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City of Mesa

2018 Water Master Plan Update

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CITY OF MESA
2018 MASTER PLAN UPDATE

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1.0 OVERVIEW

1.1 MASTER PLANNING BACKGROUND AND PURPOSE

The City of Mesa currently provides water service for a population of approximately 500,000 within a water service area (WSA) of 128 square miles. The City's WSA contains eight pressure zones with a current Annual Average Day (AAD) demand in 2017 of 83 million gallons/day (mgd) and a Max Day (MD) demand of 125 mgd.

In 2010, Black & Veatch Corporation developed a comprehensive Water Master Plan. Subsequently, in 2012, City of Mesa Water Resources Department staff prepared an update to the 2010 Master Plan utilizing internal resources.

The purpose of the 2018 Water Master Plan Update is to address changing conditions since completion of the 2012 Water Master Plan Update. The primary trigger for this update is to evaluate the needs in Southeast Mesa, where most of the future growth is going to occur. However, because an evaluation of Southeast Mesa independent of the whole system is very difficult, it was decided to prepare a Master Plan Update for the whole system, with primary focus being Southeast Mesa.

1.2 SCOPE

Previous water master plans were completed every five to ten years by consultants and provided comprehensive plans for water production and distribution infrastructure that would take the City through Buildout. The Master Planning is now being done internally by Water Resources Staff and will be updated as needed. On this basis, the scope of the 2018 Water Master Plan is defined as:

1) Update water demand projections based on current water consumption and revised growth projections. Re-evaluate peaking factors and seasonal variations.
2) Assess the impact that the revised demands will have on the City's surface water resources, groundwater resources, water production facilities and add or reduce capacity accordingly.
3) Perform distribution system hydraulic analyses using the revised demands and production plan, and refine the capacity and phasing of pipe, pumps, and reservoirs where indicated.

4) Provide a detailed year-by-year Infrastructure Improvement Plan (IIP) for water production/water distribution infrastructure based on revised growth and land use plans. The IIP identifies capital improvement projects that are needed to meet future demands and development. IIP projects may be paid for with funds generated by development impact fees.

Three planning years were analyzed for this master plan update, 2018 (Base), 2028 (Intermediate), and 2040 (Buildout). Scenarios were created in the City's water model for each planning year. The base scenario includes existing infrastructure including the new Signal Butte Water Treatment Plan, the intermediate and buildout scenarios includes additional infrastructure needed to meet future demands. The year 2040 has been used for buildout per the City of Mesa's General Plan. The buildout year may change as the General Plan is updated.

1.3 WATER MASTER PLAN ORGANIZATION

The results of the master planning effort are divided into four chapters as shown below.

- Chapter 1 – Overview
- Chapter 2 – Water Demand and Production Plans
- Chapter 3 – Distribution Infrastructure and Hydraulic Analysis
- Chapter 4 – Infrastructure Improvement Plan

2.0 WATER DEMAND AND PRODUCTION PLANS

This chapter presents updated demand projections in response to current water consumption rates and economic conditions. The City's water resources portfolio was updated and assessed considering the revised demands. New water production plans were developed to confirm/revise the capacity required for the water treatment plants and potable water wells.

2.1 DEMANDS

The overall number of water accounts has increased since 1990, but the amount of water being used per account has been trending down, see Figure 2-1 and Figure 2-2. Historical data dating back to 1990 indicates that the amount of water consumed per account peaked in 1997 and has steadily decreased since. In 2017, the overall water consumed per account was 23% less than it was in 1990 and 30% less than the peak water usage in 1997.This appears to be a long-term trend that was not affected by the 2008 economic downturn. The lower water use per account may be attributed to water conservation efforts, low-use landscaping techniques on new homes, and higher efficiency plumbing code changes with appliances and plumbing fixtures. It is assumed that water conservation efforts will continue as well as technological advances in high efficiency appliances and low water-use plumbing fixtures.

Figure 2-1: Historical Water Account Growth

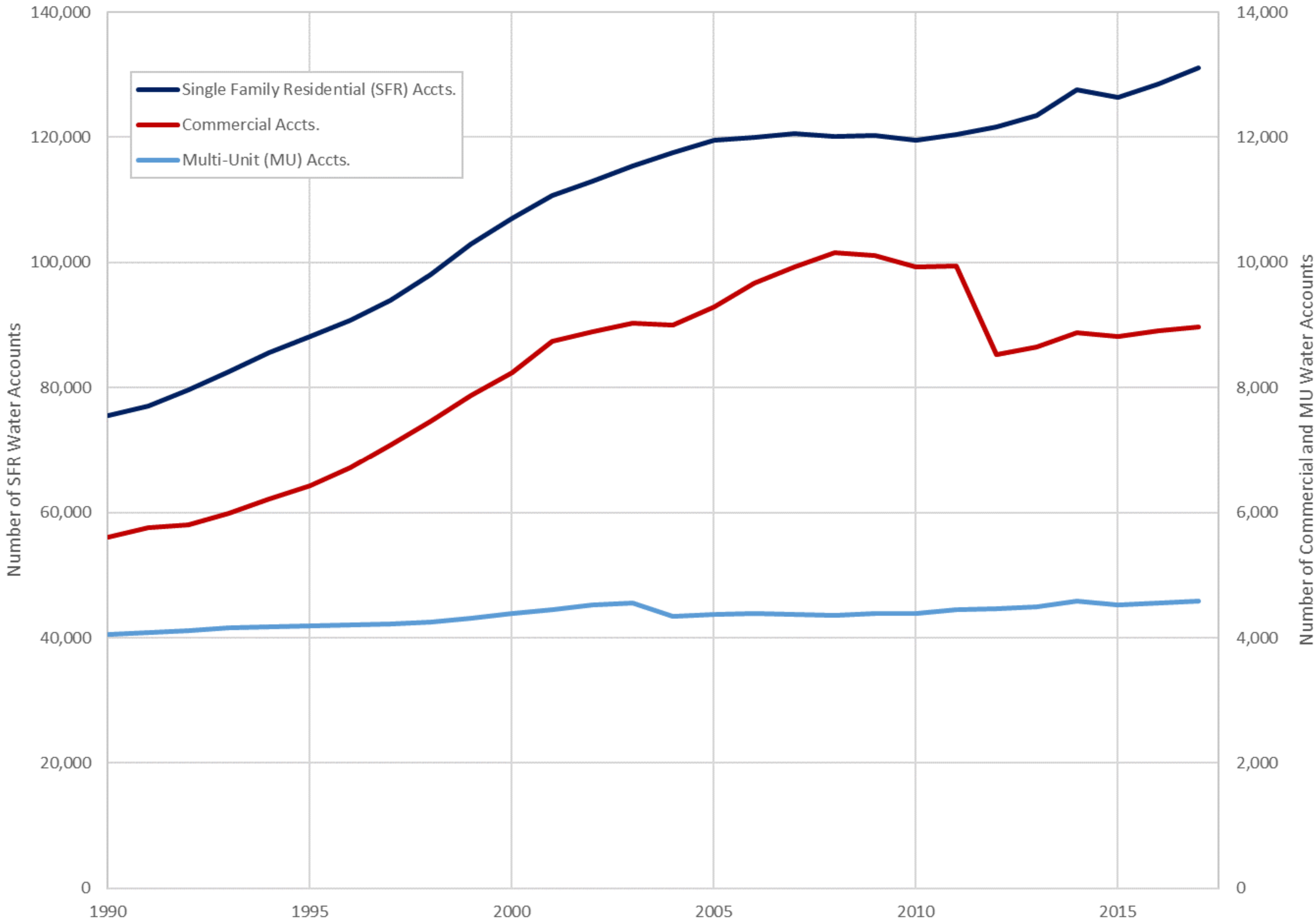
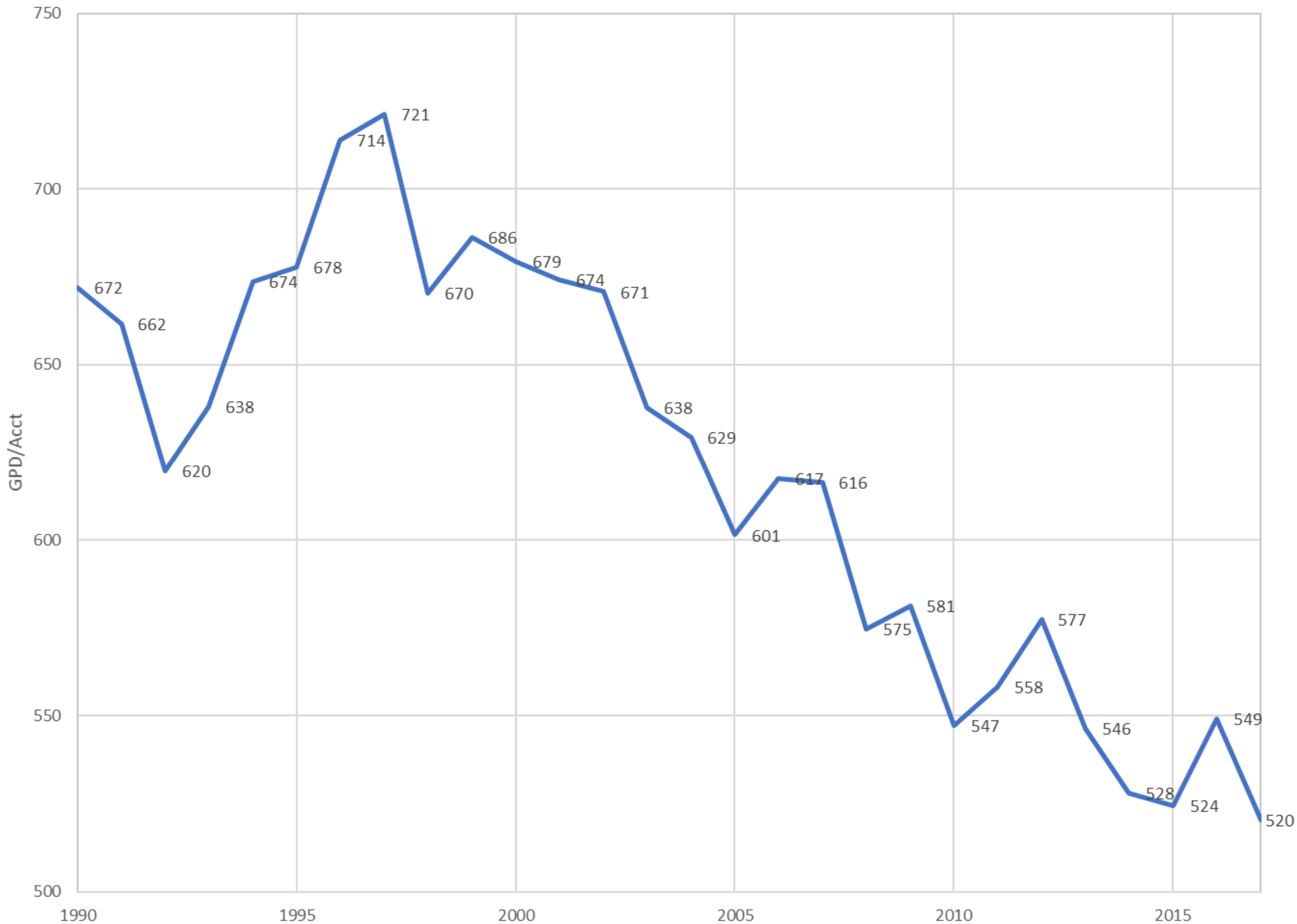


Figure 2-2: Historical Water Usage per Account



The City of Mesa tracks water consumption for four different water meter account types: single family residential (SFR), commercial, multi-unit (MU) and temporary fire hydrant meters typically used for construction water. There are approximately 147,000 water accounts in the service area. Table 2-1 summarizes the four different account types and the percentage of total accounts and the percentage of total water consumption.

Table 2-1: Account Type

Account Type	Percentage of Accounts	Percentage of Consumption	Average Consumption per Account (gpd)
Single Family Residential (SFR)	86%	49%	296
Commercial	8%	33%	2,589
Multi-Unit	3%	17%	2,905
Fire Hydrant	3%	1%	-

The following observation can be made from Table 2-1**.** Even though SFR accounts make up 86% of the water accounts, they only account for 49% of the water consumption. Commercial accounts make up 8% of the accounts but 33% of water consumption. The overall water demands in the City of Mesa are mostly dependent on trends in residential development and residential water consumption. It is important to note that, on average, a commercial account has 8 times the SFR account demand and the loss or addition of a small number of commercial accounts can significantly change demand projections.

Because of the decreasing water use per account, the projected overall water demand is less than what was predicted in the previous Master Plans. To account for these changes, a demand analysis was performed which analyzed 2017 water usage by the General Plan Land Use Type.

The 2017 metered water sales were summed by land use type and scaled up to account for unaccounted for water and inactive accounts. Average daily water consumption for each land use type was divided by the number of acres in a land use type to arrive at a water usage rate per acre. Table 2-2 presents the average unit water demand by land use type.

Table 2-2: Average Unit Water Demands by Land Use Type (GPAD)

Land Use Type	Unit Water Demand
Business Park	949
Community Commercial	983
General Industrial	748
High Dens Res (10-15 dwelling units/acre)	1,706
High Dens Res (15+ dwelling units/acre)	2,643
Low Dens Res (0-1 dwelling units/acre)	1,041
Low Dens Res (1-2 dwelling units/acre)	1,041
Light Industrial	949
Med Dens Res (2-4 dwelling units/acre)	1,119
Med Dens Res (4-6 dwelling units/acre)	1,212
Med Dens Res (6-10 dwelling units/acre)	1,035
Mixed-Use/Community	1,489
Mixed Use/Employment	1,489
Mixed Use/Res (30% at 15+ dwelling units/acre)	1,282
Neighborhood Commercial	1,350
Office	1,182
Open Space	976
Parks	976
Public/Semi-Public	976
Regional Commercial	1,069
Education	1,095
Town Center (25% at 15+ dwelling units/acre)	1,398

2017 production flow records were used to determine the 2017 AAD demand. Buildout demand was calculated by adding the following increments of projected additional demand to the Base Year:

Vacant Parcels. Additional demand associated with the development of parcels identified as vacant was calculated by multiplying the acreage for each vacant parcel times the applicable water unit demand in gallons per acre per day (gpad) based on the land use type classification for that parcel as identified in the City's General Plan.

Inactive Accounts. There was a high number of inactive accounts (9%) across the SFR, Commercial, and MU account types. It was assumed that these inactive accounts would eventually be re-connected by Buildout. Therefore, an additional 9% of the 2017 billed demand was added to include these currently inactive accounts.

Unaccounted for Water. This is water that was produced at water treatment plants or ground water wells but was not accounted for in the metered consumption. For 2017 it was 6.5% and was calculated by taking the difference between metered consumption and plant production and dividing it by the metered consumption.

Contingency. Because of the uncertainty of forecasting water demands and the timing of development, a 10% contingency was added to the Buildout demand before adding potential interagency demand obligations.

Interagency Demands. There are two active interagency connections to the City of Mesa's water distribution system, Arizona Water Company and Town of Apache Junction (IS3 and IS5 respectively on Exhibit B). In the past, the City provided water to meet a substantial portion of their water demand from the City's Desert Sage Service Zone. Currently they are not taking water to meet water demand and would only take water in the case of an emergency in their system. Their demands are not shown in the base year but were added in 2030. Both water utilities are currently meeting their water demand through groundwater and it was assumed that they would eventually return to taking surface water treated and wheeled through the City's system. These demands account for the jog and change in slope of the demand projection at 2030.

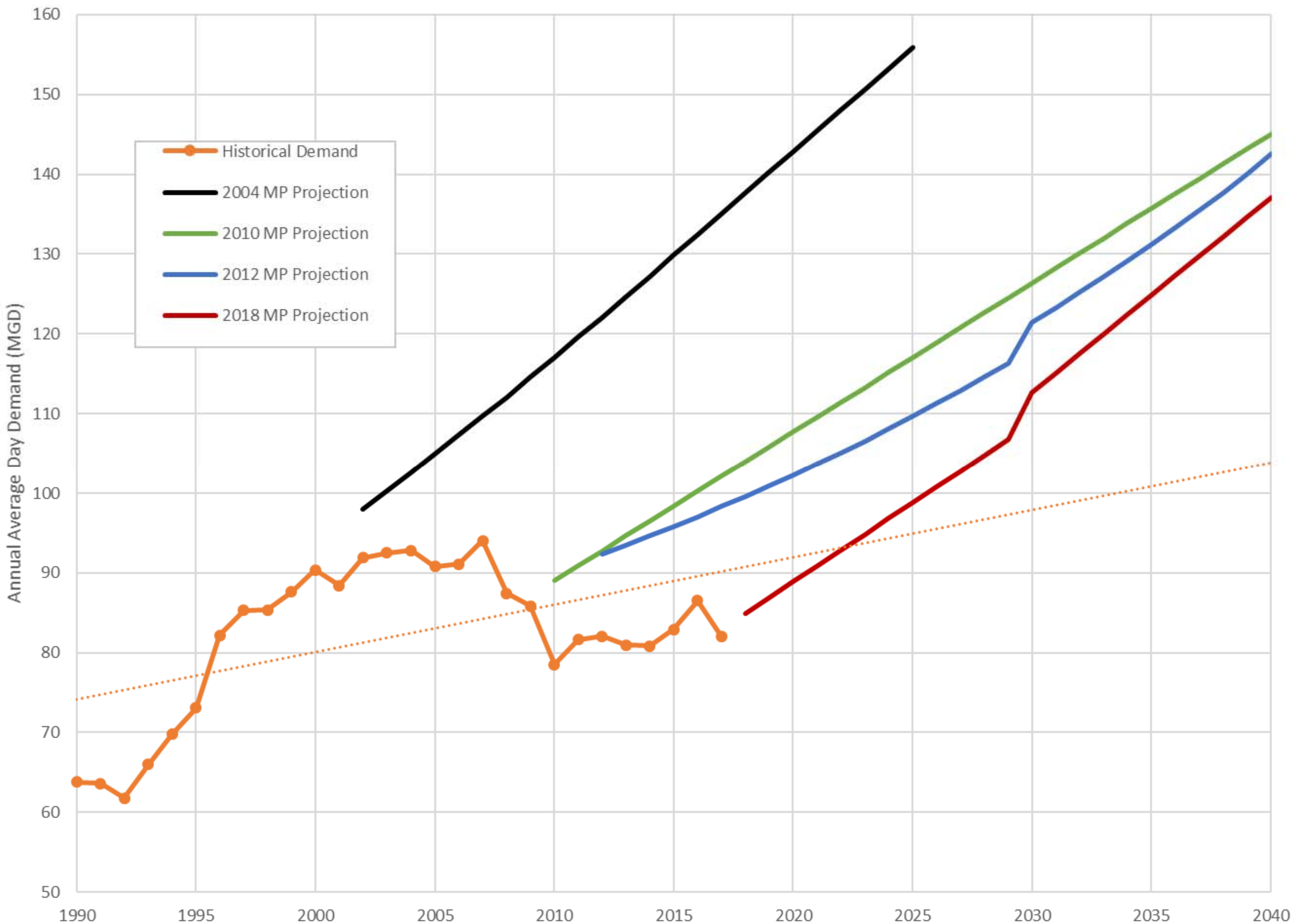
Base year water and Intermediate year demands were calculated based on straight-line interpolations between the measured 2017 production flows and projected Buildout demands. The resulting projected Annual Average Day (AAD), Max Day (MD), and Peak Hour (PH) demand, for base year through Buildout, is listed in Table 2-3 and graphed in Figure 2-3 where it is also compared with the projections from previous Water Master Plans.

Table 2-3: Water Service Area Demand Projections by Service Zone, AAD, MD, PH

Pressure Zone		2018 (mgd)	2028 (mgd)	Buildout (mgd)
Average Day	**City Zone**	**39.0**	**42.9**	**47.7**
	Falcon Field Zone	16.6	21.6	27.7
	Desert Wells Zone	18.9	26.6	36.0
	Desert Sage Zone	6.6	8.1	9.9
	Arizona Water Company (IS3)	0.0	0.00	3.5
	City of Apache Junction (IS5)	0.0	0.00	5.0
	Desert Sage Zone Total	6.6	8.1	18.4
	County Line Zone	2.4	3.0	3.6
	Apache Junction Zone	1.1	1.6	2.3
	Range Rider Zone	0.3	0.5	0.8
	Highlands Zone	0.1	0.2	0.3
	Usery 1 Zone	0.0	0.1	0.15
	Usery 2 Zone	0.0	0.0	0.07
	Eastern Zones Subtotal	**46.0**	**61.8**	**89.3**
	System-Wide Total	**84.9**	**104.8**	**137.0**
Maximum Day (1)	**City Zone**	**62.3**	**68.7**	**76.4**
	Falcon Field Zone	26.5	34.6	44.4
	Desert Wells Zone	30.2	42.6	57.5
	Desert Sage Zone	10.6	13.0	15.8
	Arizona Water Company (IS3)	0.0	0.0	5.6
	City of Apache Junction (IS5)	0.0	0.0	8.0
	Desert Sage Zone Total	10.6	13.0	29.4
	County Line Zone	3.9	4.8	5.8
	Apache Junction Zone	1.7	2.6	3.7
	Range Rider Zone	0.5	0.9	1.3
	Highlands Zone	0.2	0.3	0.5
	Usery 1 Zone	0.0	0.1	0.24
	Usery 2 Zone	0.0	0.1	0.11
	Eastern Zones Subtotal	**73.6**	**98.9**	**142.9**
	System-Wide Total	**135.9**	**167.6**	**219.3**
Peak Hour (1)	**City Zone**	**93.5**	**103.1**	**114.5**
	Falcon Field Zone	39.7	51.9	66.6
	Desert Wells Zone	45.3	64.0	86.3
	Desert Sage Zone	15.9	19.4	23.7
	Arizona Water Company (IS3)	0.0	0.0	8.4
	City of Apache Junction (IS5)	0.0	0.0	12.0
	Desert Sage Zone Total	15.9	19.4	44.1
	County Line Zone	5.8	7.1	8.7
	Apache Junction Zone	2.5	3.9	5.5
	Range Rider Zone	0.8	0.5	1.9
	Highlands Zone	0.2	0.2	0.8
	Usery 1 Zone	0.00	0.1	0.36
	Usery 2 Zone	0.00	0.1	0.17
	Eastern Zones Subtotal	**106.5**	**148.3**	**214.3**
	System-Wide Total	**199.1**	**251.4**	**328.9**

(1) The MD factor is 1.6 times the AAD and the PH factor is 2.4 times the AAD

Figure 2-3: AAD Demand Projections



The following observations can be made from Table 2-3 and Figure 2-3:

1. The overall Buildout AAD demand, now projected at 137 mgd, has decreased 5 mgd system wide from the overall Buildout AAD demand of 143 mgd projected in the 2012 Water Update.

