Water Demand Analysis

Section 6

6.1 Existing Water Use

6.1.1 Definitions

System water demand is the quantity of water that the treatment plant must produce in order to meet all water needs in the community. Water demand includes water delivered to the system to meet the needs of consumers, water supply for fire fighting and system flushing, and water required to properly operate the treatment facilities. Additionally, virtually all systems have a certain amount of leakage that cannot be economically removed and thus total demand typically includes some leakage. The difference between the amount of water sold and the amount delivered to the system is referred to as unaccounted water. Unaccounted water can result from system flushing, leakage, fire fighting, meter inaccuracies, and other non-metered usage. Water demand varies seasonally with the lowest usage in winter months and the highest usage during summer months. Variations in demand also occur with respect to time of day. Diurnal peaks typically occur during the morning and early evening periods, while the lowest usage occurs during nighttime hours.

The objective of this section is to determine the current water demand characteristics and to project future demand requirements that will establish system component adequacy and sizing needs. Water demand is described in the following terms:

Average Annual Demand (AAD) - The total volume of water delivered to the system in a full year expressed in gallons. When demand fluctuates up and down over several years, an average is used.

Average Daily Demand (ADD) - The total volume of water delivered to the system over a year divided by 365 days. The average use in a single day expressed in gallons per day.

Maximum Month Demand (MMD) - The gallons per day average during the month with the highest water demand. The highest monthly usage typically occurs during a summer month.

Peak Weekly Demand (PWD) - The greatest 7-day average demand that occurs in a year expressed in gallons per day.

Maximum Day Demand (MDD) - The largest volume of water delivered to the system in a single day expressed in gallons per day. The water supply, treatment plant and transmission lines should be designed to handle the maximum day demand.

Peak Hourly Demand (PHD) - The maximum volume of water delivered to the system in a single hour expressed in gallons per day. Distribution systems should be designed to adequately handle the peak hourly demand or maximum day demand plus fire flows, whichever is greater. During peak hourly flows, storage reservoirs supply the demand in excess of the maximum day demand.

Demands described above, expressed in gallons per day (gpd), can be divided by the population or Equivalent Dwelling Units (EDUs) served to come up with a demand per person or per capita which is expressed in gallons per capita per day (gpcd), or demand per EDU (gpd/EDU). These unit demands can be multiplied by future population or EDU projections to estimate future water demands for planning purposes.

6.1.2 Existing Water Demand

Existing water demand in Newport has been determined from daily plant operational records from 2004 through 2007. At the Newport water treatment plant, water demand records include quantities of water pumped into the distribution system plus water used for plant operations; primarily filter backwashing. On average 95% of the water treated is sent into the distribution system while 5% is used for plant operation. Daily water production (water pumped to system plus backwash water) for the period of record is shown below.

