

Chapter 2 Basic Planning Data and Water Demand Forecasting

Chapter 2 of the 2012 WSP has been amended in 2018. The purpose of this amendment is to provide a description of historical, 2017, and updated future projected population and employment. This chapter also summarizes historical and 2017 water demands within the City, and identifies target year (2018, 2025, and 2032) demand projections based on population and employment projections, water use data, and conservation effects. This data meets DOH reporting requirements and also provides the basis for the water system analysis performed to determine improvements necessary to serve current and future City customers.

2.1 Historical Population and Employment Trends

The City of Lynnwood was incorporated in 1959. The City's population and employment growth from 1960 to 2017 is summarized in Table 2-1. Estimated total employment for years 2000 to 2010 listed in Table 2-1 was calculated by combining a Covered Employment estimate (representing approximately 85 to 90 percent of total employment) with a percentage of households receiving self-employed income as reported by the American Community Survey (ACS). The City's most recent ACS reports that 13.3 percent of households received self-employment income. Estimated total employment for years 2011 to 2017 was based on information received from Puget Sound Regional Council (PSRC).

The City's population increased by approximately 8.6% percent between 2000 and 2017; the average annual population growth was approximately 0.5 percent.

Employment increased by approximately 18 percent between 2000 and 2017, with an average annual growth of approximately 1 percent. There were significant population fluctuations year to year due to economic factors.

Table 2-1 Historical Population and Employment 2000 to 2017

Year	Population ⁽¹⁾	Annual Population Growth Rate	Estimated Total Employment ⁽¹⁾	Annual Employment Growth Rate
1960	7,207	--	--	--
1970	16,919	--	--	--
1980	22,641	--	--	--
1990	28,637	--	--	--
2000	33,847	--	25,312	--
2001	34,010	0.5%	24,390	(3.6%)
2002	33,990	(0.1%)	23,497	(3.7%)
2003	34,500	1.5%	24,910	6.0%
2004	34,540	0.1%	25,485	2.3%
2005	34,830	0.8%	26,016	2.1%
2006	35,230	1.1%	27,556	5.9%
2007	35,490	0.7%	29,176	5.9%
2008	35,680	0.7%	29,298	0.4%
2009	35,740	0.2%	26,917	(8.1%)
2010	35,836	0.3%	25,933	(3.7%)
2011	35,860	0.1%	25,640	(1.1%)
2012	35,900	0.1%	27,068	5.6%
2013	35,960	0.2%	27,110	0.2%
2014	36,030	0.2%	27,153	0.2%
2015	36,420	1.1%	29,010	6.8%
2016	36,590	0.5%	29,852	2.9%
2017	36,950	1.0%	29,878	0.1%

Notes:

(1) Data Sources: Population 1960-2009: Washington State Office of Financial Management (OFM) April 1 City Density Reports; Population 2010: 2010 Census; Estimated Total Employment: Covered Employment estimates provided by the Puget Sound Regional Council and Lynnwood 3-Year American Community Survey 2008 to 2010; Population 2011-2017: OFM 2018 population estimates.

2.2 Water Service Area Population

The population within the City’s water service area boundary is estimated using the number of occupied single-family residential units (subtracting out the Alderwood Water and Wastewater District (AWWD) direct and subtract accounts within the City limits from the single-family residential units) and the multi-family residential units within the service area, multiplied by the number of people per unit. The unit density (persons per unit) from the US Census Bureau 2010 Demographic Profile Data (2.62 persons/unit, single-family residential and 2.36 persons/unit, multi-family) was used in the water demand forecasting. Table 2-2 is a summary of the estimated population within the water service area broken out by residential type.