2. Demand growth rates have steadily decreased since 2002. This is likely due to the reduction in water use by residential customers through water saving measures such as high efficiency appliances and xeriscape landscaping.

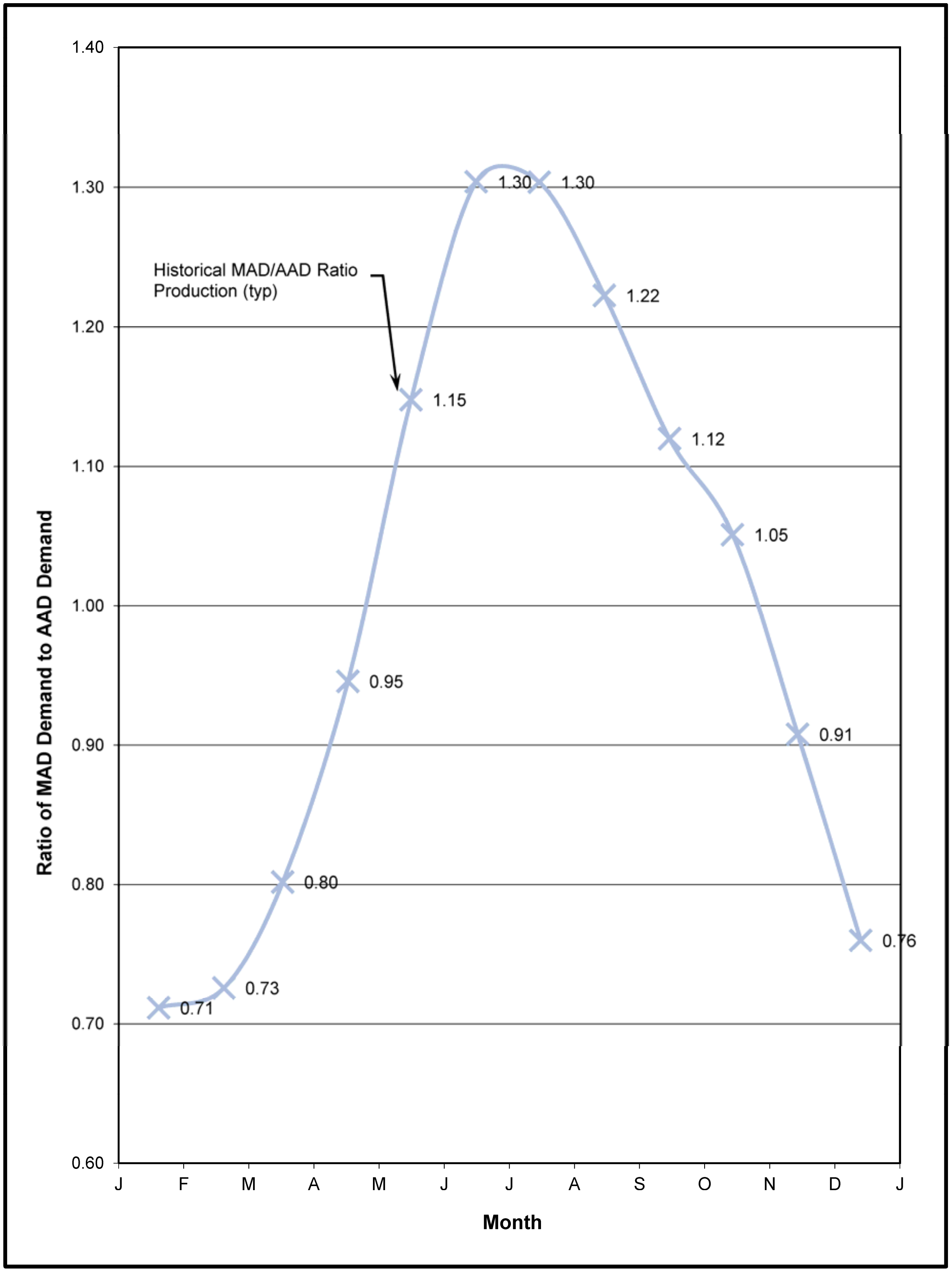
Projected AAD, MD, and PH demands are also summarized in Table 2-3 by water service zone. The demands in Table 2-3 include unaccounted for water and inter-agency demands which are served from the Desert Sage Zone.

Table 2-4 presents historical demand data from 1990 to 2017. Historical AAD and MD production data for the years of 1990 to 2017 were obtained from historical records and master plans. Historical PH demand was obtained using Supervisory Control and Data Acquisition (SCADA) system data from 2007 to 2017 and from the 2004 Water Master Plan for 1999 to 2002. Peaking factors were calculated by dividing the MD by the AAD and PH by the AAD. Peaking factors of 1.6 for MD to AAD and 2.4 for PH to AAD were established, which coincide with the same peaking factors used in the previous Water Master Plan and correlate with historic values as shown in Table 2-4. Seasonal factors used to calculate monthly average demands for this study were averaged over the period between 2000 and 2017 and are shown on Figure 2-4.

Table 2-4: Historical AAD, MD, PH

Year	AAD (mgd)	MD (mgd)	PH (mgd)	MD/AAD	PH/AAD
1990	63.8	99.7		1.6	
1991	63.6	93.8		1.5	
1992	61.8	94.8		1.5	
1993	66.0	104.1		1.6	
1994	69.8	104.5		1.5	
1995	73.1	111.9		1.5	
1996	82.2	114.4		1.4	
1997	85.3	117.1		1.4	
1998	85.4	121.2		1.4	
1999	87.6	126.4	168.6	1.4	1.9
2000	90.4	122.8	178.4	1.4	2.0
2001	87.5	127.4	167.5	1.5	1.9
2002	93.6	132.3	194.8	1.4	2.1
2003	93.4	141.0		1.5	
2004	92.9	132.2		1.4	
2005	90.8	138.0		1.5	
2006	91.1	131.1		1.4	
2007	94.0	135.3	207.9	1.4	2.2
2008	87.4	125.5	219.5	1.4	2.5
2009	85.8	118.3	195.9	1.4	2.3
2010	78.5	116.3	173.2	1.5	2.2
2011	81.6	117.2	159.4	1.4	2.0
2012	82.1	120.0	161.0	1.5	2.0
2013	81.0	122.0	170.0	1.5	2.1
2014	80.9	117.0	169.0	1.4	2.1
2015	82.9	113.0	165.0	1.4	2.0
2016	86.5	114.0	162.0	1.3	1.9
2017	82.1	125.0	165.0	1.5	2.0
			Average =	**1.5**	**2.1**
			Maximum =	**1.6**	**2.5**
			Design Ratio =	**1.6**	**2.4**

Figure 2-4: Ratio of Monthly Average Day (MAD) to Annual Average Day (AAD)



2.2 RESOURCE AVAILABILITY

The City of Mesa has a number of surface water and groundwater resources available for meeting current and future water demands. The available resources are summarized for each of the design years in Table 2-5. A detailed discussion of the individual resource components and their legal and hydraulic constraints can be found in the 2011-2015 Water Resources Master Plan.

Table 2-5: Water Resources Portfolio

Salt River Project (SRP) Resources		2018 af/yr	2028 af/yr	2040 af/yr
	SRP Cutover Land (Acres) [1]	*21,194*	*22,637*	*24,368*
	Surface Water Allocation (af/ac/yr) [1]	*2.27*	*2.27*	*2.27*
	Allocation Water Availability =	48,111	51,386	55,315
	Normal Flow Water Availability	14,000	14,000	14,000
TOTAL ON-PROJECT WATER RESOURCE (af/yr) =		**62,111**	**65,386**	**69,315**
(mgd) =		**55.5**	**58.4**	**61.9**
Central Arizona Project (CAP) Resources				
	Current CAP Allocation	43,503	43,503	43,503
	Future White Mountain Apache Tribe Lease Water		3,157	3,157
	SRPMIC Lease Water	1,669	1,669	1,669
	Wellton-Mohawk Exchange Water	2,761	2,761	2,761
	RWCD Assignment Water	627	627	627
	Hohokam Water	4,924	4,924	4,924
	GRIC Exchange Water [2]	8,671	12,015	16,027
	TOTAL CAP Surface Water (af/yr) =	**62,155**	**68,656**	**72,668**
	(mgd) =	**55.5**	**61.3**	**64.9**
Groundwater Resources				
	Future Long-Term Storage Credits [3]	5,000	5,000	5,000
	Existing Long-Term Storage Credits [4]	4,850	4,850	4,850
	Assured Water Supply Groundwater [5]	12,043	12,043	12,043
	TOTAL Groundwater (af/yr) =	**21,893**	**21,893**	**21,893**
	(mgd) =	**19.5**	**19.5**	**19.5**
TOTAL OFF-PROJECT WATER RESOURCE (af/yr) =		**84,048**	**90,549**	**94,561**
(mgd) =		**75.0**	**80.8**	**84.4**
TOTAL MESA WATER RESOURCE (af/yr) =		**146,159**	**155,934**	**163,876**
(mgd) =		**130.5**	**139.2**	**146.3**

Notes:
(1) The SRP cutover land is based on the number of acres no longer receiving flood irrigation, that have cutover their water to the City. The Surface water allocation varies annually and is set by the SRP Board. 2.27 acre-feet per acre per year is very conservative and is based on the lowest level seen in the last 20 years.
(2) GRIC Exchange Water rate was based on actual water to wastewater return rates in 2017 at the Greenfield and Southeast Wastewater Reclamation Plants.
(3) A future long-term storage credit is obtained by taking reclaimed water produced at the Northwest Wastewater Reclamation Plant and recharging it at Granite Reef Underground Storage Project (GRUSP). Water recharged at GRUSP is intended to be banked and withdrawn during drought but could be withdrawn immediately to meet demands in non-drought years. Mesa has 23,120 acre-feet of leased storage space at GRUSP. Due to groundwater mounding at GRUSP on average only 5,000 acre-feet of the recharge capacity is being used.
(4) Mesa Currently has 485,004 long term storage credits, which averages out to 4,850 acre-feet/year over a 100-year assured water supply.
(5) City of Mesa Designation of Assured Water Supply (DWR No. 86-002023.0001)

The principal water resources available to the City are similar to those in the 2012 MP. The total annual resource available to the City is 163,876 acre-feet per year, which is adequate to meet projected demands. Several key water resource utilization goals of the City to note include:

Groundwater Resources. Following the enactment of the 1980 Groundwater Code, renewable surface water sources became the main component of the City's potable supply. The City's goal is to maximize the use of renewable surface water resources first and utilize groundwater second, as needed as a supplement during times of peak summer demand, drought, canal dry up, or unusual operational situations. Upon reaching buildout, surface water resources will be fully utilized, and it will be necessary to begin utilizing groundwater and stored underground water supplies as a base portion of the City's annual supply. At buildout the City will utilize approximately 20,000 acre-feet of groundwater annually which will account for roughly 12% of the City's annual supply.

Reclaimed Water Resources. The City utilizes its reclaimed water resources to improve its overall water resources balance. These resources are exchanged and recharged to earn storage credits and used for irrigation purposes which support sustainable groundwater pumping. The reclaimed water generated at the 91st Ave Wastewater Reclamation Plant (WWRP) is sold to the Palo Verde nuclear power plant. The reclaimed water generated at the Southeast and Greenfield WWRPs is used for irrigation on the Gila River Indian Community (GRIC) lands and is exchanged for CAP water. The reclaimed water generated at the Northwest WWRP is sent to the Granite Reef Underground Storage Project (GRUSP) for groundwater recharge when available; otherwise it is discharged to percolation ponds or back into the Salt River. Due to groundwater mounding in the area, GRUSP is not always available for recharge. Based on historical data, it was assumed that only 5,000 acre-feet is available for recharge at GRUSP from the NWWRP and that the remaining approximate 4,500 acre-feet is wasted to the river without counting as a recharge credit.

The exchange agreement with the GRIC allows up to 29,400 acre-feet of reclaimed water to be exchanged annually for CAP water. When this agreement was negotiated, the wastewater to water return ratio was much higher than it is at present due to water efficiencies of newer plumbing fixtures. Using the current wastewater return rates of average daily water demand, it is projected at buildout that the City will only be sending 16,027 acre-feet of water per year to the GRIC. A separate analysis will look at the benefit and feasibility of sending reclaimed water generated at the NWWRP to the GRIC for CAP water exchange.

New Conservation Space (NCS) Resources. The City of Mesa has a fifteen (15) percent ownership in the Additional Active Conservation Capacity (AACC) of the Modified Roosevelt Dam, commonly referred to as the "New Conservation Space" or "NCS". This percent ownership equates to approximately 41,000 acre-feet of additional surface water storage capacity available to the City at Roosevelt Dam. Mesa's permit to appropriate this water is listed at the lesser of 67,958 acre-feet, or its share of the maximum amount of water that may be captured in the NCS between October 1st and September 30th, depending on whether there are multiple fills in any given water year. This volume was calculated by model runs forecasting future supply and demand in the year 2035 which was undertaken by the Salt River Project and the other cities that participated in the modification project. Mesa has a permit to appropriate this water and is in the process of beneficially using it to perfect this right. ADWR estimated the annual average volume of 12,500 acre-feet per year for the City's designation. However, to perfect this water right volume, the City must be prepared to take delivery of up to the full amount of 41,000 acre-feet or even 67,958 acre-feet in those years when available.

2.3 SUPPLY VERSUS DEMAND

Table 2-6 shows a comparison of available water resources versus base year, intermediate, and buildout demands.

Table 2-6: Demand versus Available Resource in acre-feet

On-Project	**2018**	**2028**	**2040**
Supply (SRP)	62,111	65,386	69,315
Supply (Groundwater) (1)	5,300	5,800	6,400
On-Project Supply Total	67,411	71,186	75,715
On-Project Demand	43,634	48,105	53,471
Difference Supply to Demand (acre-ft) =	**23,777**	**23,080**	**22,244**
Off-Project			
Supply (CAP)	62,155	68,656	72,668
Supply (Groundwater) (2)	16,593	16,093	15,493
Off-Project Supply Total	78,748	84,779	88,161
Off Project Demand	51,580	69,320	90,608
Difference Supply to Demand (acre-ft) =	**27,168**	**15,429**	**-2,447**

Notes:
(1) Groundwater is used in the City Zone for annual VVWTP maintenance and SRP Canal outages. 5,300 acre-feet is based on average of last 6 years and accounts for 12% of the On-Project water demand. 12% of the On-Project water demand was used for the needed groundwater supply in the On-Project water resource calculations for the intermediate and buildout planning years.
(2) The available Off-Project groundwater supply is equal to the total estimated Groundwater resources (21,893 af/yr) minus the On-Project Groundwater Supply. Currently, groundwater is used Off-Project for CAP dry-ups, WTP outages, and to meet base demand. Once the SBWTP is operational, groundwater will be used as backup to supplement peak summer demand, CAP dry-ups and unusual operational situations.

The following observations can be made from Table 2-6 with regard to meeting water demand and the City's water resource utilization goals:

- On-Project SRP supply is significantly greater than On-Project demands today and through buildout, providing a secure supply for the On-Project portion of the City's WSA. It should be noted that the SRP resource in excess of On-Project demand cannot be transferred and utilized Off-Project.
- The City's CAP supply currently exceeds the Off-Project demands. However, at buildout CAP resources fall short of meeting projected Off-Project demand and must therefore be supplemented with groundwater pumping on the order of 18,000 ac-ft/year which exceeds the groundwater available. The deficit will have to be made up by utilizing additional long-term storage credits that are to be held in reserve for a drought. This

underscores the importance of the reclaimed water resources which are to be recharged to support projected groundwater pumping.

- NCS resources were not listed in Table 2-6 as they are not available every year but only in years of above average run-off on the SRP watershed. However, in those years when available, they could be utilized to reduce Off-Project groundwater pumping and/or consumption of more expensive CAP resources. This could be accomplished by recharge and recovery of groundwater, or treatment at the Val Vista Water Treatment Plant (VVWTP) and pumping through Transfer Station 1 (TS1) and Transfer Station 3 (TS3).

2.4 WATER PRODUCTION PLANS

To properly size the treatment plants and wells which will produce the City's daily supply of potable water, Water Production Plans were developed showing the manner in which seasonal variations in demands are to be met from the City's resources. Through an iterative process, a series of water production plans were prepared for the Base Year (2018), Intermediate Year (2028) and Buildout (2040). These plans list the scenarios/plans analyzed, as follows:

- Analyzed the interaction of supply versus demand on an annual and seasonal basis and assessed the ability to meet projected demands through buildout.

- Determined the configuration and capacity of surface water and groundwater production facilities which will provide for robust system operation across the projected range of demand and resource conditions.

- Established seasonal operating plans for wells and water treatment plants which became the starting point for hydraulic analysis and design of supply, treatment, and distribution system elements.

Within each of the Water Production Plans, the operating levels established for the City's water production facilities must achieve the following:

- Balance production and demand for each monthly variation in accordance with established seasonal patterns.

- Overcome limitations and constraints on the availability of water supplies for both monthly and annual totals.

Using the supplies available by production facility, water production was totaled for the selected facilities and balanced against demand for each month over the course of a year to properly assess annual water consumption, seasonal peaking and determine the peak production capacity required for each facility. Table 2-7 through Table 2-9 present the resulting Water Production Plans showing the proposed manner by which resource and operating criteria are to be met over the course of a year under normal supply conditions. Normal supply conditions were assumed to be as shown in Table 2-6, where there is neither a shortage in surface water resources brought on by drought nor a surplus as would be the case when NCS resources are available.

TABLE 2-7: 2018 ANNUAL WATER RESOURCES TO PRODUCTION BALANCE

2018

	Annual Average af/yr	Annual Average mgd	January Peaking Factor	January Flowrate (mgd)	February Peaking Factor	February Flowrate (mgd)	March Peaking Factor	March Flowrate (mgd)	April Peaking Factor	April Flowrate (mgd)	May Peaking Factor	May Flowrate (mgd)	June Peaking Factor	June Flowrate (mgd)	**July (max month) Peaking Factor**	**July (max month) Flowrate (mgd)**	August Peaking Factor	August Flowrate (mgd)	September Peaking Factor	September Flowrate (mgd)	October Peaking Factor	October Flowrate (mgd)	**November (Dry-Up) Peaking Factor**	**November (Dry-Up) Flowrate (mgd)**	December Peaking Factor	December Flowrate (mgd)
D E M A N D																										
City Zone	43,642	38.96	0.71	27.7	0.73	28.4	0.80	31.2	0.95	37.0	1.15	44.8	1.3	50.6	**1.3**	50.6	1.22	47.5	1.12	43.6	1.05	40.9	**0.91**	35.5	0.76	29.6
Total Mesa On Project (SRP)	**43,642**	**38.96**		**27.7**		**28.4**		**31.2**		**37.0**		**44.8**		**50.6**		**50.6**		**47.5**		**43.6**		**40.9**		**35.5**		**29.6**
Falcon Field Zone	18,552	16.56		11.8		12.1		13.2		15.7		19.0		21.5		21.5		20.2		18.5		17.4		15.1		12.6
Desert Wells Zone	21,167	18.90		13.4		13.8		15.1		18.0		21.7		24.6		24.6		23.1		21.2		19.8		17.2		14.4
Desert Sage Zone	7,410	6.61		4.7		4.8		5.3		6.3		7.6		8.6		8.6		8.1		7.4		6.9		6.0		5.0
County Line Zone	2,709	2.42		1.7		1.8		1.9		2.3		2.8		3.1		3.1		2.9		2.7		2.5		2.2		1.8
Apache Junction Zone	1,166	1.04		0.7		0.8		0.8		1.0		1.2		1.4		1.4		1.3		1.2		1.1		0.9		0.8
Range Rider Zone	377	0.34		0.2		0.2		0.3		0.3		0.4		0.4		0.4		0.4		0.4		0.4		0.3		0.3
Highlands Zone	115	0.10		0.1		0.1		0.1		0.1		0.1		0.1		0.1		0.1		0.1		0.1		0.1		0.1
Total Mesa Off Project (CAP)	**51,495**	**45.97**		**32.6**		**33.6**		**36.8**		**43.7**		**52.9**		**59.8**		**59.8**		**56.1**		**51.5**		**48.3**		**41.8**		**34.9**
Other IAG - AZWC (Off)	0	0.00		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0
Other IAG - AJ (Off)	0	0.00		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0
Total Interagency (IAG)	**0**	**0.00**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**
Total System Demand =	95,137	84.9		60.3		62.0		67.9		80.7		97.7		110.4		110.4		103.6		95.1		89.2		77.3		64.5
Max Day Demand =			1.23	74.2	1.23	76.3	1.23	83.6	1.23	99.2	1.23	120.1	1.23	135.8	1.23	135.8	1.23	127.4	1.23	117.0	1.23	109.7	1.23	95.1	1.23	79.4
P R O D U C T I O N	SRP Ratio	88%		96%		96%		96%		97%		97%		98%		98%		97%		97%		87%		0%		82%
Surface Water	CAP Ratio	86%		68%		68%		68%		68%		68%		94%		92%		94%		99%		99%		99%		98%
SRP - Val Vista WTP	38,354	34.2		26.5		27.2		30.0		35.8		43.6		49.4		49.4		46.3		42.4		35.7		0.0		24.4
Brown Road WTP	34,273	30.6		22.3		22.9		25.1		29.9		36.2		37.9		36.9		35.4		35.2		33.0		28.6		23.9
Signal Butte WTP	9,999	8.9		0.0		0.0		0.0		0.0		0.0		18.3		18.3		17.1		15.7		14.7		12.6		10.4
Total Surface Water Production =	82,625	73.8		48.8		50.2		55.1		65.7		79.8		105.6		104.6		98.8		93.3		83.4		41.2		58.7
Groundwater																										
VVWTP Service Area Wells	5,289	4.7		1.2		1.2		1.2		1.2		1.2		1.2		1.2		1.2		1.2		5.2		35.5		5.2
BRWTP Service Area Wells	112	0.1		0.1		0.1		0.1		0.1		0.1		0.1		0.1		0.1		0.1		0.1		0.1		0.1
SBWTP Service Area Wells	6,273	5.6		10.3		10.6		11.6		13.8		16.7		0.6		0.6		0.6		0.6		0.6		0.6		0.6
Total Groundwater Production =	11,674	10.4		11.6		11.9		12.9		15.1		18.0		1.9		1.9		1.9		1.9		5.9		36.2		5.9
Total Production =	94,299	84.2		60.4		62.1		68.0		80.8		97.8		107.5		106.5		100.7		95.2		89.3		77.4		64.6
Hydraulic Transfer (+ Off to On / - On to Off)=		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0
RESOURCE TRANSFER	Annual Balance (ac-ft)		(ac-ft)	(mgd)	(ac-ft)	(mgd)	(ac-ft)	(mgd)	(ac-ft)	(mgd)	(ac-ft)	(mgd)	(ac-ft)	(mgd)	(ac-ft)	(mgd)	(ac-ft)	(mgd)	(ac-ft)	(mgd)	(ac-ft)	(mgd)	(ac-ft)	(mgd)	(ac-ft)	(mgd)
(+ On Project & - Off Project)	0		0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	Running Balance =		0		0		0		0		0		0		0		0		0		0		0		0	

