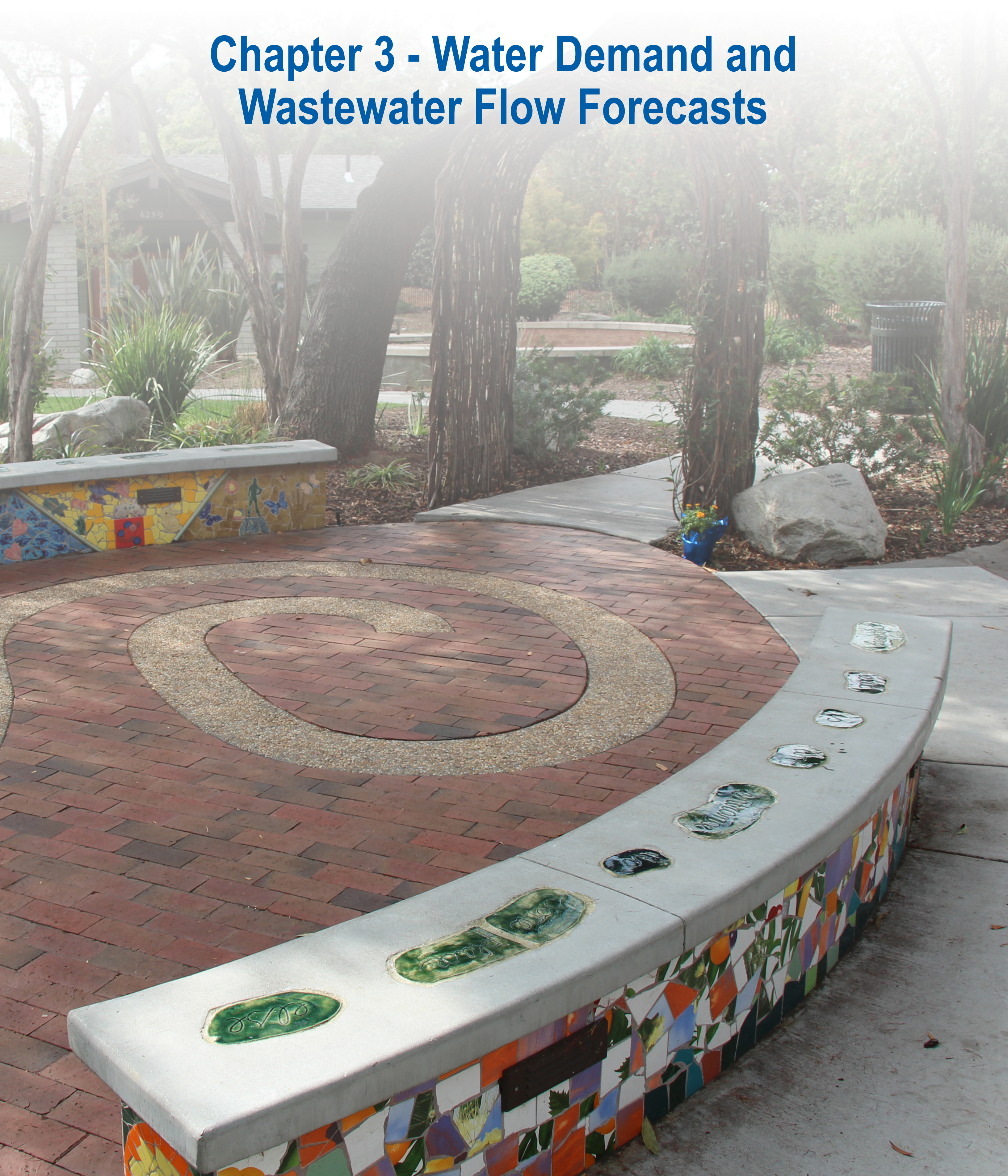
Chapter 3 - Water Demand and Wastewater Flow Forecasts



Chapter 3

WATER DEMAND AND WASTEWATER FLOW FORECASTS

This chapter summarizes the existing and projected demand and flow forecasts for the potable water, recycled water, and wastewater water systems through year 2050.

3.1 Potable Water Demands

This section describes the City's existing and projected potable water demand. The existing water demand section consists of a discussion of the historical water consumption and un-accounted for water. The future water demand section consists of a description of per-capita water use, water demand factors, and water demand projections through year 2050. The ongoing water conservation measures and the anticipated impacts these measures will have on the City's future water demands are described, along with potable water peaking factors. Water supply sources are discussed in more detail in Chapter 5.

3.1.1 Existing and Historical Water Demands

Water demand consists of water that leaves the distribution system through metered and unmetered connections (such as fire hydrants). Additional unmetered flows contributing to water demand include maintenance flushing, reservoir cleaning, leaks at pipe joints, or breaks. The City meters all of their customer accounts. A description of historical water consumption and the estimated amount of water loss or unaccounted for water is presented below.

3.1.1.1 Historical Potable Water Consumption

The City provided historical customer billing records by customer class for fiscal year 2016 and for calendar year 2019. While total water demand varied between these years, the proportion of total water demanded by each customer class stayed relatively constant. The historical water use is summarized in acre-feet per year (afy) by billing classification in Table 3.1 and presented graphically in Figure 3.1. As shown in Figure 3.1, single-family residential demands account for the majority (56 percent) of the City's demands. Together with multi-family residential demands (31 percent), the residential water use comprises of 87 percent of the City's total water demand. Commercial water use accounts for the next largest category, representing 10 percent. Government users accounted for 3 percent of total water use, while irrigation / landscape and private fire / hydrant uses each make up less than 1 percent of annual consumption.

Table 3.1 Historical Annual Consumption by Customer Class

Customer Class	Percent of Total[(1)]	Demand (afy) [(2)]
Single Family Residential	56%	1,805
Multi-Family Residential	31%	1,036
Commercial	10%	377
Government	3%	73
Irrigation / Landscape	<1%	6
Private Fire / Hydrant	<1%	2
Total	**-**	**3,299**

Notes:

(1) Customer class percentage is an average of two time periods: fiscal year 2015/2016 and calendar year 2019.

(2) Demand by customer class has applied the customer class average percentage to average total demand from 2014 to 2019 to find average demand by customer class.

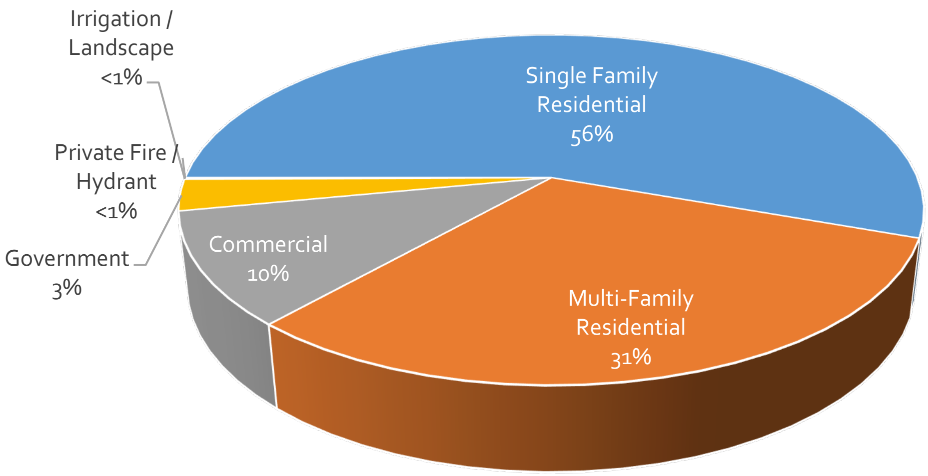


Figure 3.1 Historical Annual Consumption by Customer Class

3.1.1.2 Unaccounted-For Water

The difference between water supply and consumption (billed to customers) is defined as water loss, which is also referred to as non-revenue water. Water loss may be attributed to leaking pipes, unmetered or unauthorized water use, inaccurate meters, tank overflows, hydrant testing, system flushing, reservoir cleaning, and firefighting. The City's estimated historical water loss based on fiscal year 2015/2016 is summarized in Table 3.2.

Table 3.2 Historical Water Loss

Year	Demand (afy)	Supply (afy)	Water Loss	
			(afy)	(%)
2015/2016	3,317	3,047	270	8.1%

The water loss for well-operated systems is typically less than 10 percent. As shown in Table 3.2, the City's estimated historical water loss is 8.1 percent. This is within the generally accepted range of water loss for a well-operated system.

3.1.2 Demand Forecast

Both population-based and land-use based methods were used to forecast water demand through 2050. Population-based demand forecasting utilizes a calculated per-capita water use, while land-use-based demand forecasting is based on water use by customer class.

3.1.2.1 Population-Based Demand Forecasting

An average per-capita water use expressed in gallons per capita per day (gpcd) was developed using historical service area population and water use and is presented in Table 3.3.

Table 3.3 Historical Per Capita Water Use

Year	Estimated Service Area Population(1)	Total Water Supply(2) (mgd)	Per Capita Use (gpcd)
1990-1991	23,900	4.0	169
1991-1992	23,796	3.8	159
1992-1993	23,888	4.0	166
1993.1994	23,869	4.1	173
1994-1995	23,677	4.2	177
1995-1996	23,870	4.4	186
1996-1997	23,775	4.6	195
1997-1998	23,777	4.1	174
1998-1999	23,880	4.6	191
1999-2000	24,021	4.7	196
2000-2001	24,268	4.6	189
2001-2002	24,592	4.7	190
2002-2003	24,865	4.5	179
2003.2004	25,078	4.5	180
2004-2005	25,264	3.9	153
2005-2006	25,376	4.4	172
2006-2007	25,312	4.9	192
2007-2008	25,324	4.5	179
2008-2009	25,358	4.5	179
2009-2010	25,486	4.2	166
2010-2011	25,596	3.9	153
2011-2012	25,722	4.0	154
2012-2013	25,820	4.1	158
2013.2014	25,933	4.1	157
2014-2015	26,188	3.4	132
2015-2016	26,369	3.0	112
2016-2017	26,337	3.1	117
2017-2018	26,315	3.4	128
2018-2019	26,276	3.2	120
Average (1990-2019)	**N/A**	**4.1**	**165**
Average (2014-2019)	**N/A**	**3.2**	**122**

Notes:

(1) Source: Historical population values are from Report E-4, California Department of Finance, Table 2.

(2) Total water supply obtained from City production records includes both consumption and unaccounted-for-water.

As shown in Table 3.3, the City's per capita water use decreased significantly in recent years. The 1990 to 2019 average water use was 165 gpcd, but 2014 to 2019 average water use was 122 gpcd. This reduction in per capita water use is likely due to increased conservation triggered by the state-wide drought and the City's water conservation programs.

Demand was projected through 2050 by multiplying projected population by projected per capita water use. As described in Section 2.4.2, population is expected to increase from the current population of 26,000 to approximately 27,500 by 2050 using SCAG projections or is expected to increase to a population of approximately 32,400 by 2050 accounting for the RHNA required housing additions. Multiplying this population projection by the recent 5-year average per capita water use of 122 gpcd results in the projection shown in Table 3.4. Overall demand is expected to increase as population increases when not accounting for additional water conservation.

Table 3.4 Population- Based Demand Projection through 2050

Year	SCAG Population	Demand (afy)[2]	RHNA Population	RHNA Demand (afy)[2]
Existing[1]	26,300	3,590	26,300	3,590
2020	26,000	3,549	26,000	3,549
2025	26,200	3,581	28,900	3,938
2030	26,500	3,613	31,200	4,258
2035	26,700	3,645	31,500	4,295
2040	**27,100**	**3,700**	**31,900**	**4,359**
2045	27,300	3,728	32,200	4,393
2050	**27,500**	**3,757**	**32,400**	**4,427**

Notes:
(1) 2014-2018 Average.
(2) Projected demand does not include future conservation and assumes a constant per capita water use of 122 gpcd.

3.1.2.2 Land Use-Based Demand Forecast

Land use-based demand forecasting considers water demand for each of the customer classes described in Section 3.1.1.1.

Residential Demand

Future residential demand has been estimated using the current and future number of housing units in the City's service area. As of 2018, there were 11,157 housing units in the City. Per the City's General Plan, 589 additional units, or a 5 percent increase in residential units, are planned by 2040. This growth rate of approximately 28 housing units per year has been extrapolated out to 2050 to project a total of 12,026 housing units in 2050. The alternative scenario that considers the RHNA requirement to add 2,062 housing units by 2029 results in a sharp 18 percent increase in residential units by 2029. Assuming that population continues to grow at the 0.2 percent annual increase projected by SCAG after 2029 through 2050, an additional 566 housing units would be added resulting in a total of 13,785 housing units by 2050. Current demand per housing unit is approximately 0.25 afy.

Commercial Demand

Commercial demand is made up of office and retail uses. According to the City's General Plan, there is currently 1,256,000 square feet (sq. ft.) of office and retail space in the City. The General Plan estimates that office and retail space will increase by an additional 430,000 sq. ft., or 34 percent, by 2040. This growth rate of approximately 21,500 sq. ft. per year has been extrapolated out to 2050 for a total of 1,901,000 sq. ft. in of commercial space in 2050. The average water demand for commercial space is approximately 0.3 afy per 1,000 sq. ft. This unit demand is expected to stay constant over time. Commercial demand is assumed to be the same in the General Plan growth scenario and in the RHNA growth scenario.

Other Demand

Government, irrigation, and fire uses make up less than 3 percent of total demand. These demands are expected to stay constant over time in both the General Plan growth scenario and the RHNA growth scenario. Water loss is also assumed to stay at a constant rate of 8.1 percent over time.