Table 2-2 2017 Water Service Area Population			
Customer Class	Occupied Residential Units⁽¹⁾⁽²⁾	Unit Density (persons per unit)⁽¹⁾	Estimated 2017 Population⁽¹⁾
Single Family Residential	7,507	2.62	19,667
Less AWWD direct accounts ⁽²⁾	481	2.62	1,260
Less AWWD subtract accounts, within City limits ⁽²⁾	87	2.62	228
Total Single Family Residential	6,939	2.62	18,179 ⁽⁴⁾
Multi-Family Residential	6,710	2.36	15,835 ⁽⁵⁾
Total Housed Population ⁽³⁾	13,648	----	34,014
Notes: (1) Information on single family residential and multifamily residential is from OFM, 2018. Information on the occupied residential units and unit density is from US Census Bureau, 2010 Demographic Profile Data. (2) Assumption made that all AWWD direct and subtract accounts are single family residential units. (3) City served residential population. (4) 49.50% of 2010 City Census population is occupied single-family residential population. (5) 44.02% of 2010 City Census population is occupied multi-family residential population.			

2.3 Water Service Connections by Customer Class

Table 2-3 lists the number of City water service connections per customer type.

Table 2-3 City of Lynnwood Historical Service Connections		
Customer Type	Total Water Service Connections ⁽¹⁾	
	2015	2017
Single Family Residential ⁽²⁾	6,777	6,746
Multi Family Residential	487	509
Institutional ⁽³⁾	1,294	1,263
Total	8,558	8,518
Notes: (1) Water service connection data from City of Lynnwood Utility Billing Summaries, 2015 and 2017. No data was available for 2016. (2) Single Family Residential includes Single Family, Special Rate C, and Mobile Home P customer classes. (3) Institutional includes commercial, school, municipal, government, commercial-various and does not apply categories.		

The total water service connections remained approximately the same between 2015 and 2017.

2.4 Water Use

2.4.1 Average and Peak Day Purchased Water History

The master meters connecting the City and the Alderwood Water & Wastewater District (AWWD) water systems are recorded daily to determine the amount of water use by the City. In addition, master meter data is telemetered to the AWWD operational headquarters. The AWWD telemetry system records and archives hourly and daily flows as recorded at the master meters. In addition, the AWWD keeps seven-day circular charts indicating continuous flow data as measured at the City master meters. The AWWD accounts are subtracted from the total amount billed to the City and the unmetered read (UMR) accounts are added to the City bill. Table 2-4 provides a summary of the historical amount of water purchased from the AWWD, along with the peak day water purchased.

Table 2-4 Historical Master Meter Data		
Year	Total Master Meter Usage (mgd)⁽¹⁾	Peak Day Meter Usage (mgd)⁽²⁾⁽³⁾
2015	3.48	5.92
2016	3.54	6.02
2017	3.60	6.12
Notes: (1) Data from AWWD Water Consumption/Loss Reports. AWWD accounts in City service area subtracted out. (2) Average peaking factor from Table 2-4 of 2012 WSP. (3) Peak day meter usage was obtained from multiplying total master meter usage by the 1.70 peaking factor developed for the 2012 WSP.		

2.4.3 Consumption History

The City's water consumption for 2015 and 2017 for each customer class is listed in Table 2-5. Water consumption data was not available for 2016. As shown in Table 2-5, the City's total water consumption decreased from 2015 to 2017.

Table 2-5 Historical Metered Water Consumption by Customer Class		
Customer Type	Average Day Annual Consumption (mgd) ⁽²⁾	
	2015	2017
Single Family Residential ⁽¹⁾	1.234	1.057
Multi Family Residential	0.799	0.874
Institutional ⁽³⁾	1.029	0.928
Total	3.063	2.859
Notes: (1) Single Family Residential includes Single Family, Special Rate C, and Mobile Home P customer classes. (2) Water consumption and service connection data from the City of Lynnwood Utility Billing Summaries. (3) Institutional includes commercial, school, municipal, government, commercial-various and does not apply categories.		

2.4.4 Distribution System Leakage

Distribution System Leakage (DSL) is all unauthorized uses, water system leakage, and any authorized uses the water system does not estimate or track (WAC 246-290-820(2)).

