, -0.18]	-3.1%
log(Temperature)	0.15	[0.08, 0.22]	1.5%
log(Precipitation)	0.00	[-0.004, 0.003]	0.00%
			Change in Consumption from Predictor Event
COVID-19: Office/Professional	-0.21	[-0.31, -0.11]	-18.7%
COVID-19: Health/Education/Recreation	-0.24	[-0.37, -0.11]	-21.4%
COVID-19: Manuf./Wholesale/Trade/Trans.	-0.12	[-0.21, -0.04]	-11.6%
COVID-19: Other	-0.09	[-0.16, -0.02]	-8.9%
COVID-19: Retail	-0.28	[-0.43, -0.13]	-24.2%
Drought	-0.002	[-0.06, 0.06]	-0.2%
Account Fixed-Effects	Yes		
R-squared	0.87		

5.2. Demand Projection

Table 5-2 summarizes the commercial and industrial demand projection. The SF Planning Department projects that the City will experience significant employment growth of 27.8%, where the number of jobs will increase from 725,300 in FY 2024-25 to 927,214 in FY 2049-50. The projection is calibrated to match total commercial and industrial consumption in FY 2024-25, which was 12.4 MGD where per-employee demand was 16.9 gallons per day. Active conservation programs and non-potable onsite reuse systems are expected to reduce commercial and industrial water use by 1.8 MGD in FY 2049-50. With conservation, commercial and industrial water use is projected to decline by 13.7% or from 12.4 MGD in FY 2024-25 to 10.7 MGD in FY 2034-35 before rising by 14.0% or to 12.2 MGD in FY 2049-50. On a per-employee basis, average water use is expected to decline by 21.9% or to 13.2 gallons per day, which is partially offset by growth in total employment.

Table 5-2: Demand Projection – Commercial and Industrial Sector

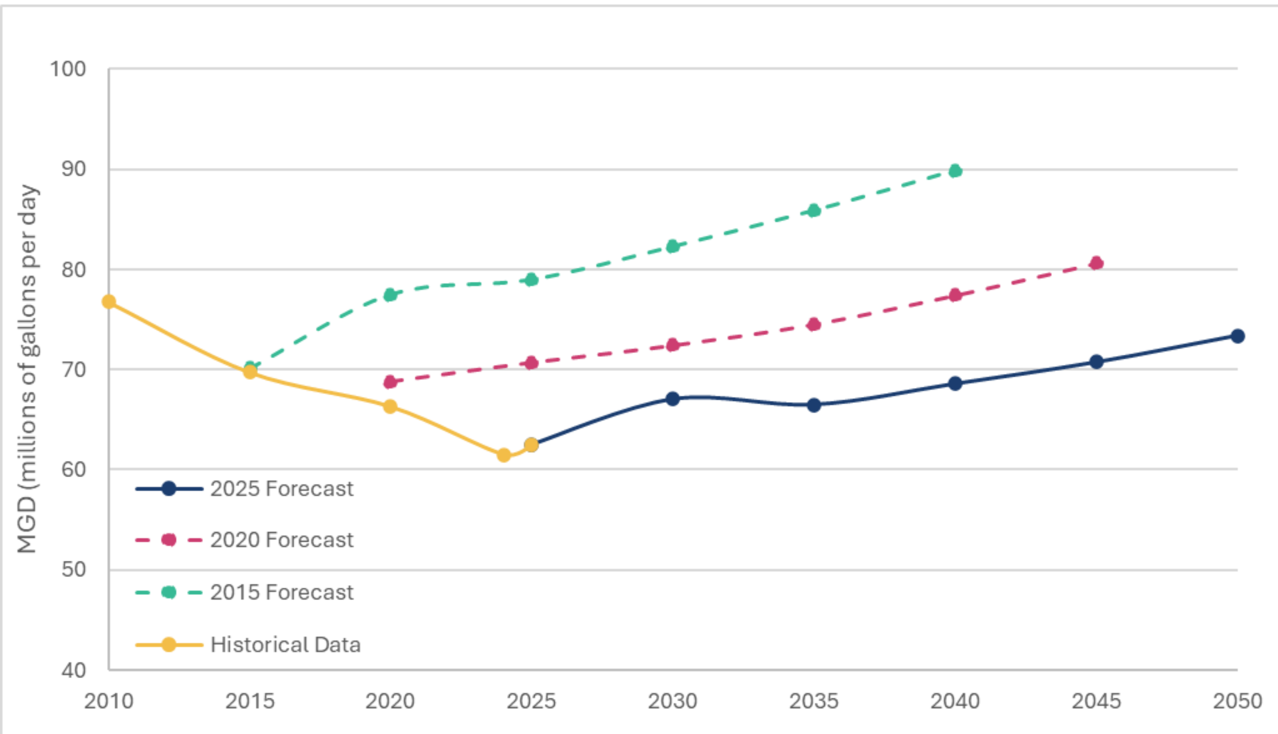
		FY 2024-25 (Actual)	FY 2029-30	FY 2034-35	FY 2039-40	FY 2044-45	FY 2049-50
Number of Employees		725,300	802,020	815,302	854,241	880,439	927,214
Avg. Consumption per Employee (gal / day)							
Unadjusted Baseline Demand		17.1	16.0	15.3	15.1	15.1	15.1
Conservation	*Active*	0.0	-0.4	-0.6	-0.5	-0.4	-0.4
	Non-Potable / Onsite Reuse	-0.2	-0.7	-1.6	-1.6	-1.6	-1.6
	Demand per Employee	***16.9***	***14.9***	***13.1***	***13.0***	***13.0***	***13.2***
Projection - Total Consumption (MGD)							
Unadjusted Baseline Demand		12.6	12.9	12.4	12.9	13.3	14.0
Conservation	*Active*	0.0	-0.4	-0.5	-0.4	-0.4	-0.4
	Non-Potable / Onsite Reuse	-0.2	-0.5	-1.3	-1.4	-1.4	-1.4
	Total Demand	***12.4***	***12.0***	***10.7***	***11.1***	***11.5***	***12.2***

