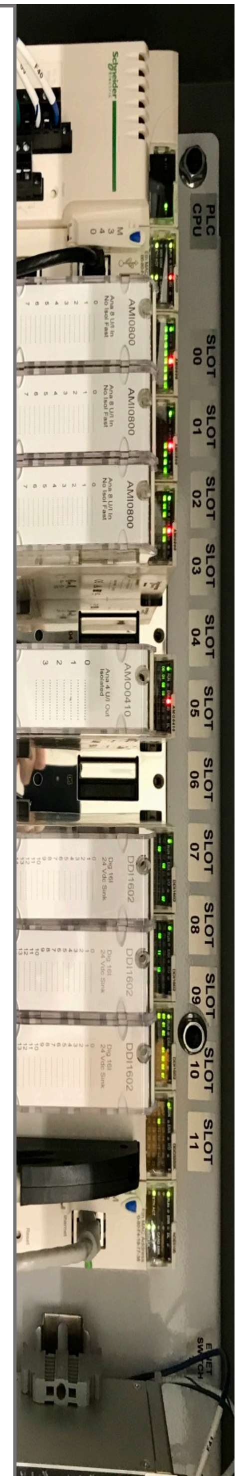
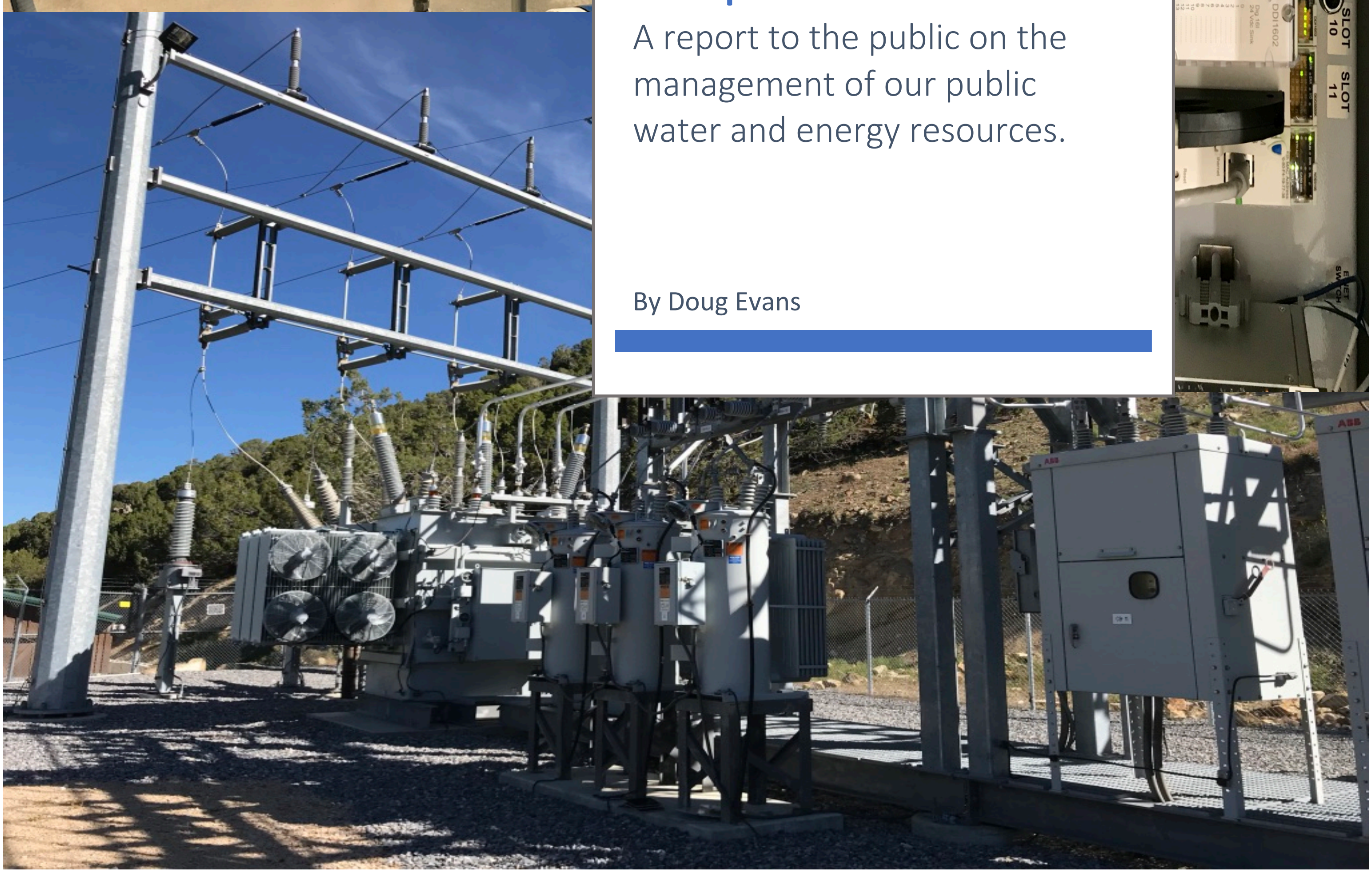
Mountain Regional Water
Special Service District

2018 Water and Energy Report

A report to the public on the management of our public water and energy resources.

By Doug Evans





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1.0 Introduction

Mountain Regional Water District (the District) is proud to present to the public and our valuable customer base our 2018 Water and Energy Report. This is an annual effort to present the work we have done the past year in fulfilling our vital water and energy mission and stewardship. The Mission and Vision Statements of the District are as follows:

MISSION:
To provide high-quality water and exceptional service in a safe, reliable, efficient, and sustainable manner.

VISION:
Mountain Regional Water District will continue to be a recognized model for regional water resource quality and innovation. We will be respected and trusted by our customers and stakeholders for our leadership in delivering sustainable water services to the thriving communities within our secure stewardship. We will become more responsive while providing safe and reliable water services that meet or exceed all current and future regulatory demands. And we will strive to honor our fiscal, human resources, and caring attention given to every single person we encounter.

In our continuing efforts to meet or exceed these values, we believe that the District has done a masterful job of delivering vital water resources to its customers in the Western Region of Summit County since its beginning in the year 2000. At that period the Snyderville Basin area was suffering from numerous water quality and quantity issues. Through an arduous regionalization effort of combining many small systems, applying our strategic economies of scale and operational excellence, reliable water service has been achieved with sustainability at the core of its mission.

Even though the District functions in a high desert water starved area—one which was fairly late in the development game, by utilizing the intellect and innovation of District staff and consultants, the region has become a leader in water development, water quality, and efficiencies of delivery.

This brief 2018 Water and Energy Report is designed to paint a clear and relevant picture of the District water system's physical, managerial, and operational capacity, which leads to its ability to deliver and service the challenging water needs of Western Summit County. Words are primarily replaced in this document with more charts and tables which we believe deliver a better understanding of the history, current function, and trends guiding us into an exciting future.

If you would like to learn more about the District and its operation, please visit the District's web site at mtregional.org for a more detailed narrative and resource of information.

2.0 Water Infrastructure Scope and Capacity

The water system of Mountain Regional Water District (the District) is extremely complex and covers a scope and geography that can be particularly challenging. An efficient and high quality of service is key to maintaining public trust and remaining viable. Efficiencies are regularly suggested by staff and implemented when they are found to be practical and economical. A brief review of the District water system capacity and delivery metrics is shown below:

KEY SYSTEM METRICS:

- Approximately 6,000 customers with 4,300 active connections
- Area: 40 square miles
- 10.5 million gallons delivered on a peak day
- 6,500 acre-feet of water delivered annually
- 10,000 gallons per minute ("GPM") capacity at the Lost Canyon pump station
- 4 million gallons per day ("MGD") capacity water treatment plant
- 18 groundwater wells and 1 groundwater spring
- Over 200 miles of pipe
- 24 storage reservoirs
- 13,000,000 gallons of raw water storage
- 39 water pressure zones
- 30,000 GPM total water pumping capacity
- 80 Pressure Reducing Stations ("PRVs")
- 5 Disinfection Plants
- More than 1,500 fire hydrants
- 9,000 acre-feet of Water Rights
- 10.7 million gallons of drinking water stored which equates to:
  ~172,000 citizen days and ~15 district days

KEY ENERGY METRICS:

- 140 pumps spread over 44 remote sites
- A pumping elevation which spans from 6,000' to 9,300'
- 9,400 horsepower in electric motors for pumping
- 140 kw Hydro Generation Energy Recovery Facility
- 3.34 billion gallons pumped in 2018
- 10.49 million Kilowatt Hours ("kWh") of Energy used in 2018

3.0 The District's Customer Level of Service Standard

In order to properly service any customer with a safe and secure water service, a supplier, must establish and follow certain Levels of Service (LoS) which can reliably supply a customer through varying conditions of climate or other emergencies, such as a fire or natural disaster.

The District furnishes water to its customers at quality levels exceeding State of Utah and Federal requirements. Water quality must comply with strict, ever changing and increasing standards. See the 2018 District Consumer Confidence Report at mtregional.org/ccr for more information regarding our water quality standards, including compliance and outreach.

The District has established a set amount of resources, or Level of Service which must be provided to each customer. To better define a standardized customer, we create a unit known as an Equivalent Residential Connection, or ERC. An ERC unit is based upon the average residential customer of the District. All other customers, such as very large residences, commercial, industrial, institutional, recreational, etc. are rated in capacity demands upon our water system, by how many ERC units of impact they represent. For example, a certain sized (seats) restaurant, may be assigned an impact value of 7.5 ERC's. Again—a typical home would simply be 1.0 ERC's.

There are four quantity or sizing elements (beyond water quality), which must be met to service one ERC. They are:

WATER RIGHTS: The amount of legal water rights in a source of water needed to annually service current and future ERC's of the District. This value is 0.50 and is measured in Acre-Feet per year.

WATER SOURCE: The amount of water source capacity needed by an ERC, as averaged over a peak demand day (mid-summer) of the year. This value is 0.79 and is measured in Gallons per Minute (GPM).

WATER STORAGE: The amount of water storage (reservoir) capacity needed by an ERC to meet the peak instantaneous demand in the peak day, as well as storage for emergencies, such as fires, etc. This value is 1,000 and is measured in Gallons (GALS).

WATER DISTRIBUTION: The amount of water distribution (underground pipelines and hydrants) capacity needed to service an ERC with water flows which meet peak instantaneous and firefighting flows, while maintaining a minimum pressure of 20 psi at that moment. This value is 1.44 and is measured in Gallons per Minute (GPM), as a daily average value. In an emergency, as much as 2,000 GPM must be deliverable to any ERC or customer within the District's distribution system.