P R O D U C T I O N P L A N S

	MAX DAY JUNE/JULY PRODUCTION (mgd)	Peak		DEMAND (mgd)		MAX DAY NOVEMBER (with SRP Dry-Up) PRODUCTION (mgd)	Peak		DEMAND (mgd)		MAX DAY NOVEMBER (with CAP Dry-Up) PRODUCTION (mgd)	Peak		DEMAND (mgd)	
	Val Vista WTP =	**1.12**	**62.3**	62.3	Mesa On	Val Vista WTP =	**0.00**	**0.0**	43.6	Mesa On	Val Vista WTP =	**1.32**	**73.0**	43.6	Mesa On
	Brown Road WTP =	**1.33**	**50.4**	50.4	BR Area	Brown Road WTP =	**0.95**	**36.3**	35.3	BR Area	Brown Road WTP =	**0.00**	**0.0**	35.3	BR Area
	Signal Butte WTP =		**23.2**	23.2	SB Area	Signal Butte WTP =		**16.3**	16.3	SB Area	Signal Butte WTP =		**0.0**	16.3	SB Area
	On Project Wells =		**0.0**			On Project Wells =		**42.6**			On Project Wells =		**0.0**		
	Off Project Wells =		**0.0**			Off Project Wells =		**0.0**			Off Project Wells =		**22.2**		
	Total Production =		**136.0**	136.0	Total	Total Production =		**95.2**	95.2	Total	Total Production =		**95.2**	95.2	Total
	Hydraulic Transfer =		**0.0**	(+On & -Off)		Hydraulic Transfer =		**1.0**	(+On & -Off)		Hydraulic Transfer =		**-29.4**	(+On & -Off)	

A N N U A L A V E R A G E S U P P L Y U T I L I Z A T I O N[1]

	Available	Consumed	Unused
SW @ VV WTP=	62,111	38,354	23,757
SW @ CAP WTPs=	62,155	44,272	17,884
GW Credits =	21,893	11,674	10,219
Total =	146,159	94,299	51,860

Notes: (1) Annual Average Supply Utilization only includes City of Mesa WSA demands. AZWC, and Apache Junction demands are ommitted.

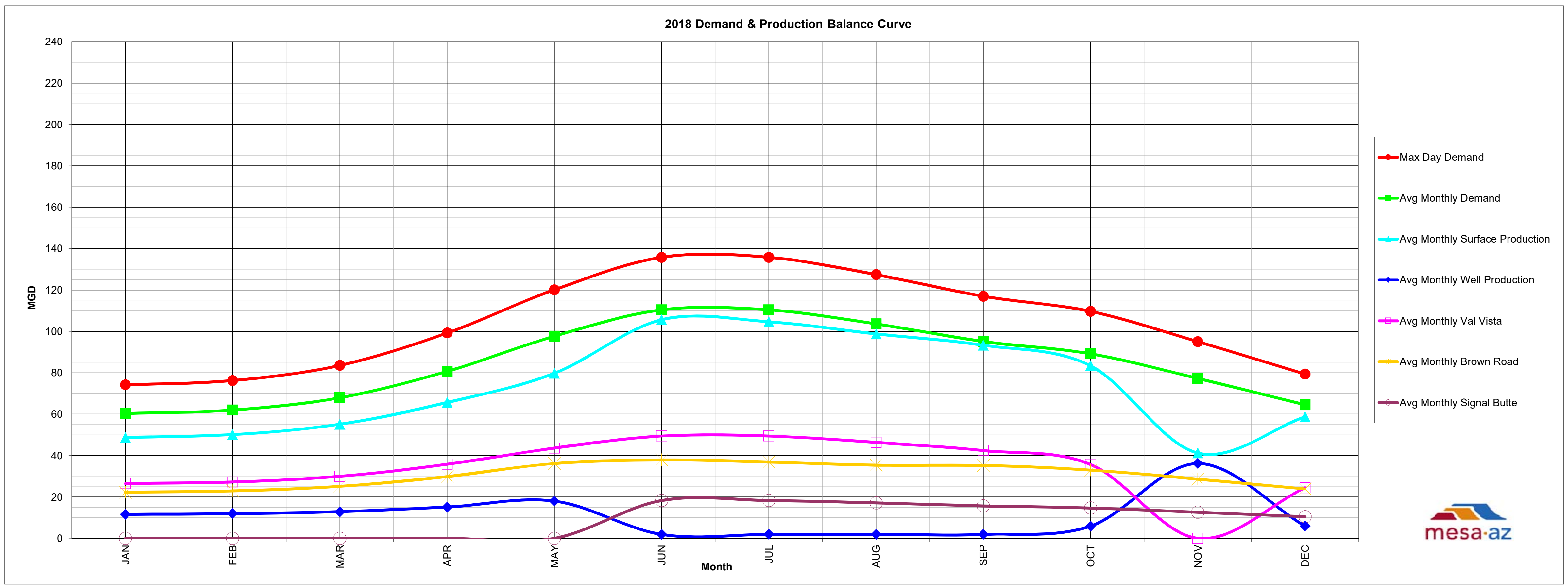


TABLE 2-8: 2028 ANNUAL WATER RESOURCES TO PRODUCTION BALANCE

2028

	Annual Average af/yr	Annual Average mgd	January Peaking Factor	January Flowrate (mgd)	February Peaking Factor	February Flowrate (mgd)	March Peaking Factor	March Flowrate (mgd)	April Peaking Factor	April Flowrate (mgd)	May Peaking Factor	May Flowrate (mgd)	June Peaking Factor	June Flowrate (mgd)	**July (max month) Peaking Factor**	**July (max month) Flowrate (mgd)**	August Peaking Factor	August Flowrate (mgd)	September Peaking Factor	September Flowrate (mgd)	October Peaking Factor	October Flowrate (mgd)	**November (Dry-Up) Peaking Factor**	**November (Dry-Up) Flowrate (mgd)**	December Peaking Factor	December Flowrate (mgd)
D E M A N D																										
City Zone	48,115	42.95	0.71	30.5	0.73	31.4	0.80	34.4	0.95	40.8	1.15	49.4	1.3	55.8	**1.3**	55.8	1.22	52.4	1.12	48.1	1.05	45.1	**0.91**	39.1	0.76	32.6
Total Mesa On Project (SRP)	**48,115**	**42.95**		**30.5**		**31.4**		**34.4**		**40.8**		**49.4**		**55.8**		**55.8**		**52.4**		**48.1**		**45.1**		**39.1**		**32.6**
Falcon Field Zone	24,244	21.64		15.4		15.8		17.3		20.6		24.9		28.1		28.1		26.4		24.2		22.7		19.7		16.4
Desert Wells Zone	29,853	26.65		18.9		19.5		21.3		25.3		30.6		34.6		34.6		32.5		29.8		28.0		24.3		20.3
Desert Sage Zone	9,067	8.09		5.7		5.9		6.5		7.7		9.3		10.5		10.5		9.9		9.1		8.5		7.4		6.2
County Line Zone	3,326	2.97		2.1		2.2		2.4		2.8		3.4		3.9		3.9		3.6		3.3		3.1		2.7		2.3
Apache Junction Zone	1,804	1.61		1.1		1.2		1.3		1.5		1.9		2.1		2.1		2.0		1.8		1.7		1.5		1.2
Range Rider Zone	604	0.54		0.4		0.4		0.4		0.5		0.6		0.7		0.7		0.7		0.6		0.6		0.5		0.4
Highlands Zone	226	0.20		0.1		0.1		0.2		0.2		0.2		0.3		0.3		0.2		0.2		0.2		0.2		0.2
Total Mesa Off Project (CAP)	**69,124**	**61.71**		**43.8**		**45.0**		**49.4**		**58.6**		**71.0**		**80.2**		**80.2**		**75.3**		**69.1**		**64.8**		**56.2**		**46.9**
Other IAG - AZWC (Off)	0	0.00		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0
Other IAG - AJ (Off)	0	0.00		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0
Total Interagency (IAG)	**0**	**0.00**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**
Total System Demand =	117,239	104.7		74.3		76.4		83.7		99.4		120.4		136.1		136.1		127.7		117.2		109.9		95.2		79.5
Max Day Demand =			1.23	91.4	1.23	94.0	1.23	103.0	1.23	122.3	1.23	148.0	1.23	167.3	1.23	167.3	1.23	157.0	1.23	144.2	1.23	135.2	1.23	117.1	1.23	97.8
P R O D U C T I O N	SRP Ratio	88%		96%		96%		96%		97%		97%		98%		98%		97%		97%		88%		0%		84%
Surface Water	CAP Ratio	99%		98%		98%		98%		98%		99%		99%		99%		99%		99%		99%		98%		98%
SRP - Val Vista WTP	42,336	37.8		29.1		30.0		33.0		39.5		48.0		54.5		54.5		51.1		46.8		39.8		0.0		27.3
Brown Road WTP	42,199	37.7		26.7		27.5		30.1		35.8		43.3		49.0		49.0		46.0		42.2		39.6		34.3		28.6
Signal Butte WTP	25,897	23.1		16.1		16.6		18.3		21.9		26.7		30.3		30.3		28.4		26.0		24.3		21.0		17.3
Total Surface Water Production =	110,433	98.6		72.0		74.1		81.4		97.2		118.1		133.8		133.8		125.5		115.0		103.6		55.2		73.2
Groundwater																										
VVWTP Service Area Wells	5,778	5.2		1.3		1.3		1.3		1.3		1.3		1.3		1.3		1.3		1.3		5.3		39.1		5.3
BRWTP Service Area Wells	162	0.1		0.1		0.1		0.1		0.1		0.1		0.1		0.1		0.1		0.1		0.1		0.1		0.1
SBWTP Service Area Wells	1,075	1.0		1.0		1.0		1.0		1.0		1.0		1.0		1.0		1.0		1.0		1.0		1.0		1.0
Total Groundwater Production =	7,016	6.3		2.5		2.5		2.5		2.5		2.5		2.5		2.5		2.5		2.5		6.5		40.2		6.5
Total Production =	117,448	104.8		74.4		76.5		83.9		99.6		120.6		136.3		136.3		127.9		117.4		110.1		95.4		79.7
Hydraulic Transfer (+ Off to On / - On to Off)=		0.0		0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0
RESOURCE TRANSFER	Annual Balance (ac-ft)		(ac-ft)	(mgd)	(ac-ft)	(mgd)	(ac-ft)	(mgd)	(ac-ft)	(mgd)	(ac-ft)	(mgd)	(ac-ft)	(mgd)	(ac-ft)	(mgd)	(ac-ft)	(mgd)	(ac-ft)	(mgd)	(ac-ft)	(mgd)	(ac-ft)	(mgd)	(ac-ft)	(mgd)
(+ On Project & - Off Project)	0		0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	Running Balance =		0		0		0		0		0		0		0		0		0		0		0		0	

P R O D U C T I O N P L A N S

M A X D A Y J U N E / J U L Y — P R O D U C T I O N (mgd)	Peak		DEMAND (mgd)	
Val Vista WTP =	1.18	68.7	68.7	Mesa On
Brown Road WTP =	1.62	60.5	60.5	BR Area
Signal Butte WTP =		38.5	38.5	SB Area
On Project Wells =		0.0		
Off Project Wells =		0.0		
Total Production =		167.8	167.8	Total
Hydraulic Transfer =		0.0	(+On & -Off)	

M A X D A Y N O V E M B E R (with SRP Dry-Up) — P R O D U C T I O N (mgd)	Peak		DEMAND (mgd)	
Val Vista WTP =	0.00	0.0	48.1	Mesa On
Brown Road WTP =	1.13	42.3	42.3	BR Area
Signal Butte WTP =		27.0	27.0	SB Area
On Project Wells =		48.1		
Off Project Wells =		0.0		
Total Production =		117.4	117.4	Total
Hydraulic Transfer =		0.0	(+On & -Off)	

M A X D A Y N O V E M B E R (with CAP Dry-Up) — P R O D U C T I O N (mgd)	Peak		DEMAND (mgd)	
Val Vista WTP =	1.37	80.0	48.1	Mesa On
Brown Road WTP =	0.00	0.0	42.3	BR Area
Signal Butte WTP =		0.0	27.0	SB Area
On Project Wells =		0.0		
Off Project Wells =		37.4		
Total Production =		117.4	117.4	Total
Hydraulic Transfer =		-31.9	(+On & -Off)	

A N N U A L A V E R A G E S U P P L Y U T I L I Z A T I O N (1)	Available	Consumed	Unused
SW @ VV WTP=	65,386	42,336	23,049
SW @ CAP WTPs=	68,656	68,096	559
GW Credits =	21,893	7,016	14,877
Total =	155,934	117,448	38,486

Notes: (1) Annual Average Supply Utilization only includes City of Mesa WSA demands. AZWC, and Apache Junction demands are ommitted.

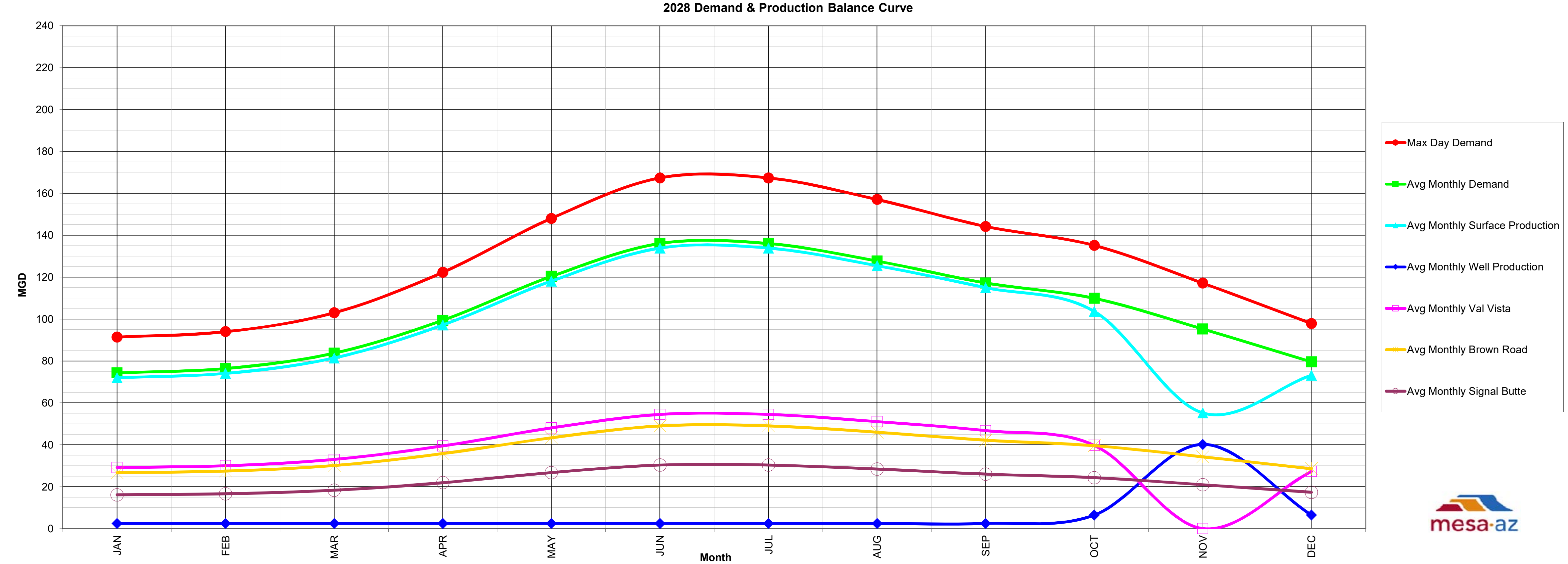


TABLE 2-9: 2040 ANNUAL WATER RESOURCES TO PRODUCTION BALANCE

2040

	Annual Average af/yr	Annual Average mgd	January Peaking Factor	January Flowrate (mgd)	February Peaking Factor	February Flowrate (mgd)	March Peaking Factor	March Flowrate (mgd)	April Peaking Factor	April Flowrate (mgd)	May Peaking Factor	May Flowrate (mgd)	June Peaking Factor	June Flowrate (mgd)
D E M A N D														
City Zone	53,482	47.74	0.71	33.9	0.73	34.9	0.80	38.2	0.95	45.4	1.15	54.9	1.3	62.1
Total Mesa On Project (SRP)	**53,482**	**47.74**		**33.9**		**34.9**		**38.2**		**45.4**		**54.9**		**62.1**
Falcon Field Zone	31,074	27.74		19.7		20.2		22.2		26.4		31.9		36.1
Desert Wells Zone	40,275	35.95		25.5		26.2		28.8		34.2		41.3		46.7
Desert Sage Zone	11,057	9.87		7.0		7.2		7.9		9.4		11.4		12.8
County Line Zone	4,067	3.63		2.6		2.7		2.9		3.4		4.2		4.7
Apache Junction Zone	2,571	2.29		1.6		1.7		1.8		2.2		2.6		3.0
Range Rider Zone	876	0.78		0.6		0.6		0.6		0.7		0.9		1.0
Highlands Zone	359	0.32		0.2		0.2		0.3		0.3		0.4		0.4
Total Mesa Off Project (CAP)	**90,279**	**80.59**		**57.2**		**58.8**		**64.5**		**76.6**		**92.7**		**104.8**
Other IAG - AZWC (Off)	3,921	3.50		2.5		2.6		2.8		3.3		4.0		4.6
Other IAG - AJ (Off)	5,601	5.00		3.6		3.7		4.0		4.8		5.8		6.5
Total Interagency (IAG)	**9,522**	**8.50**		**6.0**		**6.2**		**6.8**		**8.1**		**9.8**		**11.1**
Total System Demand =	153,283	136.8		97.2		99.9		109.5		130.0		157.4		177.9
Max Day Demand =			1.23	119.5	1.23	122.9	1.23	134.6	1.23	159.9	1.23	193.6	1.23	218.8
P R O D U C T I O N	SRP Ratio	88%		96%		96%		96%		97%		98%		98%
Surface Water	CAP Ratio	82%		89%		86%		85%		80%		80%		80%
SRP - Val Vista WTP	47,110	42.1		32.6		33.5		36.8		44.0		53.6		60.7
Brown Road WTP	58,026	51.8		38.1		39.2		42.9		49.2		57.9		66.0
Signal Butte WTP	24,131	21.5		18.2		16.9		17.4		18.8		23.9		27.2
Total Surface Water Production =	129,266	115.4		88.9		89.6		97.2		111.9		135.4		153.9
Groundwater														
VVWTP Service Area Wells	6,372	5.7		1.3		1.3		1.3		1.3		1.3		1.3
BRWTP Service Area Wells	2,308	2.1		0.1		0.1		0.1		2.0		4.0		4.0
SBWTP Service Area Wells	15,683	14.0		7.0		9.0		11.0		15.0		17.0		19.0
Total Groundwater Production =	24,363	21.7		8.5		10.5		12.5		18.3		22.3		24.3
Total Production =	153,629	137.1		97.4		100.1		109.7		130.3		157.7		178.3
Hydraulic Transfer (+ Off to On / - On to Off)=		0.0		0.0		0.0		0.0		0.0		0.0		0.0
RESOURCE TRANSFER	Annual Balance (ac-ft)		(ac-ft)	(mgd)	(ac-ft)	(mgd)	(ac-ft)	(mgd)	(ac-ft)	(mgd)	(ac-ft)	(mgd)	(ac-ft)	(mgd)
(+ On Project & - Off Project)	0		0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	Running Balance =		0		0		0		0		0		0	

