Current Projections for Future Growth, Water Demand and Storage Needs

a report of the

Pagosa Area Water and Sanitation District
and
San Juan Water Conservancy District

February 23, 2009

San Juan River Diversion site

Dry Gulch Reservoir site

EXECUTIVE SUMMARY

This report provides an explanation for all growth projection, future water demand and storage requirement calculations for the Pagosa Area Water and Sanitation District (PAWSD) and San Juan Water Conservancy District (SJWCD) service areas. This report is specific to the future potable and irrigation water infrastructure needs of these water Districts, and does not attempt to address potential additional needs of recreational or downstream users.

The horizon used for future water planning is approximately fifty years, or through 2055. The water demand growth rate chosen is 3.9%, which is an average over the last ten years of actual growth in Equivalent Units (EUs) connected to the PAWSD water distribution system and State Demographer's Office estimated annual population growth in Archuleta County.

The future water demand of an anticipated 43,640 EUs in 2055 will be 13,610 acre feet (AF). This figure incorporates a savings from water conservation programs and measures as well as the current contractual raw water obligation of PAWSD to various irrigation customers.

The 2055 raw water storage requirement beyond current PAWSD reservoir capacity is 19,000 AF. This capacity is required to ensure that 13,610 acre feet of demand can be met during a drought similar to the drought of 2002 with an additional one year of demand (safety supply), in the case of a prolonged drought or for some other reason water is not available to divert for up to a year. This storage requirement does not account for inactive or "dead" storage, which is an additional amount that cannot be utilized for water demand due to fish, wildlife, wetland or recreational requirements and physical impossibility to withdraw.

Due to the long planning horizon and broad scope of this project, several assumptions based on water infrastructure projects of similar magnitude had to be made. The assumptions, and the data, used in these projections calculations will be revisited annually and projections adjusted accordingly.

SECTION I.

GROWTH: 3.9% per year (1999-2008)

Growth projections are based on historical records. Historical records are viewed as presenting the most accurate indication of future trends. Records used were:

1. PAWSD historical records of actual new Equivalent Unit (EU) connections between 1999 and 2008, and
2. Colorado State Demographer's Office (SDO) population estimates from 1999 to 2008.

Why 1999-2008 records? Both PAWSD and the SDO have annual growth records from 1985 forward and thus the projections could have been based upon the last 22 years of growth. However, the most recent ten year time period was chosen in order to be conservative while still allowing for economic fluctuations. The growth rate would be somewhat higher if the last 22 years of records were used (see **Chart 1**).

Why average of the average? As illustrated by **Chart 1 – Comparison of Historical Rates of Growth Increases**, there is a difference each year between actual PAWSD growth and SDO estimated growth. In order to average the errors of choosing one method versus the other, or choosing one historical time frame versus the other, an "average of averages" was chosen to be the most representative of the overall record history, including averaging the effects of natural economic cycles.