LEVEL OF SERVICE ELEMENT	Standard	Unit per ERC
Water Right	**0.50**	**Acre-Feet**
Water Source	**0.79**	**GPM**
Water Storage	**1,000**	**Gallons**
Water Distribution	**1.44**	**GPM**

Table 1 - District Level of Service Standards

4.0 Water Supply and Demand Report

2018 was the driest year on record, and as such, water production was the highest since the formation of the District in 2000. Chart 1 shows the monthly Palmer Drought Severity Index (PDSI) for the NE Utah Region since 2000. The 2018 average was -3.69. Negatives represent dry months.

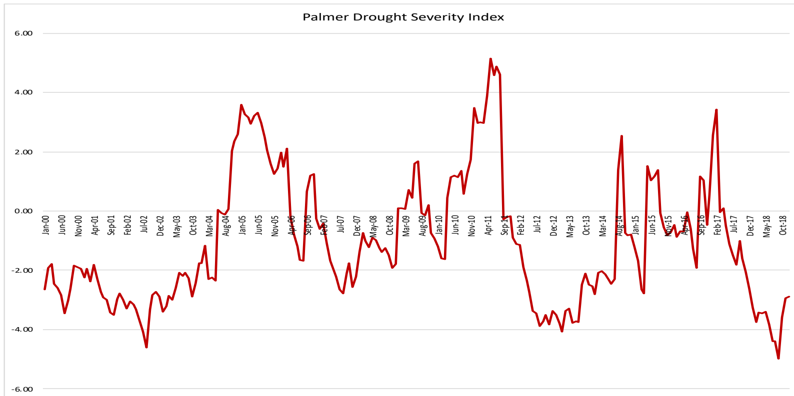

Chart 1 - Drought Severity Index

For the year 2018, water production by source in million gallons (MG) is listed in Table 2 below. This table also includes production which supplies Park City, and any other wholesale customers.

SOURCE	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTAL
Well 15b	18.486	16.059	-	4.759	0.326	5.621	14.784	47.307	20.907	29.924	9.250	-	**167.423**
Silver Creek Well 10	-	0.664	-	0.006	0.157	2.116	7.638	9.912	9.677	5.064	1.298	0.467	**36.999**
Jailhouse Well 3	-	-	-	0.005	-	-	0.079	0.232	0.142	0.029	-	-	**0.487**
Atkinson Well 2	-	-	-	-	-	-	3.525	8.395	2.844	1.075	-	2.182	**18.021**
3 Mile Well	-	-	-	-	-	5.552	5.210	4.489	5.456	4.640	3.369	4.802	**33.518**
Lost Canyon BPS Source	104.285	108.693	72.462	81.814	89.601	165.935	183.309	193.759	201.389	131.134	38.239	117.018	**1,487.638**
Spring Creek Spring	3.921	3.563	4.776	5.287	4.735	16.024	11.679	7.398	5.837	4.083	4.558	4.963	**76.824**
Lake Well 1	0.022	-	-	0.083	1.131	5.297	5.525	6.124	7.109	3.510	2.248	1.624	**32.673**
Well 15c (Bison Bluffs Well)	21.116	11.572	9.129	0.117	3.599	13.989	28.000	0.004	30.567	4.716	21.044	28.576	**172.429**
SWDC Interconnect (Sportspark)	1.359	2.707	0.350	-	1.175	1.163	2.006	2.859	2.900	1.553	2.323	5.928	**24.323**
Nugget Well	0.725	0.148	-	-	-	0.027	3.793	4.734	2.984	0.988	4.836	7.270	**25.505**
Blackhawk Well 2R	-	-	-	-	-	0.012	0.168	0.156	0.148	0.060	-	0.037	**0.582**
Gorgoza Well 6	1.177	0.330	-	-	-	0.152	4.572	5.828	3.576	1.534	4.633	3.630	**25.432**
Summit Park Well 7	0.315	0.379	0.296	0.239	0.126	0.384	0.384	0.352	0.306	0.288	0.526	0.919	**4.757**
TOTALS:	**151.406**	**144.115**	**87.013**	**92.310**	**100.850**	**216.516**	**270.672**	**291.549**	**293.842**	**188.598**	**92.324**	**177.416**	**2,106.611**

Table 2 - 2018 Water Production by Source

Chart 2 below, displays graphically the monthly profile and production of each water source:

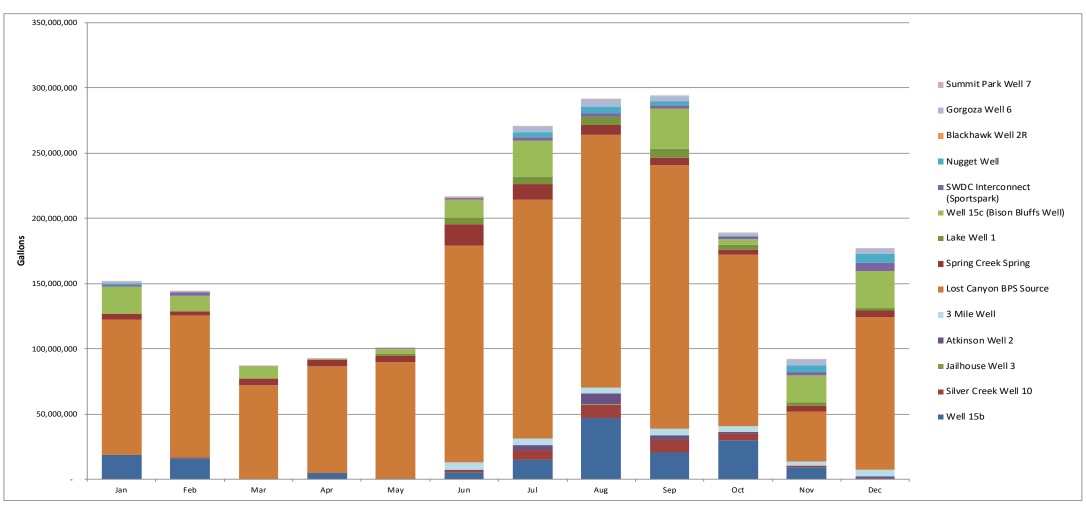

Chart 2 - Production Profiles by Source

Chart 3 shows the total water production by year since 2000 in acre feet and is further divided into the four largest delivery types of service. The total production for 2018 was 6,465 acre-feet.

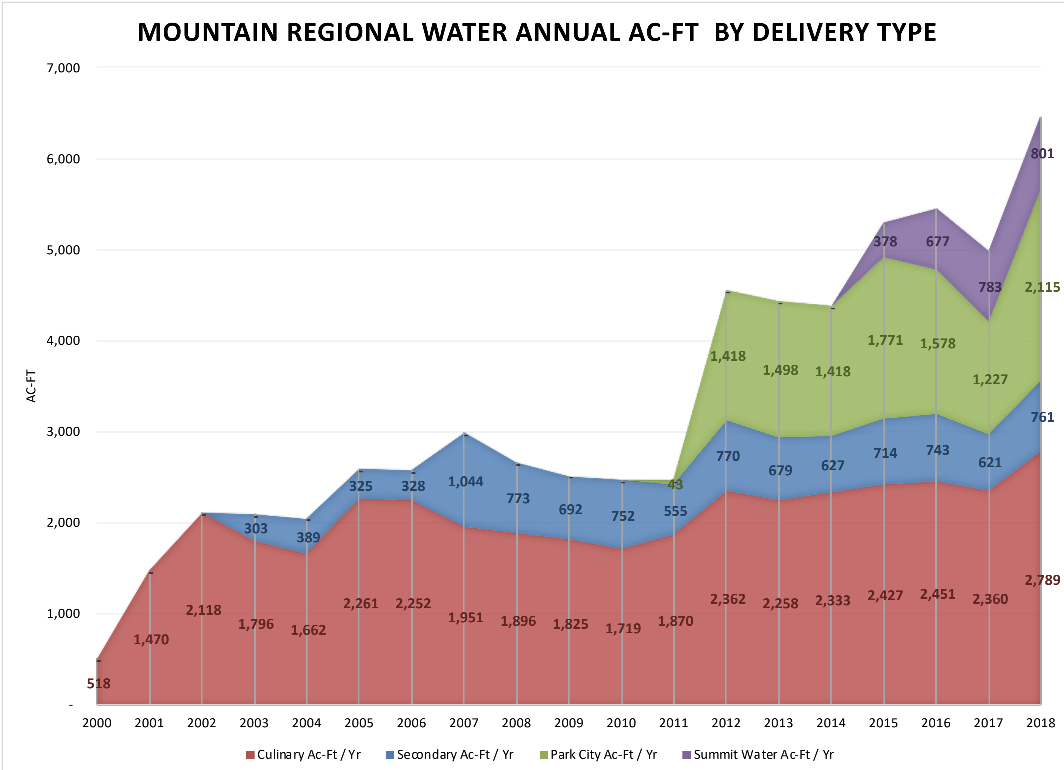

Chart 3 - Annual Production and Delivery by Year and Type

The monthly water source supply or production since 2000 is now overlaid below by the District customer demands (customer use) for the same periods in gallons and is displayed on Chart 4:

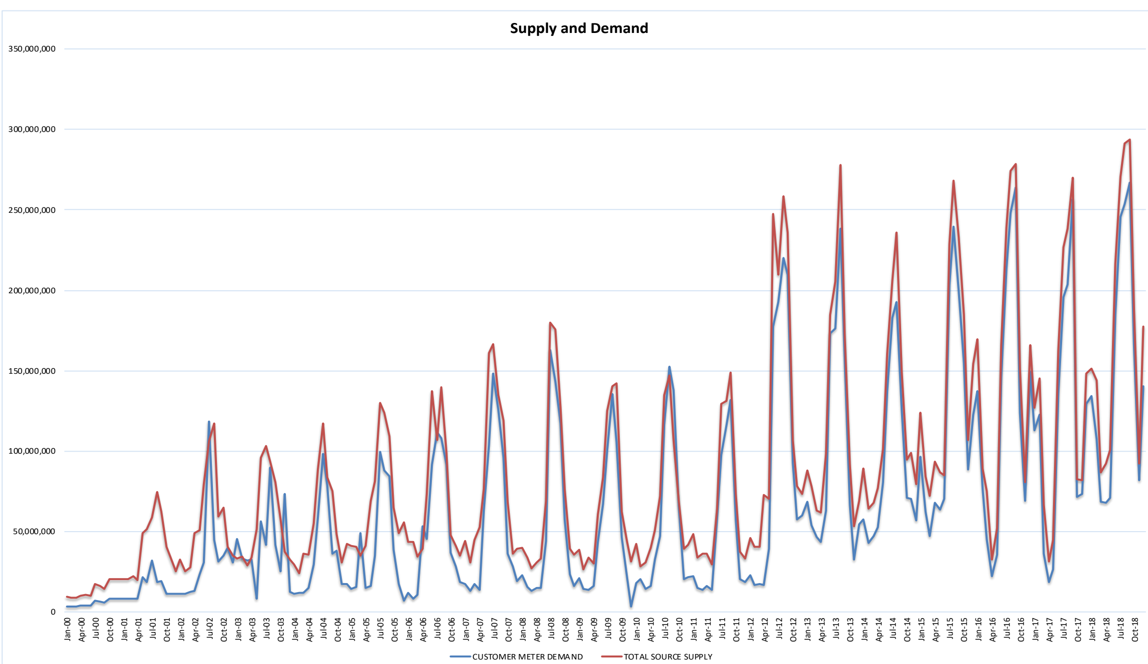

Chart 4 - Annual Supply and Demand in Gallons

Charts 5 and 6 below show the annual water pumped each year. Source pumping totaled 2,106,611 gallons in 2018, while water pumped by distribution boosting facilities totaled 1,235,903 gallons. In 2018, 63% of water moved originated from sources while 37% was used in other boosting.