Notes: Minor 'inconsistencies' in subtotal are result of rounding significant figures

6 Comparison to 2020 and 2015 Demand Projections

Figure 6-1 compares the 2025 Demand Projection to the demand projections developed for the UWMPs in 2020 and 2015. The 2020 UWMP projection was produced using the same methodology as the 2025 projection—an econometric model of household-level water use for customers within the City and County of San Francisco—whereas the 2015 projection was based on utility-level econometric model that compared water use between San Francisco and other Bay Area utilities. As noted previously, these demand projections are for single family residential, multi-family residential, commercial, and industrial sectors and does not include other retail demands such as water losses, dedicated irrigation, municipal, or suburban retail accounts.

Figure 6-1: Comparison of Demand Projections from 2025, 2020, and 2015 UWMPs



Several key factors account for the lower projection of water use developed in 2025 relative to projections developed in 2020 and 2015:

- **Lower per-capita water use:** The 2025 projection incorporates more recent data with lower baseline per-capita water use than was included in the 2015 and 2020 analyses, contributing to lower projected total demand. Per-capita water use is 9% lower compared to that of the 2020 analyses (baseline year: 2019), and 17% lower than that of the 2015 analyses (baseline year: 2009).

- **Higher water conservation:** Projected water conservation is slightly higher (about 5% higher in terms of cumulative volume over the projection period) in 2025 than was predicted in the conservation model from 2020.

- **Lower population and employment:** Projected population and employment is lower in 2025 relative to that projected in the 2020 projections, for example, the projected number of employees in 2025 is 3% lower in 2025 than that in the 2020 analysis.

- **Drought and pandemic adjustments:** Upward adjustments were made to the baseline water use projections in 2015 and 2020 to remove the temporary effects of the ongoing drought and the COVID-19 pandemic, respectively, from observed water use data. As a result, projected water use in those years was higher than the historical data. The 2025 projection does not include any such adjustments.

The 2025 projection assumes modest declines in per-capita water use—consistent with past projections—but incorporates increases in population and employment that offset these declines, resulting in an overall increase in total water demand. Retail demands are projected to decrease from 62.5 MGD to 58.8 MGD in FY 2034-35 primarily due to larger rate increases expected in the near-term. From FY 2034-35 to FY 2049-50, demands are anticipated to increase to 73.4 MGD due to growth in housing unit and employment projections outpacing rate increases. To test the robustness of the projection to alternative assumptions about population and employment growth, Appendix A to this report contains a sensitivity analysis that evaluates how projected demand changes under projections from alternative data sources.

7 Conclusion

The 2025 demand model updates the 2020 demand model using the latest billed consumption data. Using FY 2024-25 consumption as a baseline, the model calibrates residential use with an estimated vacancy rate of 8.6% from the California Department of Finance and then assumes full occupancy beginning in FY 2029-30 to reflect the SFPUC's capacity to serve all future households. Under these conditions, single family demand rises modestly from 12.6 MGD to 13.0 MGD despite no increases in unit count, driven by the assumption of full occupancy with some declines in average consumption per household. Multi-family demand grows more substantially due to the addition of new housing and the assumption of full occupancy, yet per unit consumption also trends downward. In the commercial and industrial sectors, demand remains relatively stable through FY 2049-50, even though there is projected employment growth. This is because water use per employee is expected to fall and because conservation and onsite water reuse savings play a larger role than in the residential sectors combined.