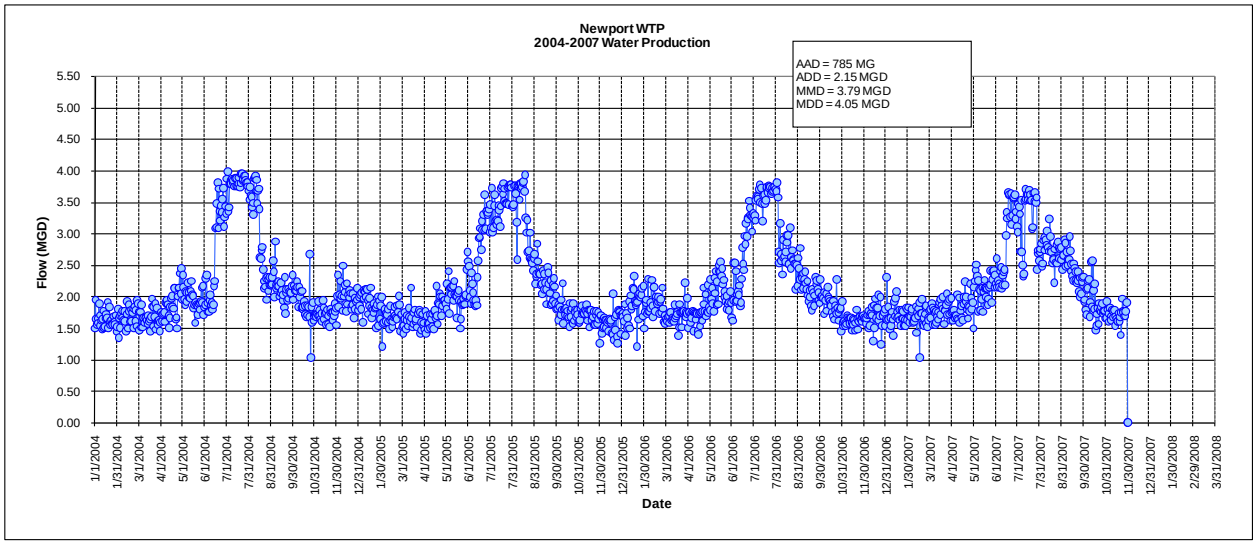

Figure 6.1.2-1 – Daily Water Production, 2004-2007

Total annual demand has ranged from 776 to 795 million gallons with an average (AAD) of 785 million gallons. Peaks occur in the summer (June, July, August) as is typical for most communities. Maximum month flows ranged from 100 to 117 million gallons per month, always in July, resulting in a MMD range of 3.2 to 3.9 mgd. The average daily demand (ADD) for the period is 2.15 mgd. The measured maximum day demands ranged from 3.7 to 4.0 mgd however these peaks are not representative of the true MDD as discussed below.

For the last several years the water treatment plant has operated at full capacity during peak summer demand periods but sometimes is unable to produce enough water to keep up with use in the system. During these times the plant runs virtually 24 hours per day while water levels in the distribution system storage tanks continue to drop. The plant should be able to meet maximum daily needs while keeping system storage full with only peak hourly demands or fire demands causing the storage levels to drop temporarily. This situation prevents the true maximum daily demand (MDD) from being measured. As can be seen in the graphical representations of plant data in Figures 6.1.2-1 through 6.1.2-6, summer peaks of the annual demand curves are truncated where plant capacity is reached near 24 hour run times.

To determine actual MDD flows storage tank levels were evaluated during peak days to measure volume demanded by the system in excess of plant output. On the peak days measured in 2004 and 2006, storage levels dropped by 61,100 gallons and 235,000 gallons respectively. Plant output was sufficient to maintain tank levels in 2005 and 2007. These storage tank volume reductions are added to the measured plant output to estimate the actual current MDD at 4.1 mgd.

