CHAPTER 4

WATER DEMANDS

Panorama Heights Booster Pump Station

INTRODUCTION

A detailed analysis of system demands is crucial to a water purveyor's planning efforts. A demand analysis first identifies current supplies and demands to determine if the existing system can effectively provide an adequate quantity of water to its customers under the most crucial conditions, in accordance with federal and state laws. A future demand analysis identifies projected supplies and demands to determine how much water will be needed to satisfy future water system growth while continuing to meet federal and state laws.

Water system demands determine the size of storage reservoirs, supply facilities, water mains, and treatment facilities. Several different types of demands were analyzed and are addressed in this chapter, including average day demand (ADD), maximum day demand (MDD), peak hour demand (PHD), fire flow demand, future demands, and a conservation demand reduction forecast.

The magnitude of water demands is typically based on three main factors: 1) population; 2) weather; and 3) water use classification. Population and weather have the two largest impacts on

water system demands. Population growth has a tendency to increase the annual demand, whereas high temperatures have a tendency to increase the demand over a short period of time. Population does not solely determine demand, because different populations use varying amounts of water. Use varies based on the number of users in each type of customer class, land use density, and irrigation practices. Water use efficiency efforts will also impact demands and can be used to accommodate a portion of system growth without increasing a system's supply capacity.

Certificate of Water Availability

In accordance with the requirements of the Growth Management Act (GMA), the City of Bonney Lake (City), must identify that water is available prior to issuing a building permit. A Certificate of Water Availability (CWA) is issued if there is sufficient water supply to meet the domestic water service and fire flow requirements of the proposed customer. The requirement for providing evidence of an adequate water supply was codified in 1990 under Title 19.27.097 of the Revised Code of Washington (RCW) in the Building Code Section. To assist governments with implementing these requirements, the Washington State Department of Health (DOH) has developed a handbook titled *Guidelines for Determining Water Availability for New Buildings*.

CURRENT POPULATION AND SERVICE CONNECTIONS

Residential Population Served

As discussed in **Chapter 3 – *Land Use and Population***, it is estimated that in 2018, the City's water system provided service to approximately 38,797 people. It is estimated that approximately 19,562 of these people are located within the City limits, and approximately 19,235 people are located outside the City limits. Therefore, approximately 50 percent of the total population served is inside the City. These population numbers are slightly different between **Chapter 3 – *Land Use and Population*** and this chapter due to when they were calculated. **Chapter 3 – *Land Use and Population*** numbers are from April 2014, and the numbers in this chapter are from 2018. The computation of these numbers is discussed later in this chapter, and a more detailed discussion of the City's population and household trends is in **Chapter 3 – *Land Use and Population***.

By the end of 2018, the City provided water service to 12,876 customer accounts, of which 13,211, or approximately 95 percent were single-family residential customers, 335 accounts, or approximately 2 percent, were multi-family residential customers, and 363 accounts, or approximately 3 percent, were non-residential customers.

In terms of equivalent residential units (ERUs), at the end of 2018, the City provided water service to 12,876 single-family ERUs (71 percent), 1,043 multi-family residential ERUs (6 percent), 2,621 non-residential ERUs (14 percent), and 1,641 ERUs (9 percent) were associated with non-revenue water and leakage.

Water Use Classifications

The City has divided its water customers into six different classes for billing purposes. For planning purposes, the water customers have been combined into three different groups: 1) single-family residential; 2) multi-family residential; and 3) non-residential. The non-residential user group includes: commercial and public, schools, and irrigation and parks billing classes. Note that the single-family residential classification includes duplexes and that multi-family is considered three or more residential units. The demand analysis in this, water system plan (WSP) documents the water use patterns of these three user groups. **Table 4-1 – *Historical Water Connections*** shows historic connection data by customer class for 2009 through 2018.

EXISTING WATER DEMANDS

Water Consumption

Water consumption is the amount of water used by all customers of the system, as measured by the customers' meters, and is used for billing purposes.

As shown in **Chart 4-1 – *2018 Water Connections by Customer Class***, the single-family residential class represents approximately 95 percent of all connections, but only 78 percent of total system consumption, as shown in **Chart 4-2 – *2018 Consumption by Customer Class***. This is due to the lower consumption per connection of single-family residential customers as compared to other customers. **Table 4-2** – ***Average Annual Metered Consumption and Service Connections*** shows the historical average number of connections, average annual consumption, and average daily consumption per connection of each customer class for the City from 2009 through 2018. As shown in **Table 4-2** – ***Average Annual Metered Consumption and Service Connections***, over the last 10 years, single-family residential customers used an average of approximately 196 gallons per day (gpd) per connection, compared to multi-family customers that used an average of approximately 521 gpd per connection, and the non-residential customers that used an average of approximately 1,356 gpd per connection. The higher consumption of non-single-family customers is expected, since these customers include multi-family residential customers, where one connection may serve several units, and commercial customers that include the system's highest individual water users.