Potable Water Demand Forecast

The assumptions methodology described above produces the projections summarized in Table 3.5. Residential demands increase as population grows gradually in the General Plan growth scenario and more drastically in the RHNA growth scenario. Commercial demands increase as commercial space increases. Other demands stay constant. Total demand is expected increase from the current demand of 3,590 afy to 4,011 afy in 2050 under the General Plan growth scenario, which equates to a 12 percent increase. Under the RHNA growth scenario, total demand is expected to increase to 4,495 afy, which equates to a 25 percent increase.

Table 3.5 Land Use-Based Demand Projection – General Plan

Year	Residential Demand (afy)	Commercial Demand (afy)	Other Demand (afy)	Water Loss (afy)	Total Demand (afy)
Existing[(1)]	2,841	377	81	291	3,590
General Plan Growth Scenario					
2020	2,848	383	81	268	3,580
2025	2,884	414	81	274	3,652
2030	2,919	444	81	279	3,724
2035	2,955	475	81	284	3,796
2040	**2,991**	**506**	**81**	**290**	**3,867**
2045	3,027	536	81	295	3,939
2050	**3,062**	**567**	**81**	**301**	**4,011**
RHNA Growth Scenario					
2020	2,841	383	81	268	3,572
2025	3,103	414	81	291	3,889
2030	3,373	444	81	316	4,214
2035	3,406	475	81	321	4,283
2040	**3,441**	**506**	**81**	**326**	**4,354**
2045	3,475	536	81	332	4,424
2050	**3,510**	**567**	**81**	**337**	**4,495**

Note:
(1) 2014-2018 Average.

Comparison of Demand Forecast Methodologies

The results of both demand forecast methodologies and both growth scenarios are shown in Figure 3.2. Both methodologies show that demand is expected to stay relatively constant under the General Plan growth scenario whereas demand increases are more significant under the RHNA growth scenario. The General Plan growth scenario land use-based methodology predicts slightly higher demand as it considers water uses separately, and commercial growth (34 percent) is expected to outpace residential growth (5 percent) according to the City's General Plan through 2040. Conversely, the population-based methodology assumes that all demands will increase proportionally with population, so it may undercount increases in future commercial demands. Both methodologies for the RHNA scenario are driven by the sharp increase in residential units before 2029 so project similar levels of demand in 2050.

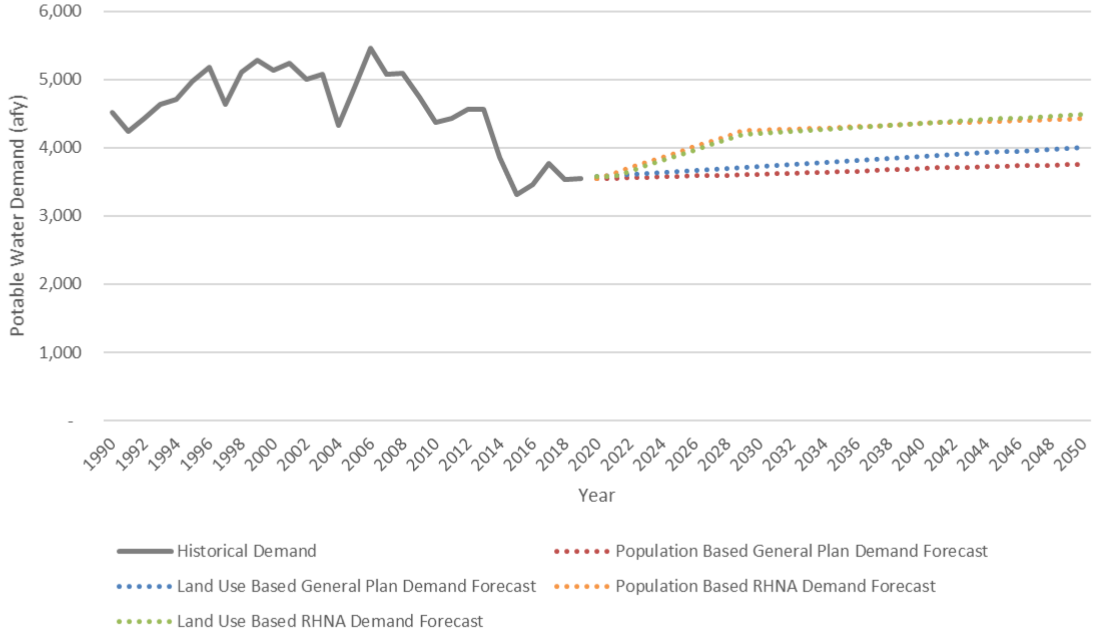


Figure 3.2 Historical and Projected Demand

3.1.3 Water Conservation

The City has significantly reduced total water use over the past five years in response to state and local voluntary and mandatory restrictions following to the statewide drought of 2012 through 2015. In 2015, the City revised its Conservation Ordinance to include a water shortage contingency plan and various restrictions to permanently promote conservation, which has led to lasting water use changes. Per capita water use has dropped from a long-term average of 165 gpcd to an average of 122 gpcd over the past five years, which reflects a 26 percent decrease. The City has ongoing demand management measures to encourage conservation, which are described in the City's 2015 Urban Water Management Plan:

- Water waste prevention ordinances.
- Metering at water service connections.
- Conservation pricing.
- Public education and outreach.

- Programs to assess and manage distribution system real loss.
- Water Conservation program coordination and staffing support.

Although the City has significantly reduced water demand in recent years, further conservation is required under the state-wide indoor residential standard defined in Assembly Bill (AB) 1668 and Senate Bill (SB) 606. This standard requires indoor residential water use to decrease to 55 gpcd by 2025 and to 50 gpcd by 2030. The City's 2017 *Water and Wastewater Rate Study* estimated that current indoor residential water use is approximately 60 gpcd. Thus, indoor residential water use must be reduced by 5 gpcd over the next five years and by 10 gpcd by 2030.

Incorporating this conservation into both the population-based and land use-based demand projections for the General Plan growth scenario results in a slight decrease in total demand through 2030 followed by a slight increase in demand through 2050, as shown in Table 3.6 and Figure 3.3. For the RHNA growth scenario, incorporating conservation in projections results in a more gradual demand increase through 2030, as shown in Table 3.6 and Figure 3.4. Incorporating conservation into demand projections results in an 8 percent reduction in total demand in 2050 compared to the projections that do not include additional conservation.

Table 3.6 Population-Based and Land Use-Based Demand Projections

Year	Population-Based Demand Projection (afy)		Land Use-Based Demand Projection (afy)		Conservation (% of Total Demand)
	Without Conservation	With Conservation	Without Conservation	With Conservation	
Existing[1]	3,590	3,590	3,590	3,590	-
General Plan Growth Scenario					
2020	3,549	3,549	3,580	3,566	1%
2025	3,581	3,434	3,652	3,498	4%
2030	3,613	3,316	3,724	3,413	8%
2035	3,645	3,346	3,796	3,481	8%
2040	**3,700**	**3,396**	**3,867**	**3,549**	**8%**
2045	3,728	3,422	3,939	3,617	8%
2050	**3,757**	**3,448**	**4,011**	**3,685**	**8%**
RHNA Growth Scenario					
2020	3,549	3,549	3,572	3,550	1%
2025	3,939	3,777	3,889	3,743	4%
2030	4,258	3,908	4,214	3,894	8%
2035	4,295	3,942	4,283	3,961	8%
2040	**4,359**	**4,001**	**4,354**	**4,028**	**8%**
2045	4,393	4,032	4,424	4,095	8%
2050	**4,427**	**4,063**	**4,495**	**4,163**	**8%**

Notes:
(1) 2014-2018 Average.

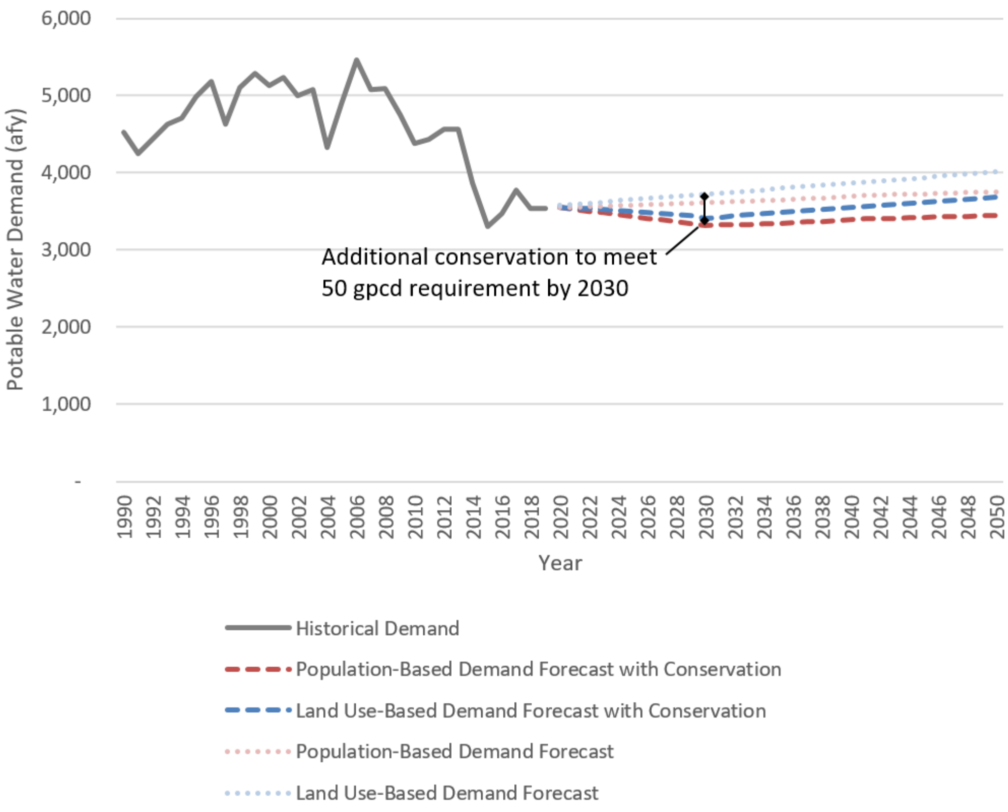


Figure 3.3 Population-Based and Land Use-Based General Plan Demand Projections With and Without Conservation

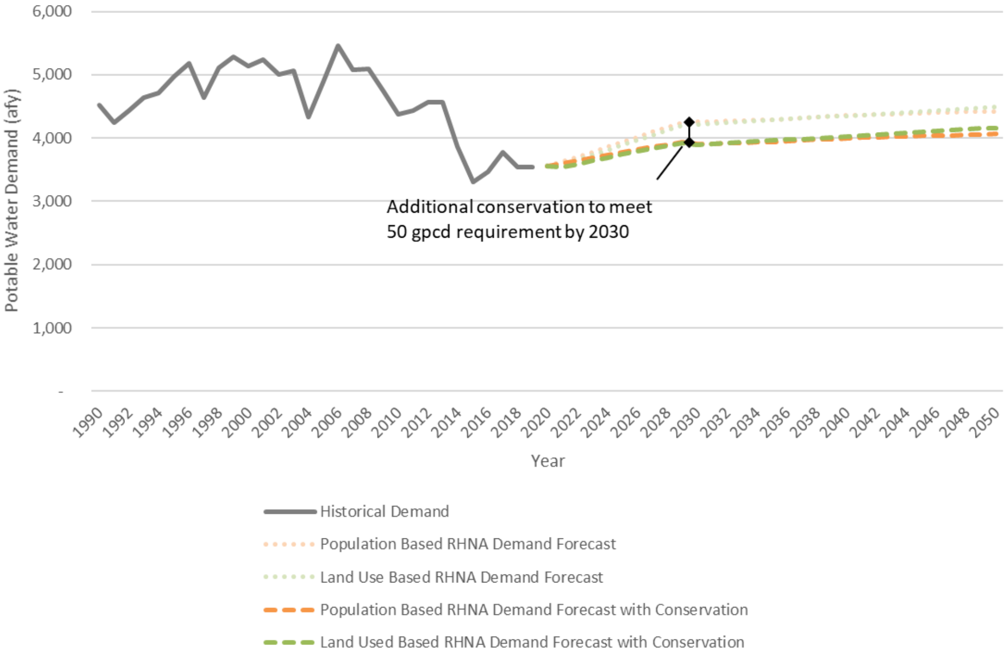


Figure 3.4 Population-Based and Land Use-Based RHNA Demand Projections With and Without Conservation

3.1.4 Recommended Demand Forecasts

For the purposes of this Plan, the General Plan and RHNA growth scenarios that use land use-based demand projections including conservation are recommended as a basis for future system analysis and sizing of recommendations. These projections incorporate the expected growth in commercial demand, as described in the City's General Plan, and also includes the mandatory, state-wide conservation measures for indoor residential water use. These projections are shown in Table 3.7 and Figure 3.5 and form the foundation of the future water demand scenarios that are modeled in Chapter 6 of this Plan.

Table 3.7 Recommended Demand Forecasts

Year	General Plan Forecast	RHNA Forecast
Existing(1)	3,590	3,590
2020	3,566	3,550
2025	3,498	3,743
2030	3,413	3,894
2035	3,481	3,961
2040	**3,549**	**4,028**
2045	3,617	4,095
2050	**3,685**	**4,163**

Note:
(1) 2014-2018 Average.

