

#### Memorandum

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From: Dan Rodrigo, CDM Smith

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Subject: Orange County Water Demand Forecast for MWDOC and OCWD

# **Purpose and Background**

For the purposes of water supply reliability planning and to support the preparation of 2020 UWMPs, CDM Smith prepared water demand forecasts for the MWDOC and OCWD service areas using a consistent forecast methodology. While the methodology was a bottoms-up approach meaning water demand forecasts were developed for every retail water agency in Orange County—the results presented in this technical memorandum are for the total service areas for MWDOC and OCWD, as well as a total for Orange County. All retail water agencies were given an opportunity to review both the forecast methodology and forecast results to determine if they wanted to utilize the information for their own 2020 UWMPs and local planning.

CDM Smith developed and presented a draft forecast methodology to a meeting of both MWDOC and OCWD member agencies for input. CDM Smith then developed draft retail agency forecasts for agency review. Based on interest, several retail water agencies met with CDM Smith individually to refine assumptions specific to their agency. We believe these meetings with the retail agencies improved both the methodology and demand forecast results. In the end, six retail water agencies decided to utilize their own water demand forecast.

## **Demand Forecast Methodology**

Given the significant changes in residential water use in the past 5 years due to California plumbing codes and landscape ordinances, as well as substantial customer participation in agency rebates for water use efficiency programs, the focus of the forecast methodology was on single-family and multifamily residential sectors. This decision to focus more on residential sectors was also supported by the relatively constant commercial/institutional/industrial (CII) water demands on a per account basis for the last five years.

The forecast methodology for residential sectors also provided the ability to separate indoor vs outdoor water use to support agency reporting for California's indoor residential target of 55 gallons per capita per day (gpcd) by 2025 and approximately 50 gpcd by 2030.

The forecast methodology began with a retail water agency survey that asked for FY2018, 2019 and 2020 water use by major sector, including number of accounts (see Figure 1 for example survey for FY2018). If an agency provided recycled water to customers that information was also requested. All retail agencies had provided the requested information to MWDOC and OCWD by December of 2020.

#### Figure 1. Member Agency Water Use Survey

Please fill out all three worksheets for FY Ending 2017-18, 2018-19, and 2019-20.									
Input billed water demand data by sector, use <u>either:</u> AFY, CCF, or GPD columns.									
If non-residential sectors are combined for commercial, institutional, industrial, enter values under commercial sector and provide comments to indicate what is included.									
Non-revenue water, the difference between total water production from all sources of water supply minus total billed water, includes system losses, fire protection, system									
flushing and meter error.									
FY Ending 2017-18									
Water Demand by	Water Demand	Water Demand	Water Demand	Number					
Billing Sector	(AFY)	(CCF)	(GPD)	of Accounts	Comments				
Residential, Single-Family									
Residential, Multifamily									
Government/Institutional									
Commercial									
Industrial									
Large Landscape (Irrigation)									
Recycled Water									
Other									
Total Consumptive Demand									
Non-Revenue Water									
Total Water Production									

Given that FY 2018 was a slightly above-normal demand year (warmer/drier than average) and FY 2019 was a slightly below-normal demand year (cooler/wetter than average), water use from these two years were averaged to represent an average-year base water demand. FY 2020 was examined to determine potential impacts of the COVID-19 pandemic on water use.

#### **Residential Forecast Methodology**

For the residential sectors (single-family and multifamily) the base year water demand was divided by households in order to get a total per unit water use (gallons per home per day). In order to split household water use into indoor and outdoor uses, three sources of information were used, along with professional judgement. The sources of information included: (1) *the Residential End Uses of Water* (Water Research Foundation, 2016); (2) California's plumbing codes and landscape ordinances; and (3) CA DWR's Model Water Efficient Landscape Ordinance (MWELO) calculator.

Three different periods of residential end uses of water were analyzed as follows:

- **Pre-2010 efficiency levels** Has an average indoor water use that is considered to be moderately efficient, also does not include the most recent requirements for MWELO.
- **High-efficiency levels** Includes the most recent plumbing codes that are considered to be highly efficient, and also includes the most recent requirements for MWELO.
- **Current average efficiency levels** Represents the weighted average between pre-2010 efficiency and high efficiency levels, based on average age of homes for each retail water agency.

Table 1. Shows the three indoor single-family residential end uses of water for the three efficiency levels assumed for the Orange County water demand forecast.

