La Mesa Water Cooperative
Placitas, New Mexico

Water Supply Plan

September 30, 2018

Prepared by:
Jock Embry

Reviewed by:
John Wilson
Marty Davis
Phil Carter

Board Members:
Bob Davey
Glenn Ingram
Dave Otter
Paula Redwine
Lisa Thomka
Gren Yuill

Change History

Draft 3 (Final)

- Updated Terminology section
- Added references to AWWA "Distribution System Requirements for Fire Protection"
- Added discussion on water levels in tanks to meet fire protection requirements
- Added section on Water Conservation
- Added section to explain rationale for well #3 treatment flow sizing
- Added Sources section to identify spreadsheets that provide tables and figures
- Minor edits and corrections

Draft 2

- Added Terminology section
- Data was updated to include all of 2017 and first half 2018
- Except for yearly demand, all other demand charts and tables were changed to be gallons per house (rather than gallons per capita), and adjusted for unbilled water.
- Corrected Figure & Table numbers
- Changed Forecast section to cover peak month and peak day estimates
- Changed to insert Excel charts as Special | Microsoft Office Graphic Object

Draft 1

- Based on Water Supply Plan, 12/29/2015
- Reorganized sections
- Revised demand charts and tables to show demand per capita instead of per house (based on 1.95 residents per house); added data from smart meters.
- Updated well capacity material

Table of Contents

Figures

Tables

Mission Statement

To provide a safe, reliable, long-lasting water supply to Members, at acceptable costs.

Executive Summary

This is the continuation of Supply Plan documents prepared by the Cooperative every several years. It provides a detailed review of current demand and capacity, and a forecast out ten years. Current capacity is sufficient to meet current demand for a peak month. Of more immediate concern is the fact that by operating on two wells (#5 and #6), there is not sufficient capacity to meet demand if one of those is out of service in the summer. We cannot meet demand with only one well. Wells #2 and #3 are kept on standby, and are not used. Well #3 has plenty of capacity, but has not been used since 2008 because water from it exceeds the maximum allowable level for arsenic. Well #2 has also exceeded the maximum allowable arsenic level. The project plan to build an arsenic treatment facility for well #3 and put it into regular operation will provide the needed redundancy and capacity out to 2028 and beyond. Figure 1 shows past peak demand and capacity, and projections for the next ten years.

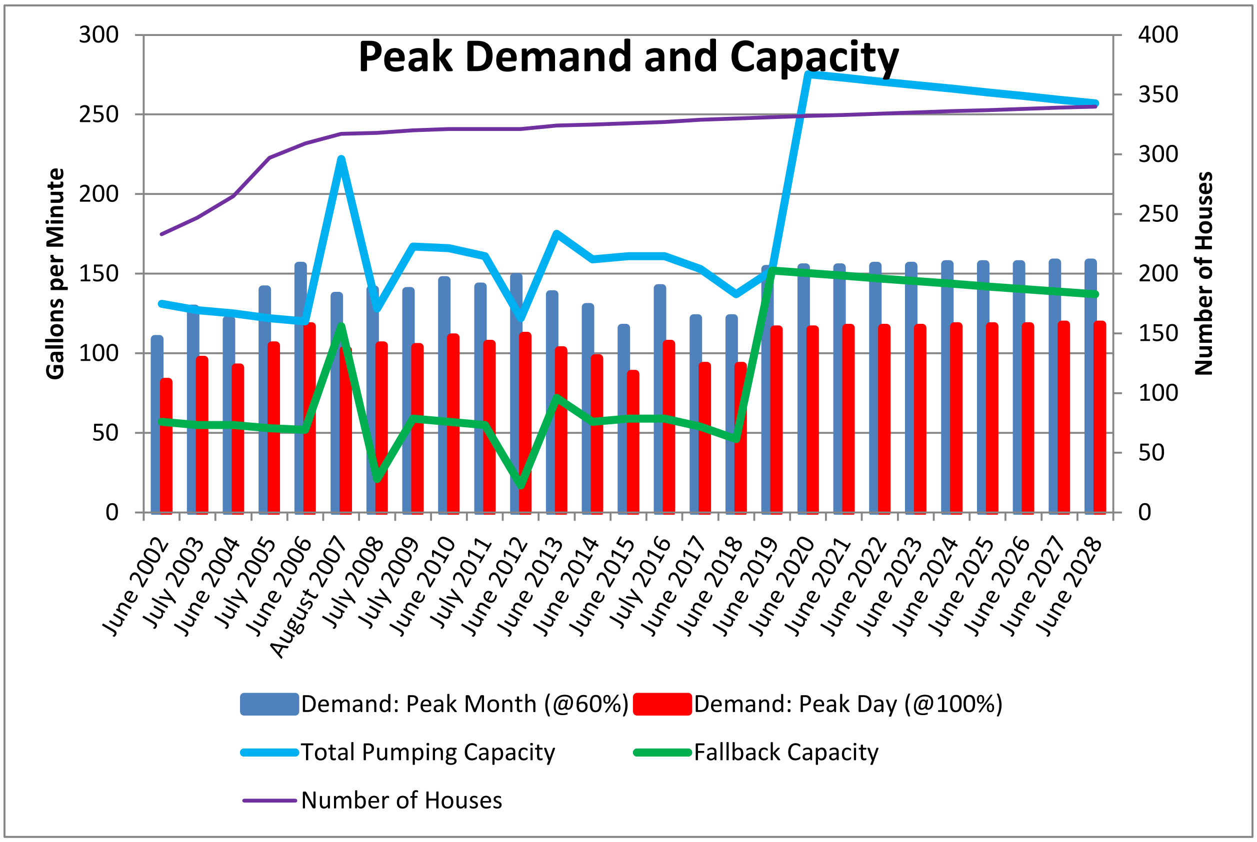

Figure 1 – Historical and Forecast Demand and Capacity, 2002 - 2028

- Demand in peak month is forecast to be same as highest month in past ten years (June 2013, 400 gallons per house per day), and does not go up or down.
- Monthly demand is to be met by operating all wells at no more than 60% duty cycle.
- Peak day demand, estimated at 125% of monthly average, to be met with one well out of service, and remaining wells running up to 100% duty cycle.
- Well #3 arsenic treatment facility is in operation for June 2020.

Terminology

Billed Water is all the water delivered to Cooperative members, as measured by individual house water meters.

Capacity is the amount of pumped water that could be produced, measured in gpm. For each well, this is a function of the aquifer, well design and construction, and pump and motor. In some cases (such as well #3), changing just the pump and motor may increase pumping capacity.

Demand is the amount of pumped water required at any particular time.

Fallback Capacity is the total pumping capacity of the Cooperative with the highest capacity well out of service.

Gallons per Minute (gpm) is the common metric for water flow.

Intended Use is the portion of billed water that the resident expected to use, so excludes leaks, etc.

Known Unbilled Water is unbilled water for which we have a measurement or can make an estimate, such as:

- Fire hydrant flushing
- Well flushing
- Distribution systems leaks that are found and fixed
- Water sold to non-Cooperative members, such as that provided to the North Ranchos Water District in early 2018 while they drilled a new well

Needed fire flow (NFF). The NFF is the rate of flow considered necessary to control a major fire in a specific building for a certain duration. ... [1]

Pumped Water is the total amount of water produced, as measured by well water meters.

Pumping Water Level (PWL) is the number of feet from the top of the well casing to the below ground water surface, when the well pump is running. As normal for most wells, this increases (water level drops) the longer the pump runs.

Static Water Level (SWL) is the number of feet from the top of the well casing to the below ground water surface, when the well pump is not running. This decreases (water level comes up) the longer the pump is off, and finally stabilizes after a day or so.

Unaccounted for Water is the difference between pumped water and billed water, and accounting for known unbilled water. This may be:

- Unknown leaks in the distribution system
- Water not measured due to inaccurate water meters. For example, as meters age, they tend to get less accurate, or not even record very low flows, such as for a swamp cooler. And it is very difficult to calibrate or verify the accuracy of the well meters.
- Water stolen from fire hydrants

Unbilled Water is pumped water that is not delivered to houses.

Unintended Use, also called leaked, wasted or fugitive water, is caused by things such as:

- Leaks or breaks in pipes, fittings, valves, etc. on house side of water meter
- Hose left running
- Drip irrigation system malfunction, such as a valve stuck open
- Water softener malfunction

The relationships between different demand categories are shown in Figure 2.

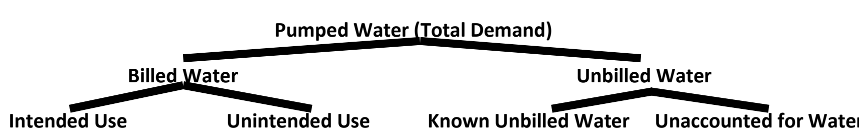

Figure 2 – Water Demand Categories

[1] NFF definition from "Distribution System Requirements for Fire Protection"

Assumptions, Requirements, and Goals

1. The Cooperative should always maintain sufficient capacity to meet estimated demand.
2. Estimated future demand is based on historical demand and projected growth, without any significant changes in water use patterns. For example, we are assuming that we will not have to supply a new orchard or vineyard, or that people will not remove all landscaping.
3. Well duty cycle will normally not exceed 60%.
4. The Cooperative should be able to meet normal demand with the highest capacity well (#5 in 2018 and #3 in the future) out of service for as long as three months. In the case of a well outage, the target duty cycle may be exceeded for the well(s) remaining in service.
5. The Cooperative should meet the letter and spirit of water quality regulations. For example, the arsenic rule says that a system is in violation when the running average concentration of four consecutive quarterly samples is above the limit (10 parts per billion, ppb). The Cooperative plans to not have a single quarterly sample exceed the limit.
6. The Cooperative should be able to meet the Needed Fire Flow (NFF) recommended by the American Water Works Association (AWWA) of 500 gpm at a minimum residual pressure of 20 psi for at least two hours (60,000 gallons). Since the two water tanks together hold about 20,700 gallons per foot, this means that the tanks should never go below three feet, with five feet (103,000 gallons) providing some margin. Note that NFF can be provided to most of the Cooperative service area, even without power. Until the booster system is replaced or updated, NFF is not provided by houses and hydrants on that system.
7. One new house will be added per year until full build-out. See Table 1.

	La Mesa	**Sundance Mesa**	**Total**
Houses	149	181	330
Undeveloped Lots	16	21	37
Total	165	202	367

Table 1 – Numbers of Houses and Lots as of September 2018

Notes:

- This includes three La Mesa lots that are not currently Cooperative members.
- This excludes three La Mesa houses on private wells that are not Cooperative members.
- In Sundance Mesa, an undeveloped lot owned by the neighboring homeowner, that has a water meter and receives service is billed and treated here as a house.

8. The number of houses using private wells (three) will not change. One house that has a private a well and is also a member of the Cooperative is included in demand estimates, since they could use water at any time.
9. The La Mesa HOA CC&Rs allows lots to be subdivided; the Sundance Mesa HOA CC&Rs does not. It is assumed that additional lots created by subdividing will be roughly balanced by existing empty lots that are never built on.
10. Full time vs part time house occupancy will not change.
11. Cooperative demographics are not significantly different than Placitas overall, and will not change.
    - The 2010 Census has the Placitas population as 4,977 people in 2,556 houses.
    - This is an average of 1.95 residents per house ("per capita").
12. Unaccounted for water each month should be less than 10% of total pumped.

Water Demand and Historical Measurements

There are several sources of data to show how much water is pumped and billed:

- Well meter readings (flow and gallons pumped) are recorded for each well, each month (usually the 1st or 2nd day); data goes back to 9/1/1998. This is probably fairly accurate data since the wells have high quality meters. There is not a simple way to calibrate or validate the well meters. This data does not show the amount of water pumped within a month, such as by day or week.
- Billing data for each house for each month; data goes back to 1/31/2010. From experience and industry reports, household meters tend to under-report low flow as they age.
- Smart water meters (with Orion® endpoints from Badger Meter) collect data hourly. The Cooperative began replacing old meters with these in early 2016. As of May 2018, all houses have new smart meters.
- Surveillance data, collected through a telemetry system from Mission Communications, includes tank level, booster system pressure, and flow rate into and out of the tanks. In 2015 and 2016, Mission systems were installed for wells #6 and #5, respectively, to collect pressures, flow rates, and water levels in each well. This data is normally reported every two minutes, and is available back to 12/2013 for the tank site. This data is somewhat noisy for a number of reasons, is moderately accurate, and allows for demand analysis by hour and day. We also have Telog surveillance data from 2001 through 2013; that data was not used in this study.

Historical Demand

From the monthly well meter readings, Table 2 shows the annual gallons pumped, the number of houses, and the average Gallons per Capita per Day (GPCD), for the period 2001 - 2017. For comparison, Santa Fe reports GPCD as 95 (2014), the lowest of western cities and Albuquerque GPCD was 135 in 2013. It is not clear how non-residential water users are reflected in GPCD measurements.

Year	Total Gallons Pumped	Number of Houses	Average Gallons Pumped per House per Day	Average Gallons Pumped per Capita per Day
2001	20,733,373	225	252	129
2002	22,397,507	238	256	131
2003	24,230,300	252	264	135
2004	25,558,800	280	249	128
2005	28,642,700	303	260	133
2006	28,349,700	312	249	128
2007	29,593,300	317	256	131
2008	29,667,814	320	253	130
2009	27,702,695	320	237	122
2010	28,775,800	321	244	125
2011	28,197,640	321	242	124
2012	28,712,631	322	245	126
2013	26,935,830	324	227	116
2014	26,593,261	325	225	115
2015	25,247,435	326	213	109
2016	27,037,798	327	226	116
2017	28,022,222	329	233	119
Average	26,846,989		243	125
Standard Deviation	1,600,351		15	7
Average 2005-2017	27,959,910		239	123
Max 2001-2017	29,667,814		264	135

Table 2 – Yearly Gallons Pumped, and Average Gallons Pumped per House and per Capita per Day

Figure 3 shows this annual demand data for the past several years.

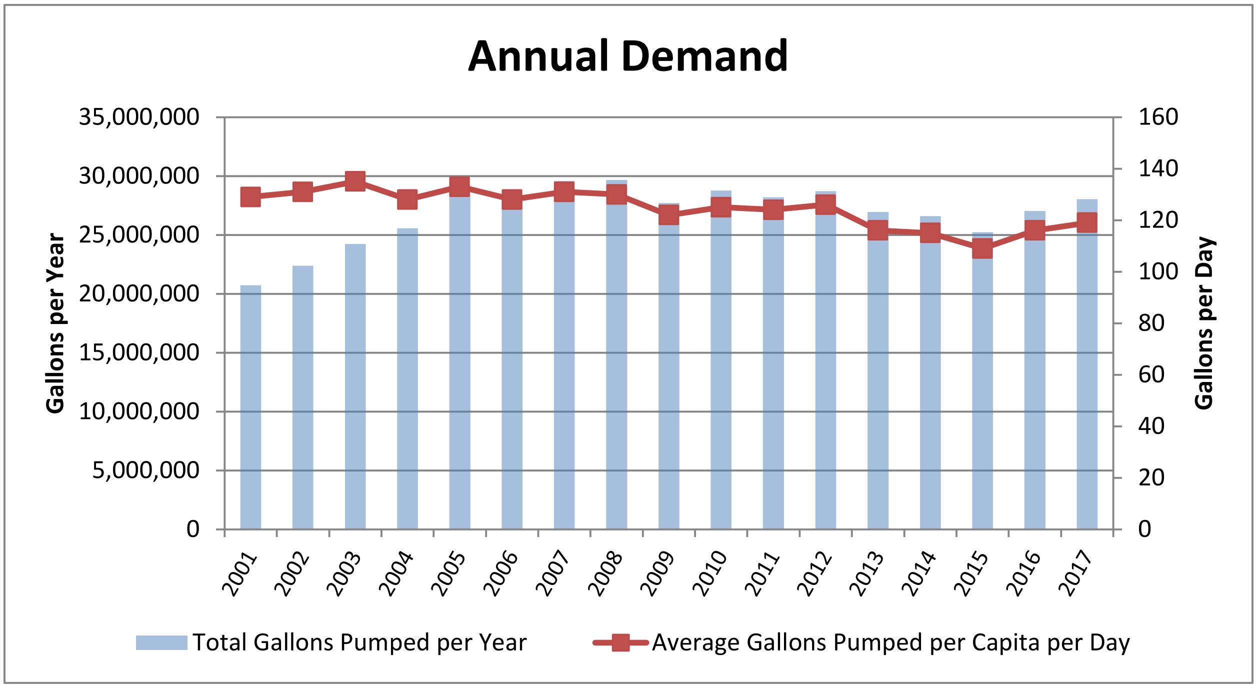

Figure 3 – Annual Demand

Several observations on the annual data:

- The period 2001 to 2005 reflects the major development of Sundance Mesa.
- From 2005 on, total demand has been about 28,000,000 gallons per year.
- There was a drop in demand from 2012 – 2015, which was reversed in 2016 and 2017 (see below).
- Because of the wide variation between winter and summer demand (see below), yearly averages are not much use in capacity planning.

Figure 4 shows the water pumped (from the well meter readings) and billed (from the house meter readings), by month, for the past several years. These are shown as gallons per house per day, to normalize for number of houses and days in month.

