WATER MASTER PLAN

Prepared by:

Prepared for:

AUGUST 2020

MAGNA WATER DISTRICT

WATER MASTER PLAN

August 2020

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MAGNA WATER DISTRICT

Prepared by:

BOWEN COLLINS & ASSOCIATES

EXECUTIVE SUMMARY

INTRODUCTION

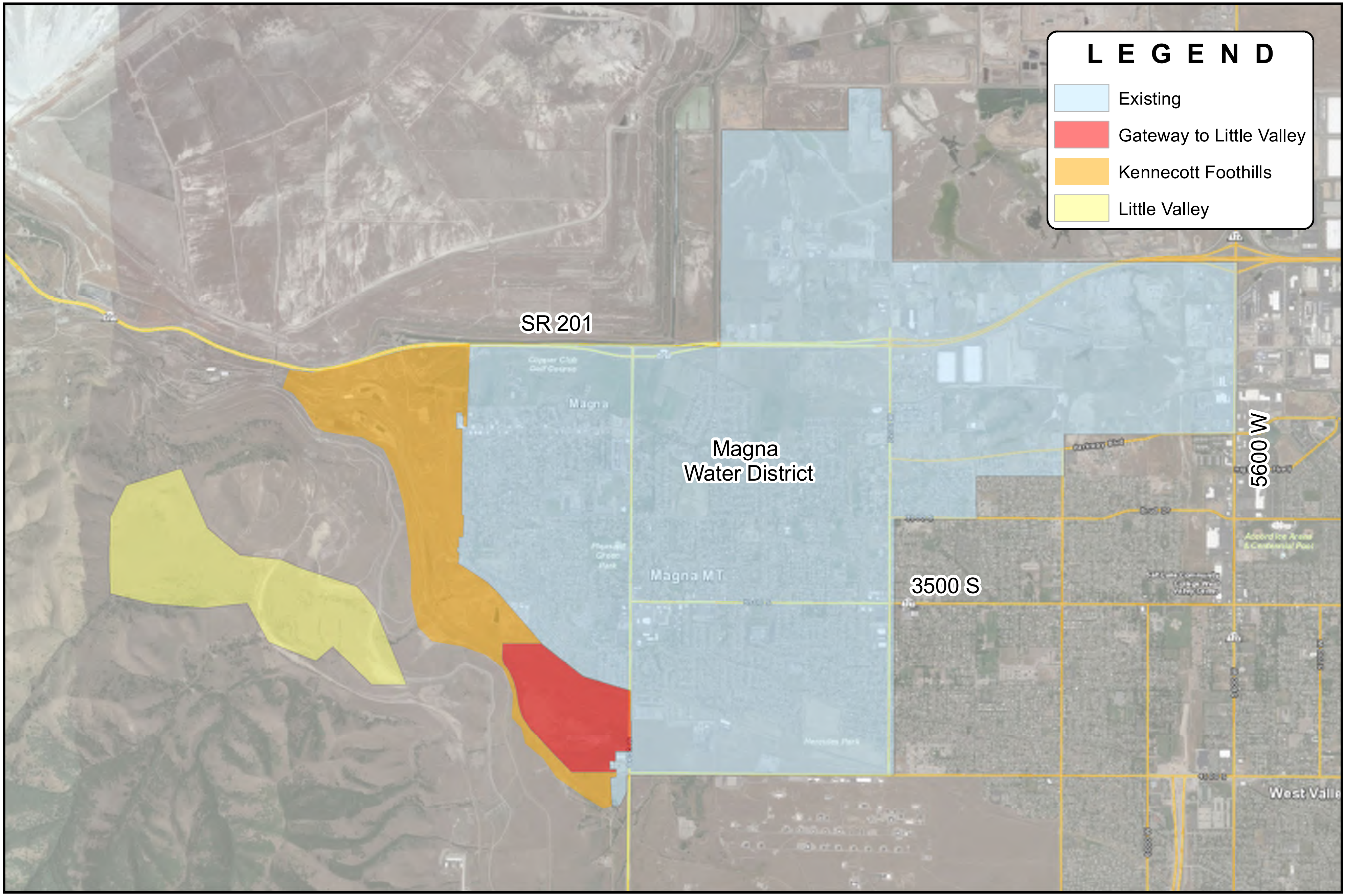
Magna Water District retained Bowen Collins & Associates (BC&A) to prepare a Supply and Demand Master Plan, Storage and Conveyance Master Plan, and an Implementation Plan. The purpose of the three separate reports are as follows:

- **Supply and Demand Master Plan** – An examination of water demands expected in the District and the existing and future supplies available to meet these demands.
- **Conveyance and Storage Master Plan** – An evaluation of the District's existing conveyance and distribution system and its ability to deliver water when and where it is needed.
- **Implementation and Capital Facilities Plan –** A plan for completing the necessary improvements identified in the supply and conveyance master plans.

This executive summary provides a brief summary of the evaluation process and the recommended system improvements. Whereas each of the plans have been written such that they can be stand-alone documents, this executive summary has been prepared to summarize all three documents.

DEMAND PROJECTIONS

Through the planning window of this study (2060), the District is expected to see significant growth including within the existing service area and within annexation areas adjacent to the District. These areas have been identified as part of Figure ES-1 and include: Gateway to Little Valley, Kennecott Foothills, and the Little Valley annexation areas. Growth rates for the annexation areas are anticipated to be significantly higher than for areas within the existing service area. Figure ES-2 identifies the population projections for the District service area.



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MAGNA WATER DISTRICT

WATER MASTER PLAN

POTENTIAL ANNEXATION AREAS

NORTH:

SCALE: 0 2,000 4,000 Feet

FIGURE NO. ES-1

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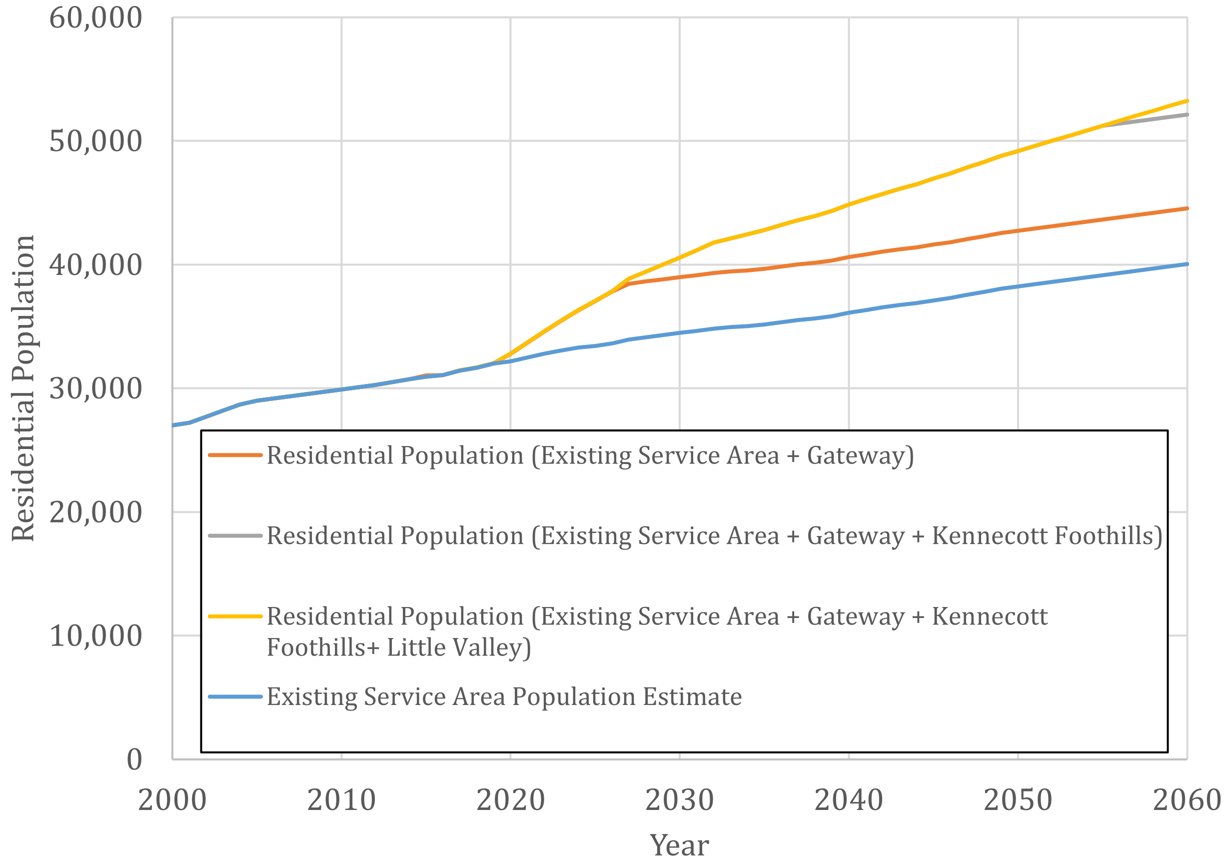


Figure ES-2
Residential Population

CONSERVATION

The District projections of demand include 25 percent reduction of year 2000 per capita demands by the year 2025 with an additional 10 percent reduction in demand by the year 2060. Meeting these conservation goals will be an essential part of the District's overall supply plan.

SECONDARY WATER EXPANSION

Effectively using District water resources will be a balancing act. The District must continue to expand its secondary system, or it will run of culinary water to supply future growth. Conversely, if it grows the secondary system too quickly, it will require major investments in new secondary sources. Based on available secondary water and culinary water sources, the recommended approach to secondary expansion will be to require secondary service in all new areas but limit initial expansion in existing areas to locations with existing dry secondary lines or larger properties along transmission lines. This strikes the right balance of pulling enough demand off culinary sources to avoid running out of culinary water while going slow enough to not unnecessarily accelerate secondary source improvements. See Figure ES-3 for the District's raw water demands.