Table 2-6 shows the City's meter usage, UMR consumption, purchased water, total sold to City customers, and DSL for 2015 through 2017. As shown, the City's DSL ranges from 12.6 percent in 2016 to 16.6 percent in 2017, assuming UMR is excluded from the total, as UMR consumption does not go through the master meter and cannot be properly tabulated. According to DOH, utilities must implement a leak detection program if their DSL for water is greater than 10 percent. For comparison, the DSL for water for other utilities in Snohomish County are listed in Table 2-7.

Table 2-6 Distribution System Leakage for Water							
Year	Total Master Meter Usage, MG	Consumption Not Through Master Meter (UMR Accts), MG	Total Usage per AWWD Billings, MG	Total Sold to City Customers	Distribution System Leakage for Water		
					(MG)	% of Total, including UMR	% of Total, excluding UMR
2015	1,271	38	1,309	1,118	191	14.6%	15.0%
2016	1,293	33	1,326	1,163	162	12.2%	12.6%
2017	1,315	37	1,352	1,133	219	16.2%	16.6%
					Average	14.3%	14.7%
Notes: (1) Average Day Master Meter Usage from AWWD. AWWD accounts in Lynnwood are subtracted out. Data from Water Consumption/Loss Reports, given in CCF, calculated to MG. (2) Total sold to City Customers data from 2015-2017 City of Lynnwood Utility Billing Summary, total Water/Irrigation Consumption (given in CCF, calculated to MG). (3) Use % Lost excluding UMR, as UMR does not go thru master meter and UMR loss cannot be properly tabulated. Assume UMR loss is same as entire system loss, percentage-wise.							

Table 2-7 Distribution System Leakage for Water for Nearby Utilities		
Utility	Years of Data	Average Distribution System Leakage for Water ⁽¹⁾
Silver Lake Water District	2010-2016	1.2% ⁽²⁾
Mukilteo Water District	2009-2014	3.4% ⁽³⁾
City of Everett	2005	5.5%
AWWD	2004 - 2006	6.9%
Notes: (1) The Distribution System Leakage was obtained from each utility's Water System Plan. (2) 3-year rolling average as of 2016. (3) 3-year rolling average as of 2014.		

As shown in Table 2-6, the City's DSL for water has averaged approximately 14.7 percent over the last three years, excluding UMR consumption, which is higher than the utilities listed in Table 2-7. As the City exceeds the DOH threshold of 10 percent, a leak detection program is in place. The City purchased and installed data loggers and a correlator to detect leaks. A distribution system map identifying locations of leaks is maintained, and pipe segments with multiple leaks are identified and scheduled for replacement. In 2017, the City replaced several 4-inch diameter steel mains that were scheduled for replacement. Records for 2018 will indicate the effectiveness of these replacements.

2.4.5 Equivalent Residential Units

The concept of Equivalent Residential Units (ERUs) is a way to express water use by non-residential customers as an equivalent number of residential customers. ERUs are calculated by dividing the total volume of water utilized in the single family residential customer class by the total number of active residential connections. This number defines the average single family residential water use. The volume of water used by other customer classes can then be divided by the average single family residential water use to determine the number of equivalent residential units utilized by other customer classes. Table 2-8 summarizes the City's ERU value for 2015 and 2017. Flow data was not available for 2016.

Population for 2015 and 2017 was based on the percent occupied units from the 2010 occupied population data from the US Census Bureau 2010 Demographic Profile Data and OFM; 91 percent occupied for single-family residences and 99 percent occupied for multi-family residences. AWWD direct and subtract accounts were subtracted from the total single-family residential units.

Table 2-8 Equivalent Residential Units 2015-2017			
	2015	2017	Average (2015-2017)
Single Family Residential Flow, mgd ⁽¹⁾	1.234	1.057	
Total Housing Units ⁽²⁾	7,481	7,507	
Flow per ERU	165	141	153
Gallons per Capita per Day (GPCD) ⁽⁴⁾	63	54	58
Multi Family Residential Flow, mgd ⁽¹⁾	0.799	0.874	
Total Housing Units ⁽³⁾	6,708	6,710	
Flow per ERU	119	130	125
GPCD ⁽⁴⁾	50	55	53
Notes:			
(1) Single Family Residential and Multi Family Residential Average Day Consumption from Utility Billing Summaries from City			
(2) Based on 91% occupied units from 2010 calculation (2010 census occupied units divided by 2010 total units counted by OFM). AWWD direct accounts (assumed 625 units), and AWWD Subtract accounts (88 units) subtracted out.			
(3) Based on 99% occupied units from 2010 calculation (2010 census occupied units divided by 2010 total units counted by OFM).			
(4) GPCD was calculated using the flow per ERU and unit density provided in Table 2-2.			