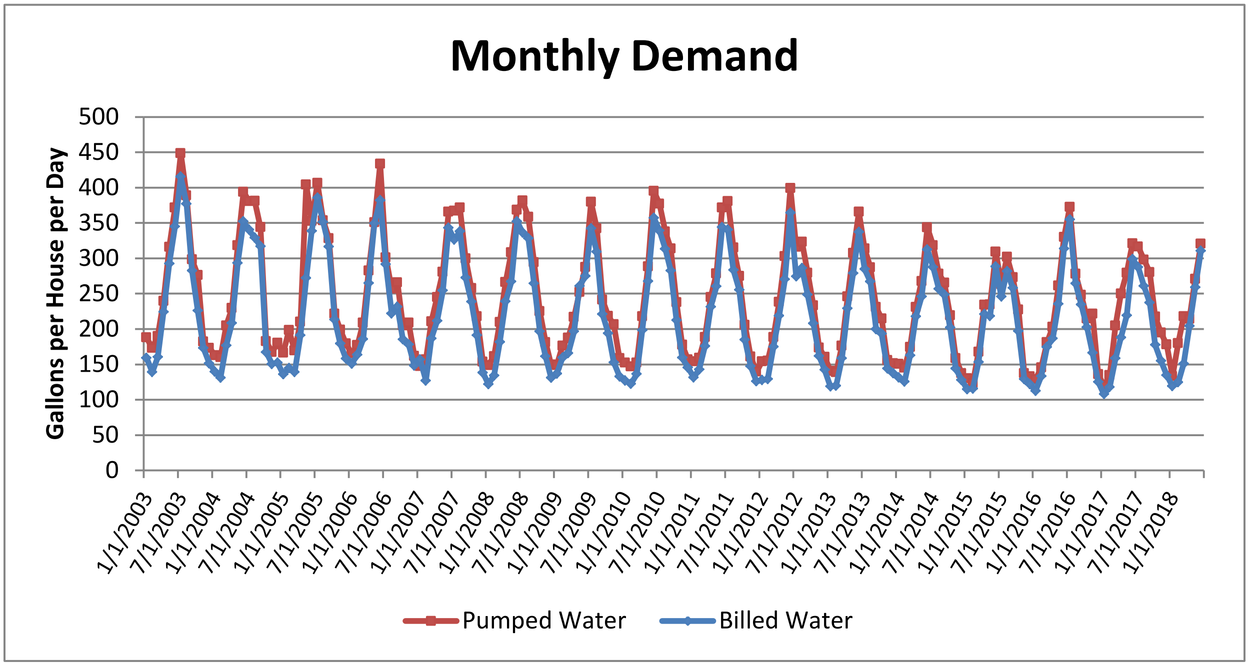

Figure 4 – Average Monthly Gallons Pumped and Billed

Several observations from this chart:

- There is a large seasonal variation; summer demand is two to three times winter use.
- The difference between pumped and sold ("unaccounted for water" and other unbilled uses, such as hydrant flushing) is relatively constant over this time. The slight bulges for April – May and August 2017 reflect water used for the well #3 arsenic treatment pilot tests.
- Winter demand has stayed relatively constant, with a slight decrease.
- From 2012 through 2015, demand in the peak summer month declined; this trend ended in 2016. (From 2010 to 2017, the number of houses served went from 320 to 329.)
- In 2016, there were a number of unintended water use events at houses, that appear as increased demand.
- In February and March 2018, the Cooperative provided water to North Ranchos Water District, so pumped water is substantially greater than billed (which only covers household meters). They were charged for the water provided.

Short Term Demand

Estimated daily demand, based on data collected from smart meters for the peak demand month in 2018, June, is shown in Figure 5 and Table 3. These numbers have been adjusted[2] to include un-billed water; hence "estimated".

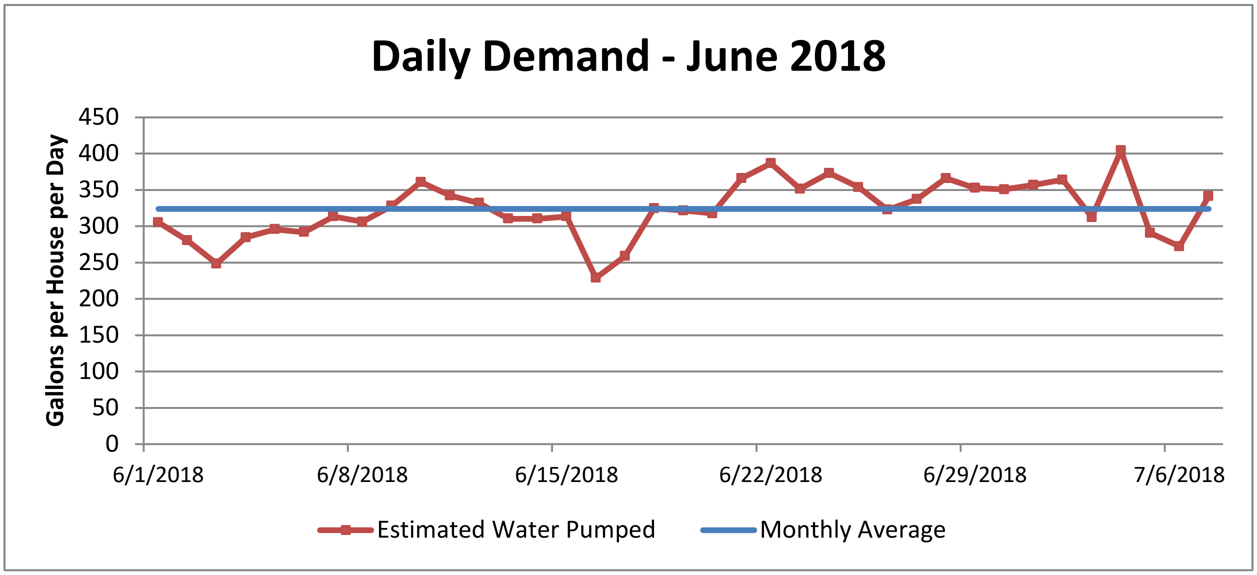

Figure 5 – Estimated Daily Demand, June 1 – July 7, 2018

	Estimated Gallons Pumped per House per Day
Average	324
Minimum	229
Maximum	404
Standard Deviation	39
Maximum : monthly average	125%

Table 3 – Estimated Daily Demand, June 1 – July 7, 2018

Observations from this table and chart:

- All houses had smart meters during this period.
- The first week of July 2018 is included, because of the peak demand on July 4, 2018.
- There is not an obvious trend or pattern, such as a peak every seven days, or weekends.
- The average for the period, 324 gallons per house per day, is close to the monthly average for just June 2018 (320) from well meter readings shown in Figure 4. So readings and data collection from the well meters and the house meters are consistent, indicating there are not any significant inaccuracies or errors.
- The ratio of one day maximum compared to the average, 125%, is used later in this document to project peak short term demand.

[2] To get estimated gallons pumped per day, the gallons billed (total of house meters) each day were divided by the ratio of monthly total gallons billed to total gallons pumped (97% in June 2018).

Estimated total demand[3] (including billed and unbilled water), based on hourly data collected from 330 smart meters (all houses) for the peak week, June 24-30, 2018, is shown in Figure 6.

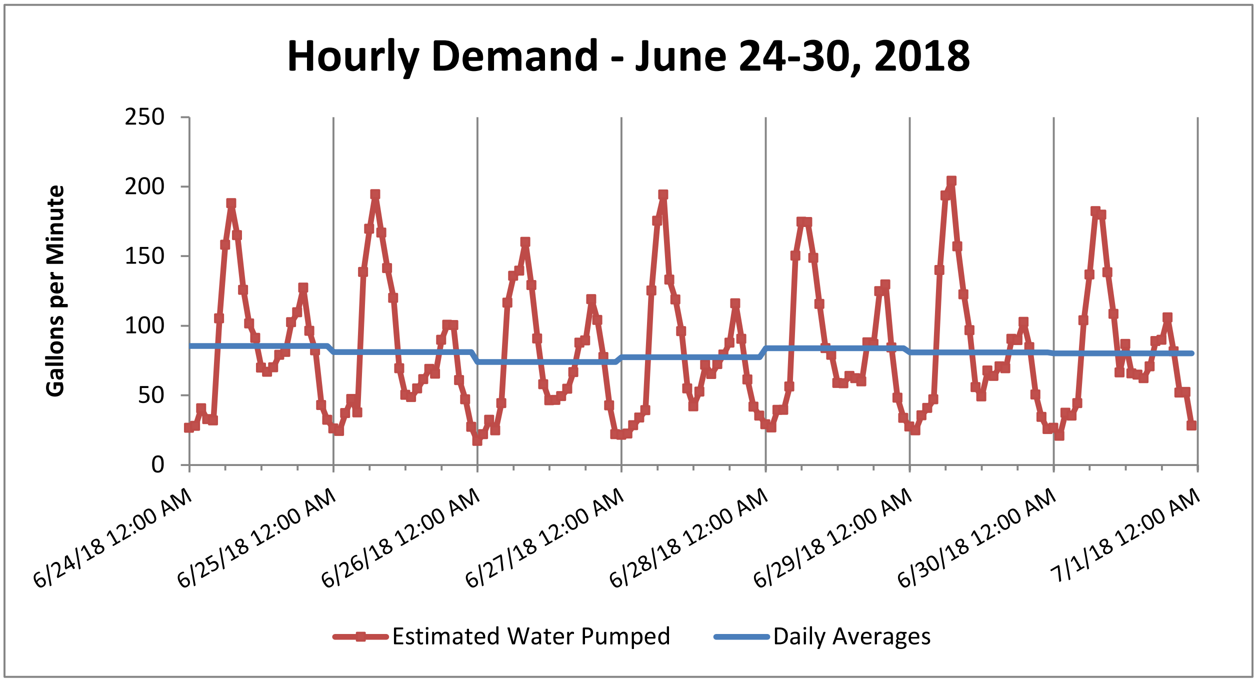

Figure 6 – Estimated Hourly Demand

Observations from this chart:

- There is a very distinct pattern of two peaks each day, with the high between 6 and 10 AM, and a lower peak between 6 and 9 PM.
- Peak demand (204 gpm) in a day, about 8 AM, is 12 times the low demand (17 gpm), around midnight, and about 2.5 times average daily demand (81 GPM).
- This reinforces the important role that the two storage tanks play in the system on a day-to-day basis. During this period, the wells were able to keep the two tanks filled between the desired 12' and 12.5', substantially above the 5' considered necessary for fire protection.

[3] The adjustment to get total demand by hour is the same described above for daily data, that is, divide the hourly billed water (reported by house meters) by 97% (percent of pumped water that was billed in June 2018).

Hourly data (estimated from smart meter readings) for two peak days, June 29, 2018 and July 4, 2018, are shown in Figure 7, Figure 8 and Table 4, with estimated gpm for each zone. Note that this is an estimate of pumped water (demand), including unaccounted for water, but not controlled unbilled water use, such as hydrant flushing, which would not likely occur on a peak demand day, nor be related to the same zones as house meters.

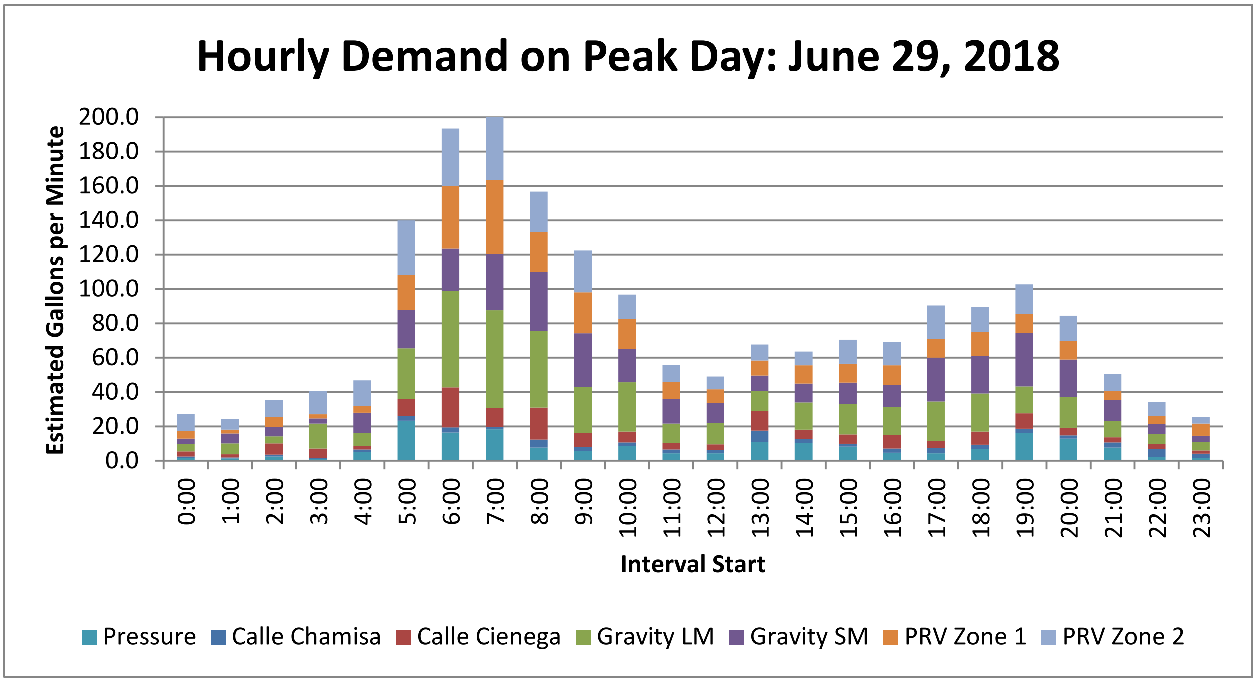

Figure 7 – Hourly Demand on June 29, 2018

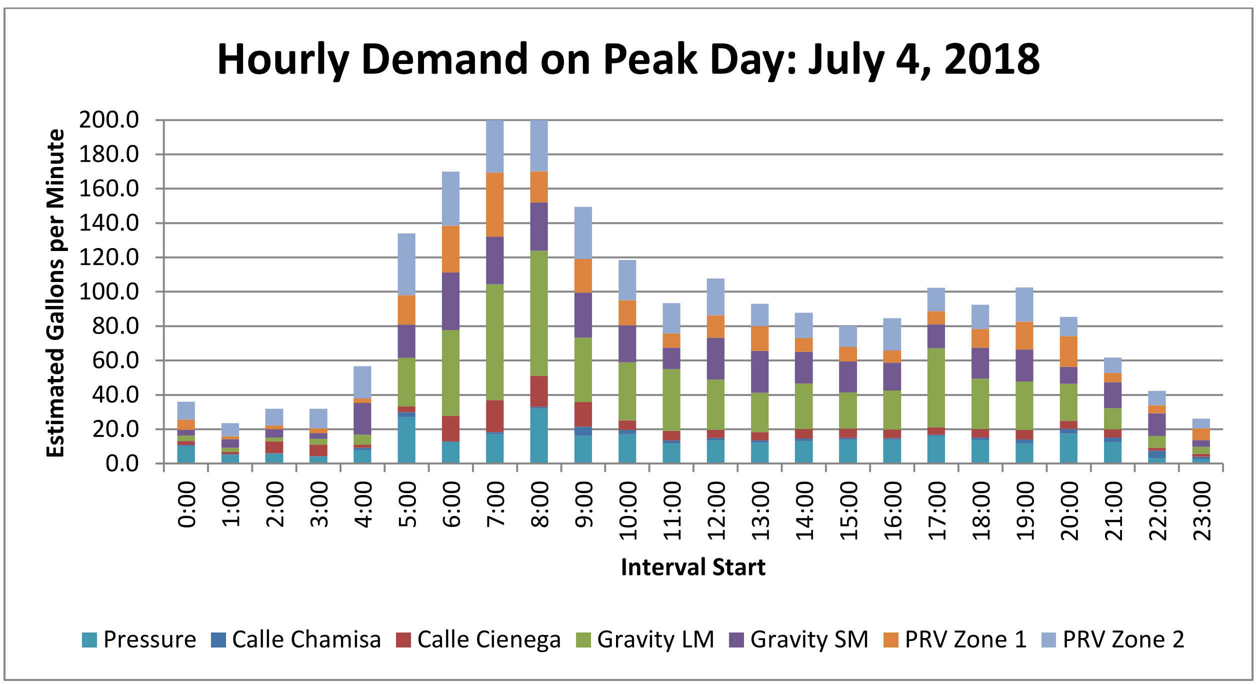

Figure 8 – Hourly Demand on July 4, 2018

Zone	Number of Meters	Estimated Maximum gpm 6/29/2018	Estimated Maximum gpm 7/4/2018
Pressure	40	23	32
Calle Chamisa	14	7	5
Calle Cienega	24	23	19
Gravity La Mesa	74	57	73
Gravity Sundance Mesa	58	34	34
PRV Zone 1	50	43	37
PRV Zone 2	70	41	36
Total	330	204	204

Table 4 – Estimated gpm by Zone on Peak Days

Observations on this data:

- Totals from 6 AM to 9 AM (193 to 204 gpm) substantially exceed the combined pumping capacity of both wells #5 and #6 (about 150 gpm), with the difference coming out of the tanks.
- Estimated flow for the peak hour for each zone could be used to evaluate distribution system pipe sizing and performance.
- The higher demand in the pressure system on July 4, 2018 was because one resident was filling their swimming pool (after notifying the Cooperative). This brings out the important point that capacity planning must recognize that there will be "unusual" use incidents, such as a hose left running or filling a pool.

Distribution of Demand by House

Demand also varies quite a bit by house. Billing data for 2017 (with known residential "leaks" replaced by estimated use) is shown in Figure 9. This shows, for each month, the average number of gallons used (per house per day) for different percentiles. For example, in January 2017, 10% of the houses used about 43 gallons or less per house per day. And in June 2017, 90% used about 528 gallons per day or less, and three houses used between 800 and 1,100 gallons per day in June 2017. The median (50%) was 97 gallons in January and 259 gallons in June.