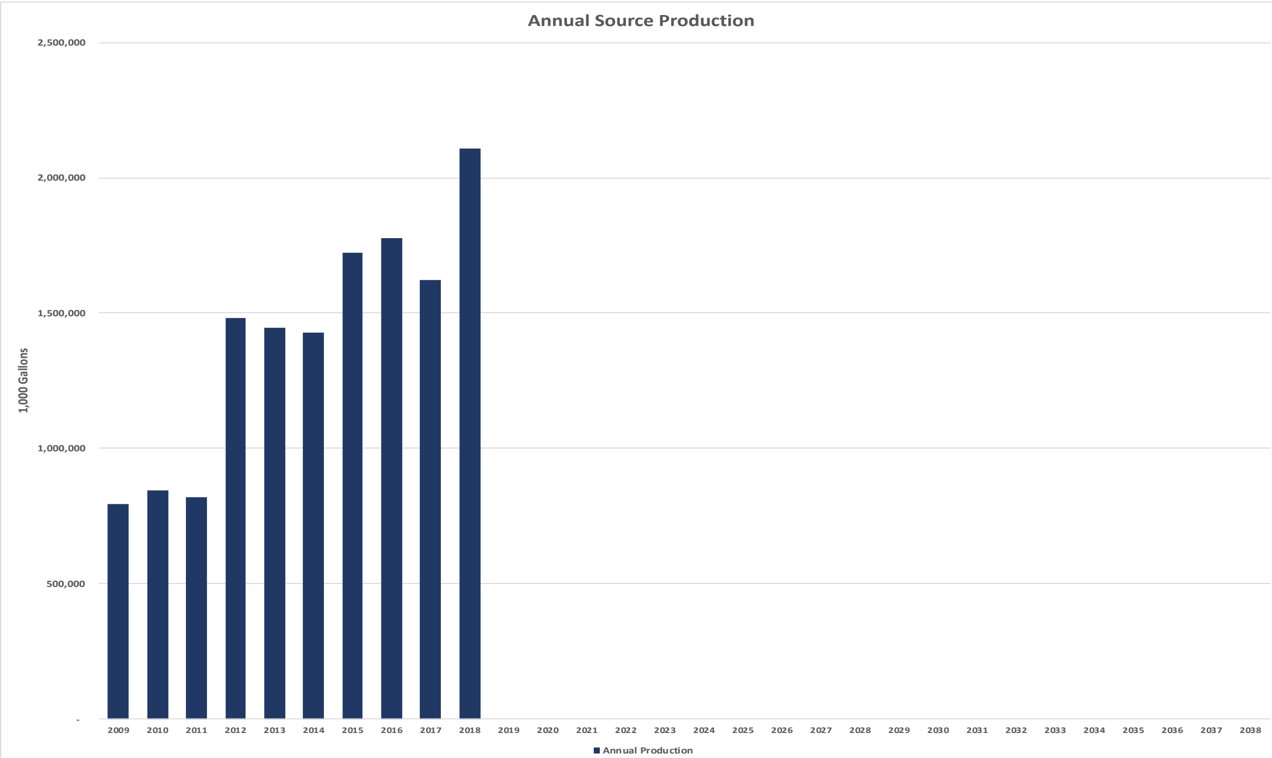

Chart 5 - Annual Water Source Pumped Production

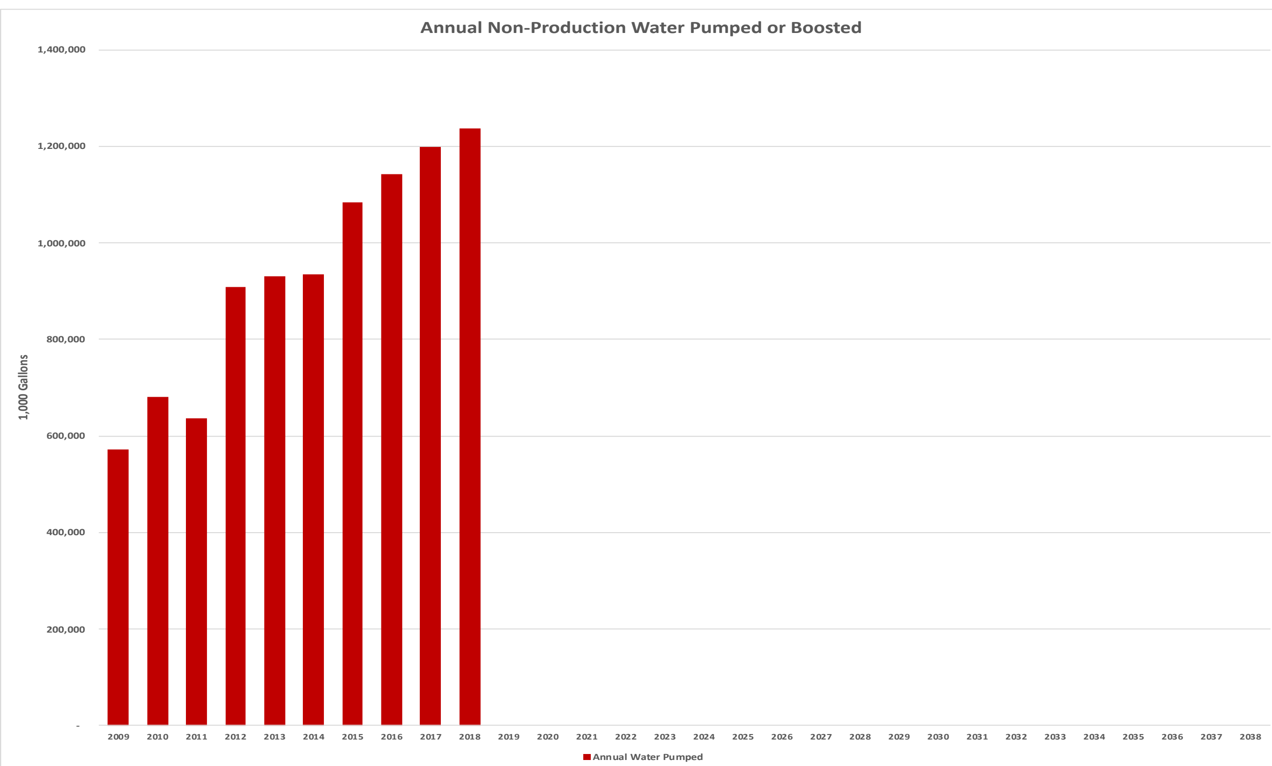

Chart 6 - Annual Non-Source Water Pumped

Unaccounted for water (including losses) of the District become the difference between the supply (production), and the customer demands (metered usages). Chart 7 below shows the total monthly losses since 2000 as a percent of production and a total in gallons using a 12 month running average. The District is continually working to identify and reduce any unaccounted for water.

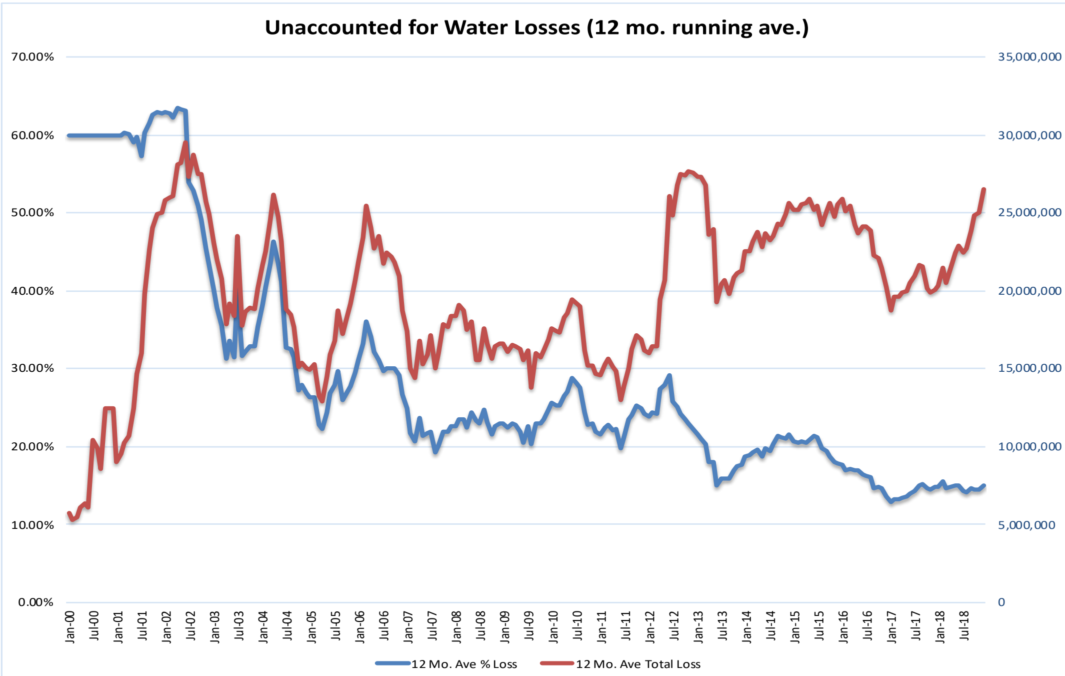

Chart 7 - Monthly Unaccounted for Water

Chart 8 represents the effects of water conservation programs and education over time by the District on residential Equivalent Residential Connections (ERC) under the four (4) types of residential customers. Some large residential customers may have more than one ERC per residence due to their size and capacity demands on the water system.