Citywide demand increases through FY 2029-30 and decreases in FY 2034-35 due to near-term rate impacts and anticipated conservation savings based on known programs. Demand then gradually rises again as long-term growth in housing and employment become the dominant driver. Despite this growth, continued improvements in water efficiency keep projected demands lower than in past projections. Together, these trends illustrate a system in which expanding population and economic activity are balanced by sustained gains in efficiency.

A. Appendix A: Discussion of Assumptions for Demand Projection and Sensitivity Analysis

This appendix contains further discussion of how the key assumptions used in the demand projections for the 2025 UWMP were developed. It also presents two additional demand scenarios based on alternative assumptions regarding housing and employment growth.

The following scenarios were developed by SFPUC staff in collaboration with Berkeley Research Group, WestWater Research, and Woodard & Curran. The narrative in this section was primarily prepared by SFPUC staff and reflects the collective discussions held among SFPUC and the consultant team. While the text was drafted by SFPUC, the authors of this report support the analytical framework and assumptions underlying this work.

A. Purpose

The SFPUC routinely updates its 20-year demand projections as part of its water supply planning. Included in this effort is the UWMP, which is updated every five years and must reflect local land use planning. As such, the housing and employment growth projections in the UWMP are provided to the SFPUC by SF Planning. The water demand projections which are published in the UWMP are referred to as the “UWMP Scenario”.

In 2019, the SFPUC established the Alternative Water Supply (AWS) Program to help meet future dry-year needs. The roadmap for this program is laid out in the AWS Plan (February 2024). During the development of this plan, the SFPUC received several public comments asking the agency to (1) develop additional demand scenarios and (2) conduct a sensitivity analysis similar to what the Bay Area Water Supply and Conservation Agency (BAWSCA) produced in their 2022 Regional Water Demand and Conservation Projections Update.[17] The nature of these comments reflected the general observation across all water suppliers, not just SFPUC, that demand projections provided in the Urban Water Management Plans tend to be higher than actual demands. In response to these comments, the SFPUC included a recommendation in the AWS Plan to develop one to two additional demand scenarios and to conduct a sensitivity analysis. This memo documents the sensitivity analysis and development of the additional demand scenarios which will be used for future water supply planning and incorporated in the next AWS Plan Update (anticipated to begin following completion of the 2025 UWMP).

B. Scope of the Sensitivity Analysis

The SFPUC produces water demand projections for its retail service area, which includes both in-City and suburban demand. To determine future demands for the majority of accounts—in-City single family residential, multi-family residential, commercial, and industrial accounts—the SFPUC uses an econometric model that estimates the relationship between water consumption and demand factors (e.g.,

[17] https://bawsca.org/uploads/userfiles/files/BAWSCA%202022%20Demand%20Study%20Update%20Final%20Report(1).pdf

rates, temperature, precipitation). This relationship is estimated for each household or business account using multiple regression analysis with account-level fixed effects.

Each variable used in the econometric model was evaluated for potential inclusion in the sensitivity analysis. Then, the sensitivity analysis examined the relative impact on demand from using one data source compared to another. For example, the sensitivity analysis estimates how much water demand changes if an additional 5% increase in water savings was assumed on top of the SFPUC's conservation model output. Additionally, the SFPUC closely reviewed the sensitivity analysis described in BAWSCA's 2022 Regional Water Demand and Conservation Projections Update for additional variables to consider. This section describes all the variables and corresponding source data options considered in SFPUC's sensitivity analysis.

Lastly, there are various types of demands that are not projected by an econometric model and instead are projected using estimates based on historical consumption or assumed to remain steady over time. These other types of demand that are not modeled include dedicated irrigation accounts, municipal accounts, suburban retail accounts, and water losses. While these demands are not projected by the SFPUC's econometric model and not included in the sensitivity analysis, their corresponding projections, consistent with the UWMP, are included in the resulting projections of the three demand scenarios.

1. Housing Growth

This section describes the housing and population growth projections considered for the sensitivity analysis.

San Francisco Planning Department

Because the SFPUC is not a land use agency, housing growth projections is provided to the SFPUC by the San Francisco Planning Department for use in the UWMP. The SF Planning Department reviews the information in the City's General Plan Housing Element and routinely updates the citywide Land Use Allocation when the Association of Bay Area Governments (ABAG) and Metropolitan Transportation Commission (MTC) update their regional projections, which is typically every four years as part of the Plan Bay Area adoption process. This plan is currently being updated, and the next iteration is called Plan Bay Area 2050+. The plan is anticipated to be adopted by early 2026. In the meantime, as of the preparation of this memo, the Final Blueprint for Plan Bay Area 2050+, which contains growth strategies for the region, has been advanced to the environmental phase of the planning process. To meet the timeline of the UWMP, the SF Planning Department has informed the SFPUC to use the housing projections published in the Housing Element (adopted in January 2023). These projections were also used to develop the 2023 Interim Water Demand Projections for the City and County of San Francisco. The average annual growth rate of SF Planning's housing projections is 1.06%.