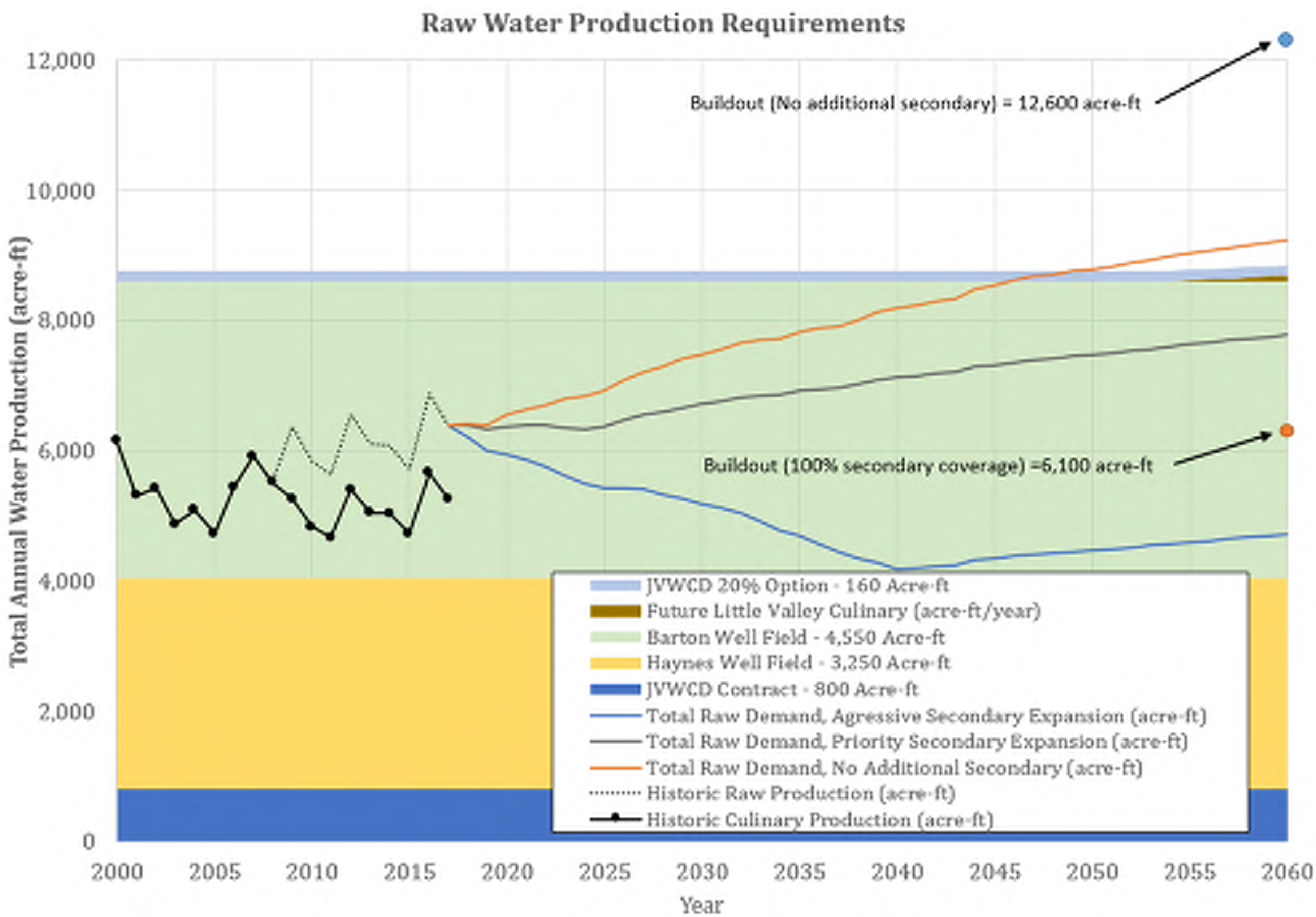


Figure ES-3
Projected Growth in Wastewater (MGD)

RAW & CULINARY WATER SOURCES

The District should seek to add at least 1,000 gpm of capacity to the Haynes and/or Barton well fields to provide adequate redundancy for projected demands. This could include construction of a new well or rehabilitation of one or more existing wells. An additional 500 gpm of capacity is projected to be required by 2033 to meet long-term supply needs, but this may not be needed depending on conversion of demands to secondary supply and should be reassessed in the future.

SECONDARY SUPPLY DEVELOPMENT

The District will need to budget $16 million for future supply development to meet projected secondary demands. This includes additional canal shares, development of wastewater reuse, and new shallow groundwater sources. It should be noted that $12.5 million of this total is for reuse and has been budgeted separately as part of the sewer improvement plan. See Figure ES-4 and Figure ES-5 for the District's culinary and secondary annual production requirements.

LITTLE VALLEY DEVELOPMENT

This document assumes that the potential Little Valley annexation area would provide its own water supply. If this is not possible, additional source capacity for both culinary and secondary demands will need to be developed within the District.

DISTRIBUTION SYSTEM IMPROVEMENTS

Figure ES-6 and Figure ES-7 show pipe improvements recommended for the culinary distribution system and secondary distribution system within the District. Table ES-1 summarizes the recommended projects and associated costs for these projects. These improvements include new pipes necessary to serve new growth for developing areas. It is worth noting that the location for developing projects are schematic and it is anticipated that the alignments will change to match frontage roads or road alignments as areas develop.

Table ES-1
Summary of 2060 Culinary and Secondary Improvements

Improvement Type	Project Cost
Culinary Storage Facilities	$3,635,000
Secondary Storage Facilities	$11,227,500
Booster Stations	$2,637,500
Culinary Distribution	$27,941,000
Secondary Distribution	$31,254,000
Total	**$76,695,000**