As shown in Table 2-8, the average daily Single Family Residential water use for the City from 2015 to 2017 (which is equivalent to one ERU) was 153 gpd/ERU, or 58 gpcd. These values will be used in projecting future flows. The 2015 to 2017 average for multi-family residential water use was 125 gpd/ERU or 53 gpcd.

Table 2-9 breaks down all customer-type connections into ERUs using 2017 data.

Table 2-9 2017 Equivalent Residential Units					
Customer Type	Number of Connections⁽²⁾	Average Daily Consumption (gpd)⁽²⁾	Average gpd per Connection	ERUs per Connection	Total ERUs
Single Family Residential ⁽¹⁾	6,746	1,057,483	157	1	6,746
Multi Family Residential	509	874,053	1,717	11	5,576
Institutional ⁽³⁾	1,263	927,676	735	5	5,918
Total	8,518	2,859,213	336⁽⁴⁾	2.1⁽⁵⁾	18,240

Notes:

- (1) Single Family Residential includes Single Family, Special Rate C, and Mobile Home P customer classes.
- (2) Water consumption and service connection data from the City of Lynnwood Utility Billing Summaries.
- (3) Institutional includes commercial, school, municipal, government, commercial-various and does not apply categories.
- (4) The average gpd per connection is calculated using the average daily consumption and the total number of connections.
- (5) The average ERUs per Connection is calculated using the average gpd per connection and the gpd per connection for a single family residence.

Table 2-10 further distills equivalent residential units into an equivalent employee unit, which is useful for future employment water use projection. Employment consumption considers all customer classes except for residential customers, and assumes all employees use the same amount of water.

Table 2-10 Equivalent Employee Units 2015 and 2017		
	2015	2017
Employment Consumption (gpd) ⁽¹⁾⁽²⁾	1,028,947	927,676
Employee Population	27,637	28,505
gpd/employee	37.2	32.5
Average gpd/employee	35	

Notes:

- (1) Employment Consumption includes Commercial, Government, School, Municipal, and Commercial-Variou customer class information
- (2) Water consumption from City of Lynnwood Utility Billing Summary 2015 and 2017. Utility Billing summary was not available for 2016. Converted to gpd from CCF.
- (3) 2015 and 2017 employment population are from PSRC (Table 2-1); 1,373 employees were subtracted from the employment population to account for the employment population in the area served directly by AWWD.
- (4) Average gpd/employee assumes that all employees are equal.

2.5 Total City Population and Employment Forecasts

Population and employment forecasts developed from the planning efforts cited are summarized in Table 2-12 and 2-13. Population information for years 2010, 2012, and 2018 is obtained from OFM, 2018. Population information for years 2025 and 2035 is obtained from PSRC residential population forecast. Population for year 2032 is calculated using straight-line interpolation between 2025 and 2035 and population for year 2038 is calculated using straight line interpolation between 2035 and 2040. Historical and projected populations are shown in Figure 2-1.

Table 2-12 Population Forecast		
Year	Population	Source
2010	35,836	See Table 2-1
2012	35,900	See Table 2-1
2018	38,260	OFM 2018
2025	44,131	PSRC Residential Population Forecast
2032	51,570	Interpolation
2035	54,758	PSRC Residential Population Forecast
2038	58,342	Interpolation

Table 2-13 Employment Forecast		
Year	Employment	Source
2010	25,933	See Table 2-1
2012	27,058	See Table 2-1
2018	30,664	Interpolation
2025	34,159	PSRC Forecast
2032	38,262	Interpolation
2035	40,975	PSRC Forecast
2038	44,956	Interpolation