Table 4-1
Historical Water Connections

Utility Connections (Accounts)	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Connections by Customer Class										
Commercial & Public	167	169	174	173	178	182	197	197	202	210
Inside Single-Family	5,648	5,699	5,778	5,862	6,043	6,184	6,255	6,338	6,444	6,496
Outside Single-Family	5,688	5,822	5,958	6,076	6,275	6,390	6,433	6,432	6,372	6,380
Inside Multi-Family[1]	120	131	132	132	89	99	100	103	103	103
Outside Multi-Family[1]	301	300	303	315	232	231	231	231	231	232
Irrigation & Parks	130	132	137	143	152	154	151	149	150	153
Schools	17	17	15	15	15	13	-	-	-	-
Total Connections	**12,071**	**12,270**	**12,497**	**12,716**	**12,984**	**13,253**	**13,367**	**13,450**	**13,502**	**13,574**
Total Residential Connections Inside	5,768	5,830	5,910	5,994	6,132	6,283	6,355	6,441	6,547	6,599
Total Residential Connections Outside	5,989	6,122	6,261	6,391	6,507	6,621	6,664	6,663	6,603	6,612
Total Residential Connections	11,757	11,952	12,171	12,385	12,639	12,904	13,019	13,104	13,150	13,211
Percent Residential Connections	**97%**	**97%**	**97%**	**97%**	**97%**	**97%**	**97%**	**97%**	**97%**	**97%**
Population (Capita)										
Total Population Served	**34,684**	**35,476**	**36,310**	**37,187**	**37,205**	**38,009**	**38,335**	**38,604**	**38,752**	**38,797**
Total Population Growth Rate	*-2.5%*	*2.3%*	*2.4%*	*2.4%*	*0.0%*	*2.2%*	*0.9%*	*0.7%*	*0.4%*	*0.1%*
Population Served Inside City	17,161	17,385	17,677	18,004	18,258	18,689	18,895	19,142	19,446	19,562
Population Served Outside City	17,523	18,092	18,633	19,184	18,947	19,320	19,440	19,462	19,307	19,235
Average Single-Family Connections	11,282	11,429	11,629	11,837	12,128	12,446	12,631	12,729	12,793	12,846
Average Multi-Family Connections	418	426	433	441	384	326	331	333	334	335
Average Non-Residential Connections	311	316	322	329	338	347	349	347	349	358
Average Total Connections	***12,010***	***12,171***	***12,384***	***12,607***	***12,850***	***13,119***	***13,310***	***13,409***	***13,476***	***13,538***
Residential Connections Growth Rate	1.0%	1.7%	1.8%	1.8%	2.1%	2.1%	0.9%	0.7%	0.4%	0.5%
Total Annual Growth	1.0%	1.6%	1.9%	1.8%	2.1%	2.1%	0.9%	0.6%	0.4%	0.5%
Total Single-Family Connections	11,336	11,521	11,736	11,938	12,318	12,574	12,688	12,770	12,816	12,876
Number of Equivalent Residential Units (ERU)										
Total Single-Family ERU	11,336	11,521	11,736	11,938	12,318	12,574	12,688	12,770	12,816	12,876
New Units	109	185	215	202	380	256	114	82	46	60
Growth in SF ERU	1.0%	1.6%	1.9%	1.7%	3.2%	2.1%	0.9%	0.6%	0.4%	0.5%
Total MF Connections	421	431	435	447	321	330	331	334	334	335
Total MF Units	1,989	2,148	2,283	2,459	1,918	1,972	1,978	1,996	1,996	1,929
Total Multi-Family ERU	900	966	1,024	1,097	482	1,011	971	1,097	1,018	1,043
Growth in MF ERU	-31.4%	7.4%	5.9%	7.1%	-28.2%	2.8%	0.3%	0.9%	0.0%	0.3%
Total Non-ResConnections	314	318	326	331	345	349	348	346	352	363
Total Non-Residential ERU	2,281	2,040	2,001	2,201	2,896	2,417	2,455	2,661	2,457	2,621
Growth in Non-Res ERU	5.6%	-10.6%	-1.9%	10.0%	31.6%	-16.5%	1.6%	8.4%	-7.7%	6.7%
Total Billed ERU Served	**14,517**	**14,527**	**14,761**	**15,236**	**15,696**	**16,002**	**16,114**	**16,527**	**16,291**	**16,540**
UnBilled and DSL ERU	3,655	2,615	3,388	2,953	2,164	1,983	2,533	1,934	1,625	1,641
TOTAL ERU SERVED	**18,172**	**17,142**	**18,148**	**18,189**	**17,860**	**17,985**	**18,647**	**18,461**	**17,916**	**18,181**
Annual Total Growth in ERU	*2.2%*	*-5.7%*	*5.9%*	*0.2%*	*-1.8%*	*0.7%*	*3.7%*	*-1.0%*	*-3.0%*	*1.5%*
Mid-Year Number (ERU)	**17,977**	**17,657**	**17,645**	**18,169**	**18,025**	**17,923**	**18,316**	**18,554**	**18,188**	**18,048**
Residential Growth Rate (ERU)	*-2.4%*	*2.1%*	*2.2%*	*2.2%*	*-1.8%*	*6.1%*	*0.5%*	*1.5%*	*-0.2%*	*0.6%*
Non-Residential Growth Rate (ERU)	*5.6%*	*-10.6%*	*-1.9%*	*10.0%*	*31.6%*	*-16.5%*	*1.6%*	*8.4%*	*-7.7%*	*6.7%*
Non-Billed and DSL Growth Rate (ERU)	*18.5%*	*-28.5%*	*29.5%*	*-12.8%*	*-26.7%*	*-8.4%*	*27.7%*	*-23.7%*	*-16.0%*	*1.0%*