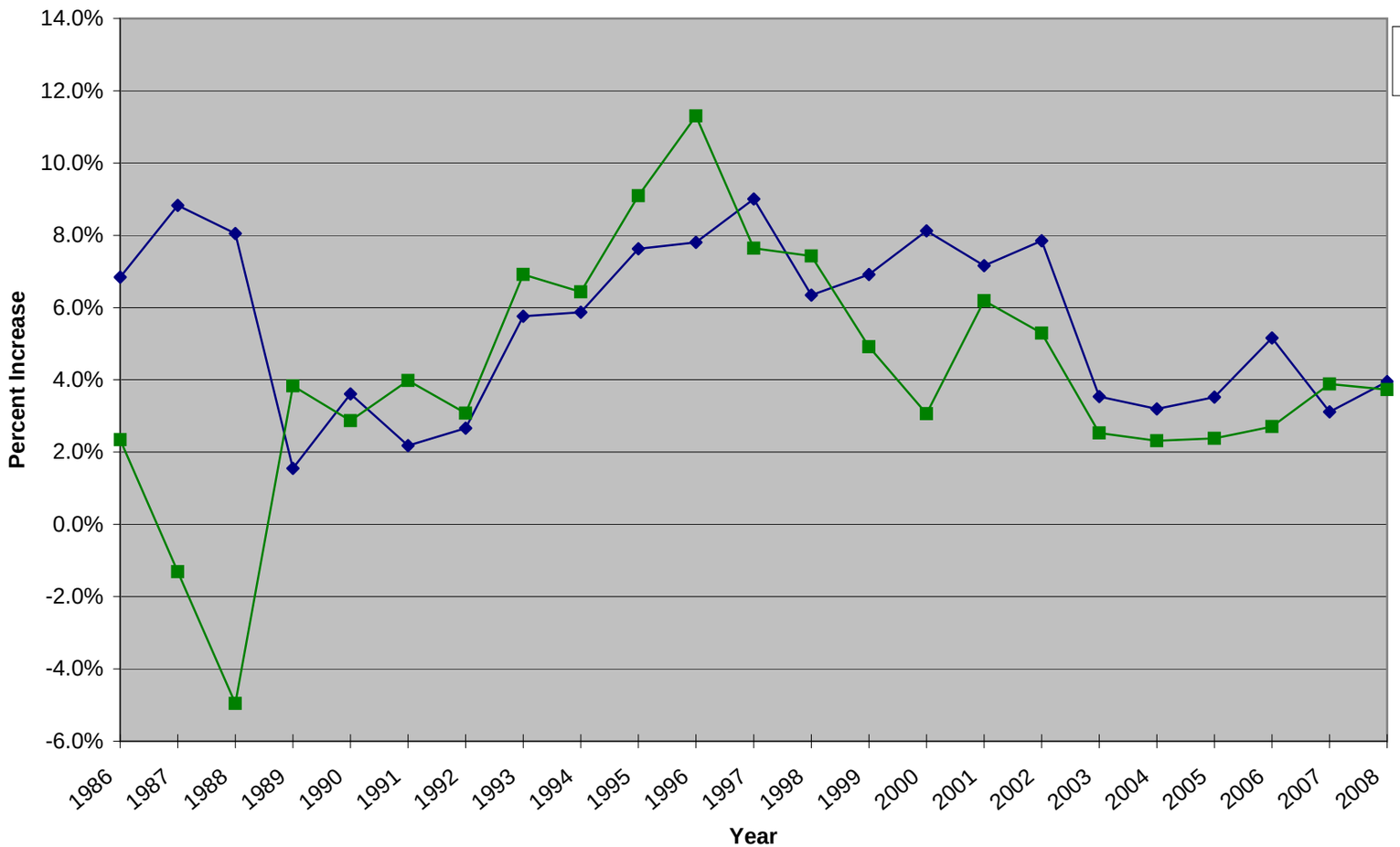
Acknowledgements:

1. EUs, as opposed to permanent population, are used for the purposes of future demand and storage projections because: EUs are a quantifiable known amount; permanent population does not represent tourists, part-time residents, irrigation or commercial users; permanent population does not accurately indicate peak water demand by all users; there is no way of knowing exactly what the permanent population of the PAWSD service area is; and there is no way of knowing what exactly the permanent population of the County is between decade Census years.

2. Ten years may not be a long enough historical time frame to adequately average economic cycles. By choosing the 10 over the 22 year period, 3.9% vs. 4.3% average annual growth, PAWSD acknowledges that it may be underestimating the long term need of the community (see 3, below).

3. Note in Table 1. that in the last 22 years, there have only been 8 years that the actual EU growth has been below 3.9%.

CHART 1
Comparison of Historical Rates of Growth Increases*
1986-2008



PAWSD Actual EU Growth
SDO Estimated Permanent Population growth

Sources of Data:

SDO: State Demographer's Office; represents data found at http://www.dola.state.co.us/dlg/demog/pop_cnty_estimates.html

PAWSD: Pagosa Area Water and Sanitation District; represents actual EU growth.