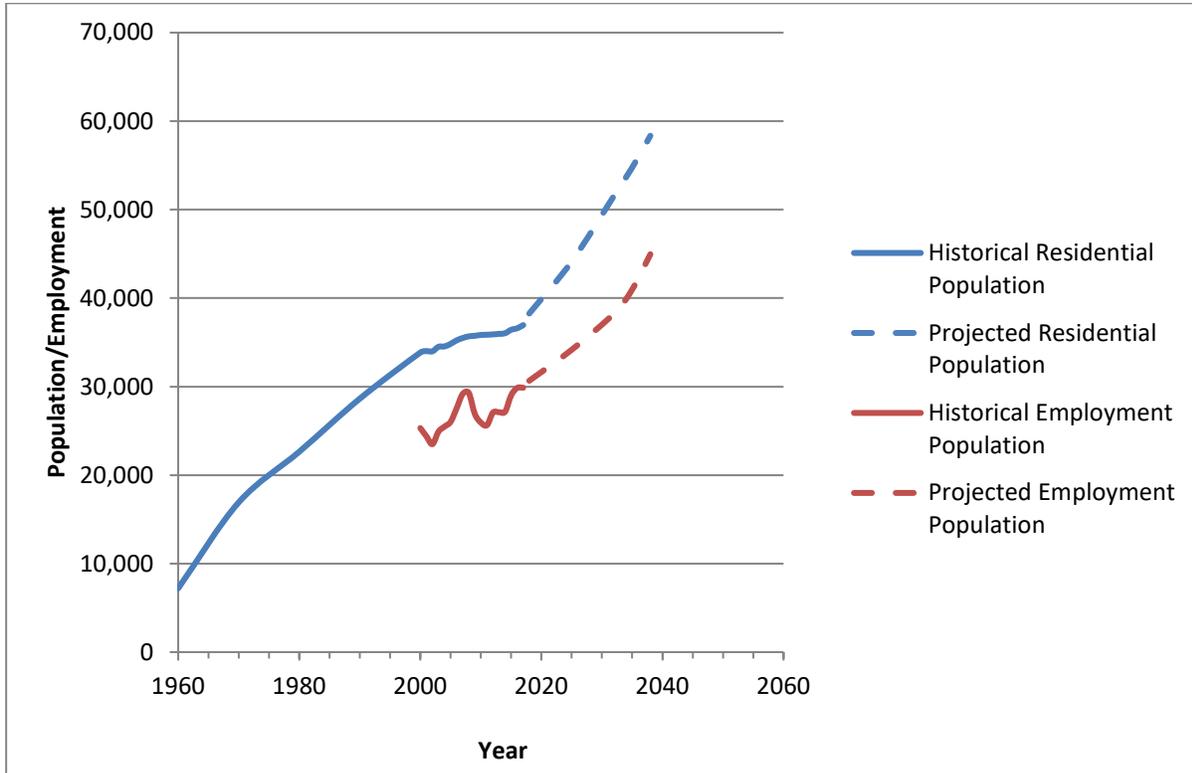


Figure 2-1 Historical and Projected Populations

2.6 Water Use Projections

Using the projected City residential populations as shown in Table 2-12, subtracting out the AWWD direct and subtract accounts within the City limits, and assuming the 2010 percentage of residential population for single-family and multi-family occupied residences (see Table 2-2), water use was projected for the City water service area as summarized in Table 2-14. The single and multi family occupied population percentage rates were assumed to remain the same in future forecasting as they were in 2010.

The projected employment population as shown in Table 2-13 was used in Table 2-14, less the AWWD direct accounts.