Chart 4-1
2018 Water Connections by Customer Class

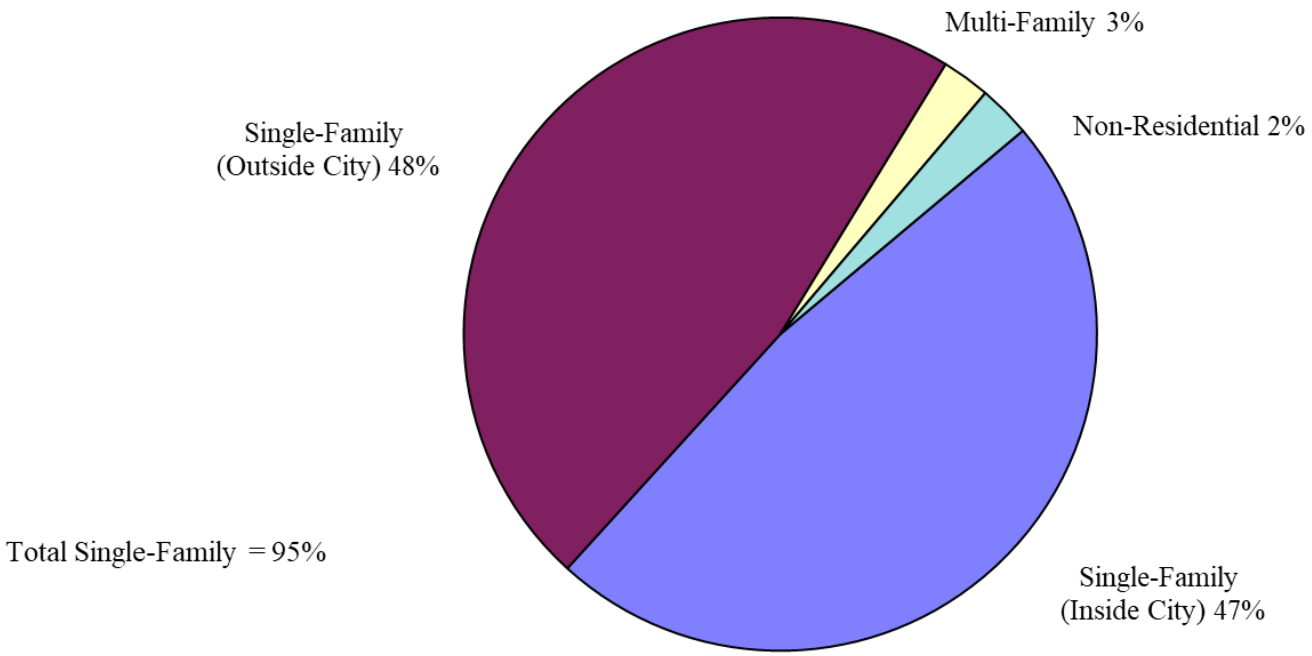

Chart 4-2
2018 Consumption by Customer Class

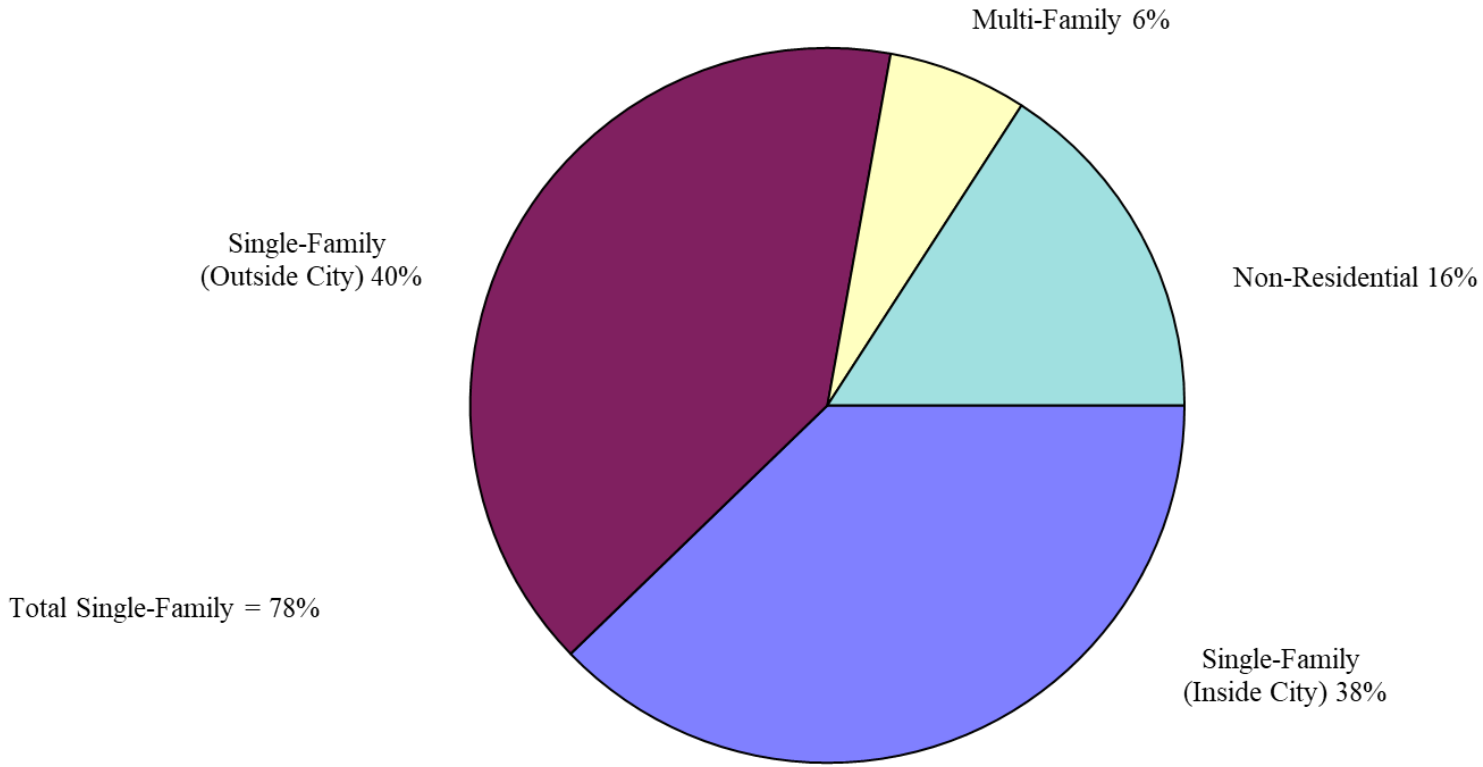

Table 4-2
Average Annual Metered Consumption and Service Connections

Customer Class				
Year	**Single-Family**	**Multi-Family**	**Non-Residential**	**Totals**
Average Number of Connections				
2009	11,282	418	311	12,010
2010	11,429	426	316	12,171
2011	11,629	433	322	12,384
2012	11,837	441	329	12,607
2013	12,128	384	338	12,850
2014	12,446	326	347	13,119
2015	12,631	331	349	13,310
2016	12,729	333	347	13,409
2017	12,793	334	349	13,476
2018	12,846	335	358	13,538
Average Annual Consumption (1,000 gallons)				
2009	877,010	69,964	177,331	1,124,305
2010	788,468	66,664	140,709	995,842
2011	793,226	69,871	136,580	999,678
2012	820,921	75,659	151,852	1,048,432
2013	843,755	71,694	163,816	1,079,265
2014	887,032	71,954	172,021	1,131,007
2015	960,132	73,694	186,417	1,220,242
2016	900,047	77,651	188,397	1,166,095
2017	949,730	75,422	182,053	1,207,204
2018	925,402	75,018	188,465	1,188,885
Average Daily Consumption per Connection (gal/day/connection)				
2009	213	459	1,565	
2010	189	429	1,220	
2011	187	442	1,162	
2012	189	469	1,263	(Leap Year)
2013	191	512	1,328	
2014	195	606	1,358	
2015	208	611	1,466	
2016	193	638	1,483	(Leap Year)
2017	203	619	1,429	
2018	197	614	1,444	
10-yr Avg	**196**	**521**	**1,356**	

Table 4-3 – *2018 Largest Water Users* shows the largest water users of the system in 2018, and their total amount of metered consumption for the year. The total water consumption of these 20 water accounts represented approximately 4.4 percent of the system's total consumption in 2018. The list of accounts in the table consists of commercial facilities, schools, irrigation, one single-family residential leak, and multi-family residences.