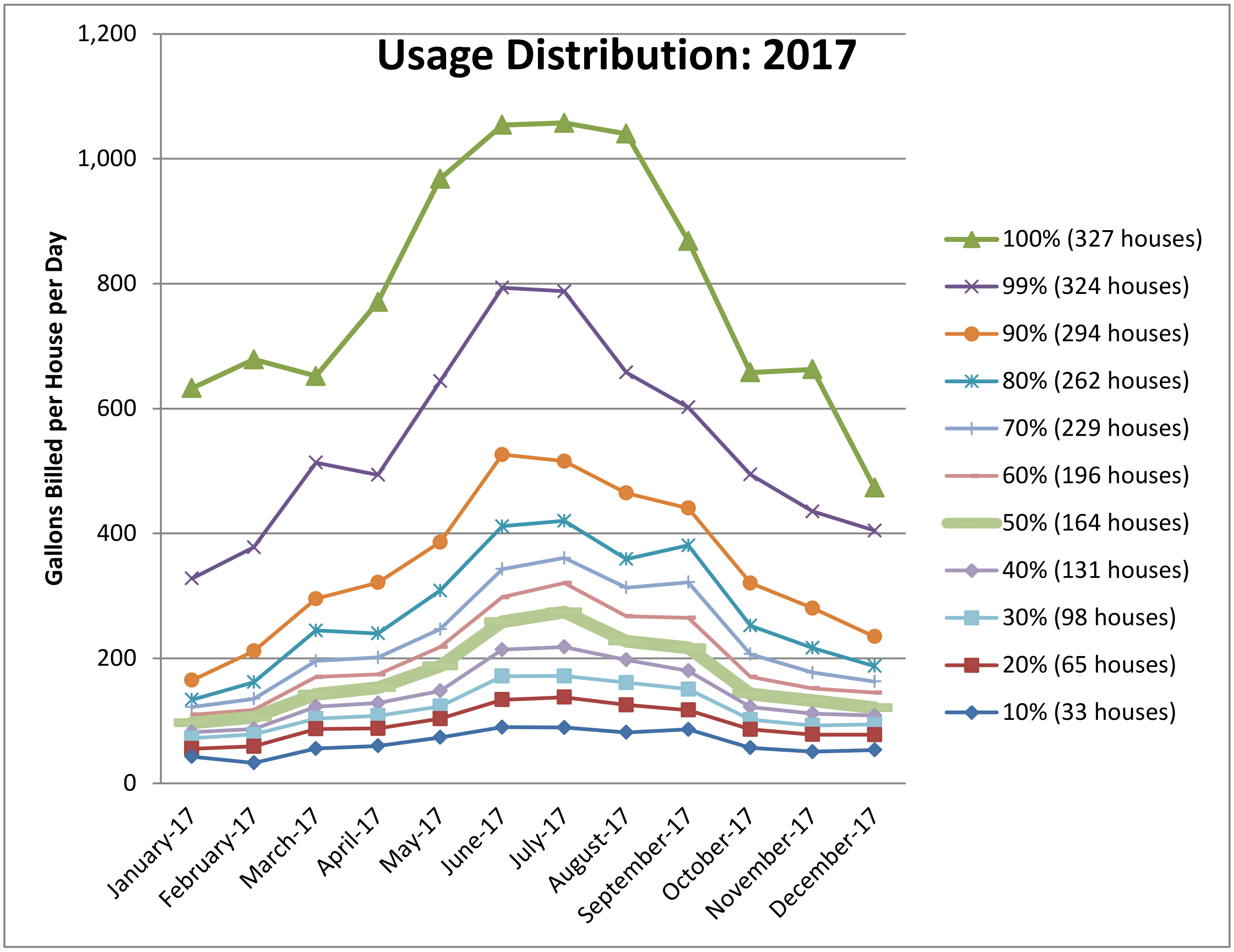

Figure 9 – Average Gallons Billed per House per Day, by Percentile

Observation on this chart:

- The overall pattern of summer demand being about twice winter is consistent when looked at by house.
- In the summer, fewer than 10% of the houses account for disproportionate share of demand – up to twice what 90% of the houses use.

More conventional histograms, showing the frequency of different levels of water use, are shown in Figure 10 and Figure 11, for January 2018 and June 2015, 2016, 2017, and 2018.

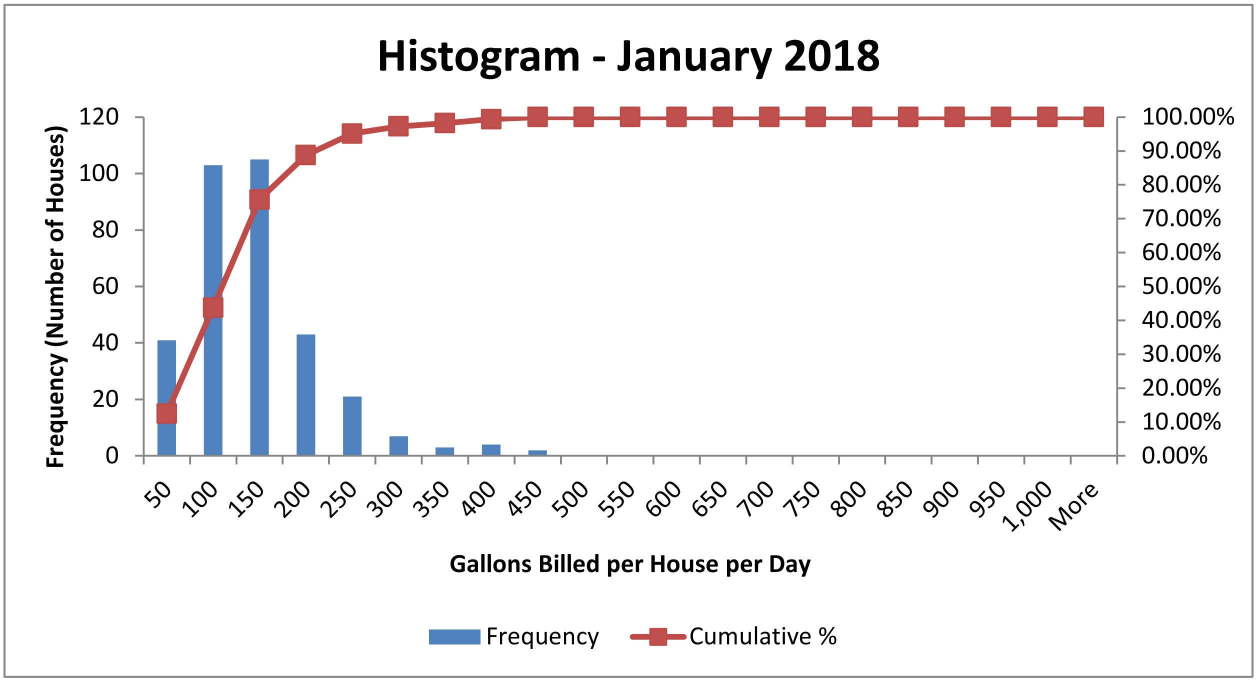

Figure 10 – Histogram of Water Demand, January 2018

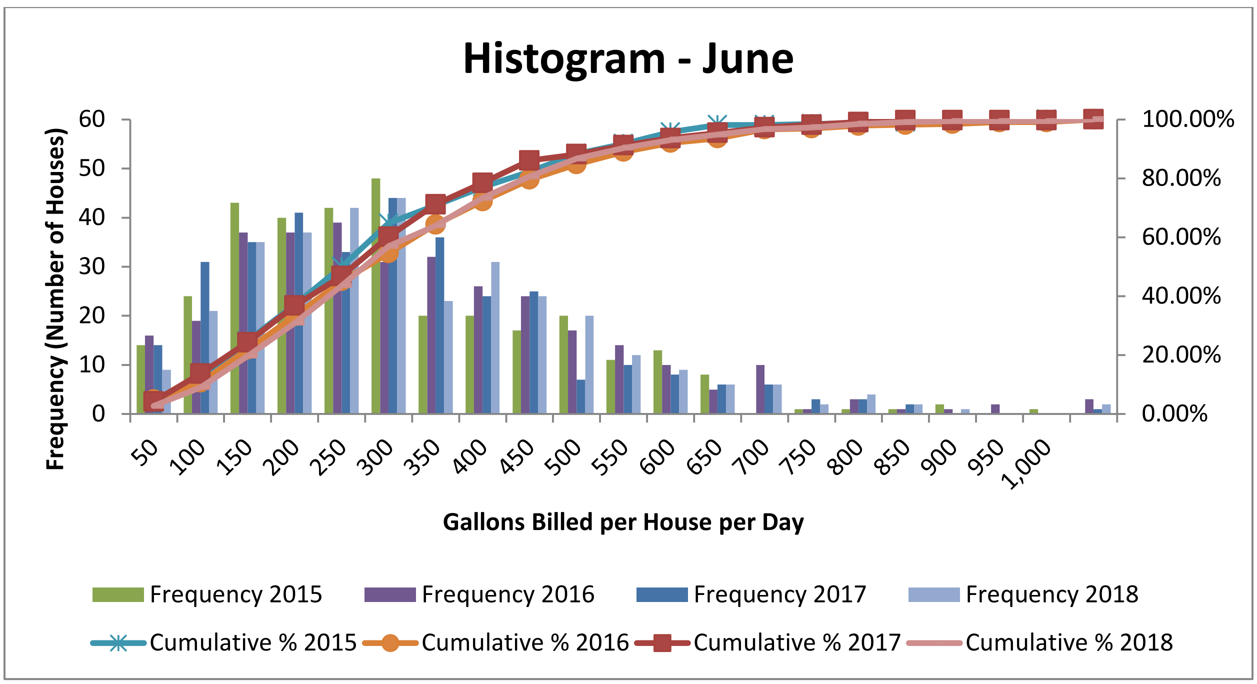

Figure 11 – Histogram of Water Demand, June 2015, 2016, 2017 & 2018

Observations from these charts:

- Most (95%) of the houses used less than 650 gallons per day in June 2018, and 73% of the houses used less than 400 gallons. (This is 19,500 and 12,000 gallons per month, respectively.)
- There were 17 houses that used over 650 gallons per day (19,500 per month) in June 2018.

Unintended Water Use

A constant source of discussion at the Cooperative Board, and with members, are the cases where more water goes through a household meter than the residents intended to use. There are many causes, such as:

- Broken pipe or fitting, either inside or outside – these can leak a small amount (less than 0.1 gpm) for years and go un-noticed. A complete failure of the supply line from the meter to the house can leak 10 or even 20 gpm.
- Toilet running constantly
- Misadjusted swamp cooler fill valve
- Hose left running
- Irrigation system failure, such as a valve stuck open or broken pipe

After the fact, one-off events are fairly easy to detect when monthly demand goes out of the normal pattern for that house. Figure 12 shows the demand for one example house, with three distinct events. The use without each unusual event was estimated, usually by averaging the adjacent months, with some seasonal adjustment. The difference between the amount billed and the adjusted estimate is considered "wasted".

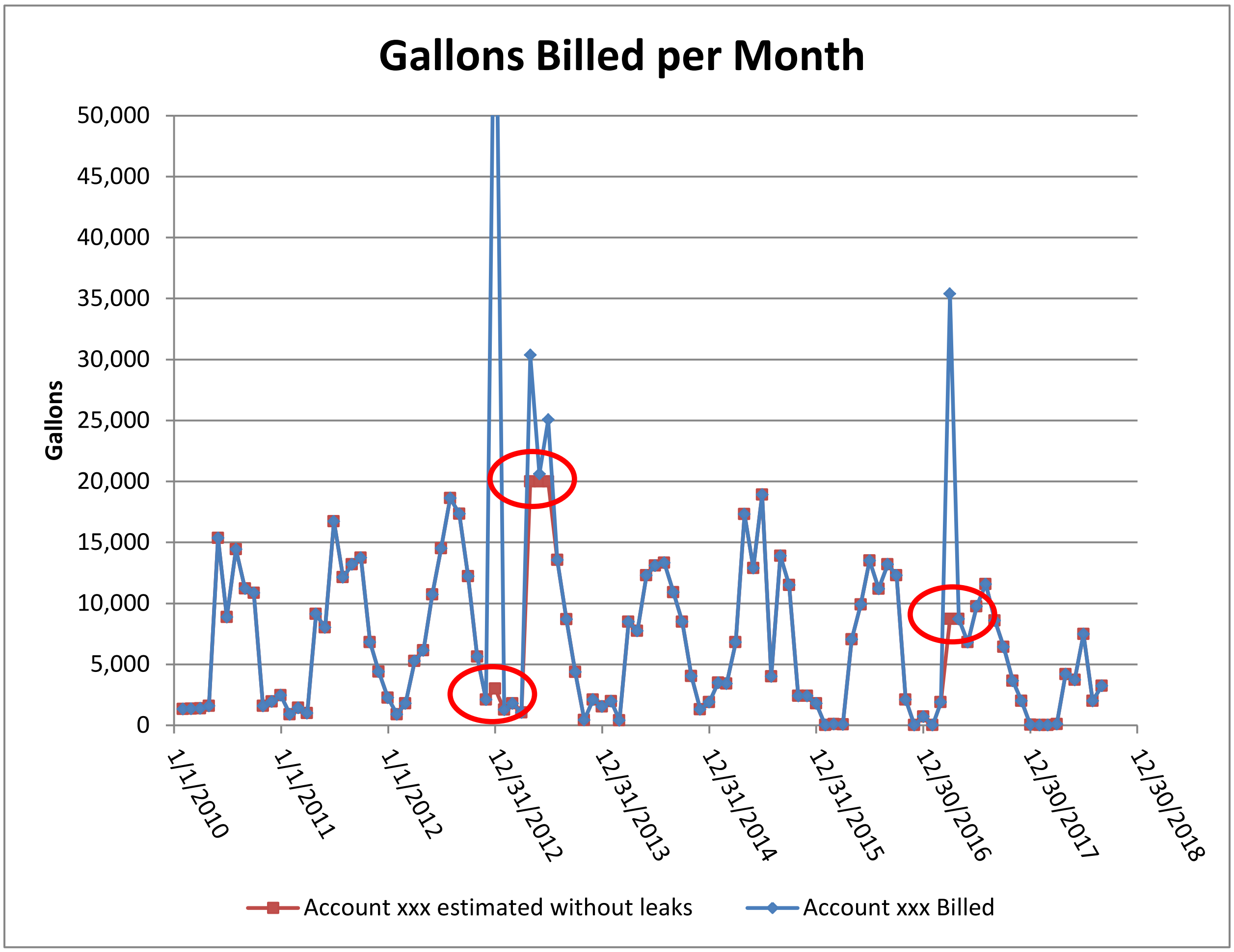

Figure 12 –Unintended Water Use Events for One Example House, 2010 - 2017

Typically, several such events happen every month. Figure 13 shows events for the past several years.

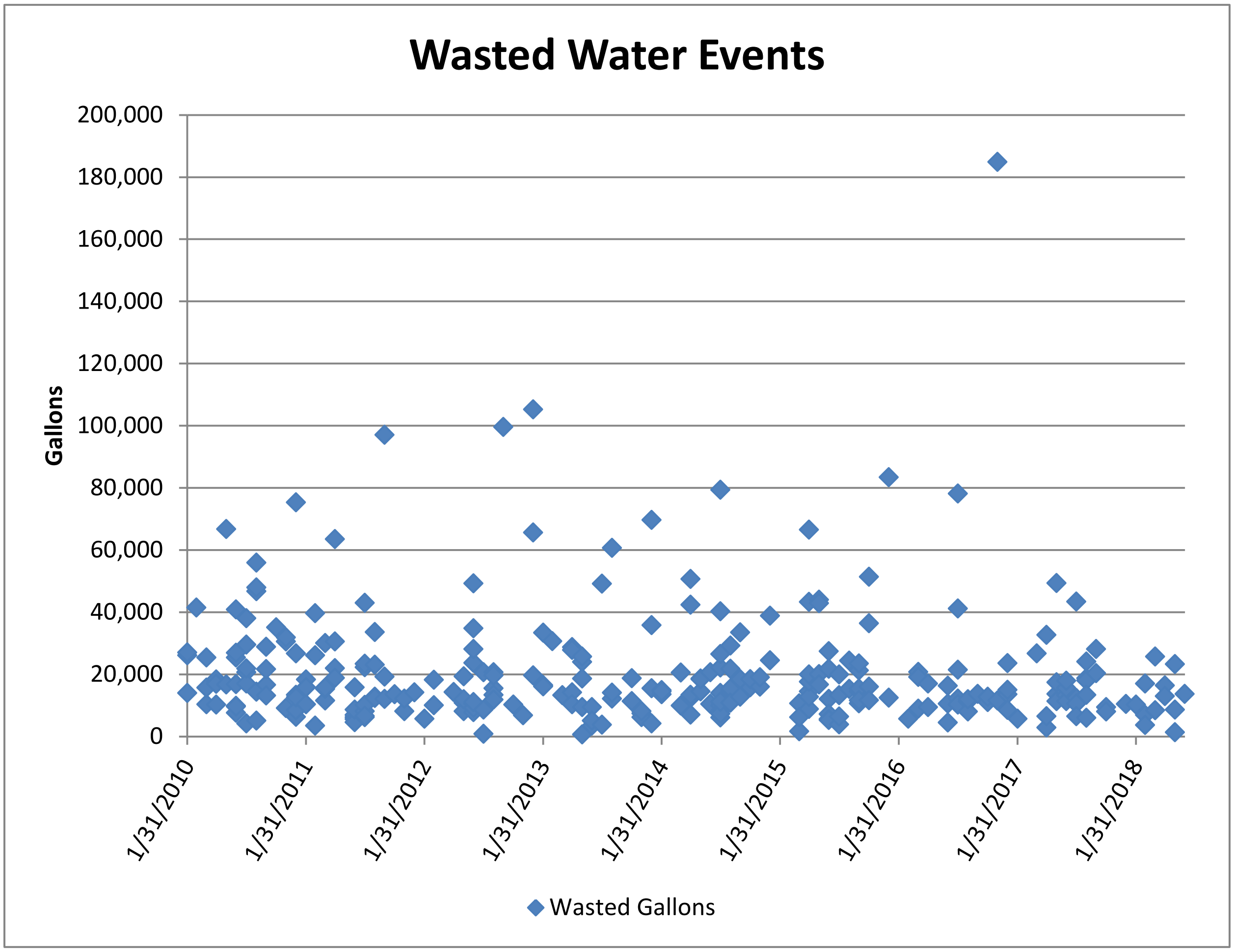

Figure 13 – Wasted Water Events, 2010 - 2018

Observations on this chart:

- Most events waste less than 20,000 gallons. (The 2016-2018 leak policy only allows the alternative flat rate for events over 25,000 gallons.)
- There were a few cases over the past seven years that wasted over 80,00 gallons; the largest wasted over 180,000 gallons.
- There are not any obvious patterns in terms of season.

Figure 14 shows the number of events and the total amount of water wasted per year for 2010 - 2018.