Table 2-14 Projected Service Area ADD Water Demands (Without Conservation)

Year	Projected Single Family Population	Projected Single Family ERUs ⁽¹⁾	Single Family Residential Water Demand (gpd) ⁽²⁾	Projected Multi Family Population	Projected Multi Family ERUs ⁽¹⁾	Projected Multi Family Residential Water Demand (gpd) ⁽²⁾	Projected Employment (from Table 2-13) ⁽³⁾	Projected Employment Water Demand (gpd) ⁽⁴⁾	Water Demand (gpd)	Total Water Demand (gpd) ⁽⁵⁾	Distribution System Leakage (gpd) ⁽⁶⁾
2018	18,824	7,185	1,098,726	16,396	6,947	866,516	29,291	1,021,877	2,987,120	3,503,802	516,683
2025	21,712	8,287	1,267,326	18,912	8,014	999,483	32,786	1,143,807	3,410,617	4,000,552	589,935
2032	25,372	9,684	1,480,954	22,100	9,364	1,167,963	36,889	1,286,949	3,935,866	4,616,653	680,788
2038	28,704	10,956	1,675,428	25,002	10,594	1,321,336	43,583	1,520,483	4,517,247	5,298,596	781,349

Notes:

- (1) Projected ERUs based on 2.62 persons/unit for Single Family and 2.36 persons/unit for Multi Family residences.
- (2) Uses 153 gpd/ERU for Single Family residences and 125 gpd/ERU for Multi Family residences.
- (3) Projected employment subtracts out 1,373 employees from total to account for AWWD direct customers employment population.
- (4) Calculated based on average gpd/Employee.
- (5) Total of projected water use and Distribution System Leakage (DSL) for water.
- (6) DSL based on 14.7% average loss.
- (7) AWWD direct and subtract account populations have been removed/accounted for in the Single Family Occupied Population numbers.

THIS PAGE INTENTIONALLY BLANK.

2.6.1 Conservation

The City maintains an ongoing water conservation program in recognition of the significant water demands that population growth are placing on the Puget Sound regional water supply. Efficient use of the existing supply is a central component of sustaining the City’s needs. The goal of the conservation program is to eliminate waste and encourage the City’s customers to use water wisely, thereby reducing per capita use on a long-term basis.

Table 2-8 indicates water use per ERU has decreased between 2015 and 2017. It is believed this reduction is in part due to conservation measures and serves as documentation that the City’s conservation efforts are successful.

The City buys City of Everett water through the AWWD. Everett has established the Everett Water Utility Committee (EWUC) to communicate system information and to coordinate activities. The City is a member of EWUC, and thus shares in the system-wide conservation goal. The City of Everett shows the following forecast for programmatic demand reduction in their 2007 Plan:

Table 2-15 Annual Conservation Goal	
Year	Annual Reduction Goal
2007	1.5%
2008	1.4%
2009	1.3%
2010	1.3%
2011	1.3%
2012	1.2%

As conservation methods are implemented (including conservation water pricing, education, indoor and outdoor conservation kits, toilet and washer rebates), a decrease in conservation will be noticed. Estimating out to year 2038, and assuming a continual decline in water use demand, this water system plan assumes annual conservation beginning in 2012 at 1.2 percent, reducing to 0.5 percent in 2032, and 0.46% in 2038, based on the trend the City of Everett shows in their 2007 Plan. It is possible that more or less savings will be realized within the City’s service area; future water system plans will adjust these projections based on actual demand reductions. With this conservation goal, the water demand forecast has been adjusted on a City-Wide basis. The projected demands with conservation accounted for are summarized in Table 2-16.

THIS PAGE INTENTIONALLY BLANK.

Table 2-16 Projected Service Area ADD Water Demands (With Conservation)

