Water Demands

4

INTRODUCTION

A detailed analysis of system demands is crucial to the planning efforts of a water supplier. A demand analysis first identifies current 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 demands to determine how much water will be needed to satisfy the water system's future growth and continue to meet federal and state laws.

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 temperature has a tendency to increase the demand over a short period of time. Population does not solely determine demand because different user types use varying amounts of water. The use varies based on the number of users in each customer class, land use density, and irrigation practices. Water conservation efforts also impact demands and can be used to accommodate a portion of system growth without increasing a system's supply capacity.

Demands on the water system 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, maximum day demand, peak hour demand, fire flow demand, future demands, and a demand reduction forecast based on the proposed Water Use Efficiency program.

Certificate of Water Availability

In accordance with the requirements of the Growth Management Act (GMA), the City of Stanwood (City) must identify that water is available prior to issuing a building permit. A Certificate of Water Availability is issued if there is sufficient water supply to meet the domestic water service and fire flow requirements of the proposed building. The requirement for providing evidence of an adequate water supply was codified in 1990 under the Revised Code of Washington (RCW) 19.27.097 in the Building Code Section. The City requires water and sewer certificates of availability in accordance with Stanwood Municipal Code (SMC) 17.148.050.

CURRENT POPULATION AND SERVICE CONNECTIONS

Residential Population Served

The population within the City limits was 6,340 in 2013 based on estimates from the City of Stanwood Community Development Department. Since the City provides water service to many customers outside of the City limits, the actual population served by the City's water system is larger. The 2013 residential population served by the City within the water service area is estimated to be approximately 7,075. The computation of the population served is discussed, along with a more detailed discussion of the City's population and household trends, in **Chapter 3**.

In 2013, the City provided water service to an average of 2,554 connections. Approximately 2,151 connections (84%) were single-family residential customers, 68 connections (3%) were multi-family residential customers, and 335 connections (13%) were all other customer types. The 68 multi-family residential connections serve approximately 748 units (units represent individual apartments, condominiums, or other components of a multi-family dwelling).

Water Use Classifications

The City has divided all water customers into 11 different classes for billing purposes. For planning purposes, the water customers have been combined into three different groups: 1) single-family residential (including the low income/senior/handicap discount class); 2) multi-family residential; and 3) commercial/other. The commercial/other group includes the following billing classes: light commercial, heavy commercial, schools, nursing homes, restaurants, irrigation, general industrial, and churches/meeting halls. The demand analysis that follows will report on the water use patterns of these three user groups. Twin City Foods, formerly the City's largest water user, was analyzed as a separate group in the previous Comprehensive Water System Plan (WSP), but significantly reduced its water usage beginning in 2010 and is now included within the commercial/other category.

EXISTING WATER DEMANDS

Water Consumption

Water consumption is the amount of water used by all customers of the system, as measured by the customer's meters. **Table 4-1** shows the historical average number of connections, average annual consumption and average daily consumption per connection of each customer class for the City from 1997 through 2013. Consumption data prior to 1997 and from 2000 through 2003 was not available for inclusion in this WSP. The 2000 through 2003 data was lost when the City went through a billing software change.

Table 4-1
Average Annual Metered Consumption and Service Connections

Year[1]	Customer Class			Totals
	Single-family[2]	Multi-family[3]	Commercial/Other[4]	
Average Number of Connections				
1997	1,258	---	216	---
1998	1,348	---	221	---
1999	1,357	---	257	---
2004	1,672	---	281	---
2005	1,706	---	291	---
2006	1,770	69	299	2,138
2007	1,898	71	303	2,272
2008	2,010	69	328	2,407
2009	2,046	69	330	2,445
2010	2,046	67	336	2,449
2011	2,062	68	333	2,463
2012	2,072	68	334	2,474
2013	2,151	68	335	2,554
Average[5]	2,007	69	325	2,400
Average Annual Consumption (1,000 gals)				
1997	128,298	28,862	128,969	286,128
1998	118,744	14,241	138,347	271,332
1999	114,970	22,004	141,074	278,048
2004	117,885	22,608	174,136	314,629
2005	128,327	13,960	149,607	291,894
2006	125,397	25,911	162,576	313,885
2007	135,123	23,538	150,223	308,884
2008	126,936	24,618	158,399	309,952
2009	136,680	26,164	161,705	324,549
2010	120,184	22,608	103,807	246,599
2011	117,840	22,590	103,836	244,266
2012	114,854	23,311	93,182	231,346
2013	120,806	22,896	99,519	243,220
Average[5]	124,727	23,955	129,156	277,838
Average Daily Consumption Per Connection (gal/day/conn)				
1997	279	---	1,636	
1998	241	---	1,715	
1999	232	---	1,504	
2004	193	---	1,693	
2005	206	---	1,409	
2006	194	1,029	1,490	
2007	195	908	1,358	
2008	173	975	1,319	
2009	183	1,039	1,343	
2010	161	924	846	
2011	157	910	854	
2012	151	937	762	
2013	154	922	814	
Average[5]	171	956	1,098	

1 = Connection and consumption data from 2000 to 2003 is not available.
2 = Single-family connection totals for 2008-2013 include connections classified as receiving the low income/senior/disabled discount. In the previous WSP, the discounted class for 2008 and 2009 was included in the Commercial/Other category. It is unknown if this classification was included in the single-family totals for years prior to 2008.
3 = Each multi-family connection serves multiple units.
4 = Twin City Foods is included in the Commercial/Other category rather than its own category as in the previous WSP.
5 = Average includes years 2006 through 2013.

The number of multi-family connections is less than the number of units served since one connection typically serves several units. **Table 4-2** shows the historical average number of available multi-family units, occupied multi-family units, and the average daily consumption per multi-family unit within the City's water service area from 2006 through 2013. Multi-family connection and unit data is not available prior to 2006.

Table 4-2
Multi-family Units

Year	Total Available Units[1]	Average Number of Occupied Units	Average Daily Consumption Per Unit (gal/day/unit)
2006	689	656	108
2007	704	670	96
2008	714	680	99
2009	714	675	106
2010	738	703	88
2011	784	747	83
2012	784	751	85
2013	784	748	84
Average	739	704	94

1 = For years 2006-2008 and 2010-2011 the "Total Available Units" was based on an assumed 5% vacancy rate above the "Average Number of Occupied Units." 2009 assumes a higher vacancy rate as units were not likely removed from service. No permits were issued for multi-family after 2010 (i.e. no new units built since 2011) therefore the "Total Available Units" remains static. Vacancy rate (5%) based on Dupre & Scott, Rental Market & Development Trends, published September 23, 2013.

As shown in **Chart 4-1**, the single-family residential class represents approximately 84 percent of all connections, but only 50 percent of total system consumption, as shown in **Chart 4-2**. This is due to the lower consumption per connection of single-family residential customers as compared to other customer types. As shown in **Table 4-1**, the single-family residential customers use an average of approximately 171 gallons per day (gpd) per connection, compared to the multi-family customers that use an average of approximately 956 gpd per connection, and the commercial and other customers that use an average of approximately 1,098 gpd per connection. Since multiple units are typically served by one multi-family connection, **Table 4-2** includes the average daily consumption per unit for the multi-family class, which historically has been approximately 94 gallons per day per unit. The lower consumption of multi-family customers is expected since the average household size of multi-family units is usually less than the average household size of single-family units and multi-family units consume considerably less water for lawn and garden maintenance. Additionally, the higher consumption of commercial customers is expected since these customers include the system's highest individual water users.