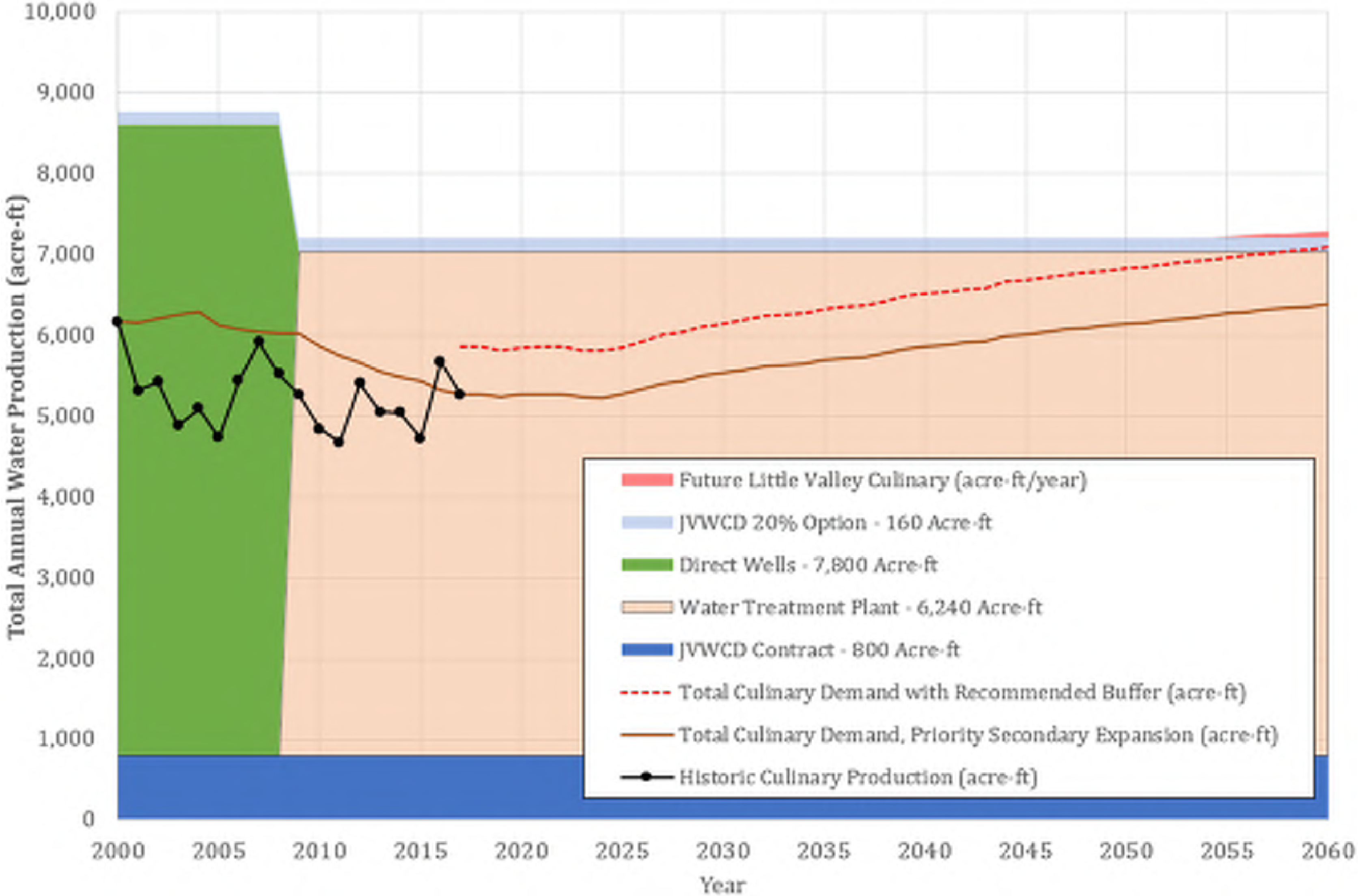


Figure ES-4
Culinary Water Production Requirements

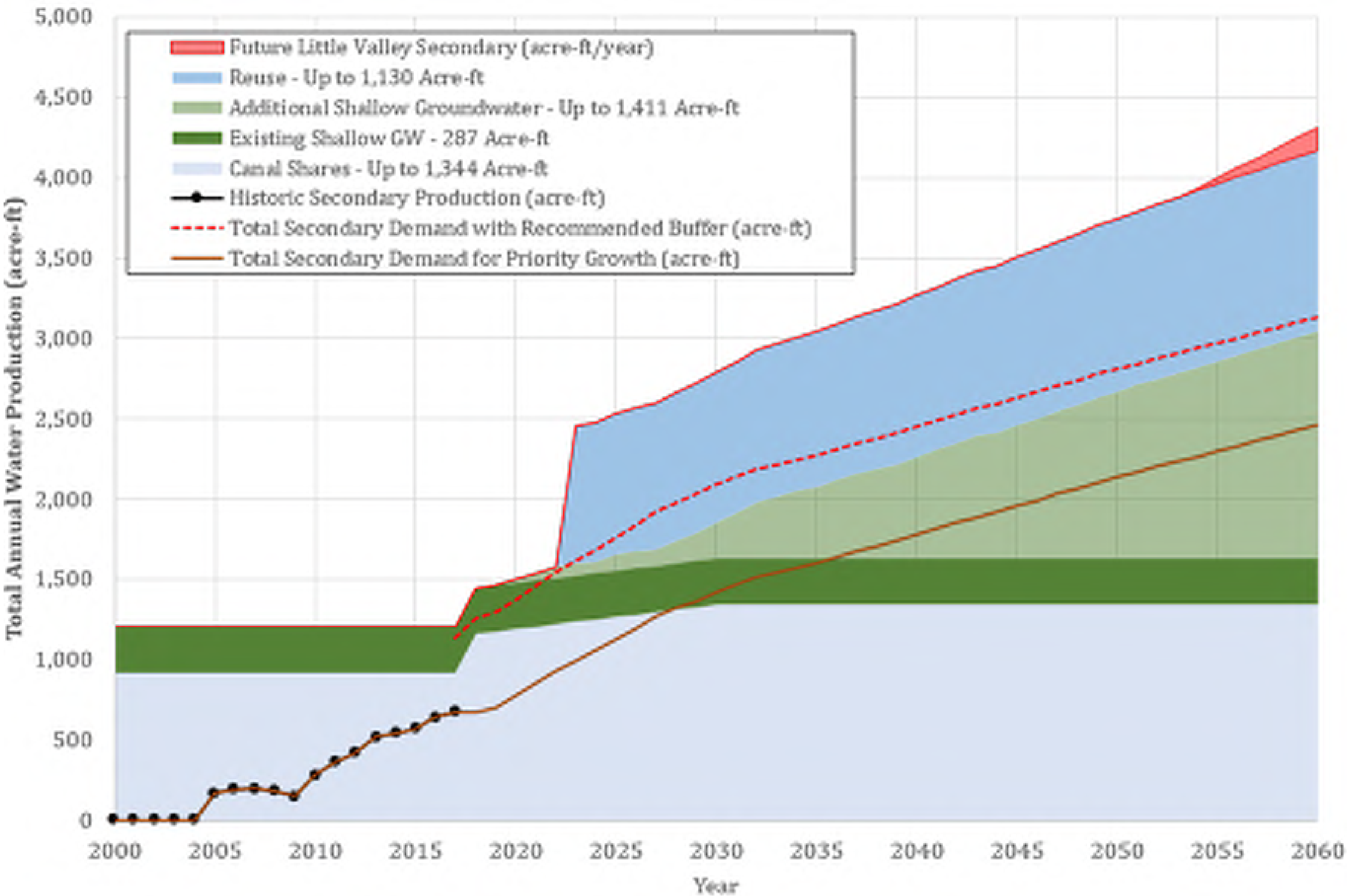
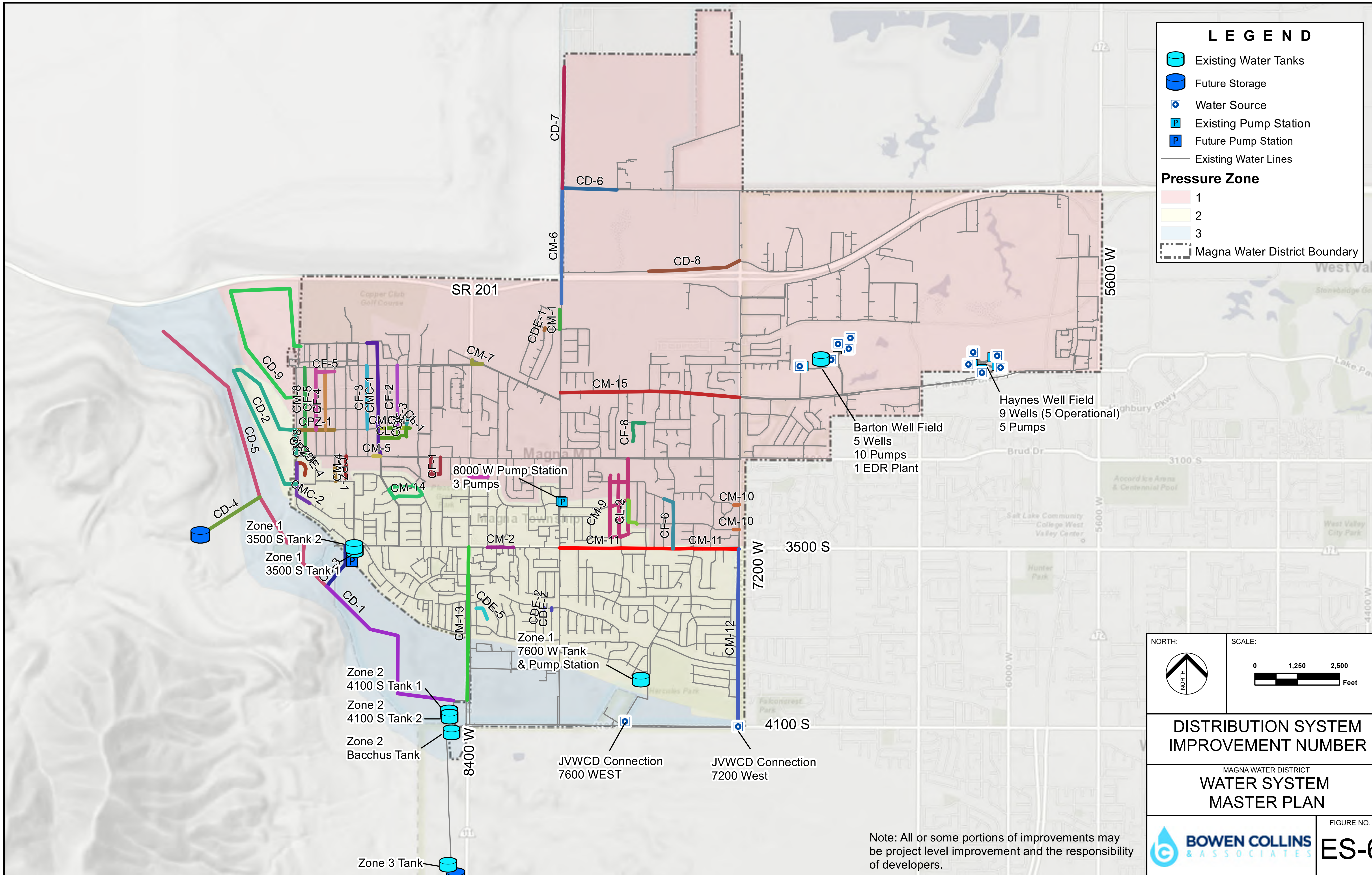
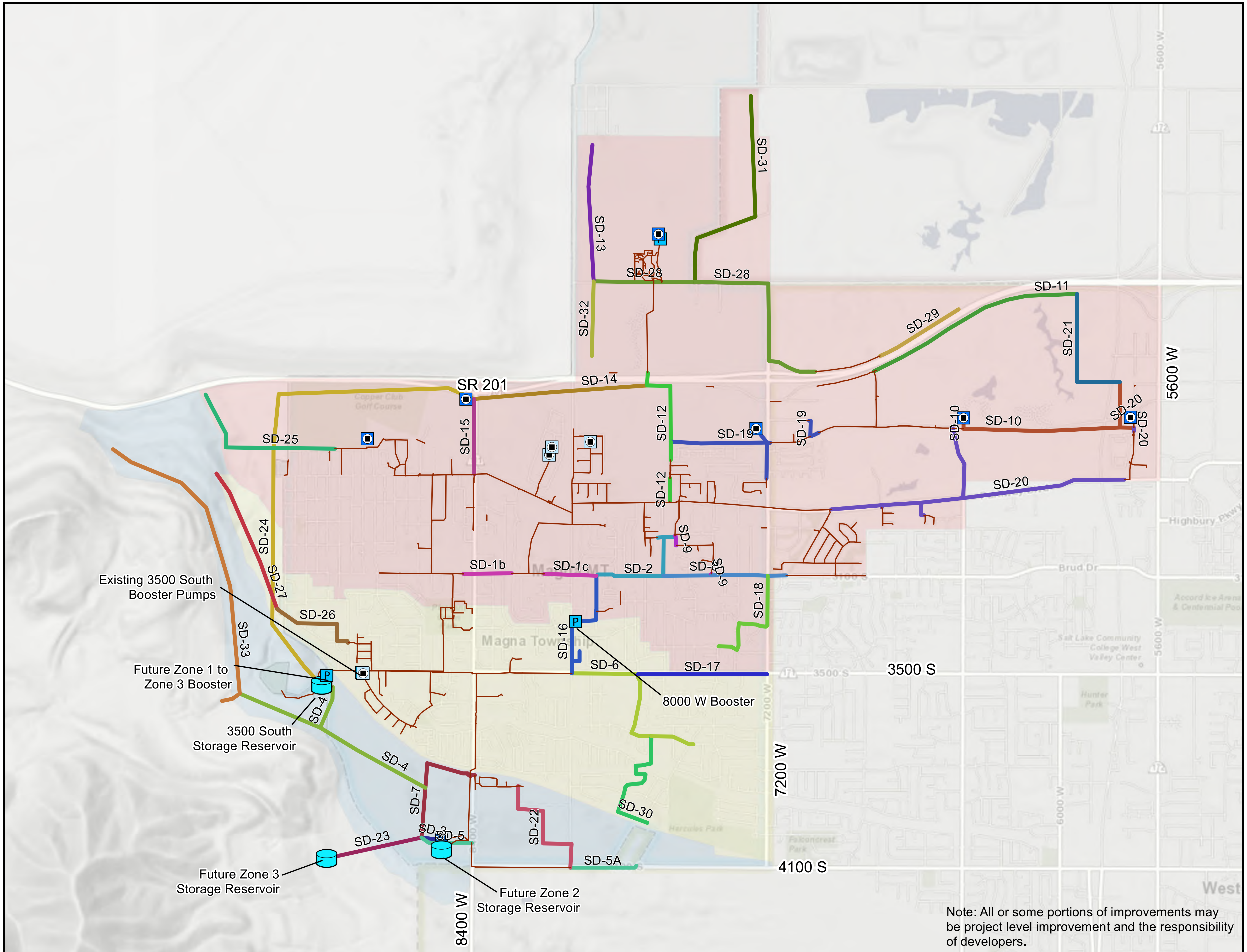