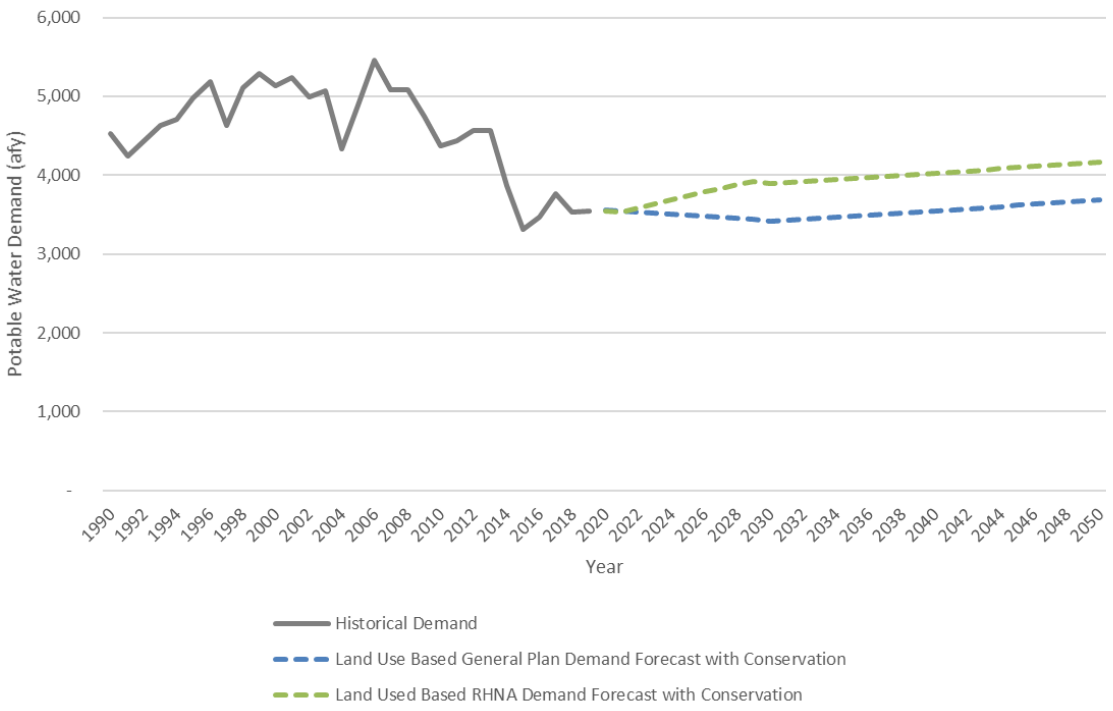


Figure 3.5 Recommended Demand Forecasts

3.1.5 Potable Water Peaking Factors

Peaking Factors (PF) are typically used to determine the water demands for conditions other than average day demand (ADD) conditions. Peaking factors account for fluctuations in demands on a seasonal or hourly basis. For example, during hot summer days, water use is typically higher than on a colder winter day due to increased irrigation demands.

Common PFs include factors for MDD and MinDD conditions. PFs are determined using the water system demands for a selected period and dividing the quantity by the ADD. The MDD factor, for example, is determined by comparing the water demands for the day of the year with the highest daily water demand to the ADD.

The peaking factors determined in this report include:

- Monthly Peaking Factors.
- Daily Peaking Factors.

These PFs not only reflect a different time scale but are often calculated using different data sources. The City's PFs and data used to establish these are discussed below.

3.1.5.1 Monthly Peaking Factors

Monthly PFs represent the seasonal demand variation on a monthly basis, such as the MMD and MinMD factors. In the absence of daily production data for an entire calendar year, these factors can be established using monthly production summaries or historical billing data. The City's monthly peaking factors based on historical monthly production are summarized in Table 3.8.

Table 3.8 Monthly Peaking Factors

Year	ADD	MMD	MinMD	MMD		MinMD	
	(mgd)	Month	Month	(mgd)	PF	(mgd)	PF
2009	4.4	Sept	Feb	5.4	1.2	3.2	0.7
2010	4.0	Aug	Feb	5.1	1.3	2.8	0.7
2011	3.9	Aug	Mar	5.0	1.3	3.0	0.8
2012	4.0	Aug	Dec	5.2	1.3	2.8	0.7
2013	4.1	Sept	Jan	5.0	1.2	3.0	0.7
2014	3.8	Jul	Dec	4.5	1.2	2.5	0.6
2015	3.1	Aug	Jan	3.5	1.1	2.7	0.9
2016	3.1	Jul	Jan	3.6	1.2	2.4	0.8
2017	3.3	Jul	Jan	4.0	1.2	2.0	0.6
2018	3.4	Aug	Mar	4.3	1.3	2.4	0.7
2019	3.0	Aug	Feb	3.9	1.3	2.0	0.7
Average (2009-2019)	**3.6**	**Jul-Sept**	**Dec-Mar**	**4.5**	**1.2**	**2.6**	**0.7**
Average (2015-2019	**3.2**	**Jul-Aug**	**Jan-Mar**	**3.9**	**1.2**	**2.3**	**0.7**
Recommended PFs(2)				**N/A**	**1.3**	**N/A**	**0.6**

Notes:
(1) Historical production data provided by City.
(2) For conservative planning purposes, the recommended PFS for MMD and MinDD are based on the maximum and minimum values observed in the last 10 years, respectively.

As shown in Table 3.8, the MMD typically occurs between July and September when temperatures are high, while the MinMD typically occurs between December and March when temperatures are lower. The calculated average peaking factors for MMD and MinMD conditions based on historical production data are 1.2 and 0.7, respectively. These factors represent slightly lower seasonal variation than other water agencies in Southern California. This is likely due to the City's relatively consistent weather year-round and thus continued irrigation in the winter months as well as warmer summer months.

3.1.5.2 Daily Peaking Factors

Historical supply records are typically used to determine the seasonal demand factors, such as MDD and MinDD. The MDD PF represents the ratio of the largest daily demand observed in one year to the ADD for the same year. This factor can then be applied to the ADD of future planning years to project MDD. The estimated MDD is commonly used to establish water supply, storage, and pumping capacity requirements. The PFs calculated in this section should be reevaluated prior to designing the facilities.

Daily water production data for 2019 was provided by the City. The City's 2019 MDD PF was derived by dividing the maximum day production by the average day. Likewise, the MinDD PF was established by dividing the minimum day production by the average day production. The City's MDD and MinDD as well as PFs are summarized in Table 3.9. As shown in Table 3.9, the calculated MDD and MinDD PFs are 1.5 and 0.6, respectively.

Table 3.9 Daily Peaking Factors

Year	ADD (mgd)	Day of MDD	Day of MinDD	MDD		MinDD	
				(mgd)	PF	(mgd)	PF
2019	3.0	July 22	Feb 14	4.4	1.5	1.8	0.6

Note:
(1) Historical production data provided by City.

For the purpose of this Plan, the existing demands are considered to be the average of years 2014 through 2019 and the future demands are projected for both growth scenarios using the land use-based methodology incorporating conservation presented above. The existing and future demands used for this analysis are summarized in Table 3.10.

Table 3.10 Existing and Future Potable Water Demands

Phase	ADD (mgd)	MMD(1) (mgd)	MDD(2) (mgd)
Existing (2014-2019 Average)	3.20	3.88	4.65
Near-Term (year 2025) General Plan Growth Scenario	3.12	4.06	4.68
Long-Term (year 2050) General Plan Growth Scenario	3.29	4.28	4.93
Near-Term (year 2025) RHNA Growth Scenario	3.34	4.34	5.01
Long-Term (year 2050) RHNA Growth Scenario	3.72	4.83	5.57

Notes:
(1) MMD PF for future planning years is assumed to be 1.3 per Table 3.8.
(2) MDD PF for future planning years is assumed to be 1.5.

3.2 Recycled Water

This section presents a discussion on the estimated existing and future recycled water demand.

3.2.1 Existing Recycled Water Demand

The City currently does not have a recycled water system.

3.2.2 Future Recycled Water Demand Projection

Future potential recycled water customers have been identified as current large water users that have a significant amount of outdoor water use that could be converted to recycled water. These customers include parks, schools, transit authorities, a golf course, and an equestrian center. Other large water users, such as multi-family apartment complexes, were considered but not included as potential recycled water customers because most of their water demand was determined to be for indoor use. South Pasadena High School and South Pasadena Middle School were not included as potential customers as they use artificial turf for their sports fields and have low other irrigation needs. The Monterey Hills Elementary school was not included due to the limited amount of irrigation demand and undesired topography, requiring significant pumping for an isolated customer.

Future potential recycled water demands have been developed by identifying these users' historical potable water use and estimating the portion of that use that could be converted to recycled water. Parks without large buildings, transit authorities, the equestrian center, and the golf course were assumed to be able to convert 95 percent of their current potable water demand to recycled water. Finally, schools and parks that also include large buildings were assumed to be able to convert 50 percent of their water demand to recycled water.

These potential recycled water users and their potential recycled water demand are shown Table 3.11. As shown, the total potential recycled water demand is estimated to be 176 afy. The largest potential recycled water user is the Arroyo Seco Golf Course, which has an estimated demand of 111.5 afy.

It should be noted that the future demands described herein do not necessarily represent the actual future demands. This section is limited to identifying the future demand potential. The recycled water system feasibility analysis described in Chapter 7 concludes with a recommendation for potential recycled water system alignment that only serves a portion of these customers. Hence, the demand listed in Table 3.11 is considered the maximum future recycled water demand.

Table 3.11 Potential Recycled Water Demand

User	2015 -2016 Potable Use (afy)	Recycled Water Factor	Estimated Recycled Water Demand (afy)
Arroyo Seco Golf Course	117.4	95%	111.5
Caltrans along 110 -1(1)	7.4	95%	7.0
Caltrans along 110 -2(1)	6.7	95%	6.4
Caltrans along 110 -3(1)	5.4	95%	5.2
Caltrans along 110 -4(1)	4.3	95%	4.1
Arroyo Park North	8.6	95%	8.2
Arroyo Park South	8.6	95%	8.2
Garfield Park	8.3	95%	7.8
San Pascual Equestrian Center	8.1	95%	7.7
Marengo Elementary	5.9	50%	2.9
Metro MTA	3.8	95%	3.6
Arroyo Vista Elementary	2.4	50%	1.2
Eddie Park	0.8	95%	0.8
Orange Grove Park	0.6	95%	0.6
Library Park	0.2	50%	0.1
War Memorial Park	0.2	50%	0.1
Total	**189**	**-**	**176**

Note:
(1) Caltrans is separated into multiple potential users corresponding with different irrigation areas along Interstate 110.

3.2.3 Recycled Water Peaking Factors

Similar to potable water, PFs are used to estimate recycled water demands for conditions other than average annual demand conditions. PFs are used to account for fluctuations in demands on a seasonal and hourly basis.

Since the City currently bills customers on a bi-monthly basis, only MMD peaking factors could be estimated from existing customer data. Using the 2015/2016 billing data available for the potential customers shown in Table 3.11, a MMD peaking factor of 1.7 was calculated using the ratio of maximum month demand (September) to average annual demand. To account for the difference between MMD and MDD, this peaking factor was increased by 20 percent to 2.0.

For future system sizing, the MDD peaking factor needs to be multiplied by a Peak Hour Demand (PHD) peaking factor. Assuming that the City would implement a demand management program to spread the recycled water usage over an 8-hour period, the PHD/MDD peaking factor is 3.0 (24/8). Hence, the net PHD/ADD peaking factor used for system analysis and system sizing is 6.0 (2.0 * 3.0). Applying these peaking factors to the total potential recycled water demand results in the values shown in Table 3.12.

Table 3.12 Total Potential Recycled Water Demand Including Peaking Factors

Total Demand (afy)	ADD (mgd)	MMD (mgd)	MDD (mgd)	PHD (mgd)
176	0.16	0.27	0.31	0.94

3.3 Wastewater

This section describes the City's existing and projected wastewater flows. This section includes a discussion of the various flow components present in wastewater. The existing wastewater flow section summarizes the current flows generated within the City's sewer service area, and the future wastewater flow section consists of the wastewater flow projections through 2050.

3.3.1 Existing Wastewater Flow

The City discharges its wastewater into LA County Sanitation District's trunk sewers at multiple locations. There are no flow meters that record this flow nor are there other records that can be used to calculate the City's wastewater flow. Thus, existing wastewater flow has been estimated as a proportion of the City's water use.

3.3.1.1 Average Dry Weather Flow

The average dry weather flow (ADWF) is the average flow that occurs on a daily basis during the dry weather season, with no evident reaction to rainfall. The ADWF includes wastewater flow generated by the City's residential, commercial, and government users. As described in Section 3.1 of this Plan, these water uses make up over 99 percent of the City's total water use. As the other water uses, irrigation and fire, make up less than 1 percent of total water use and are mostly consumed via outdoor uses, this analysis assumes that those water uses do not contribute to wastewater flow.

The City's 2017 *Water and Wastewater Rate Study* estimated that current indoor residential water use is approximately 60 gpcd and all of this indoor water use is eventually converted into wastewater flows. This is a reasonable assumption as it accounts for slightly over half of the residential per capita water use of approximately 102 gpcd. This proportion of indoor vs outdoor water use is similar to those of other water agencies.

The *Water and Wastewater Rate Study* also estimates that 80 percent of commercial water use is carried through to the wastewater collection system. This is also a reasonable assumption as many commercial areas do not have outdoor areas that require irrigation and thus the majority of commercial water is used indoors.

Billing data from fiscal year 2015/2016 indicates that park irrigation accounts for approximately 67 percent of government water use. The remaining government water use is assumed to carry water through to the wastewater collection system at the same rate as commercial water use, 80 percent.

Applying the 60 gpcd indoor water use factor to the existing population of 26,297 results in a total residential wastewater flow of 1.58 mgd. Applying the 80 percent indoor water use factor to the current commercial water demand of 377 afy yields a total commercial wastewater flow of 0.27 mgd. Currently government demand is 73 afy. Assuming 67 percent of this water is used for parks, applying the 80 percent indoor water use factor to the remaining demand yields a total government wastewater flow of 0.02 mgd. The combined estimated ADWF is 1.86 mgd.