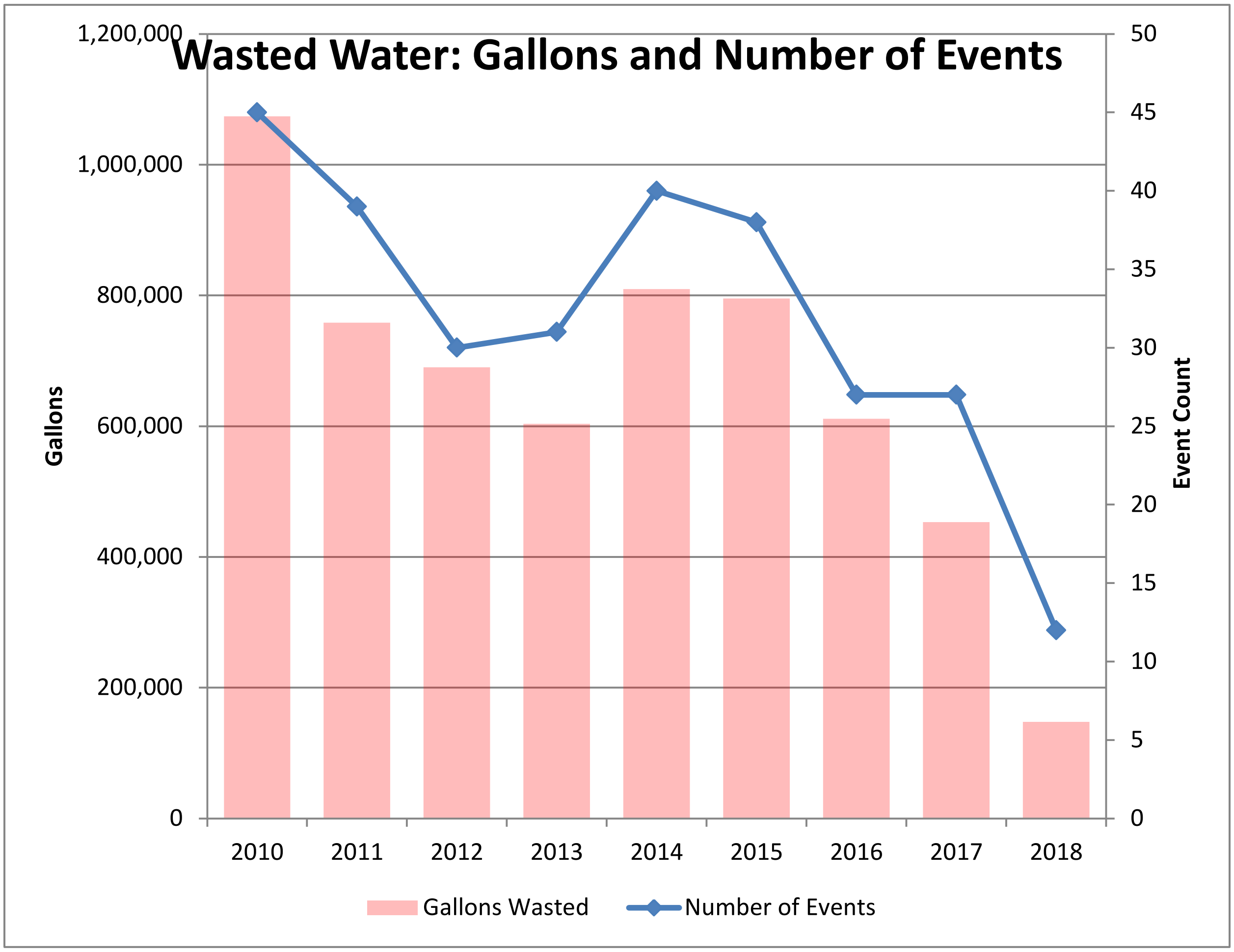

Figure 14 – Volume and Number of Wasted Water Events, 2010 - 2018

Observations from this and the previous chart:

- It is not clear why 2014 and 2015 should have shown increases.
- Although we have many anecdotes where a smart water meter caught a leak, the impact of smart meters is just becoming apparent; 2017 appears to have fewer events than previous years and the first half of 2018 is even better. None of the houses that had major events in 2016 and 2017 had smart meters; as of May 2018, all houses have smart meters.

Because the Cooperative has a very progressive rate structure (the more water used, the higher the price), a large amount of wasted water results in a very high (and unexpected) water bill, so this tends to be an emotional topic. Figure 15 shows the amount of wasted water in context with total water pumped for the peak month each year, from 2010 through 2018. Only peak months are considered, since they drive needed capacity. Water wasted in other months, say January, is undesirable for a number of reasons, but will not have any impact on system capacity. These values are from monthly well meter readings, with wasted water identified in monthly billing data, and does not use smart meter data, which was not available for all houses until mid-2018.

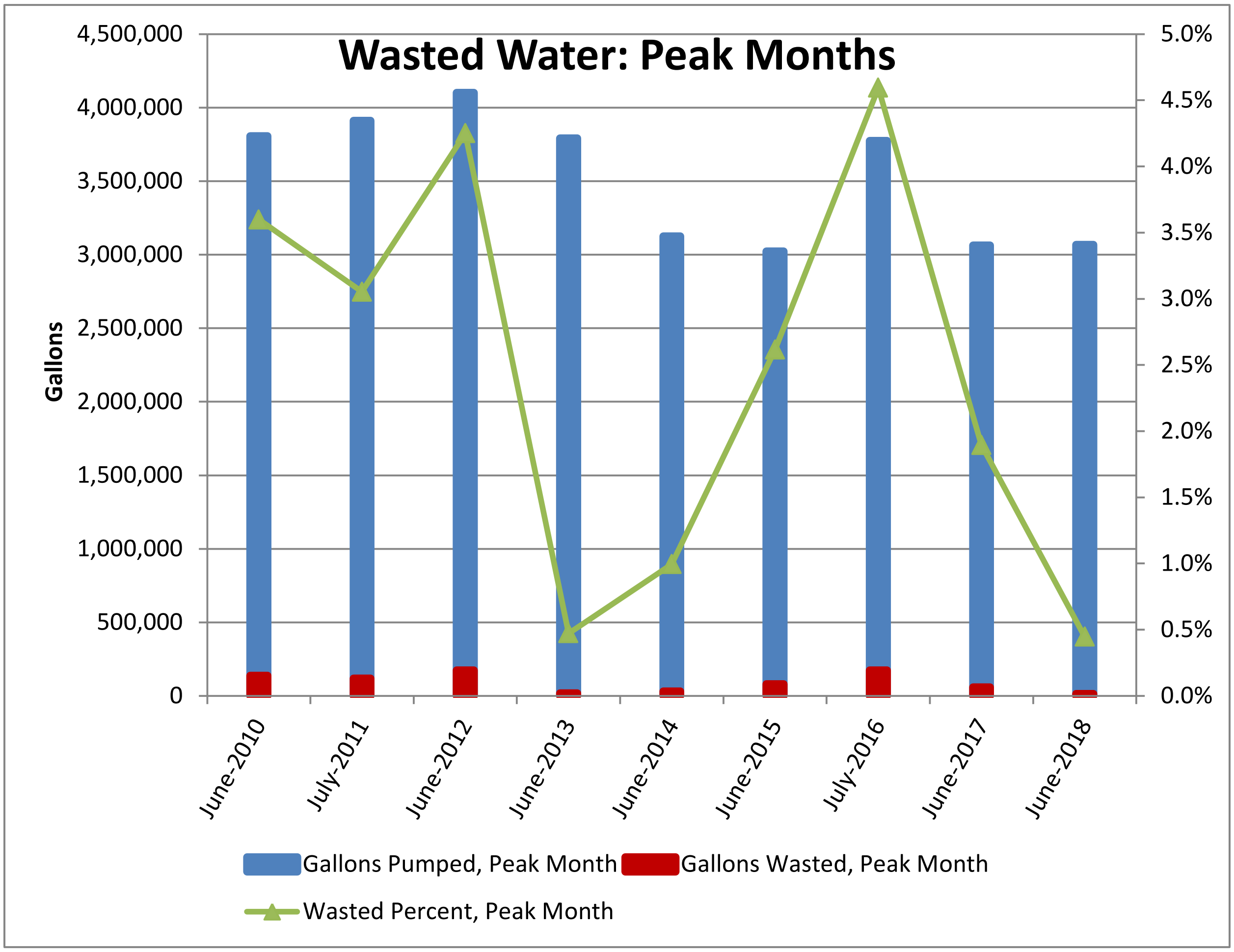

Figure 15 – Gallons Wasted Compared to Gallons Pumped in Peak Months 2010 - 2018

Observations on this chart:

- In June 2012, wasted water accounted for slightly more than 4% of water pumped.
- For 2015 – 2017, wasted water average was about 1.5%, except 4.5% in 2016.
- For June 2018, wasted water was about 0.4% of that pumped.
- Again, there are not any obvious trends.

Conclusion: Even if all large unintended use (wasted) water events can be eliminated, which may happen with smart meters, demand in peak months will not be significantly different.

Highest Water Users

A frequent topic of discussion is the amount of water used by the top users. From the previous charts, it is clear that the statistical distribution is very skewed – a few number of houses use quite a bit more than most people. To understand the impact, Figure 16 shows the amount of water used by the top 1% (4 houses), compared to the total pumped, for the peak month each year during the period 2010 - 2018. These values are from monthly well meter readings, and monthly billing data, and does not use smart meter data, which was not available for all houses until mid-2018.

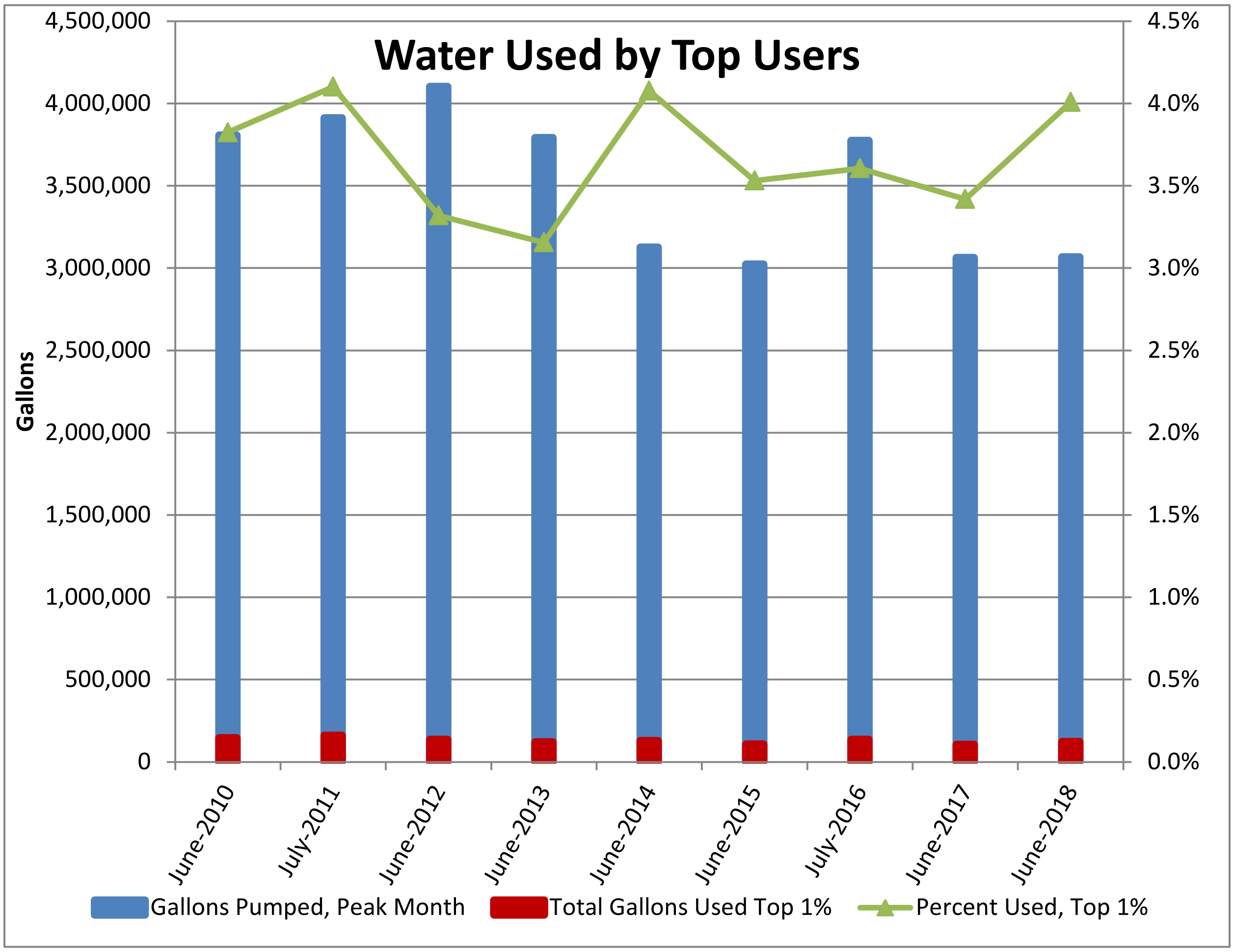

Figure 16 – Water Used by Top Users in Peak Months, 2010 - 2018

Observations on this chart:

- The three to four houses that used the most water in each peak month used about 3.5% to 4% of the total water pumped.
- If those top users were to change to reduce use closer to the average, that would have a negligible effect on supply planning.
- Because of the very progressive water rates, those top users provide the Cooperative with a disproportionate share of revenue.

Unbilled and Unaccounted Water

The Operations Report reviewed each month by the Cooperative Board of Directors includes pumped, billed, and unbilled (known and unaccounted for unbilled) water. As shown in Figure 2, above, known unbilled water includes things as hydrant and well flushing, and known distribution system leaks, etc. The remainder is called "unaccounted for water", which includes amounts that may be caused by things such as:

- Inaccurate well meters
- Inaccurate house meters
- Unknown leaks in the distribution system

The history of unbilled water, for the peak months, 2010 to 2018, is shown in Figure 17. Amounts are from well meters and water operator estimates of known unbilled water.

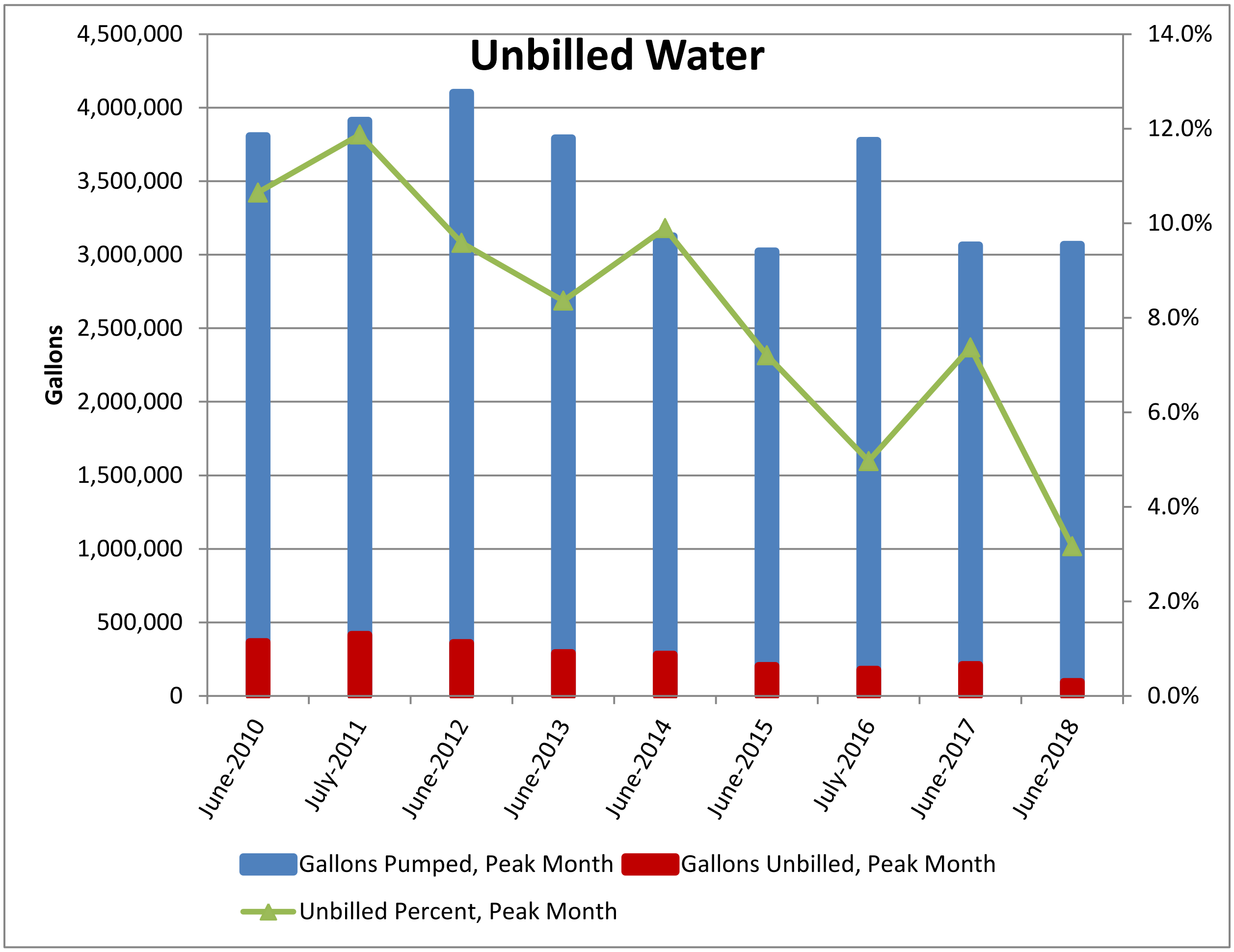

Figure 17 – Unbilled Water in Peak Months, 2010 - 2018

A well-recognized problem in the industry is that as water meters age, they become less accurate, particularly with low flow. This is significant for the Cooperative, since most houses use swamp coolers, that have continuous low flow, which may not be recorded at all by an old meter. From December 2015 through May 2018, all house meters have been replaced, which may explain the record low unbilled and unaccounted for water in June 2018. As those meters age over the next ten years or so, and likely will become less accurate at low flows, the percent unbilled will probably go up. Activities that cause unbilled water, such as hydrant flushing were avoided in June 2018.