Figure ES-5
Secondary Water Production Requirements



P:\Magna Water District\483-18-01 Master Plan\4.0 GIS\4.1 Projects\Water-Figure ES-6-System Improvement Number.mxd wandersen 8/6/2020



Note: All or some portions of improvements may be project level improvement and the responsibility of developers.

2060 SECONDARY PIPE IMPROVEMENT PROJECT NUMBERS

MAGNA WATER DISTRICT

WATER MASTER PLAN

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FIGURE NO.

ES-7

P:\Magna Water District\483-18-01 Master Plan\4.0 GIS\4.1 Projects\Water-Figure ES-7-Secondary Pipe Nos.mxd wandersen 8/6/2020

REHABILITATION AND REPLACEMENT – TOTAL RECOMMENDED INVESTMENT

Based on this analysis, the recommended District budget for the 10-year planning window of this implementation plan is approximately $2.0 million towards rehabilitation and replacement activities for the water conveyance and storage facilities each year and an additional $1.1 million towards rehabilitation and replacement activities in the source and treatment facilities each year. These values are reported in 2019 dollars and should be adjusted for construction inflation over time. These budget levels should be revisited from time to time and adjusted as part of future asset management planning.

RECOMMENDED 10-YEAR CAPITAL IMPROVEMENT PROGRAM

Based on the system improvements identified in Chapter 13, Table ES-2 lists improvement projects that are recommended within the next 10-years, the budget required to complete those projects, and the recommended timing of those projects. For budgeting purposes, capital costs for most major capital improvements have been split up into at least two years; the first year usually includes about 10% of the total project cost for design services, while future years include the remaining budget for actual construction.

Table ES-2
Recommended 10-Year Capital Improvement Plan

Project ID	Project Description	Project Total (2019 $s)	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	10-yr Total
Culinary Storage Improvements													
CS-1	Zone 3 II Culinary	$1,210,000	$124,630	$1,155,320									$1,279,950
Subtotal		***$1,210,000***	***$124,630***	***$1,155,320***	***$0***	***$0***	***$0***	***$0***	***$0***	***$0***	***$0***	***$0***	***$1,279,950***
Secondary Storage Improvements													
SS-1	Zone 3 Secondary	$4,150,000				$467,086	$4,329,889						$4,796,975
Subtotal		***$4,150,000***	***$0***	***$0***	***$0***	***$467,086***	***$4,329,889***	***$0***	***$0***	***$0***	***$0***	***$0***	***$4,796,975***
Culinary and Secondary Booster Stations													
CBS-1	Zone 3 II Culinary	$775,000	$79,825	$739,978									$819,803
SBS-1	Zone 3 I Secondary	$575,000	$59,225	$549,016									$608,241
SBS-2	Zone 3 II Secondary	$1,000,000				$112,551	$1,043,347						$1,155,898
Subtotal		***$2,350,000***	***$139,050***	***$1,288,994***	***$0***	***$112,551***	***$1,043,347***	***$0***	***$0***	***$0***	***$0***	***$0***	***$2,583,941***
Culinary Distribution Improvements													
CD-1	Zone 3 Conveyance	$1,339,000	$137,917	$1,278,491									$1,416,408
CD-3	Zone 3, Zone 3 Pump Connection	$347,000		$368,132									$368,132
CMC-1	8800 W, 3100 S to 2600 S Pipe Upsize	$897,000				$100,958	$935,882						$1,036,840
CPZ-1	3000 S, 9200 W to 9000 W Zone Change	$353,000										$447,170	$447,170
CDE-1	Twain Dr & Thoreau Dr Dead-End	$22,000			$24,040								$24,040
CDE-2	Westbury Dr,8070 W & 8035 W	$31,000			$33,875								$33,875
CDE-3	8950 W 3100 S 10 Valves	$30,000			$32,782								$32,782
CDE-4	Copper Cove Cir	$126,000							$154,964				$154,964
CDE-5	Sage Brook Cir	$120,000							$147,585				$147,585
CL-1	2900 S 8700 W Loop	$430,000			$469,873								$469,873
CL-2	7700 W to Broadway, 3100 S to 3500 S	$157,000			$171,558								$171,558
CL-3	Broadway St, 3240 S Loop	$215,000			$234,936								$234,936
CF-1	8520 W 3100 S	$290,000								$367,363			$367,363
CF-2	8950 W 3100 S 10 Valves	$425,000								$538,377			$538,377
CF-3	8850 W, 3000 S to 2700 S	$427,000							$52,516	$486,820			$539,335
CF-4	9000 W, 2700 S to 3150 S	$392,000										$526,815	$526,815
CF-6	Upsize Magnolia	$380,000								$48,137	$446,232		$494,370
CF-7	Aleen Ave	$126,000										$169,333	$169,333
CF-8	Melanie Ann Ct	$209,000										$280,879	$280,879

Project ID	Project Description	Project Total (2019 $s)	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	10-yr Total
CM-1	2" Lateral - 8000 Melville Houses	$134,000			$146,425								$146,425
CM-2	3500 S, Rulon to Oquirrh	$229,000			$250,234								$250,234
CM-3	8950 W 3100 S 10 Valves	$123,000			$134,405								$134,405
CM-4	8950 W 3100 S 10 Valves	$162,000			$177,022								$177,022
CM-5	8900 W 3100 S, Abandon 6" Steel	$51,000			$55,729								$55,729
CM-6	8000 W, 2600 S to 2100 S (Transite)	$1,110,000			$121,293	$1,124,383							$1,245,676
CM-7	2700 S 8400 W, Intersection Valve Replacement	$103,000			$112,551								$112,551
CM-8	9150 W, 3000 S to 3100 S Valve Replacements	$594,000		$63,017	$584,172								$647,189
CM-10	Replace Valves	$81,000			$88,511								$88,511
CM-11	3500 S, 7200 W to 8000 W Replace 8	$1,876,000							$230,724	$2,138,815			$2,369,539
CM-14	Florence & Edith, Helen to Katherine	$526,000						$62,807	$582,222				$645,029
CM-15	2820 S, 8000 W to 7200 W 1960s Cast Iron	$1,207,000									$157,486	$1,459,896	$1,617,382
Subtotal		***$12,512,000***	***$137,917***	***$1,709,640***	***$2,637,406***	***$1,225,341***	***$935,882***	***$62,807***	***$1,168,011***	***$3,579,512***	***$603,719***	***$2,884,093***	***$14,944,329***
Secondary Distribution Improvements													
SD-1	3100 S, Dayton St to 7900 W	$717,000					$83,120	$770,522					$853,642
SD-2	3100 S, 7900 W to 7600 W	$931,000						$111,166	$1,030,511				$1,141,678
SD-3	Zone 2 Tank & Pump Station Piping	$143,000	$147,290										$147,290
SD-4	Zone 3 Gateway Piping	$1,265,000	$130,295	$1,207,835									$1,338,130
SD-5	Zone 3 Magna Regional Park	$340,000									$44,362	$411,238	$455,601
SD-6	Scott Matheson Jr & Copper Hills Elementary	$1,214,000			$132,657	$1,229,731							$1,362,388
SD-7	Gateway to Little Valley Piping	$454,000		$481,649									$481,649
SD-9	7600 W Connections	$85,000								$107,675			$107,675
SD-12	SR201 Crossing Transmission	$1,059,000	$109,077	$1,011,144									$1,120,221
SD-16	8000 W Booster Piping	$1,021,000									$133,217	$1,234,925	$1,368,142
SD-19	2600 S, 7600 W to 7200 W	$955,000	$98,365	$911,844									$1,010,209
SD-22	Zone 3, 8200 W Pipe	$704,000						$84,061	$779,248				$863,309
SD-23	Zone 3 Tank Pipe	$438,000				$492,973							$492,973
Subtotal		***$9,326,000***	***$485,027***	***$3,612,471***	***$132,657***	***$1,722,704***	***$83,120***	***$965,749***	***$1,809,759***	***$107,675***	***$177,580***	***$1,646,163***	***$10,742,906***
Source Rehabilitation and Replacement Improvements													
1	Haynes Well #8	$1,600,000			$174,836	$1,620,733							$1,795,569