Table 4-3
2018 Largest Water Users

Name	Address	City Limits[1]	Annual Consumption (gallons per year)
Fred Meyer	20901 State Route 410	In	4,985,420
Mt View Middle School (Irrigation)	10921 199th Avenue Court East	In	3,576,936
North Tapps Middle School (Irrigation)	20029 12th Street East	Out	3,311,396
Four Lakes Apartments (Irrigation)	6821 Udall Street Southeast	Out	3,288,956
Cedar Ridge Retirement Center	9515 198th Avenue East	In	3,231,360
Bonney Lake High School (Irrigation)	10920 199th Avenue Court East	In	3,193,212
Haggen Foods	1406 Lake Tapps Parkway	Out	3,138,608
Pink Elephant Car Wash	19311 State Route 410	In	2,953,852
Crestwood Elementary	3914 West Tapps Drive	Out	2,830,432
Red Robin (Irrigation)	9401 192nd Avenue East	In	2,305,336
Fairweather Cove (Irrigation)	17501 16th Street Court East	Out	2,171,444
Applebee's Restaurant	9430 192nd Avenue East	In	2,148,256
Post Office	18429 Veterans Memorial Drive East	In	2,108,612
Costco (Irrigation)	9801 204th Avenue East	In	2,051,016
Safeway	21301 State Route 410	In	1,875,984
Evergreen Way (Irrigation)	6202 Evergreen Way	Out	1,867,008
Home Depot (Irrigation)	9602 214th Aveneue East	In	1,851,300
Lake Tapps Elementary School (Irrigation)	1320 178th Avenue East	Out	1,846,064
Heatherwood (Irrigation)	1108 59th Street Southeast	Out	1,840,828
Bonney Lake High School	10920 199th Avenue Court East	In	1,754,060
Largest Water Users Total			**52,330,080**
Water System Total			**1,188,884,664**
Percent of Total			**4.4%**

Note:

[1]In = Inside City Limits; Out = Outside City Limits

Average Day Demand

Average Day Demand (ADD) is the total amount of water delivered to the system in a year divided by the number of days in the year. ADD is determined from the system's historical water use data and can be used to project future demands. ADD data are typically used to determine standby storage requirements for water systems. Standby storage is the volume of a reservoir used to provide water supply under emergency conditions when supply facilities are out-of-service. Water production records from the City's wells, springs, and wholesale sources were reviewed to determine the system's ADD.

Maximum Day Demand

Maximum Day Demand (MDD) is the maximum amount of water used throughout the system during a 24-hour time period of a given year. MDD is typically determined from the combined flow of water into the system from all supply sources and water reservoirs on the peak day. MDD typically occurs on a hot summer day when lawn watering is occurring throughout much of the system. In accordance with Washington State Administrative Code (WAC) 246-290-230 – Distribution Systems, the distribution system shall provide fire flow at a minimum pressure of 20 pounds per square inch (psi) during MDD conditions. Supply facilities (i.e., wells, springs, pump stations, interties) are typically designed to supply water at a rate that is equal to or greater than the system's MDD.

Peak Hour Demand

Peak Hour Demand (PHD) is the maximum amount of water used throughout the system, excluding fire flow, during a 1-hour time period of a given year. PHD, like MDD, is typically determined from the combined flow of water into the system from all supply sources and water reservoirs. In accordance with WAC 246-290-230 – Distribution Systems, new public water systems or additions to existing systems shall be designed to provide domestic water at a minimum pressure of 30 psi during PHD conditions. Equalizing storage requirements are typically based on PHD data.

Maximum Month Demand

Maximum month demand is the maximum amount of water used over a 1-month period. It is expressed in terms of gallons per day, which is an average of the total demand in gallons over one month divided by the number of days in the month. This demand can be used to see how different summers compare from year to year and how peak MDD is compared to average summer usage.

4-Day Maximum Demand

4-Day Max Demand (4DMD) is the maximum amount of water used over a consecutive 4-day period. It is expressed in terms of gallons per day, which is an average of the total demand in gallons over the 4-day period divided by 4 days. This demand can be used to see how a MDD compares to a longer peak period. It is also used by TPU to track how big peaks are in a system and calculate wholesale water system development charges.

Water Supply

Water supply, or production, is the total amount of water supplied to the system, as measured by the meters at each supply source. Water supply is different than water consumption, in that water supply is essentially the recorded amount of water put into the system and water consumption is the recorded amount of water taken out of the system. The measured amount of water supply of any system is typically larger than the measured amount of water consumption, due to non-metered water use and water loss (i.e., distribution system leakage). **Table 4-4** – ***Historical Water Supply and System Demand*** summarizes the total amount of water supplied to the City's system from 2009 through 2018 and the calculated ADD for each year.

Table 4-4
Historical Water Supply and System Demand

Year	Annual Supply		Average Daily Demand	
	(gallons per year)	(afy)	(gpm)	(MGD)
2009	1,408,433,000	4,323	2,680	3.86
2010	1,176,247,000	3,610	2,238	3.22
2011	1,230,755,000	3,777	2,342	3.37
2012	1,252,663,000	3,845	2,377	3.42
2013	1,229,826,000	3,774	2,340	3.37
2014	1,272,342,000	3,905	2,421	3.49
2015	1,412,783,657	4,336	2,688	3.87
2016	1,302,437,000	3,997	2,478	3.57
2017	1,327,824,000	4,075	2,526	3.64
2018	1,307,096,000	4,012	2,487	3.58

Table 4-5 – ***Existing Per Capita Demand*** presents the computation of the existing system per capita demand, based on 2018 data. As shown in the table, the residential population served by the City's water system is approximately 35,584, and is based on the recorded number of single-family residential units served and the average residential household size. This population number and the City's residential consumption records for 2018 were used to arrive at the existing per capita demand of 71 gpd.

Table 4-6 – *Multi-Family and NonResidential Demand* presents a computation of multi-family and nonresidential demands compared to single-family demand. Periodically, the City conducts an inventory of all multi-family units. This was done in 2013 and 2018. The results of the latest inventory and the billing records for multi-family consumption were used to calculate the ADD for a multi-family unit. This number was compared to the ADD for a single-family household. The multi-family ADD was consistently 54 percent of single-family ADD. For the same comparison years, NonResidential demands varied between 681 percent to 723 percent of single-family ADD.

