Appendix D - District Demand Forecast Model TM

A&N Technical Services, Inc.

DRAFT FINAL Technical Memorandum

Lake Arrowhead Community Services District Integrated Water Resources Program

Subject: **District Demand Forecast Model and Method**

Prepared For: Lake Arrowhead Community Services District

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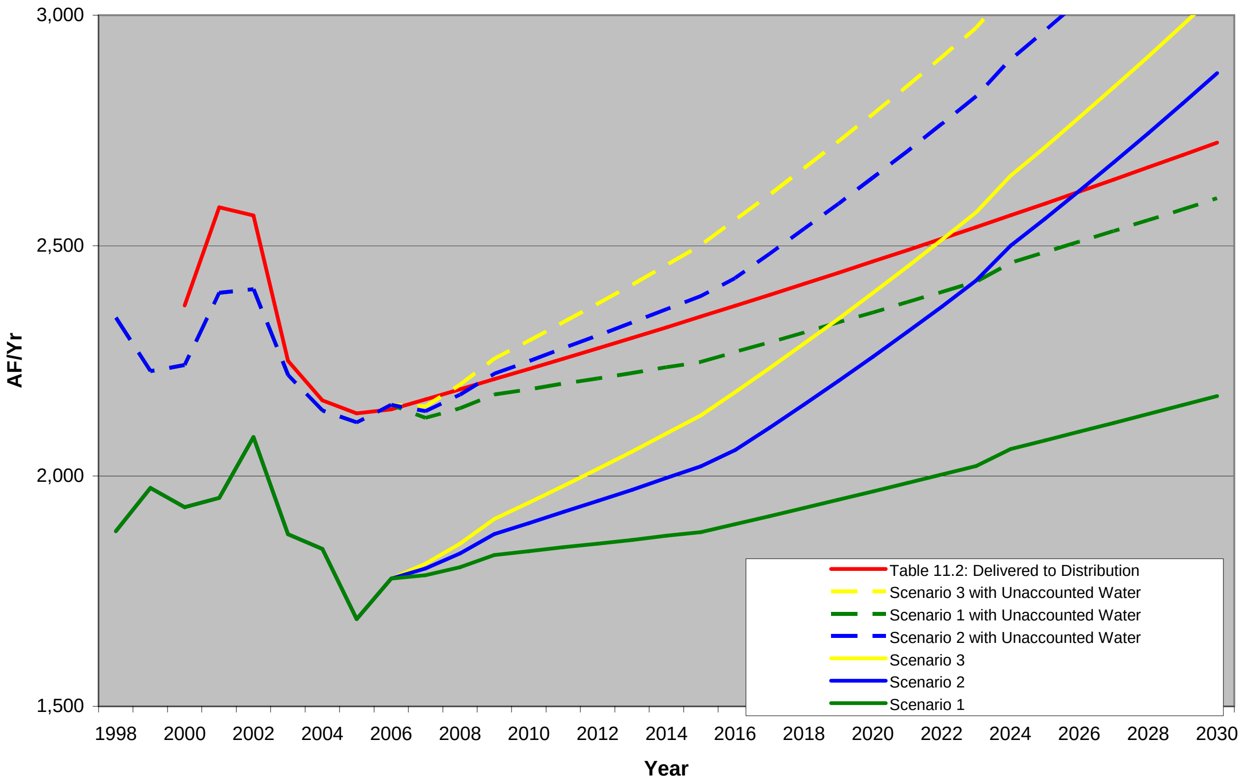
1 Summary and Recommendations

This technical memorandum (TM) documents the models and methods used to forecast water demand for the Lake Arrowhead Community Services District (District). The demand model forecasts water demand at the customer meter. This is necessary to allow for separate consideration of system loss control programs. The water demand model carefully separates out the effects of weather, ongoing (passive) conservation, future (active) conservation, and the real increases in the price of water.

Figure 1 summarizes the three water demand forecast scenarios developed for the District as well as the District's "Delivered to Distribution" demand projection provided in Table 11.2 (as revised in Attachment A).

Figure 1: Demand Forecast Scenarios (without Future Active Conservation)



Does not include transfers to Grass Valley Lake, recycled water irrigation, or plant backwash & utility water in Table 11.2.

To be comparable to "Delivered to Distribution," the demand forecast scenarios in Figure 1 do not include transfers to Grass Valley Lake, recycled water irrigation, or Plant Backwash & Utility Water. All commercial customers are included.

Scenario 1 assumes a constant level of water demand per meter, with growth only due to an increase in the number of meters - these assumptions are similar to the constant meter demand assumptions used previously at the District [see Table 11.2. of the District's 2005 Urban Water Management Plan (UWMP)]. Scenario 2 assumes that water use per meter will grow at a rate similar to historical, pre-drought growth rates (from 1998 to 2002), and that the price increases in more recent years will affect water demand. Scenario 3 also assumes that water use per meter will grow at the actual rate of growth in the pre-drought years from 1998 to 2002, but it does not include a price effect. All three scenarios assume the growth in meters is restricted to 60 meters per year while current ordinances are in effect until 2015. After 2015, it is assumed that the number of meters will increase to an average of 97 meters per year to reach planned full build-out in 2030.

Based on this comparative analysis, recommendations include the following:

- Use the Scenario 2 forecast as the best estimate of the most likely outcome and consider Scenarios 1 and 3 a systematic examination of what demand would look like if our assumptions are off - upper and lower bounds, or simply other possible outcomes.
- Revise UWMP Table 11.2 demand and supply to reflect revised assumptions for growth in number of connections. That is, new connections are assumed to be limited to an annual growth of 60 meters per year through 2015, and then it is assumed there will be 97 new connections per year to the planned build out of the service area in 2030.
- Clarify whether the growth assumptions of UWMP Table 11.2 reflect conservation activity - passive conservation due to changes in the plumbing code or due to active conservation programs (device installation, rate reform, and information programs.)
- Although some of the policy debate has been cast in terms of the number of full time versus part time residents, it would be more instructive to consider:
    a. Growth in the number of "person-days" whether due to more people moving to Lake Arrowhead to live or due to more visitors and longer stays in vacation homes; and
    b. Growth in irrigated area.