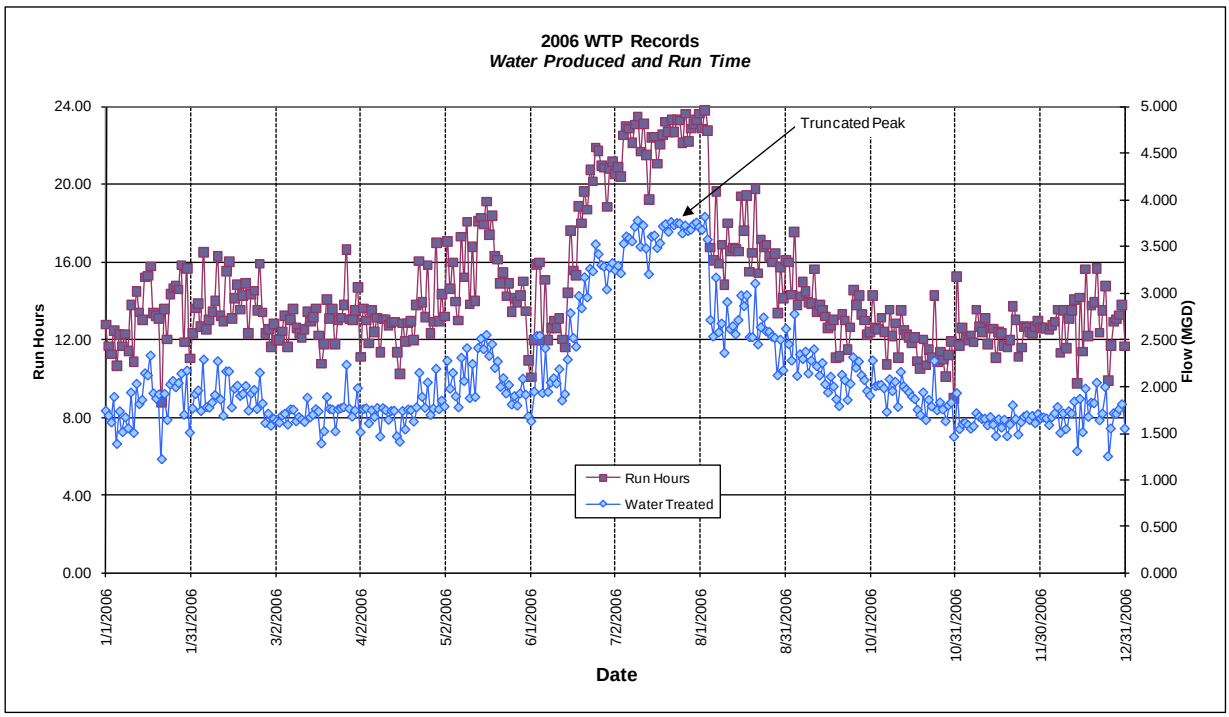

Figure 6.1.2-2 – Plant Run Hours and Daily Production, 2006

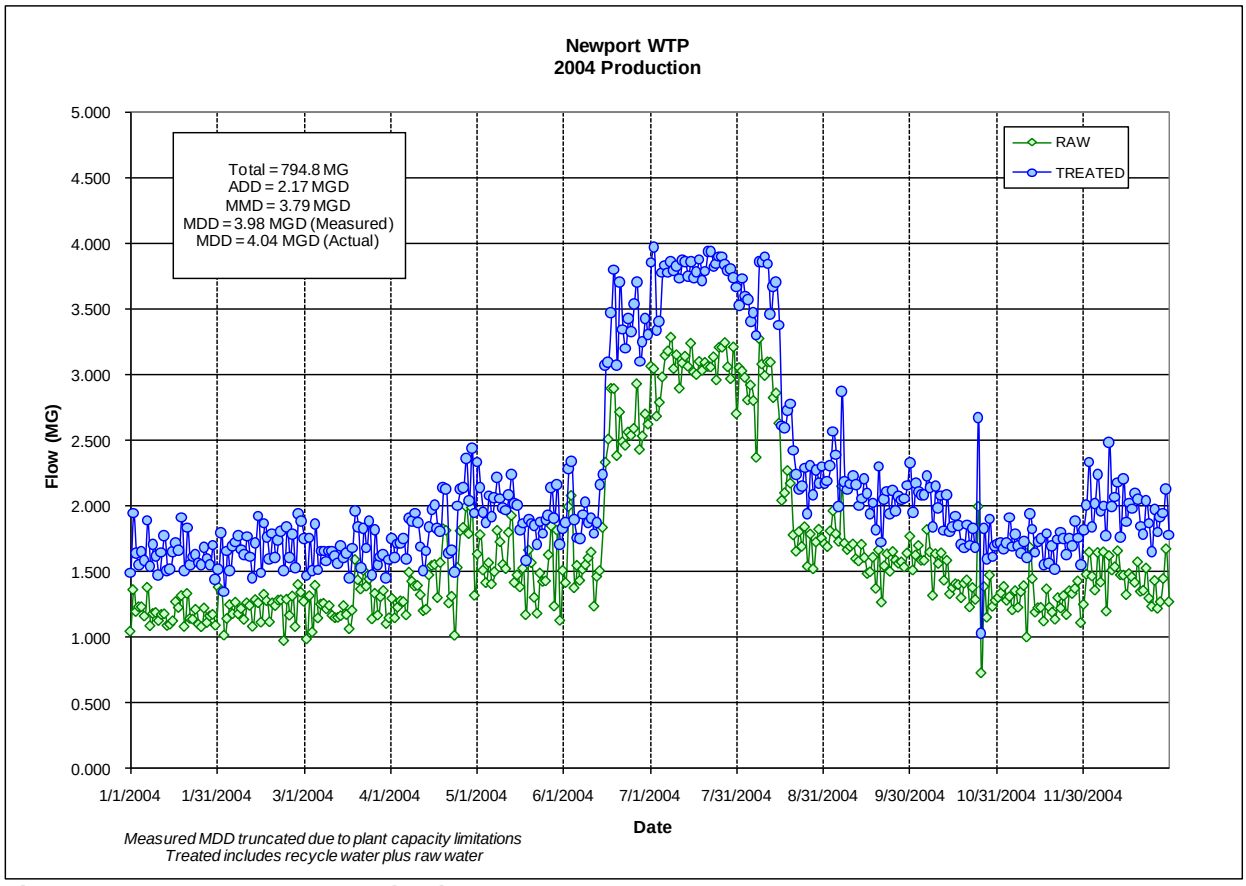

Figure 6.1.2-3 – 2004 WTP Production

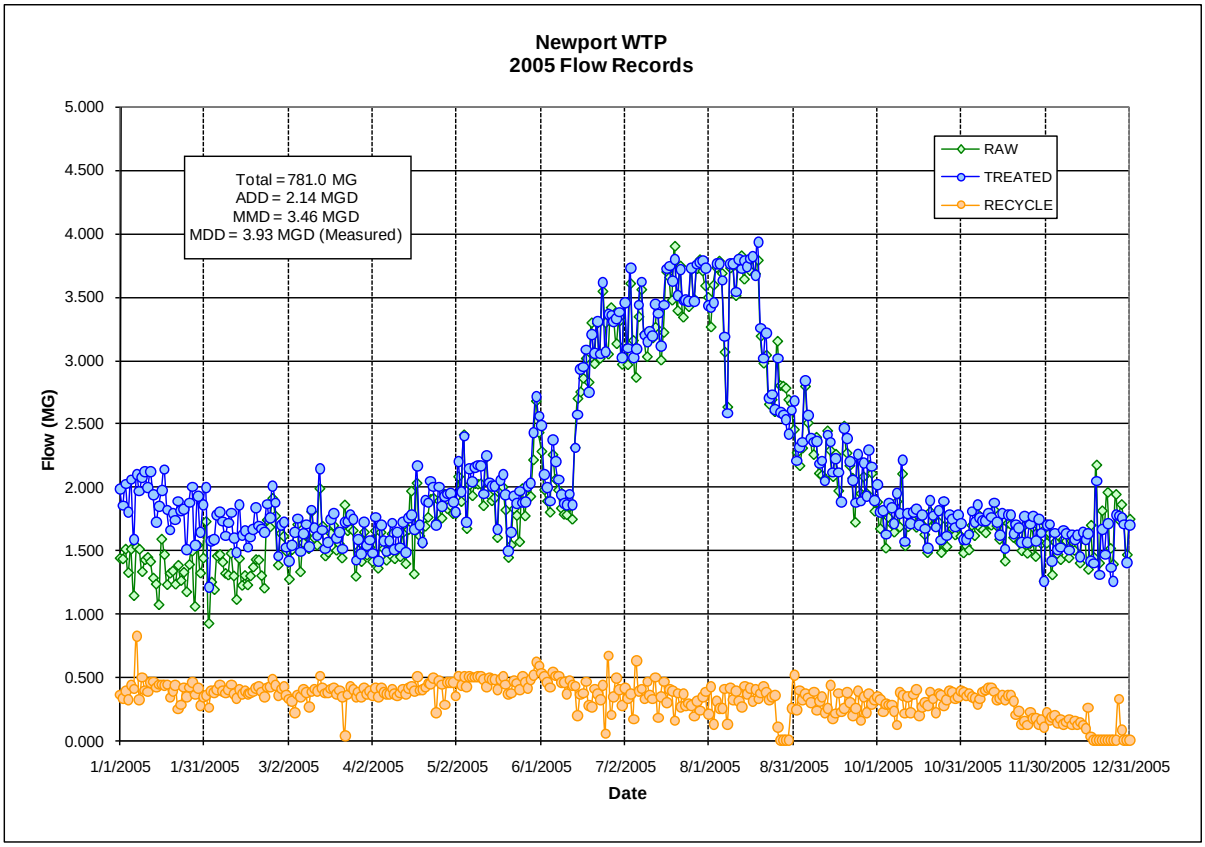

Figure 6.1.2-4 – 2005 WTP Production

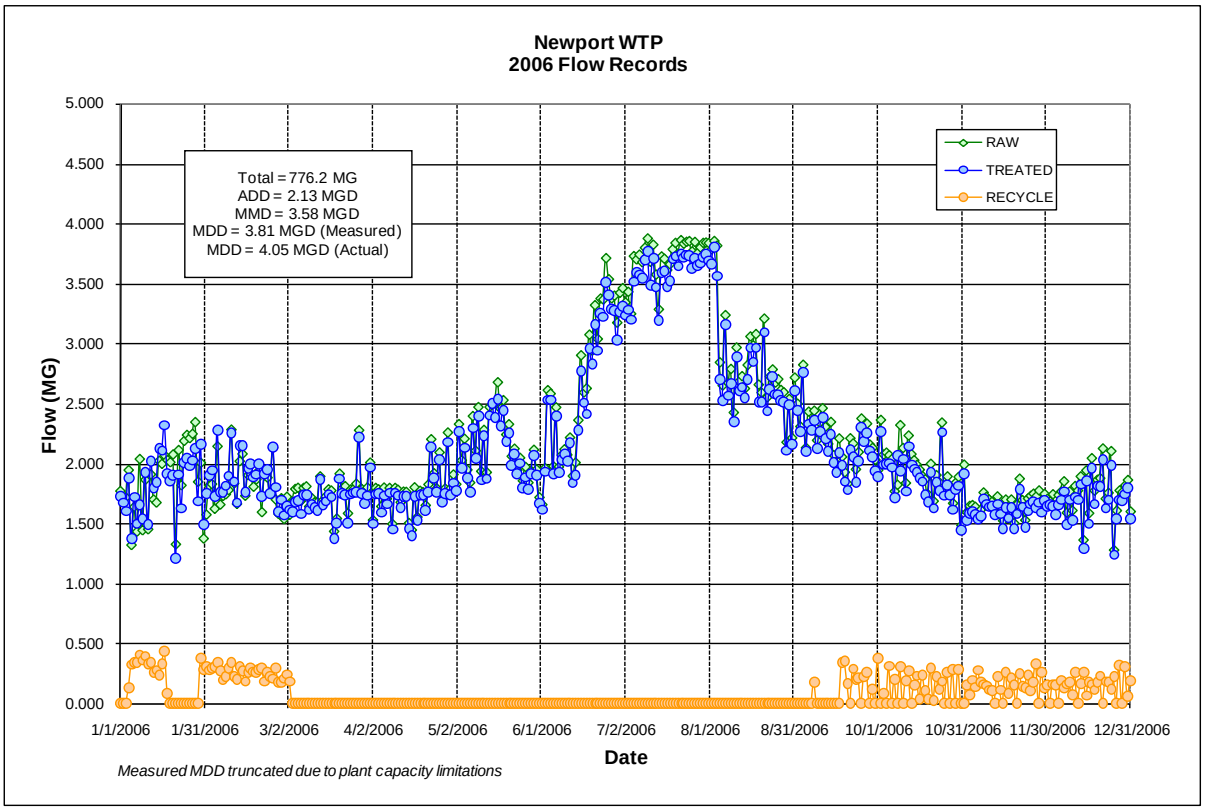