Project ID	Project Description	Project Total (2019 $s)	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	10-yr Total
2	Well Field Rehabilitation	$250,000		$132,613					$153,734				$286,347
4	Well Field SCADA	$250,000		$26,523	$245,864								$272,386
5	Immediate EDR Project (Add 3rd Stage)	$2,754,500		$292,225	$2,708,925								$3,001,150
6	EDR Membrane Replacement	$3,420,000					$99,118	$1,939,738					$2,038,856
7	Brine Pump Station	$250,000		$26,523	$245,864								$272,386
8	Standby Generator	$120,000			$131,127								$131,127
9	SCADA Upgrades	$250,000			$273,182								$273,182
Subtotal		***$8,894,500***	***$0***	***$477,882***	***$3,779,797***	***$1,620,733***	***$99,118***	***$1,939,738***	***$153,734***	***$0***	***$0***	***$0***	***$8,071,003***
Shallow Groundwater Development													
1	Shallow Groundwater Development	$3,450,000					$79,990	$741,506					$821,496
Subtotal		***$3,450,000***	***$0***	***$0***	***$0***	***$0***	***$79,990***	***$741,506***	***$0***	***$0***	***$0***	***$0***	***$821,496***
Valve, Hydrant, and Meter Replacement													
1	Valve, Hydrant, and Meter Replacement	-	$400,000	$423,211	$447,277	$471,781	$496,969	$511,878	$527,234	$543,051	$559,343	$576,123	$4,956,867
Subtotal		***$0***	***$400,000***	***$423,211***	***$447,277***	***$471,781***	***$496,969***	***$511,878***	***$527,234***	***$543,051***	***$559,343***	***$576,123***	***$4,956,867***
TOTAL		**$41,892,500**	**$1,286,624**	**$8,667,518**	**$6,997,137**	**$5,620,196**	**$7,068,314**	**$4,221,679**	**$3,658,739**	**$4,230,239**	**$1,340,641**	**$5,106,380**	**$48,197,467**

Note: Costs include 3% inflation per year

SUPPLY & DEMAND MASTER PLAN

PART 1 OF WATER MASTER PLAN

TABLE OF CONTENTS

Note: This report is the first in a series of three reports comprising the Magna Water District Water Master Plan. Chapters 7 through 16 are located in the second and third reports in this series.

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CHAPTER 1
INTRODUCTION

INTRODUCTION

The Magna Water District (MWD or District) desires to develop an updated master plan for its water system. This is the first in a series of three expected reports that will comprise the planning documents for the District's water system. The expected reports will be:

- **Supply and Demand Master Plan** – An examination of water demands expected in the District and the existing and future supplies available to meet these demands.
- **Conveyance and Storage Master Plan** – An evaluation of the District's existing conveyance and distribution system and its ability to deliver water when and where it is needed.
- **Implementation and Capital Facilities Plan –** A plan for completing the necessary improvements identified in the supply and conveyance master plans.

BACKGROUND

The focus of this report is supply and demand. The primary previous master planning document addressing supply and demand is:

- Culinary Water, Secondary Water, & Sanitary Sewer Impact Fee Facility Plan – Prepared by Epic Engineering in August 2013

Since the completion of the previous study, a number of changes have occurred. Changes that need to be evaluated and addressed for the District to meet its future water supply commitments include:

- **Land Use Changes –** Since the preparation of the last master plan, several areas adjacent to the District's service area have begun development planning that includes a need to annex into the District. The District would like to plan for future areas likely to annex into the District:
    - **Gateway to Little Valley –** This development sits just west of the District's current service area and has proposed developing 1,220 indoor equivalent residential connections within the next 10-years.
    - **Kennecott Foothills –** Additional area directly west of the existing District service area (beyond that identified as part of Gateway to Little Valley) is likely to develop and annex into the District. For the purpose of District planning, all areas directly west of the existing service area under an elevation of approximately 4,660 feet have been included as potential annexation.
    - **Little Valley –** Kennecott has long term plans for development in the area called "Little Valley". This is a small valley within the Oquirrh Mountains west of the District. The District would like to plan facilities to meet the needs of the Little Valley in its long-term plans.
    - **Magna Regional Park –** Salt Lake County will begin constructing the first phase of the Magna Regional Park in late 2019. The long-term plan for the park will include approximately 50 acres of irrigated area with restrooms and a splashpad. The first phase of the park will include approximately 25 acres of irrigated acres with restrooms and a splash pad. This area was previously zoned as an open space park with natural vegetation (non-irrigated). The development of the park into play fields

will require a significant amount of additional irrigation in the District with a small increase in anticipated culinary demand from the restrooms and splash pad.

- **Continued Growth and Additional Density –** In addition to areas that will potentially annex into the District, densities for new development have generally been increasing and are higher than densities included in the previous master plan.
- **Conservation –** The State of Utah is in midst of adjusting water conservation goals on a State-wide basis. It is unclear at this time what the future goals will be. However, the District will adjust its own conservation goals as part of its overall strategy for meeting future water needs. This report will need to evaluate the potential for conservation and its effect on water supply plans.
- **Drought –** Recent years of drought have emphasized the importance of planning for drought scenarios. Multiyear droughts affect water supplies most critically and several extended periods of drought have been observed since the completion of previous studies. Consideration of these more frequent drought periods may change how the District plans for drought in the future.
- **Climate Change –** Climate change has the potential to affect both demand (e.g. irrigation season becomes longer and evapotranspiration increases with higher temperatures) and supply (e.g. less precipitation in the form of snow affects how water is available in the system). To be prepared for these impacts, the District needs to consider the potential effects of climate change in its demand and supply planning.

To consider these and other issues relative to the District's future water supply commitments, the District has retained Bowen, Collins & Associates (BC&A) to evaluate demand and supply needs within the District.

SCOPE OF SERVICES

The scope of the work documented in this report includes three major tasks:

Task 1 – Water Demand Projections

This report will use and compare the Wasatch Front Regional Council (WFRC) populations projections to projected future residential and employment populations in the MWD service area thru 2060. Available GIS mapping of the District will be used to examine the geographic distribution of existing and future demands. There are some specific issues that will be considered as part of the demand analysis:

- Annual demands will be converted to peak day demands based on existing peaking ratios and the expected changes in the future resulting from your conservation efforts.
- Conservation goals and their impact on projected demands will be considered.
- The impact to demand from drought and climate change will be estimated.

Task 2 – Evaluated Available Water Supply

The report will examine all identified potential water sources for MWD including deep aquifer groundwater, shallow aquifer groundwater, reuse (including reuse of brine streams and wastewater streams), and canal sources. This will include consideration of how the supplies will be impacted in drought scenarios and climate change.

Task 3 - Evaluate the Adequacy of the Projected Supply of the District to Meet Projected Demands

With updated system demands and an understanding of available supply, we will evaluate the adequacy of existing supplies and master plan future supply development as follows:

- The adequacy of District sources to meet projected demands on an annual volumetric basis will be evaluated.
- The adequacy of District sources to meet projected peak demands will also be evaluated.
- Both types of evaluations will consider the effects of conservation and will factor in the District's plans for source development.

Subsequent chapters of this report document the execution of these tasks along with the corresponding results.

REPORT ASSUMPTIONS

As a long-term planning document, this report is based on a number of assumptions relative to future growth patterns, service area expansion, and source availability. Of special significance to the District are a number of assumptions relative to conservation throughout the District and water demands associated with annexation areas and development densities. If any variables are significantly different than what has been assumed, the results of this report will need to be adjusted accordingly. Because of these uncertainties, this report and the associated recommendations should be updated every five to ten years or sooner if significant changes occur such as annexation or changes in development patterns.

CHAPTER 2
DEMAND PROJECTIONS

There are several methods that can be used to estimate future water demand. This study developed demand projections using equivalent residential connections (ERCs). The methodology of this approach can be summarized as follows:

1. Define the service area
2. Project residential populations for the service area based on existing and projected patterns of development
3. Project equivalent residential connections (including non-residential growth) for the service area based on existing and projected patterns of development
4. Separate growth in irrigated acreage to be able to identify potential use of water in a secondary system
5. Estimate the contribution of equivalent residential connections based on a statistical analysis of existing levels of development and historic water use. Include a breakdown of indoor and outdoor use
6. Convert projections of equivalent residential connections and irrigated acreage to water demands based on their historic contributions
7. Adjust projected demands as necessary to account for conservation trends and goals.