  For example, longer stays because of the ability to telecommute is not captured by the full time versus part time distinction. Nor is the increase in irrigated area that can take place at either primary or vacation homes.
- The determinants of District's demand should be conceptualized into components:
    - Weather Effect: Uses precipitation and maximum air temperature
    - Indoor Trend: Demand grows with increase in person-days
    - Outdoor Trend: Demand grows due to increased use of irrigated landscape
    - Active conservation: Conservation programs implemented by the District
    - Passive conservation: Conservation as a result of natural replacement of conservation devises.
    - Price Effect: Demand reduces over time as price increases in real terms.[1]

The Scenario 2 forecast is included in Attachment B. Note that the demand projections add in Plant Backwash & Utility Water[2] so that it is consistent with what is needed for the Confluence Model.

[1] The magnitude of change in demand due to price is dependent on the quality of information the consumer has. For example, with separate irrigation meters, the consumer knows how much water is consumed outdoors. If there is a price difference for outdoor water (or other programmatic activity or water budget related to outdoor use), then the consumer can act to conserve in a more informed manner.

2 Demand Forecast Method

The method to forecast demand includes these steps:

1. Calculate actual water use per meter
2. Weather-adjust actual water use
3. Quantify conservation achieved
4. Develop base forecast
5. Construct scenarios

This memo refers to sheets and cells in the demand forecast spreadsheet provided to the District called **LACSD Demand Forecast_8-24-07.xls**. In this Excel workbook, the worksheet names that start with "D_" indicate data sheets, those that start with "M_" are model sheets, and those that start with "G_" are graph sheets. All references to the workbook are footnoted in the TM.

2.1 Calculate Actual Water Use per Meter

Data from the District billing system was utilized to calculate the actual water use per meter. Water use records from 1998 to 2006 were merged into a time series. Assignment to year was made based on meter-reading date, rather than billing date, by merging read dates from the meter reading schedule.

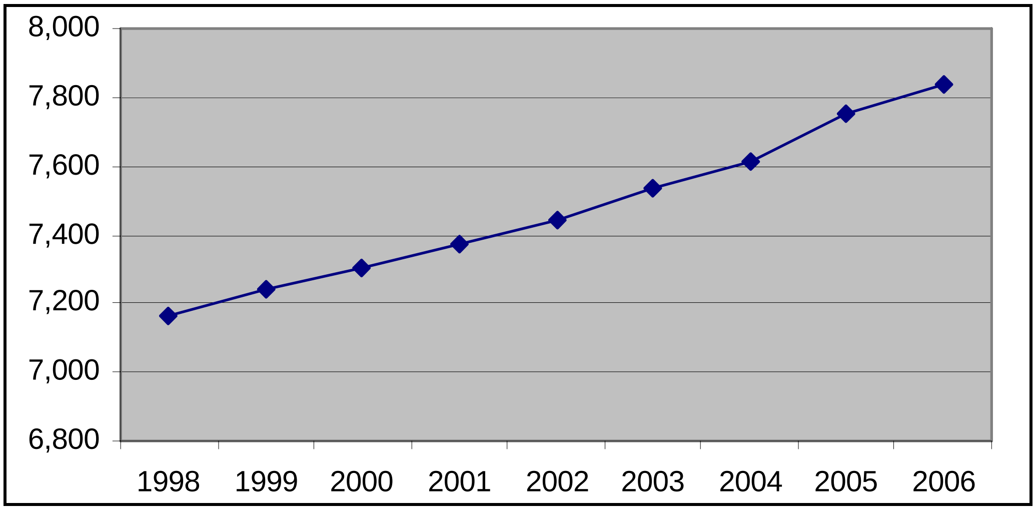
Water use per meter was calculated by rate category and overall. **Table 1** shows the total water use and water use per meter. **Figure 2** shows the number of meters over time.[3]

Table 1: Water Use per Meter by Rate Category

	Total			Residential			Commercial		
Year	AF/yr	meters	AF/yr/meter	AF/yr	meters	AF/yr/meter	AF/yr	meters	AF/yr/mete
1998	1,805	7,160	0.25	1,562	7,014	0.22	211	145	1.45
1999	2,209	7,241	0.31	1,798	7,096	0.25	241	144	1.67
2000	2,243	7,304	0.31	1,823	7,159	0.25	239	144	1.66
2001	2,337	7,372	0.32	1,880	7,227	0.26	257	144	1.79
2002	2,506	7,446	0.34	2,039	7,301	0.28	206	144	1.43
2003	2,100	7,538	0.28	1,746	7,391	0.24	159	146	1.09
2004	2,114	7,613	0.28	1,643	7,466	0.22	221	146	1.51
2005	1,775	7,752	0.23	1,520	7,604	0.20	189	147	1.29
2006	1,882	7,839	0.24	1,563	7,689	0.20	205	149	1.37
	LACC			Total Minus LACC					
Year	AF/yr	meters	AF/yr/meter	AF/yr	meters	AF/yr/meter			
1998	32	1	32	1,773	7,159	0.25			
1999	171	1	171	2,039	7,240	0.28			
2000	182	1	182	2,061	7,303	0.28			
2001	200	1	200	2,138	7,371	0.29			
2002	261	1	261	2,245	7,445	0.30			
2003	196	1	196	1,904	7,537	0.25			
2004	251	1	251	1,863	7,612	0.24			
2005	66	1	66	1,710	7,751	0.22			
2006	114	1	114	1,768	7,838	0.23			

[2] Note there are 16 metered LACSD institutional accounts that are included as "customers" in the billing system data. Table 11.2 "Utility Water" does not refer to these LACSD accounts.
[3] These values are also provided in the Excel workbook on the "M_Analysis" worksheet, Column P.