			Pre-2010 Efficiency Level		High Efficiency Level		Current Avg. Efficiency Level	
Indoor Single-Family		Per Person	Flow Rate	Per Capita	Flow Rate	Per Capita	Flow Rate	Per Capita
End Use of Water	Unit	Use Rate	per Day	Use (gal/day)	per Day	Use (gal/day)	per Day	Use (gal/day)
Toilet (gal/flush)	gal/flush	5	1.4	7.0	1.28	6.40	1.36	6.80
Shower (gmp)	gal/min	5.1	2.1	10.7	1.8	9.18	2.00	10.19
Bathroom Faucet (gpm)	gal/min	4.2	1.8	7.6	1.2	5.04	1.60	6.71
Kitchen Faucet (gpm)	gal/min	6.2	2.1	13.0	1.8	11.16	2.00	12.39
Dishwashing	gal/load	0.1	12	1.2	9	0.90	10.98	1.10
Clotheswashing	gal/load	0.3	30	9.0	28	8.40	29.32	8.80
All Others	gal/day	1	3.5	3.5	3	3.00	3.33	3.33
Leaks	gal/day	1	6.8	6.8	6.5	6.50	6.70	6.70
Total				58.79		50.58		56.01

#### Table 1. Single-Family Residential Indoor End Uses of Water Used for OC Water Demand Forecast

The multifamily residential uses were similar in magnitude as shown in Table 1, although slightly lower for certain end uses.

For outdoor residential water use, the indoor per capita total was multiplied by each retail agency-specific persons per household in order to get an indoor residential household water use (gallons per day per home), and then was subtracted from the base year total household water use for single-family and multifamily for each agency based on actual water use as reported by the agency surveys.

For illustrative purposes, the average single-family household water use for Orange County was derived showing indoor and outdoor water uses for both single-family and multifamily homes (see Figures 2 and 3).









For existing residential homes, the current average indoor and outdoor water use (as illustrated in Figures 2 and 3) for each agency were used for the year 2020. It was assumed that indoor water uses would reach the high efficiency level by 2040. Based on current age of homes, replacement/remodeling rates, and water utility rebate programs it is believed this assumption is very achievable. It was also assumed that current outdoor water use would be reduced by 5% by 2050.

For new homes, the indoor high efficiency level was assumed for the years 2025 through 2050. Outdoor uses for new homes were assumed to be 25% and 30% lower than current household water use for single-family and multifamily homes, respectively.

The residential water demand methodology is depicted in Figure 4.

![](_page_3_Figure_4.jpeg)

Figure 4. Residential Water Demand Methodology for Orange County

Existing and projected population, single-family and multifamily households for each retail water agency were provided by the Center for Demographic Research (CDR) under contract by MWDOC and OCWD. CDR provides historical and future demographics by census tracts for all of Orange County. Census tract data is then clipped to retail water agency service boundaries in order to produce historical and projected demographic data by agency.

#### **CII Forecast Methodology**

For the CII water demands, which have been fairly stable from a unit use perspective (gallons/account/day), it was assumed that the unit demand in FY2020 would remain the same from 2020-2025 to represent COVID-19 impacts. Reviewing agency water use data from FY2018 through FY2020 revealed that residential water use increased slightly in FY2020 while CII demands decreased slightly as a result of COVID-19. From 2030 to 2050, the average CII unit use from FY2018 and 2019 was used. These unit use factors were then multiplied by an assumed growth of CII accounts under three broad scenarios:

- Low Scenario assuming no growth in CII accounts
- Mid Scenario assuming 0.5% annual growth in CII accounts
- High Scenario assuming 1.5% annual growth in CII accounts

For most retail agencies, the Mid Scenario of CII account growth was used, but for those retail agencies that have had faster historical growth the High Scenario was used. For those retail agencies that have had relatively stable CII water demand, the Low Scenario was used.

#### **Other Demand Categories Forecast Methodology**

For those agencies that supply recycled water for non-potable demands, we used agencyspecified growth assumptions. Most agencies have already maximized their recycled water and thus are not expecting for this category of demand to grow. However, a few agencies in South Orange County do expect moderate growth in recycled water customers.

For large landscape customers served currently by potable water use, we assumed these demands to be constant through 2050, except for agencies that have growing recycled water demands. For the agencies that have growing recycled water demands, we reduced the large landscape demands served by potable water accordingly.