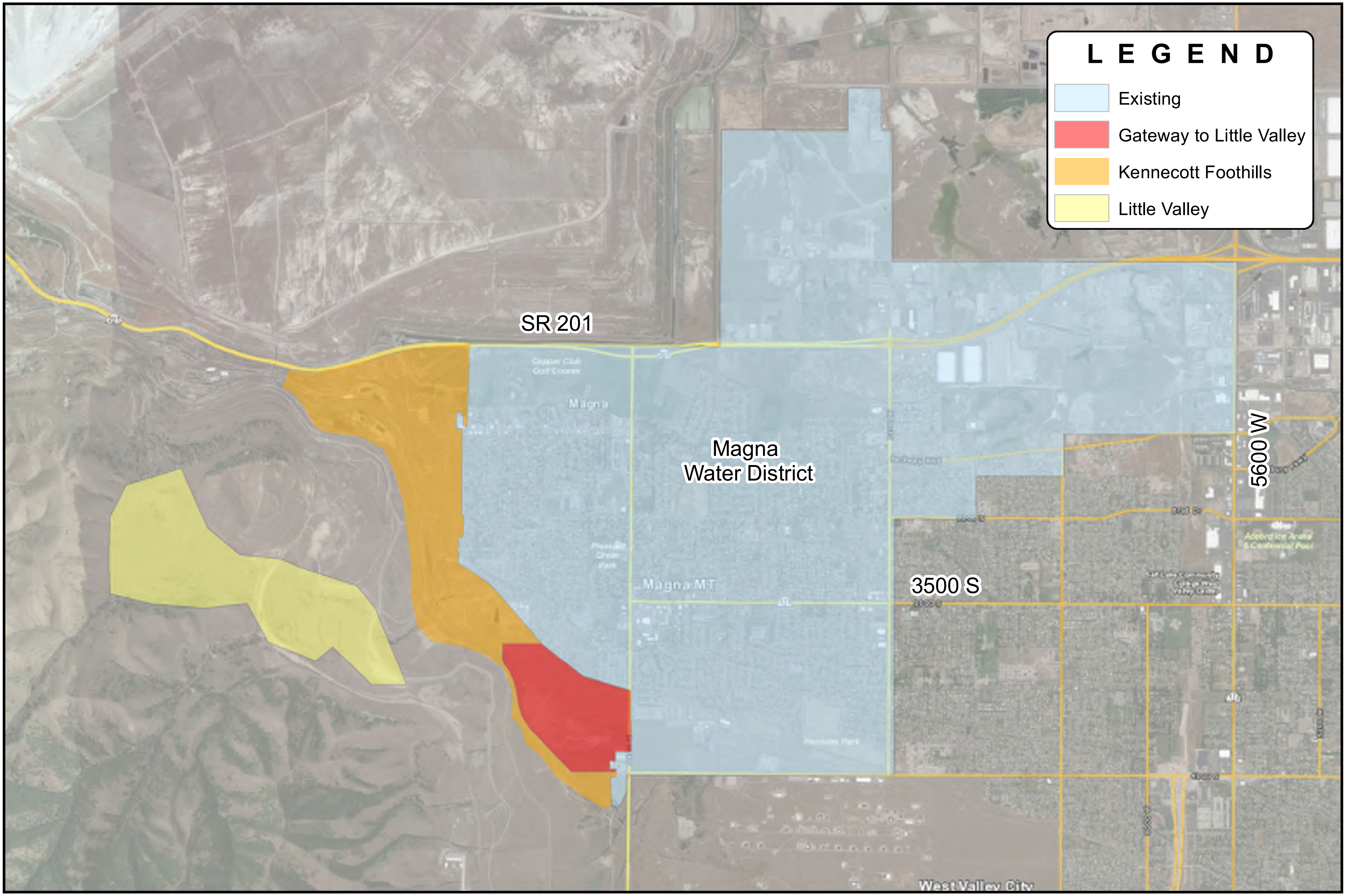
Each step of this process is summarized in the sections below.

SERVICE AREA

MWD currently provides all retail water service within Magna Water District service. This service area is likely to expand as developable areas west of the District require water and sewer service. These areas have been identified as part of Figure 2-1 and include: Gateway to Little Valley, Kennecott Foothills, and the Little Valley annexation areas.

RATES OF GROWTH

There are a number of planning agencies that produce growth estimates covering the area included in the Magna Water District: the State of Utah Governor's Office of Management and Budget (GOMB), the Kem C. Gardner Policy Institute, and the Wasatch Front Regional Council (WFRC). The first two agencies generally plan on a county or state level. As a result, planning estimates at those scales are often unhelpful for service district's because boundaries often do not line up with service district boundaries. The WFRC does planning on a smaller scale as a result of needing to conduct traffic modeling of future conditions. The WFRC develops traffic analysis zones (TAZs) that include sub-areas that include residential and employment projections divided into relatively small areas representative of collector roads. As a result, the WFRC projections are the more helpful than State of Utah estimates for projecting rates of growth for population and employment growth for service districts.



MAGNA WATER DISTRICT

WATER MASTER PLAN

POTENTIAL ANNEXATION AREAS

NORTH:

SCALE: 0 2,000 4,000 Feet

FIGURE NO. 2-1

BOWEN COLLINS & ASSOCIATES

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Existing Service Area

BC&A reviewed the WFRC draft TAZ projections for the Magna Water District and used the existing population estimates and growth rate for each TAZ within the District to help define the rate of growth for the existing service area through the year 2050. The WFRC does not have population projections beyond the year 2050, so the rate of growth shown through 2060 is extrapolated at the 2050 rate for the existing service area.

Annexation Areas

The rate of growth for the annexation areas is based on discussions with Kennecott planning personnel, the developers of the Gateway to Little Valley, Kennecott Foothills, and Little Valley. The timelines given below are based roughly on feedback from Kennecott planning personnel. It is worth noting that the range of growth rates from Kennecott planning personnel has varied widely, but is anticipated to be reliable for at least the next 10 years.

- Gateway to Little Valley – The Gateway to Little Valley area has specific plans that have been submitted to the County already and the developer believes the area will develop within the next 10 years. For planning purposes, it has been assumed that this area will fully develop within 7.5 years.
- Kennecott Foothills – As the Gateway develops, it is anticipated that some of the areas adjacent to the Gateway considered as part of the Kennecott Foothills will continue to develop at approximately the same rate as the Gateway area or around 120 equivalent residential connections (ERCs) per year. Once some of the area directly around the Gateway fully develops (the area south of 3500 South in Pressure zone 3 is anticipated to develop by approximately the year 2033), it is anticipated that the rate of growth will slow to approximately 60 ERCs per year for the remaining portion of the Kennecott Foothills. Based on the total available area, the Kennecott Foothills is projected to fully develop by approximately 2055
- Little Valley – It has been assumed that no growth in the Little Valley area will occur until the Kennecott Foothills fully develops. Thus, growth in the Little Valley area has been assumed at a rate of 60 ERCs per year beginning in the year 2055. While no immediate plans existing, Kennecott personnel indicate that there is at least a possibility that development of Little Valley could begin quite a bit sooner than 2055. However, if that is the case, it has been assumed that any growth in Little Valley would be offset by a decrease in growth in the Kennecott Foothills. Thus, overall growth would remain about the same as currently assumed.

Table 2-1 and Figure 2-2 identify the population projections for the District service area.

Table 2-1
Population Projections for Magna Water District

Year	Existing Service Area	Gateway to Little Valley	Kennecott Foothills	Little Valley	Total Population	Rate of Growth
2018	31,649	0	0	0	31,649	
2020	32,166	265	0	0	32,430	1.2%
2025	33,424	1,588	0	0	35,012	1.5%
2028	34,127	1,985	801	0	36,913	1.8%
2030	34,486	1,985	1,576	0	38,047	1.5%
2035	35,143	1,985	3,126	0	40,254	1.1%
2040	36,105	1,985	4,233	0	42,323	1.0%
2045	37,102	1,985	5,340	0	44,427	1.0%
2050	38,230	1,985	6,447	0	46,662	1.0%
2055	39,131	1,985	7,592	0	48,709	0.9%
2060	40,054	1,985	7,592	1,107	50,738	0.8%

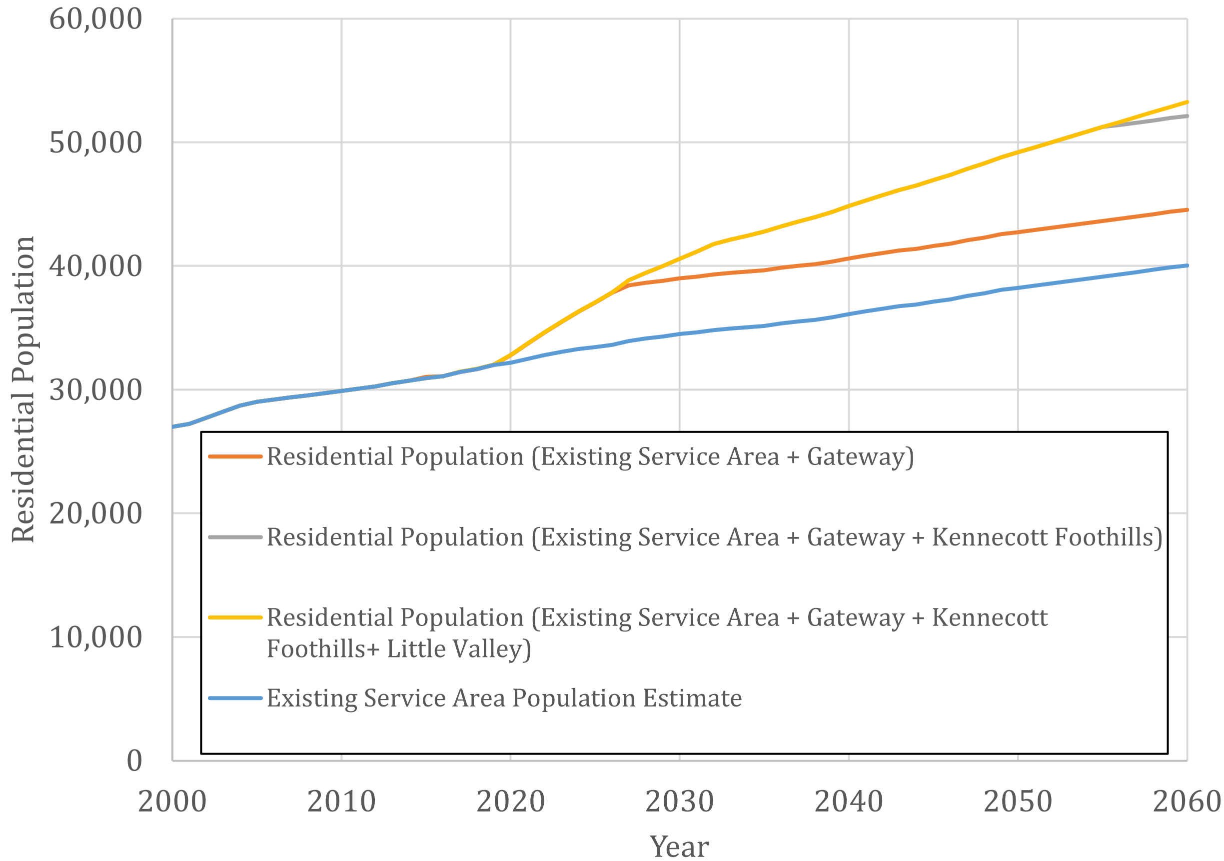


Figure 2-2
Residential Population

Land Use

While the rates of growth from the WFRC are useful for projecting how fast growth will occur, it is less useful for predicting final densities and buildout growth for the District. This was especially true for some of the annexation areas which have little growth shown according to WFRC projections through 2050 and no land use plans by cities or other agencies. Based on recent development trends, the District would like to plan on an average density of 6 ERCs/acre for areas generally identified as residential and an average density of 2 ERCs/acre for areas generally identified as non-residential.