Historical Growth

Predicting future population based on historical estimates was considered for the sensitivity analysis since past growth may be an indicator of future growth. The SFPUC used historical population estimates from the California Department of Finance (CA DOF) between 2000 and 2025[18] and applied a linear regression to estimate population through year 2050. This produced an average annual growth rate of 0.44%.

Moody's

Moody's Corporation is a globally recognized financial services company specializing in credit ratings, risk analysis, and data-driven insights. Moody's provides credit ratings for bonds, governments, and corporations, including the SFPUC. Their subsidiary, Moody's Analytics, provides economic forecasting and modeling solutions used by governments, financial institutions, corporations, and other organizations worldwide.[19] Population projections from Moody's were used for the sensitivity analysis and the data show that these projections were slightly lower than CA DOF in the near-term but surpassed CA DOF's projections in the long-term with an average annual growth rate at 0.44%.

California Department of Finance

The California Department of Finance releases population projections for the State and counties of California on a periodic basis.[20] These population projections incorporate the latest historical population, birth, death, and migration data available and are informed by U.S. Census data products. The average annual growth rate of the CA DOF's population projection is 0.077% as of September 2025.

Analysis of Housing Growth Inputs

For this sensitivity analysis, the SFPUC evaluated the impact on demand from changing SF Planning Department's housing unit growth assumption to various population projections. However, since the SFPUC's econometric model estimates demand on an account-level basis and the additional growth projections are in terms of population (i.e., number of people), an assumption of 2.2 persons per household was made to convert population to households. The persons per household estimate is an average of the latest estimates from the CA DOF[21] and the U.S. Census (Decennial Census and American Community Survey [ACS] 5-year estimates),[22] see Table A-1.

Table A-1: Population per Household Estimates by Year

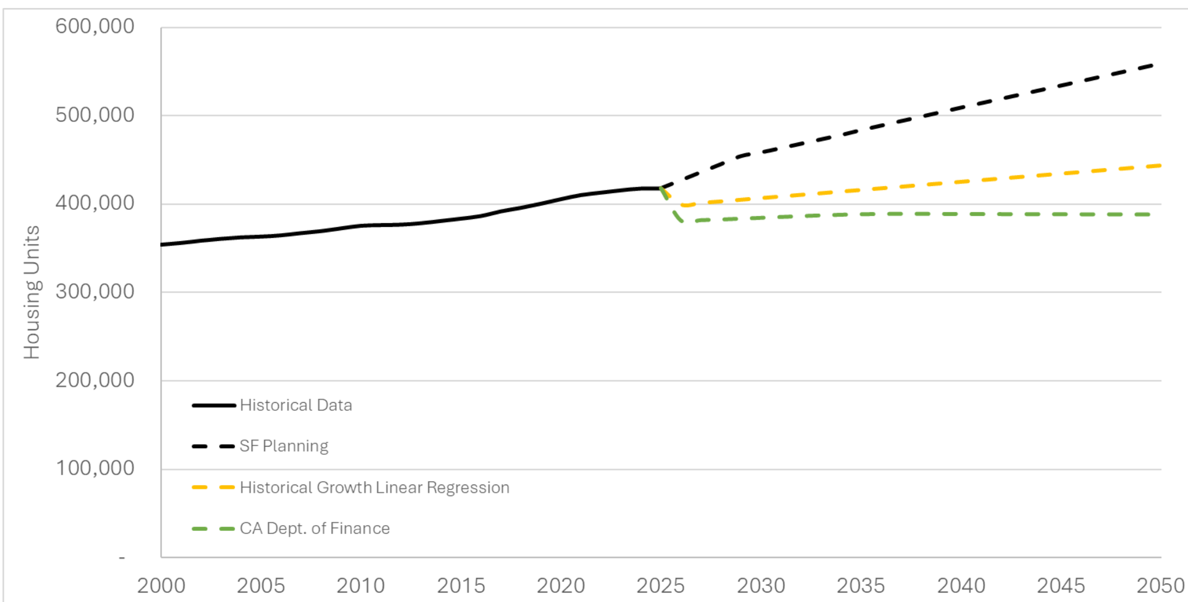
Year	CA DOF	U.S. Census and ACS 5-year Estimates
2020	2.26	2.35
2021	2.21	-
2022	2.15	-
2023	2.14	2.24
2024	2.12	-
2025	2.10	-

[18] https://dof.ca.gov/forecasting/demographics/estimates
[19] https://www.economy.com/products/data
[20] https://dof.ca.gov/forecasting/demographics/projections/
[21] State of California, Department of Finance, E-5 Population and Housing Estimates for Cities, Counties and the State — January 1, 2021-2025. Sacramento, California, May 2025. Retrieved September 17, 2025, from https://dof.ca.gov/forecasting/demographics/estimates/e-5-population-and-housing-estimates-for-cities-counties-and-the-state-2020-2025.
[22] U.S. Census Bureau, U.S. Department of Commerce. (n.d.). Households and Families. American Community Survey, ACS 5-Year Estimates Subject Tables, Table S1101. Retrieved September 17, 2025, from https://data.census.gov/table/ACSST5Y2023.S1101?q=average+household+size+in+san+francisco,+ca.