Chart 4-1
2013 Water Connections by Customer Class

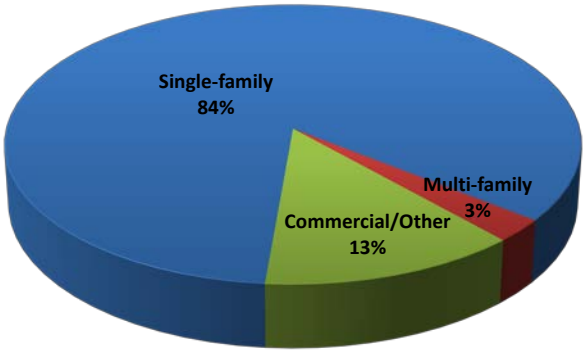


Chart 4-2
2013 Water Consumption by Customer Class

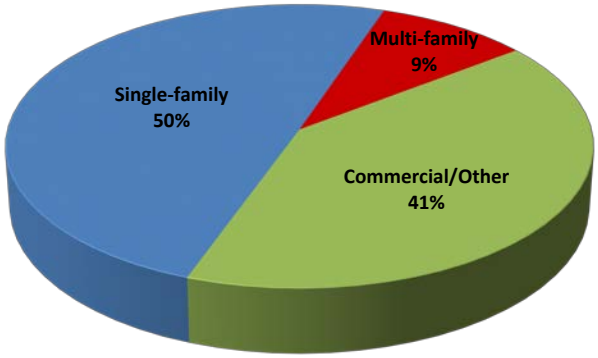


Table 4-3 shows the largest water users of the system in 2013 and their total amount of metered consumption for the year. The total water consumption of these 10 water accounts represented approximately 27 percent of the system's total consumption in 2013. The list of accounts in the table consists of water users from the commercial/other customer class. The top 6 users from the previous WSP are provided for comparison purposes.

Table 4-3
Largest Water Users

Name	Address	2009 Consumption (gals)	2013 Consumption (gals)
Schenk Packing Co Inc.	8204 288th St NW	34,159,121	26,966,527
Twin City Foods Inc.	10120 269th Pl NW	52,814,483	12,944,898
Josephine Sunset Home	9901 272nd Pl NW	9,253,052	9,093,993
North Star Cold Storage	27100 Pioneer Highway	5,952,250	4,313,417
Haggen Grocery Store	26603 72nd Ave NW	4,472,528	3,393,014
Emeritus Corporation	7212 265th St NW	2,076,353	2,129,255
City of Stanwood	9600 276th St NW	---	1,911,348
Draper Valley Farms	29210 88th Ave NW	---	1,866,801
Stanwood Villa	9720 272nd Pl NW	---	1,722,487
Stanwood Camano SD 401	7403 272nd St NW	---	1,717,453
Largest Water Users Total			66,059,193
Water System Total			243,220,378
Percent of Total			27%

Residential demand varies throughout the year, typically peaking in the hot summer months. Commercial/other customers often peak at different times or have different peaking factors because their uses differ. The demand for single-family residential customers in the City generally peaks in July or August, as shown in **Chart 4-3**. Multi-family residential consumption is fairly constant through the year, but typically peaks in the summer, as shown in **Chart 4-4**. Commercial/other consumption typically peaks in the summer or fall, as shown in **Chart 4-5**. The City reads meters bi-monthly and the monthly totals in **Chart 4-3**, **Chart 4-4**, and **Chart 4-5** assume that half of the recorded consumption occurs in each of the two months.

As shown in **Chart 4-6**, the peak month consumption versus average month consumption factor for single-family customers is higher than the peak month consumption versus average month consumption factor for multi-family and commercial/other customers, indicating that the single-family class experiences higher peaks than the multi-family and commercial/other classes. The higher peaks are likely associated with lawn watering and other residential summer water usage.