3.3.1.2 Peak Wet Weather Flow

The peak wet weather flow (PWWF) is the highest hourly flow that occurs during the wet weather season. The PWWF is typically used for designing the capacity of the sewer system. Without the ability to calculate PWWF from flow data, a wet weather peaking factor of 2.5 is recommended based on other wastewater systems in Southern California. Thus, the combined estimated PWWF is 4.66 mgd.

3.3.2 Projected Wastewater Flows

As described in Section 3.1 in this Plan, commercial and residential water demands are expected to change slightly between 2020 and 2050. Commercial water demand is expected to increase as more commercial space is developed. Residential demand is expected to decrease through 2030 to meet statewide conservation requirements and then increase through 2050 as population grows under the General Plan growth scenario and is expected to sharply increase through 2030 and then level off through 2050 under the RHNA growth scenario. These changes are reflected in wastewater flow projections; commercial wastewater flow is expected to steadily increase under both growth scenarios while residential wastewater demand is expected to decrease through 2030 as indoor residential use decreases from 60 gpcd to 50 gpcd and then increase between 2030 and 2050 as population grows under the General Plan growth scenario. Under the RHNA growth scenario, residential wastewater flow is expected to stay constant through 2050 as growth and conservation balance out. Government wastewater demand is expected to stay constant through 2050 under both growth scenarios.

Projections for ADWF and PWWF are shown in Figure 3.6 and Table 3.13.

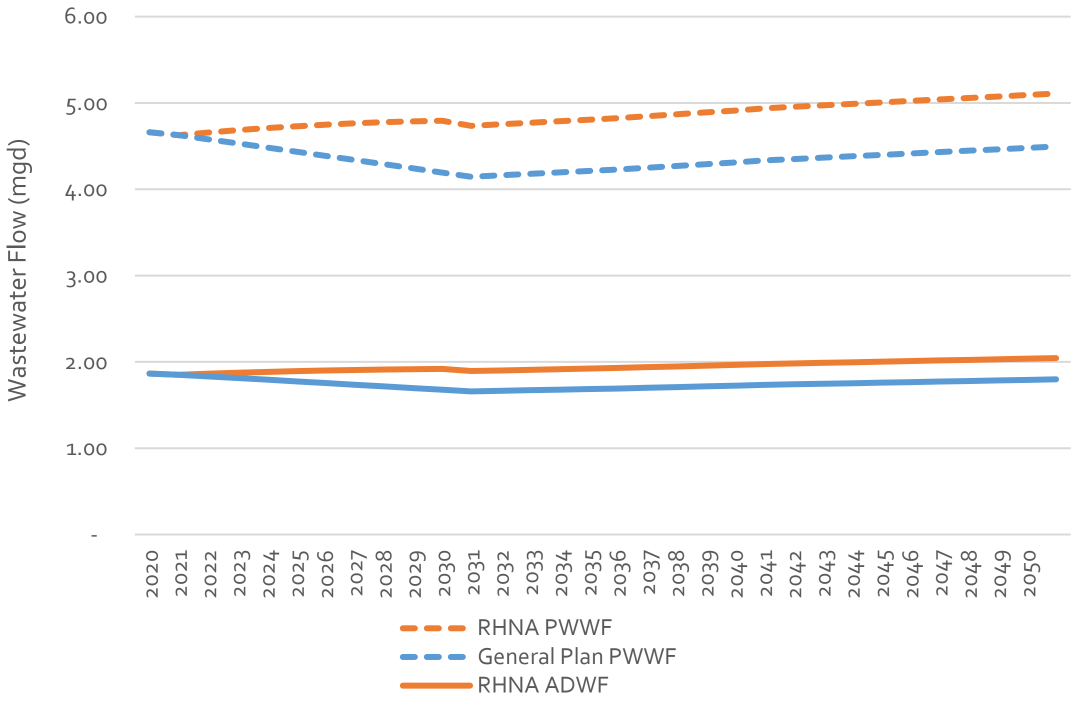


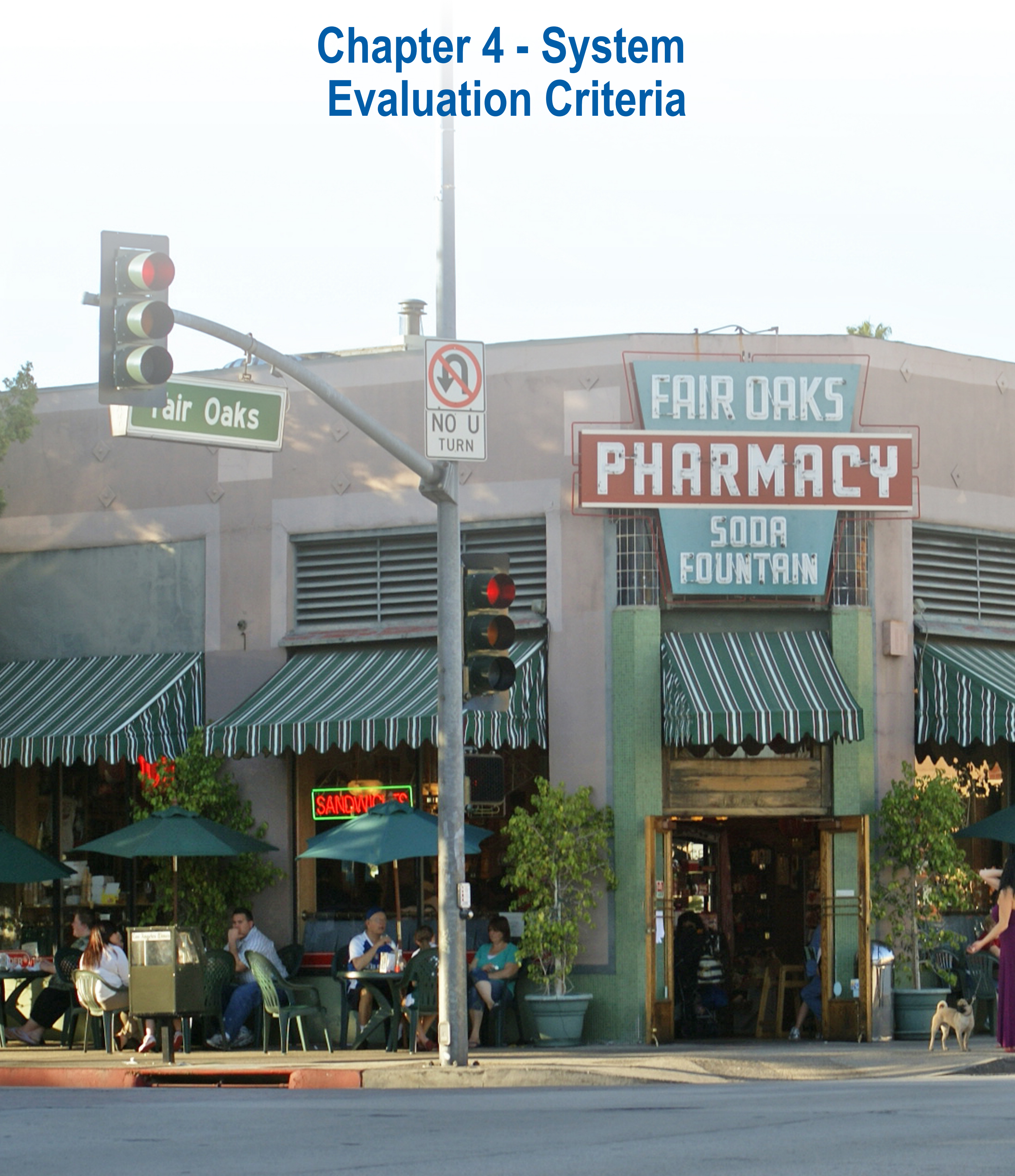
Figure 3.6 Projected Wastewater Flows

Table 3.13 Projected Wastewater Flows

Year	Population	Indoor Residential Water Use (gpcd)	Residential Wastewater Flow (mgd)	Commercial Water Use (mgd)	Commercial Wastewater Flow (mgd)	Government Water Use (mgd)	Government Wastewater Flow (mgd)	Total ADWF (mgd)	PWWF (mgd)
Existing (1)	26,300	60	**1.58**	0.34	0.27	0.03	0.02	**1.86**	**4.66**
General Plan Growth Scenario									
2020	26,000	60	**1.56**	0.34	0.27	0.03	0.02	1.85	4.63
2025	26,200	55	**1.44**	0.37	0.30	0.03	0.02	1.76	4.39
2030	26,500	50	**1.32**	0.40	0.32	0.03	0.02	1.66	4.14
2035	26,700	50	**1.34**	0.42	0.34	0.03	0.02	1.69	4.23
2040	27,100	50	**1.36**	0.45	0.36	0.03	0.02	1.73	4.33
2045	27,300	50	**1.37**	0.48	0.38	0.03	0.02	1.77	4.41
2050	27,500	50	**1.38**	0.51	0.41	0.03	0.02	1.80	4.50
RHNA Growth Scenario									
2020	26,000	60	1.56	0.34	0.27	0.02	0.02	1.85	4.63
2025	28,900	55	1.59	0.37	0.30	0.02	0.02	1.90	4.75
2030	31,200	50	1.56	0.40	0.32	0.02	0.02	1.89	4.73
2035	31,500	50	1.57	0.42	0.34	0.02	0.02	1.93	4.82
2040	31,900	50	1.60	0.45	0.36	0.02	0.02	1.97	4.94
2045	32,200	50	1.61	0.48	0.38	0.02	0.02	2.01	5.02
2050	32,400	50	1.62	0.51	0.41	0.02	0.02	2.04	5.11

Note:
(1) 2014-2018 Average.

Chapter 4 - System Evaluation Criteria



Chapter 4

SYSTEM EVALUATION CRITERIA

This chapter presents the planning criteria and methodologies for the analysis used to evaluate the existing potable water system, wastewater system, and recycled water systems and the associated facilities to identify existing system deficiencies and size future improvements and expansions. The planning criteria are used in the existing and future system analyses presented in Chapters 6 Potable Water System Analysis, Chapter 7 Recycled Water System Feasibility Analysis, and Chapter 8 Wastewater Collection System Analysis and to define capital improvement projects in Chapter 10.

4.1 Potable Water System Evaluation Criteria

The City's water system is evaluated under a range of normal and emergency operating conditions and demand scenarios. The normal operating conditions are:

- Average Day Demand (ADD).
- Peak Hour Demand (PHD).
- Maximum Day Demand (MDD).
- MDD Plus Fire Flow (MDD+FF).

Distribution system evaluation criteria are required to determine the performance of the City's water system under the range of operating conditions as discussed above and to identify system deficiencies and improvement projects. Under each operating condition, the capacities and performance of the water system are compared to the evaluation criteria to determine which pipelines or water facilities need to be upgraded or replaced. The evaluation criteria for the potable water system consist of the following categories:

- System Pressure.
- Pipeline Velocity.
- Storage Volume.
- Pump Station (PS) Capacity.
- Pressure Reducing Valve (PRV) Capacity.

The evaluation criteria used for the evaluation of the City's potable water system are summarized in Table 4.1. Detailed descriptions for each evaluation criteria are provided following the table.

Table 4.1 Potable Water System Evaluation Criteria

Description	Value(1)	Units
Maximum Pressure		
Without Individual Pressure Regulator at Meter	80	psi
With Individual Pressure Regulator at Meter	150	psi
Minimum Pressure		
Peak Hour Demand (PHD)	40	psi
Maximum Day Demand (MDD) + Fire Flow	20	psi
Pipeline Criteria		
Maximum Velocity With ADD	5	fps
Maximum Velocity With PHD	8	fps
Maximum Velocity With MDD + Fire Flow	10	fps
Hazen-Williams C-Factor		
Pipelines Greater Than 50 Years in Age	120	N/A
Pipelines Between 20 to 50 Years in Age	130	N/A
Pipelines Less Than 20 Years in Age	140	N/A
Minimum Size for Pipeline Replacement	8	inches
Fire Flow Requirements(2)		
Very Low Density Residential (VLDR)	1,000	gpm for 2 hours
Low Density Residential (LDR)	1,000	gpm for 2 hours
Medium Density Residential (MDR)	2,000	gpm for 2 hours
High Density Residential (HDR)	2,500	gpm for 3 hours
Professional Office (PO)	2,500	gpm for 4 hours
Commercial/Retail/Office/Mixed Use	2,500	gpm for 4 hours
Civic or Public Facilities	2,500	gpm for 4 hours
Parks and Open Space	1,000	gpm for 1 hour
Conservation	0	N/A
Storage Volume		
Operational	30% MDD	MG
Fire Fighting Storage	Maximum fire flow in zone	MG
Emergency Storage	100% MDD	MG
Pump Station Capacity		
Zones With Gravity Storage	Meet MDD with the largest pump unit out of service	gpm
Zones Without Gravity Storage	Meet MDD + FF with all pumps	gpm
Pressure Reducing Valve Capacity		
Zones Without Gravity Storage	Meet MDD + FF with largest valve in the pressure zone out of service	gpm

Note:

(1) Use for planning purposes only. Values may be reduced with the use of fire sprinklers.