A comparison of each of the housing projections is shown in Figure A-1. As mentioned above, the SF Planning Department relies on growth projections provided by the Plan Bay Area, which are expressed as the number of households. An assumption of 2.2 persons per household was used to convert CA DOF and Moody's population projections into housing units since that is the unit used by the SF Planning Department. The SF Planning Department's historical housing unit estimates and projected growth reflect the total inventory of the housing stock (i.e., occupied and unoccupied units). While the CA DOF and Moody's population projections are converted into housing units and start with a lower number of housing units than historical estimates since it only reflects occupied units.

Population projections from Moody's and CA DOF reflect a more conservative growth rate for San Francisco. Since CA DOF's projections are the lowest of these data sources when looking at year 2050, it could serve as a low end for scenario planning. In coordination with BAWSCA and their demand projections update, both SFPUC and BAWSCA will be aligned in using population projections from CA DOF as one of the additional demand scenarios.

Figure A-1: Historical and Projected Housing Growth by Source



Note: As stated above, the SF Planning's housing units reflect the total inventory of housing stock (i.e., occupied and unoccupied units). The CA DOF and Moody's population projections have been converted into housing units and only reflect the number of occupied units, which is why there is initially fewer housing units in 2025 compared to historical estimates.

2. Employment Growth

This section describes the employment growth projections considered for the sensitivity analysis.

San Francisco Planning Department

In addition to providing household projections, SF Planning also provides employment growth projections. These projections are also based on the regional projections from ABAG and MTC's Plan Bay Area. The average annual growth rate of SF Planning's employment projections is 0.5%.

Historical Growth

Like estimating future population based on historical estimates, future employment was also estimated based on historical job estimates. The SFPUC used job estimates published by the California Employment Development Department (CA EDD) for the years 2000 through 2023 (the most current estimate available for the CCSF).[23] A linear regression was applied to project the number of jobs through year 2050, and this produced an average annual growth rate of 1.3%.

Moody's

Employment projections from Moody's were also used for sensitivity analysis. These projections were the lowest of the three considered. The average annual growth rate of the Moody's employment projection is 0.5%.

State of California

SFPUC explored datasets published by two state agencies: CA DOF and CA EDD. While the CA DOF conducts economic projections, they do not have employment growth projections by county. The CA EDD publishes 10-year occupational employment projections.[24] However, the most recent projection available was for 2022-2032, which does not cover the UWMP planning period. Moreover, even if the growth rate was assumed to remain constant through 2050, these employment projections were not available by city or county. The projections are only available by state or by metropolitan area where data for the County of San Francisco is combined with the County of San Mateo.

Analysis of Employment Growth Inputs

Three sources of employment growth projections were considered for the sensitivity analysis. The SF Planning Department's projections have been and continue to be used for the UWMP. Additionally, the SFPUC applied a linear regression to historical job estimates which produced the highest growth rate of the three options. A 20+ year time horizon was used for this linear regression since a shorter time frame, particularly 2008-2023, would have yielded a higher average annual growth rate since the beginning of that period was during the Great Recession where the number of jobs steadily increased until the COVID-19 pandemic. Moody's employment forecast was the third data source considered for this analysis and had the most conservative growth of all the options, which could serve as a low end for scenario planning. Refer to Figure A-2 for a comparison of each of the employment projections.