*1993 inclusion effect removed

Average annual growth:

	PAWSD EU	SDO
5 yr	3.8%	3.0%
10 yr	5.3%	3.7%
22 yr	5.6%	4.2%

Average 3.9%

Average 4.3%

Table 1. Historic Growth Data

YEAR	PAWSD EUs	PAWSD annual % EU growth[1]	SDO County population[2]	SDO % population growth
1985	1389		5213	
1986	1484	6.8%	5335	2.3%
1987	1615	8.8%	5265	-1.3%
1988	1745	8.0%	5004	-5.0%
1989	1772	1.5%	5196	3.8%
1990	1836	3.6%	5345	2.9%
1991	1876	2.2%	5558	4.0%
1992	1926	2.7%	5729	3.1%
1993	3047	5.8%	6125	6.9%
1994	3226	5.9%	6519	6.4%
1995	3472	7.6%	7112	9.1%
1996	3743	7.8%	7916	11.3%
1997	4080	9.0%	8521	7.6%
1998	4339	6.3%	9154	7.4%
1999	4639	6.9%	9604	4.9%
2000	5016	8.1%	9898	3.1%
2001	5375	7.2%	10511	6.2%
2002	5797	7.9%	11067	5.3%
2003	6002	3.5%	11347	2.5%
2004	6194	3.2%	11610	2.3%
2005	6412	3.5%	11886	2.4%
2006	6743	5.2%	12208	2.7%
2007	6953	3.1%	12682	3.9%
2008	7227	3.9%	13155	3.7%

[1]effect of 1993 inclusion (1010 EUs) removed
[2]data can be found at http://www.dola.state.co.us/dlg/demog/pop_cnty_estimates.html

Table 2. Growth Projections at 3.9%

YEAR	EUs
2009	7509
2010	7802
2015	9446
2020	11,438
2025	13,849
2030	16,769
2035	20,304
2040	24,584
2045	29,767
2050	36,042
2055	43,640

Net new Equivalent Units in 2055: **36,413**

SECTION II.

WATER DEMAND: 13,610 Acre Feet in 2055

In order to calculate Future Water Demand, several decisions must be made. The following decisions were made based on assumptions that are the most reasonable at this time.

1. Planning Horizon: Based on the September 11, 2008 water rights Remand Decree, the planning horizon used for future demand projections is **2055**.

2. Treated Water Usage Rate and Water Conservation Effects: As with growth projections, historic water usage rates are an accurate indication of future trends, with an average taken over a long time period typically more accurate than over a shorter period. However, as a result of the 2002 drought and implementation of effective water conservation programs, average per EU use has dropped approximately 25% since 2001, the time period prior to the drought and the majority of these programs and measures. In the recently adopted 2008 Water Conservation Plan, it is the stated goal of PAWSD to maintain this 25% reduction in average use (p.13). Therefore, the substantially lower 2002-2007 average use of **260 gallons** (rounding down) per EU per day, which incorporates 25% savings per year due to water conservation, is used for future demand projections. See Table 3 below for details.

Table 3. Historic Treatment Plant Production*

***Records prior to 1995 unavailable

YEAR	Total Annual Demand (gallons)	Average Gal per EU per day (treated)
1995	441,988,503	337
1996	461,537,466	324
1997	485,830,237	316
1998	573,509,907	350
1999	547,366,587	315
2000	593,870,917	332
2001	648,548,800	340
2002	542,892,000	268
2003	538,760,000	249
2004	638,046,000	287
2005	617,382,000	269
2006	592,628,000	247
2007	634,212,599	255
	1995-2001 Average	331
	2002-2007 Average	**263**

3. Raw Water Usage Rate: Contractually, PAWSD currently must provide up to 900 Acre Feet (AF) of raw water for irrigation, evaporation and related uses each year. The assumption was made that there would be no further raw water irrigation obligations

until after 2055, leaving total raw water demand at **900 AF**. This assumes no more parks, golf courses or other large irrigation customers in the community.

Combining the effects of the above four decisions with the 3.9% projected EU growth results in **a total water demand of 13,610 AF in the year 2055**. See Table 4 for details.