Chart 4-3
Historical Monthly Single-family Consumption

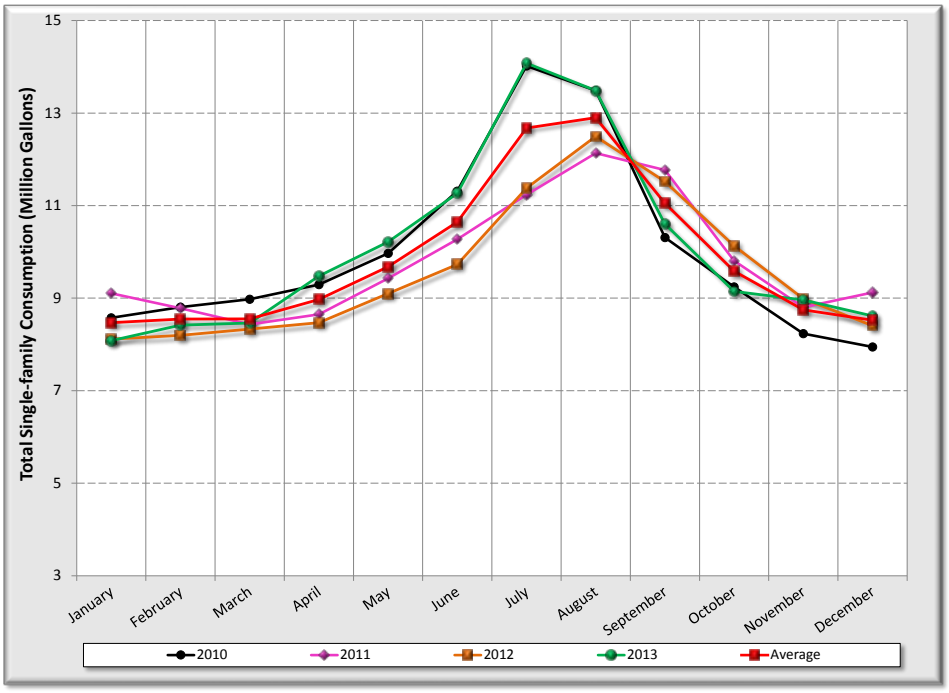


Chart 4-4
Historical Monthly Multi-family Consumption

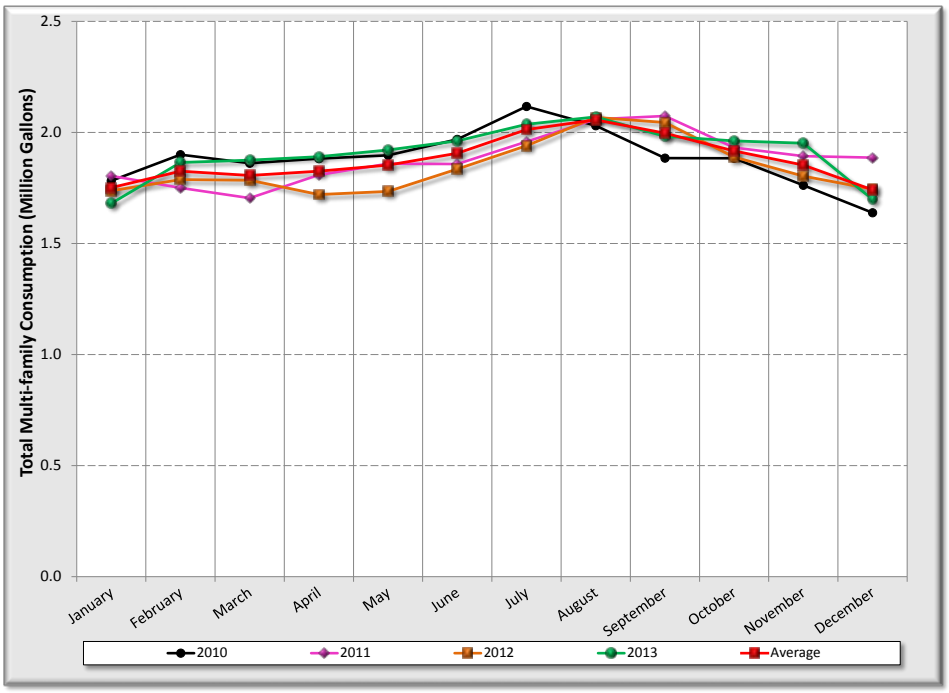


Chart 4-5
Historical Monthly Commercial/Other Consumption

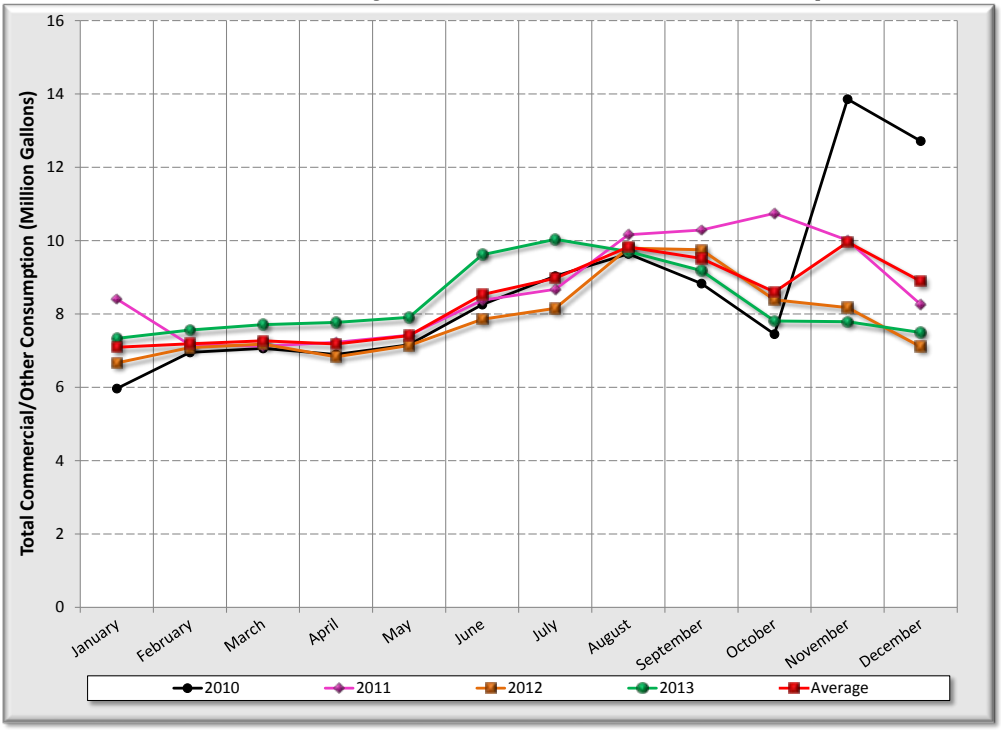
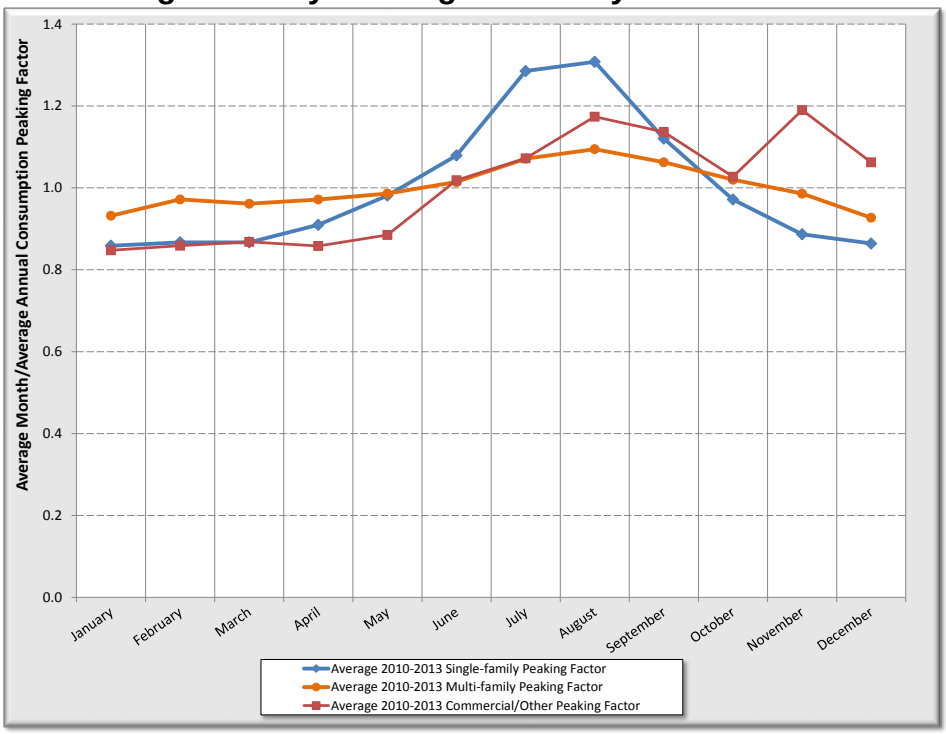


Chart 4-6
Average Monthly Peaking Factors by Customer Class



Water Supply

Water supply, or production, is the total amount of water supplied to the system, as measured by the meters at source of supply facilities. Water supply is different than water consumption in that water supply is 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 (DSL)), which will be described more in the **Distribution System Leakage** section. **Table 4-4** summarizes the total amount of water supplied to the system from 1992 through 2013 and the calculated average day demand for each year. The average daily demand is the total annual supply in terms of gallons per minute.

Table 4-4
Historical Water Supply and System Demand

Year	Annual Supply (gallons)	Average Daily Demand (gpm)
1992	430,059,600	816
1993	347,541,950	661
1994	342,162,215	651
1995	353,665,000	673
1996	347,018,191	658
1997	360,709,473	686
1998	338,001,593	643
1999	337,599,296	642
2000[1]	---	---
2001	299,445,937	570
2002	345,569,337	657
2003	354,804,548	675
2004	363,152,529	689
2005	354,672,584	675
2006	373,942,267	711
2007	348,153,550	662
2008	344,998,534	655
2009	355,421,020	676
2010	320,462,009	610
2011	285,662,129	543
2012	280,534,000	532
2013	302,454,000	575

1 = Complete data for 2000 not available.