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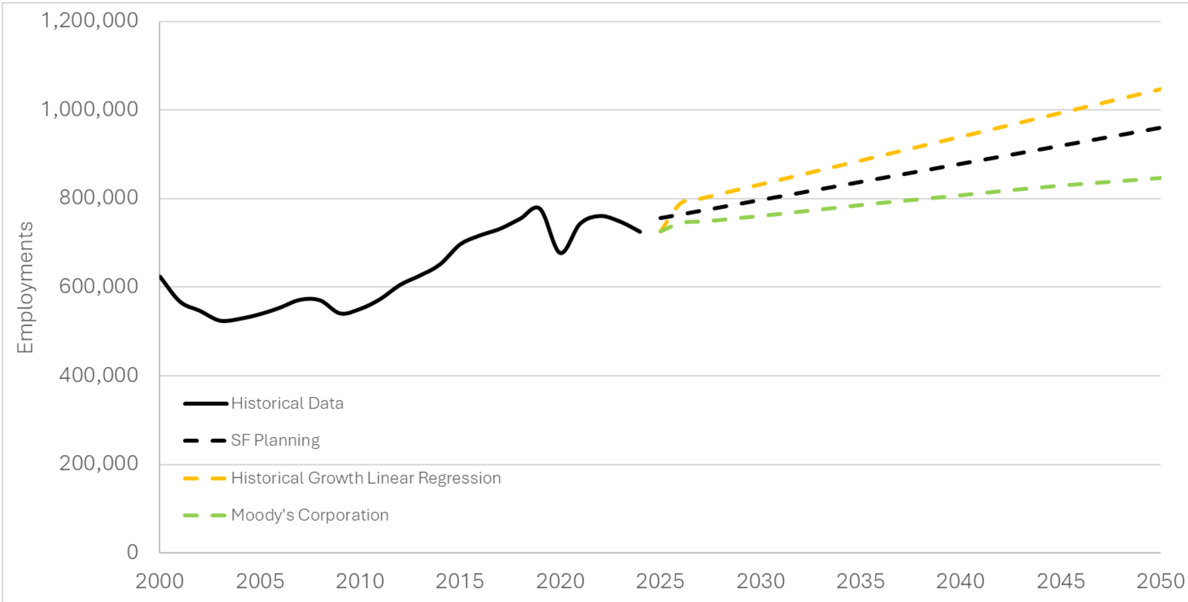
[23] https://data.ca.gov/dataset/current-employment-statistics-ces-2

[24] https://labormarketinfo.edd.ca.gov/data/employment-projections.html

Figure A-2: Historical and Projected Employment by Source



3. Housing Density

The future proportion of single family housing units to multi-family housing units was explored in BAWSCA's 2022 Regional Water Demand and Conservation Projections Update. The SFPUC relies on household growth data from the SF Planning Department and defers to their guidance for a breakdown of single family and multi-family households. In a memo[25] provided by the SF Planning Department, the number of single family homes is expected to stay the same over the next 20 years. This assumption has been incorporated into the single family residential and multi-family residential demand projections for all scenarios.

4. Water Conservation

The SFPUC has an established data-informed process to evaluate and determine the suite of conservation measures to implement in its retail service area and uses conservative, industry-accepted methods and models to estimate water savings. The SFPUC implements some measures, such as public education, that do not have modelled water savings due to the lack of industry standards that make estimating savings difficult. The SFPUC draws on many sources to periodically review and update its conservation program offerings with the goal of maintaining a balanced and effective mix of program measures considered reasonably feasible to implement. Since 2005, the SFPUC has evaluated and implemented over 80 measures and continues to explore new measures. For more details about these measures, see SFPUC's most recent Retail Water Conservation Plan.[26] The SFPUC's conservation

[25] Memo dated 10/27/2020. Re: Projected of growth for San Francisco 2020-2040

[26] The SFPUC's Retail Conservation Plan is available at https://www.sfpuc.gov/about-us/policies-plans/urban-water-management-plan.

model output used for the 2025 UWMP assumes continued implementation of a comprehensive conservation program and generally reflects the upper end of what the SFPUC anticipates achieving.

Projections are more likely to overestimate rather than underestimate customer participation and water savings, based on an analysis of projections and actual participation rates for the last 10 years. Achieving savings greater than SFPUC projections is deemed less likely, but not impossible. For this reason, the sensitivity analysis looked at the impact of further increasing conservation savings to up to 5% more and up to 10% under the standard conservation model output. A small amount of additional projected savings potentially could be assumed by counting savings from implemented measures not modeled, adding new potential measures not yet envisioned for which savings could be modeled, increasing incentive amounts, and reducing eligibility requirements for some existing measures where feasible. Conversely, a small to moderate decrease in projected savings potentially could be assumed if customer participation in some conservation programs declines, and overall demand continues to harden.

An additional 5% increase in water conservation savings translates to a decrease in total demand by about 0.1 MGD. Meanwhile, a decrease of 10% savings from the standard conservation model output translates to an increase in total demand by about 0.2 MGD. The impact from achieving slightly more or less water conservation savings than what the conservation model predicts equates to a small change in overall demand. Changes to the standard conservation model output were explored for this sensitivity analysis but were ultimately not included in the additional demand scenarios.

5. Climate Change

The econometric model uses the Representative Concentration Pathways 4.5 climate change scenario in its demand projections. This climate change scenario is associated with California's Fourth Climate Change Assessment and the data were retrieved from the Cal-Adapt portal.

6. SFPUC Rates

Water, wastewater, and stormwater rates from the approved 10-Year Financial Plan (February 2025)[27] were incorporated into the water demand model. Because the SFPUC Finance Division does not currently have alternative rate scenarios, the water rates in the approved 10-year Financial Plan were used for all demand scenarios.