As shown, the fire flow requirement and duration are associated with the land use category as a general indicator of the building type and size. The distribution of fire flow requirements is shown on Figure 4.1. The highest fire flow requirement of parcels surrounding each model node is used in the hydraulic modeling analysis. For locations that show deficient system pressure under MDD plus fire flow requirements of 2,000 gallons per minute (gpm) and higher, the fire flow demand is divided between two adjacent hydrants to verify if the minimum residual pressure criterion of 20 psi can be met. This approach reflects actual field conditions when fires are combatted using multiple hydrants and fire trucks. System improvements are recommended for locations that cannot meet the fire flow requirement with two hydrants.

4.1.1 Potable Water System Pressures

Minimum system pressures are evaluated under both PHD and MDD plus fire flows conditions. Maximum system pressures are evaluated under ADD. The minimum pressure criterion for PHD demand conditions is 40 pounds per square inch (psi), while the minimum pressure criterion under MDD with fire flow conditions is 20 psi. The pressure analysis is limited to demand nodes, because only locations with service conditions need to meet such pressure requirements. Lower pressures are only acceptable for junctions at water system facilities and on transmission mains. However, no pressure shall be less than 5 psi to avoid potential water quality issues.

Maximum system pressures are evaluated under the ADD conditions. The maximum pressure criterion for normal ADD conditions is 80 psi for service connections without individual pressure-reducing valves conform the California Building Standards Code (CBC, 2019). In areas where the maximum pressure exceeds 80 psi, individual pressure-reducing valves are required on service connections. However, the system pressure shall generally not exceed 150 psi to protect pipeline integrity.

4.1.2 Potable Water Pipeline Velocities

Pipeline velocities are evaluated using three different maximum velocity criteria for selected flow conditions under both existing and future demand scenarios. For transmission and distribution pipelines, a maximum velocity of 5 feet per second (fps) and 8 fps was used for ADD and PHD conditions, respectively. Fire hydrant laterals are excluded from these criteria, as higher velocities are acceptable. Under fire conditions, velocities of up to 10 fps were allowed. Ideally, all transmission and distribution pipelines should have maximum velocities less than 8 fps to minimize head loss. However, higher velocities in existing pipelines are not, by them self, sufficient justification for pipeline replacement.

4.1.3 Potable Water Storage Capacity

The total storage required for a water system is evaluated in three components.

- Operational Storage.
- Fire Flow Storage.
- Emergency Storage.

These three components are determined for each pressure zone to evaluate the ability of the water system to meet the storage criteria on both a zone-by-zone basis, as well as a system-wide basis. These three storage requirements are discussed in more detail below:

- **Operational Storage.** Operational storage is defined as the quantity of water that is supplied to meet daily fluctuations in demand beyond the quantity of water that is produced on a daily basis. It is necessary to coordinate the production rates of water sources and the available storage capacity in a water system to provide a continuous flow of treated water supply to the system. Water systems are often designed to supply the average flow on the day of maximum demand. Water storage is then used to supply water for peak hour flows that may occur throughout the day. This operational storage is continuously replenished throughout the day to maintain water quality.

The American Water Works Association (AWWA) recommends an operational supply volume ranging from one-quarter to one-third of the demand experienced during one maximum day. It is recommended that pressure zones in the City's water system have operational storage of 30 percent of the MDD supplied by that reservoir.

- **Fire Flow Storage.** The governing fire department provides the City with the fire flow rate and duration to determine if fire storage is required for a pressure zone. The values provided in Table 4.1 are provided as a reference and are based on typical values for water utilities. Fire flow storage is determined based on the single greatest fire flow requirement (flow and duration) within each pressure zone. As shown, the fire flow requirements range from 1,000 to 4,000 gpm depending on land use type.
- **Emergency Storage.** Storage is also required to meet system demands during emergencies. Emergencies cover a wide range of rare but probable events, such as water contamination, failure at a water treatment plant, power outages, transmission pipeline ruptures, several simultaneous fires, and earthquakes. The volume of water that is needed during an emergency is usually based on the estimated amount of time expected to elapse before the disruptions caused by the emergency are corrected. The occurrence and magnitude of emergencies is difficult to predict. The City's recommended emergency storage is set to 100 percent of the MDD.

4.1.4 Potable Water Pump Station Capacity

Typically, a pump station consists of multiple pump units, including one spare pump to provide reliability in case of a breakdown or repair. In addition, critical booster pumps may be equipped with emergency power supplies in case of failure of the primary power source.

For the purpose of this One Water 2050 Plan, the capacity and design criteria were modified to reflect system conditions typically evaluated as part of a master plan. These criteria are the sizing of pump stations under normal demand conditions using MDD and MDD plus maximum fire flow for zones with and without gravity storage, respectively. Each station shall have sufficient capacity to meet the required MDD and the maximum zone fire flow with the largest unit out of service, or based on the available backup power.

4.1.5 Pressure Reducing Station Capacity

Typically, a pressure reducing valve station includes multiple valves of varying sizes. For pressure zones without gravity storage, supply sources, or pump stations, the PRV stations serve as the primary source of supply for that pressure zone. The criteria used in this situation requires that all PRVs supplying the pressure zone must meet the required MDD and maximum zone fire flow with the largest valve out of service.

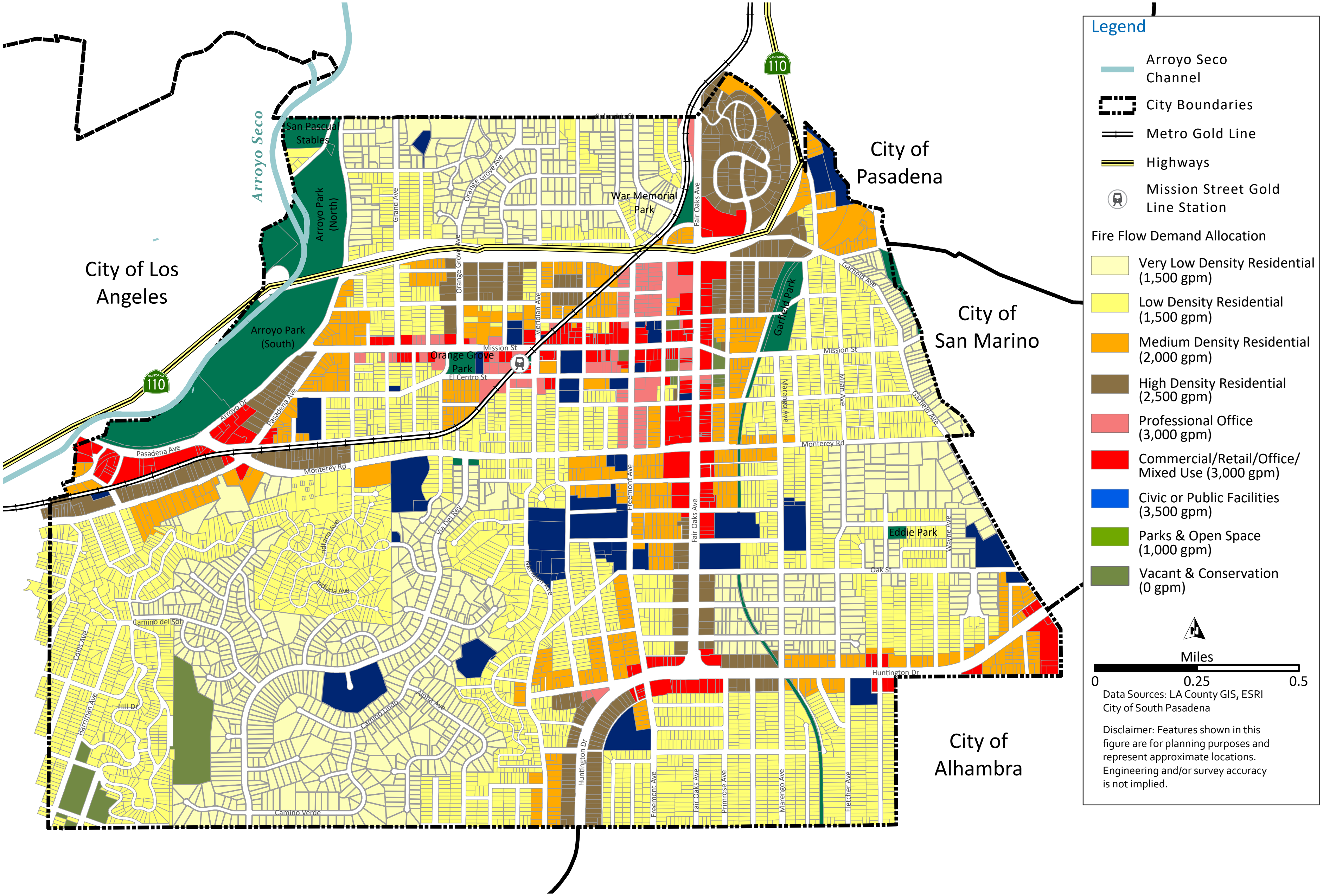


Figure 4.1 Fire Flow Demand Allocation by Land Use

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4.2 Recycled Water System Evaluation Criteria

This section presents the evaluation criteria that was used to analyze the City's future prospective recycled water system and size facilities. The criteria discussed includes system pressures, pipelines velocities, storage reservoirs volumes, and pump station capacities.

A list of recommended criteria used in the evaluation of the City's recycled water system is presented in Table 4.2.

Table 4.2 Recycled Water System Evaluation Criteria

Description	Value	Units
Pipeline Criteria		
Maximum Pressure	150	psi
Minimum Pressure Under Static Conditions	40	psi
Maximum Velocity With MDD	8	fps
Hazen Williams C-Factor for Pipelines 12-inches in Diameter or Less	120	n/a
Hazen Williams C-Factor for Pipelines Greater Than 12-inches in Diameter	130	n/a
Minimum Size for Pipelines	6	inches
Storage Volume		
Operational	Difference between PHD and MDD	MG
Pump Station Capacity		
Normal Conditions	Meet PHD with largest unit out of service	gpm

4.2.1 Recycled Water Pipeline Sizing Criteria

Since the City currently does not have a built-out recycled water system, the criteria developed was focused on new potential infrastructure.

For planning purposes, the Hazen William's C-factor used for pipelines equal to or less than 12 inches in diameter was 120, while a Hazen William's C-factor of 130 was used for pipelines greater than 12 inches in diameter. The minimum pipeline size used was 6 inches in diameter.

4.2.2 Recycled Water System Pressures

The recycled water system pressure is ideally designed to be slightly lower than the potable water system pressure. This pressure differential reduces the risk of potable water contamination from recycled water, in the event that an adjacent recycled water main breaks. There are circumstances where this requirement is not met since it is preferred to maintain a static pressure in the recycled water system of approximately 60 psi to meet operating requirements for most sprinkler systems. However, the minimum pressure in potable water systems is typically 40 psi.

The maximum pressure criteria used for the analysis of the future recycled water system was 150 psi and the minimum system pressure used for pipeline sizing in this One Water 2050 Plan was 60 psi under static conditions.

4.2.3 Recycled Water Pipeline Velocities

The maximum velocity criteria used for sizing future recycled water pipelines was 8 fps under MDD conditions. Ideally, all transmission and distribution recycled water pipelines should have maximum velocities less than 8 fps to minimize head loss. However, higher velocities in existing pipelines are not, by themselves, sufficient justification for pipeline replacement.

4.2.4 Recycled Water Storage Sizing Capacity

The total storage required for a recycled water system that serves outdoor irrigation demands only is solely based on operational storage needs as these recycled water systems are not used for firefighting and could be temporarily interrupted, eliminating the need for emergency storage.

The operational storage is defined as the quantity of recycled water that is required to meet daily fluctuations in demand beyond the quantity of water that is produced on a daily basis. As outdoor irrigation demands typically occur at night and can result in substantial peaking, it is critical to provide sufficient storage to buffer the diurnal variations between peak demand and recycled water supplies.

Recycled water supplies are often produced at higher rates during the day due to the diurnal pattern of wastewater flows. Hence, if there is no buffer volume at the water reclamation plant to buffer recycled water production, the total storage need for the recycled water system needs to take this into account also. However, if a water reclamation plant only treats a portion of the total wastewater flow at a constant rate, or if the WRP has sufficient treated water storage, the recycled water system distribution storage does not need to account of supply variability.

For the purpose of this One Water 2050 Plan, it is assumed that either the City of Pasadena or Upper District would supply the City of South Pasadena recycled water at a constant rate sufficient to meet MDD. Hence, the recycled water storage criterion is the total volumetric difference between PHD and MDD. However, if recycled water cannot be provided at a constant rate and follow the diurnal pattern of the water reclamation plants (which are characterized by higher flows during the day and lower flows during nighttime) the City would need to construct additional storage to buffer daily recycled water supply variations.

4.2.5 Recycled Water Pump Station Capacity

Pump stations for recycled water shall be sized to maintain a level of service during normal operating conditions. The pump stations shall be able to meet PHD conditions with the largest unit out of service.

4.3 Wastewater System Evaluation Criteria

The capacity of the City’s sanitary sewer collection system will be evaluated based on the planning criteria defined in this section. The planning criteria address the collection-system capacity, gravity sewer pipe slopes, and maximum allowable depth of flow within a sewer.

The evaluation criteria used for the evaluation of the City’s sewer system are summarized in Table 4.3. Detailed descriptions for each evaluation criteria are provided following the table.