Figure 1: Number of District Water Meters



2.2 Weather-Adjust Actual Water Use

The purpose of the weather-normalizing statistical model is to determine demand based on a normal weather year. Weather normalization is done for two purposes: 1) To understand to what degree a decline in historical demand during the period 2003 to 2006 was due to weather, rather than conservation; and 2) to create a demand forecast based on normal weather conditions for future years. This statistical model used two primary data sets:

- Water production from 1988 to 2006 (supplied by District)
- Temperature and rainfall statistics from 1951 to 2006 at the NOAA Lake Arrowhead weather station located at the County of San Bernardino Fire House.

A statistical model was developed to estimate the effect of weather (precipitation and air temperature) on District aggregate water production.[4] (Lake Arrowhead County Club was removed from this analysis.). Robust regression techniques were used to identify observations of questionable data validity.[5] The model fits the historical data quite well with the Adjusted R-Squared statistic of 0.9614 indicating that the predictive model can explain more than 96 percent of the total variation in (the natural logarithm of) aggregate monthly production. The model was estimated using data from before the drought response years 2003 through 2006. A series of matching sine and cosine harmonics (sin1-cos4) were used to capture constant seasonal patterns. A set of variables reflecting rain and temperature (expressed as departures from their seasonal means) were used to capture the effect of weather through the year. The test for an annual trend was not significantly different from zero. **Table 2** shows detailed results from the statistical model.

[4] The production data was used to estimate the weather effect because the production data go back further and in a more consistently defined time series in what is "Delivered to Distribution." The percent weather effect, as described below, is applied to metered consumption. Since Delivered to Distribution production is highly correlated with metered consumption, it is reasonable to apply the weather effect as estimated with production to metered consumption. We accounted for system losses by later adding in an historical average unaccounted for water to the weather normalized metered consumption.

[5] The Robust Estimation method calculates a weight for each observation that indicates the probability that the observation is an outlier. A small percentage of the production data observations (1-2%) were dropped during in the Robust Estimation method.

Table 2: Results from the Weather Normalizing Statistical Model

Source	SS	df	MS		Number of obs	91
Model	16.75592	16	.98564212		F(16, 74)	132.7
Residual	0.542229	74	.07427793		Prob > F	0
Total	17.29814	90	.19220161		R-squared	0.9687
					Adj R-squared	0.9614
					Root MSE	0.08618

	Coefficient	Std. Err	t	P>|t|	[95% Conf.	Interval]
sin1	-0.369338	0.013691	-26.98	0	-0.39663	-0.34205
cos1	-0.444072	0.015053	-29.5	0	-0.47407	-0.41407
sin2	0.023114	0.013331	1.73	0.087	-0.00345	0.049682
cos2	0.016584	0.013716	1.21	0.231	-0.01075	0.04392
sin3	0.056668	0.013467	4.21	0	0.029829	0.083507
cos3	0.006425	0.013082	0.49	0.625	-0.01965	0.032498
sin4	0.024474	0.013525	1.81	0.074	-0.00248	0.051429
cos4	0.003188	0.013507	0.24	0.814	-0.02373	0.030107
DLRain	-0.087231	0.021707	-4.02	0	-0.13049	-0.04397
dlr_sin1	0.052944	0.023532	2.25	0.027	0.006045	0.099843
dlr_cos1	0.067152	0.029351	2.29	0.025	0.008656	0.125648
DLR_1	-0.048057	0.016091	-2.99	0.004	-0.08013	-0.01599
DLTemp	0.529181	0.192825	2.74	0.008	0.14488	0.913481
dlt_sin1	0.211409	0.269151	0.79	0.435	-0.32501	0.747827
dlt_cos1	-0.362597	0.250836	-1.45	0.153	-0.86251	0.137318
Annual Trend	0.002257	0.004956	0.46	0.65	-0.00762	0.012134
Intercept	5.15701	0.053231	96.88	0	5.050921	5.2631