Year	Projected Single Family Population	Projected Single Family ERUs ⁽¹⁾	Conservation	Projected Single Family Residential gpcd/ERU with Conservation ⁽²⁾	Projected Single Family Residential Water Demand (gpd)	Projected Multi Family Population	Projected Multi Family ERUs ⁽¹⁾	Multi Family Residential gpcd/ERU with Conservation ⁽²⁾	Projected Multi Family Residential Water Demand (gpd) ⁽²⁾	Projected Employment (from Table 2-13)	Projected Employment gpcd/Employee with Conservation ⁽³⁾	Projected Employment Water Demand (gpd)	Water Demand (gpd)	Total Water Demand (gpd) ⁽⁵⁾	Distribution System Leakage (gpd) ⁽⁴⁾
2018	18,824	7,185	1.00%	141	1,013,682	16,396	6,947	116	804,723	30,864	32	997,941	2,816,346	3,303,490	487,144
2025	21,712	8,287	0.75%	133	1,100,854	18,912	8,014	109	873,926	32,786	30	998,092	2,972,871	3,487,089	514,218
2032	25,372	9,684	0.50%	127	1,232,732	22,100	9,364	105	978,618	36,889	29	1,076,129	3,287,479	3,856,114	568,636
2038	28,704	10,956	0.46%	127	1,388,195	25,002	10,594	104	1,102,034	43,583	29	1,265,558	3,755,787	4,405,426	649,639

Notes:

- (1) Projected ERUs based on 2.62 persons/unit for Single Family and 2.36 persons/unit for Multi Family residences.
- (2) Conservation based on 153 gpd/ERU Single Family residence and 125 gpd/ERU Multi Family residence.
- (3) Conservation based on 35 gpd/Employee.
- (4) Distribution System Leakage (DSL) based on 14.7% average loss.
- (5) Total of projected water use and DSL for water.
- (6) AWWWD direct and subtract account populations have been removed/accounted for in the Single Family Occupied Population numbers.

THIS PAGE INTENTIONALLY BLANK.

2.6.2 Peak Water Demand

The City's maximum day demand through the master meter has averaged approximately 1.7 times the average day demand (Table 2-4 of 2012 WSP) . This factor is used to project maximum day demands.

The maximum quantity of water purchased over a one-hour period during a maximum day demand is the peak hour demand. If precise records of peak hour demand are not available, the peak hour demand is often expressed in terms of a peaking factor. A peaking factor is defined as the ratio of peak hour to the maximum day demand. It is generally accepted that peak hour factors range from 1.5 to 2.5. The DOH *Water System Design Manual*, provides a methodology for calculating peak hour demand (PHD). The generalized equation is as follows:

$$PHD = (MDD/1440)[(C)(N) + F] + 18$$

Where:

PHD = *Peak Hourly Demand, (gallons per minute, gpm)*
 C= *Coefficient Associated with Ranges of ERUs*
 N= *Number of ERUs*
 F= *Factor Associated with Ranges of ERUs*
 MDD= *Maximum Day Demand, (gpd/ERU)*

The values for C and F of the peak hour demand formula are taken from the DOH *Water System Design Manual*, Table 5-1. C is equal to 1.6 and F is equal to 225. Based on the 2010 maximum day demand and the above formula, the City's maximum day to peak hour factor is approximately 1.62.

The projected average day, maximum day, and peak hour demand for the City through 2038 are summarized in Table 2-17.

Table 2-17 Projected City-Wide Average Day, Maximum Day, and Peak Hour Demand				
Year	Projected Average Day Demand (mgd)⁽¹⁾	Projected Maximum Day Demand (mgd)⁽²⁾	Projected Peak Hour Demand (mgd)⁽²⁾	Projected Peak Hour Demand (gpm)
2018	3.50	5.96	9.63	6,689
2025	4.00	6.80	11.00	7,637
2032	4.62	7.85	12.69	8,813
2038	5.30	9.01	14.57	10,115

Notes:

- (1) Without conservation.
- (2) Projected maximum day demand is based on an average day to maximum day peaking factor of 1.70.
- (3) Projected peak hour demand is based on a maximum day to peak hour peaking factor of 1.62.

Figure 2-2 is a graphical representation of the water demand between years 1998 and 2038.