Table 4-5
Existing Per Capita Demand

2018 Single-Family Population Served	
2018 Single-Family Units Inside City (ERUs at mid-year)	6,470
Average Owner-Occupied Household Size (People Per Unit)	2.90
Calculated 2014 Single-Family Population Served Inside City	18,731
2018 Single-Family Units Outside City (ERUs at mid-year)	6,433
Average Owner-Occupied Household Size (People Per Unit)	2.62
Calculated 2018 Single-Family Population Served Outside City	16,853
Calculated 2018 Total Single-Family Population Served	**35,584**
2018 Total Annual Supply	
2018 Total Annual Single-Family Consumption (gallons)	925,402,412
Existing Per Capita Demand (gal/day/capita)	**71**

Table 4-6
Multi-Family and Non-Residential Demand

Multi-Family Units	**2013**	**2018**	**Average**
Multi-Family Units	2,019	2,031	
Occupancy Rate	95%	95%	
Multi-Family Units (Occupied Unit)	1,918	1,929	
Total Annual Multi-Family Consumption (gallons per year)	71,693,556	75,017,668	
Multi-Family Average Day Demand (gpd/occupied unit)	**102**	**107**	**104**
Single-Family Units (ERUs at mid-year)	12,128	12,846	
Total Annual Single-Family Consumption (gallons per year)	843,755,220	925,402,412	
Single-Family Average Day Demand (gpd/single-family unit or gpd/ERU)	**191**	**197**	**194**
Multi-Family to Single-Family Ratio	**54%**	**54%**	**54%**
Multi-Family ERUs	1,028	1,043	
Multi-Family Connections	321	335	
ERU/Multi-Family Connection	**3.20**	**3.11**	**3.16**
NonResidential Connections	**2013**	**2018**	**Average**
NonResidential Connections	345	363	
Total Annual NonResidential Consumption (gallons per year)	163,816,488	188,464,584	
NonResidential Average Day Demand (gpd/connection)	**1,301**	**1,422**	**1,362**
Single-Family Connections (ERUs at mid-year)	12,128	12,846	
Total Annual Single-Family Consumption (gallons per year)	843,755,220	925,402,412	
Single-Family Average Day Demand (gpd/single-family unit or gpd/ERU)	**191**	**197**	**194**
NonResidential to Single-Family Ratio	**681%**	**723%**	**702%**
NonResidential ERUs	2,350	2,623	
NonResidential Connections	345	363	
ERU/NonResidential Connection	**6.81**	**7.23**	**7.02**

Table 4-7 – *2018 Demands by Pressure Zone* shows the average demand in the City's main 748 Pressure Zone and four boosted pressure zones, based on 2018 water demand data.

Table 4-7
2018 Demands by Pressure Zone

Pressure Zone	2018 Annual Supply		Average Day Demand		Portion of Total Demand
	(gallons per year)	(afy)	(gpm)	(MGD)	(%)
Lakeridge 810[1]	115,611,621	355	220	0.32	10%
Ponderosa 800[2]	165,419,565	508	315	0.45	14%
Summit 790	4,254,771	13	8	0.01	1%
Pinnacle Estates 795	12,084,826	37	23	0.03	1%
Bonney Lake 748[3]	868,723,817	2,666	1,653	2.38	74%
Total	**1,166,094,600**	**3,579**	**2,219**	**3.19**	**100%**

Notes:
[1]Includes unmetered flows to the 47th Street and 166th Avenue Zones.
[2]Assumes 100 percent of TPU wholesale water is consumed in this zone.
[3]Includes unmetered flows to the Rhodes, Angeline Valley, and lower zones.

Distribution System Leakage

An important factor in analyzing water system demands is knowing how much water is consumed knowingly by City customers (e.g., metered residential and non-residential accounts, operation and maintenance (O&M) uses, firefighting, etc.) and how much is consumed or lost unintentionally (e.g., theft, meter inaccuracies, and leaks). Water use efficiency programs developed under WAC 246-290-810 require purveyors to track and report to DOH how much water is lost to system leakage. Total production (TP) can be divided into two categories: Authorized Consumption (AC) and Distribution System Leakage (DSL). WAC 246-290-820 defines DSL as the difference between total water produced and authorized consumption (DSL = TP – AC). Prior to water use efficiency programs, water was classified as accounted-for and unaccounted-for water. These terms are no longer used. AC includes metered consumption by all City customers, as tracked by the City's Finance Department: metered consumption by the City's O&M staff for City uses; unmetered and known, but estimated uses such as firefighting and water main breaks. In a typical water system, there are several sources of water loss, or DSL, including water system leaks, inaccurate meters, and illegal water system connections or water use.

The Water Use Efficiency Rule, which became effective January 2007, sets a standard for DSL of less than 10 percent averaged over the last 3-year period. WAC 246-290-820(1)(b)(i) requires purveyors to implement a stricter water use efficiency program until their DSL 3-year average is less than 10 percent. To meet this standard, the City will continue to implement the measures discussed in the Water Use Efficiency Program. These measures include water main replacements, leak detection programs, system-wide service meter replacements, source meter calibration, and increased monitoring of water used for construction and firefighting.

Chart 4-3 – *Revenue and Non-Revenue Water Distribution*, shows the different classifications of all water produced. This chart divides all water into revenue generating water and non-revenue water and shows the different components that make up DSL water. The chart also describes how the various categories, or classifications, are specific to the City's system.

Chart 4-3
Revenue and Non-Revenue Water Distribution

<table>
<tr><td rowspan="10">Total Water Produced (TP)
(water supplied from all sources)</td><td rowspan="5">Own Sources: Victor Falls, Grainger Springs, Tacoma Point, & Ball Park</td><td>Exported Water</td><td rowspan="3">Authorized Consumption (AC)
to customers, other purveyors, contractors, fire departments, and the City</td><td rowspan="3">Billed Consumption to customers, other purveyors, contractors.</td><td>Billed Water Exported
(Occasionally to Auburn & Tapps Island)</td><td rowspan="3">Revenue Water
(money collected)</td></tr>
<tr><td rowspan="9">Water Supplied to the Bonney Lake water system</td><td>Billed Metered Consumption
(customers and contractors)</td></tr>
<tr><td>Billed Unmetered Consumption
(currently not applicable)</td></tr>
<tr><td rowspan="2">Unbilled Consumption to the City and fire departments</td><td>Unbilled Metered Consumption
City uses (i.e., flushing & street washing)</td><td rowspan="7">Non Revenue Water
(lost revenue)</td></tr>
<tr><td>Unbilled Unmetered Consumption
(Firefighting & water main breaks)</td></tr>
<tr><td rowspan="5">Imported Water (from TPU wholesale interties)</td><td rowspan="5">Distribution System Loss
(DSL) or Unintentional losses</td><td rowspan="2">Apparent Losses and theft</td><td>Unauthorized Consumption
(water theft)</td></tr>
<tr><td>Meter Inaccuracies & Data Errors
(source & customer meters; accounting)</td></tr>
<tr><td rowspan="3">Real Losses or actual water loss through leaks</td><td>Leaks from Transmission & Mains
(leaks from City owned water mains)</td></tr>
<tr><td>Leaks from Service Lines
(leaks from service lines on City side of meter)</td></tr>
<tr><td>Leaks & Overflows from Storage Facilities
(Ponderosa, Lakeridge, Tacoma Point, Peaking Storage)</td></tr>
</table>

Since 2007, when the City started to more closely track water loss, the amount of DSL has ranged between a high of 15.4 percent (2011) and a low of 8.3 percent (2017), as shown in **Table 4-8 – *Authorized Consumption and Distribution System Leakage***. The average amount of DSL over the last 3 years is 9.0 percent. This table also shows unbilled consumption and DSL in terms of ERUs for comparison purposes.