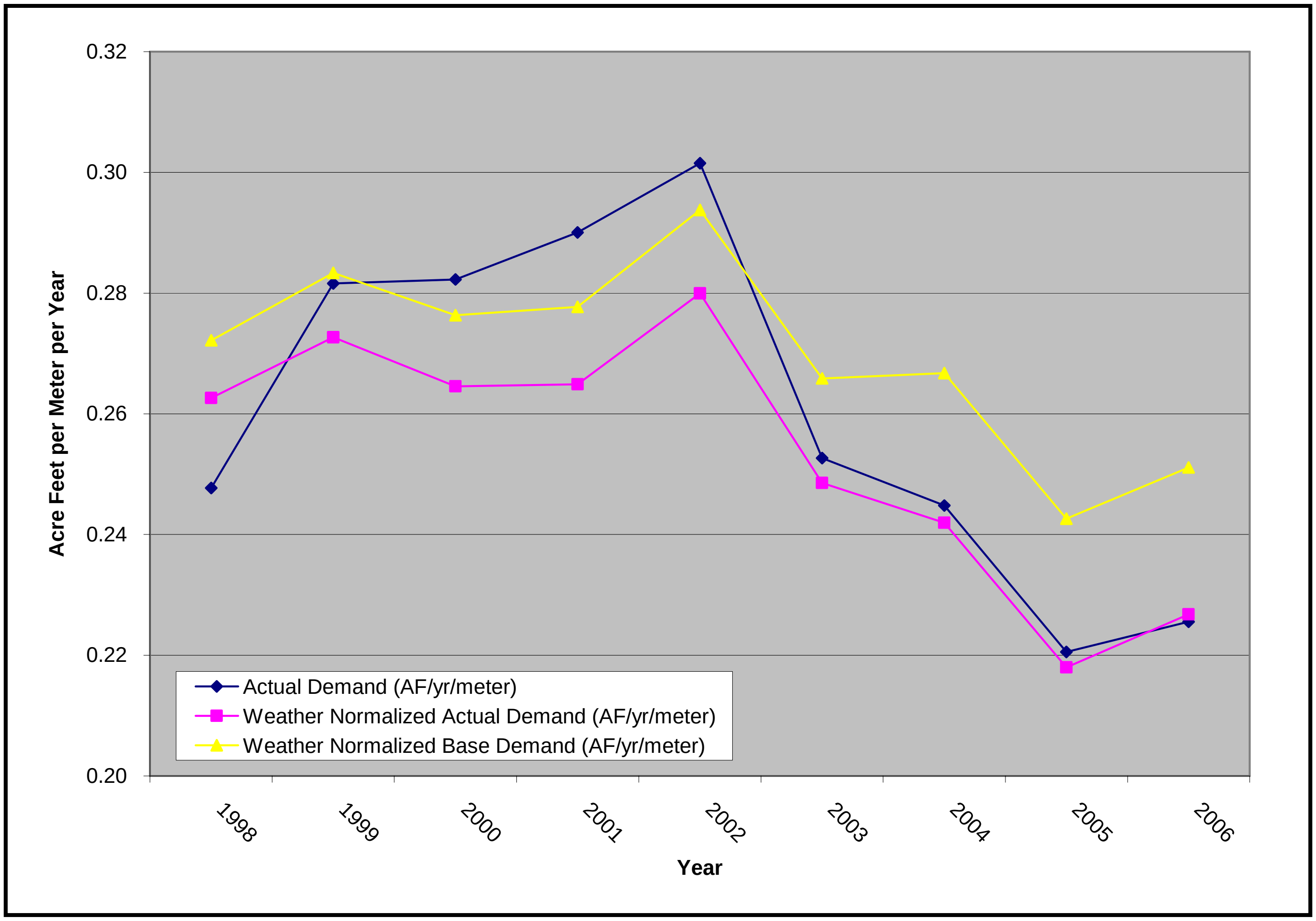
Figure 3 shows actual water use per meter (blue line) compared to weather normalized actual use (yellow line) from 1998 to 2006. The figure shows that actual water use is higher than weather normalized from 1999 to 2002, and vice versa for the other years. The reason is that in years hotter than average - and after accounting for time lag - dryer than average, the weather normalization effect is negative.[6] A list of the terms used in defining demand are presented below.

- Actual demand: Demand given actual weather conditions.
- Predicted (actual) demand: Demand predicted with the statistical model under conditions of actual weather.
- Predicted normalized demand: Demand predicted with the statistical model under conditions of normal weather.
- Weather effect: Difference between the predicted actual demand and the predicted normalized demand or the demand due <u>only</u> to weather.[7]

[6] Weather normalized actual demand is calculated in Column AW on the M_Analysis Sheet.
[7] Column AU contains the weather effect percentages estimated with the statistical model. The percentages are used to calculate weather normalized demand from actual demand in Column AW. Column BF is the statistical model estimated conservation (how much actual demand was less than expected demand). Col. BG is the conservation from active programs calculated by counting up the program activity LACSD has achieved as reported in the BMP reports and the ET Controllers—also in percentage terms. Col BH is the remaining conservation after accounting for active programs: e.g.,

- Weather normalized actual demand: Actual demand after applying the weather effect.
- Conservation effect: Difference between actual demand and predicted actual demand or the difference between the demand that was observed and the demand that was expected. This difference can be attributed to conservation measures or other conserving drought behaviors.[8]

Figure 3: Actual, Weather-Normalized, and Weather-Normalized Base Water Use Per Meter



2.3 Quantify Conservation Achieved

To understand historical demand and future demand, one needs to understand more than the effects of weather. Conservation has reduced demand in the past and it has the potential to reduce demand in the future. To quantify conservation it is necessary to delineate the following concepts:

- Passive conservation is the water saved as a result of plumbing codes that require water efficient devices and practices - savings occur regardless of whether water agencies or others promote or otherwise conduct conservation activities. Examples include the requirements for water conserving toilets and showerheads which have been in place since 1991.
- Active conservation is the water saved as a result of programs implemented by water agencies and other parties. Active conservation may accelerate the adoption of conserving devices if water efficiency plumbing code exists.

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1) Remaining price effects not confounded with concurrent active conservation; and/or 2) drought behavior. How much of the remaining conservation will persist over time is an empirical question.
[8] Ibid.

- Conservation savings were estimated outside the demand model in a spreadsheet using savings assumptions presented below.[9] The following assumptions were made for the passive conservation calculations. Sectors included in the passive savings model include showerheads, high efficiency washers, ultra low flow toilets, dishwashers, and sink aerators.
- The passive conservation model covers single family residences (SFR). The number of SFR in 1991 was estimated using the billing system data for 2006 merged with the Assessor data that indicates date of construction. We estimated that there were 6,430 in 1991 and 7,550 SFR in 2006.
- The device inventory was estimated using parameters from the empirical literature, summarized in **Table 3**.
- The natural replacement rate was assumed to be 3% for all of the included devices except showerheads which we assumed were replaced at 4% per year. Rates of replacement assumptions and estimates from the literature for toilets are typically 4%. We speculate that rate of replacement in the LACSD service area may be lower because of the high part time population.
- The savings estimates used for passive conservation are contained in **Table 4**.