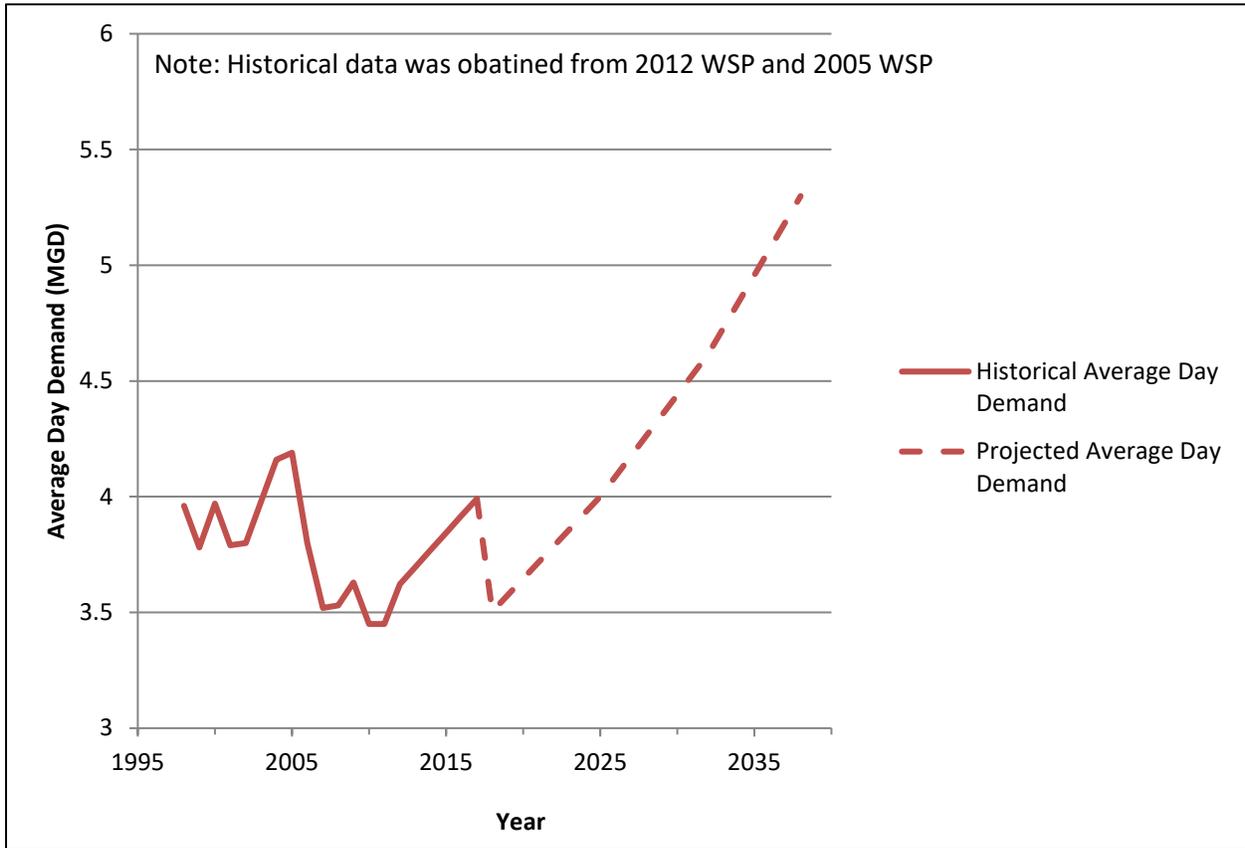


Figure 2-2 Water Demand between 1998 and 2038

Table 2-18 provides previous water demand estimates and current water demand estimates for years 2032.

Table 2-18 Water Demand¹			
	Average Daily Demand (gpm)	Maximum Day Demand (gpm)	Peak Hour Demand (gpm)
From 2012 WSP (For Year 2032)	3,613	6,143	9,941
From 2015 Analysis	3,938	6,698	10,838
Estimated for 2038 (2018 Amendment)	3,679	6,255	10,115
Notes: (1) Without conservation.			

The water demand used in 2015 analysis was compared to the required water demand for the projected 2038 population and employment as shown in Table 2-18. In all cases, the ADD, MDD, and PHD used in the 2015 analysis exceed the projected 2038 water demands, as shown on Table 2-18. Since no additional improvements are needed to meet the 2015 Analysis water demands, the system is capable of meeting the 2038 water demands with no additional improvements.

THIS PAGE INTENTIONALLY BLANK.