Table 4-8
Authorized Consumption and Distribution System Leakage

Year	Authorized Consumption			Distribution System Leakage						
	Total Water Produced (ccf)	Billed Consumption (ccf)	Unbilled Consumption (ccf)	ccf	gpm	Percent	gpd/ERU	Unbilled ERU	DSL ERU	Total Unbilled and DSL ERU
2009	1,882,932	1,503,082	169,098	210,751	300	11.2%	213	1,627	2,028	3,655
2010	1,572,523	1,331,339	28,086	213,098	303	13.6%	189	305	2,310	2,615
2011	1,645,394	1,336,468	55,444	253,483	361	15.4%	187	608	2,780	3,388
2012	1,674,683	1,401,647	25,370	247,666	352	14.8%	189	274	2,679	2,953
2013	1,644,152	1,442,868	14,554	186,731	266	11.4%	191	156	2,008	2,164
2014	1,700,992	1,512,042	10,202	178,748	254	10.5%	195	107	1,876	1,983
2015	1,888,748	1,631,340	15,584	241,824	344	12.8%	208	153	2,380	2,533
2016	1,741,226	1,558,950	8,372	173,904	247	10.0%	193	89	1,845	1,934
2017	1,775,166	1,613,909	13,375	147,882	210	8.3%	203	135	1,490	1,625
2018	1,747,455	1,589,418	8,438	149,599	213	8.6%	197	88	1,553	1,641
3-year Average					304 gpm	9.0%				

Table 4-9 – *2018 Non-Revenue Water* shows an estimated summary of non-revenue water volumes for 2018. Both authorized O&M uses and unauthorized DSL uses are shown. During 2018, approximately 5.3 percent of non-revenue water was authorized consumption (AC). The remaining 94.7 percent of non-revenue water is, therefore, assumed to be DSL.

Table 4-9
2018 Non-Revenue Water

2018 Non-Revenue Water Classification	Total Amount (ccf)	Percent (%)
Leaking Water Mains (DSL)	149,599	94.7%
Permitted Hydrant Use	3,161	2.0%
Firefighting Activities	1,580	1.0%
Water Main Flushing	3,697	2.3%
Total	**158,037**	**100%**

The amount of water for each classification, except for leaking water mains, was estimated based on City data and estimates. In the future, the City will continue to improved recordkeeping for all known water uses.

Equivalent Residential Units

The demand of each customer class can be expressed in terms of ERUs for demand forecasting and planning purposes. One ERU is equivalent to the amount of water used by an average single-family residence. The number of ERUs represented by the demand of other customer classes is determined from the total demand of the customer class and the unit demand per ERU from the single-family residential demand data.

Table 4-10 – ***Equivalent Residential Units*** presents the computed number of ERUs for each customer class from 2009 through 2018 for the City's WSA. Over the last 10 years, the average ADD per ERU was 197 gpd. The maximum value for an ADD factor for a single-family connection over the last 10 years of data was 213 gpd and occurred in 2009. The demands shown are based on data that was computed from the consumption of each customer class for each year. To convert non-single-family customers to ERUs, the total demand for each customer class was divided by the average single-family demand for each year. This enables the City to understand how other customer classes compare to single-family usage for any given year. For example, total nonresidential customers in 2018 used the same amount of water as 2,621 single-family homes (e.g., 188,464,584 gallons divided by 197 gpd ERU divided by 365 days per year equals 2,621).

Production data were also used to determine demand values for the system. Unlike consumption data, source production data are available from the City's telemetry system on an hourly basis. Therefore, production data can be used to determine, ADD, MDD, and PHD values for each year. Demand values based on production data are presented in **Table 4-11 – *Historic Demand Values***.

Table 4-10
Equivalent Residential Units

Year	Average Number of Connections	Average Annual Demand (gallons)	Demand per ERU[1] (gal/day/ERU)	Total ERU's
Single Family Residential (ERU Basis)				
2009	11,282	877,009,804	213	11,282
2010	11,429	788,468,296	189	11,429
2011	11,629	793,226,324	187	11,629
2012	11,837	820,921,024	189	11,869
2013	12,128	843,755,220	191	12,128
2014	12,446	887,032,256	195	12,446
2015	12,631	960,132,052	208	12,631
2016	12,729	900,047,456	194	12,729
2017	12,793	949,729,616	203	12,793
2018	12,846	925,402,412	197	12,846
10-year Maximum			213	
10-year Average			197	
Multi-Family Residential				
2009	418	69,964,180	213	900
2010	426	66,664,004	189	966
2011	433	69,871,428	187	1,024
2012	441	75,658,704	189	1,097
2013	384	71,693,556	191	1,028
2014	326	71,953,860	195	1,011
2015	331	73,693,708	208	971
2016	333	77,650,628	194	1,097
2017	334	75,421,588	203	1,018
2018	335	75,017,668	197	1,043
Non-Residential				
2009	311	177,331,352	213	2,281
2010	316	140,709,272	189	2,040
2011	322	136,580,312	187	2,001
2012	329	151,852,228	189	2,201
2013	338	163,816,488	191	2,350
2014	347	172,021,300	195	2,417
2015	349	186,416,560	208	2,455
2016	347	188,396,516	194	2,661
2017	349	182,052,728	203	2,457
2018	358	188,464,584	197	2,621
System-Wide Totals				
2009	12,010	1,124,305,336	213	14,462
2010	12,171	995,841,572	189	14,435
2011	12,384	999,678,064	187	14,653
2012	12,607	1,048,431,956	189	15,167
2013	12,850	1,079,265,264	191	15,506
2014	12,881	1,131,007,416	195	15,874
2015	13,081	1,220,242,320	208	16,057
2016	13,188	1,166,094,600	194	16,486
2017	13,268	1,207,203,932	203	16,268
2018	13,335	1,188,884,664	197	16,510

Note:

[1]Demand per ERU is calculated for single-family customers and then applied to all non-single-family customers to convert to a standard ERU.