In general, the amount of water supplied to the City, or system-wide water demand, remained relatively steady from the mid-1990s until approximately 2009, while the City population has more than doubled as shown in **Chart 4-7**. This was most likely the result of water use efficiency practices, including new buildings with low flow plumbing fixtures and the repair of water system leaks. In approximately 2010, Twin City Foods, the City's single largest historic water user, significantly reduced the use of water in its processing of fruits and vegetables resulting in an overall decrease in system-wide supply as shown in **Table 4-4**. The system-wide average day demand was at a 20-year low in 2012 due to the changes at Twin City Foods. The City does not expect Twin City Foods to increase to its previous water use levels in the future.

Chart 4-7
City Population and Annual Water Supply

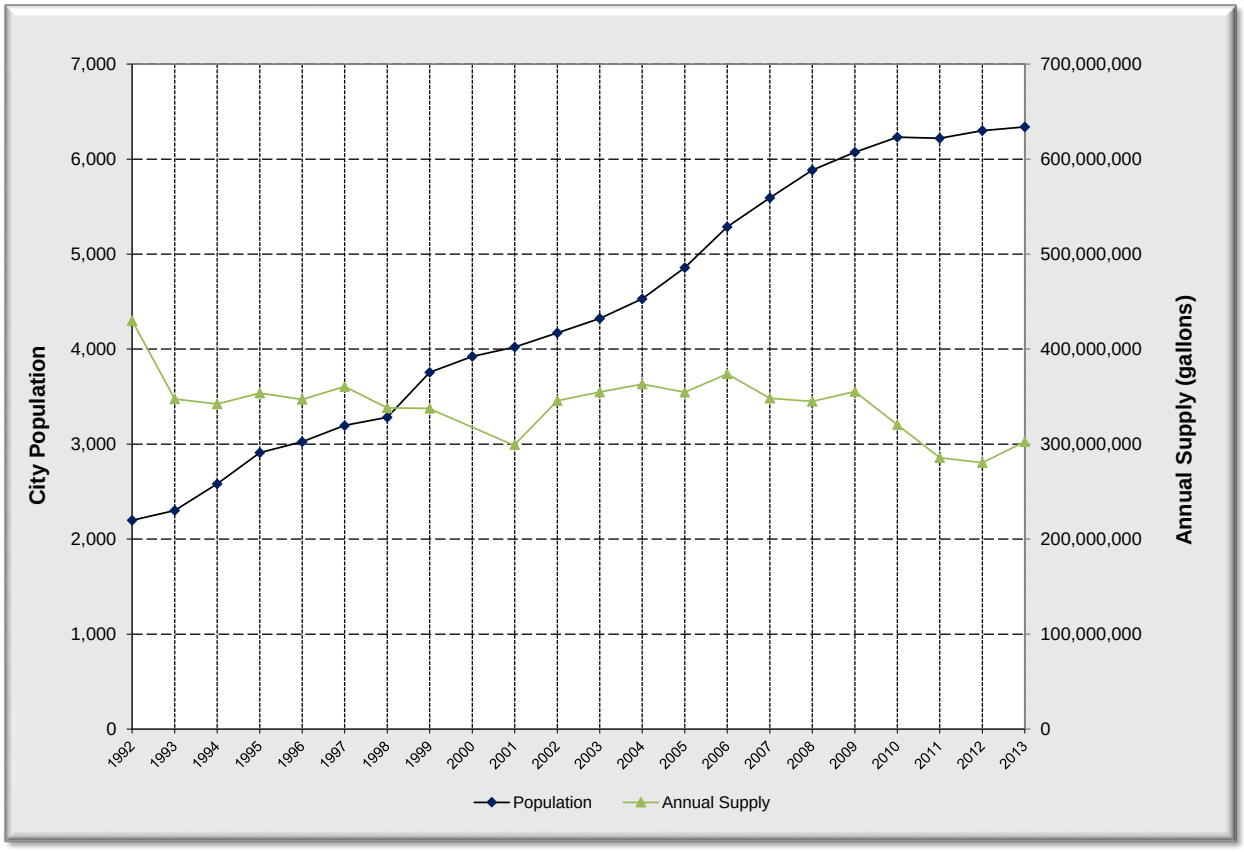


Table 4-5 presents the computation of the existing system per capita demand based on 2013 data. As shown in the upper portion of the table, the residential population served by the City's water system is approximately 7,075. The methodology used to determine the population served is described in **Chapter 3**. This population served and the City's total water supply in 2013 were used to arrive at the existing per capita demand of 117 gpd. The per capita demand has decreased from 137 gpd per capita as reported in the City's previous WSP, which is comparable to water use reduction experienced by other water systems in the Puget Sound area. However, the City is unique in that it has a significant amount of large non-residential water users for a City of its size, such as Schenk Packing, Twin City Foods, and others, shown in **Table 4-3**. The City's ten largest users accounted for 27 percent of the City's total water consumption.

Table 4-5
Existing Per Capita Demand

2013 Residential Population Served	
Calculated 2013 Residential Population Served	7,075
2013 Total Annual Supply	
2013 Total Annual Supply (gal)	302,454,000
Existing Per Capita Demand (gal/day/capita)	**117**

Since it is likely that the future growth of the City and future demand for water supply will not be similar to the existing demand allocation (i.e., approximately 41 percent non-residential demand), the use of the existing system per capita demand of 117 gpd would not be accurate for projecting future demands. Therefore, an additional computation of per capita demand was performed to provide a more accurate estimate for use in forecasting future water demand. The computation of future per capita demand shown in **Table 4-6** is based on a reduced proportion of non-residential demand that is likely to be more representative of the future type of demand to occur in the City's system. Specifically, the demands (including DSL) for Twin City Foods and Schenk Packing were excluded from the total annual supply, and an adjusted annual supply was calculated. The estimated per capita demand of 99 gpd is used later in this chapter to forecast water demands in future years based on future population estimates.

Table 4-6
Future Per Capita Demand Projection

Residential Population Served Computation	
Calculated 2013 Residential Population Served	7,075
Adjusted Total Annual Supply	
2013 Total Annual Supply (gal)	302,454,000
Less Annual Demand of Large Users Not Representative of Future New Users (gal)	46,215,338
2013 Net Annual Supply Adjusted for Future Anticipated Users (gal)	256,238,662
Estimated Per Capita Demand for Future Demand Projections (gal/day/capita)	**99**