Table 4.3 Wastewater System Evaluation Criteria

Minimum Slopes for New Circular Pipes	
Pipe Size (in)	**Minimum Slope(1) (ft/ft)**
8	0.004
10	0.003
12	0.0024
15	0.0017
18	0.0014
21	0.0011
24	0.0010
Flow Depth, d/D	
Maximum Flow Depth for Existing Sewers	
Pipe Diameter	**Maximum d/D Ratio Under PWWF(2)**
8 Inches and Smaller	3 feet below manhole rim
12 Inches and Larger	3 feet below manhole rim
Pipe Diameter	**Maximum d/D Ratio PDWF(2)**
8 Inches and Smaller	0.75
12 Inches and Larger	0.85
Maximum Flow Depth for New Sewers	
Pipe Diameter	**Maximum d/D Ratio Under PWWF(2)**
8 Inches and Smaller	0.67
12 Inches and Larger	0.75
Design Storm	
10-Year, 24-Hour Storm	
Head Loss in Existing Pipelines (Roughness Coefficients)	
Gravity Pipeline	Manning’s n = 0.013
Pressure Pipelines	Hazen Williams C = 120
Lift Stations and Force Mains	
Minimum Velocity	3 ft/s
Maximum Velocity	8 ft/s
Lift Station Capacity	Firm capacity(3) under peak flows

Notes:

(1) Minimum Slope values are based on pipeline flowing half full at 2 ft/s.

(2) PWWF = Peak Wet Weather Flows; PDWF = Peak Dry Weather Flows.

(3) Firm capacity represents the lift stations capacity with the largest pump out of service.

4.3.1 Gravity Mains

The majority of sewer collection systems are gravity mains, where flows travel downhill from manhole to manhole. Criteria associated with gravity mains are Manning’s roughness coefficient, flow depth criteria (d/D), design velocities, and minimum slope.

4.3.1.1 Manning's Roughness Coefficient

The Manning's roughness coefficient (n) is a friction coefficient that varies with respect to pipe material, size of pipe, depth of flow, smoothness of joints, root intrusion, and other factors. For gravity pipelines, the Manning's roughness coefficient value is typically 0.013. The Manning's roughness factor was refined as necessary during model calibration to accurately simulate field-measured levels and velocities.

4.3.1.2 Flow-Depth Criteria (d/D)

The primary criterion used to identify capacity-deficient sewers or to size new sewer improvements is the maximum flow depth-to-pipe diameter ratio (d/D). The d/D value is defined as the depth of flow (d) in a pipe during peak (design) flow conditions divided by the pipe's diameter (D). Based on Carollo's experience and industry standards, the following criteria were recommended.

- **Flow Depth for Existing Sewers.** Maximum flow-depth criteria for existing sanitary sewers are established based on a number of factors, including the acceptable risk tolerance of the utility, local standards and codes, and other factors. Using a conservative d/D ratio when evaluating existing sewers may lead to unnecessary replacement of existing pipelines. Conversely, lenient flow-depth criteria could increase the risk of sanitary sewer overflows (SSOs). Ultimately, the maximum allowable flow-depth criteria should be established to be as cost-effective as possible, while at the same time reducing the risk of SSOs to the greatest extent possible.

  The maximum flow depth for an existing sewer 8-inches in diameter or smaller is 0.92 and 0.50 under PWWF and Peak Dry Weather Flows (PDWF) conditions, respectively. The maximum flow depth for an existing sewer 12-inches in diameter or larger is 0.92 and 0.67 under PWWF and PDWF conditions, respectively.

  A capacity-deficient sewer (i.e., system bottleneck) raises the hydraulic grade line of upstream sewers, leading to backwater conditions. The greater the capacity deficiency, the higher the water levels will surcharge upstream of the bottleneck pipeline (or pipelines). The hydraulic model is used to determine "backwater" pipelines in order to specify which specific pipelines are the actual root causes of the capacity deficiency. Capital projects are proposed to provide greater flow capacity for the deficient sewers, which eliminates the backwater conditions that cause surcharging.

- **Flow Depth for New Sewers**. When sizing new sewer pipelines, it is common practice to adopt variable flow depth criteria for various pipe sizes. Design d/D ratios typically range from 0.5 to 0.92, with the lower values typically used for smaller pipes, which may experience flow peaks greater than design flow or blockages from debris, paper, or rags. For pipelines 8-inches in diameter and smaller, the maximum d/D value is 0.67 or 67 percent of the pipeline depth. For pipelines 12-inches and larger, the maximum d/D is 0.75.

4.3.1.3 Design Velocities and Minimum Slope

To minimize the settlement of sewage solids, it is standard practice in the design of gravity sewers to specify that a minimum velocity of 2 fps be maintained when the pipeline is half-full. At this velocity, the sewer flow will typically provide self-cleaning for the pipe. Due to hydraulics of a circular conduit, velocity of half-full flow in pipes approaches the velocity of nearly full flow in pipes.

Table 4.3 lists the recommended minimum slopes and their corresponding maximum flows for maintaining self-cleaning velocities (equal to or greater than 2 ft/s) when the pipe is flowing at its maximum depth (d/D ratio).

4.3.1.4 Changes in Pipe Size

When a smaller sewer joins a large one, the invert of the larger sewer should be lowered sufficiently to maintain the same energy gradient. An approximate method for securing these results is to place the 0.8 depth point of both sewers at the same elevation. For planning purposes and designing new pipes, and in the absence of field data, sewer crowns were matched at the manholes.

4.3.2 Lift Stations

Industry standard practice is to require that sewage lift stations have sufficient capacity to pump the PWWF with the largest pump out of service (firm capacity).

4.3.3 Force Mains

Force main piping should be designed to provide a minimum velocity of 3 ft/s at the design flow rate of the lift station and no more than 8 ft/s. For the determination of head loss, the Hazen Williams Equation is used with a C-factor of 120. These factors are typical for sewer system master planning purposes.

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Chapter 5 - Water Supply Analysis

Chapter 5

WATER SUPPLY ANALYSIS

This chapter summarizes the City's existing water supply sources and potential future sources. Existing water supply sources include local groundwater, purchased groundwater water, and imported water. The potential future sources considered include recycled water and stormwater.

5.1 Existing Water Supply Sources

The City's has three sources of potable water supply: groundwater pumped from the Main San Gabriel Basin (Main Basin), surface water imported from the Metropolitan Water District of Southern California (MWD), and a mix of groundwater and surface water purchased from Pasadena Water and Power (PWP).

Groundwater pumped from four wells in the Main Basin and is the primary source of water supply for the City. The annual water supply mix for the period 1990 through 2019 is graphically presented in Figure 5.1 and summarized in Table 5.1.

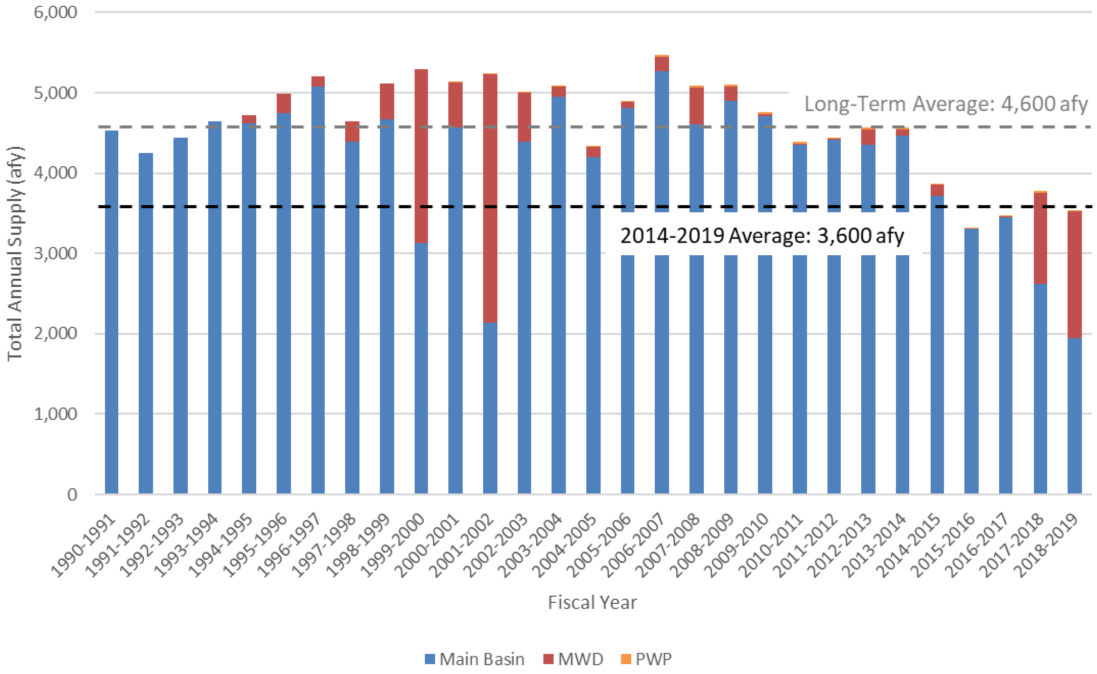

Figure 5.1 Historical Annual Supply by Water Source

Table 5.1 Historical Annual Production by Supply Source

Fiscal Year	Total Annual Supply (afy) (1)			
	Main Basin	MWD	PWP	Total
1990-1991	4,531	0	0	4,531
1991-1992	4,252	0	0	4,252
1992-1993	4,441	0	0	4,441
1993-1994	4,645	0	0	4,645
1994-1995	4,617	100	0	4,717
1995-1996	4,745	244	0	4,989
1996-1997	5,083	115	0	5,198
1997-1998	4,388	254	0	4,642
1998-1999	4,674	445	0	5,119
1999-2000	3,136	2,161	0	5,297
2000-2001	4,572	550	23	5,146
2001-2002	2,137	3,098	13	5,248
2002-2003	4,395	608	6	5,008
2003-2004	4,953	124	4	5,081
2004-2005	4,199	123	20	4,342
2005-2006	4,809	73	20	4,902
2006-2007	5,265	178	27	5,470
2007-2008	4,603	458	27	5,088
2008-2009	4,897	178	21	5,096
2009-2010	4,713	18	23	4,754
2010-2011	4,354	15	19	4,387
2011-2012	4,421	4	21	4,446
2012-2013	4,350	196	23	4,569
2013-2014	4,461	88	23	4,572
2014-2015	3,710	145	17	3,872
2015-2016	3,303	0	14	3,317
2016-2017	3,451	5	18	3,474
2017-2018	2,620	1,136	21	3,778
2018-2019	1,950	1,577	15	3,542
Average (1990-2019)	**4,196**	**410**	**12**	**4,618**
Average (2014-2019)	**3,007**	**573**	**17**	**3,597**
Percent(2)	**91%**	**9%**	**<1%**	**-**

Notes:
(1) Historical production data provided by City.
(2) Percent based on average of years 1990-2019.

As shown in Table 5.1 and Figure 5.1, the City has historically purchased only very limited amounts of water from PWP because the connection with PWP only serves approximately 39 customers within the Pasadena pressure zone, which is located on the northern part of the system along Fair Oaks Avenue (see Figure 6.1). The amount of water purchased from MWD varies from year to year and the City typically avoids purchasing imported water unless a groundwater well becomes non-operational because imported water is the costliest supply source for the City. For example, more water was purchased from MWD in 2001 because the pump and motor of Wilson Well No. 3 went out and the well also experienced water quality issues at the same time. Similarly, Graves Well No. 2 has been non-operational since 2017 so the City has purchased more water from MWD since fiscal year (FY) 2017/2018.

Additionally, the total amount of water produced and used has decreased from the long-term average of approximately 4,600 afy per year (1990-2019) to an average of approximately 3,600 afy per year in the past five years (2015-2019). This 1,000 afy decrease reflects a 22 percent demand reduction. This decrease is attributed to voluntary and mandatory water use restrictions during the statewide drought of 2012 through 2015 and lasting water use changes since that time as a result of the City's water conservation program, behavioral changes, and statewide policies.

5.1.1 Groundwater

The City owns four wells that pump groundwater from the Main Basin, namely: Graves Well No. 2, Wilson Well No. 2, Wilson Well No. 3, and Wilson Well No. 4. However, only two have been active in the past four years as Graves Well No. 2 is currently under reconstruction. The status and pumping capacities of the City's groundwater wells are listed in Table 5.2. As shown, the City currently has a total pumping capacity of 3,000 gpm from two active wells, which is 79 percent of the estimated total pumping capacity once Graves No. 2 is back online.

The amount of water pumped from the Main Basin by the City and other water suppliers is managed by the Main San Gabriel Basin Watermaster (Watermaster). The Watermaster determines the total operational safe yield for all groundwater pumpers each year. The City has pumping rights to 1.8 percent of the total operating safe yield of the Main Basin or up to 3,568 afy, as determined by the Watermaster. The total storage capacity of the Main Basin is estimated to be about 8.6 million acre-feet (af) and is recharged by rainfall, snowmelt, and imported water. Since year 1990, the City's groundwater pumping rights from the Main Basin have ranged from 2,527 afy to 4,332 afy and averaged 3,411 afy. However, the City's groundwater pumping right from the Main Basin has been below average at 2,707 afy during the past five years and is projected to decrease even further to 2,347 afy through year 2025 as a result of drought conditions[1]. Groundwater pumping within the City's water right is estimated to cost $315 per af.

The City and other pumpers are currently permitted to pump above and beyond their water rights by paying an additional fee for replenishment water, which is managed by the Watermaster. The maximum amount and cost of replenishment water is subject to the availability of water that can be used to recharge the groundwater basin, which includes stormwater collected in the San Gabriel River Watershed as well as recycled water. Due to this

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[1] Historical and projected water rights information for the City is from the Main San Gabriel Basin Watermaster.

decreasing amount of groundwater available, the cost of available groundwater to the City will continue to increase, as recharge water is no longer available at a discounted rate from Metropolitan. It is estimated that groundwater over the City's water rights will cost Metropolitan Full Service Untreated volumetric cost (see Table 5.3), plus the City's groundwater costs.