Figure 6.1.2-5 – 2006 WTP Production

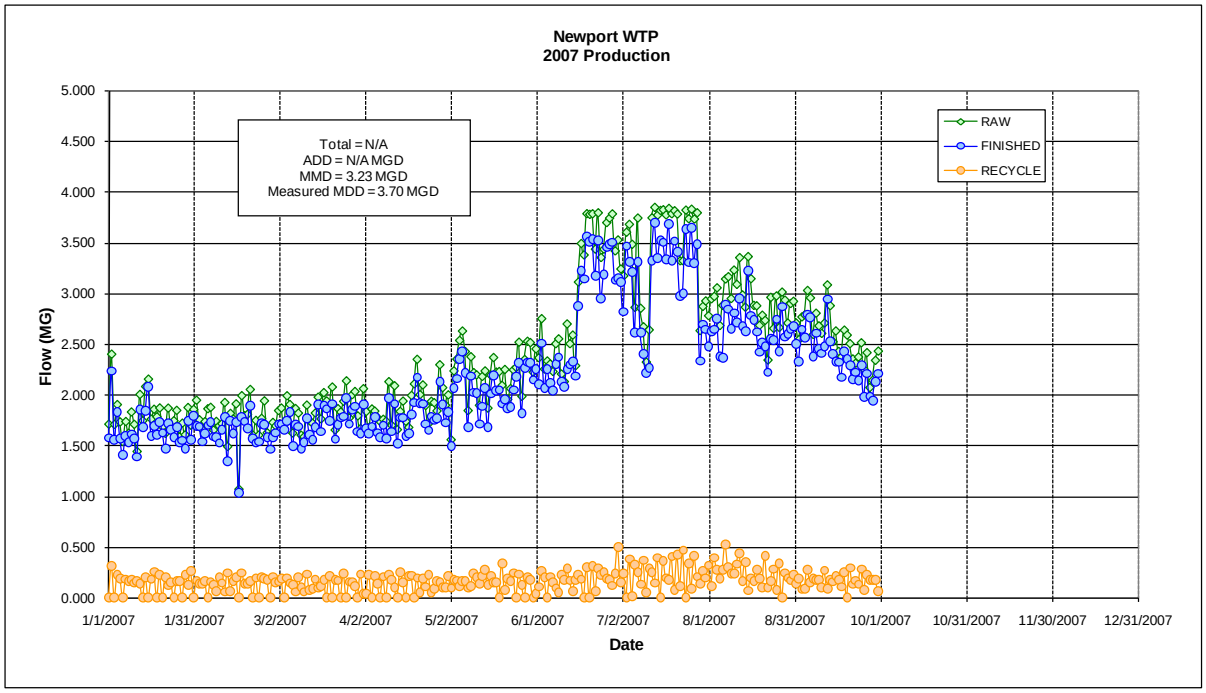

Figure 6.1.2-6 – 2007 WTP Production

Water system design literature suggests typical MDD/ADD peaking factors ranging from 1.5 to 3.0 and PHD/ADD peaking factors ranging from 2.5 to 5.0. For most communities in Oregon the MDD is 2.0 to 3.0 times the ADD and a value of 2.5 is commonly used when measured data is not available. An analysis of several Oregon communities with data readily available shows MDD peaking factors ranging from 2.03 to 3.2 with an average of 2.37.