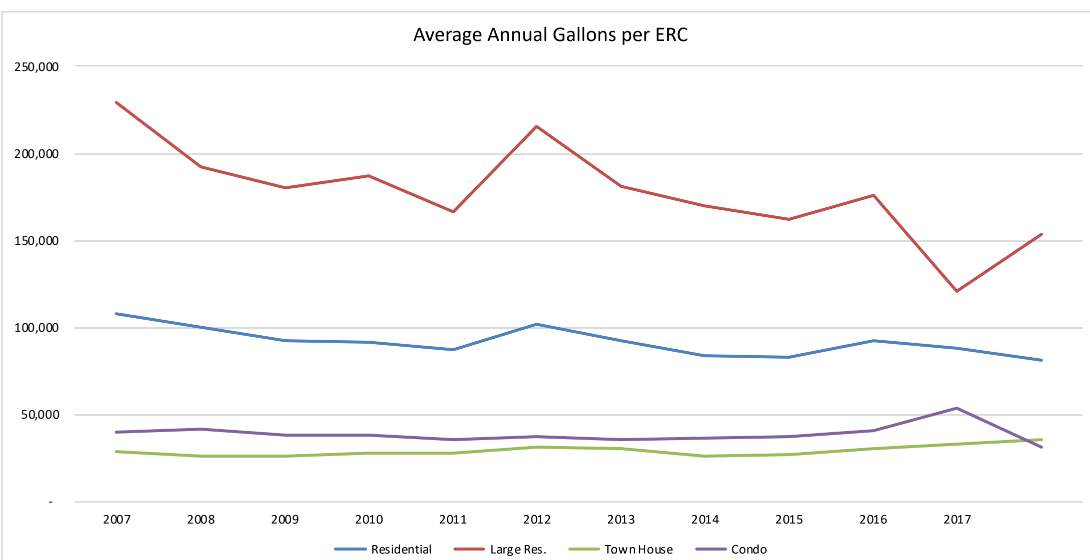

Chart 8 - Average Annual Gallons per ERC

Chart 9 below examines only the demand (customer meter) side and shows the base rate revenue plus the overage block revenue each month as derived from the District's utility billing system. The total customer meter demands in thousands of gallons per month is also overlaid with green line.

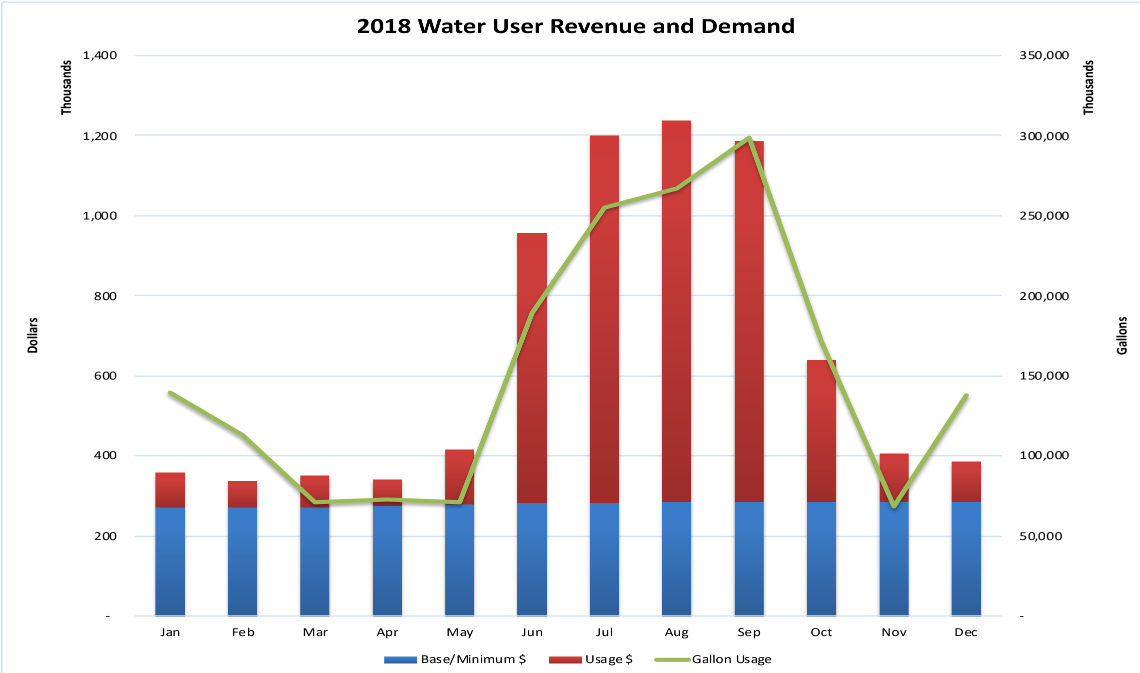

Chart 9 - 2018 Water User Revenue Compared to Demand

Finally—while Chart 10 below may appear difficult to read, it shows more visually the DAILY production for 2018 by Total Retail (light green), Raw Irrigation in Promontory (blue), Park City wholesale raw delivery (yellow), and Summit Water Distribution wholesale delivery (dark green). This chart clearly shows the annual profile(s) and demands of each type of water delivery.

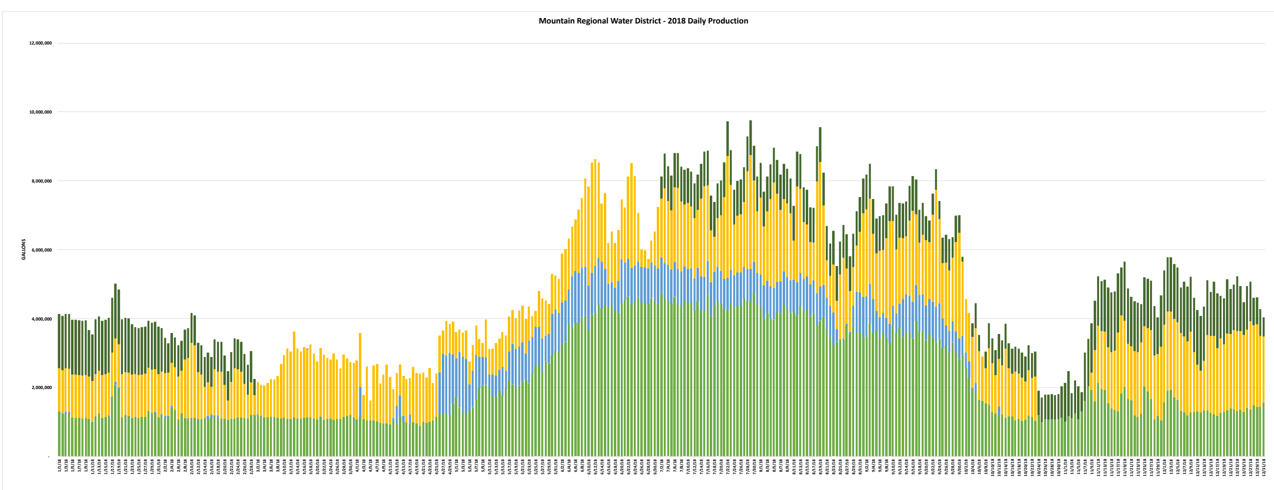

Chart 10 - Daily Production for 2018

The peaking factor of water source production for the year 2018 (the ratio of average annual production to peak day production, averaged by month) is 1.67 for all District water produced and 1.95 for the segment of water deliveries attributed to only the District's retail customers.

5.0 Energy and Power Report

Energy and Power represent one of the largest direct costs of the District's water delivery system. This section focuses on the quantities of energy and power as related to the water production and delivery in the overall distribution system and shows visually the District's efficiency initiatives.

Every gallon of water pumped, whether from a source (well) or to boost it higher up the mountain, consumes energy and uses power. The amount of energy and power is dependent upon the volume of water moved and the head or elevation in feet (pressure) which it must be boosted up to. Large electrical consumers like us, are billed for both energy and power, and any particular pumping account could amount to half of its total bill for energy and half for power.

To understand energy and power, more simply stated, energy is likened to the gallons of gas you consume in your car to get from one place to another. Power is more like the peak speed you traveled in that trip (the maximum horsepower), even if for a very short amount of time. Energy is consumed in the process as the common unit Kilowatt Hours (kWh), Power is the amount of peak capacity a utility must size infrastructure to deliver a needed peak, which is often measured in units such as Horsepower (hp), or more properly in an electrical utility—as Kilowatts (kW).

Chart 11 below shows the annual pumping costs overlaid by the millions of gallons pumped annually. Pumped gallons in all charts means water pumped from a source AND further boosted in a distribution system if necessary. The closer the red and blue lines approach at the top, the more efficient in a rough view, the overall system has become at a pumping unit per an energy unit.

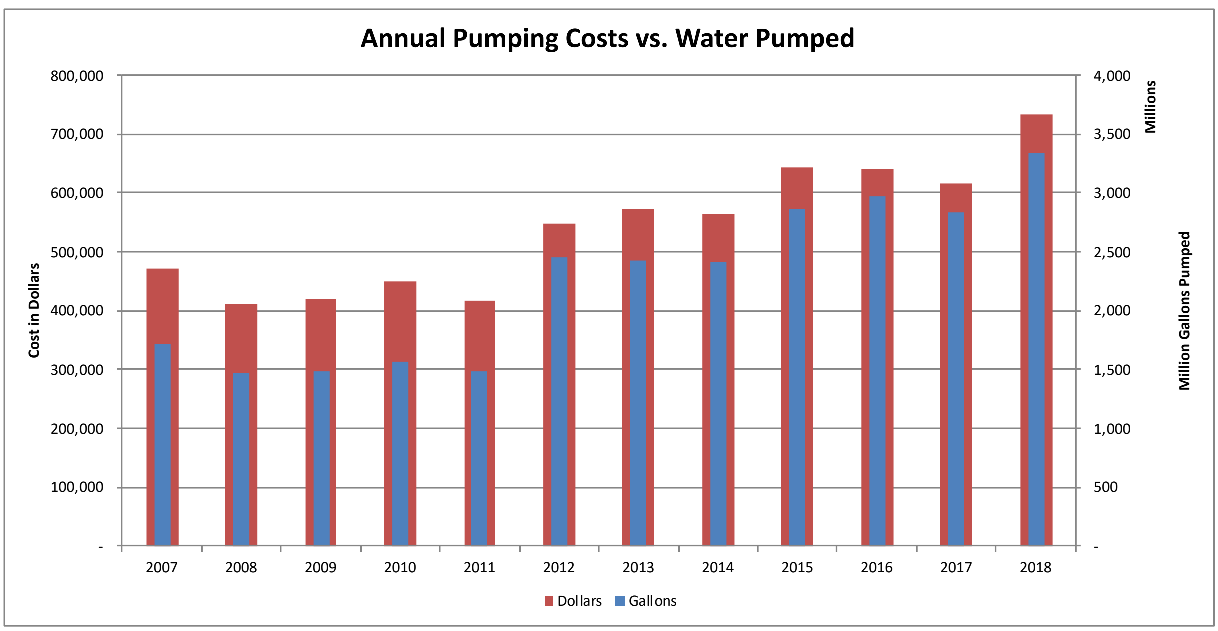

Chart 11 - Annual Pumping Costs vs. Water Pumped

Chart 12 on the following page, shows the total annual Energy consumed in Kilowatt hours (kWh) since 2009. For a comparable reference to size, a typical residential home in the United States consumes 10,400 kWh. In 2018, the District used over 10.4 million kWh, which is the equivalent energy footprint of 1,000 average sized homes per year. The increase in 2018 was due to the lack of precipitation and higher customer use.