Table 4. Future Annual Water Demand*

***annual water demand only, does not include one-year safety supply

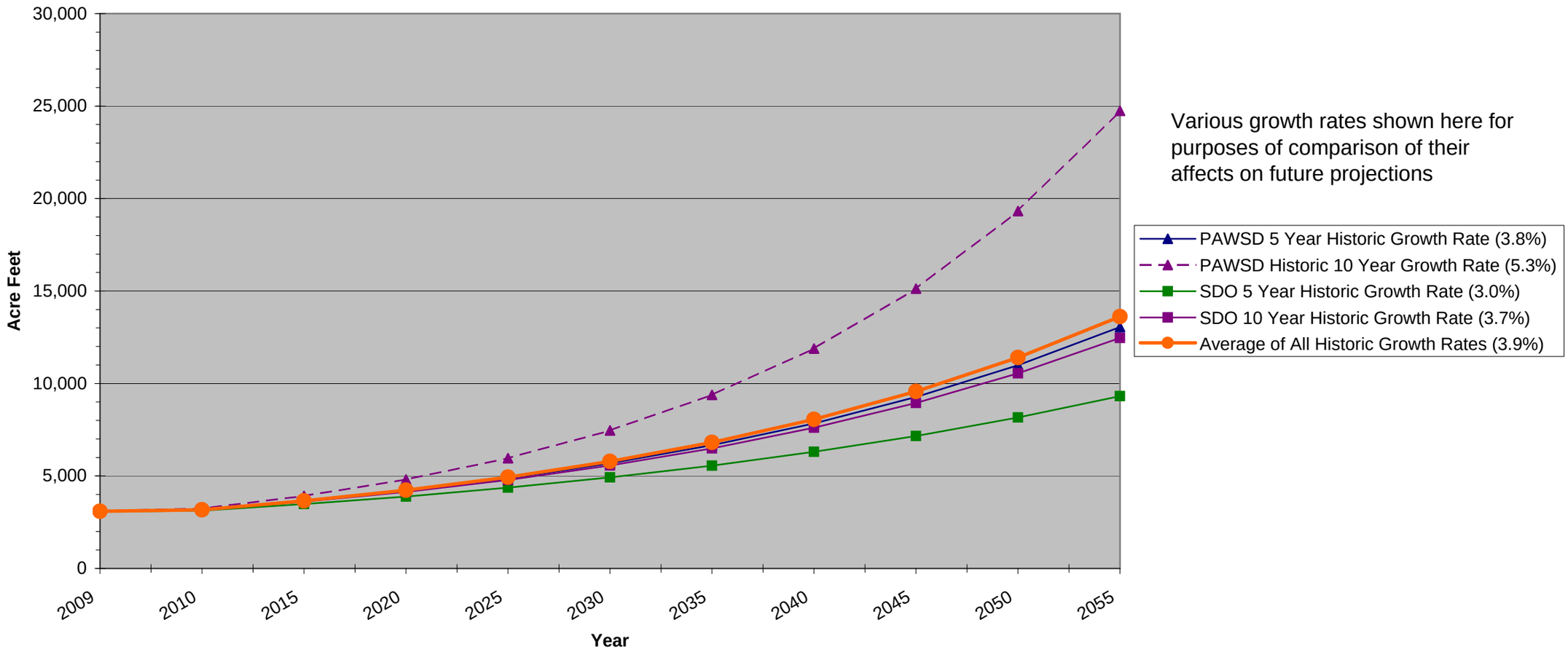
YEAR	EUs	Total Treated Annual Demand (AF)	Total Annual Demand (AF)
2009	7509	2187	3087
2010	7802	2272	3172
2015	9446	2751	3651
2020	11,438	3331	4231
2025	13,849	4033	4933
2030	16,769	4884	5784
2035	20,304	5913	6813
2040	24,584	7160	8060
2045	29,767	8669	9569
2050	36,042	10,497	11,397
2055	43,640	12,710	13,610

Acknowledgements: These underlying assumptions will be revisited annually and projections adjusted accordingly.

Chart 2 – Future Annual Water Demand Projections displays the application of various growth models on future projections, and the result of using a 3.9% average growth rate.

CHART 2
Future Annual Water Demand Projections

Using 2002-2007 Average Historic Usage of 260 Gal/EU/day (treated) given continued water conservation practices and 900 AF/yr (raw)



SECTION III.

TREATMENT and STORAGE: Additional 19,000 Acre Feet Needed in 2055

Treated water demand is supplied by two sources: diverting water from river sources and drawing water from reservoir storage. Thus, there are two raw water supply components to the Dry Gulch project: increasing diversion capacity and increasing storage capacity.