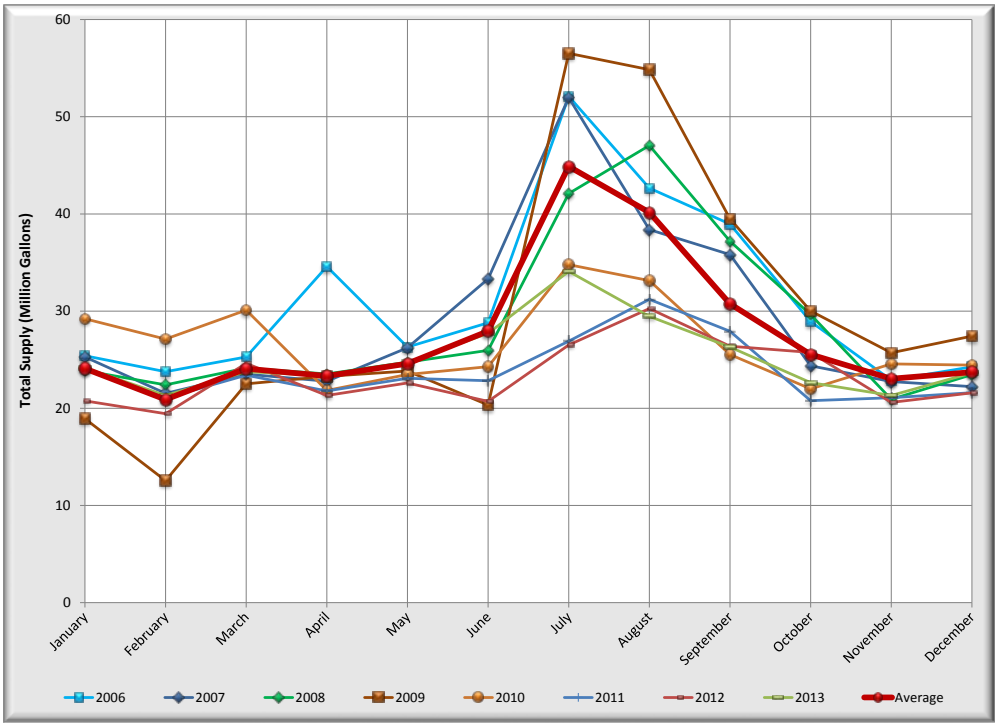
Table 4-7 shows the average demand of each of the City's seven existing pressure zones, based on 2013 water demand data. The City's two largest pressure zones, the 297 and 125 Zones, account for approximately 80 percent of the total system demand. **Figure 2-1** in **Chapter 2** displays the City's pressure zones.

Table 4-7
2013 Demands by Pressure Zone

Pressure Zone	2013 Annual Supply (gallons)	Average Daily Demand (gpm)	Percent of Total Demand (%)
365	22,075,200	42	7.3%
297	152,513,946	290	50.4%
265	7,073,752	13	2.3%
255	7,932,136	15	2.6%
252	1,512,270	3	0.5%
245	10,934,899	21	3.6%
125	100,598,989	191	33.3%
Total	302,454,000	575	100%

Like most other water systems, the City's water use varies seasonally. **Chart 4-8** shows the historical amount of water supplied to the City's system for each month from 2006 to 2013.

Chart 4-8
Historical Monthly Water Supply



As shown in **Chart 4-8**, water supply increases significantly during summer months, primarily due to irrigation. The City's highest water use typically occurs in July and August. On average, the amount of water supplied during these two months is approximately 24 percent of the total supply for the entire year.

Chart 4-9 shows the monthly water supply by source for 2013. In 2013, all water was provided from Bryant Well No. 1 and the Cedarhome Well. **Chart 4-10** shows the annual water supply by source from 2003 to 2013. The Hatt Slough Springs source has been offline since late 2011 due to a landslide impacting the access road and Bryant Well No. 2 has been offline since 2006 due to declining yield.

Chart 4-9
2013 Monthly Water Supply by Source

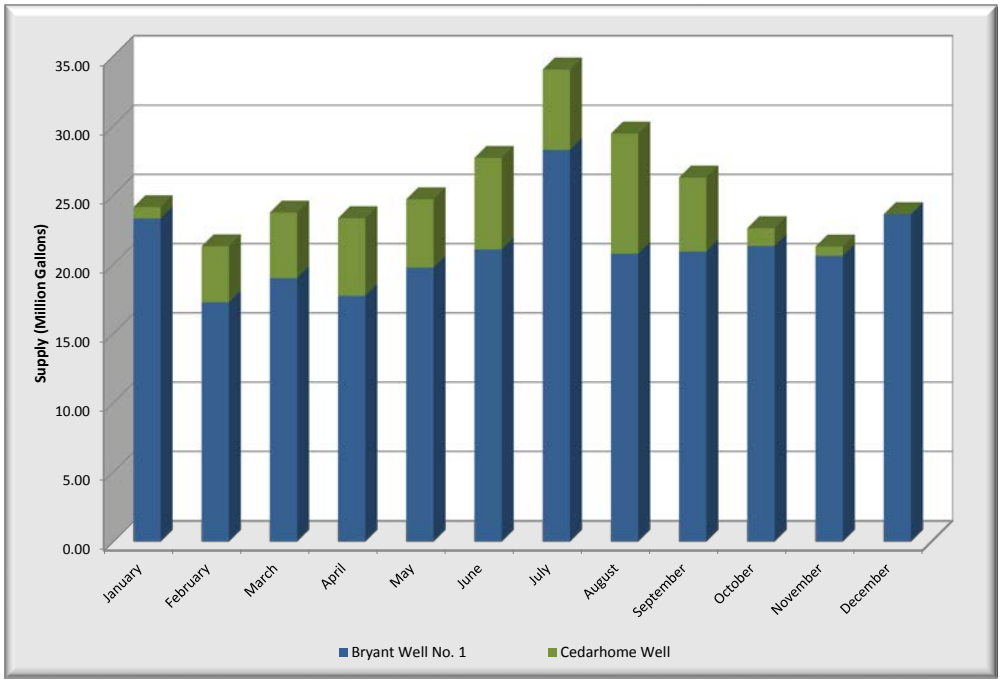
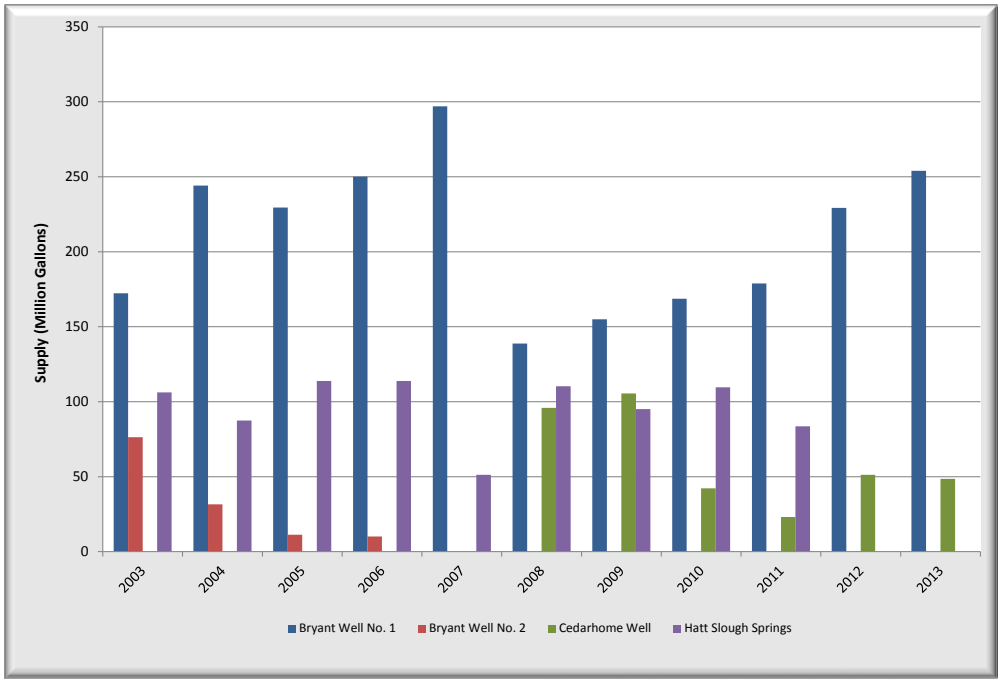