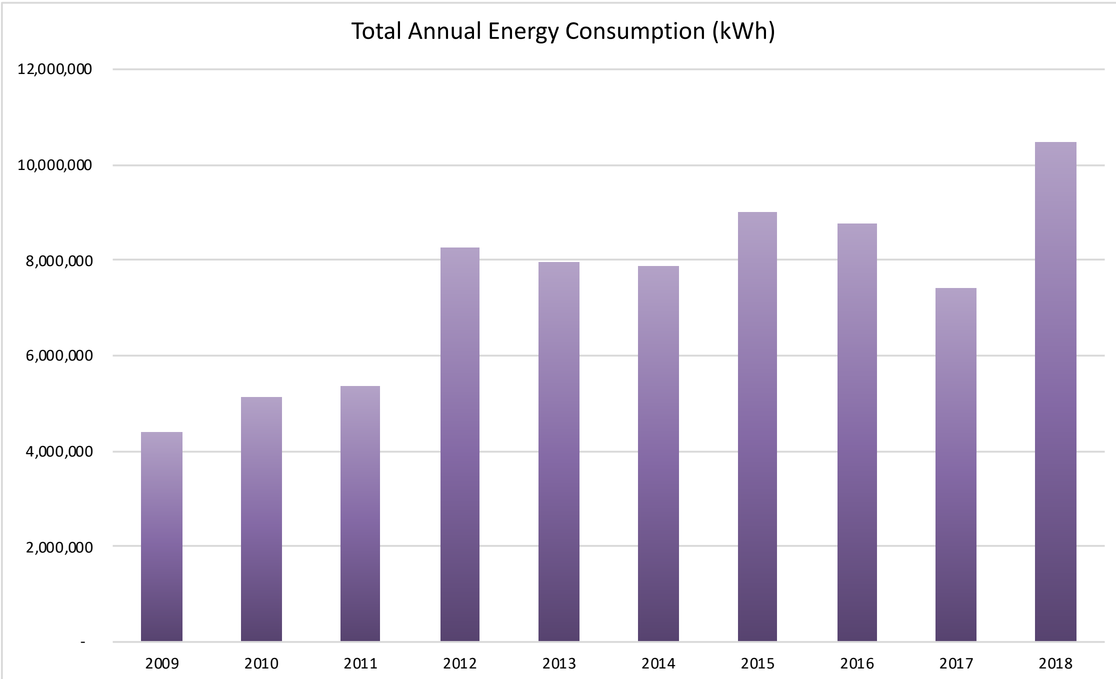

Chart 12 - Annual Energy Consumption in kWh

After understanding better the annual volumes of water pumped and the cost of energy used in pumping, we can now derive an overall electrical cost (energy and power) per 1,000 gallons pumped to begin observing more closely the viability and success of District energy and water conservation efforts. Chart 13 below shows total electrical unit costs versus gallons pumped.

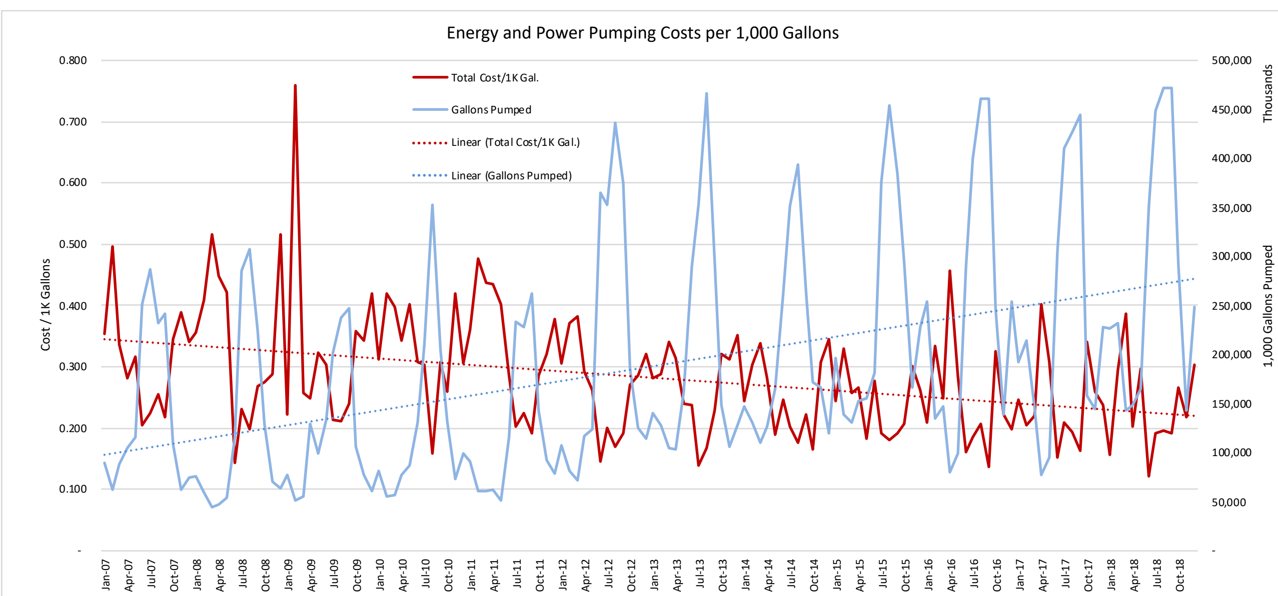

Chart 13 - Energy and Power Costs per 1K gallons vs. Gallons Pumped

Chart 13 is very notable because it shows a steady decline in unit cost of energy and power per 1,000 gallons but an increase in the monthly pumping volumes of water. Because District electrical costs were soaring, beginning in the year 2010, the District recognized the need to become a stronger advocate for energy and water efficiency. This effort can be clearly seen past the intersection of the two trend lines. It should also be noted that the years 2010 through about 2017 saw steady energy and power rate increases from Rocky Mountain Power, a trend which is clearly drowned out within District efficiency efforts. Chart 14 below shows more clearly this trend when the monthly water demands, and loads are smoothed out upon a running 12 month average.

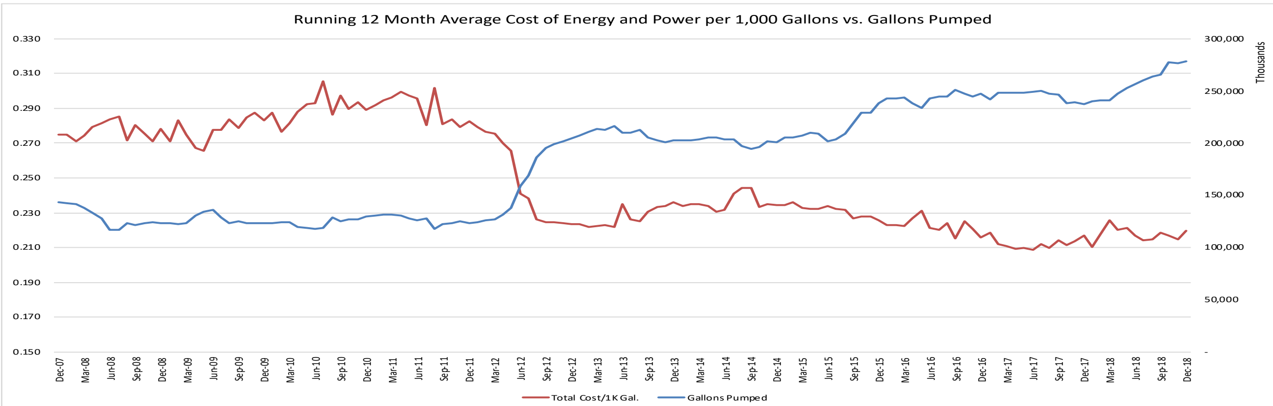

Chart 14 - Energy and Power vs Gallons Pumped on 12 Month Moving Average

The crossing on Chart 14 also corresponds to the period when the District converted its largest account, Lost Canyon Booster Pump Station to a high voltage industrial Rate 9 service. This action allowed that facility to operate in a much more efficient manner, with a lower cost rate and a longer period (16 hours as opposed to 8 hours) of off-peak pumping. (Off-peak pumping is a strategy which moves the heavy pumping loads to periods of the day which have a lower impact on the Rocky Mountain Power (RMP) distribution and transmission grids as well as large power generation facilities. As such, RMP incentivizes this usage strategy.)

Another key metric used to evaluate energy efficiency programs is to take the total electrical costs (energy and demand) and divide that by the total kWh (energy) used. If this cost is stable or drops, it shows that (even with rate hikes) the District is efficiently utilizing the off-peak period, and its energy efficiency efforts are leading to lower "cost per gallon". Chart 15 below—shows this trend.

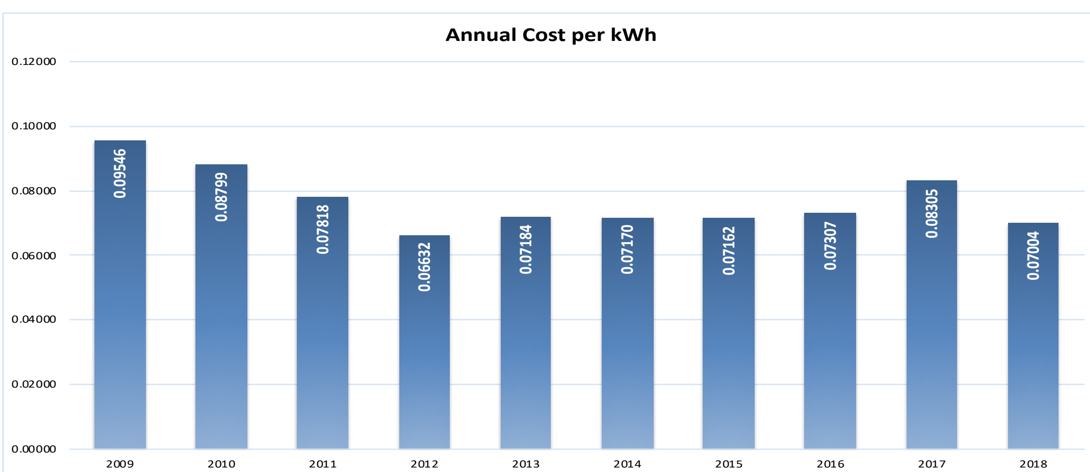

Chart 15 - Annual Averaged Unit Cost of Energy (kWh)

Because Energy is tied very closely to the gallons of water pumped, we can further refine any efficiency analyses by establishing a metric known as Specific Energy (SE). Specific Energy is a dimension showing the Energy in kWh relative to some unit of water pumped, say 1 thousand gallons, or 1 million gallons. This is a valuable statistic because if tracked continuously (as is the case with the District), it can show a relevant pump performance dropping off over time (as SE increases), signaling an operations alarm to service or overhaul the applicable pump. Specific Energy is the "gold standard" of pumping performance and Chart 16 below shows the overall District SE values, along with District goals reaching out to 2025. This value is further tracked and reviewed specifically for every pump station and every pump. Note that 2018 is higher than usual because of the very large pumping demands which forced the District to use at times, pumps of lesser performance.