Demand – Peak Month

Since the Cooperative does not have long term storage, such as a multi-acre reservoir, that would allow us to spread the summer and winter demand, we must plan capacity to meet peak demand. The average demand during the peak month each year is shown in Table 5 and Figure 18. (The Days Between Readings is shown because meters were not read on the same day every month.) Numbers are from well meters, so include unbilled water.

Peak Month	Days Between Readings	Number of Houses	Total Gallons Pumped	Average Gallons per House per Day	Average Gallons per Capita per Day	Average Demand gpm (@60%)
June 2001	29	219	3,409,840	537	275	136
June 2002	31	233	2,922,305	405	208	109
July 2003	31	247	3,433,500	448	230	128
June 2004	28	265	2,923,500	394	202	121
July 2005	31	297	3,741,800	406	208	140
June 2006	30	309	4,020,150	434	223	155
August 2007	34	317	4,007,300	372	191	136
July 2008	31	318	3,761,300	381	195	140
July 2009	33	320	4,008,288	376	193	141
June 2010	30	321	3,806,422	394	202	147
July 2011	32	321	3,911,454	381	195	141
June 2012	32	321	4,101,700	399	205	148
June 2013	32	324	3,790,528	364	187	137
June 2014	28	325	3,125,567	342	175	129
June 2015	30	326	3,023,280	307	157	117
July 2016	31	327	3,774,245	329	169	141
June 2017	29	329	3,062,284	321	165	122
June 2018	29	330	3,066,349	320	164	122
			Average	390	200	135
			Standard Deviation	52	27	12
			"1 in 10 year"[4]	457	234	150
			Min	307	157	109
			Max	537	275	155
			Without 2001			
			Average	381	195	135
			Standard Deviation	37	19	12
			"1 in 10 year"	428	220	150
			Min	307	157	109
			Max	448	230	155
			Max 2008-2017	399	205	148
			2011-17 Average	355	182	134

Table 5 –Demand in Peaks Months, 2001 – 2018

[4] The “One in ten year” concept appears in the 2007 Water Use Analysis, and for several years after that. It is included here for context with past water supply plans, but is not used here.

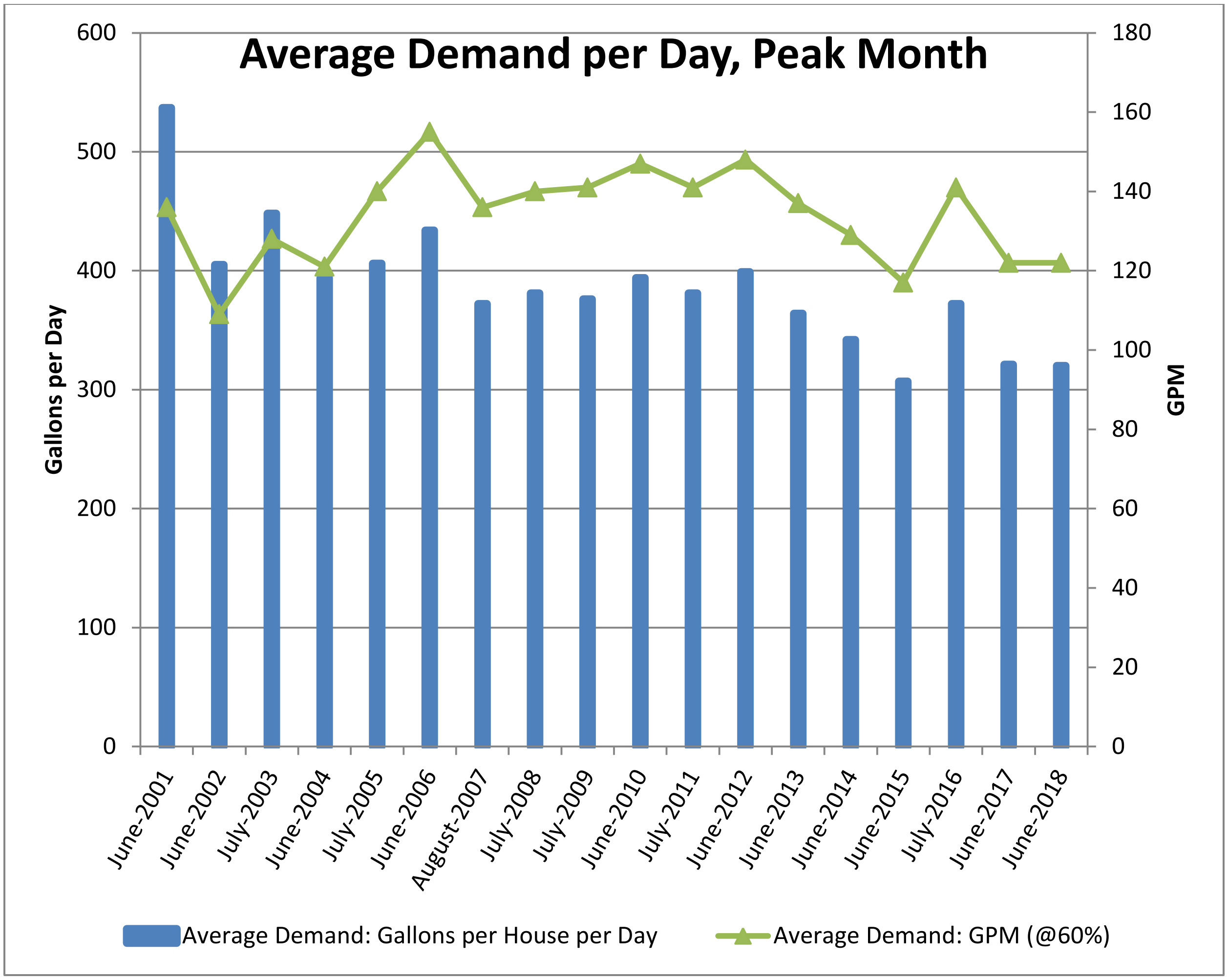

Figure 18 – Water Pumped in Peak Months, 2001 - 2018

Observations on this data and chart:

- For unknown reasons, demand in June 2001 was exceptionally high.
- Excluding the 2001-2006 measurements, during the peak month for each year, the average demand has been between 300 and about 400 gallons per house per day.
- Assuming a 60% duty cycle, this means we've needed an average of 120 to 150 gpm throughout the peak month since 2001.
- Table 3, above, indicates that demand on the peak day of 2018 (July 4) was about 125% of the average demand for the peak month, June.

Trends

Looking at Figure 3, Figure 4, Figure 16, and Figure 18, there was a trend of declining demand from 2012 through 2015, most noticeable in the peak months. The 2015 Water Supply plan had some analysis, and possible alternative explanations. Since this trend reversed in 2016 through 2018, those explanations are moot. There does seem to be a somewhat irregular trend over the past fifteen years for demand to decline.

Capacity

Tanks and Distribution System

The Cooperative has two water storage tanks on Camino Barranca for short term storage and fire protection. The tanks, wells, and all houses are connected to a single, simple distribution system, as shown in Figure 19. The wells and tanks are said to "float", in that water pumped out of each well goes first to the closest houses, and the excess eventually goes into the tanks. When the wells are not pumping, water flows out of the tanks though the same distribution pipes to houses and fire hydrants. There are not any pipes that go directly from a well to the tanks. Well pumps are controlled based on the water level in the tanks, and chlorination is done at each well site.

- The tanks together store about 21,000 gallons per foot, and we keep them filled between 11.5' and 12.5'.
- If neither well is operational in the summer, we only have one to two days of stored water before the level drops to the minimum needed for fire protection (5').
- Both tanks were refurbished and recoated, inside and out, in September and October 2015.
- Most houses and fire hydrants are located below the water tanks, so are gravity fed. There are 43 houses served by a pressure booster system, which consists of six pressure tanks and two booster pumps, all located in the building at the tank site.

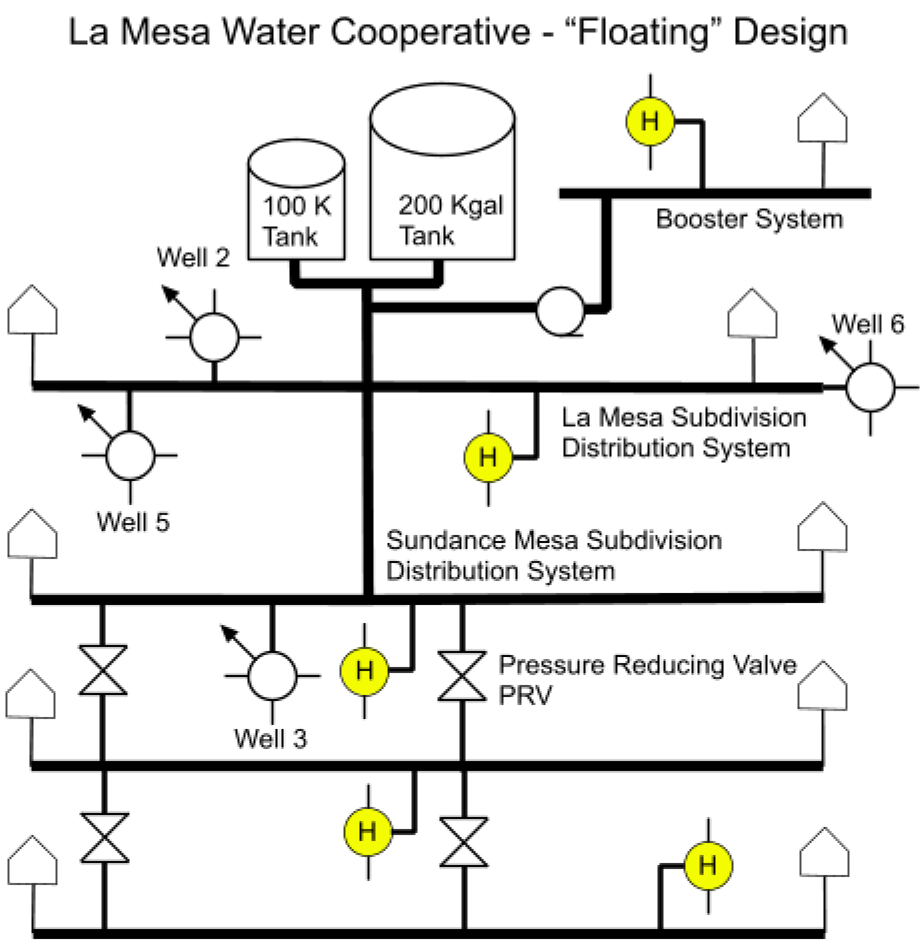

Figure 19 – Schematic of Water Cooperative Key Components

Tanks

The two water storage tanks provide several critical functions:

- Buffer short (hours to days) term fluctuations in demand and pumping rate. Well pumps can be run for several hours at a time, rather than constantly being turned on and off.
- Provide water pressure to most houses, even if there is not any power for pumps, such as during an electric supply outage.
- Reserve storage for firefighting, with water provided to hydrants throughout the neighborhood.

Water Storage Level Required for Fire Protection

To meet this last function, the water level in the water storage tanks must be maintained to provide adequate volume for fire protection. The Needed Fire Flow (NFF) recommended by the American Water Works Association (AWWA) is 500 gpm at a minimum residual pressure of 20 psi for at least two hours, which means at least 60,000 gallons should always be available. Since the two water tanks together hold about 20,700 gallons per foot, this means that the tanks should never go below three feet, with the minimum target of five feet (103,000 gallons) providing some margin. As of September 2018, the wells are operated to keep the water level between 12.17' and 12.50'. Since the peak hourly demand on high use days exceeds the combined capacity of well #5 and #6, the tank level currently goes below 12.17' for a few hours on high demand days. See Figure 8, above.

Figure 28, below, shows that future pumping capacity under fallback conditions (largest capacity well out of service) will meet the projected peak day demand at 100% well pump duty cycle, thereby maintaining normal storage tank water level on a 24-hour average basis. However, peak hourly flows on the peak demand day will exceed the average day flow and could potentially cause drawdown of the water storage tank below the minimum normal operating level.

An operating scenario could be:

- One day, only well #3 is available, operating at its 125 gpm design flow; wells #5 and #6 are out of service.
- This occurs on the peak demand day of the year, when 500 gallons per house per day is required.
- This occurs in 2028 when there are 340 house to supply.
- Forecast daily average demand will be 118 gpm.
- As shown in Figure 6, above, peak hourly demand is about 2.5 times daily average demand, and the peak demand period lasts about 4 hours (typically in the morning), for 295 gpm demand.
- The net outflow from the tanks is 170 gpm; 40,800 gallons over 4 hours.
- This drops the tank level about 2'.
- If this occurs when the tanks are at their low operating level, say 11.5', the level drops to 9.5', still well above the fire protection level of 5'.

In this scenario, the tank level drops for several hours and then recovers. Changes, such as fewer houses, lower demand, more pumping capability, etc. reduce the amount of drop.

A worst-case scenario could be:

- All pumping capacity is lost, say, because of an area-wide power outage.
- This occurs on the peak demand day of the year, when 500 gallons per house per day is required.
- This occurs in several decades, at full buildout, with 367 house to supply.
- This occurs when the tanks are at their low operating level, say 11.5'.
- Demand will be 183,500 gallons per day or an average of 7,646 gallons per hour.
- Without any pumping, at that demand rate, the tanks will take 2.71 hours to drop a foot.
- The tank level will drop from 11.5' to the fire protection level of 5' in 17 hours. 35 minutes.

In this scenario, the tanks store enough water to last over half a day. Changes, such as fewer houses, lower demand, some pumping capability, etc. extend this time.

This analysis shows that planned pumping capacity will maintain adequate water storage tank volume for fire protection under peak demand conditions.

Wells

As of September 2018, the Cooperative has two wells in operation (#5 and #6), and two wells available but not used (#2 and #3) because arsenic levels exceed current standards (10 parts per billion, ppb), as shown in Table 6. Capacity is an indication of the flow that the well could produce, based on the aquifer, depth, and screen, independent of pump and motor. Current Pumping Rate is determined by pump, motor, and operating speed.

	Well #2	**Well #3**	**Well #5**	**Well #6**
Capacity	15 gpm	250 gpm	105 gpm	60 gpm
Current Pumping Rate	0	60 gpm	90 gpm	52 gpm
Status	Inactive since 9/11/2013	Inactive since 3/1/2008	Active	Active
Began Service	1992	1998	4/1/2007 refurbished 1/1/2017	5/1/2013
Capacity Loss	3% per year	0.1% per year	0.4% per year	0.5% per year
Arsenic Level	21 ppb (8/2013)	26-28 ppb (3-8/2017)	5.2 ppb (2/14/2018)	7.5 - 19 ppb (2017 – 3/2018)
Well Depth		700 feet	771 feet	965 feet
Last Well Test		6/21/2017	5/4/2018	5/3/2018
Static Water Level (SWL)		255 feet	306 feet	442 feet
Pumping Water Level (PWL)		289 feet	348 feet	504 feet
Usable Water		310 feet	323 feet	361 feet
Annual SWL decline		0.5 foot / year	5.8 feet / year	6.5 feet / year
Annual PWL decline		0.8 foot / year	? feet / year	6.1 feet / year
Casing Diameter		6 5/8"	6 5/8"	6 5/8"
Screen	Carbon steel	Carbon steel	Stainless steel	Stainless steel
PNM Power	240 V 1-phase	240 V 1-phase	240 V 1-phase	240 V 3-phase
Motor	240 V 1-phase	240 V 3-phase	Franklin 20 HP 460 V 26.9 A 236 6148 120 3-phase	Franklin 20 HP 230 V 15 KW 236 5048 120 3-phase
Phase convertor / Variable Frequency Drive (VFD)	none	Rotary phase convertor	Allen-Bradley PowerFlex® 400 22C-D072A 103 Series A	Allen-Bradley PowerFlex® 400 22C-B075A 103 Series A
Load Reactor	NA	NA	Allen-Bradley 1321-3R 35 B	Allen-Bradley
Pump			Grundfos 20 HP 12B63617	Berkeley 15 HP 6TS15-70
Well Estimated Lifetime	zero	25-30 years from 1998	30 years from 2007	30 years from 2013
Well Lifetime limiting factor	Arsenic level	Casing	Water table?	Water table?

Table 6 – La Mesa Water Cooperative Wells

Notes on wells:

- Water levels are measured twice each year as part of controlled well tests. In 2016 and 2017, transducers were installed in wells #6 and #5, respectively, and water levels are now collected every two minutes through the Mission surveillance system.
- Well #1 was replaced by #6 in 2013, so is not listed here.
- Well #2 arsenic level was less than 10 ppb up to 2012. Plans are to decommission it in several years.
- Well #3 could provide up to 250 gpm with appropriate pump and motor, as stated in the Well #3 Completion Report. The well #3 project plan calls for replacing the current pump and motor (60 gpm) with ones that will produce 125 gpm to match the planned arsenic treatment train.
- Well #4 was abandoned during development.
- Well #6 arsenic level seems to vary, with the level increasing the longer the well is pumped. An Isolux adsorption system was put into service June 2015. Treating about half of the water at 18 ppb results in blended water with 9 ppb arsenic.

Figure 20 shows the configuration of wells #3, #5, and #6.