Chart 4-10
Annual Water Supply by Source



Distribution System Leakage

The difference between the amount of water supply and water consumption is the amount of DSL. The amount of DSL in a water system is calculated as the difference between the amount of water supply and the amount of authorized water consumption. There are many sources of DSL in a typical water system, including water system leaks, inaccurate supply metering, inaccurate customer metering, illegal water system connections or water use, fire hydrant usage, water main flushing, and malfunctioning telemetry and control equipment resulting in reservoir overflows. Several of these types of usages, such as water main flushing and fire hydrant usage, may be considered authorized uses if they are tracked and estimated. Although real losses from the distribution system, such as reservoir overflows and leaking water mains, should be tracked for accounting purposes, these losses must be considered leakage. The Water Use Efficiency (WUE) Rule, which became effective in 2007, establishes a DSL standard of 10 percent or less based on a rolling 3-year average.

The amount of DSL in the City's system decreased significantly from 1997 to 2009, as shown in **Table 4-8**. This was probably due to the system-wide replacement of old and likely inaccurate customer meters that began in the mid-1980s; the repair of water system leaks that were discovered in 1993 when half of the system was surveyed for leaks; and the reduced usage of non-metered water for construction projects. In 1999, the City changed its policy from charging an annual flat fee for construction water use to a per load charge to discourage unnecessary water use. Since 2009, the amount of DSL has increased and this is due to a variety of factors. In 2010, Twin City Foods began demanding less water and Hatt Slough Springs continued to supply the City's 125 Zone without telemetry to turn off the source when the Bailey Reservoirs were full. The City was experiencing a significant amount of reservoir overflow, which increased the DSL for 2010. When the City turned Hatt Slough Springs off in 2011, the DSL for the system decreased. Despite an improved authorized water usage tracking system implemented in 2012, the DSL for the system was above the minimum of 10 percent in 2012 and 2013, which is likely due to water main leakage in the system's older pipes. In addition, the fire department use of City water is not accurately measured or reported.

The City intends to continue to reduce the amount of DSL in the system to meet the DSL standard through its leak detection surveys and water main replacement program. The City will continue to record authorized water usage and will improve the reporting of additional authorized water uses, including coordination with the fire department. The City will also implement the WUE Program contained in **Appendix F**.

Table 4-8
Distribution System Leakage

	Year[1]												
	1997	1998	1999	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Authorized Consumption (AC)[2]													
Metered Customer Use (1,000 gal)	286,128	271,332	278,048	314,629	291,894	313,885	308,884	309,952	324,549	246,599	244,266	231,346	243,220
Hydrant Meter Use (1,000 gal)	---	---	---	21	157	768	316	148	148	100	---	1,019	60
Fire Department Usage (1,000 gal)	---	---	---	---	---	---	1,700	1,745	13	13	---	100	810
Water Main Flushing (1,000 gal)	---	---	---	---	---	---	---	300	3	1,930	---	3,448	12,881
Miscellaneous Authorized Consumption (1,000 gal)[3]	---	---	---	---	---	---	---	---	---	554	4,734	1,206	4,227
Total Authorized Consumption (1,000 gal)	286,128	271,332	278,048	314,649	292,050	314,653	310,900	312,145	324,712	249,196	249,000	237,119	261,198
Total Production (TP)													
Total Production/Supply (1,000 gal)	360,709	338,002	337,599	363,153	354,673	373,942	348,154	344,999	355,421	320,462	285,662	280,534	302,454
Distribution System Leakage (TP - AC)													
Total Distribution System Leakage (1,000 gal)	74,581	66,669	59,552	48,503	62,622	59,290	37,253	32,853	30,709	71,266	36,662	43,415	41,256
Total Distribution System Leakage (%)	20.7%	19.7%	17.6%	13.4%	17.7%	15.9%	10.7%	9.5%	8.6%	22.2%	12.8%	15.5%	13.6%
Rolling 3-Year Average DSL (%)	---	---	19%	---	---	16%	15%	12%	10%	13%	15%	17%	14%

1 = Data from 2000 through 2003 is not available.

2 = Authorized consumption records (other than Metered Customer Use) were not available for 2011 due to misplaced records during staff changes. The estimate of total authorized consumption from the 2011 Water Use Efficiency Annual Performance Report was used within and the difference between this value and the Metered Customer Use was classified as Miscellaneous Authorized Consumption.
3 = Miscellaneous Authorized Consumption consists of water used for water quality analyzers, tank cleaning, wastewater treatment plant usage, and other uses.

Equivalent Residential Units

The demand of each customer class can be expressed in terms of equivalent residential units (ERUs) for demand forecasting and planning purposes. One ERU is equivalent to the amount of water used by a single-family residence (i.e., 191 gal/day). The number of ERUs represented by the demand of the 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 4-9A and **Table 4-9B** present the computed number of ERUs for each customer class from 1997 through 2013. The demands shown are based on supply data that was computed from the consumption of each customer class and the average amount of DSL and authorized (non-metered customer) water use from each year. Data is excluded for the years 2000 through 2003 due to missing consumption data for all of the customer classes when the City changed billing systems. The average demand per ERU from 2010 through 2013 (4-year average) was 192 gpd. This is less than the average single-family demand in the Puget Sound area, which is typically between 250 and 300 gpd.

Table 4-9A
Equivalent Residential Units

Year	Average Number of Connections[1]	Average Annual Demand (gallons)	Demand per ERU (gal/day/ERU)	Total ERUs
Single-family Residential (ERU Basis)[2,3]				
1997	1,258	161,739,438	352	1,258
1998	1,348	147,921,061	301	1,348
1999	1,357	139,594,328	282	1,357
2004	1,672	136,065,345	222	1,672
2005	1,706	155,926,677	250	1,706
2006	1,770	149,390,151	231	1,770
2007	1,898	152,301,365	220	1,898
2008	2,010	141,288,138	192	2,010
2009	2,046	149,681,078	200	2,046
2010	2,046	156,181,803	209	2,046
2011	2,062	137,810,611	183	2,062
2012	2,072	139,273,409	184	2,072
2013	2,151	150,227,043	191	2,151
Multi-family Residential[1,2]				
1997	---	36,384,994	352	283
1998	---	17,740,044	301	162
1999	---	26,716,556	282	260
2004	---	26,094,510	222	321
2005	---	16,962,340	250	186
2006	656	30,869,218	231	366
2007	670	26,530,622	220	331
2008	680	27,401,456	192	390
2009	675	28,652,656	200	392
2010	703	29,380,276	209	385
2011	747	26,418,290	183	395
2012	751	28,267,109	184	421
2013	748	28,471,482	191	408

1 = Data from 2000 through 2003 is unavailable.
2 = Multi-family data represents average number of units served.
3 = Single-family connection totals for 2008-2013 include connections classified as receiving the low income/senior/disabled discount. In the previous WSP, the discounted class for 2008 and 2009 was included in the Commercial/Other category. It is unknown if this classification was included in the single-family totals for years prior to 2008.