Treatment

Regardless of the source, historic daily water treatment plant production data for peak summer months shows that water production required to meet demand is more than twice the average annual daily use the remainder of the year (.41 gallons per minute vs. .18 gpm, or 260 gallons average, per EU per day). Therefore, in calculating the treatment plant capacity requirements for 2055, the average peak demand (.41 gpm per EU) since 2002 was used. In cases where peak demand exceeds .41 gpm, PAWSD will rely on potable water storage tanks to buffer that demand.

Storage

Source One: Diversion

PAWSD's current maximum diversion capacity is 6.9 cubic feet per second (cfs). Although the Dry Gulch project will increase that diversion capacity in order to meet demand, particularly at peak periods, the 2002 drought showed that the rivers would not yield more than 6.9 cfs during droughts.

Chart 3 – Diversion Capacity Required to Meet Demand illustrates demand versus supply available from direct diversion.

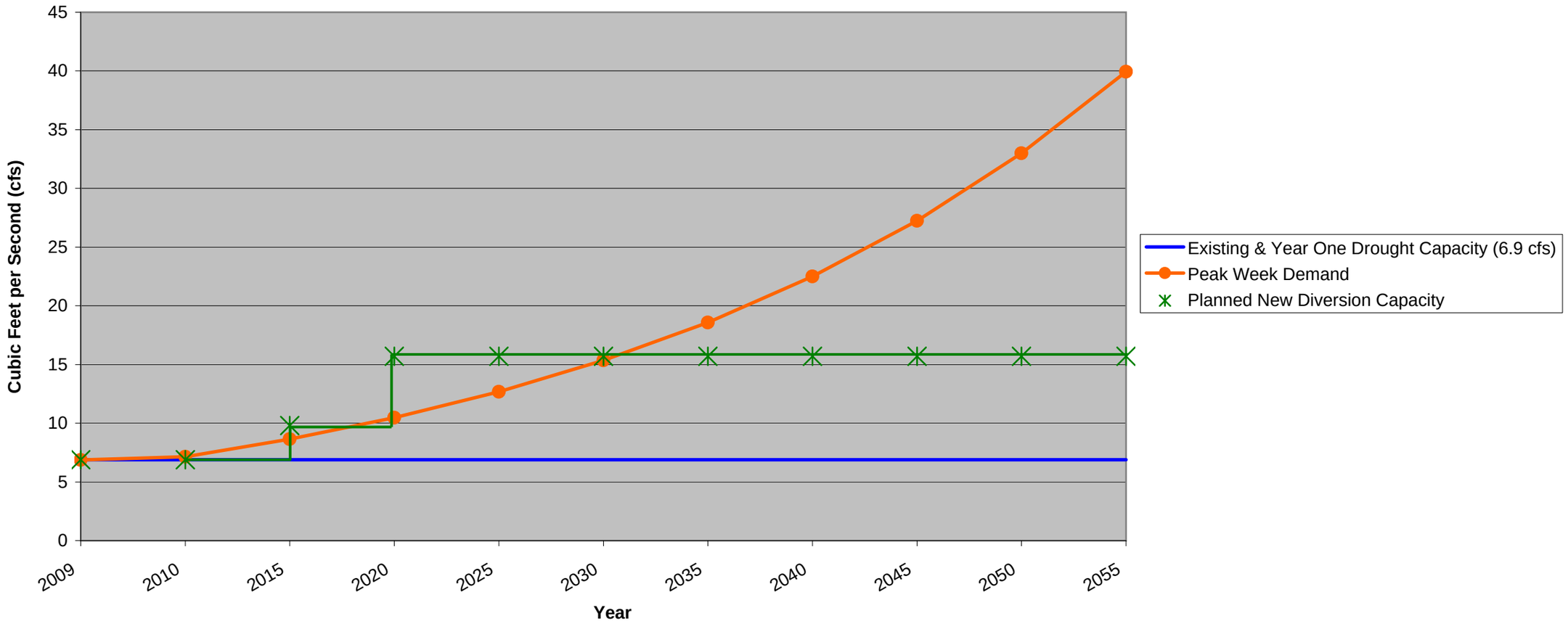
As illustrated by **Chart 3**, in non-drought years when water is available in rivers, increased diversion alone will not be able to supply peak demand by approximately year 2030. Storage will be required to make up the balance.