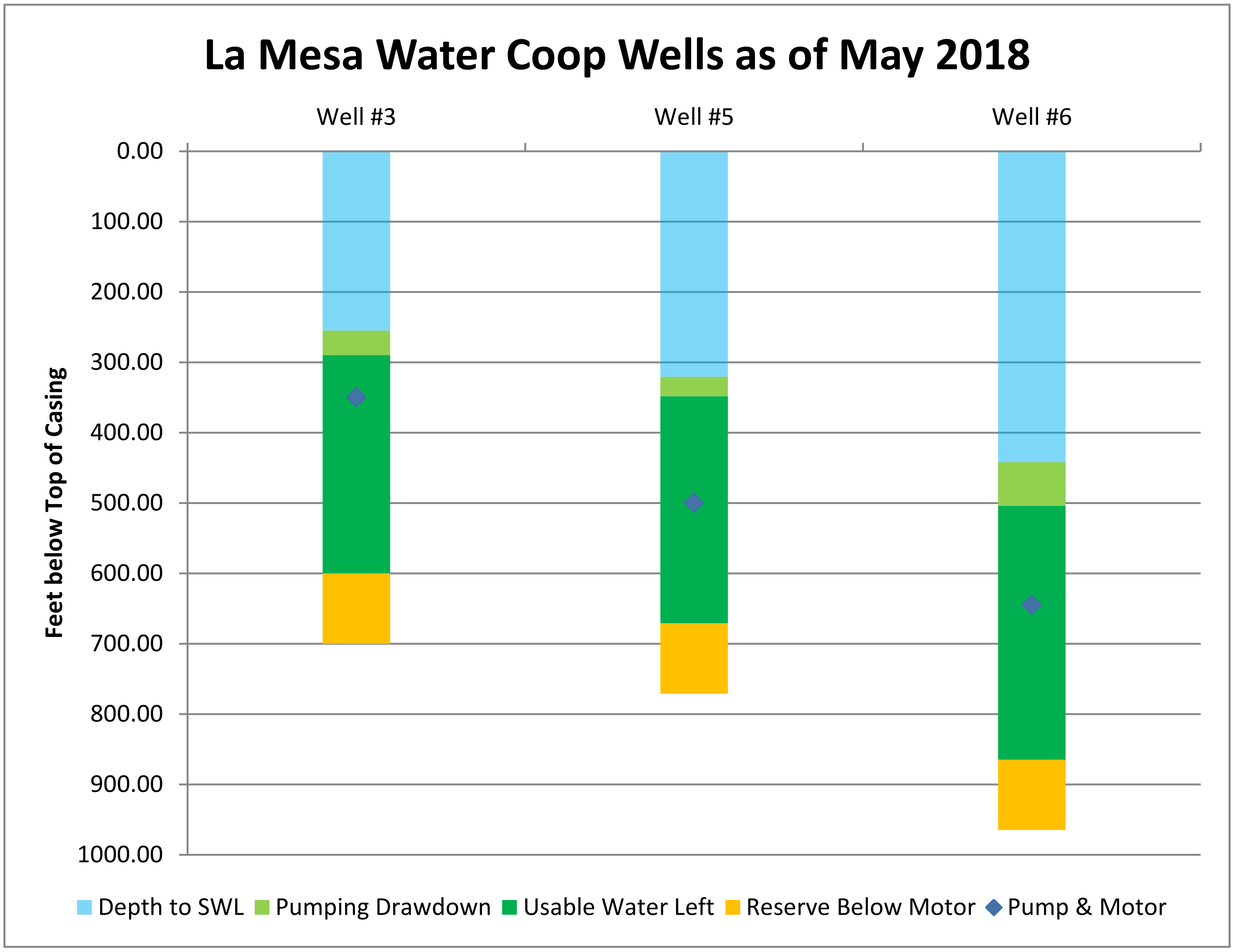

Figure 20 – La Mesa Cooperative Wells, July 2018

A study [Johnson] done on Placitas water has our water about 10,000 years old. Given that and the depth of our wells, there is virtually no recharge from the surface and therefore there is only a very loose connection between year-to-year weather, which drives surface runoff and shallow groundwater, and our water supply. That is, the current drought has little or no influence on our water supply. Once pumped out of the ground, that water is gone, and will not be replenished in our lifetimes. The Static Water Level (SWL) is lowest in the summer, and rises each winter, indicating some form of subsurface recharge, or at least flow toward the well from a wider area. The SWL measurements of wells #1, #2, #5, and #6 all show a decline from year to year; see Table 5, above. After well #3 had been used for about ten years, the SWL showed minimal decline.

Figure 21 and Figure 22 show the well #5 and #6 static and pumping levels from the biannual well tests. To run the test, each well is taken out of service for 24 hours, then run continuously for several hours, with the water level measured every several minutes. The PWL values shown are measured or extrapolated values. In normal operation, we do not run a well as long as 1,000 minutes (16 hours, 20 minutes).

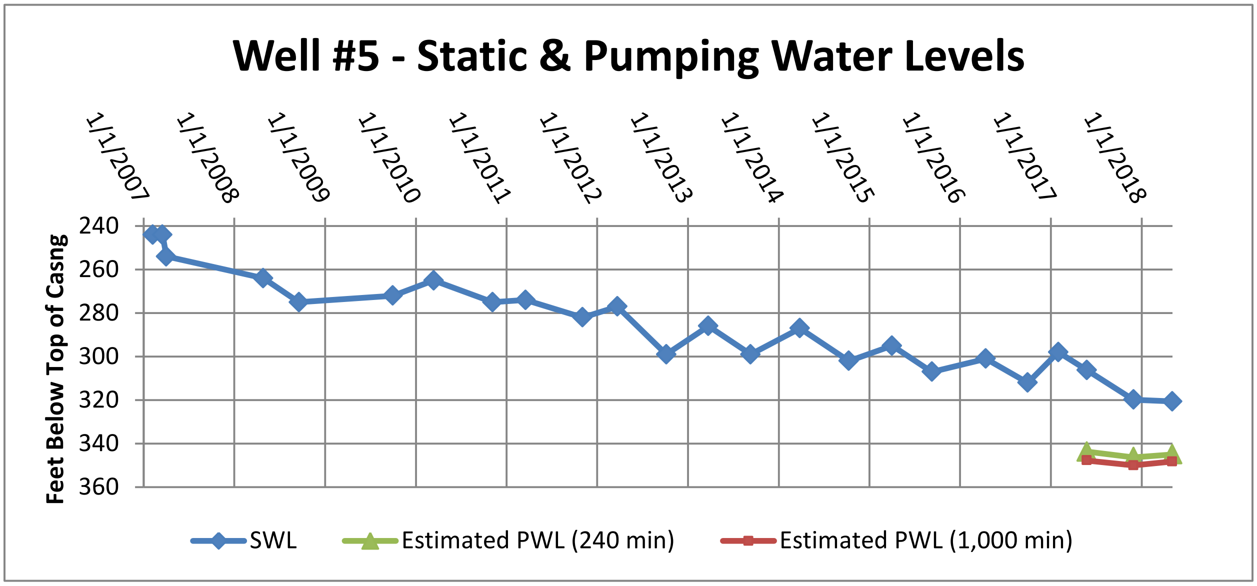

Figure 21 – Well #5 Static and Pumping Levels from Well Tests, 2007 - 2018

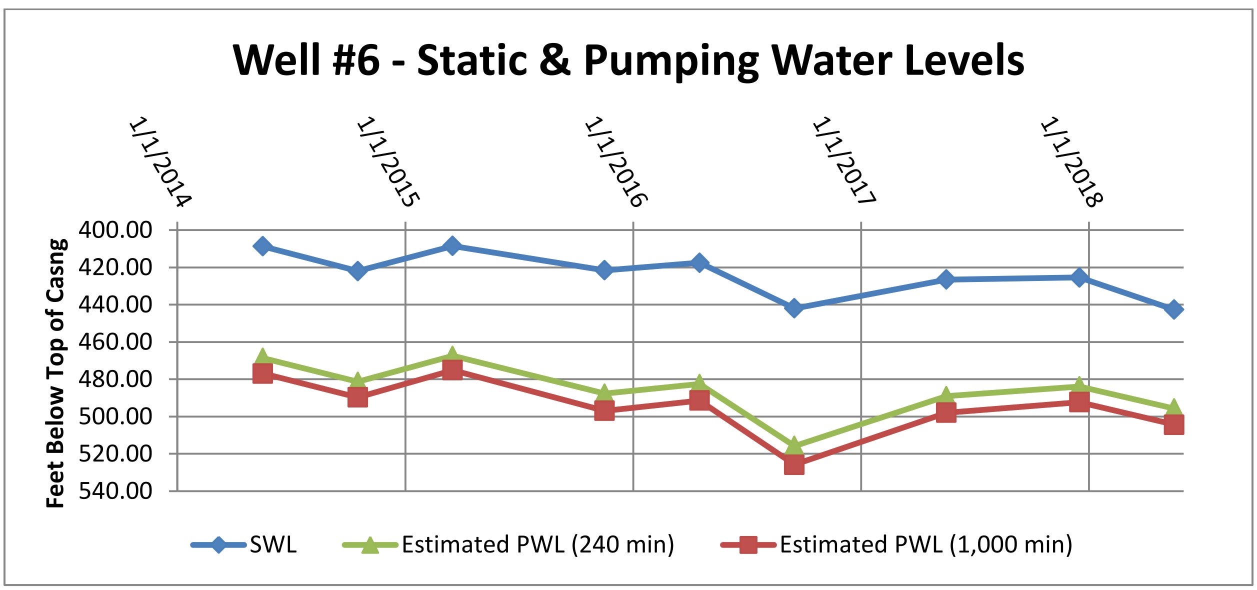

Figure 22 – Well #6 Static and Pumping Levels from Well Tests, 2014 - 2018

Observations on these charts:

- There is a clear spring / fall pattern, where the wells recover some each winter.
- The trend is clearly lower levels each year for each well. (About 5.8 feet per year for #5 and 6.5 feet per year for #6.)

- The spring well tests for 2018 were not run until May, at which point the SWL had already been drawn down in each well.

Figure 23 and Figure 24 show more detailed water levels. These are based on transducers installed in each well in the past few years. Data is reported every two minutes through the Mission surveillance system. These charts show the SWL and PWL for each pumping cycle, which occurs up to several times each day.

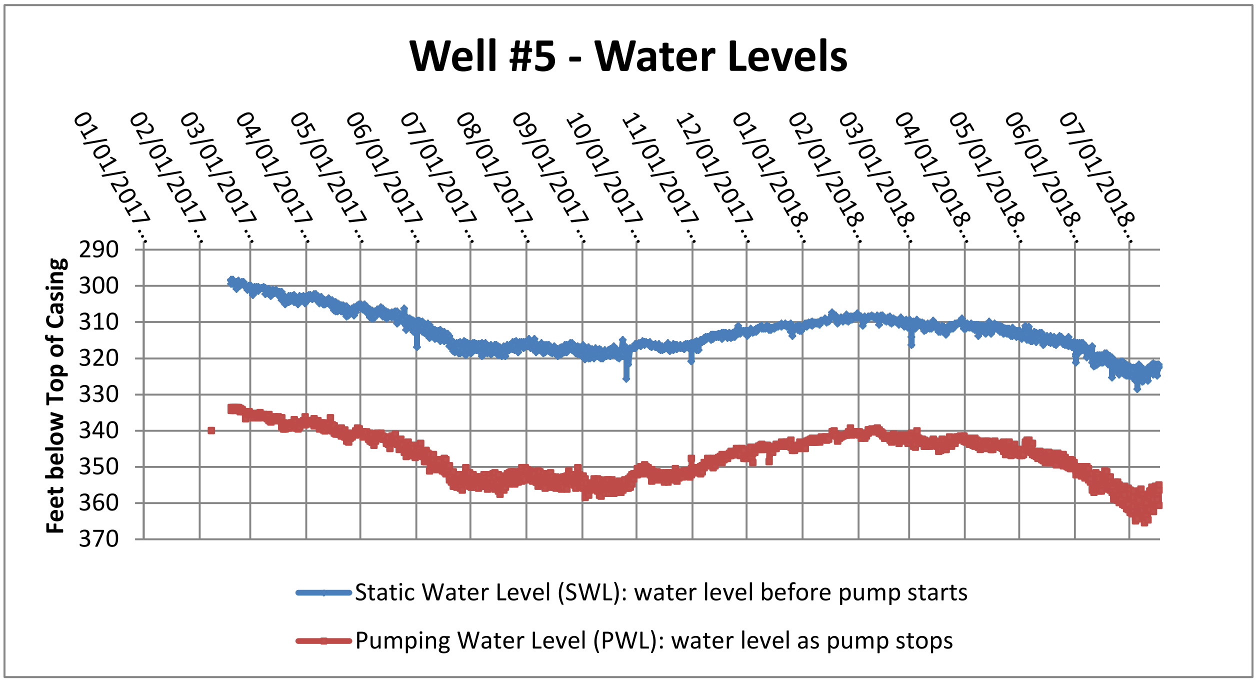

Figure 23 – Well #5 Static and Pumping Water Levels from Transducer, 2/2017 – 7/2018

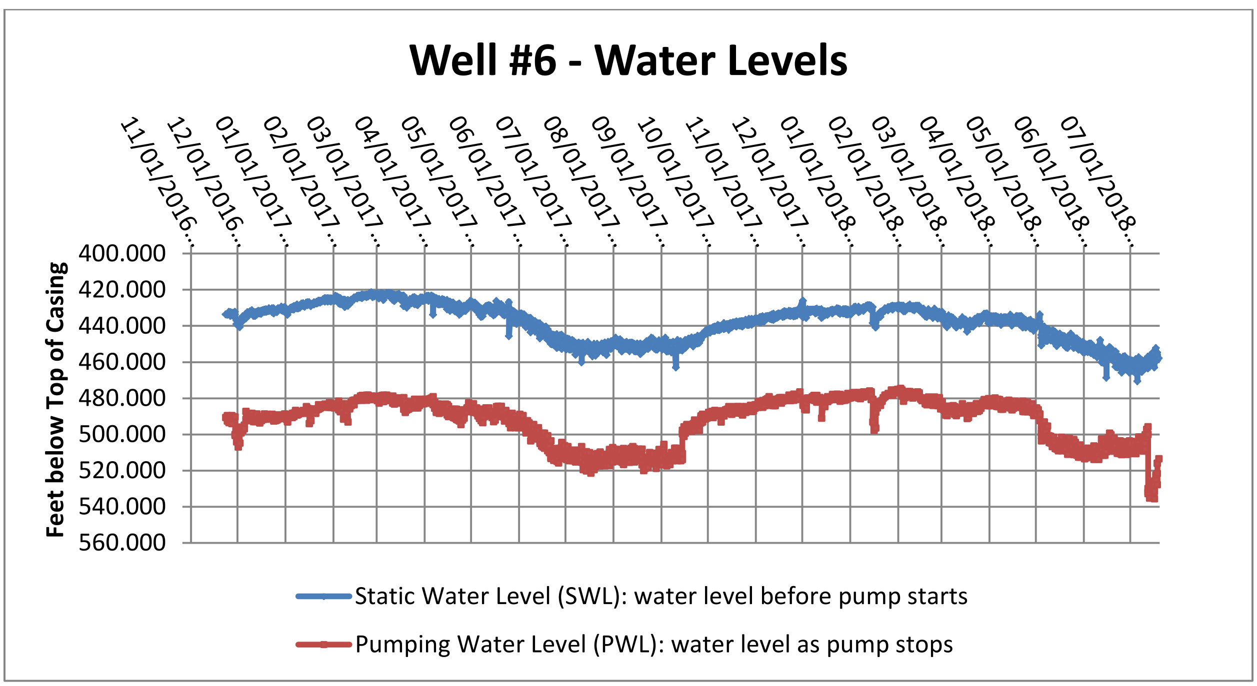

Figure 24 – Well #6 Static and Pumping Water Levels from Transducer, 12/2016 – 7/2018

Although these only cover a bit more than one year, the seasonal pattern is fairly clear. There's not enough data to extrapolate any trend over several years. Detailed data and charts with metrics such as drawdown, flow rates, pump runtime, etc. are available in Cooperative files, but not included here.

Demand Compared to Well Capacity

From the monthly well meter readings, Figure 25 shows the monthly averages of demand and various well pumping capacities, expressed in gpm, from 1/2005 through 6/2018. The average demand is calculated by dividing the total gallons pumped in a month by the number of days in the month, divided by 1,440 (minutes per day), multiplied by the assumed 60% duty cycle. The pumping capacity for each well is from the monthly Operations Reports.