Table 3: Device Inventory Parameters for Passive Savings Calculations

Parameters	Value	Source
Toilets per SF structure pre-92	2.43	Assessor data shows 2.43 bathrooms per hh in pre-1992 houses
Toilets per SF structure >= 92	2.97	Assessor data shows in >=1992 houses
Showers per HH SF	1.8	EBMUD 2002, Market Penetration Study
Persons per HH SF	2.68	Household size from Census data PPH for owner occupied (renter occupied is 2.98)
Pct SF HH with Washer	96.6%	OC Saturation Survey in pre 1992 households (96.5 for post 92, so just used one figure)
Pct SF HH with Dishwasher	82.1%	OC Saturation Survey in pre 1992 households (83% for post, 92 so just used one figure)

Past active conservation programs are summarized in the Best Management Practices BMP Reports. **Table 5** summarizes historically achieved conservation reported in the District's BMP Reports to the CUWCC. In addition, the Evapotranspiration (ET) Controller Pilot Program installations and pre-rinse spray valves have been included in the table. The table shows the considerable effort the District has made in recent years to reduce water demand. Savings estimates for past achieved conservation are shown in Table 4.

The demand model shows projected water use with or without new added future conservation programs. One future program has been modeled so far: Water Use Efficiency (WUE1) from the Preliminary Water Use Efficiency Plan TM (A&N and RMC, May 2007). Savings estimates are also summarized in Table 4.

[9] The results copied in to Columns AI:AK on the M_Analysis Sheet . The savings were calculated using the values in Tables 3, 4, and 5 in a spreadsheet called "CPM2_LACSD_DRAFT_20070701.xls" which we used to calculate active savings, passive savings, and device saturation.

Table 4: Device Savings

Savings Assumptions Table
* All indoor savings estimates weighted by factor to adjust values from the literature to LACSD, which has a use distribution with a relatively high number of low use customers (vacation homes)

Intervention	Model	GPD*	Days Per Yr			BMP	Sector	Indoor/Outdoor	Source
Dishwasher: SF	Passive	0.9	365				SF	Indoor	See CUWCC Potential PBMP p 10
HE Washer: SF	Passive	11.2	365				SF	Indoor	See AWWARF 2007 p 122
Showerhead: SF	Passive	4.4	365			2	SF	Indoor	See AWWARF 2007 p 140
Sink Aerators: SF	Passive	1.2	365			2	SF	Indoor	See AWWARF 2007 p 144
ULFT: SF	Passive	16.0	365			14	SF	Indoor	See AWWARF 2007 pp 149-154
Intervention	Model	GPD*	Days Per Yr	Life Yrs	Decay Per Yr	BMP	Sector	Indoor/Outdoor	Source
Showerhead: SF	Past Active	4.4	365	5	0	2	SF	Indoor	See AWWARF 2007 p 140
HE Washer: SF	Past Active	11.2	365	12	0		SF	Indoor	See AWWARF 2007 p 122
ULFT: SF	Past Active	16.0	365	20	0	14	SF	Indoor	See AWWARF 2007 pp 149-154
Dishwasher: SF	Past Active	0.9	365	10	0		SF	Indoor	See CUWCC Potential PBMP p 10
Sink Aerators: SF	Past Active	1.2	365	2	0	2	SF	Indoor	See AWWARF 2007 p 144
BMP 1 Residential Surveys	Past Active	10	365	5	0	1	SF	Indoor	
BMP 2 Toilet-Displ. Devices	Past Active	1	365	2	0	2	SF	Indoor	
BMP 3 System Leak Detection	Past Active	10	365	10	0	3	System	Indoor	
BMP 5 Large Landscape Surveys	Past Active	50	150	5	0	5	CII	Outdoor	
BMP 9 Commercial Surveys	Past Active	50	365	8	0	9	CII	Indoor	
Pre-Rinse Spray Valves	Past Active	20	365	5	0	9	CII	Indoor	
Pilot Irrigation Controller Program	Past Active	37	150	10	0	5	SF	Outdoor	
Smart Rebate: HE Washers Residential	Future Active WUE1	19	365	15	0	0	CII	Indoor	Smart Rebate Budget
Smart Rebate: HE Washers Commercial	Future Active WUE1	48	365	15	0	0	CII	Indoor	Smart Rebate Budget
Smart Rebate: ULFT/HET Residential	Future Active WUE1	25	365	20	0	0	CII	Indoor	Smart Rebate Budget
Smart Rebate: Urinals	Future Active WUE1	37	365	20	0	0	CII	Indoor	Smart Rebate Budget
Smart Rebate: X-Ray Film Retrofit	Future Active WUE1	3,164	365	10	0	0	CII	Indoor	Smart Rebate Budget
Smart Rebate: ULFT Commercial	Future Active WUE1	35	365	20	0	0	CII	Indoor	Smart Rebate Budget
Smart Rebate: HET Commercial	Future Active WUE1	42	365	20	0	0	CII	Indoor	Smart Rebate Budget
Conservation Kits Distributions	Future Active WUE1	5	365	5	0	0	CII	Indoor	CEA Analysis
Home Water Audits (Top Users)	Future Active WUE1	40	365	5	0	0	CII	Indoor/Outdoor	CEA Analysis
CII Surveys	Future Active WUE1	50	365	10	0	0	CII	Outdoor	CEA Analysis

Table 5: BMP Reports Summary of Achieved Conservation [a]

BMP: Measure	2003	2004	2005	2006
BMP 1 Residential Surveys	67	125	29	27
BMP 2 Showerheads	2,000	3,702	70	69
BMP 2 Faucet Aerators	4,000	5,006	107	104
BMP 2 Toilet Displacement Devices	2,000	2,500		
BMP 3 System Leak Detection	39	44	7	5
BMP 5 Large Landscape Surveys	2	20	30	28
BMP 9 Commercial Surveys	2	15	1	1
BMP 14 ULF Toilets		1,000		
Pre-Rinse Spray Valves [b]	16			
Pilot Irrigation Controller Program [c]		59		

Footnotes:

a. If reported in fiscal year, adjusted to calendar year
b. Reported by District staff
c. Reported in District Board Memos

Figure 4 shows both passive and active conservation savings that are input into the demand model. Active savings are calculated separate from passive savings because when planning to invest conservation dollars, it is important to understand the additional savings you are buying with those conservation dollars.