For non-revenue water, which represents the difference in total water production less all water billed to customers, we held this percentage constant through 2050.

### **Demand Forecast Results**

The results of the water demand forecast for MWDOC's service area are presented in Table 2 by major category of demand and for average weather under Mid Scenario for CII. MWDOC's service area includes all retail water agencies in Orange County except Anaheim, Fullerton and Santa Ana.

Sector Demand (AFY)	2020	2025	2030	2035	2040	2045	2050
Single-Family Residential	171,622	170,108	168,573	167,335	164,546	163,979	163,411
Multifamily Residential	60,013	61,411	60,994	60,916	60,364	61,123	61,882
CII	65,252	66,868	76,557	78,450	80,391	80,391	80,391
Large Landscape Potable	36,819	35,439	35,169	35,119	35,094	35,094	35,094
Non-Potable Recycled Water	50,174	52,645	54,094	56,774	56,829	56,829	56,829
Non-Revenue	27,102	27,267	28,198	28,384	28,470	28,507	28,544
Grand Total	410,982	413,738	423,584	426,978	425,694	425,923	426,151

Table 2. MWDOC Service Area Water Demand Under Average Weather and Mid Scenario Growth

As CDR is projecting only slight single-family housing growth for MWDOC's area, plus the impacts of highly efficient plumbing codes and MWELO on new development and retrofits, it is forecasted that single-family water use will steadily decrease from current 171,622 acre-feet (AFY) in 2020 to 163,411 AFY in 2050. While plumbing codes and MWELO will impact multifamily water demand in similar ways as single-family, CDR is projecting significantly more multifamily units—thus, these two factors are countering each other somewhat and results in a relatively constant multifamily water demand. CII water demands, based on 0.5% annual growth in CII accounts, are forecasted to increase from 65,252 AFY in 2020 to 80,391 AFY in 2040 and then hold relatively constant. Large landscape demands served by potable water are expected to decrease somewhat due to increases in non-potable recycled water (although not on a one to one basis). Finally, there will be a slight increase in non-revenue water in the planning horizon. In total, MWDOC's average year water demands under Mid Scenario CII growth are expected to increase from 410,982 AFY in 2020 to 426,978 AFY in 2035, and then level off through 2050.

The results of the water demand forecast for OCWD's service area are presented in Table 3 by major category of demand and for average weather under Mid Scenario for CII. OCWD's service area includes all retail water agencies in Orange County that produce groundwater from the Orange County Basin, including Anaheim, Fullerton and Santa Ana. It also includes a portion of IWRD's service area that overlays the groundwater basin.

Sector Demand (AFY)	2020	2025	2030	2035	2040	2045	2050
Single-Family Residential	157,755	155,725	153,616	151,319	148,737	148,311	147,885
Multifamily Residential	69,188	72,351	72,778	73,137	73,132	74,534	75,937
CII	86,886	89,043	100,752	103,251	105,812	105,812	105,812
Large Landscape Potable	22,988	22,988	22,988	22,988	22,988	22,988	22,988
Non-Potable Recycled Water	24,899	24,899	24,899	24,899	24,899	24,899	24,899
Non-Revenue	22,406	22,719	23,671	23,881	24,044	24,111	24,178
Grand Total	384,123	387,726	398,705	399,475	399,613	400,656	401,699

OCWD's service area demands for single-family are decreasing until 2040, but then stabilize due to the older housing stock which uses more water per home than new development in Anaheim, Fullerton and Santa Ana. Multifamily water demands for OCWD's area are expected to increase from 2020 to 2050 due to significantly greater projected multifamily housing in Anaheim, Fullerton, and Santa Ana. CII water demands, based on 0.5% annual growth in CII accounts, are forecasted to increase from 86,886 AFY in 2020 to 105,812 AFY in 2040 and then hold relatively constant. Large landscape served by potable water and non-potable recycled water demands served by potable water are forecasted to remain fairly constant. Finally, there will be a slight increase in non-revenue water in the planning horizon. In total, OCWD's average year water demands under Mid Scenario CII growth are expected to increase from 384,123 AFY in 2020 to 401,699 AFY in 2050.

The results of the water demand forecast for the total Orange County are presented in Table 4 by major category of demand and for average weather under Mid Scenario for CII. The total Orange County area includes all retail water agencies in Orange County.