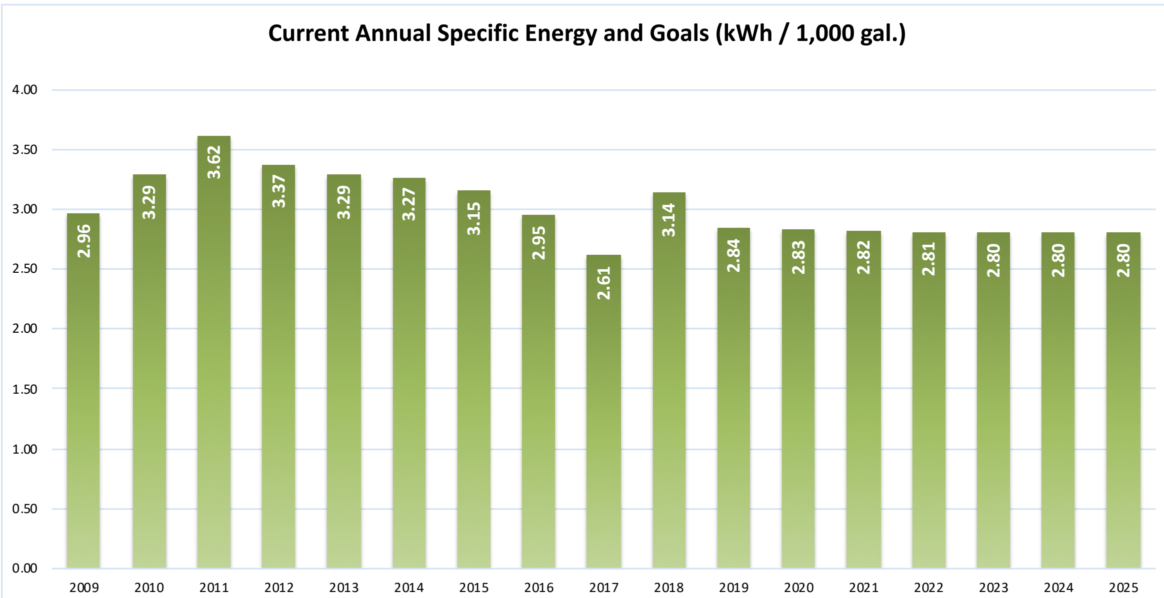

Chart 16 - Annual Historical and Future Specific Energy Goals

By tracking individual pumping system costs as well as the Specific Energy (SE) values of each system, the District can better prioritize wells or water sources, and booster pumping plants, down to which individual pumps to start-up first, with the most efficient pumps utilized for the longest periods of time. Holding the less efficient system(s) in reserve when they may be needed during a shorter peak pumping cycle or high demand period can save significant costs in energy and wear and tear.

Often the Specific Energy of a pumping system may be reduced (made efficient) by installing smaller "jockey type" pumps which run for a longer periods of time at lower flows, using lower motor horsepower. This technique is referred to as increasing the Load Factor, or the period which a lower load is used nearly around the clock—rather than a very high load being used a short period of time.

The next two charts show in a more visual detailed form how this important operational concept works. Chart 17 shows the annual costs for 2018 of each of the District's major pumping facilities (wells or booster pumping stations). Looking at this data alone simply tells which facility cost the most. Obviously Lost Canyon BPS, the Treatment Plant, and Well 15b / 15c appear costly. The question we ask is: they appear very costly, but are they efficient?

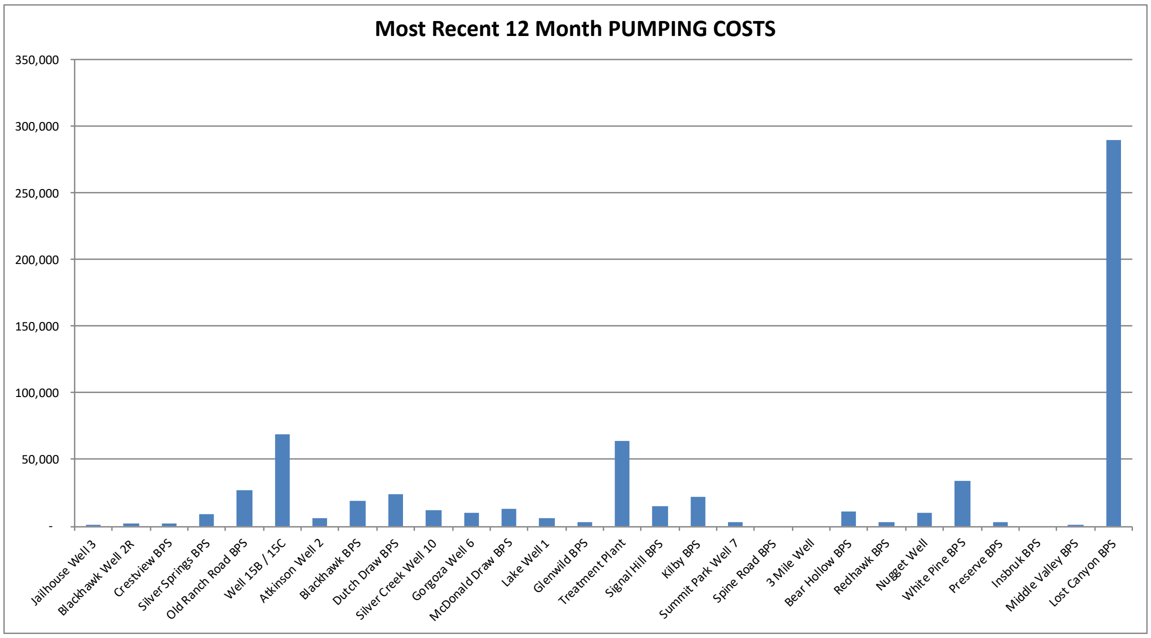

Chart 17 - 2018 Annual Pumping Costs per Pumping Facility

Now, observing Chart 18, we have converted the blue bars to a more Specific Energy (SE) value which looks at the cost in energy per million gallons (MG), as well as the cost in of the power demand charge per MG (in red bars) for each major pumping facility in the District.

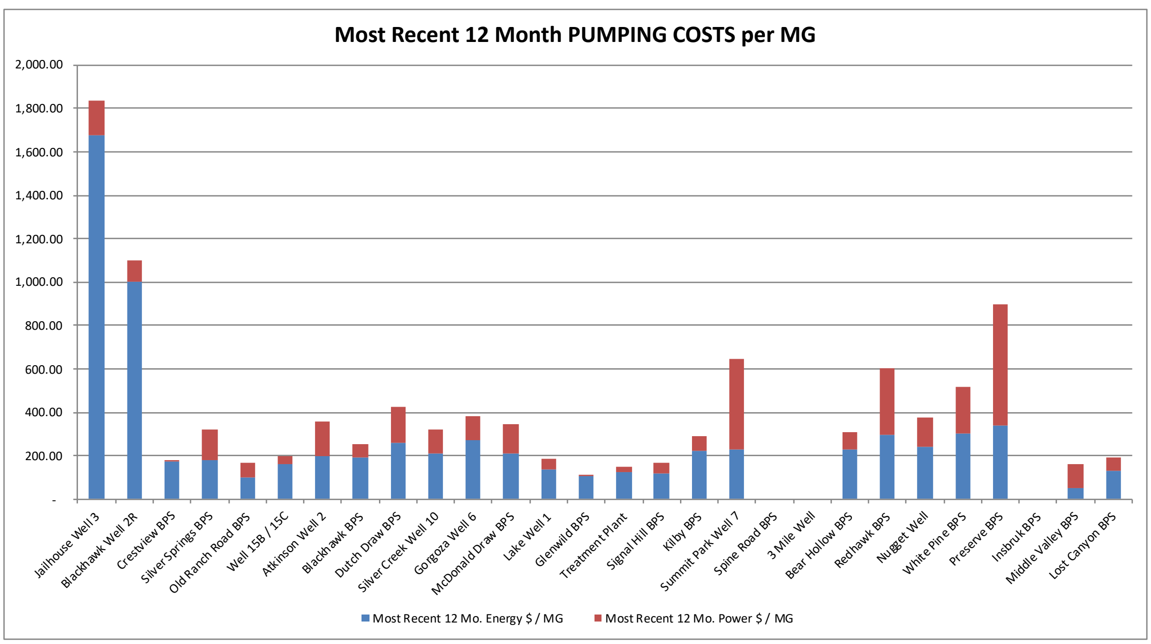

Chart 18 - 2018 Annual Pumping Specific Energy and Demand per Pumping Facility

The systems which produce the most water (singled out above), now actually have the lowest unit cost per energy (kWh), which has become the District's strategy. The most efficient systems also have a lower proportional power or demand charge (in red), because they are operated more in off-peak periods.

The Lost Canyon Booster System

The Lost Canyon Booster System (LCBS) is presented separately because it is the apparent "elephant in the room," using over 60% of the overall energy consumed and 45% of the electrical costs by the District. As such, the District pays particular attention to the LCBS operation and management. This facility houses more than 4,000 horsepower of pumps (see upper left of cover photo) which move nearly 10,000 gallons a minute of raw water from Rockport Reservoir, over a 1,000 foot high mountain, and into the District's water treatment plant and Park City's water treatment plant. Every move and decision on this system is reviewed carefully for its impact on economic efficiencies and long-term costs. Because of its massive size and load, this facility receives high voltage service from the 138 kV transmission lines of PacifiCorp, requiring the District to own and operate a 5-Megawatt sub-station (see lower cover photo). The LCBS is continuously tracked by SCADA in its performance, like all other pumping systems, but this one requires more attentiveness. Chart 19 plots the monthly Energy (kWh) and Power (kW) of this large facility and shows the growth over time of its loads.