Bonney Lake Demands

The demands for 2009 through 2018 are shown in **Table 4-11 – *Historic Demand Values***.

An ADD per ERU of 213 gpd, or 0.148 gallons per minute per ERU (gpm/ERU), will be used to forecast ERUs in future years and to estimate future demands. This demand per ERU value will also be used to determine the capacity (in terms of ERUs) of the existing system in **Chapter 7 – *Water System Analysis***.

Table 4-11
Historic Demand Values

Year	ADD[1] (gpd/ERU)	MDD[2] (gpd/ERU)	PHD[2] (gpm/ERU)	Max Month[1] (gpd/ERU)	4DMD[2] (gpd/ERU)
2009	213	465	0.51	397	433
2010	189	446	0.48	321	422
2011	187	424	0.43	317	373
2012	189	404	0.45	331	375
2013	191	397	0.43	313	361
2014	195	382	0.43	334	364
2015	208	460	0.53	410	356
2016	194	381	0.42	323	352
2017	203	452	0.55	375	359
2018	197	492	0.57	378	362
5-yr Max	208	492	0.57	410	364
10-yr Max	213	492	0.57	410	433
5-yr Avg	200	433	0.50	364	358
10-yr Avg	196	420	0.46	343	379

Notes:
[1]From source meter records .
[2]From water system telemetry data.
no data = no reliable data exists

Table 4-12 – *Historical PHD and MDD* lists the dates on which MDDs and PHDs occurred over the last 10 years for which reliable water system telemetry data existed.

Table 4-12
Historical PHD and MDD

Year	Peak Hour Demands			Maximum Day Demand	
	Flow (gpm)	Date	Time	Flow (gpm)	Date
2009	9,141	Tuesday, July 21, 2009	9:00 PM	5,803	Tuesday, July 28, 2009
2010	8,388	Wednesday, July 28, 2010	6:00 AM	5,469	Monday, July 26, 2010
2011	7,596	Thursday, August 4, 2011	9:00 PM	5,194	Friday, August 5, 2011
2012	8,125	Monday, September 10, 2012	5:00 AM	5,097	Monday, August 6, 2012
2013	7,704	Tuesday, August 13, 2013	6:00 AM	4,963	Tuesday, August 6, 2013
2014	7,729	Wednesday, July 16, 2014	9:00 PM	4,757	Monday, August 11, 2014
2015	9,770	Friday, June 26, 2015	5:00 AM	5,854	Saturday, July 4, 2015
2016	7,760	Friday, August 19, 2016	5:00 AM	4,905	Monday, August 15, 2016
2017	10,059	Friday, August 4, 2017	5:00 AM	5,706	Friday, August 4, 2017
2018	10,309	Monday, August 6, 2018	5:00 AM	6,168	Monday, August 6, 2018

Table 4-13 – *Demands Peaking Factors* shows the peaking factors of the water system based on the ADD, MDD, and PHD data presented earlier in this chapter. The MDD/ADD demand ratio (492 gpd/ERU ÷ 213 gpd/ERU) of 2.31 is within the typical range of 1.2 to 2.5 for most systems. The estimated PHD/MDD ratio (0.570 gpm/ERU ÷ 0.342 gpm/ERU) of 1.67 is within the typical range of 1.3 to 2.0 for most systems. These peaking factors will be used later in this chapter, in conjunction with projected ADD, to project future MDDs and PHDs of the system.

Table 4-13
Demands Peaking Factors

Demand Data[1]		
Demand Type	Demand	
	(gpm/ERU)	(gpd/ERU)
Average Day Demand (ADD)	0.148	213
Maximum Day Demand (MDD)	0.342	492
Peak Hour Demand (PHD)	0.570	
Peaking Factors		
Maximum Day Demand/Average Day Demand (MDD/ADD)		2.31
Peak Hour Demand/Maximum Day Demand (PHD/MDD)		1.67
Peak Hour Demand/Average Day Demand (PHD/ADD)		3.85

Note:
[1]Based on 10-year historical maximum values.

Fire Flow Demand

Fire flow demand is the amount of water required during firefighting as defined by applicable codes. Fire flow requirements are established for individual buildings and expressed in terms of flow rate (gpm) and flow duration (hours). Fighting fires imposes the greatest demand on the water system because a high rate of water must be supplied over a short period of time, requiring each component of the system to be properly sized and configured to operate at its optimal condition. Adequate storage and supply is useless if the transmission or distribution system cannot deliver water at the required rate and pressure necessary to extinguish a fire.

Each of the four land use agencies (Bonney Lake, Auburn, Sumner, and Pierce County) with interests within the City's WSA set its own minimum fire flow requirements. These minimum, or general, fire flow requirements were established for the different land use categories to provide a target level of service for planning and sizing future water facilities in areas that are not fully developed. The general fire flow requirement for each agency is shown in **Table 4-14 – *General Fire Flow Requirements***. The water system analyses presented in **Chapter 7 – *Water System Analysis*** are based on an evaluation of the water system providing sufficient fire flow in accordance with these general fire flow requirements and the fire flow requirements of existing buildings. At a minimum, the City's general requirements are used, except for areas where the other land use agency's requirements are more stringent. The general requirements do not necessarily equate to actual existing or future fire flow needs for a specific site. The values shown in **Table 4-14 – *General Fire Flow Requirements*** are the minimums set by codes for each of the jurisdictions listed.

Table 4-14
General Fire Flow Requirements

Land Use Category	Fire Flow Requirement (gpm)	Flow Duration (minutes)
Bonney Lake		
Single-Family Residential	1,000	45
Multi-Family Residential	2,500	120
Commercial	2,500	120
Commercial - Permitted Exceptions[1]	4,000	120
Industrial	3,500	180
Auburn		
Single-Family Residential	1,500	120
Multi-Family Residential	2,500	180
Commercial	2,500	180
Industrial	3,500	240
Sumner		
Medium Density Residential	1,000	120
High Density Residential	1,500	120
Commercial	1,500	120
Industrial	3,500	180
Pierce County		
Rural Areas	750	45

Note:
[1]The City's Building Department and Fire Marshal have permitted two facilities with fire flow requirements greater than the standard minimum. They are Home Depot at 3,625 gpm, and Lowe's at 4,000 gpm.