7. Vacancy Rate

The SFPUC examined whether to apply a vacancy rate for each of the housing growth projections. The SF Planning Department's housing growth projections come from the recently updated Housing Element 2022 Update which projects the number of housing units, not households. If an 8.6% vacancy

[27] https://www.sfpuc.gov/about-us/policies-plans/financial-plans-and-policies

rate[28] was applied to multi-family housing units, this could potentially reduce demands by about 3.2 mgd in 2050. However, for purposes of the UWMP, the SFPUC assumes that all housing units are fully occupied. For historical growth and CA DOF projections, this data are population, not housing units, so a vacancy rate is not applicable.

8. Additional Retail Demands

As described previously, the SFPUC's econometric model estimates demand for single family, multi-family, commercial, and industrial accounts. Retail demands that are not modeled include dedicated irrigation, municipal, suburban retail, and water loss.

Historical irrigation demands have fluctuated between 1.3 to 1.9 MGD in the past five years. During the 2020-2023 drought when the SFPUC declared a water shortage emergency and requested customers to reduce wasteful water use, the SFPUC saw a decrease in irrigation demand from 1.9 to 1.3 MGD between FY 2020-21 to FY 2022-23. Since then, irrigation demand has steadily increased to 1.5 MGD in FY 2024-25. The quantity of dedicated irrigation accounts increases yearly as new projects with landscaping come online. Between 2020 and 2025 the quantity of accounts increased by about 5%, and the SFPUC anticipates the number of dedication irrigation accounts will continue to grow at a similar pace in the future. At the same time, demands from these accounts are also anticipated to use water more efficiently due to local and state water conservation regulations, such as the SFPUC's Water Efficient Irrigation regulations, and State Water Resources Control Board's "Making Conservation a California Way of Life" volumetric standards for efficient outdoor irrigation, and bans on irrigating non-functional turf. Continued efforts to seek greater landscape water efficiency are likely to offset the yearly increase in irrigation accounts, resulting in an estimated steady future demand for this sector over the coming years.

Municipal and suburban retail demands have varied within 1 MGD in the past five years. One of the SFPUC's suburban retail customers, Groveland Community Services District, prepares an Urban Water Management Plan and has prepared water demand projections for their service area. These projections are incorporated into the SFPUC's suburban retail demand projections for all demand scenarios.

Water loss and other demands include water losses from water main breaks, leaks, and unbilled authorized consumption, e.g., water used for firefighting, water main flushing, etc. These demand are projected to be equal to the latest three-year annual average (FY 2022-23 through FY 2024-25) to align with the State Water Resources Control Board's water loss regulations.

Table A-2 shows historical and projected water consumption for these demands based on the assumptions described above.

[28] State of California, Department of Finance, E-5 Population and Housing Estimates for Cities, Counties and the State — January 1, 2021-2025. Sacramento, California, May 2025.

Table A-2: Historical and Projected Demands for Other Retail Types

	Irrigation	Municipal	Suburban Retail	Water Loss and Other[1]
FY 2022-23	1.3	1.9	3.7	7.4
FY 2023-24	1.4	2.0	3.8	8.4
FY 2024-25	1.5	2.2	4.0	7.6
FY 2029-30	*1.5*	*2.2*	*4.1*	*7.8*
FY 2034-35	*1.5*	*2.2*	*4.2*	*7.8*
FY 2039-40	*1.5*	*2.2*	*4.3*	*7.8*
FY 2044-45	*1.5*	*2.2*	*4.4*	*7.8*
FY 2049-50	*1.5*	*2.2*	*4.5*	*7.8*

[1] Other water demands include authorized unbilled unmetered consumption or water that is used in activities such as firefighting, water or sewer main flushing, street cleaning, etc.

C. Sensitivity Scenario Demand Projections

Three demand scenarios were generated from modifying the various inputs described above. These scenarios are described below and summarized in Table A-3.

UWMP Scenario

The UWMP Scenario uses housing and employment growth projections provided by the local land use authority, the SF Planning Department. The SF Planning Department's growth projections are informed by regional growth estimates from ABAG and MTC's Plan Bay Area 2050+. This scenario reflects the upper end of the range of three demand scenarios. Results from this scenario will be reflected in 2025 UWMP.

Historical Growth Scenario

The first additional demand scenario to the UWMP Scenario is the Historical Growth Scenario. This scenario is based on the historical population estimates from the California Department of Finance and historical employment estimates from the California Employment Development Department. A linear regression was applied to each data set to project population and employment growth through 2050 in San Francisco.