Table 5.2 Groundwater Well Capacities

Source	Status	Capacity (gpm)
Graves Well No. 2	Under Reconstruction	800
Wilson Well No. 2	Offline	1,200
Wilson Well No. 3	Active	1,900
Wilson Well No. 4	Active	1,100
Current Total	-	**3,000**
Maximum Total	-	**5,000**

Table 5.3 Estimated Wholesale Water Rates

Category	2020 Cost ($/af)	2025 Projected Cost ($/af)	2030 Projected Cost ($/af)
MWD full service untreated volumetric cost (Tier 2)(1)	$842	$965	$1,103
MWD full service treated volumetric cost (Tier 2)(1)	$1,165	$1,338	$1,493
Upper District fees(3)	$103(3)	$118	$135
Groundwater costs(4)	$315	$365	$423
Cost for groundwater above City water rights	**$1,157**	**$1,330**	**$1,526**
Cost for treated imported water	**$1,268**	**$1,456**	**$1,628**

Notes:
(1) Source: Metropolitan, 2020.
(2) Estimated to increase at the same percentage as Metropolitan.
(3) Source: Upper District, 2018.
(4) Estimated to increase 3 percent annually. Covers pumping costs plus Main Basin Watermaster replenishment assessment costs.

5.1.2 Imported Water from MWD

Over the past 30 years, water purchased from MWD has made up about 9 percent of the City's water supply. The volume of water purchased from MWD varies from year to year, ranging from no water purchased to up to 59 percent of the year's water supply purchased from MWD. The amount of water purchased from MWD is largely driven by the availability of groundwater, which is significantly cheaper than imported water. The City purchases water from MWD when groundwater wells are out of service due to maintenance, repairs, or water quality issues.

MWD obtains its water from the State Water Project (SWP) and the Colorado River, both of which have had significant drought conditions over the past few years. Water purchased from MWD is wheeled through the Upper District, which charges a surcharge for wheeling this water. Imported water costs approximately $1,200 per af, which is significantly more expensive than producing groundwater within the City's water right as shown in Table 5.3. It is expected that the cost of imported water will also increase significantly in upcoming years due to water scarcity, with a projected 28 percent increase from year 2020 to 2030.

The City receives water purchased from MWD through a metered connection to the Central pressure zone with a maximum supply capacity of 5,500 gpm.

5.1.3 Pasadena Water and Power

The City has historically purchased up to 27 afy per year (less than 1 percent of total water supply) from PWP to serve approximately 39 customers in the Pasadena pressure zone. This water is served to customers through a one-way connection between the Pasadena pressure zone and PWP's water system located at the intersection of Fair Oaks Avenue and E State Street. This water is purchased from PWP's supply at a rate equal to PWP's average cost of water from MWD and groundwater pumping, plus a small surcharge. The water is approximately 60 percent from MWD and 40 percent groundwater from PWP's Villa and Copelin wells disinfected by chloramine.

The City's inter-agency agreement with PWP has been in place since 1938 and stipulates that PWP agrees to provide the City with a continuous flow of up to 250 gpm (403 afy) and may provide up to 110 (177 afy) gpm of additional supply if PWP has surplus supply. The amount of water supply by PWP to the City is currently limited by the level of demand in the Pasadena pressure zone, which is significantly less than the full amount stated in the inter-agency agreement. In addition to the connection with the Pasadena pressure zone, the City has a backup connection with the Raymond pressure zone.

5.1.4 Emergency Interconnections

The City has one emergency interconnection with the City of Alhambra. This connection is not actively used but can be in the case of an emergency. The connection is located near the intersection of W Pine Street and Dos Robles Place. The connection consists of one 6-inch diameter valve that connects the City of South Pasadena' Central Pressure Zone to Alhambra's Upper Zone which has a hydraulic grade line of approximately 686 feet.

Los Angeles Department Water and Power (LADWP) owns a 12-inch diameter pipeline that runs through the intersection of Arroyo Verde and Monterey Road. It is recommended that the City add an emergency connection to LADWP (CIP Project ID **WCV-5**). The connection should be made using a pressure reducing valve in a vault connecting LADWP' 778 Zone to the Central Pressure Zone (HGL 746) in South Pasadena. The size of the pressure reducing valve would most likely be an 8-inch diameter valve which will connect the 12-inch diameter pipeline in LADWP's distribution system to the 18-inch diameter pipeline in the City's distribution system.

5.2 Water Quality

The sources of drinking water (both tap water and bottled water) include rivers, lakes, streams, ponds, reservoirs, springs and wells. As water travels over the surface of the land or through the ground, it dissolves naturally occurring minerals and, in some cases, radioactive material, and can pick up substances resulting from the presence of animals or from human activity. Contaminants that may be present in source water include:

- Microbial contaminants, such as viruses and bacteria, that may come from sewage treatment plants, septic systems, agricultural livestock operations and wildlife.
- Inorganic contaminants, such as salts and metals, that can be naturally occurring or result from urban storm water runoff, industrial or domestic wastewater discharges, oil and gas production, mining or farming.
- Pesticides and herbicides may come from a variety of sources such as agriculture, urban stormwater runoff, and residential uses.
- Radioactive contaminants can be naturally occurring or be the result of oil and gas production and mining activities.
- Organic chemical contaminants, including synthetic and volatile organic chemicals, which are byproducts of industrial processes and petroleum production, and can also come from gasoline stations, urban storm water runoff, agricultural application and septic systems.

As described in the subsequent subsections and detailed in the City's 2019 Water Quality Report (South Pasadena, 2019), the City's drinking water meets or surpasses all federal and state drinking water standards. This report is updated annually and available from the City's website, while the 2019 version is included in Appendix D

Some chemicals that have not previously been detected are increasingly being found at low levels in surface water around the country. These contaminants of emergency concern (CECs) include pharmaceuticals, personal care products, industrial chemicals, and chemicals that may affect hormone status. While these constituents are not currently regulated at the federal or state level, both the United States Environmental Protection Agency (EPA) and the California State Water Resources Control Board are tracking these contaminants and may develop regulations for their treatment and removal in the future. Several similar contaminants, including MTBE, 1,2,3-trichloropropane (1,2,3 TCP), perchlorate (ClO4), NDMA, and 1,4-dioxane have been recently regulated in California. New CECs may need to be monitored by the City in the future.

Select water quality constituents for all City water sources are included in Table 5.4 and the water quality of each source is described in more detail in the following sections. Not all constituents are reported for all water sources, so sources without reported constituents are marked with a "-". Constituents that were tested by not detected at the detection limit for purposes of reporting are marked with "ND".

Table 5.4 Water Quality Summary

Constituent	Water Source					
	Graves No. 2 (1)	Wilson No. 3 (2)	Wilson No. 4 (2)	City Groundwater (3)	PWP Groundwater (3)	MWD Imported Water (3)
Organic Chemicals						
1,2,3 TCP (MCL = 5,000 ppt) (4)						
Avg	NR	23.08	36.02	ND	ND	ND
Max	NR	28.80	53.00	ND	ND	ND
Min	NR	8.36	15.50	ND	ND	ND
Carbon Tetrachloride (MCL – 500 ppt)						
Avg	0.33	-	-	ND	ND	ND
Max	0.87	-	-	ND	ND	ND
Min	0.00	-	-	ND	ND	ND
PCE (MCL = 5 µg/L)						
Avg	8.84	1.81	1.69	1.6	ND	ND
Max	12.00	2.90	2.90	1.9	1.2	ND
Min	5.20	0.00	0.00	0.77	ND	ND
TCE (MCL = 5 µg/L)						
Avg	0.00	1.20	0.82	1.1	ND	ND
Max	0.00	2.00	1.50	1.7	1.3	ND
Min	0.00	0.00	0.00	0.65	ND	ND
Inorganic Chemicals						
Bromate (MCL = 10 µg/L)						
Avg	-	-	-	NR	NR	1.9
Max	-	-	-	NR	NR	ND
Min	-	-	-	NR	NR	8.1
Copper (MCL/AL = 1.3 mg/L)						
Avg	-	-	-	0.33	MCL Compliant	NR
Max	-	-	-	No samples exceed action limit		NR
Min	-	-	-			NR
Fluoride (Naturally Occurring, MCL = 2 mg/L)						
Avg	-	-	-	0.91	0.8	NR
Max	-	-	-	0.92	1.5	NR
Min	-	-	-	0.86	0.5	NR
Fluoride (Treatment Related, MCL = 2 mg/L)						
Avg	-	-	-	NR	NR	0.7
Max	-	-	-	NR	NR	0.9
Min	-	-	-	NR	NR	0.6
Lead (MCL/AL = 15 µg/L)						
Avg	-	-	-	ND	MCL Compliant	NR
Max	-	-	-	No samples exceed action limit		NR
Min	-	-	-			NR

Constituent	Water Source					
	Graves No. 2 (1)	Wilson No. 3 (2)	Wilson No. 4 (2)	City Groundwater (3)	PWP Groundwater (3)	MWD Imported Water (3)
Nitrate as N (MCL = 10 mg/L)						
Avg	10.14	4.87	4.86	5.1	4.9	0.5
Max	11	5.8	6.4	5.8	7.8	0.5
Min	10	0.22	0.2	3.1	ND	0.5
Perchlorate						
Avg	5.18	1.64	1.26	-	-	-
Max	6.80	2.40	2.00	-	-	-
Min	4.30	0.00	0.00	-	-	-
Radioactivity						
Combined Radium (MCL = 5 pCi/L)						
Avg	-	-	-	ND	ND	ND
Max	-	-	-	ND	1.4	ND
Min	-	-	-	ND	ND	ND
Gross Alpha Particle Activity (MCL = 15 pCi/L)						
Avg	-	-	-	3.3	8	ND
Max	-	-	-	6.5	11	ND
Min	-	-	-	ND	5	ND
Uranium (MCL = 20 pCi/L)						
Avg	-	-	-	1.6	10	ND
Max	-	-	-	1.8	15	ND
Min	-	-	-	1.4	3	ND
Secondary Drinking Water Standards – Aesthetic Standards, Not Health-Related						
Chloride (MCL = 500 mg/L)						
Avg	-	-	-	18	60	50
Max	-	-	-	19	108	55
Min	-	-	-	16	18	46
Color (MCL = 15 Units)						
Avg	-	-	-	ND	ND	ND
Max	-	-	-	ND	ND	1
Min	-	-	-	ND	ND	ND
TDS (MCL = 1,000 mg/L)						
Avg	-	-	-	260	399	266
Max	-	-	-	280	630	289
Min	-	-	-	240	260	244
Turbidity (MCL = 5 NTU)						
Avg	-	-	-	0.22	0.3	ND
Max	-	-	-	0.3	1.7	ND
Min	-	-	-	0.13	ND	ND

Notes:

(1) Source: Monthly historical water quality sampling data from 2015-2020. Graves No. 2 was out of service from 2017 through 2020, so water quality data provided for only 2015 and 2016.

(2) Source: Monthly historical water quality sampling data from 2015-2020.

(3) Source: City of South Pasadena 2019 Water Quality Report

(4) 1,2,3-Trichloropropane (TCP) not included in monthly reporting for City wells until 2018.

MCL = Maximum Contaminant Level; AL = Action Level; ppt = Parts per Trillion; µg/L = micrograms per liter; mg/L = milligrams per liter; pCi/L = picocuries per liter; NR = Not Required to be Sampled; ND = Not Detected at DLR.

5.2.1 Groundwater Quality

The water quality of the City's groundwater wells was analyzed using five years of historical water quality sampling data collected from January 2015 through October 2020. A summary of the findings for the key constituents of concern is presented in Table 5.4. The City's groundwater wells are considered vulnerable to contamination from dry cleaners, gasoline stations, automobile repair shops, high density housing, medical and dental offices and clinics, and leaking underground storage tanks (South Pasadena, 2019).

The five water quality parameters of concern are nitrate (NO3), tetrachloroethylene (PCE), trichloroethylene (TCE), ClO4, and 1,2,3 TCP. Average, maximum, and minimum values of each parameter are shown for each well in Table 5.3. The maximum contaminant levels (MCL) limit for each parameter are also included in the table.

Overall, the City's wells provide high quality water for drinking, although MCLs for Nitrate, PCE, and 123 TCP have been exceeded in the past. When these MCLs are exceeded, groundwater is either blended with other sources of water to reduce concentrations to below 80 percent of MCLs, or well water production is reduced and water is purchased from MWD. For example, the Wilson wells were shut down from April to December of 2018 due to 1,2,3-TCP contamination, so purchases from MWD were increased during that period. The City adds chlorine without ammonia, called free chlorine, to groundwater pumped from wells. A residual amount of free chlorine and chloramines in the distribution system helps prevent micro-organisms from growing in the pipes. The City does not add additional fluoride to the local water because fluoride occurs naturally in groundwater. As shown in Table 5.4, the average fluoride concentration in the City's groundwater is 0.91 mg/L.

5.2.2 Imported Water Quality

Imported water from MWD is of high quality that does not exceed MCLs. MWD is required by the State Department of Drinking Water (DDW) to conduct a source water assessment to examine possible sources of drinking water contaminates in its SWP and Colorado River Aqueduct (CRA) water sources every five years. Water from the Colorado River is considered to be most vulnerable to contamination from recreation, urban stormwater runoff, increasing urbanization in the watershed, and wastewater. Water supplies from the State Water Project are most vulnerable to contamination from urban stormwater runoff, wildlife, agriculture, recreation and wastewater (South Pasadena, 2019).