Table 4-9B
Equivalent Residential Units - Continued

Year	Average Number of Connections	Average Annual Demand (gallons)	Demand per ERU (gal/day/ERU)	Total ERUs
Commercial/Other[1,2]				
1997	216	162,585,040	352	1,265
1998	221	172,340,489	301	1,571
1999	257	171,288,412	282	1,665
2004	281	200,992,674	222	2,470
2005	291	181,783,567	250	1,989
2006	299	193,682,898	231	2,295
2007	303	169,321,563	220	2,110
2008	328	176,308,940	192	2,508
2009	330	177,087,286	200	2,421
2010	336	134,899,930	209	1,767
2011	333	121,433,229	183	1,817
2012	334	112,993,482	184	1,681
2013	335	123,755,475	191	1,772
System-wide Totals[1]				
1997	---	360,709,473	352	2,806
1998	---	338,001,593	301	3,080
1999	---	337,599,296	282	3,282
2004	---	363,152,529	222	4,462
2005	---	354,672,584	250	3,880
2006	2,725	373,942,267	231	4,431
2007	2,871	348,153,550	220	4,339
2008	3,018	344,998,534	192	4,908
2009	3,051	355,421,020	200	4,858
2010	3,085	320,462,009	209	4,198
2011	3,142	285,662,129	183	4,274
2012	3,157	280,534,000	184	4,174
2013	3,234	302,454,000	191	4,331

1 = Data from 2000 through 2003 is unavailable.
2 = Twin City Foods is included in the Commercial/Other category rather than its own category as in the previous WSP.

The average demand per ERU from 2010 through 2013 of 192 gpd will be used later in this chapter to forecast ERUs in future years based on estimated 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**.

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. The ADD is determined from historical water use patterns of the system and can be used to project future demand within the system. 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 and spring sources were reviewed to determine the system's ADD. The system's average day demand from 1992 through 2013 is shown in **Table 4-4**.

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 typically occurs on a hot summer day when lawn watering is occurring throughout much of the system. In accordance with Washington Administrative Code (WAC) 246-290-230, the distribution system shall provide fire flow at a minimum pressure of 20 pounds per square inch (psi) during MDD (i.e., peak day demand) conditions. Supply facilities (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.

Daily water production records and chart recordings of reservoir levels from June, July, and August of 2010 through 2013 were reviewed to determine the system's MDD. The City's MDD occurred on July 25, 2013, when temperatures reached approximately 80 degrees Fahrenheit (ºF) and were similar the days before and after. As shown in **Table 4-10**, the average demand of the system on July 25, 2013, or MDD, was 974 gallons per minute (gpm).

Peak Hour Demand

Peak hour demand (PHD) is the maximum amount of water used throughout the system, excluding fire flow, during a one-hour time period of a given year. In accordance with WAC 246-290-230, 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.

The PHD, like the MDD, is typically determined from the combined flow of water into the system from all supply sources and reservoirs. Hourly water production and reservoir level records were reviewed to evaluate the PHD. As shown in **Table 4-10,** the City's PHD, which occurred on July 25, 2013, from 10:00 a.m. to 11:00 a.m., was 1,407 gpm.

Table 4-10 also shows the peaking factors of the water system based on the ADD, MDD, and PHD data presented above. The MDD/ADD demand ratio of 1.69 is within the typical range of 1.2 to 2.5 for most systems. The MDD/ADD ratio has decreased from 2.51 in 2006, as reported in the previous WSP, due to the change in operations at Twin City Foods. Twin City Foods' peak processing time prior to 2010 was concurrent with the City's peak demands associated with high summer temperatures. Twin City Foods no longer performs peak processing during the summer months, which has decreased the City's MDD and maximum day factors. The estimated PHD/MDD ratio of 1.45 is towards the low end of 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 ADDs to project future maximum day and peak hour demands of the system.

Table 4-10
Maximum Day Demands and Peaking Factors

Peak Demand Data

Demand Type	Date	Demand (gpm)
Average Day Demand (ADD)	2013	575
Maximum Day Demand (MDD)	7/25/2013	974
Peak Hour Demand (PHD)	7/25/2013 10:00 AM - 11:00 AM	1,407

Peaking Factors

Maximum Day Demand/Average Day Demand (MDD/ADD)	1.69
Peak Hour Demand/Maximum Day Demand (PHD/MDD)	1.45
Peak Hour Demand/Average Day Demand (PHD/ADD)	2.45

Fire Flow Demand

Fire flow demand is the amount of water required during fire fighting 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.

General planning-level 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 planning level fire flow requirement for each land use category is shown in **Table 4-11**. The water system analyses presented in **Chapter 7** are based on an evaluation of the water system for providing sufficient fire flow in accordance with these general planning-level fire flow requirements. The fire flow requirements shown in the table do not necessarily equate to actual existing or future fire flow requirements for all buildings, since this is typically based on building size, construction type, and fire suppression systems provided. Improvements to increase the available fire flow to meet actual fire flow requirements greater than those shown in the table shall be the responsibility of the developer.

Table 4-11
General Planning-level Fire Flow Requirements

Land Use Category	Fire Flow Requirement (gpm)	Flow Duration (hours)
Low Density Residential[1]	1,000	2
Medium Density Residential[2]	1,750	2
High Density Residential[3]	2,500	2
Traditional Neighborhood[4]	2,500 - 3,000	2 - 3
Commercial/Business Park	3,000	3
Light Industrial	3,500	3
Schools	3,500	3

1 = Low Density Residential corresponds to SR 9.6 (single-family residential with 9,600 square foot minimum lot size) and SR 12.4 (single-family residential with 12,400 square foot minimum lot size).
2 = Medium Density Residential corresponds to SR 5.0 (single-family residential with 5,000 square foot minimum lot size) and SR 7.0 (single-family residential with 7,000 square foot minimum lot size).
3 = High Density Residential corresponds to MR (multi-family residential).
4 = Traditional Neighborhood fire flow requirements will depend on the density of the proposed residential development and the type of proposed commercial components.

FUTURE WATER DEMANDS

Basis for Projecting Demands

Future demands were calculated from the results of the future per capita demand computations shown in **Table 4-6** and the projected population data from **Chapter 3**. Future demand projections were computed with and without water savings expected from implementing WUE measures contained in the City's WUE Program in **Appendix F**. The calculated future per capita demand of 99 gpd was used for all demand projections without savings from WUE measures. The per capita demand was reduced to reflect the WUE goals and used as the basis for future water demand projections with implementation of the WUE Program. The City's WUE Program presents a goal to reduce the 4-year rolling average demand per ERU to 185 gpd by the year 2035.

Demand Forecasts and Conservation

Table 4-12 presents the projected water demand forecast for the City's water system. The actual demand data from 2013 is also shown in the table for comparison purposes. The future ADDs were projected based on population estimates for the given years and the estimated demand per capita values. The future MDDs and PHDs shown were computed from the projected ADDs and the existing system peaking factors shown in **Table 4-10**. The future demand projections are also shown with and without estimated reductions in water use from achieving WUE goals.