Source Two: Reservoir Storage

Reservoir storage must be planned to consider periods of drought. The amount of additional reservoir storage that is projected to be needed given Section I. Growth and Section 2. Demand projections includes a one-year safety supply in the case that a drought lasts for two years or for some other reason water is not available to divert for up to a year.

Paleoclimate (long-term historical) records and climate change predictions indicate that recorded droughts from 1910 to 2008 may not accurately reflect the potential for more severe droughts in the future. Thus, a safety supply margin is required to compensate for worse future droughts.

CHART 3
Diversion Capacity Required to Meet Demand
Peak Week curve based on .41 gpm/EU Historical Peak Demand



In order to calculate the additional storage needed to satisfy demand in a 2002-type drought with an additional one year of supply available at all times, the following approach was used:

1. The 2002 San Juan River flows were used to emulate drought conditions and river water availability. The 2002 San Juan River flows were used because this was the worst drought within the 1910 to 2008 record. This data can be found at http://waterdata.usgs.gov/CO/nwis/uv?09342500.

2. The 2055 annual demand was broken down into monthly demand based on current use percentages. Calculating monthly draw-down and storage refill periods, the result is a maximum storage draw down of 5557 AF.

3. When you are in the middle of a drought, you do not know how long a drought will last. One must assume that at the point of maximum drawdown, no diversion is available and all demand (13,610 AF) for the next year would need to be supplied by storage.

4. The maximum draw down and a second year of demand is added together for the final additional storage requirement of approximately **19,000 Acre Feet****.

Table 5 illustrates this math, which is graphically shown on **Chart 4**.

In conclusion, calculating monthly draw down and storage refill periods, the result during a 2002-type drought is a maximum storage draw down of approximately 5,600 AF. Nearly no water could be diverted from the San Juan River during June through September of 2002 and nearly all of the supply for PAWSD customers had to be provided from storage. During this four month period in 2002, PAWSD did not reduce the flow in the San Juan River below the Colorado Water Conservation Board instream flow water right amount of 50 cfs; however, the river flow was typically around 10 cfs during this period.

Acknowledgements: This is a simplified calculation for lay person explanation purposes. It builds on the decisions made in Sections I and II. There are several variables that affect this calculation that are impossible to predict, so best-guess assumptions have been used. These variables are:

- Will the Dry Gulch diversion permit require a stream flow by-pass for fish habitat?
- What will diversion availability actually be?
- What will be the level of the reservoirs prior to the spring of Year One?
- What will be the constraints of the CWCB in-stream flow water right?
- How will drought restrictions affect demand?

**** This water storage calculation does not account for inactive or “dead” storage, which is an additional amount that cannot be utilized for water demand due to fish, wildlife, wetland or recreational requirements and physical impossibility to withdraw.