	July (max month) Peaking Factor	**July (max month) Flowrate (mgd)**	August Peaking Factor	August Flowrate (mgd)	September Peaking Factor	September Flowrate (mgd)	October Peaking Factor	October Flowrate (mgd)	**November (Dry-Up) Peaking Factor**	**November (Dry-Up) Flowrate (mgd)**	December Peaking Factor	December Flowrate (mgd)
D E M A N D												
City Zone	**1.3**	62.1	1.22	58.2	1.12	53.5	1.05	50.1	**0.91**	43.4	0.76	36.3
Total Mesa On Project (SRP)		**62.1**		**58.2**		**53.5**		**50.1**		**43.4**		**36.3**
Falcon Field Zone		36.1		33.8		31.1		29.1		25.2		21.1
Desert Wells Zone		46.7		43.9		40.3		37.8		32.7		27.3
Desert Sage Zone		12.8		12.0		11.1		10.4		9.0		7.5
County Line Zone		4.7		4.4		4.1		3.8		3.3		2.8
Apache Junction Zone		3.0		2.8		2.6		2.4		2.1		1.7
Range Rider Zone		1.0		1.0		0.9		0.8		0.7		0.6
Highlands Zone		0.4		0.4		0.4		0.3		0.3		0.2
Total Mesa Off Project (CAP)		**104.8**		**98.3**		**90.3**		**84.6**		**73.3**		**61.2**
Other IAG - AZWC (Off)		4.6		4.3		3.9		3.7		3.2		2.7
Other IAG - AJ (Off)		6.5		6.1		5.6		5.3		4.6		3.8
Total Interagency (IAG)		**11.1**		**10.4**		**9.5**		**8.9**		**7.7**		**6.5**
Total System Demand =		177.9		166.9		153.3		143.7		124.5		104.0
Max Day Demand =	1.23	218.8	1.23	205.3	1.23	188.5	1.23	176.7	1.23	153.2	1.23	127.9
P R O D U C T I O N		98%		98%		97%		87%		0%		83%
Surface Water		79%		79%		79%		82%		87%		90%
SRP - Val Vista WTP		60.7		56.9		52.1		43.8		0.0		29.9
Brown Road WTP		66.0		61.7		56.3		54.6		48.9		40.8
Signal Butte WTP		25.2		24.4		22.8		22.3		21.3		20.0
Total Surface Water Production =		151.9		143.0		131.3		120.7		70.2		90.7
Groundwater												
VVWTP Service Area Wells		1.3		1.3		1.3		6.3		43.4		6.3
BRWTP Service Area Wells		4.0		4.0		4.0		2.0		0.1		0.1
SBWTP Service Area Wells		21.0		19.0		17.0		15.0		11.0		7.0
Total Groundwater Production =		26.3		24.3		22.3		23.3		54.6		13.5
Total Production =		178.3		167.3		153.6		144.0		124.8		104.2
Hydraulic Transfer (+ Off to On / - On to Off)=		0.0		0.0		0.0		0.0		0.0		0.0
RESOURCE TRANSFER	(ac-ft)	(mgd)	(ac-ft)	(mgd)	(ac-ft)	(mgd)	(ac-ft)	(mgd)	(ac-ft)	(mgd)	(ac-ft)	(mgd)
(+ On Project & - Off Project)	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Running Balance =	0		0		0		0		0		0	

P R O D U C T I O N P L A N S

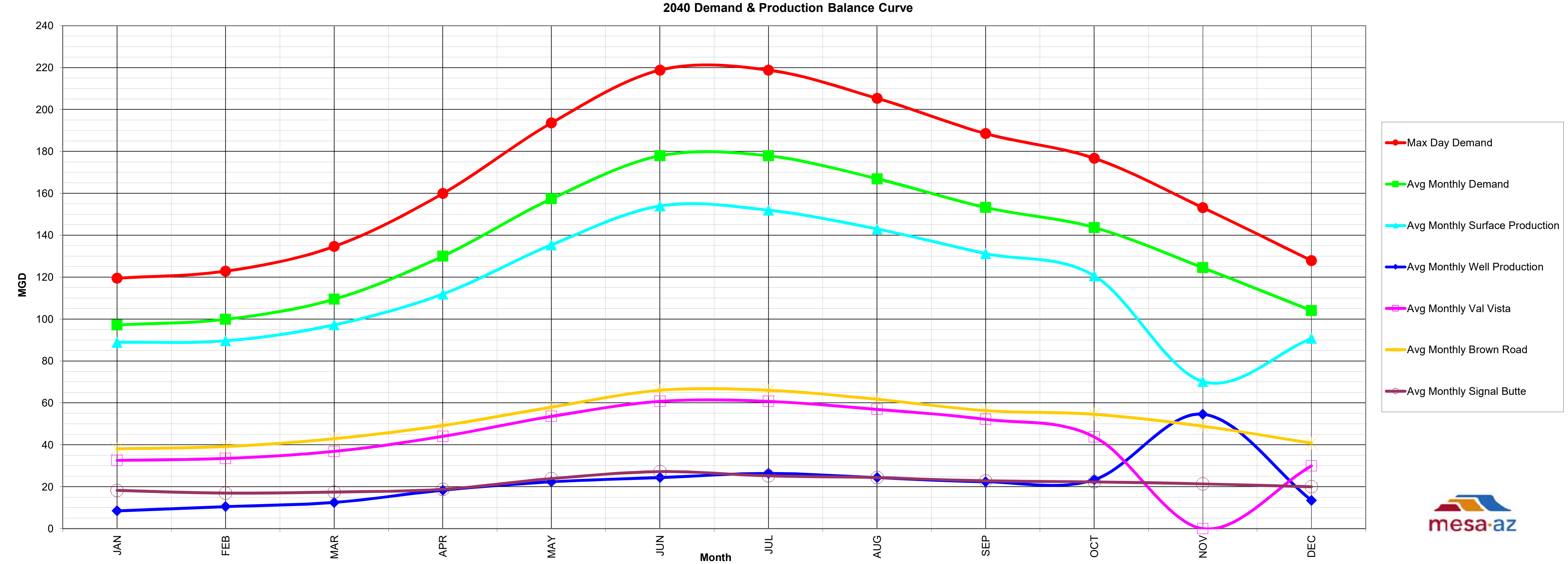
M A X D A Y J U N E / J U L Y — P R O D U C T I O N (mgd)	Peak		DEMAND (mgd)	
Val Vista WTP =	**1.23**	**76.4**	76.4	Mesa On
Brown Road WTP =	**1.85**	**72.0**	86.2	BR Area
Signal Butte WTP =		**48.0**	56.9	SB Area
On Project Wells =		**0.0**		
Off Project Wells =		**23.0**		
Total Production =		**219.4**	219.4	Total
Hydraulic Transfer =		**0.0**	(+On & -Off)	

M A X D A Y N O V E M B E R (with SRP Dry-Up) — P R O D U C T I O N (mgd)	Peak		DEMAND (mgd)	
Val Vista WTP =	**0.00**	**0.0**	53.4	Mesa On
Brown Road WTP =	**1.63**	**65.8**	60.3	BR Area
Signal Butte WTP =		**39.8**	39.8	SB Area
On Project Wells =		**47.9**		
Off Project Wells =		**0.0**		
Total Production =		**153.5**	153.5	Total
Hydraulic Transfer =		**5.5**	(+On & -Off)	

M A X D A Y N O V E M B E R (with CAP Dry-Up) — P R O D U C T I O N (mgd)	Peak		DEMAND (mgd)	
Val Vista WTP =	**1.45**	**90.0**	53.4	Mesa On
Brown Road WTP =	**0.00**	**0.0**	60.3	BR Area
Signal Butte WTP =		**0.0**	39.8	SB Area
On Project Wells =		**17.3**		
Off Project Wells =		**46.2**		
Total Production =		**153.5**	153.5	Total
Hydraulic Transfer =		**-53.9**	(+On & -Off)	

A N N U A L A V E R A G E S U P P L Y U T I L I Z A T I O N (1)	Available	Consumed	Unused
SW @ VV WTP=	69,315	47,110	22,206
SW @ CAP WTPs=	72,668	72,635	34
GW Credits =	21,893	24,363	-2,470
Total =	163,876	144,107	19,769

Notes: (1) Annual Average Supply Utilization only includes City of Mesa WSA demands. AZWC, and Apache Junction demands are ommitted.



2.4.1 Water Production Capacity and Phasing

Table 2-10 summarizes the demand placed upon each key component of water production infrastructure for the Base Year, Intermediate Year and Buildout scenarios. The Table also illustrates the recommended facility rating such that demands will be met with sufficient reserve capacity under normal seasonal conditions and normal canal dry-ups.

Table 2-10: Recommended Production Ratings and Reserve Capacity

	Available Capacity (mgd)	Production Plan			
		Annual Average (mgd)	Max Day (mgd)	Nov CAP Dry-up (mgd)	Nov SRP Dry-up (mgd)
Base Year (2018) Scenario					
Demand					
On-Project Demand		39	62	44	44
Off-Project Demand		46	74	51	51
Total Demand		**85**	**136**	**95**	**95**
Production Source					
Val Vista WTP	90	34	62	73	0
BRWTP	72	30	50	0	36
SBWTP (after June 2018)	24	9	24	0	16
On-Project Wells (Firm - 80%)	43	5	0	0	43
Off-Project Wells (Firm - 80%)	23	6	0	22	0
Total Production	**252**	**85**	**136**	**95**	**95**
Hydraulic Transfer (On to Off - / Off to On +)		0	0	-29	1
Intermediate Year (2028) Scenario					
Demand					
On-Project Demand		43	69	48	48
Off-Project Demand		62	99	69	69
Total Demand		**105**	**168**	**117**	**117**
Production Source					
Val Vista WTP	90	38	69	80	0
BRWTP	72	38	61	0	42
SBWTP	48	22	38	0	27
On-Project Wells (Firm - 80%)	48	5	0	0	48
Off-Project Wells (Firm - 80%)	40	2	0	37	0
Total Production	**298**	**105**	**168**	**117**	**117**
Hydraulic Transfer (On to Off - / Off to On +)		0	0	-32	0

	Available Capacity (mgd)	Production Plan			
		Annual Average (mgd)	Max Day (mgd)	Nov CAP Dry-up (mgd)	Nov SRP Dry-up (mgd)
Buildout (2040) Scenario					
Demand					
On-Project Demand		48	76	54	54
Off-Project Demand		89	143	100	100
Total Demand		**137**	**219**	**154**	**154**
Production Source					
Val Vista WTP	90	42	76	90	0
BRWTP	72	52	72	0	66
SBWTP	48	21	48	0	40
On-Project Wells (Firm - 80%)	48	6	0	18	48
Off-Project Wells (Firm - 80%)	46	16	23	46	0
Total Production	**304**	**137**	**219**	**154**	**154**
Hydraulic Transfer (On to Off - / Off to On +)		0	0	-54	6

The recommended capacity and phasing of water production facilities shown in Table 2-10 has changed very little from the Water Production Plans in previous Master Plan Updates, except the following revision:

- The construction of the first phase of the Signal Butte Water Treatment Plant is scheduled to come online in May 2018. The second phase expansion of Signal Butte WTP is recommended to come on line in 2025.

2.4.2 Critical Phasing

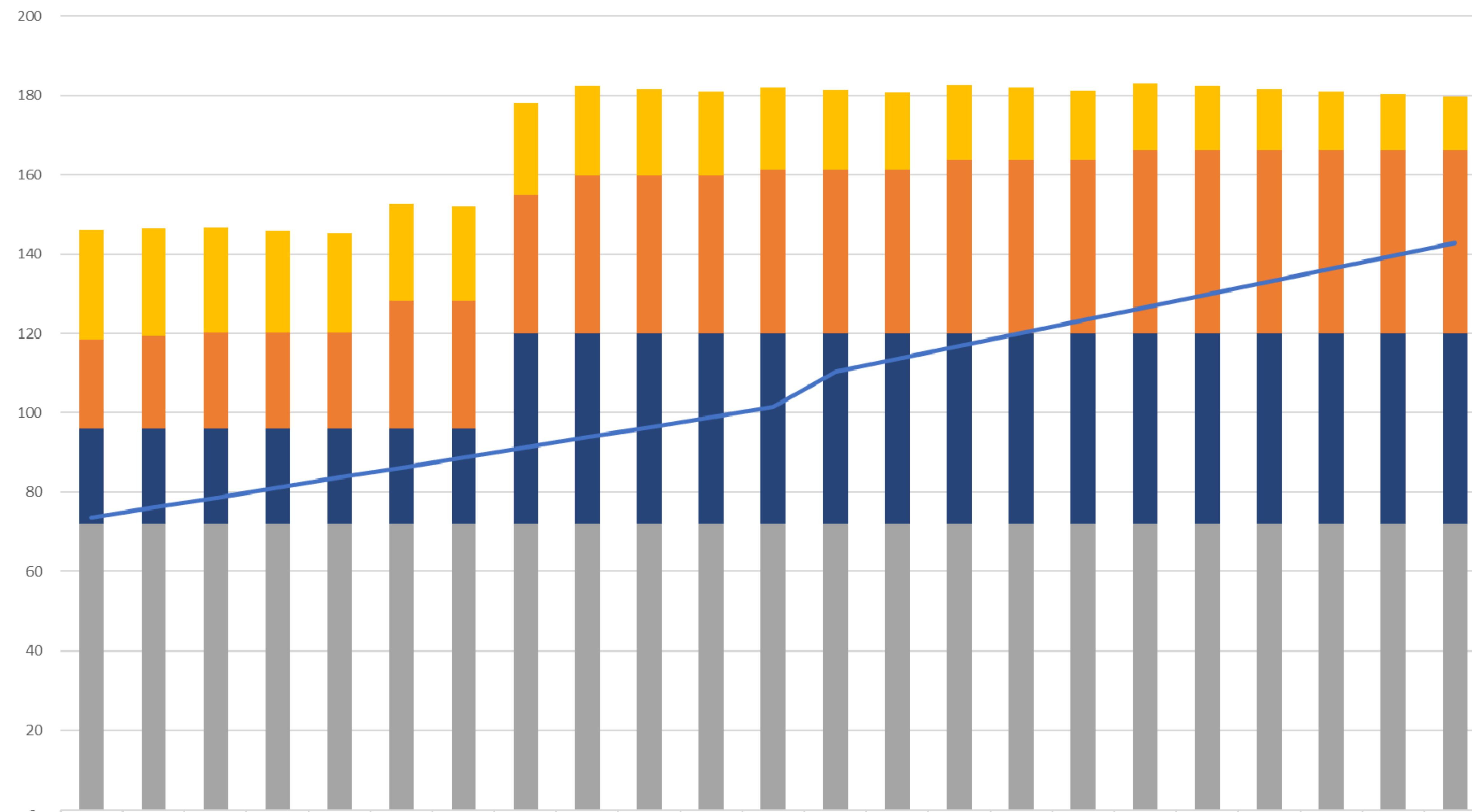
To ensure that programmed expansions for production and distribution facilities provide adequate capacity, a year-by-year analysis was done under Max Day and CAP Dry-up conditions, from Base Year to Buildout. This analysis looked only at Off-Project (eastern zones) production versus demand as the On-Project City Zone is essentially built-out and further expansions of On-Project production capacity are not required. Transfer capacity (from On-Project to Off-Project) is included in the analysis as it can be utilized to temporarily supplement Off-Project production capacity. Table 2-11 and Table 2-12 show the recommended phasing of production and transfer capacity needed to stay ahead of Off-Project demand under Max Day and CAP Dry-up conditions. The following observations and notes are provided:

Max Day Hydraulics. Table 2-11 shows a larger than needed margin of production and transfer capacity. However, it must be noted that groundwater and transfer capacity are governed by CAP Dry-up needs, which results in having more production and pumping capacity than is needed during a MD demand. Production and distribution planning calls for the full capacity of the transfer stations to be used only to offset the loss of the Brown Rd. WTP such as during a CAP dry-up or emergency outage (Table 2-12).

Signal Butte WTP. The first phase of Signal Butte WTP is scheduled to come online May 2018. The second phase is scheduled for 2025 and is subject to future bond authorizations and demand growth in southeast Mesa. Groundwater will be needed to provide the balance of water during peak demand periods until the plant can be expanded.

CAP Dry-up. The phasing of production and transfer capacity are governed by the controlling demand condition, either Max Day or CAP Dry-up. Generally, it was found that CAP Dry-up was the critical requirement which requires expanding groundwater production capacity and transfer capacity. This can be seen in Table 2-12, where the combination of groundwater production and transfer capacity lead the production requirement by a small, but sufficient margin.

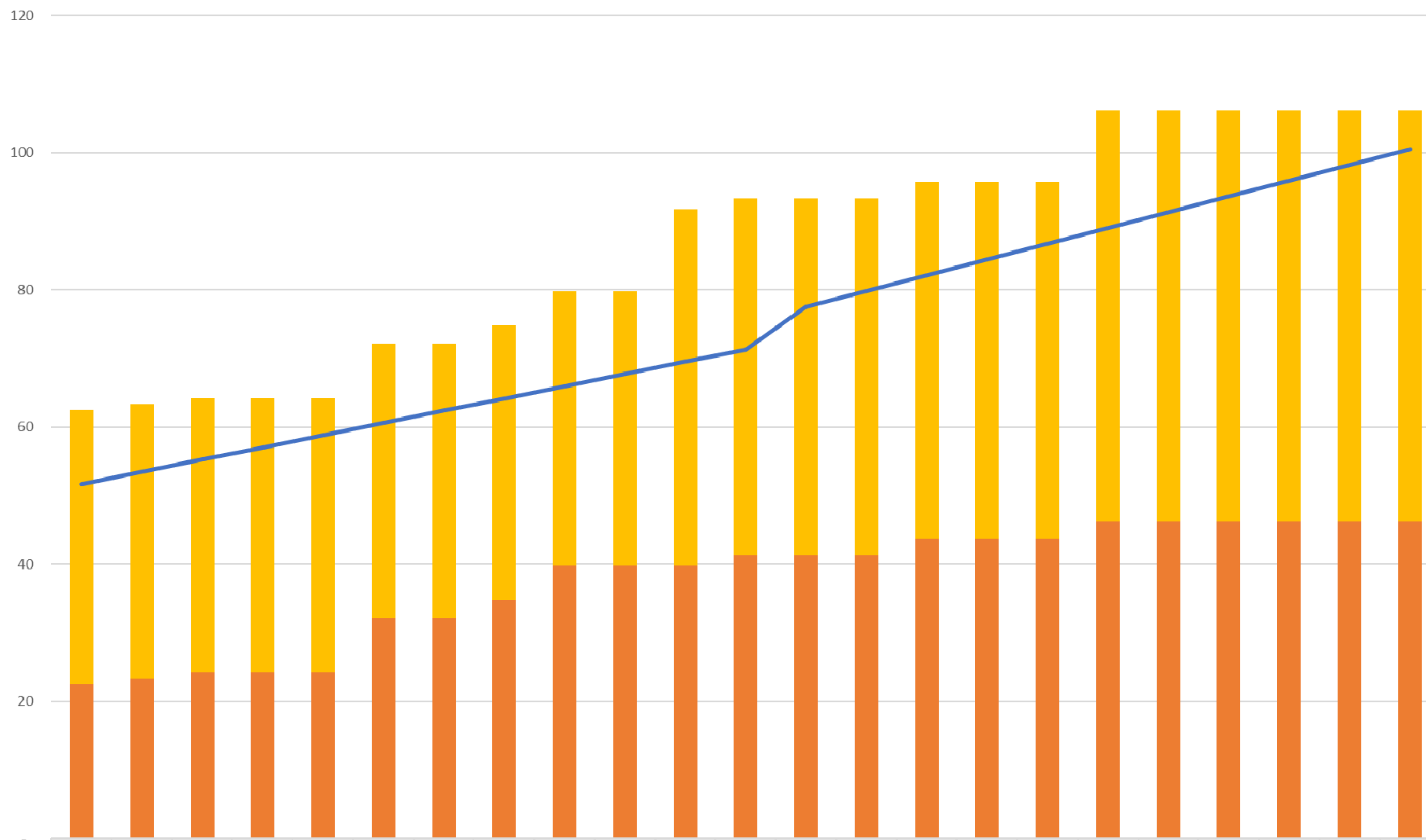
Table 2-11: Off-Project Production Capacity MD



	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
On-Off Transfer Available at MD [(1)], mgd	27.7	27.0	26.4	25.8	25.1	24.5	23.8	23.2	22.6	21.9	21.3	20.7	20.0	19.4	18.7	18.1	17.5	16.8	16.2	15.6	14.9	14.3	13.6
Eastern Zone Wells Firm Capacity [(2)], mgd	22.6	23.4	24.2	24.2	24.2	32.2	32.2	34.9	39.8	39.8	39.8	41.4	41.4	41.4	43.8	43.8	43.8	46.2	46.2	46.2	46.2	46.2	46.2
SBWTP Capacity, mgd	24.0	24.0	24.0	24.0	24.0	24.0	24.0	48.0	48.0	48.0	48.0	48.0	48.0	48.0	48.0	48.0	48.0	48.0	48.0	48.0	48.0	48.0	48.0
BRWTP Capacity, mgd	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0
Off-Project MD Demand, mgd	73.6	76.1	78.6	81.2	83.7	86.2	88.8	91.3	93.8	96.4	98.9	101.4	110.3	113.6	116.8	120.1	123.3	126.6	129.9	133.1	136.4	139.6	142.9

Notes:
(1) Available capacity for On/Off transfer is Mesa's portion of the production capacity at the VVWPT (90 mgd) minus the MD demand of the City Zone.
(2) See Table 4-2 for details about well capacity for each planning year.

Table 2-12: Off-Project Production Capacity CAP Dry-Up (Nov MD Demand)



	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
On-Off Transfer Firm Capacity [(1)], mgd	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	52.0	52.0	52.0	52.0	52.0	52.0	52.0	60.0	60.0	60.0	60.0	60.0	60.0
Eastern Zone Wells Firm Capacity [(2)], mgd	22.6	23.4	24.2	24.2	24.2	32.2	32.2	34.9	39.8	39.8	39.8	41.4	41.4	41.4	43.8	43.8	43.8	46.2	46.2	46.2	46.2	46.2	46.2
Off-Project Nov MD Demand, mgd	51.7	53.5	55.3	57.1	58.9	60.6	62.4	64.2	66.0	67.8	69.5	71.3	77.5	79.8	82.1	84.4	86.7	89.0	91.3	93.6	95.9	98.2	100.5

Notes:
(1) See Table 3-7 for Trasfer Station pumping capacities and projected improvements.
(2) See Table 4-2 for details about well capacity for each planning year.