The short term bumps that peak in 2004 and 2007 show the peak conservation from conservation with a short conservation life span, such as showerheads. The "steps down" in 2024 and 2027 show the end of the active savings for conservation with long active savings lives such as ULF toilets. Note that the savings for toilets and showerheads do not disappear - it's just the additional increment of savings due to the active program ends and passive conservation takes over because there is plumbing code, as shown by the increasing passive savings over time.

Figure 4: Passive and Active Conservation Savings

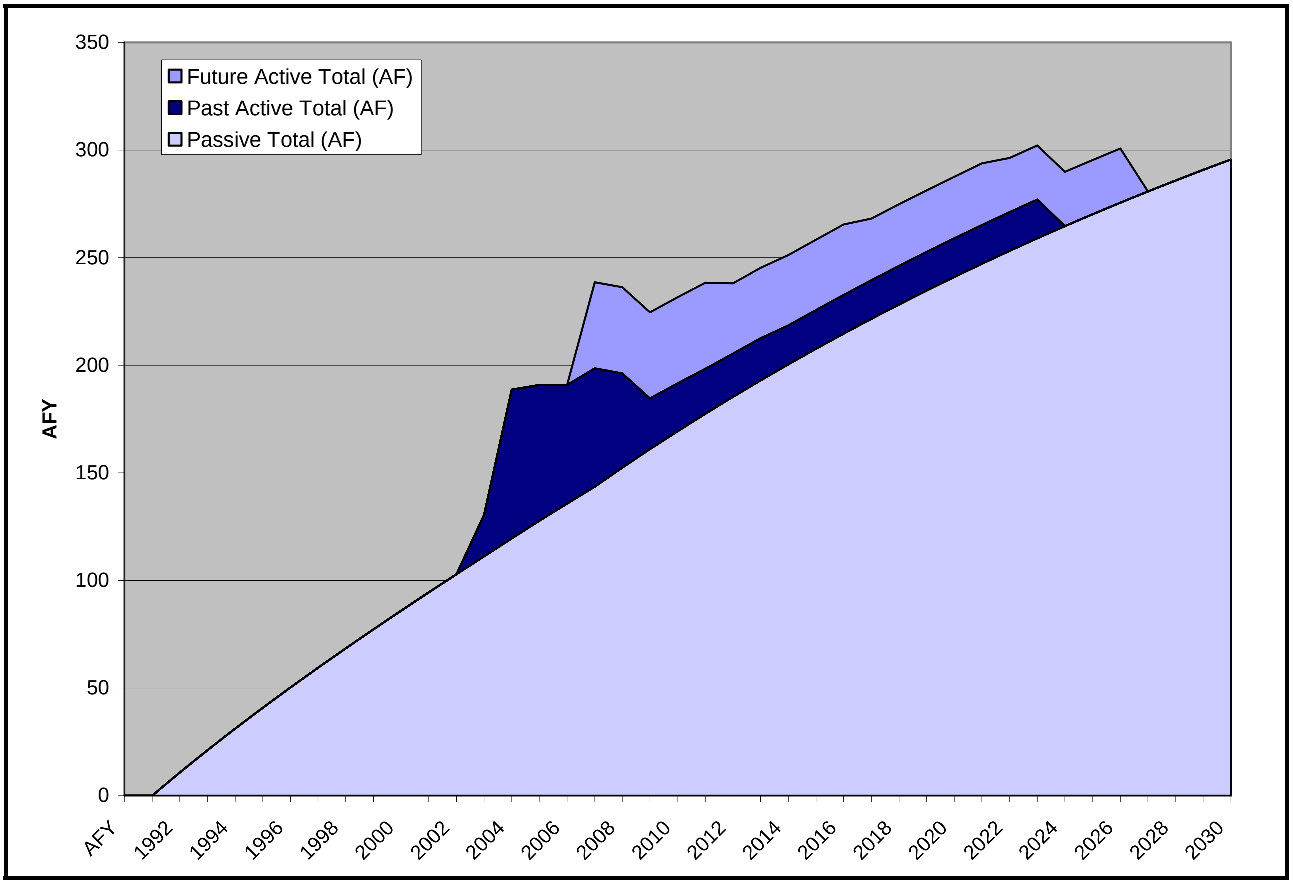

Figure 4 shows conservation savings that disappear over 10 or 20 years. The savings disappear because:

1. For devices like toilets with plumbing code, the savings don't disappear. After the life span of the program-replaced toilet is over, the toilet will be replace by another ULFT due to plumbing code, and the savings will continue. It's only the savings attributable to your program that disappear when the device life is over (active savings ends). When the toilet is replaced due to natural replacement, the savings are then attributed to plumbing code (passive savings begins). Figure 4 shows that passive savings continues to grow even as active savings peter out.
2. BUT, for devices without plumbing code, the savings do indeed disappear. Unless there is ongoing program support or other motivation to continue adoption of the conservation measure, savings will not last. For conservation measures like landscape conservation practices (aside from hardware), when the program's effect has ended (e.g. due to a change in landscape contractors or due to decreased

interest some time after the program ends) savings are not maintained. Alternatively, if the program is planned to continue in a support capacity into the future, then savings may continue.

2.4 Develop Base Forecast

The base forecast is developed as follows:

- Start with actual demand per meter as calculated with billing data.
- Then weather normalize using weather effect developed in the statistical models.
- Add passive conservation savings and past active conservation savings.