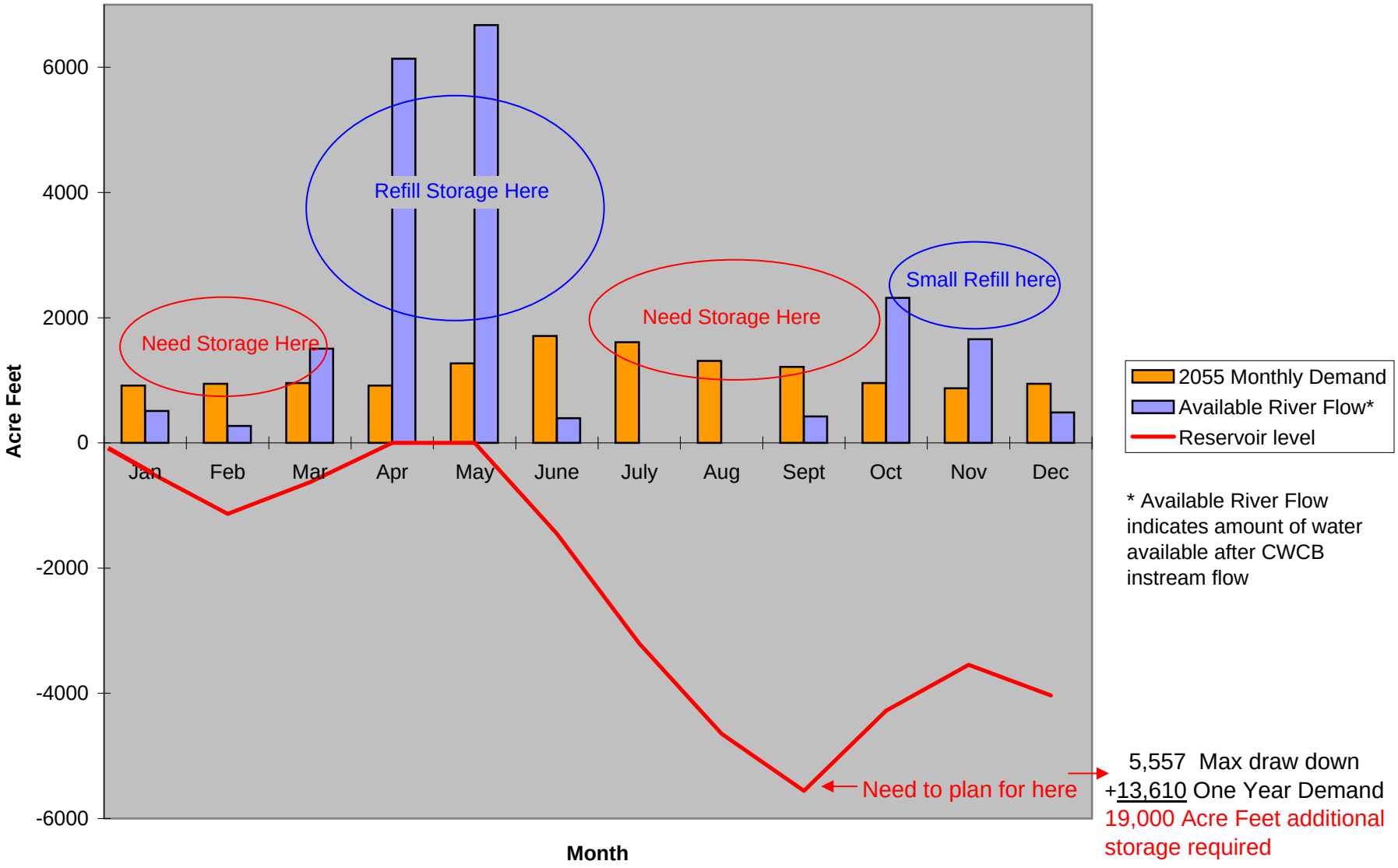
Table 5. 2002-Type Drought Affect on Diversion and Storage (all numbers in Acre Feet)

Month	2055 Demand	River Flow (Total Monthly)	CWCB Instream flow right	Available after instream	Divert to meet demand	Must draw from storage	Evaporative/Seepage Loss from Storage	Extra available to pump into reservoir	Reservoir Level
Jan	914	2355	1845	510	510	404	28	0	-432
Feb	942	1936	1667	269	269	673	28	0	-1133
Mar	955	3349	1845	1504	955	0	42	549	-626
Apr	914	9114	2976	6138	914	0	67	5224	0
May	1269	9747	3075	6672	1269	0	140	5403	0
June	1706	3371	2976	395	395	1311	141	0	-1452
July	1610	954	3075	0	0	1610	141	0	-3203
Aug	1310	827	3075	0	0	1310	135	0	-4648
Sept	1215	2208	1786	422	422	793	117	0	-5557
Oct	955	4160	1845	2315	955	0	81	1360	-4278
Nov	873	3440	1786	1654	873	0	49	781	-3546
Dec	942	2331	1845	486	486	456	32	0	-4034

Maximum draw down 5557

Total Additional Storage Required with One Year Safety Supply **19167**

CHART 4
2002-Type Drought
Reservoir Level, 2055 Water Demand and San Juan River Flow



* Available River Flow indicates amount of water available after CWCB instream flow

5,557 Max draw down
+13,610 One Year Demand
19,000 Acre Feet additional storage required