Figure 2-3 shows the undeveloped areas in the District along with the average planning densities used for projecting future demands.

Non-Residential Growth

All of the areas identified in Figure 2-3 with a density of 2 units/acres are the non-residential undeveloped areas in the District. Of the undeveloped area in the District or its future annexation areas, approximately 56 percent of the area is non-residential.

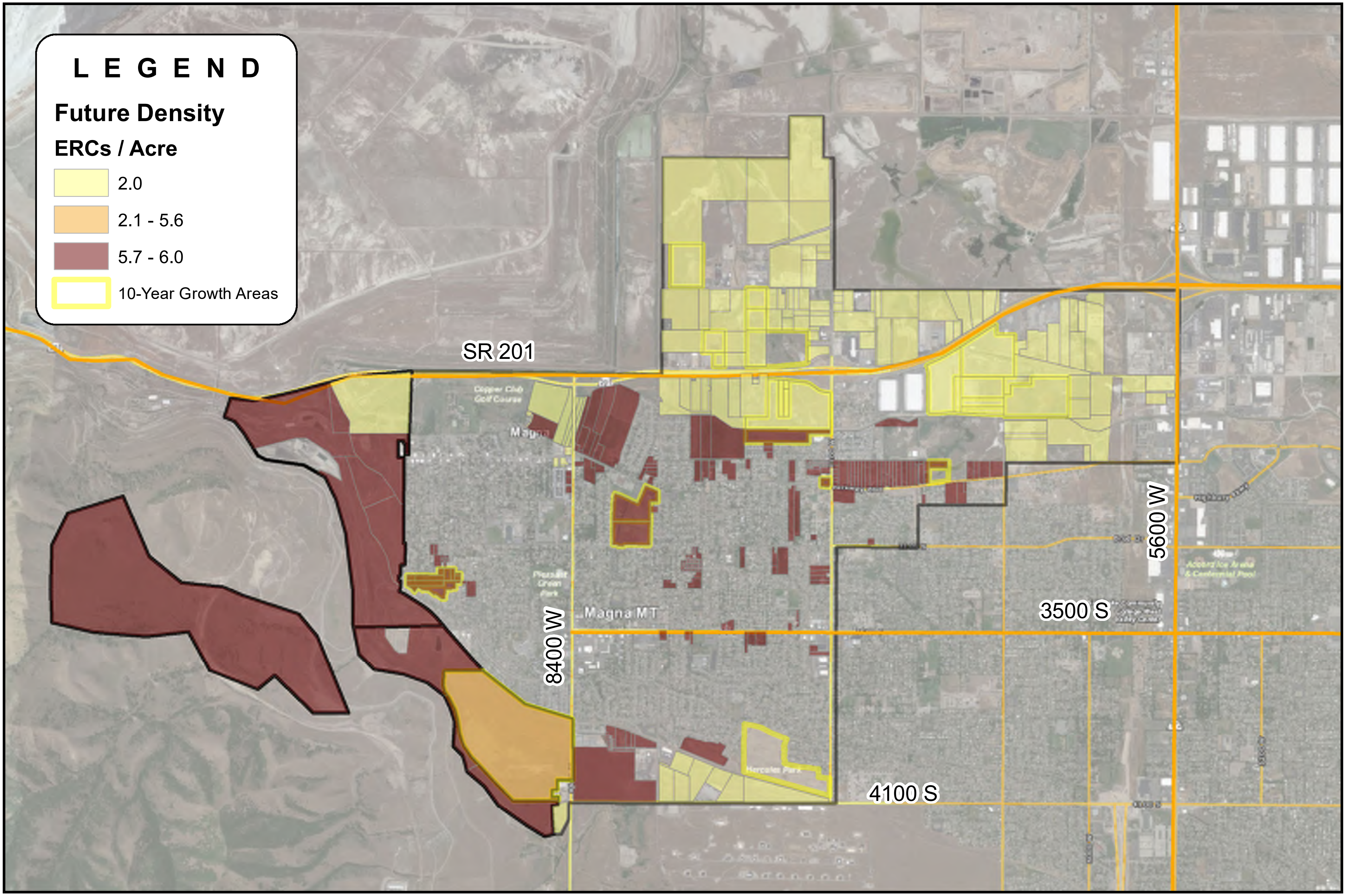
Table 2-2
Area of Undeveloped Non-Residential Property in Service Area

Service Area	Undeveloped Area (acres)	Non-residential Undeveloped (acres)	Non-residential Percentage
Existing Service Area	2,238	1,789	79.9%
Gateway to Little Valley	230	90	39.0%
Kennecott Foothills	466	75	16.1%
Little Valley	552	0	0.0%
Total	**3,486**	**1,954**	56.0%

In 2017, the District Based on 2017 data, the average persons per residential connection was calculated to be 3.65. Average annual water use per ERC was calculated to be approximately 0.60 acre-ft/ERC for 2017 based on the assumption that all connections benefit from the existing secondary supply uniformly as summarized in Table 2-3.

Table 2-3
2017 Equivalent Residential Connection Summary

Connection Information	Year 2017
Residential Connections	8,596
2017 Secondary Irrigation (acre-ft)	674.12
2017 Residential Production (acre-ft)	4,572.7
2017 Non-Residential Production (acre-ft)	693.4
Non-Residential Equivalent Residential Connections	1,304
2017 Total Production	5,940
2017 Total ERCs	9,900
Total Production per ERC (acre-ft/ERC)	0.60



BOWEN COLLINS & ASSOCIATES

MAGNA WATER DISTRICT

WATER MASTER PLAN

UNDEVELOPED OR UNDER DEVELOPED LAND

NORTH:

SCALE: 0 4,000 Feet

FIGURE NO. 2-3

Based on these calculations, the estimated number of existing ERCs for 2017 was estimated to be 9,900. Irrigated acreage for the District for 2017 was estimated based on dividing total outdoor production by an irrigation rate of 3.30 acre-ft/irrigated acre for 2017. These baseline 2017 values were used to estimate projections of future water use for the District with conservation through the year 2060.

For the next 10 years, projections of non-residential growth are based on development pressure that District personnel have identified. For the remaining period of the service area, the non-residential growth rate has been projected to grow at the rate anticipated by the WFRC. Table 2-4 summarizes the growth of equivalent residential connections within the District and includes irrigated area associated with residential and non-residential growth. Irrigated acreage within the District is anticipated to grow proportional to residential growth within the District (assuming parks and irrigated area expands with residential growth, but not with non-residential growth).

Table 2-4
Equivalent Residential Connections & Irrigated Area Projections

Year	Residential ERCs	Non-residential ERCs	Total ERCs	Irrigated Acres[1]
2018	8,668	1,382	10,049	978
2020	8,883	1,537	10,419	1,048
2025	10,037	1,925	11,961	1,228
2028	10,681	2,080	12,761	1,309
2030	10,988	2,163	13,151	1,349
2035	11,586	2,348	13,933	1,428
2040	12,146	2,608	14,755	1,513
2045	12,716	2,834	15,550	1,595
2050	13,321	2,893	16,215	1,664
2055	13,875	3,021	16,897	1,735
2060	14,425	3,116	17,542	1,802

[1] Irrigated acreage for existing conditions estimated based on outdoor water production and estimated rate of irrigation of 3.3 acre-ft/acre.

ANNUAL PRODUCTION REQUIREMENT

The final step in developing annual water production requirement projections is to convert the projections of each use component (indoor ERCs and irrigated acreage as described above) into actual water production requirement by multiplying each projected component by the water production requirement of each component (i.e. the "Production Requirement Factor"). The production requirement factor is the amount of water required to be produced for each component with allowance for system losses and other system inefficiencies. In other words, the production requirement factors answer the question, "How much water must be produced for the demands of each component of water use?" Because production requirement factors are subject to change through conservation, several scenarios of use factors are addressed in this report below.

Historic Production Requirements

In order to predict future water production requirements for Magna Water District, historical water use data was used to determine per capita demands. This assumes that future production will be a function of historical production and assumes relatively minimal system leakage or loss of water from leaking connections or pipes. The District's average system loss (sales to production loss) has been an average of approximately 16 percent for recent data (year 2015 to 2017). This is close to the State average of 15 percent and indicates the District may be able to improve metering within the District. A water loss audit can be useful for identifying areas where additional improvements may be made. For planning purposes, it will be assumed that most system loss is a result of metering inaccuracies and not from wide spread system leakage.

Two significant changes to water use patterns within the District have developed since the year 2000 when the State of Utah established a state-wide water conservation goal. First, the District began operating a secondary irrigation system within the District in 2004 with plans to expand secondary water to offset the use of culinary demands as the District expands. Second, the District began operating an Electrodialysis Reversal (EDR) water treatment facility in 2009 to treat groundwater used within the District to improve water quality.