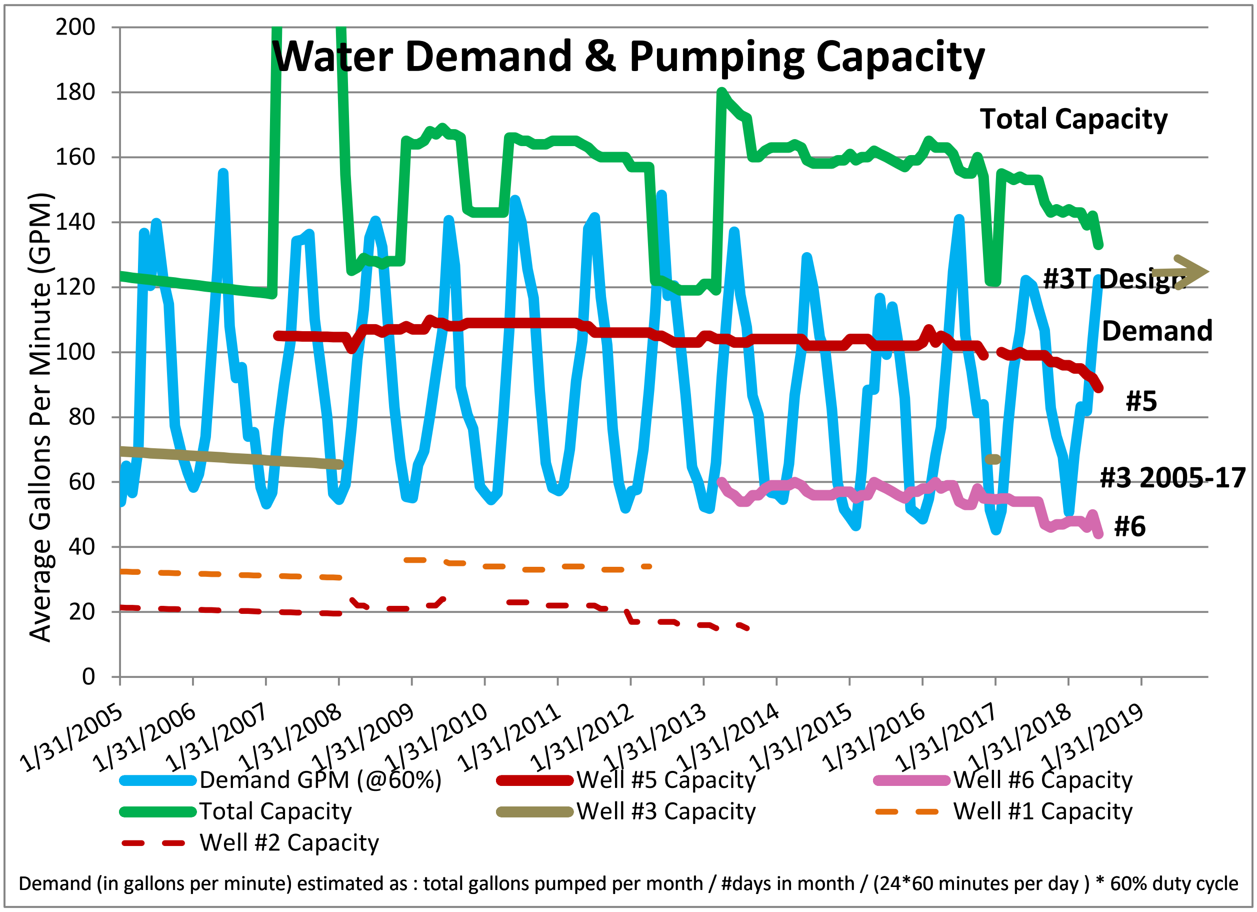

Figure 25 – Monthly Average Demand and Well Capacity, 1/2005 – 6/2018

Several observations from this chart:

- The 60% assumed duty cycle provides significant buffer for short term fluctuations.
- Since 2007, total pumping capacity has generally exceeded demand, except for June 2012, when well #1 was out of service, and before #6 was in service. Well #5 carried the entire load, with increased run times.
- Both wells #5 and #6 are required to provide sufficient pumping capacity in the summer (May through August). Well #5 alone provides sufficient pumping capacity for the other eight months. Well #6 by itself provides sufficient pumping capacity only for three winter months (December, January, February).
- Note the spike in total capacity when wells #1, #2, #3, and #5 were all running in 2007.
- Well #5 was taken out of service January – February 2017 for inspection, cleaning, and replacement of the pump, motor, and pitless adapter. Well #3 was used during that time.
- Well #5 production has declined in 2018. The cause and necessary corrections are being investigated.

- Well #6 capacity fluctuates depending on the state of the arsenic treatment vessels. Flow is reduced to prolong life of treatment cartridges.
- Well #3 arsenic treatment facility is being designed to produce 125 gpm, with new well pump and motor. See "Upgraded Well #3 and New Arsenic Treatment Facility Capacity", below, for a discussion of the planned well #3 capacity.

Duty Cycle

The Cooperative plans to keep the duty cycle (percentage of time a well runs) less than 60%, as recommended by the New Mexico State Engineer, and industry practice. We are able to do this, as long as both wells #5 and #6 are available during peak months. Figure 26 and Figure 27 shows actual duty cycles for these two wells, with running three-day averages.

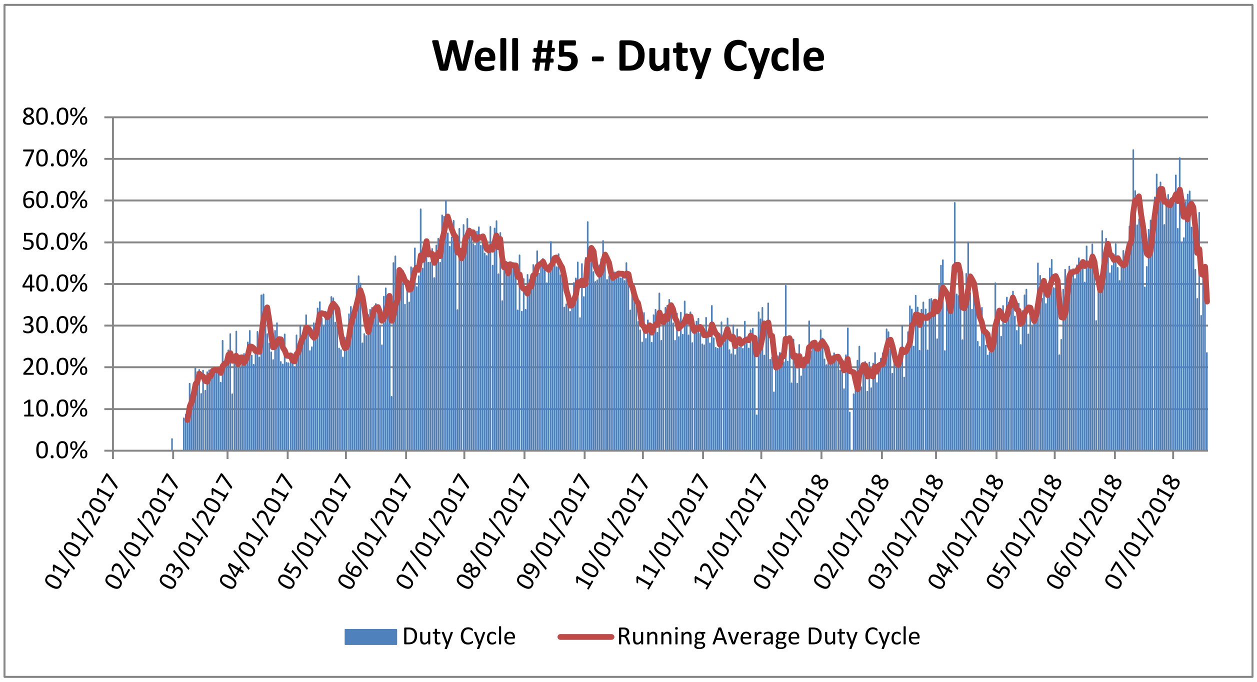

Figure 26 – Well #5 Duty Cycle, 2/2017 – 7/2018

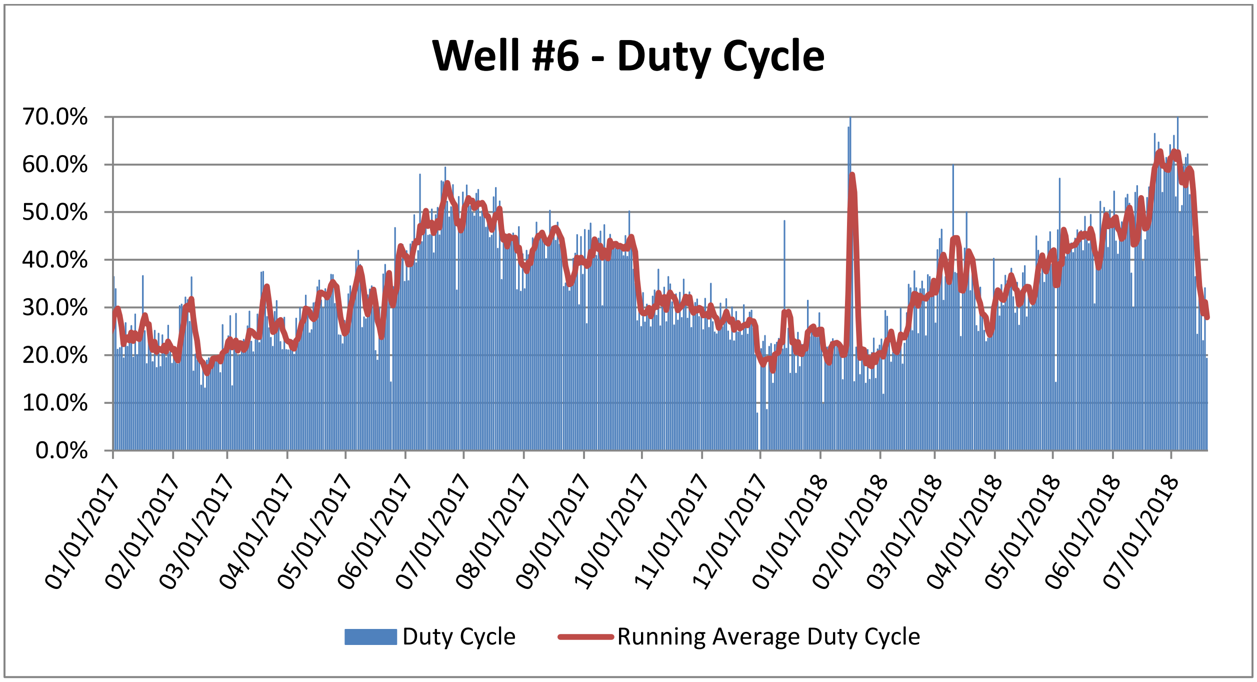

Figure 27 – Well #6 Duty Cycle, 1/2017 – 7/2018

Again, the seasonal pattern is apparent, with several summer days in 2018 reaching the 60% target.

Forecast

"It's tough to make predictions, especially about the future." – Yogi Berra

Projected Demand

In addition to the assumptions listed above, and historical demand, there are several additional factors to consider. Although it is unreasonable to predict future weather, the long term climate trend for New Mexico is hotter and dryer. The conservative approach is to assume that trend will continue, and we should plan accordingly.
The drought probably has an effect on demand, but it is not clear which direction. Are people going to water more because of less rain and snow? Or will people remove (or not replace) high water using landscaping, such as lawns and trees?

Projected Capacity Requirements

The two key parameters required to estimate long term capacity requirements are the number of houses (see Table 1, and Table 5, above), and the average gallons per house per day demand (i.e., total pumped, including billed and un-billed water), shown in Table 5 and Figure 18, above. Using historical data for these parameters, possible planning values for future demand are shown in Table 7. The "Peak Day Estimate" values are computed by multiplying the monthly averages by 125%, from Table 3, above. This is to accommodate high demand over a single peak day, that would reduce water stored in the tanks, even though pumping capacity would be sufficient to meet the average monthly demand. This is estimated because we only have daily demand data for 2018.

Source	Gallons per House per Day Monthly Average	Gallons per House per Day Peak Day Estimate
Average peak month, 2002 through 2017	381	476
Standard deviation peak month, 2002 through 2017	37	46
Average peak month, 2011 through 2017	355	444
Peak month in past 15 years (July 2003)	448	560
Peak month in past ten years (June 2012)	399	499
Number used in 2011-2015 Water Supply Plans	380	Not used
June 2017	321	401
June 2018	320	400

Table 7 – Possible Demand Planning Values

As reasonable and conservative criteria, three key planning values are selected for forecasting future demand:

- 400 Gallons per House per Day, Peak Month Average – This is the demand we need to meet with all wells running at or below the target 60% duty cycle. This would have been 153 GPM for the 330 houses in June 2018.
- 500 Gallons per House per Day, Peak Day – This is the demand we need to meet on a peak day, with our highest capacity well out of service, and the remaining wells operating up to 100% of the time. This would have been 115 GPM for the 330 houses in June 2018.
  This is a conservative requirement for two reasons: The probability that the highest capacity well will fail on the peak day is low, but non-zero. And high demand on a peak day probably does not persist for several days, so water stored in the tanks provides some additional buffer.
- 243 Gallons per House per Day, average for all days in a year, 2001-2017. See Table 2, above.

Applying the above planning values and the projected number of houses result in the demand forecasts shown in Table 8.

Date	Monthly Average: Gallons per House per Day	Peak Day: Gallons per House per Day	Number of Houses	Demand: Average gpm for Peak Month (@60%)	Demand: Average gpm for Peak Day (@100%)
June 2018 (actual)	320	400	330	122	92
June 2019 (forecast)	400	500	331	153	115
…					
June 2028 (forecast)	400	500	340	157	118
…					
June 2038 (forecast)	400	500	350	162	122
…					
Full buildout (forecast)	400	500	367	170	127

Table 8 – Demand Forecast, 2019 to Full Buildout

Applying these demand projections and the well characteristics shown in Table 6 result in the projections shown in Figure 28, with several additional assumptions:

- Demand, in terms of gallons per house per day, remains constant for the foreseeable future. Additional demand is only from new houses.
- Well #3, with the corresponding arsenic treatment facility, is in service by June 2020 at 125 gpm. See "Upgraded Well #3 and New Arsenic Treatment Facility Capacity", below.
- Well #5 can be restored to 98 gpm by June 2019.

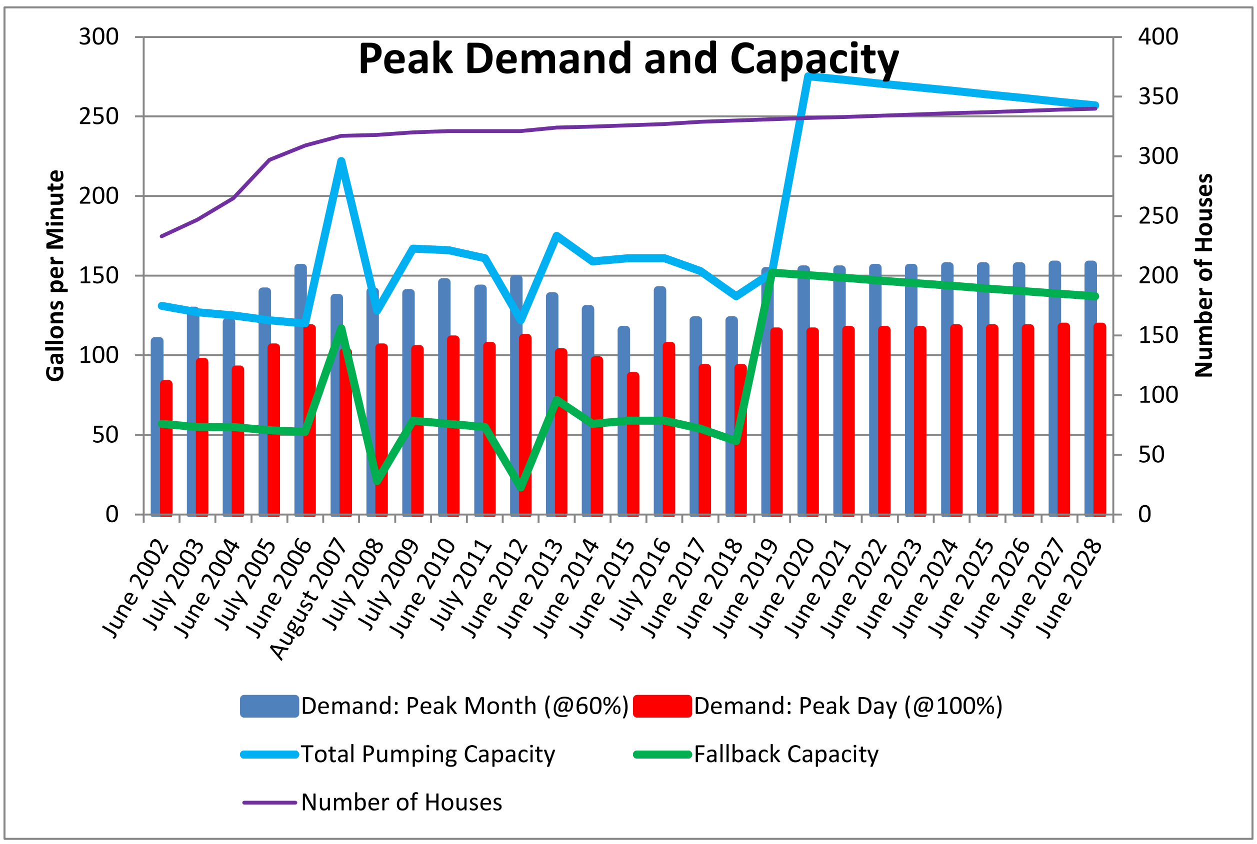

Figure 28 – Historical and Projected Demand and Capacity, 2002 - 20228

Observations on this chart:

- Only in 2007, when well #3 was in service, was there enough reserve capacity to satisfy a peak day with a well out of service. (The green line compared to the red bars.)
- With the decline in well #5 capacity in 2017-18, we can no longer meet the planning demand of 400 gallons per house per day. (The blue line compared to the blue bars.)
- With wells #3, #5, and #6 all in service, capacity exceeds demand estimate out to 2028, and beyond.
- Additional well #3 capacity (say 150 gpm rather than 125 gpm) is not needed for one or two decades, as longs as wells #5 and #6 stay in service. See section "Upgraded Well #3 and New Arsenic Treatment Facility Capacity", below.
- The margin between fallback capacity and peak day demand starts approaching zero in 2028. If demand is as projected, ways to improve the margin would be to increase well #5 and/or well #6 capacity back to their original values, which may not be possible with drop in water level, or a new well.
- There is some “hidden” reserve to the extent that actual demand is below the assumed gallons per house per day. That was equivalent to 31 gpm in June 2018, since actual demand was only 320 gallons per house per day, requiring only 122 gpm rather than the 153 gpm needed to meet 400 gallons per house per day.
- This chart does not reflect any improvement in the lifetimes of wells #5 and #6 as of result of them being used less. There is most probably a positive effect, but it is difficult to estimate.
- Unless one of the wells fails or declines more than estimated, there is not a need for a well #7 in this time frame.
- Forecast for additional houses is consistent with 2007-2018 growth.

Annual Water Demand

Using the historical average annual gallons per house per day demand shown in Table 2, above (243 gallons per house per day), the actual and forecast total gallons pumped per year from 2018 to 2028, along with the corresponding acre feet (325,851 gallons), are shown in Figure 29.