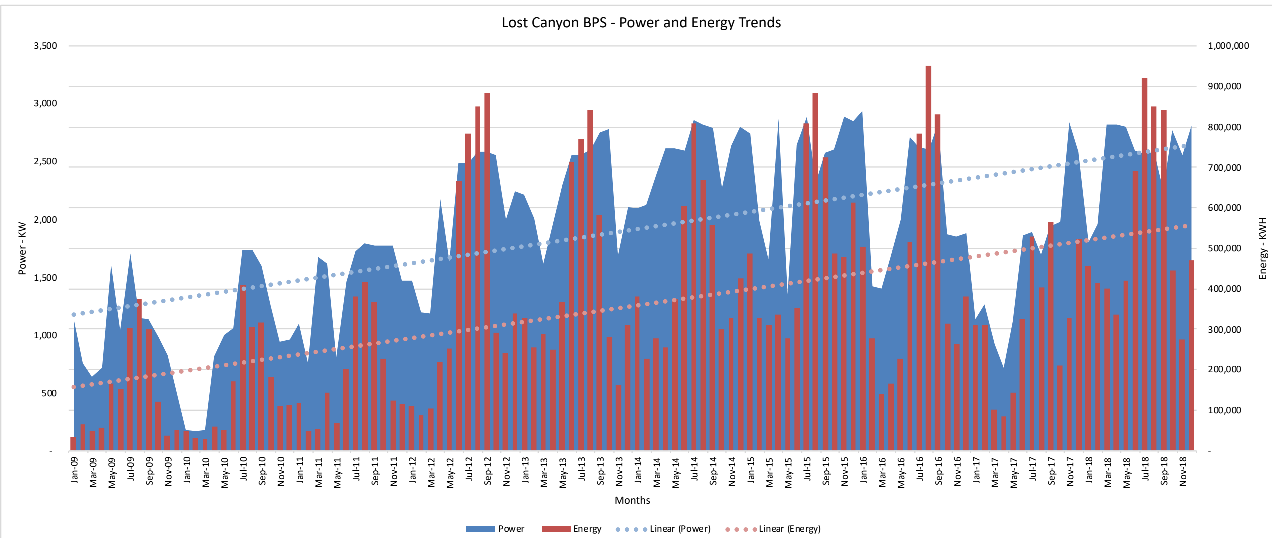

Chart 19 - LCBS Monthly Energy and Power Profile

Chart 20 displays the energy used On-Peak versus Off-Peak. Up until 2015, there was no energy consumed during the On-Peak periods. Over time however, this will increase as water demands and snowmaking needs increase. On-Peak pumping cost significantly more money to pump.

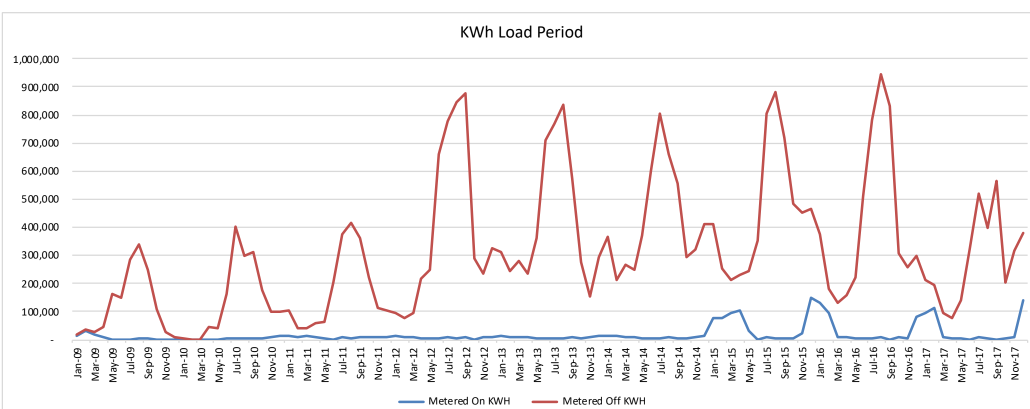

Chart 20 – LCBS On-Peak and Off-Peak Load Profiles

As shown above in Chart 16, which displays the Specific Energy (SE) of all the District pumping accounts, Chart 21 below, shows only the SE of LCBS for each year. It is hoped that the trend will continue to drop slowly each year. Again—2018 is a bit of an anomaly because of the dry year and high water demands which pushed the District into using some less efficient pumping schemes.

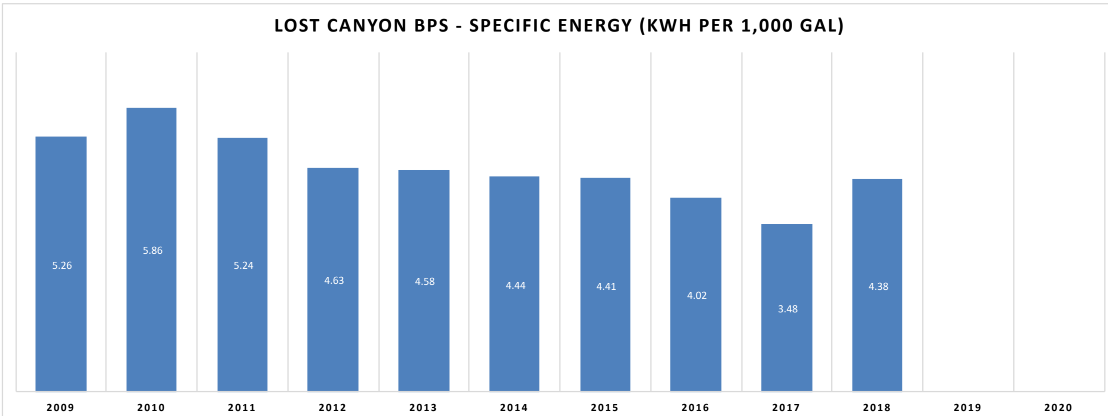

Chart 21 - LCBS Specific Capacity by Year

Furthering the quest for efficiency, Chart 22 below is comparable to the Chart 13 above which shows the cost per million gallons (MG), similar to the Specific Energy above, compared with an overlay of million gallons (MG) pumped. Again, the inverse and intersecting slopes of the two trends paints a clear picture of increasing efficiency in LCBS pumping.

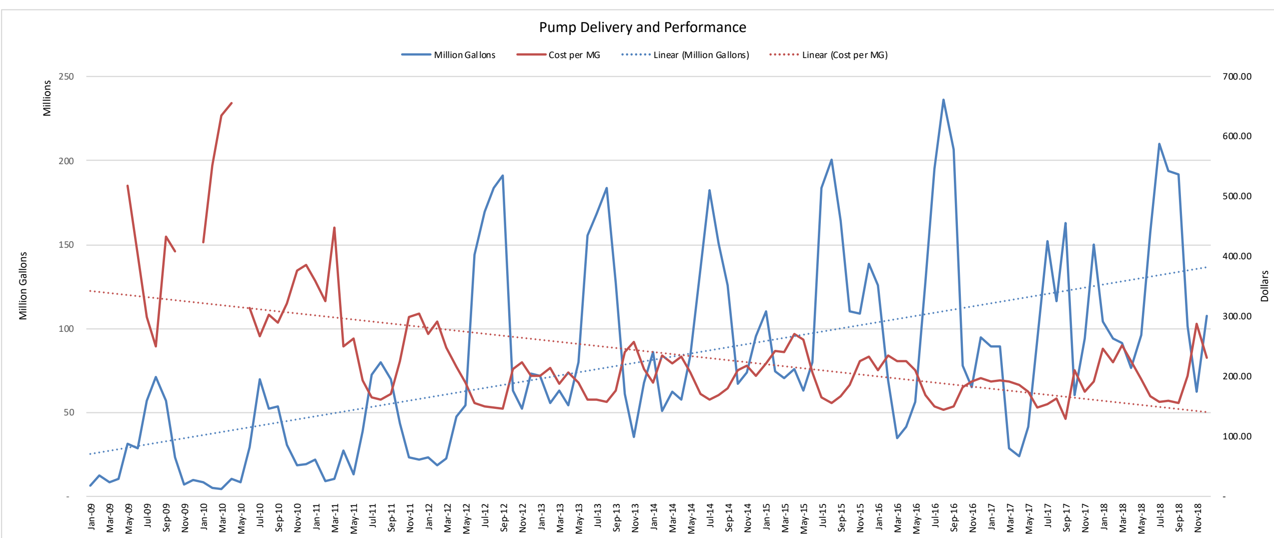

Chart 22 - LCBS Pump Delivery in MG versus Performance in $/MG

Finally—in Chart 23 below, we can plot and review various performance metrics of the LCBS facility. Million gallons (MG) pumped per year is shown in red, while the total cost of energy and power combined is shown in blue. Efficiencies increase significantly in 2011 with the installation and operation of the new power sub-station, along with an accompanying change to Rate 9. Rate 9 allows for a longer (double) off-peak pumping cycle in the critical summer months. Prior to 2011, costs exceeded relatively the volume of water pumped. The green line would be similar to a smoothed red line above in chart 22 and shows a decrease in Specific Energy (SE) and the resulting increase in the pumping and electrical efficiencies of LCBS.