Table 6.1.2-1 – Oregon Community Peaking Factors

Municipality	Year	MMD/ADD P.F.	MDD/ADD P.F.
Oregon City	2004	1.6	2.1
Tri-City	2006	1.55	2.56
Neskowin	2006	1.72	2.56
Adair Village	2001	1.55	3.2
Sherwood	2003	n/a	2.19
Sutherlin	2005	1.62	2.03
Ashland	2002	n/a	2.25
Bend	2007		2.38
Salem	1994		2.07
Average		1.61	2.37

For the City of Newport a MDD/ADD peaking factor of 1.86 to 1.90 results from the measured data. MMD/ADD peaking factors ranged from 1.68 to 1.74. A peaking factor of 4.0 is assumed for peak hour flow estimates.

Table 6.1.2-2 – Current Water Demand Values

Year	AAD (MG)	ADD (MGD)	MMD (MG)	MMD (MGD)	P.F. MMD/ADD	MDD (MGD)	P.F. MDD/ADD
2004	794.8	2.17	117.46	3.79	1.74	4.04	1.86
2005	781.0	2.14	107.24	3.46	1.62	3.93	1.84
2006	776.2	2.13	111.01	3.58	1.68	4.05	1.90
2007			100.15	3.23		3.70	
Average	*784.0*	*2.15*	*109.0*	*3.51*	*1.68*	*3.93*	*1.87*

Current Design Values							
AAD	785 MG	Million gallons per year					
MMD	112 MG	Million gallons per month					
ADD	2.15	MGD	1493	gpm			
MMD	3.80	MGD	2639	gpm			
MDD	4.10	MGD	2847	gpm			
PHD	8.60	MGD	5972	gpm			
MMD P.F.	1.77						
MDD P.F.	1.91						
PHD P.F.	4.00						

Year	PSU Est. Population	ADD (gpcd)	MMD (gpcd)	MDD (gpcd)	PHD (gpcd)
2004	9,760	222	388	414	890
2005	9,925	216	349	396	862
2006	10,240	208	350	396	831
2007	10,455	206	363	392	823

Per capita water use for Oregon is documented by the U.S. Department of the Interior in the 2000 U.S. Geological Survey - Circular 1268. According to the study, the average per capita water use for Oregon is 207 gallons per capita day (gpcd) including domestic, commercial, industrial, public use and loss. Of the total 207 gpcd, 63% is residential, commercial and public use/loss; 34% is industrial; and 3% is related to thermoelectric power generation. Note that the ADD values in 2006 and 2007 for Newport are almost identical to the State average as documented in the USGS Survey.

For comparison, the unit water demand values determined for Newport in the 1988 Water Master Plan based on the 1973-1987 average were: ADD = 210 gpcd, MMD = 282 gpcd, MDD = 460 gpcd, and PHD = 770 gpcd.

6.1.3 Existing Water Sales

Water consumption data for this Plan is based on the city's water sales records for years 2004, 2005 and 2006. For this period total annual sales ranged from 599 to 640 million gallons with a 3-year average of 622 million gallons. Approximately 53% of water is sold to residential users (apartments, residential, single-family residential, and multi-family account types). The second largest consumption sector is the fish processing plants with an average of just under 12% of total volume sold.

The total number of water accounts climbed from 3893 in January 2004 to 4188 in December 2006. Records show that the total number of accounts has risen to 4256 by June 2007. For the 2004-2006 data the overall consumption per account ranged from 8,480 to 22,540 gallons per month with an average of 12,960 gallons per month per account. Maximum use per account occurs in August or September.