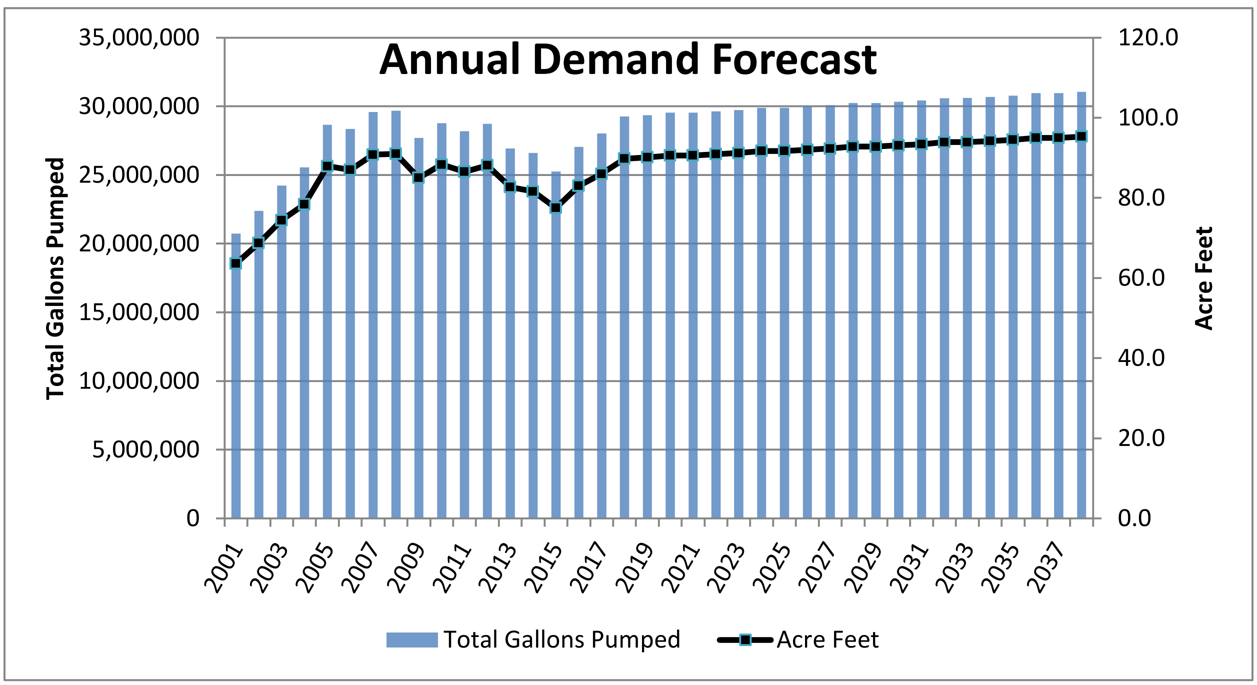

Figure 29 – Historical and Forecast Gallons Pumped per Year, 2001 - 2038

Observations from this chart:

- The forecast, based on the average over the past 17 years, is probably high, since it does not reflect the general lowering trend in the past decade.

- The forecast is also probably high since projected total gallons pumped each year is based on a constant historical demand of 243 gallons per house per day, which incorporates historical "unaccounted for" water demand. New house construction should not increase the annual "unaccounted for" water volume, and consequently future demand in terms of gallons per house per day should decrease.
- Because not many new houses are expected, total gallons per year will probably stay in the 27 million to 32 million range.

Water Rights

The estimate of 32,551,000 gallons to be pumped in 2055 (367 houses, all lots built on) is 99.9 acre feet, substantially less than the rights to 118 acre feet owned by the Cooperative. If new houses are built faster than the assumed one per year, we reach this level sooner, but the annual water pumped would be the same.

Alternatives

The immediate need is to increase reserve capacity to meet demand if either well #5 or #6 is out of service for more than a few days during the summer. This issue has been extensively considered ever since the tighter arsenic rule was announced and well #3 could not be used.

Mix Water

When the situation is first explained, many people immediately ask if the high arsenic well #3 water can be mixed with low arsenic water. New Mexico and EPA regulations allow for blending; Albuquerque does this to some extent. The "2008 Water Use Analysis and Options Evaluation" has an extensive discussion of the blending option, and explains why it is not feasible for the Cooperative:

- The existing "plumbing" does not support mixing. Each well, and the tanks "float" on the distribution pipes. (See Figure 19, above.) So water from well #3 first goes to Sundance Mesa houses and excess goes into the tanks. There are not pipes that run directly from any of the wells to the tanks.
- More important, we do not have enough low arsenic water to blend with well #3 water. For example with well #5 at 7 ppb and well #3 at 27 ppb, it would require nine gallons from well #5 mixed with one gallon from well #3 to produce 9 ppb water. In the summer, when well #3 water is needed, there is little surplus water to blend. In the winter, when there is available low arsenic water, well #3 is not needed.

Drill a New Well

A new well is always a possibility, and may be needed in the ten to thirty year timeframe. The question is where, how much water can we expect, and what arsenic level. In Placitas, and specifically in the La Mesa and Sundance Mesa area, the closer to the Rio Grande, the more water is available. At the same time, arsenic level increases closer to the river. Well #5 hit the "sweet spot" – good water production that is just under the arsenic limit. Well #6 was drilled next to and deeper than well #1; water production came out very close to expectation, without any excess. There are not any obvious locations that are likely to produce adequate low arsenic water.

Household Treatment such as Reverse Osmosis

The EPA and New Mexico arsenic regulations allow for what are called "Point Of Use" (POU) treatment systems. The most common are reverse osmosis (RO) systems installed, such as under a kitchen sink, to supply treated water just for drinking and cooking. This is appealing because almost all the high summer demand water goes to landscaping, which does not need low arsenic water. However, New Mexico regulations only allow POU to meet the arsenic rule for water utilities having 100 or fewer users.

Use Well #3 Water Only for Landscaping

Since the bulk of summer water demand goes to landscaping, is there some way to use untreated well #3 water for landscaping and reduce demand for low arsenic water? In short, not easily. The Cooperative distribution system has a single set of pipes, with a single service connection to each house. So without re-plumbing the entire neighborhood, there is not a way to pipe two sources of water to each house. An alternative would be to truck water, but since most homeowners run watering systems several times each week in the summer, water deliveries would have to be made several times a day throughout the neighborhood.

Water Conservation

One question that comes up is: "Could we avoid the need the well #3 treatment through water conservation?" The short answer is, very unlikely. We would have to reduce peak month demand by about two thirds – what well #6 could supply by itself. The Cooperative already has in place a number of things to encourage water conservation:

- Pricing – For years, water rates have been very progressive, i.e. much higher charges for high use.
- Individual monitoring - Smart water meters have been installed at every house as of May 2018.
- System metrics and house meters are checked every day to detect and handle problems.
- WaterGram newsletters are regularly distributed with conservation pointers.
- The Cooperative website has a page on water conservation, with links to other useful sites.
- The Member Handbook provides basic information to help with water conservation.

Water Treatment for Well #3 Water

The remaining alternative is to install and operate a treatment facility for well #3 to reduce arsenic to an acceptable level. This is what all of the water systems in the lower (western) part of Placitas have done, as well as Bernalillo and Santa Anna. And that is why we are designing the well #3 arsenic treatment facility.

Upgraded Well #3 and New Arsenic Treatment Facility Capacity

The Well #3 project consists of two major changes:

- Refurbish well #3 by cleaning, inspecting, and replacing the pump, motor, and rotary phase convertor with a solid state Variable Frequency Drive (VFD).
- Construct an arsenic treatment facility in a new building at the well #3 site (by purchasing part of the existing lot).

The capacity of the refurbished well #3 and associated treatment facility is based on what the well could produce, and the system demand. The #3 well completion report (April 1998) states the well could provide up to 250 gpm for 20 years. At full buildout, in 25 or 35 years, and with stable demand (in terms of gallons per house per day), the demand forecast (see Table 8, above) is that we will need 170 gpm to meet peak month demand at the target 60% duty cycle, and 127 gpm to meet demand on a peak day, running at 100% duty cycle.

Rather than immediately adding capacity that will not be needed for decades (if ever), the well #3 project specifies two different design capacity values:

- Medium life (10 years or less) components: 125 gpm
    - Well pump, motor, and VFD
    - Filters, sand separator, etc.
    - Arsenic treatment vessels, piping, and associated valves
    - Chemical and pH adjustment equipment
    - Storage tanks
    - Booster pumps
    - Meters and instrumentation
- Long life (over 10 years) components: 150 gpm
    - Building size and equipment layout
    - Underground and building piping and valves
    - Connection to distribution system

In the long term, this provides an arsenic treatment facility that could support the entire Cooperative, without either well #5 or #6. Doing that may not be prudent, because that makes the facility a single point of failure, although that is how neighboring systems (Anasazi, Desert / Sky Mountain, Placitas West, etc.) operate. Keeping well #5 and/or #6 in operation would maintain redundancy and resiliency.

Based on the Well #3 completion report, and experience running it ten years ago, it is not likely to run out of water. It is more likely to fail or become unusable if the screen or casing corrode. In that case, a new well #7 could be drilled in the same area, and probably would have similar characteristics: good water flow and moderate levels of arsenic. This could feed into the planned arsenic treatment facility. We would not want to be dependent on either well #3 or a new #7 providing all the required water, to maintain redundancy and resilience.

Load Balancing Across Three Wells

With three wells in operation, there are several alternative schemes for sharing the load.

- “Equal share” – All wells are turned on and off based on the tank level (as done today), so each contributes its “normal” capacity.
- Minimal use of #3 – Set the well control system so that well #3 is used regularly, but not at its full capacity.
- Optimized costs – Based on the marginal operating cost of each well, set the load balance to minimize overall costs.

Table 8 shows example of how the first two alternatives could work, using an arbitrary date of 2020 demand estimates, and an arbitrary 10% for well #3 (upgraded to 125 gpm). Since well #3 with a treatment facility will undoubtedly have operational costs higher than #5, it is hard to imagine a scenario where well #3 would be used to provide more than an "equal share" for a period more than a month or two.

	Well #5	**Well #6**	**Well #3 Treatment**	**Total**
2020 gpm Estimate	98	52	125	274
equal share percent	36%	19%	45%	100%
equal share gallons	10,587,322	5,585,671	13,516,007	29,689,000
minimal #3 use percent	59%	31%	10%	100%
minimal #3 use gallons	17,491,772	9,228,328	2,968,900	29,689,000

Table 9 – Load Balancing

Contingency Plans

Until a treatment facility for well #3 is operational, there are several plans to handle an outage of either well #5 or #6.

- Extend the runtime of the functioning well beyond the planned 60% duty cycle.
- Ask the community for immediate short term conservation.
- Use available spare parts – the Cooperative has a spare motor and pump for each well, since these have long lead times.
- Put well #3 into service on a temporary basis, recognizing that would go against the spirit of the arsenic rule. It is not clear if this would incur a violation, which is based on a running average of four quarterly samples. Members would be advised to use bottled water if they do not already have a reverse osmosis system.
- There is an informal agreement with the neighboring North Los Ranchos Water District to share water on an emergency basis. Since that is a much smaller system, they could not supply water in the amount we would need for more than a few days.

Recommendations

1. Put into operation an arsenic treatment facility for well #3 at 125 gpm capacity.
2. Upgrade well #3 to increase capacity and extend life.
3. Identify and fix whatever has caused well #5 capacity to decrease more than expected.

References

La Mesa Water Coop

Water Supply Plans

- “Revised Long-Term Projections of LMWC Water Requirements”, [2007]
  http://lamesawatercoop.org/misc_files/2007 Water Use Analysis (Revised).pdf
- “2008 Water Use Analysis and Options Evaluation”,
  http://lamesawatercoop.org/misc_files/2008 Water Use Analysis 081013doc.pdf
- “Water Supply Planning Committee Report”, [2009]
  http://lamesawatercoop.org/misc_files/WaterSupplyPlanning Report.pdf
- “Water Supply Options Analysis – 2009”
  http://lamesawatercoop.org/misc_files/2009-Water-Study-Rv-090630.pdf
- “Water Supply/Demand Analysis – 2010”
  http://lamesawatercoop.org/misc_files/2010-Water-Study.pdf
- “La Mesa Water Coop, Water Supply Plan”, 12-1-2011
  http://lamesawatercoop.org/misc_files/Water_Supply_Plan_2011_12_01.pdf
- La Mesa Water Coop, Water Supply Plan”, 12-1-2012
  http://lamesawatercoop.org/misc_files/Water_Supply_Plan_2012_12_01.pdf
- La Mesa Water Coop, Water Supply Plan”, 12-29-2015
  http://lamesawatercoop.org/misc_files/Water_Supply_Plan_2015_12_29.pdf

Well Completion Reports

- "summary report for La Mesa Supplemental Well 3, RG 49802-S-2", John Shomaker & Associated, Inc., April 17, 1998
- #5
- "Well Report: La Mesa Well No. 6", RG-49802-POD8", John Shomaker & Associated, Inc., December 2012

American Water Works Association (AWWA)

- Distribution System Requirements for Fire Protection, AWWA MANUAL M31, Fourth Edition, 2008
  https://www.awwa.org/store/productdetail.aspx?productid=6720

New Mexico Environment Department (NMED), Drinking Water Bureau (DWB)

https://www.env.nm.gov/dwb/index.htm

- Drinking Water Regulations, 20.7.10 NMAC (revised January 6, 2013)
  http://www.nmenv.state.nm.us/dwb/regulations/documents/DrinkingWaterRegulations2013.pdf
- Recommended Standards for Water Facilities, 2006 Edition
  https://www.env.nm.gov/cpb/NMED%20Water%20Standards_2006%20Rev.pdf

New Mexico Bureau of Geology and Mineral Resources

https://geoinfo.nmt.edu/

- Peggy S. Johnson and Andrew Campbell, August 2002, Updated January 2008, Hydrogeology and Water Resources of the Placitas Area, Sandoval County, New Mexico: New Mexico Bureau of Geology and Mineral Resources, Open-file 469
  https://geoinfo.nmt.edu/publications/openfile/details.cfml?volume=469 (Full report)
  http://www.sandovalcounty.com/uploads/Downloads/Divisions/PlanningZoning/WaterStudies/johnsontotal.pdf (Summary)

Sources

Figure 1 – Historical and Forecast Demand and Capacity, 2002 - 2028	LMWC_Wells_Forecast_2018_09_25.xlsx
Figure 2 – Water Demand Categories	(this document)
Figure 3 – Annual Demand	LMWC_Well_Meter_Readings_2018_08_03.xlsx
Figure 4 – Gallons Pumped and Billed	LMWC_Well_Meter_Readings_2018_08_03.xlsx
Figure 5 – Estimated Daily Demand, June 1 – July 7, 2018	LMWC_Daily_2018_06_01-30.xlsx
Figure 6 – Estimated Hourly Demand	LMWC_Daily_2018_06_01-30.xlsx
Figure 7 – Hourly Demand on June 29, 2018	LMWC_Daily_2018_06_01-30.xlsx
Figure 8 – Hourly Demand on July 4, 2018	LMWC_Daily_2018_06_01-30.xlsx
Figure 9 – Average Gallons Billed per House per Day, by Percentile	LMWC_Usage_estimate_2018_07_23.xlsx
Figure 10 – Histogram of Water Demand, January 2018	LMWC_Usage_estimate_2018_07_23.xlsx
Figure 11 – Histogram of Water Demand, June 2015, 2016, 2017 & 2018	LMWC_Usage_estimate_2018_07_23.xlsx
Figure 12 –Unintended Water Use Events for One Example House, 2010 - 2017	Usage_2010-01_2018-08_w_macro
Figure 13 – Wasted Water Events, 2010 - 2018	LMWC_Wasted_2018_07_23.xlsx
Figure 14 – Volume and Number of Wasted Water Events	LMWC_Wasted_2018_07_23.xlsx
Figure 15 – Gallons Wasted Compared to Gallons Pumped in Peak Months 2010 - 2018	LMWC_Wasted_2018_07_23.xlsx
Figure 16 – Water Used by Top Users in Peak Months, 2010 - 2018	LMWC_Top_Use_2018_07_23.xlsx
Figure 17 – Unbilled Water in Peak Months, 2010 - 218	LMWC_Wasted_2018_07_23.xlsx
Figure 18 – Water Pumped in Peak Months, 2001 - 2018	LMWC_Well_Meter_Readings_2018_08_03.xlsx
Figure 19 – Schematic of Water Cooperative Key Components	LMWC_Schematic_05.xar
Figure 20 – La Mesa Cooperative Wells, July 2018	LMWC_Wells_Forecast_2018_09_25.xlsx
Figure 21 – Well #5 Static and Pumping Levels from Well Tests, 2007 - 2018	LMWC_Wells_Forecast_2018_09_25.xlsx
Figure 22 – Well #6 Static and Pumping Levels from Well Tests, 2014 - 2018	LMWC_Wells_Forecast_2018_09_25.xlsx
Figure 23 – Well #5 Static and Pumping Water Levels from Transducer, 2/2017 – 7/2018	LMWC_Wells_Forecast_2018_09_25.xlsx
Figure 24 – Well #6 Static and Pumping Water Levels from Transducer, 12/2016 – 7/2018	LMWC_Wells_Forecast_2018_09_25.xlsx
Figure 25 – Monthly Average Demand and Well Capacity, 1/2005 – 6/2018	LMWC_Well_Meter_Readings_2018_08_03.xlsx
Figure 26 – Well #5 Duty Cycle, 2/2017 – 7/2018	LMWC_Well_5_Mission_data_macro_07e_2018_08.xlsm
Figure 27 – Well #6 Duty Cycle, 1/2017 – 7/2018	LMWC_Well_6_Mission_data_macro_07b_2018_08c.xlsm
Figure 28 – Historical and Projected Demand and Capacity, 2002 - 20228	LMWC_Wells_Forecast_2018_09_25.xlsx
Figure 29 – Historical and Forecast Gallons Pumped per Year, 2001 - 20	LMWC_Wells_Forecast_2018_09_25.xlsx

Table 1 – Numbers of Houses and Lots as of September 2018	LMWC_AlertList.xlsx
Table 2 – Yearly Gallons Pumped, and Average Gallons Pumped per House and per Capita per Day	LMWC_Well_Meter_Readings_2018_08_03.xlsx
Table 3 – Estimated Daily Demand, June 1 – July 7, 2018	LMWC_Daily_2018_06_01-30.xlsx
Table 4 – Estimated gpm by Zone on Peak Days	LMWC_Daily_2018_06_01-30.xlsx
Table 5 –Demand in Peaks Months, 2001 - 2018	LMWC_Well_Meter_Readings_2018_08_03.xlsx
Table 6 – La Mesa Water Cooperative Wells	LMWC_Wells_Forecast_2018_09_25.xlsx
Table 7 – Possible Demand Planning Values	LMWC_Well_Meter_Readings_2018_08_03.xlsx
Table 8 – Load Balancing	