Table 4-12
Future Water Demand Projections

Description	Actual	Projected												
	2013	2014	2015	2016	2017	2018	2019	2020	2021 (+6 years)	2022	2023	2024	2025 (+10 years)	2035 (+20 years)
Population Data														
Water Service Area Population	7,075	7,342	7,553	7,765	7,976	8,188	8,399	8,611	8,822	9,034	9,246	9,457	9,669	11,775
Increase from Base Year 2013		267	478	690	901	1,113	1,324	1,536	1,748	1,959	2,171	2,382	2,594	4,700
Demand Basis Data (gal/day/capita)[1]														
ADD without WUE		99	99	99	99	99	99	99	99	99	99	99	99	99
ADD with WUE		99	96	94	94	93	93	92	92	92	91	91	91	89
Average Day Demand (gpm)[2]														
Demand without WUE	575	584	598	613	627	642	656	671	685	700	714	729	744	888
Demand with WUE		584	597	610	624	637	650	664	677	690	703	716	729	854
Maximum Day Demand (gpm)														
Demand without WUE	974	987	1,012	1,037	1,061	1,086	1,110	1,135	1,160	1,184	1,209	1,234	1,258	1,503
Demand with WUE		987	1,010	1,033	1,055	1,078	1,100	1,123	1,145	1,167	1,189	1,211	1,233	1,446
Peak Hour Demand (gpm)														
Demand without WUE	1,407	1,427	1,463	1,498	1,534	1,569	1,605	1,641	1,676	1,712	1,747	1,783	1,818	2,173
Demand with WUE		1,427	1,460	1,493	1,526	1,558	1,590	1,623	1,655	1,687	1,719	1,750	1,782	2,090

1 = Calculated for future population only.
2 = Future ADD is calculated by multiplying the future gal/day/capita value by the population increase and adding the result to the ADD average for 2010-2013 (i.e., 565 gpm).

The analysis and evaluation of the existing water system with proposed improvements, as presented in **Chapters 7** and **9**, is based on the 2035 projected demand data without WUE reductions. This ensures that the future system will be sized properly to meet all requirements, whether or not additional water use reductions are achieved. However, the City will continue to pursue reductions in water use by implementing the WUE Program contained in **Appendix F** of this WSP.

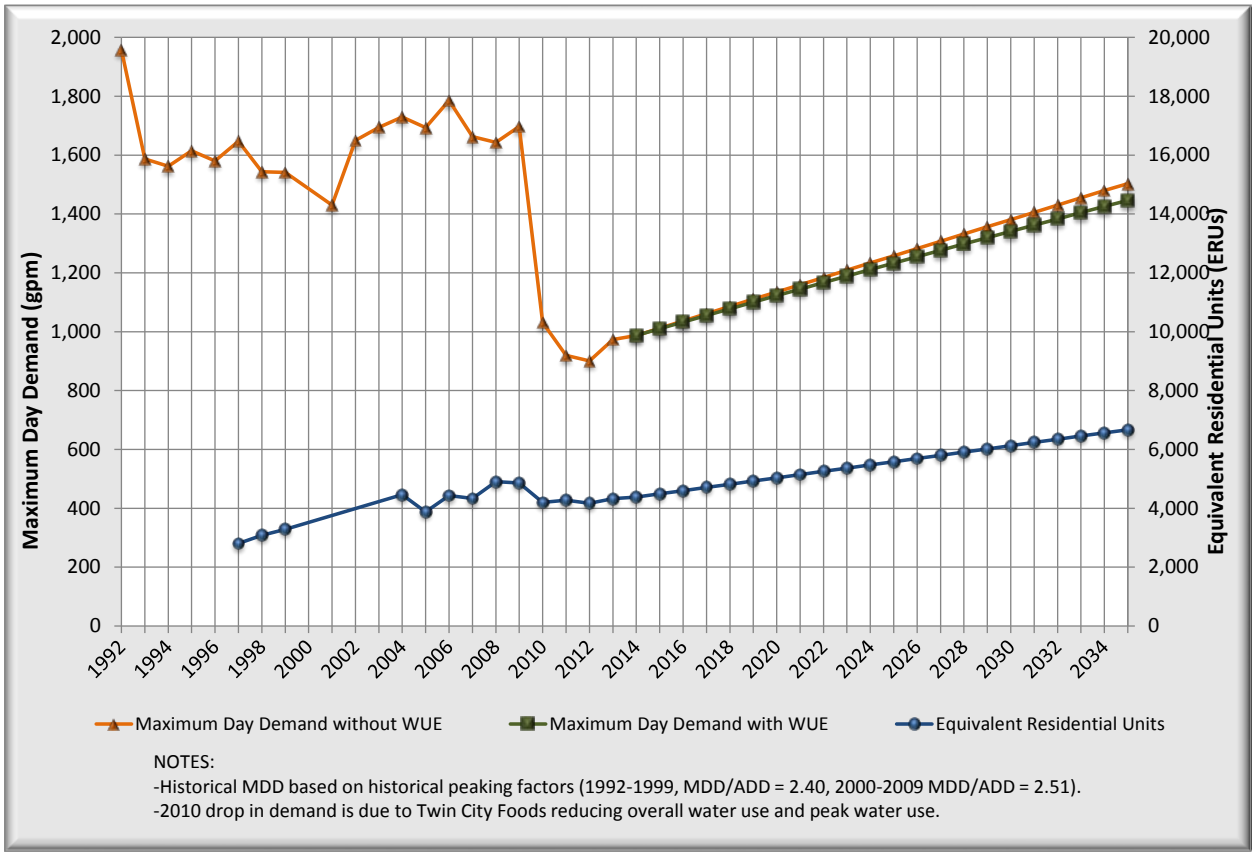
Table 4-13 presents the existing and projected ERUs of the system. The ERU forecasts are based on the projected water demands from **Table 4-12** and the 4-year rolling average demand per ERU that was computed from the actual 2010 through 2013 data. The historical and projected water demand and ERU data from **Tables 4-12** and **4-13** are also shown graphically in **Chart 4-11**. **Chart 4-11** will be used in **Chapter 7** to compare demand projections with source of supply availability.

Table 4-13
Future ERU Projections

Description	Actual	Projected												
	2013	2014	2015	2016	2017	2018	2019	2020	2021 (+6 years)	2022	2023	2024	2025 (+10 years)	2035 (+20 years)
Demand Data (gpm)[1]														
ADD without WUE	575	584	598	613	627	642	656	671	685	700	714	729	744	888
ERU Basis Data (gal/day/ERU)[2]														
Demand per ERU without WUE	191	192	192	192	192	192	192	192	192	192	192	192	192	192
Demand per ERU with WUE		192	191	191	191	190	190	190	189	189	189	188	188	184
Equivalent Residential Units (ERUs)														
Total System ERUs	4,331	4,381	4,490	4,599	4,709	4,818	4,927	5,036	5,145	5,255	5,364	5,473	5,582	6,670

1 = Demand data calculated as in Table 4-12.
2 = Future demand per ERU without WUE is based on the average demand per ERU for 2010-2013. Future demand per ERU with WUE is based on reducing the average demand per ERU for 2010-2013 to a 4-year rolling average of 185 gal/day/ERU in 2035.

Chart 4-11
Future Water Demand and ERU Projections



NOTES:
-Historical MDD based on historical peaking factors (1992-1999, MDD/ADD = 2.40, 2000-2009 MDD/ADD = 2.51).
-2010 drop in demand is due to Twin City Foods reducing overall water use and peak water use.