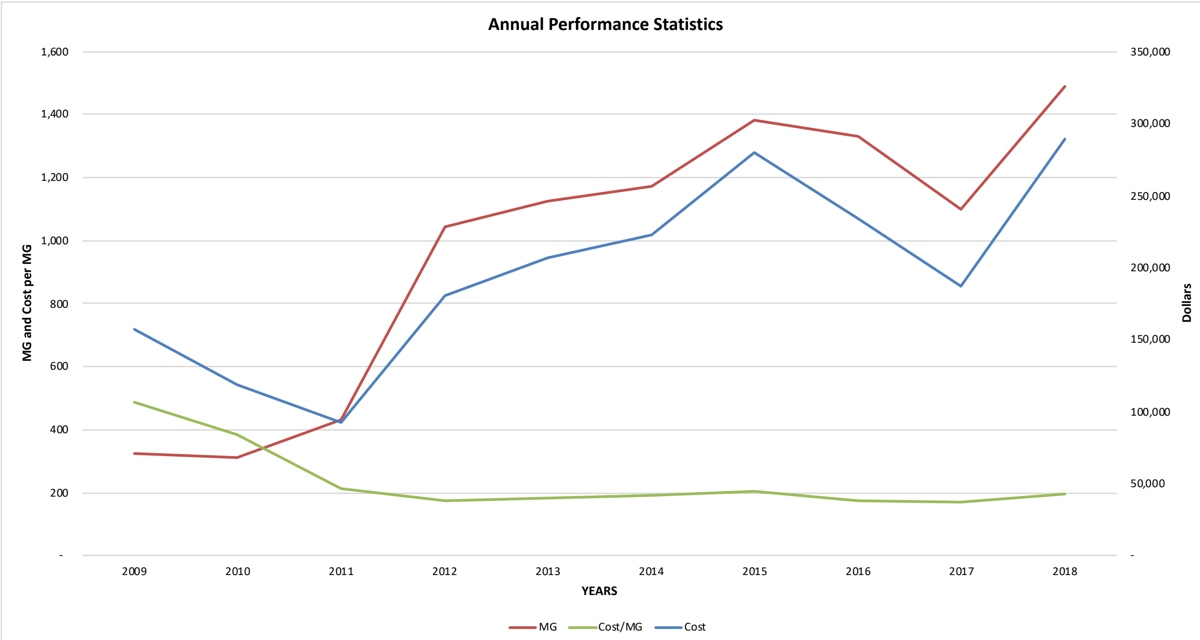

Chart 23 - LCBS Annual Performance Metrics

On one last note—the District has saved considerable money over the years by simply choosing the correct Rocky Mountain Power (RMP) rate. For a commercial water utility like the District, there are many different rate tariffs to choose from (as many as six) which can save money or cost more, depending upon the characteristics of the daily loads placed upon RMP. The default rate assigned by RMP upon an account activation is not always the best rate. Through computer modeling, the District has learned to select a precise rate which saves the greatest amount of money on each of its electrical pumping accounts. By continuously tuning how the pumps operate i.e. load factor and/or off-peak optimizations, the savings can even be increased more over time. The art of matching a load profile to the proper rate is a technique that the District has mastered, and our staff have spent years teaching these strategies to other water utilities throughout the state.

6.0 A Conclusion Based on Real Results

After a review of the water and energy report sections above, we can now develop a summary which shows the values of the District's real and ongoing efforts to improve pumping efficiencies and minimize costs to the District and its customers.

When we analyze the annual energy and power bills and remove all efforts to save energy and power in any form by extending past Specific Energy trends against increasing water production and pumping, we arrive at a 2018 annual cost baseline of approximately $1,178,528 dollars. Presently, the net cost of energy and power is $735,018 dollars, thus establishing an annual savings of approximately $443,510 dollars. This savings amounts to 37.63% of the total pie (see the red, green and purple segments below in Chart 24).

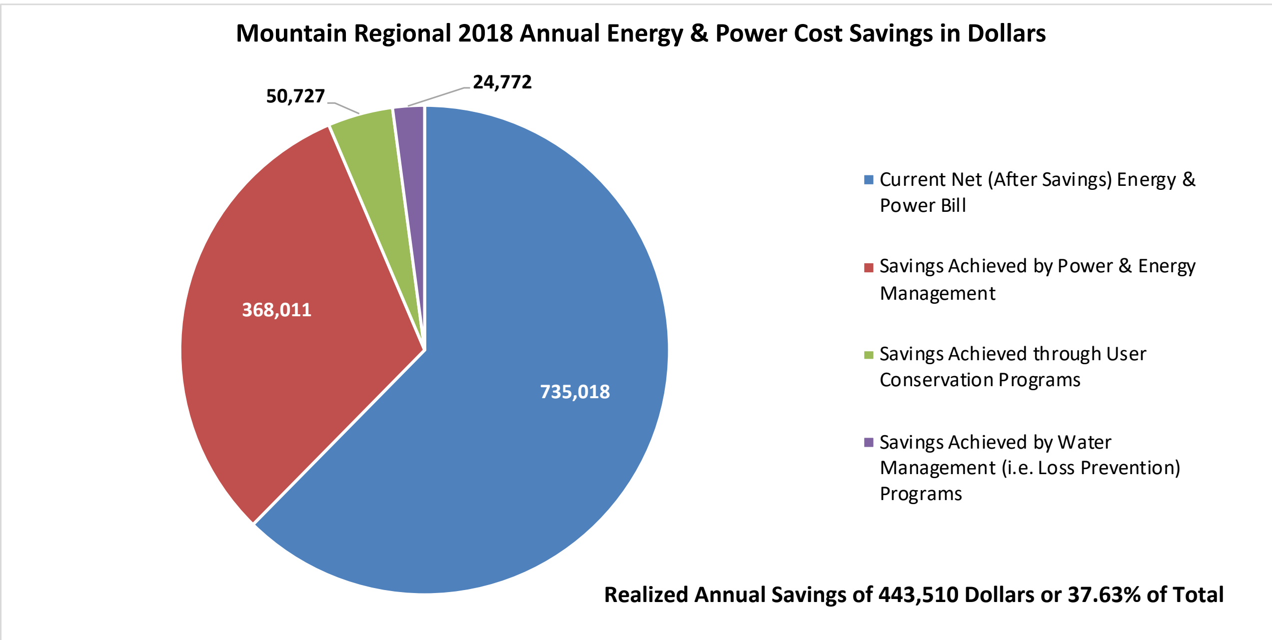

Chart 24 - 2018 District Energy and Power Savings

Within that overall segment of savings, $368,011 dollars derives from energy and power management strategies as outlined previously in this document. See the red slice above.

In the green segment, $50,727 dollars originates from an electrical savings achieved through the District's ongoing water conservation incentives and programs. These trends can be seen more clearly in Chart 8 above. However, conservation initiatives were started as early as 2001 in the District, predating by many years the documented period shown in that chart.

In the purple segment above, $24,722 dollars is calculated as a savings achieved through water management programs, such as water loss improvements over time. See Chart 7 above for a better picture of this effort. This includes all forms of unaccounted for water, such as leaks and metering errors, etc.

The final two charts below look back on the Districts efficiency and conservation efforts since 2010. This is the equivalent of showing a Chart 24 above for each year. Chart 25 shows only the savings segment, broken again into Power and Energy Management, Conservation Programs, and Water Loss Management. The total savings in dollars for each year can be viewed on the left of the chart.

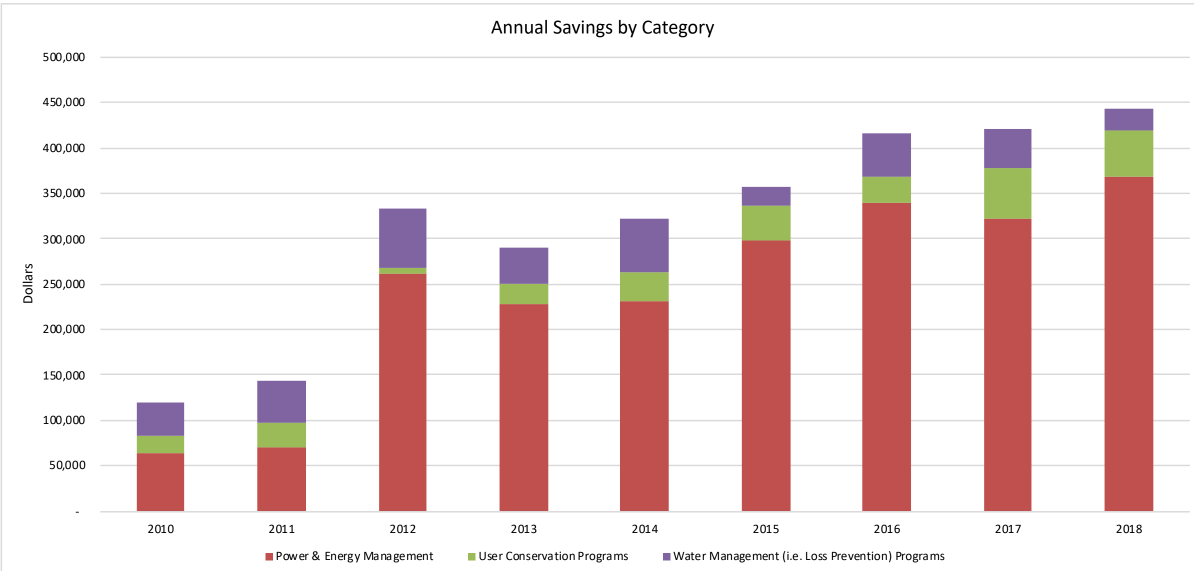

Chart 25 - District Efficiency and Conservation Savings by Year

Chart 26 below now compares the costs of energy and power each year, AND without any District efficiency and conservation efforts.

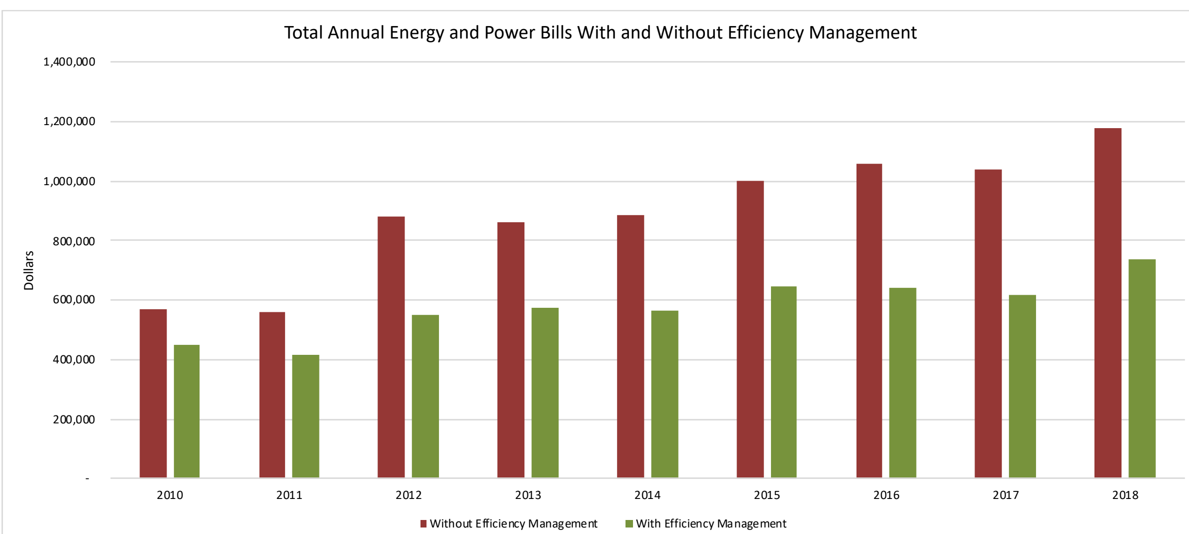

Chart 26 - Annual Energy and Power Costs - With and Without Efficiency Management

And now for the bottom line—since 2010 and through 2018, the District has realized a cumulative energy and power efficiency savings of approximately $2,846,490 dollars! The effort of many skilled heads and many strong hands. A team strategy which will carry the District forward for many rewarding years to come.