2.4.3 Maximum Sustainable Drought

Prolonged drought may result in reductions in SRP and/or CAP surface water deliveries. Such a reduction would impact both water resources and production infrastructure. In drought years, a reduction in surface water supplies would be offset with increased groundwater pumping. Projections show that if the City continues to bank an average of 5,000 acre-feet of long-term storage credits in years of normal supply, groundwater reserves will be available to offset significant reductions in surface water deliveries during drought years. The potentially more difficult issue in times of drought is not the availability of back-up resources (i.e. groundwater credits), but rather the available production and pumping capacity of back-up facilities such as wells and transfer stations.

During a drought, surface water resources may become reduced, if surface water supplies are not enough to meet the City's raw water order at the WTPs. The Arizona Water Banking Authority (AWBA) has spent hundreds of millions of dollars to store 3.2 million plus acre-feet of excess CAP water underground primarily to serve to CAP M&I and Indian Subcontractors during surface water shortages. However, depending on the costs of pumping and delivering this groundwater through the existing CAP water delivery system, the City may elect to meet water demand through increased groundwater pumping with City wells. With careful operations and sufficient groundwater credits, this method of operation can continue until the maximum rate of City groundwater pumping is reached. Any further reduction in surface water supplies that cannot be offset either with groundwater delivered through the canal or groundwater pumping within the City, could require restrictions in customer water usage.

To overcome SRP and CAP periodic dry-ups and prolonged surface water shortages caused by drought, the City is required to install and maintain a relatively large well production capacity of 82 mgd today and growing to 118 mgd by Build-out (See Table 4-2 for groundwater well production rates). Rather than estimating potential drought severity and frequency on the SRP and CAP systems, it was decided to first determine how severe of a drought can be weathered with the well capacity that is already planned and required to get the City through planned dry-ups. To develop this number, the normal annual groundwater production was subtracted from the annual groundwater production as a result of running the wells at their maximum sustainable rate. The maximum groundwater pumping rate, which could be realistically sustained year-round would be 75% of the firm well capacity (80% of installed), or 60% of total installed well capacity. The resulting maximum sustainable reduction in surface water supplies is shown by design year in Table 2-13 below. The projected well production rates must be matched in tandem with the annual legal withdrawal authorities.

Table 2-13: Maximum Sustainable Drought

	Base Year 2018	**Int. Year** 2028	**Build-out** 2040
Minimum Surface Water Requirement			
City of Mesa Annual Average Day Demand (af/yr)	95,210	117,430	144,080
Sustainable Groundwater Production (af/yr) (1)	55,310	74,120	79,500
Surface Water Required (af/yr) =	**39,900**	**43,310**	**64,580**
Normal Year Surface Water Supply			
Normal Year SRP Supply (2)	48,111	51,386	55,315
Normal Year CAP Supply (3)	62,155	68,656	72,668
Normal Year Surface Water (af/yr) =	**110,266**	**120,041**	**127,983**
Maximum Sustainable Reduction in Surface Supplies			
Maximum Sustainable Reduction in Supply (af/yr) =	**70,366**	**76,731**	**63,403**
Percent Reduction of Total Surface Supply =	**64%**	**64%**	**50%**
Percent Reduction of Normal SRP Supply =	100%	100%	100%
Percent Reduction of Normal CAP Supply =	100%	100%	87%

Notes:
(1) 75% of firm well capacity (60% of installed well capacity) for prolonged drought use.
(2) Normal year SRP supply is greater than On-Project demand, Mesa is only eligible for delivery of On-Project demand. Reported SRP supply equals estimated On-Project demand.
(3) Reported CAP supply is total available CAP supply to the City of Mesa, excluding wheeling water.

Table 2-13 shows that in 2018, the City could sustain a 64% reduction in normal surface water supply delivery without needing to restrict water usage. Sustainable drought capacity decreases to 50% percent of normal supplies at build-out. The reason this number is lower at build-out is because groundwater pumping is used to meet approximately 12% of AAD demand, leaving fewer idle wells available to offset a surface water shortage.

In 2018 the City could sustain a complete loss of either the SRP or CAP resource without needing to require water restrictions. By build out, the City can sustain either a 100% SRP supply reduction or an 87% CAP supply reduction (50% total surface water reduction) before requiring water restrictions. It should be noted, that these reductions could only be sustained with a highly planned operation of the City's production and distribution infrastructure and could not be possible during maximum day demands. It should also be noted that a CAP supply reduction would require On-Project to Off-Project transfers that would require permission from SRP and may be limited be installed transfer station capacity.

Since droughts are prolonged multi-year events it is unlikely that SRP would allow On-Project to Off-Project transfers over that time frame. In the event of a future multi-year drought the City would need to evaluate various drought mitigation options. At this time, it is recommended that no additional groundwater infrastructure be constructed solely for the purposes of drought mitigation. As the future years unfold and water supplies become more fully utilized, the issue of drought protection will need to be re-assessed considering the actual ability of the CAP and SRP to meet normal contracted deliveries.

2.4.4 Canal System Failure Response

A failure or unplanned outage of either the SRP or CAP canal system would be similar to the routine canal dry-up scenarios already considered provided that it occurs in the cooler months of the year when sufficient reserve production capacity is available. However, while the water production system has been planned around a dry-up of either the CAP or SRP canals during the winter months, peak summer demands are considerably higher than during the cooler months. Table 2-14 shows the effect of either a CAP or SRP system outage and the months for which restrictions would be required.

Table 2-14: Canal Failure Analysis

Total System Demand	**Base Year** 2018	**Int. Year** 2028	**Build-out** 2040
Average Day Demand (mgd)	85	105	137
Max Day Demand (mgd)	136	168	219
SRP System Failure affecting VVWTP			
City Zone Max Day Demand (mgd)	62	69	76
Lost VVWTP Production Capacity (mgd) (1)	(90)	(90)	(90)
80% On-Project Well Capacity (mgd)	43	48	48
Transfer Station Capacity (mgd)	15	12	0
Remaining Production Capacity (mgd)	58	60	48
Restrictions Required (mgd) (2)	-4	-9	-28
Months with Potential Shortfall	June-July	June-July	May-Oct
CAP System Failure affecting SBWTP & BRWTP			
Eastern Zone Max Day Demand	74	99	143
Lost SBWTP & BRWTP Production Capacity (1) (mgd)	(96)	(120)	(120)
80% Off-Project Well Capacity (mgd)	23	40	46
Transfer Station Capacity (mgd)	40	52	60
Remaining Production Capacity (mgd)	63	92	106
Restrictions Required (mgd) (2)	-11	-7	-37
Months with Potential Shortfall	June-Aug	June-July	May-Oct

Notes:
(1) Equals total surface and groundwater production capacity with 100% of surface water production available and 80% of groundwater production available.
(2) Based on a comparison of remaining production capacity against monthly peak day demands.

A loss of either canal system during the hotter months would leave the City unable to meet normal monthly peak demands without requiring use restrictions. Under these scenarios, demand would need to be cut back towards winter levels which can essentially be achieved by eliminating outdoor water uses (landscape irrigation, pool filling, car washing, etc.) while permitting continued indoor water use, (residential, commercial, and institutional) at normal levels, in accordance with the City adopted 2009 Drought Plan.

Given that unplanned outages of the canals should be infrequent, it is not believed to be practical to provide additional standby wells solely to guard against a summer-time canal failure. Should a canal system outage occur during the hotter months, mandatory water restrictions are recommended, in accordance with Stage 4 of the City's 2009 Drought Plan.

3.0 DISTRIBUTION INFRASTRUCTURE HYDRAULIC ANALYSIS

A series of hydraulic analyses were performed to confirm and/or refine the capacity and phasing required for the City's distribution system infrastructure. The starting point for the analyses was the recommended distribution system from the 2012 Water Master Plan Update.

The following sections provide a summary of the process to update the City's hydraulic model and the results from the Base-Year, Intermediate Year and Build-out hydraulic analyses.

3.1 DISTRIBUTION SYSTEM MODEL UPDATE AND EXISTING FACILITIES

As part of the 2010 Master Plan and the 2007 IDSE (Initial Distribution System Evaluation as part of Stage II Disinfectants and Disinfection Byproducts Rule requirements), Black & Veatch developed a water model using InfoWater version 8.5 by Innovyze. Since 2010, the City has used this model to aid in operations and has continually updated any changes to the system in this model. Black & Veatch performed extensive extended period simulation (EPS) calibration and the City has continued to refine the accuracy of the model.

3.1.1 Service Zones

Water system elevations within the City of Mesa service area range from approximately 1195 feet (City of Mesa Datum) in the southwest area to 2060 feet (City of Mesa Datum) in the northeast along the base of the Usery Mountains. The 2004 Master Plan divided the City's service area into eight major service zones. Since then, the City has made minor adjustments to the service zone boundaries to accommodate proposed highway alignments as well as small changes in the overall service area boundary. Those modifications to the service zones have been incorporated into the hydraulic model. Table 3-1 summarizes the service zone elevations and hydraulic grade line (HGL), which are illustrated on Exhibit A.

Table 3-1: Service Zones

Zone	Ground Elevation (ft)	Static Hydraulic Gradient Elevation (ft) (1)	Typical Pressure Range (psi) (2)
City Zone	1195-1290	1400	48-89
Falcon Field	1280-1410	1511	44-100
Desert Wells	1375-1525	1634	47-112
Desert Sage	1480-1635	1731	42-109
County Line	1575-1735	1836	44-113
Apache Junction	1685-1845	1941	42-110
Range Rider	1810-1920	2050	56-104
Highland	1905-2060	2164	45-112

Notes:

(1) The static HGL is the mean design HGL and will vary across the zone based on the time and day of the year.

(2) Where system pressures exceed 80 psi, water customers should install approved water pressure reducing valves.

In addition to the eight service zones, there are two boosted pressure zones in the City Zone referred to as City-Mini Zones. Several reduced pressure zones are located in the Desert Wells and Range Rider Zones.

3.1.2 Water Treatment Plants

There are currently three surface water treatment plants (WTPs) that serve the City, the Brown Road WTP, Signal Butte WTP, and Val Vista WTP, which are summarized in Table 3-2. It should be noted that Signal Butte WTP is currently under construction and is expected to be operational in June 2018. The existing WTPs are shown in Exhibit B.

Table 3-2: Base Year Water Treatment Plants

WTP	Source	2018 Rated Capacity (mgd)
Brown Road WTP	CAP	72
Signal Butte WTP	CAP	24
Val Vista WTP	SRP (South Canal)	90(1)

(1) Mesa owns 90 mgd of the total rated capacity of 220 mgd at Val Vista WTP.

3.1.3 Wells

To avoid mining of long term assured groundwater supply, the City's general philosophy in utilization of water resources is to minimize use of groundwater to meet demand, unless surface water alone cannot meet the water demand or provide desired water quality. There is currently approximately 83 mgd of installed well capacity, of which 66 mgd is firm capacity, available to supplement surface water sources (Table 4-2).

A number of the existing wells have been idled or used solely for irrigation due to poor water quality. The existing wells are shown in Exhibit B.

3.1.4 Reservoirs

There are nineteen localized storage reservoirs located throughout the distribution system providing a total storage capacity of approximately 109 million gallons. Existing storage reservoirs are shown in Exhibit B.

Each service zone contains at least one reservoir. The City has two types of storage facilities:

- Floating Storage – Water levels within floating storage reservoirs are equal to the zones' HGL. A Floating Storage Reservoir maintains a stable HGL within the zone by providing water to the distribution system by gravity during periods of peak demand, and filling with water from the distribution system during periods of lower demand.

- Ground Level Storage – Water levels in ground level reservoirs (aka "Dump and Repump" reservoirs) are located at or below the ground level and require pumps to pressurize the distribution system to the target zone HGL.

3.1.5 Transfer and Booster Pumping Stations

There are 22 existing pump stations throughout the water distribution system. Exhibit B shows their location and Figure 3-1 shows their configuration within the distribution system. Those labeled as Pumping Stations (PS) are generally located adjacent to reservoirs and pump water directly from ground level to the HGL of the zone served. Those labeled as Transfer Stations (TS) generally operate as in-line pumps and/or PRVs that transfer water directly from one pressure zone to another.

3.1.6 Pressure Reducing Valve Stations

Pressure Reducing Valve (PRV) Stations are located at zone splits and reduced pressure areas within zones to deliver water from the higher gradient zone to the lower gradient zone, with an associated reduction in the pressure. The City currently has 19 PRV stations throughout the water system. Table 3-3 summarizes the PRVs within the water distribution system. The existing in service PRVs are also shown in Exhibit B.

Table 3-3: Base Year PRVs

ID	ADDRESS	STATUS (1)	APPROX. INLET PRESSURE (PSI)	REDUCED OUTLET SETTING (PSI)	VALVE DIA.	SERVICE ZONE (FROM TO)
PRV3	758 N 58TH ST	IS	95-100	57	2.5”, 8”	DW to Dreamland Villas
PRV4	5925 E UNIVERSITY DR	IS	100-105	61	2.5”, 8”	DW to Dreamland Villas
PRV5	7147 E BROADWAY RD	IS	85-90	54	1.5”, 6”	DW to AZ Golf Resort
PRV6	830 S 75TH ST	IS	85-90	60	1.5”, 6”	DW to AZ Golf Resort (2)
PRV9	7601 E INVERNESS AVE	IS	90-95	51	8”	DW to FF (2)
PRV10	1939 S SOSSAMAN RD	IS	95-100	55	2.5”, 8”	DW to FF (2)
PRV13	2762 N WATURBURY	IS	110-115	81	2”, 6”	RR to Thunder Mountain
PRV14	3040 N HAWES RD	IS	105-110	75	2”, 6”	RR to Thunder Mountain
PRV17	3221 N 91ST ST	IS	100-105	50	2”, 6”	HL to RR (2)
PRV19	4031 N EL SERENO CIR	OS	-	-	4”, 8”	-
PRV26	2455 E MCDOWELL RD	IS	95-100	60	4”, 12”	FF to NE mini zone
PRV27	1935 S GREENFIELD RD	IS	95-100	69	4”, 10”	FF to SE mini zone
PRV28	6815 S ELLSWORTH RD	IS	90-95	51	12”, 12”	DW to FF (2)
PRV29	8351 E BASELINE RD	IS	80-85	47	2.5”, 6”	DW to FF (2)
PRV30	13303 S ELLSWORTH RD	OS	-	-	1.5”, 4”	-
PRV31	1834 E LEHI RD	IS	75-80	60	2.5”, 4”	NE mini zone to CZ for water quality and fire flow
PRV32	7039 E SIERRA MORENA CIR	OS	-	-	6”	-
PRV35	8720 E RAY RD	IS	90-100	56	8”, 8”	DW TO FF (2)
PRV36	3210 N VAL VISTA DR	IS	95-100	42	8”, 8”	FF to SE mini zone (2)

Notes:
(1) IS = In service, OS = Out of Service, OSO= Out of Service Open, UC = Under Construction, F = Future.
(2) Equipped with automatic valve controllers, which allows the operator to input a reduced pressure set point.

3.2 DEMAND ALLOCATION

Demands were allocated to the water model as part of the Water Master Plan Update using the same technique as previous master planning efforts. For a detailed explanation of the methods used to allocate demands, please refer to the 2010 Water Master Plan.

3.3 HYDRAULIC EVALUATIONS

This section provides an overview of the hydraulic analysis of the City of Mesa distribution system and the development of the recommended improvements for the 2018 Water Master Plan. The 2012 Water Master Plan infrastructure formed the starting point, which was then modified when necessary to accommodate the revised demand projections and production plans used in the 2018 Water Master Plan. The following hydraulic analyses were performed:

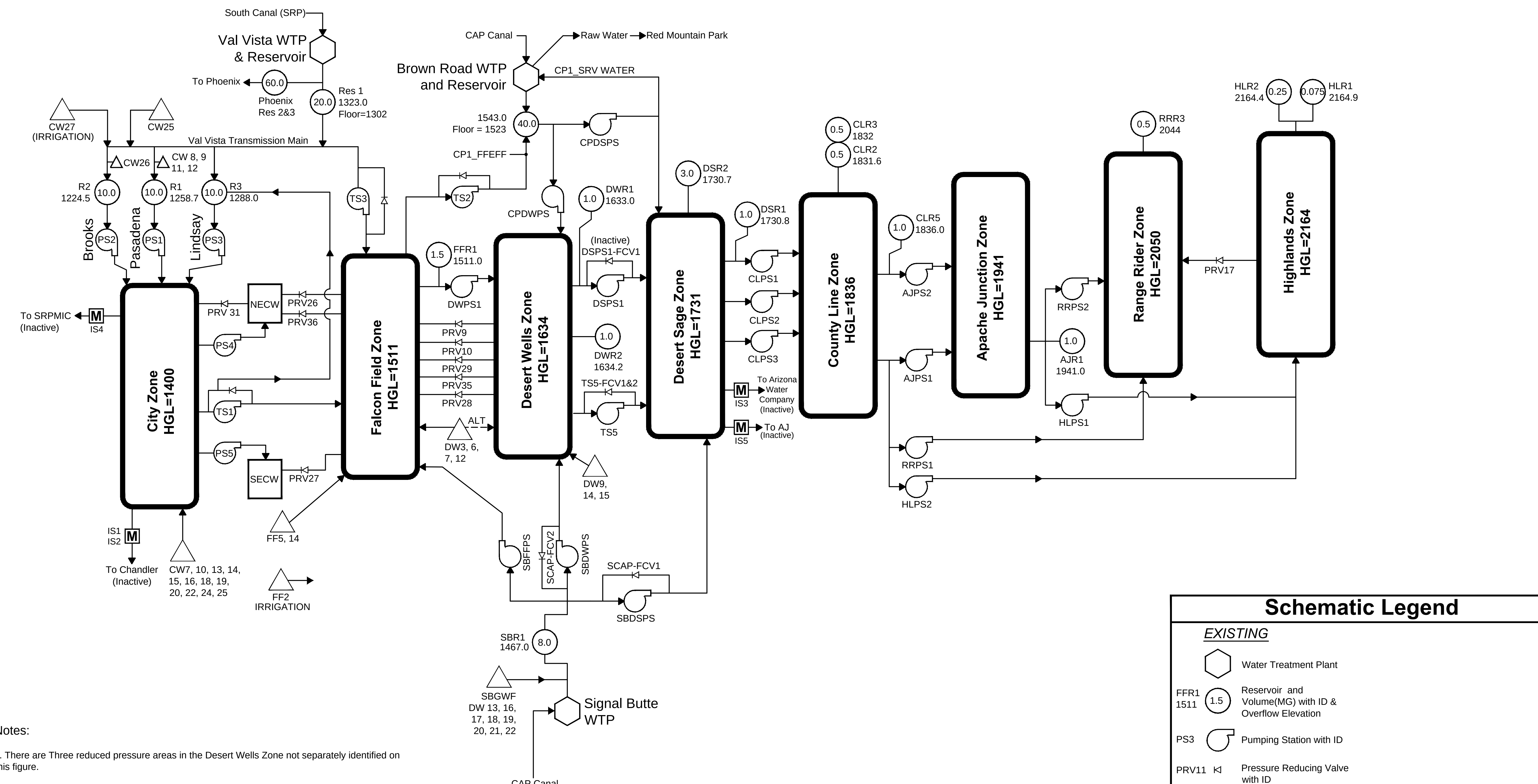
Buildout analyses were performed to establish the ultimate configuration, size and capacity for distribution system components (pipeline, reservoirs, booster stations and PRVs) to be included in the Infrastructure Improvement Plan (IIP). System components are generally sized first to accommodate build-out loads and then phased using the other model runs.

Intermediate Year hydraulic analyses were performed to establish the phasing of distribution system infrastructure for satisfactory performance under projected 2028 demands.

Base Year (2018) analyses were performed to address current issues of hydraulic stress within the distribution system that were identified by the model and/or communicated by City operations staff.

Profile Schematics, showing the recommended Base Year, Intermediate and Buildout facility components, are presented on Figure 3-1 through Figure 3-3, respectively. A discussion of the hydraulic analysis results and the recommended infrastructure is included in each of the following sections:

- Distribution Pipelines
- Storage Reservoirs
- Booster Pumps
- Transfer Stations



Notes:

1. There are Three reduced pressure areas in the Desert Wells Zone not separately identified on this figure.

2. Two SCADA tags shown on this exhibit (CP1_FFEFF AND CP1_SRVWATER) are provided for clarity and represent flow recording devices. CP1_SRVWATER is the flow returned to the CAP WTP for chemical feed and service water. CP1_FFEFF measures gravity flow from the CAP WTP to the Falcon Field Zone.