A base demand forecast is the demand that would occur under normal weather conditions, had the past active and passive conservation savings not occurred. Then passive savings are counted by showing a reduction from base. Likewise, past active savings are counted by showing how this further reduced demand on top of passive savings.

To make the demand projection (which is at the customer meter level) comparable with the actual District supplies "delivered to distribution" (which is measured as water exits the treatment plants to distribution) an estimate of unaccounted water is added. Adding unaccounted water makes the demand forecast more comparable to delivered to distribution supplies, but is not expected it to be the same because the demand forecast is weather normalized. Unaccounted water is defined in this way as a placeholder until the final system water loss audit is completed in the fall of 2007.[10]

The steps in the historical analysis are summarized as follows:

- Actual demand = Observed
- Weather Normalized = Actual - WeatherEffect
- Weather Normalized Base (WNB) = Actual - WeatherEffect + ActiveCons + PassiveCons

The demand forecast is built from the WNB by the following steps:

- WNB - Passive
- WNB - Passive - Past Active
- WNB - Passive - Past Active - Future Active

2.5 Construct Scenarios

All three scenarios presented assume that the number of meters will grow at 60 per year until 2015 and 97 per year there after. The 60 per year reflect current ordinances that limit the rate of growth. The forecast assumes that there will be adequate supply by 2015 to lift the ordinance. The 97 new meters per year figure reflects a constant rate of growth to build out assumed in 2030.[11]

Scenario 1 assumes:

- Water use per meter will be constant over the forecast period.

Scenario 2 assumes:

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[10] The difference between delivered to distribution and actual water use is shown as Column AC on the M_Analysis Sheet.

[11] Note that Table 11.2 in the spreadsheet is in its original form. Column I on sheet M_Analysis still shows 60 per year until 2030. We did not revise the meters per year in Table 11.2 because it would need to be coupled with a revision to demand, which has not yet been revised in Table 11.2.

- Water use per meter will increase at the rate of growth experienced before the drought response years of 2003 to 2006, which was 1.27%.[12]
- The short term response to the increases in water rates from 2002 to 2004 are embedded already in actual demand, but that the long run price response will not be complete until 2016.[13]

Scenario 3 assumes:

- Water use per meter will increase at the rate of growth experienced before the drought response years of 2003 to 2006, which was 1.27%.[14]
- The price increases in water rates from 2002 to 2004 are fully embedded already and there are no additional price responses in the forecast. In other words, water use per meter grows unconstrained by further responses from previous price changes or by future price changes.

The differences between the District's forecast of "delivered to distribution" in the UWMP Table 11.2 and Scenario 1 are as follows:

- The growth in number of meters in Table 11.2 is 60 per year through 2030. All three scenarios grow at 60 meters to 2015, but then at 97 meters per year from 2016 to 2030.
- Growth in "delivered to distribution" is forecasted to be 1% per year in Table 11.2. So, if the increase in number of meters is really 60 per year, the implied growth in water use per meter is roughly 0.3% and growth in the number of meters is roughly 0.7%. For Scenario 1, there is zero growth in use per meter.
- Table 11.2 starts its forecast (2007) by adding 1% to the last actual year's use (2006). The scenarios start with demand in normal weather year. It is coincidence that 2006 is close to normal year demand (weather effect is 0.5%), but the difference is more apparent in 2001 and 2002 (in Figure 1, the red line is well above the dashed blue line in these years).
- The scenarios include explicit assumptions for passive and active conservation, but it is not clear if conservation is included in the 1% growth assumption in Table 11.2 Delivered to Distribution.

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[12] This is the annual growth per meter for the historical period from 1998 to 2002. It represents weather normalized demand which means that it is the growth per meter if the weather had been normal. The effects of active conservation, passive conservation, and price are present. Growth per meter is due to increased indoor use and/or outdoor use (e.g., increased landscape area--not weather effect).

[13] See previous footnote.

[14] This is the annual growth per meter for the historical period from 1998 to 2002. It represents weather normalized demand which means that it is the growth per meter if the weather had been normal. The effects of active conservation, passive conservation, and price are present. Growth per meter is due to increased indoor use and/or outdoor use (e.g., increased landscape area--not weather effect).

Table 11.2 "One Scenario for Demand and Supply June 2007"

		Demand (AF)						
		Year [1]	Delivered to Distribution [2]	Transfer to Grass Valley Lake [3]	Recycled Water Irrigation	Plant Backwash & Utility Water	Total Demand	Connec-tions
1998			2,237					
1999			2,292					
2000		2000	2,370	182	0	269	2,821	7,293
2001		2001	2,583	200	0	165	2,947	7,381
2002		2002	2,565	261	0	330	3,157	7,462
2003		2003	2,250	196	0	327	2,772	7,546
2004		2004	2,164	250	0	130	2,544	7,613
2005		2005	2,136	66	0	126	2,327	7,746
2006	Actual	2006	2,145	114	0	103	2,362	7,836
2007		2007	2,166	200	0	100	2,466	7,896
2008		2008	2,188	200	0	100	2,488	7,956
2009		2009	2,210	0	200	100	2,510	8,016
2010		2010	2,232	0	200	80	2,512	8,076
2011		2011	2,254	0	200	80	2,534	8,136
2012		2012	2,277	0	200	80	2,557	8,196
2013		2013	2,300	0	200	80	2,580	8,256
2014		2014	2,323	0	200	80	2,603	8,316
2015		2015	2,346	0	200	70	2,616	8,376
2016		2016	2,369	0	200	70	2,639	8,436
2017		2017	2,393	0	200	70	2,663	8,496
2018		2018	2,417	0	200	70	2,687	8,556
2019		2019	2,441	0	200	70	2,711	8,616
2020		2020	2,466	0	200	65	2,731	8,676
2021		2021	2,490	0	200	65	2,755	8,736
2022		2022	2,515	0	200	65	2,780	8,796
2023		2023	2,540	0	200	65	2,805	8,856
2024		2024	2,566	0	200	65	2,831	8,916
2025		2025	2,591	0	200	65	2,856	8,976
2026		2026	2,617	0	200	65	2,882	9,036
2027		2027	2,643	0	200	65	2,908	9,096
2028		2028	2,670	0	200	65	2,935	9,156
2029		2029	2,697	0	200	65	2,962	9,216
2030		2030	2,724	0	200	65	2,989	9,276

1) 2000 to 2006 are actual data.
2) Assumes 1% annual increase from 2007 to 2030. Includes customer sales plus unaccounted losses.
3) Non potable water transferred to Grass Valley Lake from groundwater wells and/or raw water from Lake Arrowhead.