Table 6.1.3-1 – Water Sales Summary

	Annual Water Sales (gallons)				
Customer Type	**2004**	**2005**	**2006**	**Average**	**% of Total**
Airport	131,000	135,000	116,000	127,333	0.02%
COCAS	13,000	14,000	20,000	15,667	0.00%
Commercial	22,874,000	24,340,000	24,271,000	23,828,333	3.83%
Retail & Service	44,342,000	43,018,000	42,084,000	43,148,000	6.94%
Motels	48,327,000	46,409,000	42,471,000	45,735,667	7.35%
RV Parks	20,935,000	19,834,000	22,123,000	20,964,000	3.37%
Apartments	137,687,280	132,913,760	130,934,440	133,845,160	21.52%
Restaurants	25,626,000	25,159,000	25,671,000	25,485,333	4.10%
Fish Plants	82,860,000	85,830,000	49,980,000	72,890,000	11.72%
Non-Water Process	1,280,000	2,309,000	4,615,000	2,734,667	0.44%
Public Institution	56,078,000	56,014,000	57,599,000	56,563,667	9.09%
Residential	6,742,440	6,941,680	7,856,440	7,180,187	1.15%
Single-Family Res.	167,767,000	161,629,000	167,481,150	165,625,717	26.63%
Multiple Dwelling	24,678,000	23,082,000	23,208,250	23,656,083	3.80%
Res. Commercial	251,000	282,000	262,000	265,000	0.04%
Totals	639,591,720	627,910,440	598,692,280	622,064,813	100%

COCAS = Central Oregon Coast Air Service, Fixed Base Operator, City Owned

Table 6.1.3-2 – Single-Family Residential Water Sales Summary

	2004	2005	2006	3-Yr Average
Account	**Avg. Use Each per Month (gal)**	**Avg. Use Each per Month (gal)**	**Avg. Use Each per Month (gal)**	**Avg. Use Each per Month (gal)**
Single Family Res. Inside 3/4	4,727	4,525	4,549	4,600
Single Family Res. Inside 1	6,600	5,648	5,558	5,935
Single Family Res. Inside 1 1/2	9,055	7,517	7,450	8,007
Single Family Res. Outside 3/4	6,281	7,906	8,165	7,451
Single Family Res. Outside 1	7,750	9,471	11,056	9,425
Average, All SFR Accounts	6,883	7,013	7,356	7,084
SFR, 3/4", Inside, Max Month	7,019	5,912	5,879	6,270
SFR, 3/4", Inside, Min Month	3,807	3,737	3,541	3,695

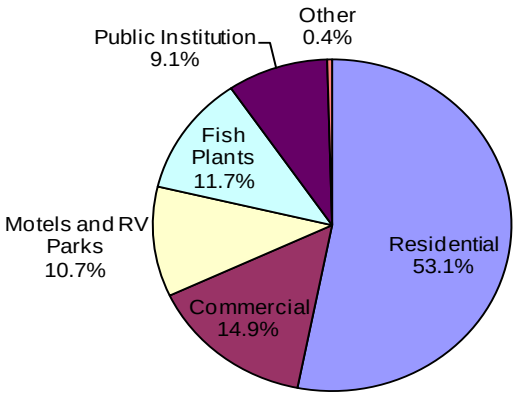

Figure 6.1.3-1 – Water Sales Percentage by Customer Type (Volume Basis)

6.1.4 Existing EDU Analysis

Based on sales records, the average quantity of water used by a single-family dwelling in Newport has been determined. This amount is considered to be the average consumption of 1 equivalent dwelling unit (EDU). When water consumption for other non-residential users is known, a comparison can be made to the consumption for 1 EDU and the number of EDUs for the non-residential user can be determined.

As shown in Table 6.1.3-2, the average monthly water consumption for the typical dwelling (single-family dwelling inside City limits with ¾-inch meter) is 4,600 gallons per month. This monthly consumption for a single EDU varies from 3,695 gallons in the winter months to 6,270 gallons in August/September.

Table 6.1.4-1 – System EDU Summary

	2004	2005	2006	Average
Customer Type	**EDU**	**EDU**	**EDU**	**EDU**
Airport	2.3	2.5	2.1	2.3
COCAS	0.2	0.3	0.4	0.3
Commercial	403.3	448.2	444.7	432.1
Retail & Service	781.7	792.2	771.0	781.7
Motels	852.0	854.6	778.1	828.2
RV Parks	369.1	365.3	405.3	379.9
Apartments	2,427.4	2,447.7	2,398.8	2,424.6
Restaurants	451.8	463.3	470.3	461.8
Fish Plants	1,460.8	1,580.6	915.7	1,319.0
Non-Water Process	22.6	42.5	84.5	49.9
Public Institution	988.7	1,031.5	1,055.2	1,025.1
Residential	118.9	127.8	143.9	130.2
Single-Family Res.	2,957.7	2,976.5	3,068.3	3,000.9
Multiple Dwelling	435.1	425.1	425.2	428.4
Res. Commercial	4.4	5.2	4.8	4.8
Total EDU	11,276	11,563	10,968	11,269
1 EDU = 1 SFR 3/4" meter inside City = 4600 gallons per month annual average				

The current number of EDUs in Newport is estimated at 11,270. The MDD water demand per EDU is therefore 364 gpd/EDU and the ADD is 191 gpd/EDU.