3. There is a reduced pressure area in Range Rider that serves the Thunder Mountain development.

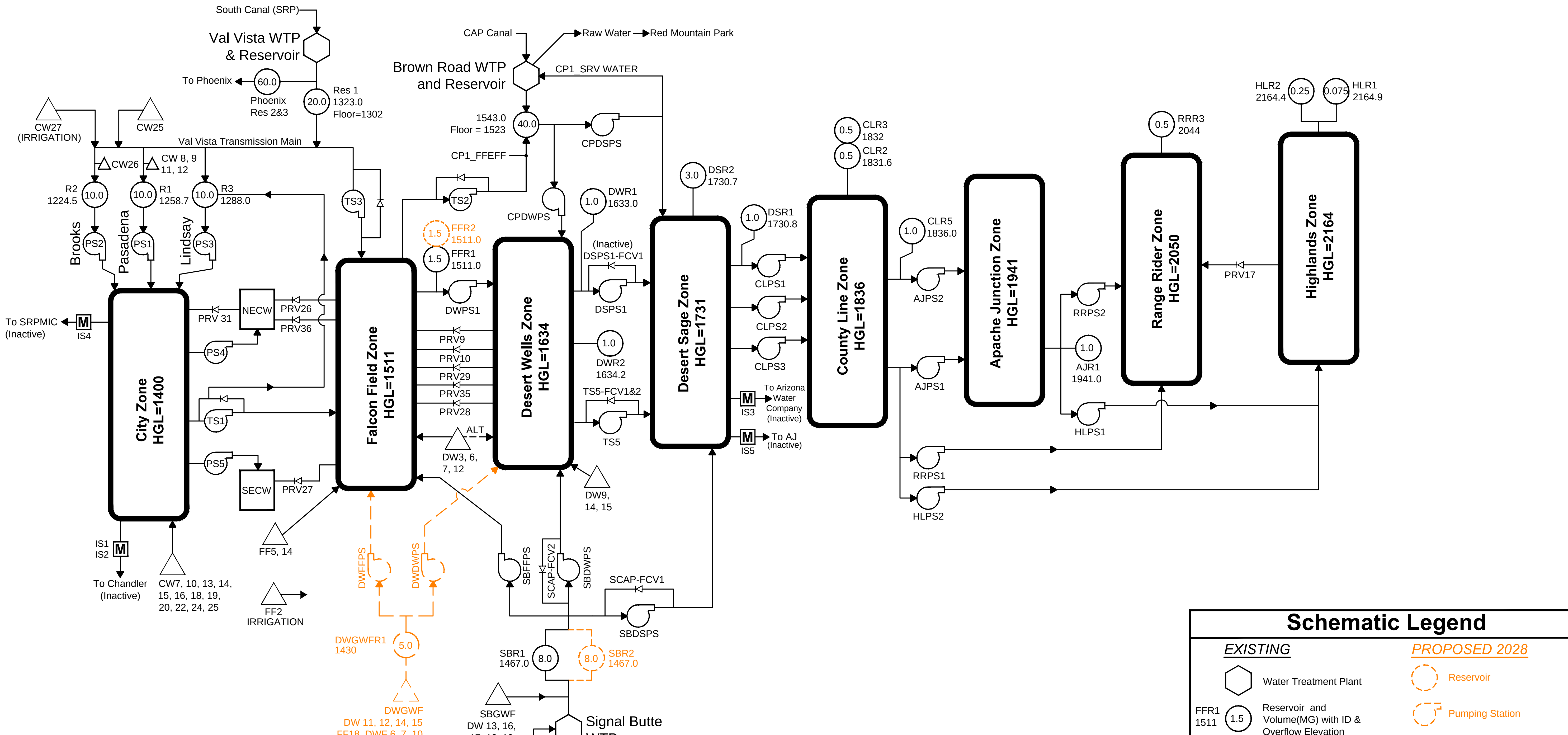
mesa·az

Updated: 2018-02

FIGURE 3.1

NOT TO SCALE

Mesa Water Resources Department
2018 Water Master Plan
YEAR 2018 SCHEMATIC



Notes:

1. There are Three reduced pressure areas in the Desert Wells Zone not separately identified on this figure.

2. Two SCADA tags shown on this exhibit (CP1_FFEFF AND CP1_SRVWATER) are provided for clarity and represent flow recording devices. CP1_SRVWATER is the flow returned to the CAP WTP for chemical feed and service water. CP1_FFEFF measures gravity flow from the CAP WTP to the Falcon Field Zone.

3. There is a reduced pressure area in Range Rider that serves the Thunder Mountain development.

Schematic Legend

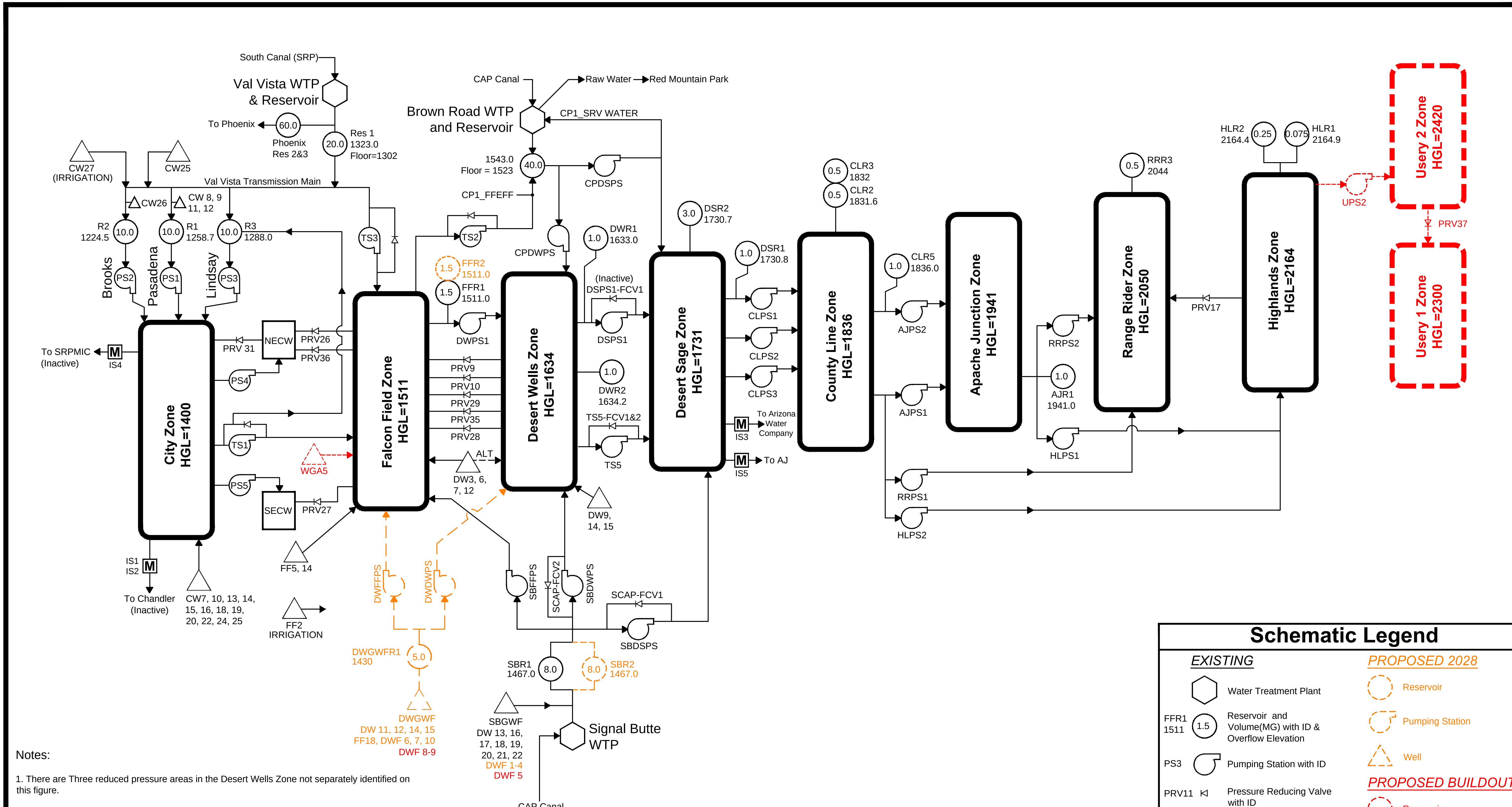
EXISTING		*PROPOSED 2028*
	Water Treatment Plant	Reservoir
FFR1 1511 (1.5)	Reservoir and Volume(MG) with ID & Overflow Elevation	Pumping Station
PS3	Pumping Station with ID	Well
PRV11	Pressure Reducing Valve with ID	
CW26	Well with ID	
IS4	Wholesale Water Meter with ID	

FIGURE 3.2
NOT TO SCALE

Mesa Water Resources Department
2018 Water Master Plan
YEAR 2028 SCHEMATIC

mesa·az

Updated: 2018-02



Notes:

1. There are Three reduced pressure areas in the Desert Wells Zone not separately identified on this figure.

2. Two SCADA tags shown on this exhibit (CP1_FFEFF AND CP1_SRVWATER) are provided for clarity and represent flow recording devices. CP1_SRVWATER is the flow returned to the CAP WTP for chemical feed and service water. CP1_FFEFF measures gravity flow from the CAP WTP to the Falcon Field Zone.

3. There is a reduced pressure area in Range Rider that serves the Thunder Mountain development.

FIGURE 3.3

NOT TO SCALE

mesa·az

Updated: 2018-02

Mesa Water Resources Department
2018 Water Master Plan
BUILDOUT SCHEMATIC

3.3.1 Transmission and Distribution Pipelines

New transmission and distribution pipes used in the Build-out model consist of pipelines which:

- Extend service into areas of new growth.
- Provide reinforcement to areas within the existing distribution system where system stress was found.
- Deliver water from new or expanded production sources.

Exhibit C shows the resulting Build-out pipeline configuration and diameters.

Falcon Field Zone – There is only one existing transmission main in the Falcon Field Zone that conveys water from Brown Road south to Baseline Road. This 30-inch transmission main is in the Recker Road Alignment and ties into an existing 48-inch transmission main in Brown Road just downstream of transfer station 2 (TS2). This configuration creates a potential single point of failure in the Zone and restricts the transfer of water between the Brown Road WTP and the Signal Butte WTP. Parallel pipes were modeled to add redundancy and increase the ability to transfer water between the two water treatment plants in the Intermediate and Buildout scenarios. The parallel pipes include a 36" transmission main from McKellips Road and Val Vista Road to Baseline Road and Power Road and a 36" transmission main from the BRWTP to the SBWTP.

PRV 9, 10, and 29 Discharge – PRV 29 is used to increase pressures in its immediate vicinity and reaches its recommended maximum flow rate of 2.6 mgd under peak hour demands. A recent project converted PRV 9 and 10 into zone PRVs to relieve the demand on PRV29. Valve controllers were added so the downstream pressure of PRV 9 and 10 can be controlled remotely from the Utility Control Center (UCC). PRV 9 and 10 connect a 20-inch Desert Wells Transmission Main to a 24-inch Falcon Field Transmission Main, creating redundancy between the zones.

Alignment Updates – Pipeline alignments were adjusted where indicated to accommodate revised roadway alignments and other development related changes. These adjustments were minor and did not result in a change in the distribution system's basic configuration or pipeline diameters.

3.3.2 Storage Requirements

Storage reservoirs are an essential component of the distribution system. Storage volume is used to equalize hourly demands over the course of a day, moderate hydraulic grade lines and provide reserve volumes which can be drawn on for firefighting.

Table 3-4 shows the calculated storage volume required to serve each zone and Table 3-5 shows how the total recommended storage will be provided at Buildout using a combination of new and existing reservoirs.

Table 3-4: Storage Requirements

Pressure Zone	Build-Out				Storage Volume (MG)			
	MD Demand (mgd)	PH Demand (mgd)	Required Equalization Volume (1) (MG)	Required Fire Volume (2) (MG)	Required Total Volume (3) (MG)	Existing	Additional Future	Total at Buildout
City	76.4	114.5	9.5	0.63	19.1	50.0(4)	0.0	50.0
Falcon Field	44.4	66.6	5.5	0.63	11.1	17.7(5)	6.4	24.1
Desert Wells	57.5	86.3	7.2	0.63	14.4	23.0(5)	6.3	29.4
Desert Sage	29.4	44.1	3.7	0.63	7.3	14.7(5)	1.8	16.5
County Line	5.8	8.7	0.73	0.63	1.5	2.0	0.0	2.0
Apache Junction	3.7	5.5	0.46	0.24	0.92	1.0	0.0	1.0
Range Rider	1.3	1.9	0.16	0.24	0.31	0.50	0.0	0.50
Highlands	0.51	0.77	0.06	0.24	0.30	0.33	0.0	0.33
Total =	**218.9**	**328.4**	**27.4**	**3.9**	**54.9**	**109.3**	**14.5**	**123.8**

Notes:

(1) Equalization storage volume requirements are based on meeting PH demand in excess of MD demand for a period of 6 hours. (PH-MD) * 6 hours / 24.

(2) Fire reserve volume based on the Insurance Service Offices (ISO) guideline of providing a 3,500 gpm fire flow for a 3-hour duration, or 0.63 MG. For the upper pressure zones, ISO guideline is 2,000 gpm for a 2-hour duration, or 0.24 MG.

(3) Calculated as the greater of twice the equalization storage requirement or equalization storage plus fire reserve.

(4) As part of the Val Vista flow separation, Mesa ownership is 20 MG Reservoir 1. City zone storage includes Val Vista Reservoir 1 (20 MG), Pasadena Reservoir (10MG), Brooks Reservoir (10MG), and Lindsay Reservoir (10MG).

(5) Buildout storage at the Brown Road WTP (40MG), Signal Butte WTP (16 MG), and DWGWF (5 MG) is proportionally distributed based on the buildout demands of the Zones they serve (Falcon Field, Desert Wells and Desert Sage).

Table 3-5: Storage Distribution by Zone (MG)

Reservoir	Existing Storage Facility									Additional Future Storage by Facility	Buildout Storage Facility								
	Distribution Storage Facility	Distribution by Zone									Distribution by Zone								Distribution by Storage Facility
		City	Falcon	Desert Wells	Desert Sage	County Line	Apache Junction	Range Rider	Highland		City	Falcon	Desert Wells	Desert Sage	County Line	Apache Junction	Range Rider	Highland	
Val Vista WTP	20	20									20								20
Brooks	10	10									10								10
Pasadena	10	10									10								10
Lindsay	10	10									10								10
FFR1	1.5		1.5							1.5		3.0							3.0
BRWTP Res (1)	40		13.5	17.5	9.0							13.5	17.5	9.0					40
Signal Butte (1)	8.0		2.7	3.5	1.8					8.0		5.4	7.0	3.6					16
DWGWF (1)	0.0									5.0		2.2	2.8						5.0
DWR1	1.0			1.0									1.0						1.0
DWR2	1.0			1.0									1.0						1.0
DSR1	1.0				1.0									1.0					1.0
DSR2	3.0				3.0									3.0					3.0
CLR2	0.5					0.5									0.5				0.5
CLR3	0.5					0.5									0.5				0.5
CLR5	1.0					1.0									1.0				1.0
AJR1	1.0						1.0									1.0			1.0
RRR1	0.5							0.5									0.5		0.5
HLR1	0.25								0.25									0.25	0.25
HLR2	0.08								0.08									0.08	0.08
Total	**109.3**	**50.0**	**17.7**	**23.0**	**14.7**	**2.0**	**1.0**	**0.5**	**0.3**	**14.5**	**50.0**	**24.1**	**29.4**	**16.5**	**2.0**	**1.0**	**0.5**	**0.3**	**123.8**
Incremental											**0.0**	**6.4**	**6.3**	**1.8**	**0.0**	**0.0**	**0.0**	**0.0**	

(1) Storage at this reservoir is proportionally distributed based on the buildout demands of the Zones it serves (Falcon Field, Desert Wells and Desert Sage).

Even though Table 3-5 shows that the existing storage volume is adequate for all zones, additional storage is required to support the proposed Signal Butte WTP and Desert Wells Groundwater Facility (DWGWF) as summarized below.

Signal Butte WTP Ground Storage Reservoir - Construction of a second 8 MG ground storage reservoir will provide operational storage for the SBWTP to meet both booster pumping equalization and WTP operational needs.

Desert Wells Groundwater Facility Ground Storage Reservoir - Construction of a 5 MG ground storage reservoir in conjunction with the proposed Desert Wells Groundwater Facility will provide operational storage needed to meet both booster pumping equalization and DWGWF operational needs.

3.3.3 Pump Stations

Booster pumping was analyzed to ensure that MD, PH, and other critical demand conditions could be met. The evaluation of required pumping capacity was based on the City's preference to not bring wells on solely to meet PH demand needs. However, in the event of an emergency, wells could be utilized provide additional PH capacity. The following criteria were utilized in the booster capacity evaluation:

- For service zones which are primarily served by floating storage, the pumping stations should be able to meet MD demands within the zone at firm capacity and therefore provide sufficient capacity to refill the reservoirs.
- For service zones which are primarily served by booster pumping from ground level storage, the pumping stations should be able to meet 120% of PH demands at firm capacity to provide operational flexibility and a margin of reserve.

Table 3-6 calculates the required pumping capacity by Zone, depending on whether the zone operates primarily as a floating storage zone or a peak hour booster zone. Table 3-7 shows how zonal pumping requirements are to be distributed amongst (met by) the individual facilities serving each zone, and indicates how the improvements in pumping capacity are to be phased.

Table 3-6: Buildout Pumping Requirements by Zone (mgd)

Zone	Demands		Operational Mode		Required Capacity at Buildout				Pumping Capacity			
	MD (mgd)	PH (mgd)	MD	PH Booster	MD (mgd)	PH Booster (mgd)	Required Firm Capacity (mgd)	Required Capacity for Dry-ups (mgd)	Existing Firm Capacity (mgd)	MDD/PHD Incremental Capacity (mgd)	Dry-up Incremental Capacity (mgd)	Buildout Firm Capacity (mgd)
City Zone	76.4	114.5		120%		114.5	137.5	167.5	172.9			172.9
Falcon Field (North)	30.6(1)	45.9	100%		30.6		30.6	53.8	40.0		28.0(2)	60.0
Falcon Field (South)	20.0	30.0		120%		30.0	36.0	46.0	16.0	20.0	16.0(2)	47.0
Desert Wells Zone	61.6(3)	92.4		120%		92.4	110.9		75.5	46.0		116.5
Desert Sage Zone	40.6(4)	61.0	100%		40.6		40.6		41.8			41.8
County Line Zone	11.2(5)	16.9	100%		11.2		11.2		14.5			14.5
Apache Junction Zone	4.6(6)	6.8	100%		4.6		4.6		7.0			7.0
Range Rider Zone	1.3	1.9	100%		1.3		1.3		5.0			5.0
Highlands Zone	0.5	0.8	100%		0.5		0.5		1.4			1.4

Notes:
(1) North FF zone MD demand is 55% of total FF zone MD demand and includes 10% of DW zone MD demand for DWPS1 which pulls from the north FF zone.
(2) Dry-up incremental capacity may be needed for SRP and CAP dry-ups or redundancy during treatment plant maintenance outages.
(3) DW zone MD demand includes 10% of DS zone MD demand for DSPS1 which pulls from DW zone.
(4) DS zone MD demand includes 100% of all upper zone, Apache Junction, and Arizona Water Company MD demand.
(5) CL zone MD demand includes 100% of AJ MD demand, and 50% of RR zone and HL zone MD demand.
(6) AJ zone MD demand includes 50% of RR zone and HL zone MD demand.