Scenario 2: Limited Per Connection Growth

Use/Meter/Yr Growth (%)	
2007 to 2030	1.27%

Meters/Year Growth	
2007 to 2015:	60
2016 to 2030:	97

	Weather Normalized Base Demand											
Year	**Base**	**Effect of Rates on Growth**	**Post Price Effect**	**Meters**	**No Conservation**	**Passive Only**	**Past Active**	**WUE1**	***Subtotal***	**15.8% Unaccounted Water**	**Backwash**	**TOTAL**
	Use/Meter/Yr	**%**	**Use/Meter/Yr**	**#**				**afy**				**afy**
1998	0.272	0.0%	0.272	7,159	1,948	(68)	0	0	*1,880*	463	0	2,343
1999	0.283	0.0%	0.283	7,240	2,051	(77)	0	0	*1,974*	253	0	2,227
2000	0.276	0.0%	0.276	7,303	2,018	(86)	0	0	*1,932*	309	269	2,509
2001	0.278	0.0%	0.278	7,371	2,047	(94)	0	0	*1,953*	445	165	2,562
2002	0.294	0.0%	0.294	7,445	2,187	(103)	0	0	*2,084*	321	330	2,735
2003	0.266	0.0%	0.266	7,537	2,004	(111)	(19)	0	*1,873*	346	327	2,546
2004	0.267	0.0%	0.267	7,612	2,030	(119)	(69)	0	*1,842*	301	130	2,272
2005	0.243	0.0%	0.243	7,751	1,880	(128)	(63)	0	*1,690*	426	126	2,242
2006	0.251	0.0%	0.251	7,838	1,968	(136)	(55)	0	*1,777*	377	103	2,257
2007	0.254	-0.5%	0.253	7,898	1,998	(144)	(55)	(40)	*1,759*	330	100	2,190
2008	0.258	-1.0%	0.255	7,958	2,028	(152)	(44)	(40)	*1,792*	336	100	2,228
2009	0.261	-1.6%	0.257	8,018	2,058	(161)	(24)	(40)	*1,834*	344	100	2,278
2010	0.264	-2.1%	0.259	8,078	2,089	(169)	(22)	(40)	*1,858*	349	80	2,286
2011	0.267	-2.6%	0.261	8,138	2,120	(177)	(21)	(40)	*1,882*	353	80	2,315
2012	0.271	-3.1%	0.262	8,198	2,151	(185)	(20)	(33)	*1,913*	359	80	2,352
2013	0.274	-3.6%	0.264	8,258	2,183	(193)	(20)	(33)	*1,938*	364	80	2,381
2014	0.278	-4.2%	0.266	8,318	2,215	(200)	(18)	(33)	*1,963*	368	80	2,412
2015	0.281	-4.7%	0.268	8,378	2,247	(208)	(18)	(33)	*1,988*	373	70	2,431
2016	0.285	-5.2%	0.270	8,475	2,289	(215)	(18)	(33)	*2,024*	380	70	2,473
2017	0.289	-5.2%	0.274	8,572	2,345	(222)	(18)	(29)	*2,076*	390	70	2,536
2018	0.292	-5.2%	0.277	8,669	2,401	(228)	(18)	(29)	*2,127*	399	70	2,596
2019	0.296	-5.2%	0.281	8,766	2,459	(235)	(18)	(29)	*2,178*	409	70	2,656
2020	0.300	-5.2%	0.284	8,863	2,518	(241)	(18)	(29)	*2,230*	419	65	2,714
2021	0.304	-5.2%	0.288	8,960	2,578	(247)	(18)	(29)	*2,284*	429	65	2,778
2022	0.307	-5.2%	0.291	9,057	2,639	(253)	(18)	(25)	*2,343*	440	65	2,847
2023	0.311	-5.2%	0.295	9,154	2,701	(259)	(18)	(25)	*2,399*	450	65	2,914
2024	0.315	-5.2%	0.299	9,251	2,764	(265)	0	(25)	*2,475*	464	65	3,004
2025	0.319	-5.2%	0.303	9,348	2,829	(270)	0	(25)	*2,534*	475	65	3,074
2026	0.323	-5.2%	0.306	9,445	2,895	(276)	0	(25)	*2,594*	487	65	3,146
2027	0.327	-5.2%	0.310	9,542	2,961	(281)	0	0	*2,681*	503	65	3,249
2028	0.332	-5.2%	0.314	9,639	3,030	(286)	0	0	*2,744*	515	65	3,324
2029	0.336	-5.2%	0.318	9,736	3,099	(291)	0	0	*2,808*	527	65	3,400
2030	0.340	-5.2%	0.322	9,833	3,170	(296)	0	0	*2,874*	539	65	3,478

Assumptions:

1. Annual growth in per meter use equal to 1998-2002 annual rate
2. Meter growth rate constant over time, two phases
3. Price response included (based on response from 2002-2006; Assume no future change in real price of water
4. Backwash = Utility usage & plant backwash; Does not include recycled backwash supply