Sector Demand (AFY)	2020	2025	2030	2035	2040	2045	2050
Single-Family Residential	215,900	213,658	211,302	209,257	205,649	204,951	204,253
Multifamily Residential	86,584	89,866	90,222	90,473	90,262	91,853	93,443
CII	101,418	103,939	118,298	121,235	124,246	124,246	124,246
Large Landscape Potable	39,545	38,165	37,895	37,845	37,820	37,820	37,820
Non-Potable Recycled Water	50,518	52,989	54,438	57,118	57,173	57,173	57,173
Non-Revenue	31,739	32,012	33,181	33,432	33,587	33,656	33,725
Grand Total	525,704	530,628	545,335	549,360	548,737	549,698	550,659

Table 4. Total Orange County Water Demand Under Average Weather and Mid Scenario Growth

The total water demand for all of Orange County is forecasted to increase from 525,704 AFY in 2020 to 550,659 AFY in 2050.

Figure 5 presents the historical and forecasted water demand over time for the total Orange County area under average weather and for all three scenarios of CII growth.

![](_page_6_Figure_1.jpeg)

Figure 5. Total Orange County Water Demand Forecast Under Average Weather

For comparison, the previous water demand used for the 2014 Orange County Water Reliability Study was approximately 580,000 AFY in 2050. Which compares closely with the demands under the High Scenario of CII growth for this forecast of 579,500 AFY. However, the Mid Scenario demand forecast is about 30,000 AFY lower than the 2014 forecast in 2050.

## Weather Variability and Long-Term Climate Change Impacts

In any given year water demands can vary substantially due to weather. In addition, long-term climate change can have an impact on water demands into the future. For the 2014 OC Water Reliability Study, CDM Smith developed a robust statistical model of total water monthly production from 1990 to 2014 from a sample of retail water agencies. This model removed impacts from population growth, the economy and drought restrictions in order to estimate the impact on water use from temperature and precipitation.

The results of this statistical analysis are:

- Hot/dry weather demands will be 5.5% greater than current average weather demands
- Cooler/wet weather demands will be 6% lower than current average weather demands
- Climate change impacts will increase current average weather demands by:
  - o 2% in 2030
  - $\circ \quad 4\% \text{ in } 2040$
  - o 6% in 2050

Figure 6 presents the water demand forecast for the total Orange County area under the High Scenario showing climate change impacts and year-to-year weather variability. This forecast represents the likely higher-end range of future water demands.

![](_page_7_Figure_1.jpeg)

Figure 6. Total Orange County Water Demand Forecast Under High Scenario with Climate Change

# **Comparison with Retail Agency Specified Demand Forecasts**

At the start of this effort, MWDOC and OCWD committed to use retail water agency generated water demand forecasts for official reporting purposes (i.e., MWDOC's 2020 UWMP) if agencies decided not to use CDM Smith's methodology. As stated earlier, six retail water agencies either provided their own water demand forecast or made significant modifications to CDM Smith's methodology such that it was no longer considered uniform.

Table 5 compares the water demand forecast generated using CDM Smith's methodology applied uniformly across all retail agencies with a forecast that represents a combination of agency-generated forecasts (for the six retail agencies that supplied them) along with CDM Smith's methodology applied to the rest of the retail agencies for MWDOC and OCWD service areas.

Table 5. Comparison of Water Demand Forecast	Under Average Weather without Climate Change
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	Ν	MWDOC Service Are	а	OCWD Service Area			
	CDM Smith			CDM Smith			
	Method	CDM Smith +		Method	CDM Smith +		
	Uniformly	Agency Provided		Uniformly	Agency Provided		
Year	Applied	Method	Difference	Applied	Method	Difference	
Act. 2020	409,025	409,025	NA	387,317	387,317	NA	
2025	413,738	431,130	(17,392)	387,726	400,460	(12,734)	
2030	423,584	440,341	(16,757)	398,705	412,568	(13,863)	
2035	426,978	446,398	(19,420)	399,475	415,973	(16,498)	
2040	425,694	445,870	(20,176)	399,613	417,371	(17,758)	
2045	425,923	445,778	(19,855)	400,656	418,308	(17,652)	
2050	426,151	445,416	(19,265)	401,699	418,973	(17,274)	

The difference between the CDM Smith method applied uniformly to all agencies vs the CDM Smith method plus agency provided forecast is between 4.3 and 4.5 percent by 2050, certainly within the reasonable range of error.