Table 3-7: Pumping Improvements

Pumping Station	Zone Served	Base year (2018) Pumping Units (No. of units @ capacity of each unit)	Existing Installed Capacity (mgd)	Existing Firm Capacity (mgd)	2028				Buildout 2040			
					Additional Pumping Units	Additional Capacity (mgd)	Total Installed Capacity (mgd)	Total Firm Capacity (mgd)	Additional Pumping Units	Additional Capacity (mgd)	Total Installed Capacity (mgd)	Total Firm Capacity (mgd)
PS1 (Pasadena)	CW	5 @ 7.9 mgd; 5 @ 5.2 mgd	65.5	57.6	-	0.0	65.5	57.6	-	0.0	65.5	57.6
PS2 (Brooks)	CW	2 @ 6.0 mgd; 5 @ 5.0 mgd; 2 @ 5.4 mgd	47.8	42.8	-	0.0	47.8	42.8	-	0.0	47.8	42.8
PS3 (Lindsay)	CW	5 @ 7.9 mgd; 3 @ 7.0 mgd 1 @ 5.4 mgd	66.0	58.1	-	0.0	66.0	58.1	-	0.0	66.0	58.1
NECWPS	NECW	3 @ 3.5 mgd	10.4	6.9	-	0.0	10.4	6.9	-	0.0	10.4	6.9
SECWPS	SECW	3 @ 3.7 mgd	11.2	7.5	-	0.0	11.2	7.5	-	0.0	11.2	7.5
City Zone Total			**200.9**	**172.9**		**0.0**	**200.9**	**172.9**		**0.0**	**200.9**	**172.9**
SBFFPS	FF	3 @ 8 mgd	24.0	16.0	1 @ 8.0 mgd	8.0	32.0	24.0	1 @ 8.0 mgd	8.0	40.0	32.0
DWGWFFFPS	FF	-	0.0	0.0	4 @ 5.0 mgd	20.0	20.0	15.0	-	0.0	20.0	15.0
Falcon Field Total			**24.0**	**16.0**		**28.0**	**52.0**	**39.0**		**8.0**	**60.0**	**47.0**
BRDWPS	DW	2 @ 6.0 mgd; 4 @ 9.0 mgd	48.0	39.0	-	0.0	48.0	39.0	2 @ 9.0 mgd [1]	6.0	54.0	45.0
SBDWPS	DW	3 @ 6.0 mgd; 2 @ 11.0 mgd	40.0	29.0	2 @ 11.0 mgd [2]	10.0	50.0	39.0	1 @ 11.0 mgd [3]	5.0	55.0	44.0
DWGWFDWPS	DW	-	0.0	0.0	4 @ 5.0 mgd	20.0	20.0	15.0	-	0.0	20.0	15.0
DWPS1	DW	1 @ 2.5 mgd; 2 @ 5 mgd	12.5	7.5	1 @ 5.0 mgd	5.0	17.5	12.5	-	0.0	17.5	12.5
Desert Wells Total			**100.5**	**75.5**		**35.0**	**135.5**	**105.5**		**11.0**	**146.5**	**116.5**
BRDSPS	DS	1 @ 6.3 mgd, 3 @ 9.0 mgd, 1 @ 6.0 mgd	39.0	30.0	-	0.0	39.0	30.0	-	0.0	39.0	30.0
SBDSPS	DS	3 @ 3.5 mgd	10.5	7.0	-	0.0	10.5	7.0	-	0.0	10.5	7.0
DSPS1	DS	3 @ 1.6 mgd	6.4	4.8	-	0.0	6.4	4.8	-	0.0	6.4	4.8
Desert Sage Total			**55.9**	**41.8**		**0.0**	**55.9**	**41.8**		**0.0**	**55.9**	**41.8**
CLPS1	CL	3 @ 2.2 mgd	6.7	4.5	-	0.0	6.7	4.5	-	0.0	6.7	4.5
CLPS2	CL	3 @ 2.5 mgd	7.5	5.0	-	0.0	7.5	5.0	-	0.0	7.5	5.0
CLPS3	CL	3 @ 2.5 mgd	7.5	5.0	-	0.0	7.5	5.0	-	0.0	7.5	5.0
County Line Total			**21.7**	**14.5**		**0.0**	**21.7**	**14.5**		**0.0**	**21.7**	**14.5**
AJPS1 (Waterbury)	AJ	3 @ 1.7 mgd	5.2	3.5	-	0.0	5.2	3.5	-	0.0	5.2	3.5
AJPS2 (Scarlet)	AJ	2 @ 1.7 mgd	5.2	3.5	-	0.0	5.2	3.5	-	0.0	5.2	3.5
Apache Junction Total			**10.4**	**7.0**		**0.0**	**10.4**	**7.0**		**0.0**	**10.4**	**7.0**
RRPS1	RR	3 @ 0.5 mgd	1.5	1.0	-	0.0	1.5	1.0	-	0.0	1.5	1.0
RRPS2	RR	3 @ 2.0 mgd	6.0	4.0	-	0.0	6.0	4.0	-	0.0	6.0	4.0
Range Rider Total			**7.5**	**5.0**		**0.0**	**7.5**	**5.0**		**0.0**	**7.5**	**5.0**
HLPS1	HL	2 @ 0.36 mgd; 1 @ 0.7 mgd	1.4	0.7	-	0.0	1.4	0.7	-	0.0	1.4	0.7
HLPS2	HL	2 @ 0.7 mgd	1.4	0.7	-	0.0	1.4	0.7	-	0.0	1.4	0.7
Highland Total			**2.8**	**1.4**		**0.0**	**2.8**	**1.4**		**0.0**	**2.8**	**1.4**
Transfer Station												
TS1	FF	2 @ 4.0 mgd; 2 @ 8.0 mgd	24.0	16.0	2 @ 8 mgd [4]	8.0	32.0	24.0		0.0	32.0	24.0
TS2	DW/DS	4 @ 8.6 mgd	34.6	25.9	1 @ 8.6 mgd	8.6	43.2	34.6	1 @ 8.6 mgd	8.6	51.8	43.2
TS3	FF	2 @ 4.0 mgd; 3 @ 8.0 mgd	32.0	24.0	1 @ 8 mgd	8.0	40.0	32.0	2 @ 6 mgd [5]	4.0	44.0	36.0
TS5	DS	3 @ 2.1 mgd	6.3	4.2	-	0.0	6.3	4.2	-	0.0	6.3	4.2

Notes:
(1) Replace 2 @ 6.0 mgd with 2 @ 9.0 mgd
(2) Replace existing 2 @ 6.0 mgd with 2 @ 11.0 mgd
(3) Replace 1 @ 6.0 mgd with 1 @ 11.0 mgd
(4) Replace 2 @ 4 mgd with 2 @ 8 mgd
(5) Replace 2 @ 4.0 mgd with 2 @ 6.0 mgd

3.3.4 Transfer Stations

As the City develops toward build-out, the transfer of water between the City Zone and Eastern Zones will become a critical component of the City's water production and distribution system, especially during SRP and CAP canal dry-ups.

The City currently has two primary transfer stations that transfer water between the City Zone (On-Project) and Eastern Zones (Off-Project). These stations are:

- TS1 – Transfer Station 1 (Lindsay Transfer)
- TS3 – Transfer Station 3 (McDowell Transfer)

The combined firm "Off-Project" transfer capacity of Transfer Stations 1 and 3, which pump water from the City Zone to the Eastern Zones, will need to be increased from 40 mgd today to 60 mgd by build out, as shown previously in the production plans in Table 2-10. The City has two other transfer stations, TS2 and TS5, which are used to transfer water between portions of the Eastern Zones. Following the recommendations of the 2010 Master Plan, TS4 has been removed from service.

To supplement the City Zone well supply during an SRP canal dry-up, water is transferred On-Project primarily through pressure reducing valves at TS1 and TS3. TS1 transfers water directly from the Falcon Field Zone to the City Zone. The PRVs at TS3 transfer water into the Val Vista Transmission Main and VVWTP Reservoir 1.

During a CAP canal dry-up, water must be transferred Off-Project by pumping at TS1, TS2 and TS3. By build-out, CAP canal dry-ups will place the largest strain on Mesa's distribution system, requiring the transfer of nearly 60 mgd from the City Zone to Eastern Zones. Extended CAP canal dry-ups have not historically occurred. However, the Central Arizona Water Conservation District (CAWCD) has indicated that regular CAP canal dry-ups will occur every five years for canal maintenance ranging in duration from less than one week to six (6) weeks.

4.0 INFRASTRUCTURE IMPROVEMENT PLAN

A summary of the recommended water production and distribution system improvements is presented in this section of the 2018 Master Plan Update along with a phased Infrastructure Improvement Plan (IIP).

4.1 RECOMMENDED IMPROVEMENTS

The resulting 2018 Master Plan Update provides a comprehensive set of recommended improvements to the City's water production and water distribution infrastructure which are presented on Exhibit C and are discussed in the following sections:

- Water Production Facilities
- Storage Reservoirs
- Booster Pumping Stations
- Water Distribution Mains
- Well Collection Lines

4.1.1 Water Production Facilities

The City's water production facilities consist of surface water treatment plants, groundwater treatment plants and direct-connect wells. Total water production capacity in the City of Mesa is programmed to increase from the current Base-Year capacity of 268 mgd to 323 mgd at Buildout. Recommended Base Year, Intermediate and Buildout water production capacity is shown in Table 4-1.

Table 4-1: Water Production Facilities

Demand / Production Source	Base Year Capacity (mgd)	2028 Year Capacity (mgd)	Buildout Capacity (mgd)	Additional Incremental Capacity at Buildout (mgd)
Production Source				
Val Vista WTP (1)	90.0	90.0	90.0	0.0
Brown Rd WTP	72.0	72.0	72.0	0.0
Signal Butte Surface WTP	24.0	48.0	48.0	24.0
Signal Butte GWF	11.0	21.4	23.4	12.4
Desert Wells GWF	0.0	12.6	16.6	16.6
On-Project Direct Connect Wells	54.1	60.6	60.6	6.5
Off-Project Direct Connect Wells	17.2	12.3	12.3	-4.9 (2)
Total Production	**268**	**317**	**323**	**55**

Notes:
(1) City of Mesa Capacity only.
(2) Reflects conversion of DW12, DW14, and DW15 direct connect wells to source wells for the DWGWF.

Signal Butte WTP

The Signal Butte WTP would add to the City's CAP water treatment capacity. It is currently proposed to come online in June 2018 with an initial capacity of 24 mgd and an ultimate capacity of 48 mgd in 2025.

Signal Butte GWF

The Signal Butte Groundwater Facility (SBGWF) allows for the blending and/or treatment of groundwater at the Signal Butte WTP site. The SBGWF allows for future treatment should arsenic, nitrates or any other groundwater contaminants be found in future wells. The SBGWF has an initial connected well field capacity of 8.8 mgd firm and 11.0 mgd connected from Wells DW13, DW16, DW17, DW18, DW21 and DW22. Programmed expansions will add another 12.4 mgd of well field capacity from wells DW19, DW20 and 5 future wells, bringing the total connected well field capacity to 23.4 mgd and a firm capacity of 18.7 mgd.

Desert Wells GWF

The Desert Wells Groundwater Facility (DWGWF) is proposed to come on line in 2025 with an initial well field capacity of 10.1 mgd firm and 12.6 mgd connected. The initial phase of the facility will convert existing direct connect wells DW11 (currently idle), DW12, DW14 and DW15 along with the addition of FF18 and two new wells. At buildout, the capacity of this facility will be expanded up to 13.3 mgd firm and 16.6 mgd connected capacity which will require the connection of two additional wells at 2 mgd each.

Direct Connect Wells

Direct Connect Wells are those which do not feed through a Groundwater Facility (GWF) with a reservoir and booster pump, but are connected directly to the distribution system. The City has an existing direct connect well capacity of 43.3 mgd firm and 54.1 mgd installed within the City Zone, 8.2 mgd firm and 10.3 mgd installed within the Falcon Field Zone, 5.5 mgd firm and 6.9 mgd installed within the Desert Wells Zone and 0.0 mgd installed within the Desert Sage Well Zone. Several direct wells will be converted from direct connection to GWF supply. The remaining direct capacity will remain unchanged. The following direct connect wells will be converted to DWGWF supply sources.

- DW11 – To be converted to DWGWF source (currently idle)
- DW12 – To be converted to DWGWF source
- DW14 – To be converted to DWGWF source
- DW15 – To be converted to DWGWF source

Table 4-2 shows well capacity by pressure zone and groundwater facility for each planning year.

Table 4-2: Well Capacity

CITY ZONE					
Well ID	**2018 Capacity (mgd)**	**2028 Capacity (mgd)**	**2040 Capacity (mgd)**	**Normal Connection Mode**	**Comments**
CW7	Idled	2.9	2.9	Distribution	To be re-drilled and equipped by FY 18/19.
CW8	3.4	3.4	3.4	PS1	To be re-drilled and equipped by FY 18/19.
CW9	4.6	4.6	4.6	PS1	To be re-drilled and equipped by FY 22/23.
CW10	1.9	1.9	1.9	Distribution	
CW11	4.4	4.4	4.4	PS1	
CW12	4.3	4.3	4.3	PS1	
CW13	Idled	3.6	3.6	Distribution	To be re-drilled and equipped by FY 22/23.
CW14	4.3	4.3	4.3	Distribution	
CW15	3.7	3.7	3.7	Distribution	To be re-drilled and equipped by FY 22/23.
CW16	2.7	2.7	2.7	Distribution	To be re-drilled and equipped by FY 24/25.
CW17	Idled	-	-		
CW18	2.8	2.8	2.8	Distribution	
CW19	4.1	4.1	4.1	Distribution	
CW20	3.5	3.5	3.5	Distribution	
CW22	2.6	2.6	2.6	Distribution	
CW23	Idled	-	-		Idled due to Arsenic and DBCP.
CW24	2.8	2.8	2.8	Distribution	
CW25	3.2	3.2	3.2	VV Res 1	
CW26	3.2	3.2	3.2	PS2	
CW27	2.6	2.6	2.6	VV Res 1	
FF8	Idled	-	-		Idled due to Arsenic and DBCP.
Total Capacity =	**54.1**	**60.6**	**60.6**		
FALCON FIELD					
Well ID	**2018 Capacity (mgd)**	**2028 Capacity (mgd)**	**2040 Capacity (mgd)**	**Normal Connection Mode**	**Comments**
FF2	Irrigation	Irrigation	Irrigation		3.6 MGD well not connected to Distribution due to DBCP
FF4	Idled	3.4	3.4	Distribution	High DBCP
FF5	3.1	3.1	3.1	Distribution	
FF6	Idled	-	-		Idled due to Arsenic.
FF7	Idled	-	-		Idled due to Arsenic.
FF10	Idled	-	-		May be used as recovery well
FF14	3.0	3.0	3.0	Distribution	
FF15	Idled	-	-		May be used as recovery well
FF16	Idled	-	-		Old air force well at airport

FALCON FIELD (continued)					
Well ID	**2018 Capacity (mgd)**	**2028 Capacity (mgd)**	**2040 Capacity (mgd)**	**Normal Connection Mode**	**Comments**
TR8	Idled	-	-		Old Turner Ranch well
WGA5	Idled	-	2.0		Old air force well at airport
DW3	2.4	2.4	2.4	Distribution	
DW7	0.7	0.7	0.7	Distribution	
DW12	1.1	-	-	Distribution	To be connected to GWF Res in 2025
Total Capacity =	**10.91**	**13.17**	**15.17**		
DESERT WELLS					
Well ID	**2018 Capacity (mgd)**	**2028 Capacity (mgd)**	**2040 Capacity (mgd)**	**Normal Connection Mode**	**Comments**
DW6	1.2	1.2	1.2	Distribution	
DW9	1.9	1.9	1.9	Distribution	
DW10	Idled	-	-		Idled due to High Nitrate Levels
Subtotal=	3.1	3.1	3.1		
DW11	Idled	1.7	1.7		Idled due to Arsenic
DW12	-	1.1	1.1		Previously connected to FF zone
DW14	1.8	1.8	1.8	Distribution	To be connected to GWF Res in 2025
DW15	2.0	2.0	2.0	Distribution	To be connected to GWF Res in 2025
FF18	-	2.0	2.0		Site obtained, never equipped
New Wells at DW GWF	-	4.0	8.0		Desert Wells GWF
Subtotal=	3.8	12.6	16.6		
DW13	2.5	2.5	2.5	Signal Butte	Signal Butte GWF
DW16	1.3	1.3	1.3	Signal Butte	Signal Butte GWF
DW17	2.1	2.1	2.1	Signal Butte	Signal Butte GWF
DW18	1.0	1.0	1.0	Signal Butte	Signal Butte GWF
DW19	Drilled	1.2	1.2	Signal Butte	Signal Butte GWF - To be connected FY18/19
DW20	Drilled	1.2	1.2	Signal Butte	Signal Butte GWF - To be connected FY18/19
DW21	2.0	2.0	2.0	Signal Butte	Signal Butte GWF
DW22	2.1	2.1	2.1	Signal Butte	Signal Butte GWF
New Wells at SB GWF	-	8.0	10.0		Signal Butte GWF
Subtotal=	11.0	21.4	23.4		
Total Capacity =	**17.9**	**37.1**	**43.1**		

DESERT SAGE					
Well ID	**2018 Capacity (mgd)**	**2028 Capacity (mgd)**	**2040 Capacity (mgd)**	**Normal Connection Mode**	**Comments**
DS9	Idled	-	-		Idled due to Arsenic.
DS10	Idled	-	-		Idled due to Arsenic.
DS11	Idled	-	-		Idled due to Arsenic.
DS12	Idled	-	-		Idled due to Arsenic.
DS13	Idled	-	-		Idled due to Arsenic.
Total Capacity =	**0.0**	**0.0**	**0.0**		
TOTAL WELL CAPACITY					
City Wells/GWFs	54.1	60.6	60.6		
Eastern Wells/GWFs	28.2	49.2	57.2		
Total =	**82.3**	**110.3**	**118.3**		
FIRM WELL CAPACITY					
City Wells/GWFs	43.3	48.5	48.5		
Eastern Wells/GWFs	22.6	39.8	46.2		
Total Firm Capacity =	**65.8**	**88.2**	**94.6**		
TOTAL NUMBER OF WELLS					
Active Wells	32	45	50		Irrigation Wells counted as active
Inactive Wells	22	16	15		Drilled but either Idled or abandoned
Total Wells	54	61	65		

Idled = Well has been disconnected from the distribution system.
Abandoned = Officially abandoned through ADWR.
Irrigation = Well disconnected from distribution system and only run for irrigation.

4.1.2 Storage Reservoirs

The required storage volumes were determined based on the ability to equalize PH demands and provide a reserve for fire protection and balance operations at each of the City's water production facilities. Recommended Base Year, Intermediate and Buildout storage capacity is shown in Table 4-3.

Table 4-3: Buildout Storage Volume

Reservoir	Existing Storage Facility (MG)	2028 Storage Facility (MG)	Buildout Storage by Facility (MG)	Additional Storage by Buildout (MG)
Val Vista WTP	20	20	20	
Brooks	10	10	10	
Pasadena	10	10	10	
Lindsay	10	10	10	
FFR1	1.5	1.5	3.0	1.5
Brown Road WTP	40	40	40	
Signal Butte WTP	8.0	16	16	8.0
DWGWF	--	5.0	5.0	5.0
DWR1	1.0	1.0	1.0	
DWR2	1.0	1.0	1.0	
DSR1	1.0	1.0	1.0	
DSR2	3.0	3.0	3.0	
CLR2	0.5	0.5	0.5	
CLR3	0.5	0.5	0.5	
CLR5	1.0	1.0	1.0	
AJR1	1.0	1.0	1.0	
RRR3	0.5	0.5	0.5	
HLR1	0.25	0.25	0.25	
HLR2	0.075	0.075	0.075	
Total	**109.3**	**122.3**	**122.3**	**14.5**

Signal Butte WTP Ground Storage Reservoir

Construction of a second 8.0 MG ground storage reservoir in conjunction with the Signal Butte WTP and groundwater facility expansion will provide operational storage for the SBWTP to meet both booster pumping equalization and WTP operational needs. The expansion of the storage volume is proposed for 2025.

Desert Wells Groundwater Facility Ground Storage Reservoir

Construction of a 5.0 MG ground storage reservoir in 2025, in conjunction with the proposed Desert Wells Groundwater Facility, will provide operational storage needed to meet both booster pumping equalization and GWF operational needs. It is intended that this site be online before the CAP dry-up in 2025.

4.1.3 Booster Pumping

Booster pumping capacity was analyzed to ensure that distribution system maximum day and peak hour demands will be met and to provide for balanced operation at each of the City's water production facilities. A summary of recommended booster improvements is provided in Table 3-6.

Several existing pumping stations in Mesa will require the installation of additional pumping capacity to meet projected buildout demands. Two new pump stations will also need to be constructed at the new Desert Wells GWF. Phasing details can be found in Table 3-7.

4.1.4 Transmission Mains

Hydraulic analyses of the distribution system were performed under base year (2018), interim year (2028) and buildout (2040) demands. Various hydraulic conditions were analyzed including; MD, PH, and seasonal supply conditions (SRP/CAP canal dry-ups and WTP maintenance outages). Recommended distribution system improvements in the IIP include 245,200 feet, or 46 miles, of new pipeline as shown in Table 4-4 and Exhibit C.

Table 4-4: Total Transmission Main Length

Transmission Main Diameter	New Pipeline length (feet)
16(1)	29,700
20	27,800
24	60,000
30	15,300
36	108,400
60	4,000
Total =	**245,200**

(1) 16-inch mains represent well-collection lines only.

All transmission main improvements are shown on the Program Map, Exhibit C. The majority of the transmission main improvements are in the Eastern Zones in areas of future growth.

4.2 INFRASTRUCTURE IMPROVEMENT PLAN

A 12-year IIP, Table 4-7, is included at the end of this Chapter showing projected costs. The IIP includes the water production and water distribution infrastructure improvements, which were outlined within this master plan. Although Buildout is projected to occur in the year 2040 for planning purposes, Buildout infrastructure is completed by 2035 with no growth-related improvements identified beyond that point.

4.2.1 Unit Cost

Where available, Table 4-7 shows project costs matching those that were developed with detailed cost estimates in the current Capital Improvement Program (CIP). Where CIP cost estimates were not available, unit costs were developed for each type of infrastructure and are shown in Table 4-5. The unit costs were developed in the 2010 Water Master Plan. Construction costs have been updated to the base year using recent project costs and inflation. For a detailed explanation of the methods used to derive construction unit costs please refer to the 2010 Water Master Plan.

Table 4-5: Construction Unit Costs

Item	Construction Cost	Unit
Pipelines 12" to 24"- Future	$21.00	$/in-ft
Pipelines 30" to 72"- Future	$15.00	$/in-ft
Pump Stations (new) - Future	$7,804 x gpm^0.6083	$/gpm
Pump Stations (expansion) - Future	$13,193 x gpm^0.5069	$/gpm
Well - Drill Only - Future	$1,250,000	Each
Well - Equipping - Future	$1,150,000	Each
Well - Drill + Equip - Future	$2,400,000	Each
Reservoir (Concrete) - Future	$196,387 x MG^1.2826	$/MG
Tank (Steel) - Future	$552,148 x MG^0.631	$/MG

Construction unit costs were converted to capital cost by multiplying by the related administrative factors and contingencies. Factors and contingencies were developed and applied for three classes of infrastructure as shown in Table 4-6.