MWD treats water from the SWP at the Joseph Jensen Water Treatment Plant (WTP). This 750 mgd WTP is MWD's largest facility and is located in Granada Hills. Water supply from both CRA and SWP is treated at the 520 mgd F.E. Weymouth WTP. MWD filters imported surface water and adds chloramines, a combination of chlorine and ammonia, as a residual disinfectant. MWD joined a majority of the nation's public water suppliers by adding fluoride to drinking water in order to prevent tooth decay. The average fluoride level in Metropolitan's treated water is 0.7 milligrams per liter (mg/L). Treated water from the Jensen WTP and Weymouth WTP is wheeled through the Upper District before getting delivered to the City. If the City uses MWD water for an extended period of time, the City uses additional break point chlorination as needed.

5.2.3 PWP Water Quality

The water purchased from PWP groundwater supply is of high quality. It has not exceeded MCLs in recent years. PWP has a combination of imported water purchased from MWD and groundwater. PWP's groundwater is pumped from the Raymond Groundwater Basin, a natural water-bearing zone underlying the communities of Pasadena, Altadena, La Cañada Flintridge, and portions of San Marino, Arcadia and Sierra Madre. Surface water from streams and precipitation enters the basin area through the natural water cycle. As surface water slowly percolates through the ground to the basin, the ground acts as a natural filter to strip the water of most contaminants. PWP's water is disinfected with chlorine and chloramines (chlorine plus ammonia) prior to being distributed to customers. PWP is responsible for testing its water supply purchased by the City for the Pasadena Zone. The information presented in Table 5.4 shows the average and range of concentrations of the constituents tested in the City's drinking water during year 2019 or from the most recent tests. The average fluoride concentration in the PWP's groundwater that is supplied to only the Pasadena Zone is 0.8 mg/L.

5.3 Potential Future Water Sources

The City's groundwater rights have historically not been enough to meet its total water demand, so the City has either paid replenishment fees to pump additional groundwater or purchased additional water from MWD, or a combination of both measures. Due to continued growth in the Los Angeles metropolitan area, natural recharge of the Main Basin will continue to decline as a result of the reduction of pervious areas. Additionally, anticipated future prolonged droughts triggered by climate change, groundwater pumping rights may decrease even further in the future. Hence, the gap between groundwater pumping within the City's water rights and water demands is expected to grow. Figure 5.2 shows the recent water supply for the City broken out by groundwater pumped within the City's groundwater rights, groundwater pumped above the City's groundwater rights, and water purchased from MWD. The figure shows that the City has historically had to pump beyond its water rights in most years. Additionally, Figure 5.2 shows the projected groundwater pumping rights through the year 2025, as predicted by the Watermaster and water demand projections as dictated by General Plan growth and RHNA allocations. More information on the future water demand projections can be found in Chapter 3 of this One Water 2050 Plan.

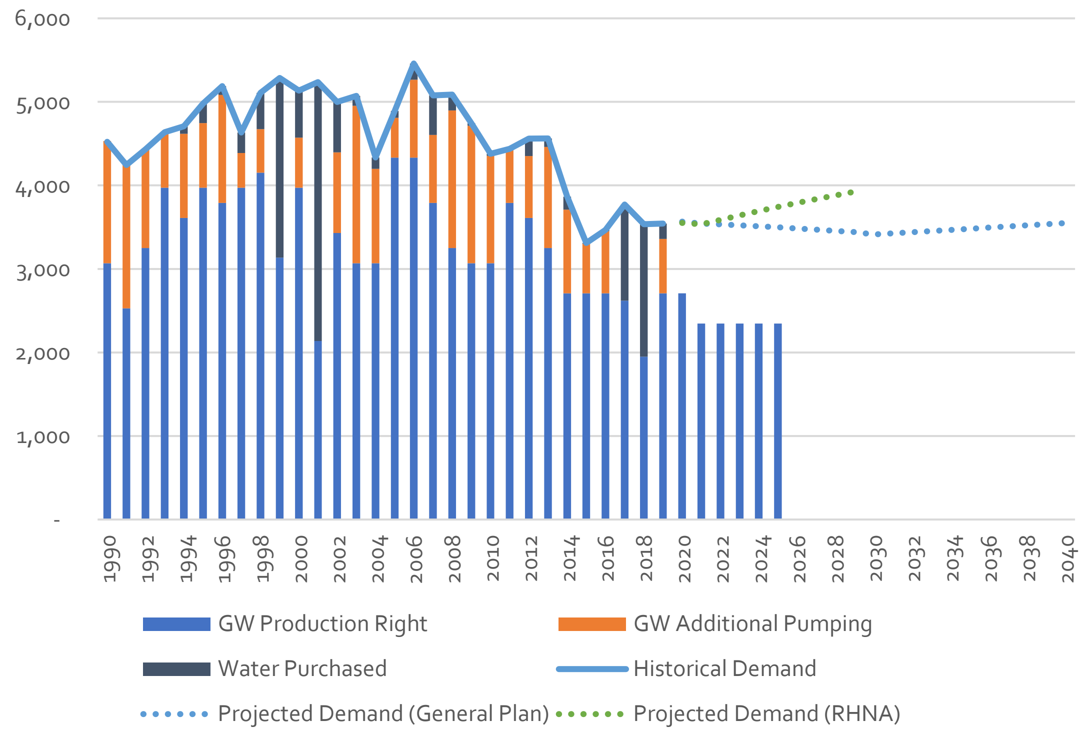

Figure 5.2 South Pasadena Historical and Projected Supply and Demand

As shown in Figure 5.2, future demands, like historical demands, are likely to exceed the City's groundwater production rights. It is projected that the City will need to continue to exceed their groundwater pumping rights (as allowed by the Watermaster) and pay the replenishment fee to do so and also continue to augment water supply with water purchased from MWD as needed. Other potential water supplies to offset potable water demand needs include recycled water, stormwater, and water conservation. The City may also explore additional backup connections with other surrounding water agencies for emergency supply.

5.3.1 Recycled Water

Recycled water is wastewater that is treated to a high enough standard to be used again. Non-potable recycled water systems have been implemented all over California for irrigation purposes. Regulation changes within the past decade have allowed for potable reuse for recycled water that is treated to a high enough standard. IPR has been implemented in the state to recharge groundwater basins and to augment surface water reservoirs. Direct potable reuse (DPR) regulations are in development and expected to be implemented in the near future. This would allow highly treated recycled water to be served directly to customers.

The City currently does not use recycled water in its service area since it does not treat its own wastewater. Its wastewater is conveyed to LA County's Whitter Narrows Water Reclamation Plant via LA County trunk sewers. The City is a member agency of the Upper District, the regional recycled water supplier, but Upper District does not have dedicated infrastructure to convey recycled water to supplies to the City. The closest recycled water pipeline of the Upper District is located in the Whittier Narrows area, roughly 10 miles from the City's boundary. However, the City of Pasadena is considering serving recycled water to their Glenarm Power Plant, located immediately north of South Pasadena's city boundary. Chapter 7 of this One Water 2050 Plan assesses the possibility of obtaining recycled water from both of these sources as well as the possibility of obtaining recycled water from the Central Basin Municipal Water District.

Chapter 7 details potential recycled water users within the City, including parks, a golf course, and other outdoor irrigation areas. The feasibility analysis concludes that the most cost-effective recycled water option for the City would provide about 140 afy of recycled water, or about 4 percent of total water demand. However, serving recycled water to customers is likely to be cost prohibitive as even the most cost-effective recycled water option is estimated to cost approximately $1,900 per af. This is significantly more costly than purchasing water from MWD or pumping groundwater.

5.3.2 Stormwater

Stormwater capture may be used a source of water for outdoor irrigation for parks, golf courses, and other irrigation around residential and commercial buildings. The City is in a relatively arid climate, averaging approximately 12 inches of rainfall per year. Precipitation occurs largely between the months of November and March. However, rainfall is typically concentrated in a few storm events, making it difficult to capture and treat without building assets that sit idle the vast majority of the year. Outdoor irrigation peaks in the summer months from April through September, meaning that stormwater would have to be stored throughout the rainy winter months to be of use several months later during the summer. This disparity between stormwater availability and stormwater need is illustrated in Figure 5.3.

While individual residences may choose to capture rainwater through small on-site rain barrels, stormwater capture is unlikely to be able to provide more substantial, system-wide water supply without investment into significant amounts of storage, which is extremely expensive. Stormwater may still be used productively by using spreading ponds, dry wells, permeable pavement, and other green infrastructure to capture available rainfall and percolate it into the groundwater.

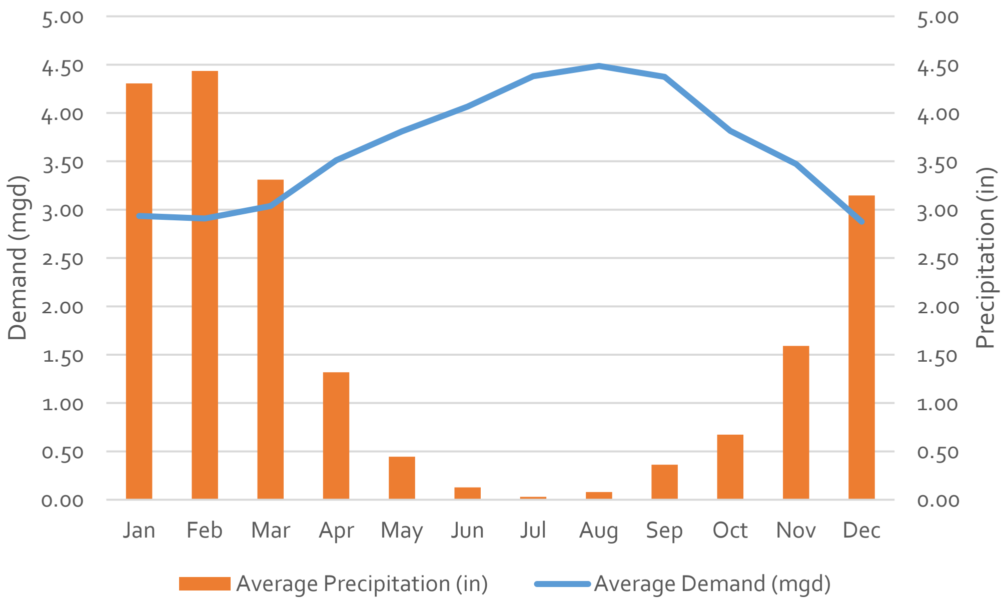

Figure 5.3 South Pasadena Average Monthly Water Demand and Average Precipitation

5.3.3 Water Conservation

Water conservation can help decrease demand and thus decrease any potential gaps between water demanded and available supply. The City's existing water conservation program is comprised of the following components:

- **Water Waste Prevention** Ordinance – Adopted in 2014, this ordinance includes the City's water use efficiency requirements and measures. Such measures include requiring evening spray irrigation and regulating car washing and decorative water features.
- **Metering** – All existing and planned service connections are metered.
- **Conservation Pricing** – The City implements a three-tiered rate structure which varies between meter size and promotes water conservation. The tiered water rate structure also includes a water efficiency fee based on water consumption and is used to promote conservation and infrastructure improvements.
- Public Education and Outreach – The City participates in the public information program by posting internet website links on conservation programs that offer incentives and rebates for high efficiency appliances and providing access to links such as Bewaterwise.com on the City's website. The City also participates in the public information program through campaigns and banners. Information pamphlets and brochures containing valuable water conservation tips are available at the City Hall and are enclosed periodically in water bills. The City promotes efficient water use at its annual Clean Air and Green Living car show and exposition.
- **Programs to Assess and Manage Distribution System Real Loss** – The City performs routine checks for leaks using leak detection devices, including sounding of fire hydrants and main pipelines. Under the City's leak detection program, monthly monitoring for leaks is conducted in the field. Repairs to leaking water mains or hydrants are performed

immediately. The City plans to install an AMR system that will trigger an alarm if a leak is detected.

- **Water Survey Program** – Residential water survey is conducted by the Management Analyst upon request by residents. The City also has a computerized billing system to monitor water consumption data, and if there are unusual variations in consumption the City is alerted. The City's billing system flags unusual consumption which alerts the City of inordinate water use. If the City is alerted of an inordinate water use, a follow-up survey will be scheduled to check for water leaks at the residence. In addition, the water bills sent to each customer contains consumption information for the "same time last year." Inclusion of this information has been helpful to customers by alerting them to unusually high consumption.

The City will continue these measures to manage demand and conserve supply. Further water conservation will be required over the next decade as state regulations require that indoor water use decrease to 55 gpcd by 2025 and to 50 gpcd by 2030. The City's current indoor water use is estimated at 60 gpcd.

5.4 Recommended Future Water Supply

The City's two largest water supply sources, groundwater pumped from the Main Basin and imported water purchased from MWD, are likely to continue to constitute the majority of the City's water supply in the future. Even though the City's groundwater pumping rights are expected to decline in the near term, the City is likely to be able to continue to pump beyond these rights by paying a replenishment fee to the Watermaster. Additionally, water purchased from MWD is not expected to be limited such that purchased water cannot be used if groundwater does not have sufficient quality to be served to customers. Water conservation is expected to increase to meet state requirements, helping to minimize the amount of replenishment water and MWD purchases required. Water supply purchased from PWP is assumed to remain constant or may slightly decline as demand in the Pasadena Zone decreases due to expected conservation.

It is recommended that the City continue with the reconstruction of Graves Well No. 1 in order to further diversify groundwater sources to mitigate future potential groundwater quality issues in other wells. Stormwater projects in Arroyo Seco park may slightly decrease irrigation demands in the park, but utilizing recycled water, or implementing larger stormwater capture efforts and are not likely to be viable in the near future.

Finally, it may be prudent for the City to explore implementing additional backup connections with surrounding agencies to provide water in emergency scenarios. One such connection may be made with the Los Angeles Department of Water and Power (LADWP) near Monterey Rd and Kolle Ave along the western edge of the City.