FUTURE WATER DEMANDS

Basis for Projecting Demands

Future demands were calculated using historic 10-year maximum ADD values as shown in **Table 4-11 – *Historic Demand Values*** and the projected population data from **Chapter 3 – *Land Use and Population***. Future demand projections were computed with and without a further reduction in water use from conservation measures included in the City's Water Use Efficiency Program. The calculated demand of 213 gpd per ERU was used for all ADD projections without water conservation. This value was reduced to reflect the water use reduction enhancement goals contained in the City's Water Use Efficiency Program and used as the basis for future water demand projections with the conservation component. The City's Water Use Efficiency Program, contained in **Appendix C – *Water Use Efficiency Program***, presents a goal of 5 percent water use reduction by the year 2028, and 10 percent water use reduction by the year 2038, with 2018 as the base year. Applying these water use reduction goals to the per customer demand of 213 gpd results in a projected per customer demand with conservation of 202 gallons per day in the year 2028 (10-year forecast) and 192 gallons per day in the year 2038 (20-year forecast), as shown in **Table 4-15 – *Future Total Water Demand Summary***.

Demand Forecasts and Conservation

Table 4-15 – *Future Total Water Demand Summary* presents the 10-year and 20-year water demand forecasts for the City's water system. The actual demand data from 2018 is also shown in the table for comparison purposes. The future ADDs were projected based on population estimates for the given years, estimated number of customers in terms of ERU, and the estimated demand per ERU values. The future MDDs and PHDs shown were computed from the projected ADDs and the existing system peaking factors shown in **Table 4-13 – *Demands Peaking Factors***. The future demand projections are also shown with and without estimated additional reductions in water use from achieving the City's conservation enhancement goals described earlier.

The analysis and evaluation of the existing water system with proposed improvements, as presented in **Chapter 7 – *Water System Analysis*** and **Chapter 9 – *Water System Improvements***, are based on the 20-year projected demand data without conservation reductions. This ensures that the future system will be sized properly to meet all requirements, whether or not additional water use reductions from conservation are achieved. However, the City will pursue reductions in per capita water use by implementing the Water Use Efficiency Program contained in **Appendix C – *Water Use Efficiency Program*** of this WSP.

Table 4-15
Future Total Water Demand Summary

Description	2018 Calculated[1,2]	2028 (+ 10 yrs)	2038 (+ 20 yrs)
Customer Data			
Customers (ERUs at mid-year)	18,554	21,584	25,815
Increase from Base Year 2018	NA	3,030	7,261
Demand Basis Data (gal/day/ERU)			
Demand without Conservation	213	213	213
Demand with Conservation	NA	202	192
Average Day Demand (gpm)			
ADD without Conservation	2,744	3,193	3,818
ADD with Conservation	NA	3,033	3,437
Maximum Day Demand (gpm)			
MDD without Conservation	6,339	7,374	8,820
MDD with Conservation	NA	7,006	7,938
Peak Hour Demand (gpm)			
PHD without Conservation	10,576	12,303	14,714
PHD with Conservation	NA	11,688	13,243

Notes:

[1]MDD and PHD values are based on actual ADD amounts for the given year and historical peaking factors and do not necessarily represent actual peak demands for these years.

[2]Demands are based on yearly average data since demand peaks near the middle of the year.

Table 4-16 – ***Future Demand Projections (ERUs)*** presents the existing and projected ERUs of the system. The ERU forecast is based on the projected water demand data. The historical and projected water demand and ERU data from **Table 4-16** – ***Future Demand Projections (ERUs)*** are also shown graphically in **Chart 4-4 –** ***Historical and Future Water Demand and Number of Customers Projections.***

Table 4-16
Future Demand Projections (ERU)

Year	Growth Rate	Customers (ERUs at mid-year)	ADD (gpm) Without Conservation	ADD (gpm) With Conservation	MDD (gpm) Without Conservation	MDD (gpm) With Conservation	PHD (gpm) Without Conservation	PHD (gpm) With Conservation	Assumed Conservation Rate[1]
2018	*(base year)*	*18,048*	*2,670*	*2,670*	*6,167*	*6,167*	*10,288*	*10,288*	100.0%
2019	1.8%	18,373	2,718	2,704	6,278	6,246	10,473	10,420	99.5%
2020	1.8%	18,704	2,767	2,739	6,391	6,327	10,661	10,555	99.0%
2021	1.8%	19,042	2,817	2,774	6,506	6,408	10,854	10,691	*98.5%*
2022	1.8%	19,386	2,867	2,810	6,623	6,491	11,050	10,829	98.0%
2023	1.8%	19,736	2,919	2,846	6,743	6,575	11,249	10,968	97.5%
2024	1.8%	20,092	2,972	2,883	6,865	6,659	11,453	11,109	97.0%
2025	1.8%	20,455	3,026	2,920	6,989	6,744	11,660	11,251	96.5%
2026	1.8%	20,825	3,080	2,957	7,115	6,831	11,870	11,395	96.0%
2027	1.8%	21,201	3,136	2,995	7,244	6,918	12,085	11,541	95.5%
2028	1.8%	21,584	3,193	3,033	7,374	7,006	12,303	11,688	95.0%
2029	1.8%	21,974	3,250	3,072	7,508	7,095	12,525	11,836	94.5%
2030	1.8%	22,371	3,309	3,110	7,643	7,185	12,751	11,986	94.0%
2031	1.8%	22,775	3,369	3,150	7,781	7,276	12,981	12,138	93.5%
2032	1.8%	23,186	3,430	3,190	7,922	7,367	13,216	12,291	93.0%
2033	1.8%	23,605	3,492	3,230	8,065	7,460	13,455	12,446	92.5%
2034	1.8%	24,031	3,555	3,270	8,211	7,554	13,698	12,602	92.0%
2035	1.8%	24,465	3,619	3,311	8,359	7,648	13,945	12,760	91.5%
2036	1.8%	24,907	3,684	3,353	8,510	7,744	14,197	12,919	91.0%
2037	1.8%	25,357	3,751	3,394	8,664	7,841	14,453	13,080	90.5%
2038	1.8%	25,815	3,818	3,437	8,820	7,938	14,714	13,243	90.0%

Note:
[1]Conservation efforts are assumed to be a 10% reduction in total demand and to happen linearly over a 20-year period.

The demand projections shown graphically in **Chart 4-4 – *Historical and Future Water Demand and Number of Customers Projections*** represent the range of demands that the City might expect as growth continues over the next 20 years. Demands are shown both without conservation efforts and with conversation efforts that might result in a 10-percent decrease in demands. Historical demands have been steadily decreasing since 2010. In order to ensure adequate supply and storage, maximum demands from the last 10 years was utilized for planning purposes.

Chart 4-4
Historical and Future Water Demand and Number of Customers Projections