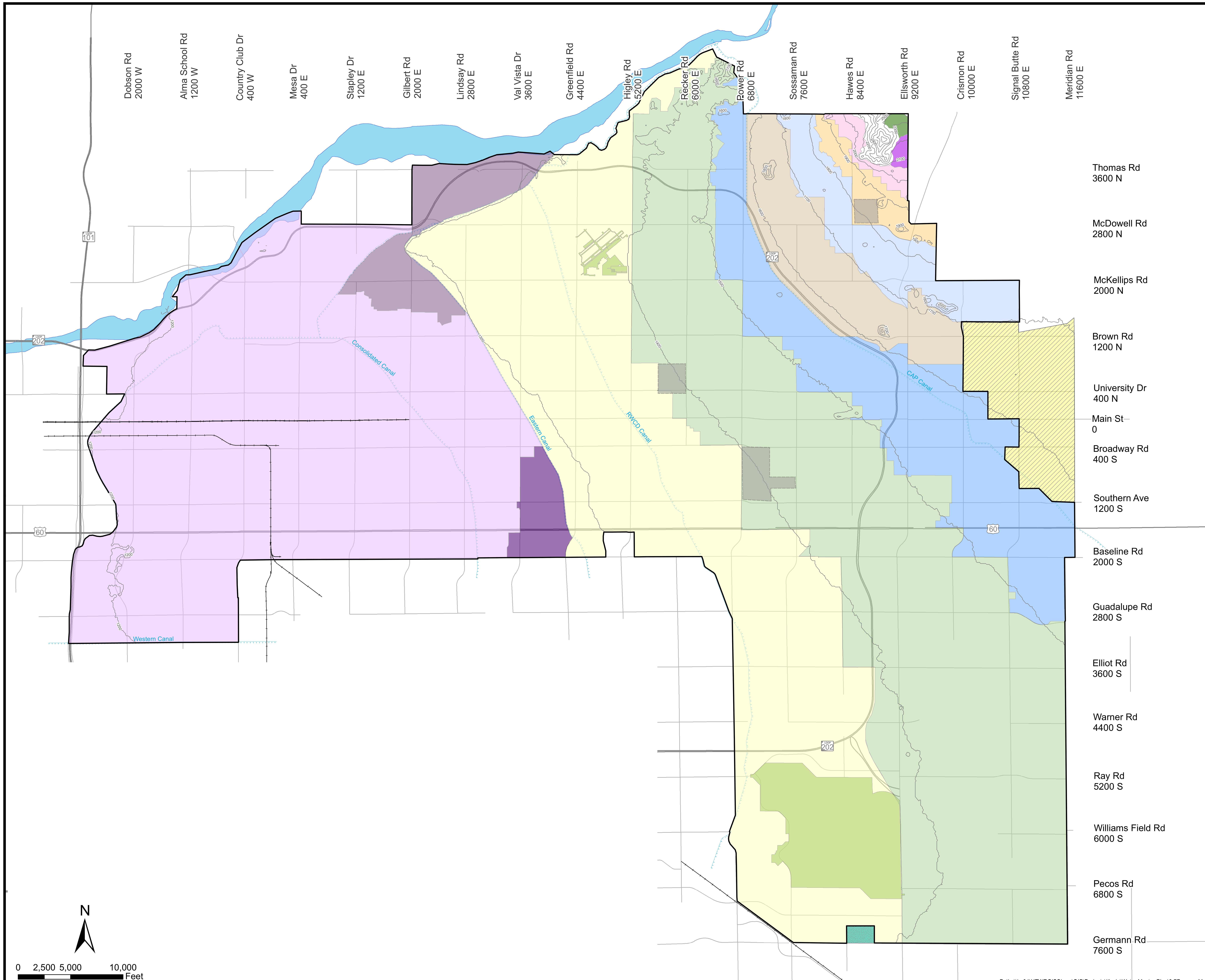
Table 4-6: Administrative and Contingency Factors

	Infrastructure Type	Pre-Design	Design	Const. Admin	Const. Contingency	Total Factor
CF-A	• Pipelines	0%	10%	8%	20%	1.43
CF-B	• Primary PRV • Secondary PRV • Reservoir • Well	2%	10%	8%	20%	1.45
CF-C	• Pump Station (new) • Pump Station (expansion) • Treatment Plant	1%	10%	10%	20%	1.47

Table 4-7: 30-Year IIP

Project No.	Project Description/ Location	Project Justification/ Trigger	Length (ft)	Project Cost ($)			
				2014 Authorization	2020 Authorization	2024 Authorization	2028-Buildout
	Treatment Facilities						
1	Signal Butte WTP Phase II expansion to 48 MGD plus Second 8 MG Reservoir	Insufficient capacity based on 2028 demand projections	NA	$0	$82,892,000	$0	$0
2	Desert Wells Groundwater Facility Treatment - Arsenic	Provide service to future development.	NA	$0	$8,787,718	$0	$0
	Transmission Mains						
3	60" City Zone Supply Waterline on Mesa Dr from Brown Rd to PS1	Insufficient capacity based on 2040 flow estimates	4,000	$0	$0	$5,000,000	$0
4	24" Desert Wells Waterline on Crismon Rd from Williams Field Rd to Pecos Rd	Provide service to future development.	5,400	$0	$0	$2,497,078	$0
5	24" Desert Wells Waterline on Signal Butte Rd from Williams Field Rd to Pecos Rd	Provide service to future development.	5,400	$0	$0	$0	$3,891,888
6	24" Falcon Field Waterline on Pecos Rd from DWGWF to Ellsworth Rd	Provide service to future development.	7,900	$0	$2,604,977	$0	$0
7	24" Desert Wells Transmission Main on Point 22 Blvd from Ellsworth Rd to Eastmark Parkway (City Share)	Provide service to future development.	5,500	$0	$1,687,838	$0	$0
8	30" Desert Wells Waterline on Signal Butte from Warner Rd to Ray Rd	Provide service to future development.	5,100	$0	$3,075,071	$0	$0
9	30" Desert Wells Waterline on Signal Butte from Rueben St to Warner Rd	Provide service to future development.	3,000	$0	$1,621,397	$0	$0
10	24" Desert Wells Waterline on Williams Field Rd from Ellsworth Rd to Crismon Rd	Provide service to future development.	5,400	$0	$1,687,838	$0	$0
11	24" Desert Wells Waterline on Williams Field Rd from Crismon Rd to Signal Butte Rd (City Share)	Provide service to future development.	5,300	$0	$530,000	$0	$0
12	24" Desert Wells Waterline on Williams Field Rd from Signal Butte Rd to Mountain Rd	Provide service to future development.	2,700	$0	$0	$900,000	$0
13	30"Falcon Field Waterline on Hawes Rd from Elliot Rd to ARS 202	Provide service to future development.	7,200	$0	$3,589,160	$0	$0
14	36" Desert Wells Transmission Main on Ellsworth Rd from Baseline Rd to Elliot Rd and on Elliot Rd from Ellsworth Rd to Signal Butte Rd	Provide redundancy for CAP canal outages in 2025.	21,000	$0	$12,402,000	$0	$0
15	36" Desert Wells Transmission Main from BRWTP to Ellsworth Rd and Baseline Rd	Provide redundancy for CAP canal outages in 2040.	42,400	$0	$0	$0	$32,741,280
16	24" Desert Wells Waterline on Signal Butte Rd from Ray Rd to Williams Field Rd (City Share)	Provide service to future development.	5,400	$530,000	$0	$0	$0
17	36" Falcon Field Transmission Main on Val Vista Dr from McKellips Rd to Brown Rd and from Greenfield Rd and Brown Rd to Power Rd and Baseline Rd	Insufficient capacity based on 2040 demand projections	41,000	$0	$30,778,266	$0	$0
18	20" Falcon Field Waterline on Ellsworth Rd from SR24 to Pecos Rd	Provide service to future development.	8,200	$3,610,166	$0	$0	$0
19	20" Desert Wells Waterline on Eastmark Parkway from Point 22 Blvd (City Share)	Provide service to future development.	7,700	$207,420	$0	$0	$0
	Pump Stations						
20	Desert Wells Ground Water Facilities	Provide service to future development.	NA	$0	$8,718,500	$0	$0
21	Transfer Station #1 Pumps - Replace 2 @ 4 MGD with 2 @ 8 MGD	Insufficient capacity based on 2028 demand projections	NA	$0	$352,980	$0	$0
22	Transfer Station #2 - Add 1 @ 8.6 MGD	Insufficient capacity based on 2028 demand projections	NA	$0	$1,987,500	$0	$1,595,166
23	Transfer Station #3 Pumps - Add 1 @ 9 MGD	Insufficient capacity based on 2028 demand projections	NA	$0	$0	$214,306	$0
24	Transfer Station #3 Pumps - Replace 2 @ 4 MGD with 2 @ 6 MGD	Insufficient capacity based on 2028 demand projections	NA	$0	$0	$0	$1,880,363
25	SBWTP FFPS Pumps - Add 1 pumps @ 8 MGD	Insufficient capacity based on 2028 demand projections	NA	$0	$517,704	$0	$0
26	SBWTP FFPS Pumps - Add 1 pumps @ 8 MGD	Insufficient capacity based on 2028 demand projections	NA	$0	$0	$0	$517,704
27	SBWTP DWPS Pumps - Replace 2 @ 6 MGD with 2 @ 11 MGD	Insufficient capacity based on 2028 demand projections	NA	$0	$0	$0	$2,563,781
28	BRWTP DWPS Pumps - Replace 2 @ 6 MGD with 2 @ 9 MGD	Insufficient capacity based on 2028 demand projections	NA	$0	$0	$0	$2,314,113
29	Desert Wells Pump Station #1 - Add 5MGD Pump	Insufficient capacity based on 2028 demand projections	NA	$0	$1,987,288	$0	$0

Project No.	Project Description/ Location	Project Justification/ Trigger	Length (ft)	Project Cost ($)			
				2014 Authorization	2020 Authorization	2024 Authorization	2028-Buildout
	Reservoirs						
30	FFR2 1.5 MG reservoir near FFR1	Insufficient capacity based on 2028 demand projections	NA	$0	$0	$1,034,039	$0
	Wells						
31	DWF1	Provide service to future development.	NA	$0	$3,755,580	$0	$0
32	DWF2	Provide service to future development.	NA	$0	$3,755,580	$0	$0
33	DWF3	Provide service to future development.	NA	$0	$3,490,580	$0	$0
34	DWF4	Provide service to future development.	NA	$0	$0	$3,755,580	$0
35	DWF5	Provide service to future development.	NA	$0	$0	$0	$3,915,000
36	DWF6	Provide service to future development.	NA	$0	$3,755,580	$0	$0
37	DWF7	Provide service to future development.	NA	$0	$0	$3,755,580	$0
38	DWF8	Provide service to future development.	NA	$0	$0	$0	$3,915,000
39	DWF9	Provide service to future development.	NA	$0	$0	$0	$3,915,000
40	DWF10	Provide service to future development.	NA	$0	$3,490,580	$0	$0
41	GW5	Provide service to future development.	NA	$0	$0	$0	$3,480,000
42	FF18	Provide service to future development.	NA	$0	$0	$3,490,580	$0
	Well Collection Lines						
43	20" Well Collection Line from DWF1 to Elliot & Crismon	Provide service to future development.	5,300	$0	$3,819,816	$0	$0
44	16" Well Collection Line from DWF2 to DWF1	Provide service to future development.	5,300	$0	$2,546,544	$0	$0
45	16" Well Collection Line from DWF3 to DW16	Provide service to future development.	2,500	$0	$1,384,360	$0	$0
46	16" Well Collection Line from DWF4 to Elliot and 96th St	Provide service to future development.	2,800	$0	$0	$1,384,360	$0
47	16" Well Collection Line from DWF5 to Elliot and 96th St	Provide service to future development.	7,700	$0	$0	$0	$3,699,696
48	24" Well Collection Line from Elliot and 96th St to Elliot and Crismon	Provide service to future development.	2,600	$0	$0	$1,873,872	$0
49	36" Well Collection Line in Pecos from DWGWF to DWF10	Provide service to future development.	1,000	$0	$772,200	$0	$0
50	16" Well Collection Line from DWF10 to DWGWF	Provide service to future development.	500	$0	$185,500	$0	$0
51	24" Well Collection Line from DWF10 to DW11	Provide service to future development.	3,500	$0	$2,767,660	$0	$0
52	16" Well Collection Line from DW11 to Pecos	Provide service to future development.	500	$0	$230,020	$0	$0
53	20" Well Collection Line from DW14 to DW11	Provide service to future development.	6,500	$0	$3,920,940	$0	$0
54	16" Well Collection Line in Meridian from DW15 to DW14	Provide service to future development.	2,700	$0	$1,292,140	$0	$0
55	36" Well Collection Line in Pecos from Crismon to DWGWF	Provide service to future development.	3,000	$0	$2,316,600	$0	$0
56	24" Well Collection Line from DWF6 to Pecos & Crismon	Provide service to future development.	2,600	$0	$1,937,680	$0	$0
57	20" Well Collection Line from DWF6 to DW12	Provide service to future development.	2,400	$0	$0	$1,441,440	$0
58	16" Well Collection Line from FF18 to DW12	Provide service to future development.	4,700	$0	$0	$2,258,256	$0
59	24" Well Collection Line from DWF7 to Pecos & Crismon	Provide service to future development.	3,000	$0	$0	$2,162,160	$0
60	20" Well Collection Line from DWF8 to DWF7	Provide service to future development.	3,000	$0	$0	$0	$1,801,800
61	16" Well Collection Line from DWF9 to DWF8	Provide service to future development.	3,000	$0	$0	$0	$1,441,440
	Total		245,200	**$4,347,586**	**$202,641,597**	**$29,767,251**	**$67,672,231**



Legend

Water Service Zones

- Apache Junction
- City Zone
- County Line
- Desert Sage
- Desert Wells
- Falcon Field
- Highlands
- Range Rider
- NE Mini Zone
- SE Mini Zone
- Usery 1
- Usery 2
- Arizona Water Co
- Queen Creek WSA

Other Features

- Reduced Pressure Areas
- 100 ft contours
- Light Rail Track
- Railroads
- Airports
- Highways
- Streets
- Canals
- Salt River

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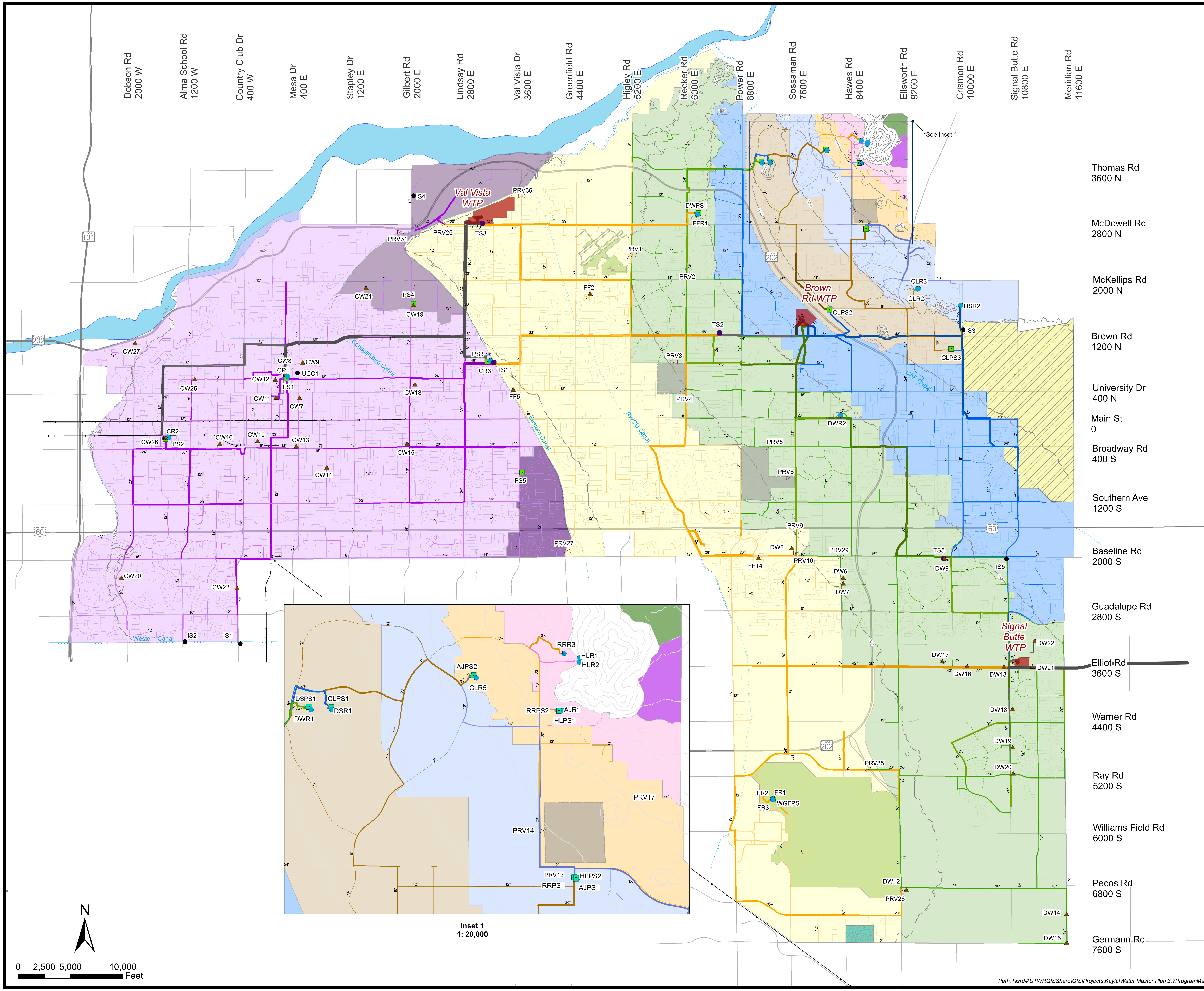
Mesa, Arizona
Water Master Plan

Exhibit A
Water Service Zones

March 2018



Legend

- Interagency Station
- Pressure Reducing Station
- Pump Station
- Reservoir
- Transfer Station
- Well
- Water Treatment Plant

Water Mains

- Apache Junction
- City Zone
- County Line
- Desert Sage
- Desert Wells
- Falcon Field
- Highlands
- Range Rider
- Supply

Water Service Zones

- Apache Junction
- City Zone
- County Line
- Desert Sage
- Desert Wells
- Falcon Field
- Highlands
- Range Rider
- NE Mini Zone
- SE Mini Zone
- Usery 1
- Usery 2
- Arizona Water Co
- Queen Creek WSA

Other Features

- Reduced Pressure Areas
- 100 ft contours
- Light Rail Track
- Railroads
- Airports
- Highways
- Streets
- Canals
- Salt River

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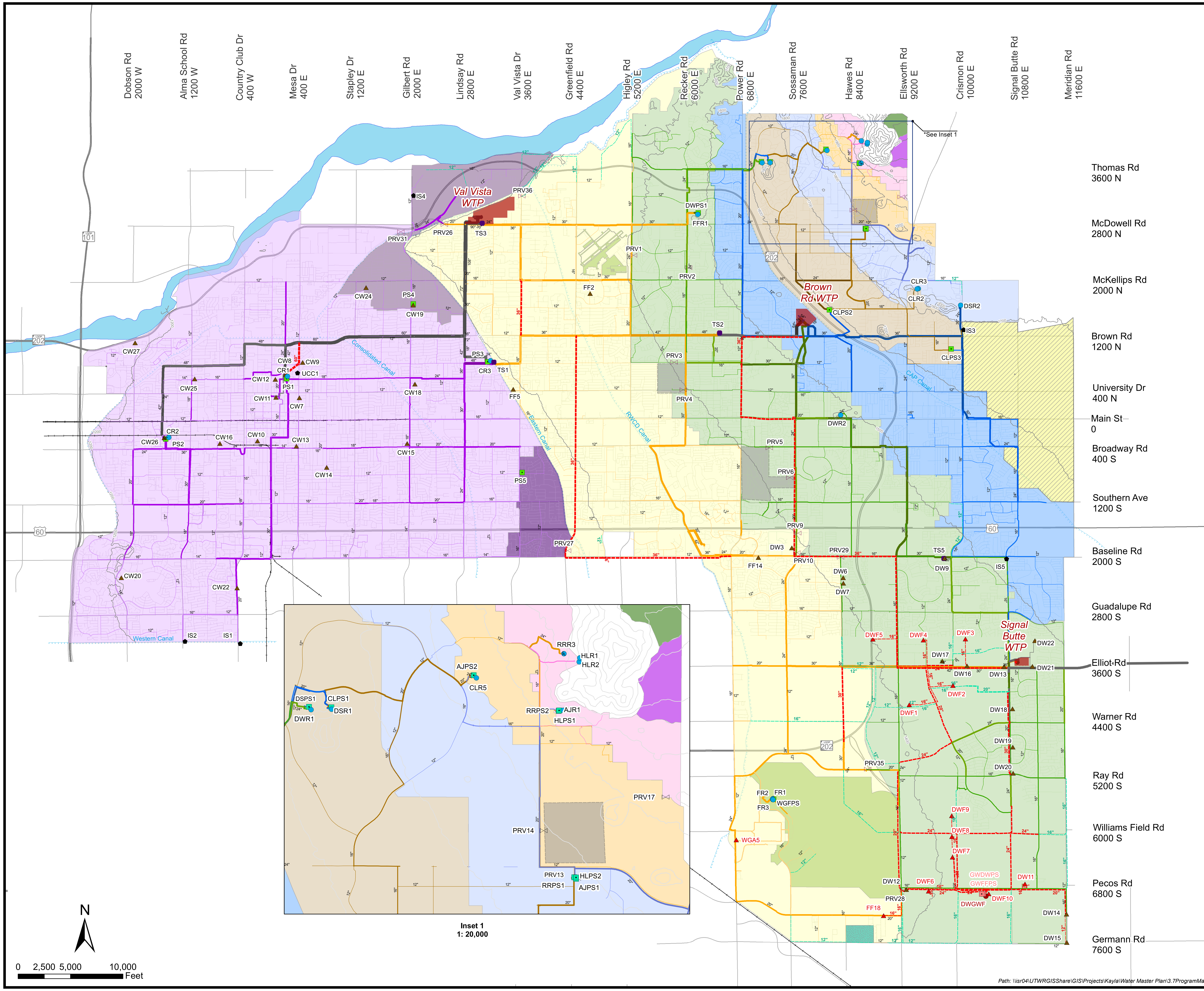
Mesa, Arizona Water Master Plan

Exhibit B
2018 Base Year
Water System

March 2018



Legend

- Interagency Station
- Pressure Reducing Station
- Pump Station
- Reservoir
- Transfer Station
- Well
- Water Treatment Plant
- Future Well
- Future Reservoir
- Future New or Expanded Pump Station

Future Water Mains

- IIP Future Mains
- Developer Future Mains

Existing Water Mains

- Apache Junction
- City Zone
- County Line
- Desert Sage
- Desert Wells
- Falcon Field
- Highlands
- Range Rider
- Supply

Water Service Zones

- Apache Junction
- City Zone
- County Line
- Desert Sage
- Desert Wells
- Falcon Field
- Highlands
- Range Rider
- NE Mini Zone
- SE Mini Zone
- Usery 1
- Usery 2
- Arizona Water Co
- Queen Creek WSA

Other Features

- 100 ft contours
- Reduced Pressure Areas
- Light Rail Track
- Railroads
- Airports
- Highways
- Streets
- Canals
- Salt River

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Mesa, Arizona
Water Master Plan

Exhibit C
Buildout

March 2018