6.1.5 Unaccounted Water

The difference between the quantity of water pumped from the water treatment plant into the distribution system and the quantity of water measured at the individual customer water meters (water sold) is unaccounted water. This comparison is typically called a "water balance." Water pumped from the WTP into the system is the amount of water produced minus the amount of water used at the plant for backwashing and other plant use.

Unaccounted water is a combination of "apparent" water loss which results from inaccurate water meters or billing discrepancies and "real" water loss resulting from leakage, water theft, and authorized unbilled usage such as firefighting and main flushing.

If there were no leakage in the system, all water meters were 100% accurate, and every drop of water used for fire fighting and system flushing was measured, there would be zero unaccounted water. In reality every water system has a certain amount of leakage, water meters are not 100% accurate, and it is rare for every drop of water used in town to be metered and measured. Therefore virtually every community water system has unaccounted water.

To quantify unaccounted water in Newport water sales records are compared to plant production records for a specific time period. Records for the 3-year period from 2004 to 2006 show an average unaccounted water quantity of 16.3% of the total water pumped to town from the treatment plant. In the 1988 Water Master Plan, unaccounted water was 16.2% for the 1973-1987 period of analysis.

Table 6.1.5-1 – Unaccounted Water

Year	Total WTP Pumped (MG)	Total Sales (MG)	Unaccounted (MG)	Unaccounted %
2004	738.904	639.592	99.312	13.44%
2005	743.438	627.910	115.528	15.54%
2006	747.213	598.692	148.521	19.88%

6.2 Projected Water Demand

6.2.1 Basis for Projections

Water demand estimates for future years are determined by multiplying the current unit demand design values (gpcd or gpd/EDU) by the projected number of future users in the water system. It is assumed new users added to the system will consume water at the same rate as current users. Population and other water user projections are presented in Section 2.3.2. The unit water demand design values (gpcd) are presented in Section 6.1.2; the following table reiterates the design values as developed therein.

Table 6.2.1-1 – Unit Water Demand Values

Demand	2007 MGD	gpcd	gpd/EDU
ADD	2.15	206	191
MMD	3.80	363	337
MDD	4.10	392	364
PHD	8.60	823	763
Current Population		10,455	
Current EDU		11,270	

6.2.2 Water Demand Projections

With the projected increase in system EDUs from the current 11,270 to a total of 15,970 EDU in the year 2030 the maximum day water demand is projected to increase to 5.8 MGD from the current 4.1 MGD. This becomes the primary planning demand for this Master Plan (20 year MDD).

If the same growth rate were to continue past the planning period the MDD would increase to 7.5 MGD in 2050 and 9.6 MGD in 2070.

Water demand projections through the planning period are shown in Table 6.2.2-1.

Table 6.2.2-1 – Water Demand Projections

Year	Population	EDU	ADD (mgd)	MMD (mgd)	MDD (mgd)	PHD (mgd)
2007	10,455	11,270	2.15	3.80	4.10	8.60
2008	10,586	11,411	2.18	3.85	4.15	8.71
2009	10,718	11,554	2.20	3.90	4.20	8.82
2010	10,992	11,817	2.25	3.98	4.30	9.02
2011	11,129	12,375	2.36	4.17	4.50	9.44
2012	11,269	12,525	2.39	4.22	4.56	9.56
2013	11,409	12,676	2.42	4.27	4.61	9.67
2014	11,552	12,829	2.45	4.33	4.67	9.79
2015	11,696	12,985	2.48	4.38	4.72	9.91
2016	11,843	13,142	2.51	4.43	4.78	10.03
2017	11,991	13,301	2.54	4.48	4.84	10.15
2018	12,140	13,462	2.57	4.54	4.90	10.27
2019	12,292	13,625	2.60	4.59	4.96	10.40
2020	12,446	14,201	2.71	4.79	5.17	10.84
2021	12,601	14,368	2.74	4.84	5.23	10.96
2022	12,759	14,537	2.77	4.90	5.29	11.09
2023	12,918	14,709	2.81	4.96	5.35	11.22
2024	13,080	14,882	2.84	5.02	5.41	11.36
2025	13,243	15,058	2.87	5.08	5.48	11.49
2026	13,409	15,236	2.91	5.14	5.54	11.63
2027	13,577	15,416	2.94	5.20	5.61	11.76
2028	13,746	15,599	2.98	5.26	5.67	11.90
2029	13,918	15,783	3.01	5.32	5.74	12.04
2030	14,092	15,970	3.05	5.38	5.81	12.19