DOF / Moody's Scenario

This scenario uses the population projections from the California Department of Finance and employment projections from Moody's Analytics. The lower forecasts of housing and employment result in lower forecasts of water demand compared to the UWMP Scenario and Historical Growth Scenario.

Table A-3: Water Demand Scenarios and Corresponding Data Sources

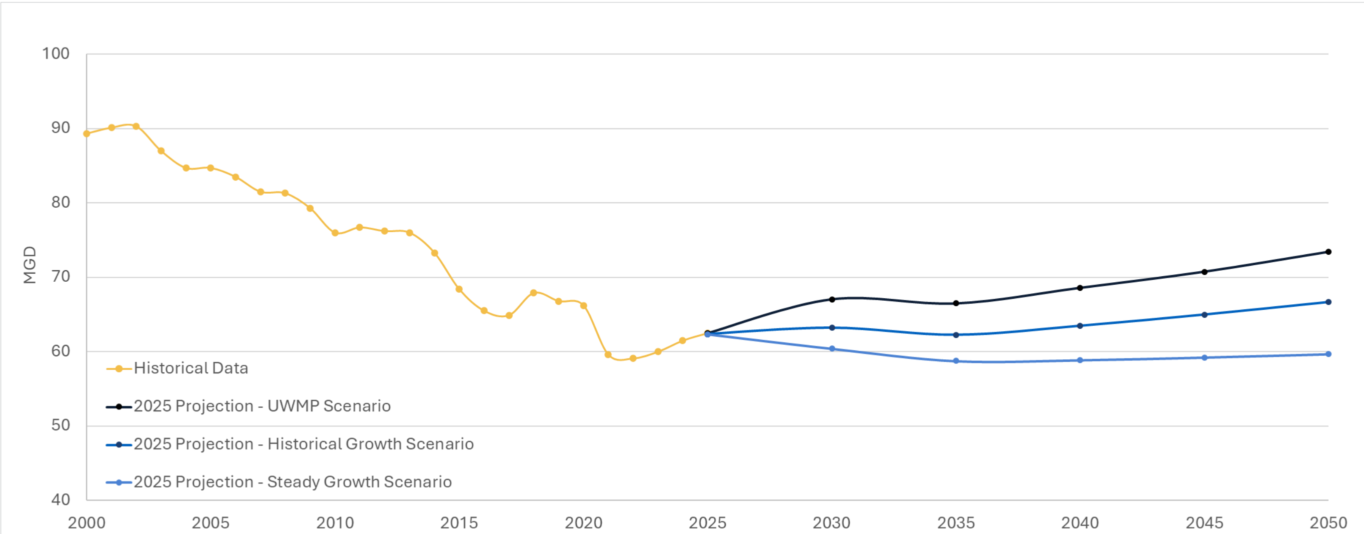
Variable	UWMP Scenario	Historical Growth Scenario	DOF / Moody's Scenario
Housing Growth and Growth Rate	SF Planning 1.1%	Historical Growth 0.4%	California Department of Finance 0.1%
Employment Growth and Growth Rate	SF Planning 0.5%	Historical Growth 1.3%	Moody's 0.5%
Housing Density	SF Planning Department		
Water Conservation Savings	Conservation Model Output		
Climate Change	Representative Concentration Pathway 4.5		
Water Rates	SFPUC's 10-Year Financial Plan		

The projected demands for the three scenarios are shown in Table A-4 and are displayed as a graph in Figure A-3.

Table A-4: Projected Retail Demands (MGD) by Scenario

UWMP Scenario						
Single Family Residential	12.6	13.3	13.0	13.0	13.0	13.0
Multi-Family Residential	22.2	26.2	27.1	28.7	30.4	32.2
Commercial and Industrial	12.4	12.0	10.7	11.1	11.5	12.2
Others	15.3	15.6	15.7	15.8	15.9	16.0
Total	*62.5*	*67.0*	*66.5*	*68.6*	*70.7*	*73.4*
Historical Growth Scenario						
Single Family Residential	12.6	12.2	11.9	11.9	11.9	11.9
Multi-Family Residential	22.2	23.0	22.9	23.5	24.1	24.7
Commercial and Industrial	12.4	12.4	11.8	12.4	13.2	14.1
Others	15.3	15.6	15.7	15.8	15.9	16.0
Total	*62.5*	*63.2*	*62.3*	*63.5*	*65.0*	*66.7*
DOF / Moody's Scenario						
Single Family Residential	12.6	12.2	11.9	11.9	11.9	11.9
Multi-Family Residential	22.2	21.4	20.9	20.9	20.8	20.8
Commercial and Industrial	12.4	11.3	10.3	10.4	10.7	11.0
Others	15.3	15.6	15.7	15.8	15.9	16.0
Total	*62.5*	*60.4*	*58.8*	*58.9*	*59.2*	*59.7*

Figure A-3: Projected Water Demand by Scenario



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