- **Secondary Water** – The beginning of the District's secondary irrigation system began allowing the District to use canal water and other water sources to supplement the District's existing potable water sources that include the EDR plant and its groundwater wells and a connection to the Jordan Valley Water Conservancy District.
- **EDR Water Treatment** – One of the byproducts of the EDR process for water treatment is the production of a brine stream that includes a concentrated stream of salts and other undesirable mineral removed as part of the water treatment process. Although the water quality of culinary water is improved as the result of the EDR process, the overall raw water demand for water also increases because some of the groundwater treated through the process cannot be used by the District's culinary water system. On average, the EDR plant has historically produced a brine byproduct equal to approximately 16 percent of the total production of groundwater wells. For future planning purposes, it is assumed that 20 percent of total groundwater production will go to brine production.

Table 2-5 shows production requirements within the District since the year 2000.

Table 2-5
Historic Water Production Requirements

Source	EDR Finished Water & JVWCD Production (acre-ft)	Total Brine Production Planning Estimate[1] (acre-ft)	Total Secondary Irrigation (acre-ft)	Total Water Produced (acre-ft)
2000	6,168	0		6,168
2001	5,314	0		5,314
2002	5,424	0		5,424
2003	4,878	0		4,878
2004	5,094	0		5,094
2005	4,730	0	169	4,899
2006	5,442	0	190	5,632
2007	5,918	0	197	6,114
2008	5,532	0	185	5,717
2009	5,266	1,109	148	6,524
2010	4,836	997	283	6,116
2011	4,673	967	364	6,003
2012	5,407	1,142	422	6,971
2013	5,050	1,060	518	6,627
2014	5,042	1,053	545	6,640
2015	4,727	983	573	6,283
2016	5,665	1,211	640	7,516
2017	5,266	1,120	674	7,060

[1] Total brine production based on 20 percent planning value due to irregularities in brine production data.

Future Production Requirements

Based on observed historic production requirements, Table 2-6 summarizes the calculated historic production rates for the District in year 2000 and projected future production rates for the District based on proposed conservation goals. As part of its overall supply plan (and consistent with the State of Utah's conservation goal), the District is encouraging conservation to reduce per capita water use in its service area by 1% each year through the year 2025, where the goal is to reach a 25% total reduction in per capita water use from year 2000 water use rates. In all of the future production requirements for Magna Water District, the conservation goal of 1% reduction to per capita water use was implemented up to the year 2025. Beyond 2025, the District has set an internal goal of reducing per capita water use another 10 percent through the year 2060 (10% over 35 years).

Table 2-6
Historic and Projected Production Requirement[1]

Component	Year 2000	Year 2018	Year 2028
Population	27,000	31,649	34,127
Equivalent Residential Connection (ERC) Estimate	8,456	10,049	12,761
Annual Culinary Per Capita Production[2] (gpcd)	203.9	167.2	151.6
Annual Indoor Demand (gpd/ERC)	297.8	244.2	221.5
Annual Irrigation Rate (acre-ft/irrigated acre)	3.99	3.27	2.99
Total Annual Demand (acre-ft)	6,168	5,932	6,696
Annual Demand (acre-ft/ERC)	0.73	0.59	0.52
Average Daily Demand (gpd/ERC)	651.2	527.0	468.5
Peak Day Demand Per Capita Production[2] (gpcd)	480.4	340.0	304.5
Peak Day Indoor Demand[3] (gpd/ERC)	372.3	305.2	277
Peak Day Irrigation Demand (gpd/irrigated acre)	12,109	9,929	9,081

Component	Year 2000	Year 2018	Year 2028
Population	27,000	31,649	34,127
Equivalent Residential Connection (ERC) Estimate	8,531	10,076	12,593
Annual Per Capita Production[2] (gpcd)	203.9	167.2	151.6
Annual Indoor Demand (gpd/ERC)	297.8	244.2	221.5
Annual Irrigation Rate (acre-ft/irrigated acre)	3.99	3.27	2.99
Peak Day Demand Per Capita Production[2] (gpcd)	491.2	338.9	305.4
Peak Day Indoor Demand[3] (gpd/ERC)	372.3	305.2	277
Peak Day Irrigation Demand (gpd/irrigated acre)	12,103	9,924	9,077

[1] Does not including brine requirements.
[2] Includes all system demand, both residential and non-residential.
[3] Peak day indoor demands include an estimated 1.25 peaking factor compared to annual.

Table 2-7 and Figure 2-4 show the projection of total annual water production needs with and without conservation along with historic production within the District. Table 2-8 and Figure 2-5 show the projections of peak day demand with and without conservation. Chapter 3 will develop supply scenario to meet future production requirements for culinary, secondary for both annual and peak day conditions.

Table 2-7
Total Water Production with and without Conservation

Year	Total Annual Water Production without Conservation (acre-ft)	Total Annual Water Production with Conservation (acre-ft)
2018	7,234	5,932
2020	7,490	5,992
2025	8,463	6,347
2028	9,006	6,696
2030	9,265	6,849
2035	9,769	7,117
2040	10,241	7,352
2045	10,722	7,582
2050	11,232	7,823
2055	11,699	8,023
2060	12,163	8,210

Table 2-8
Total Peak Day Water Production with and without Conservation

Year	Total Peak Day Demand without Conservation (gpm)	Total Peak Day Demand without Conservation (mgd)	Total Peak Day Demand with Conservation (gpm)	Total Peak Day Demand with Conservation (mgd)
2018	10,829	15.6	8,973	12.9
2020	11,211	16.1	9,313	13.4
2025	12,667	18.2	10,182	14.7
2028	13,480	19.4	10,835	15.6
2030	13,868	20.0	11,149	16.1
2035	14,622	21.1	11,768	16.9
2040	15,329	22.1	12,422	17.9
2045	16,049	23.1	13,051	18.8
2050	16,813	24.2	13,574	19.5
2055	17,512	25.2	14,102	20.3
2060	18,206	26.2	14,596	21.0

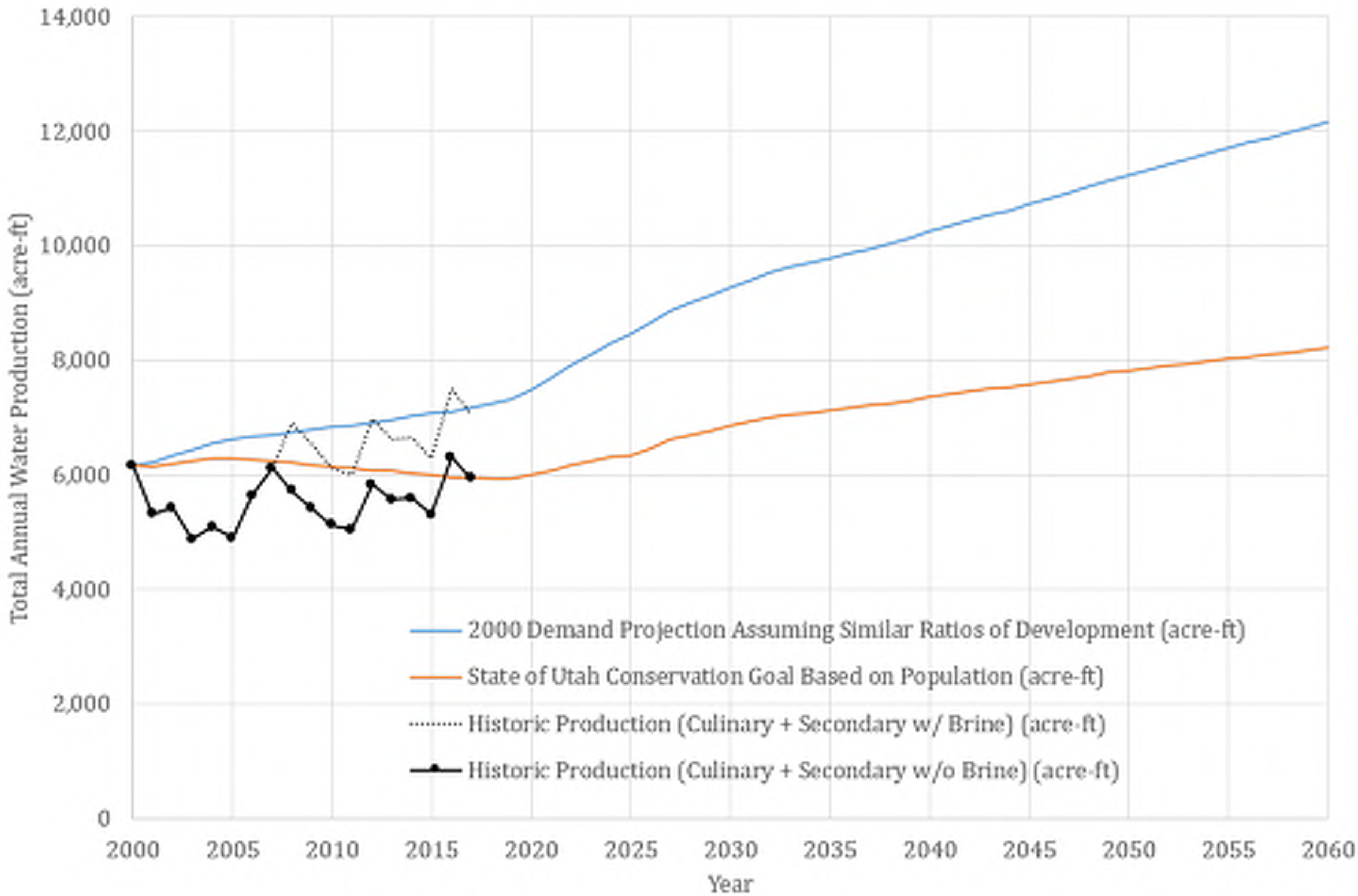


Figure 2-4: Total Annual Water Production Demand Projections

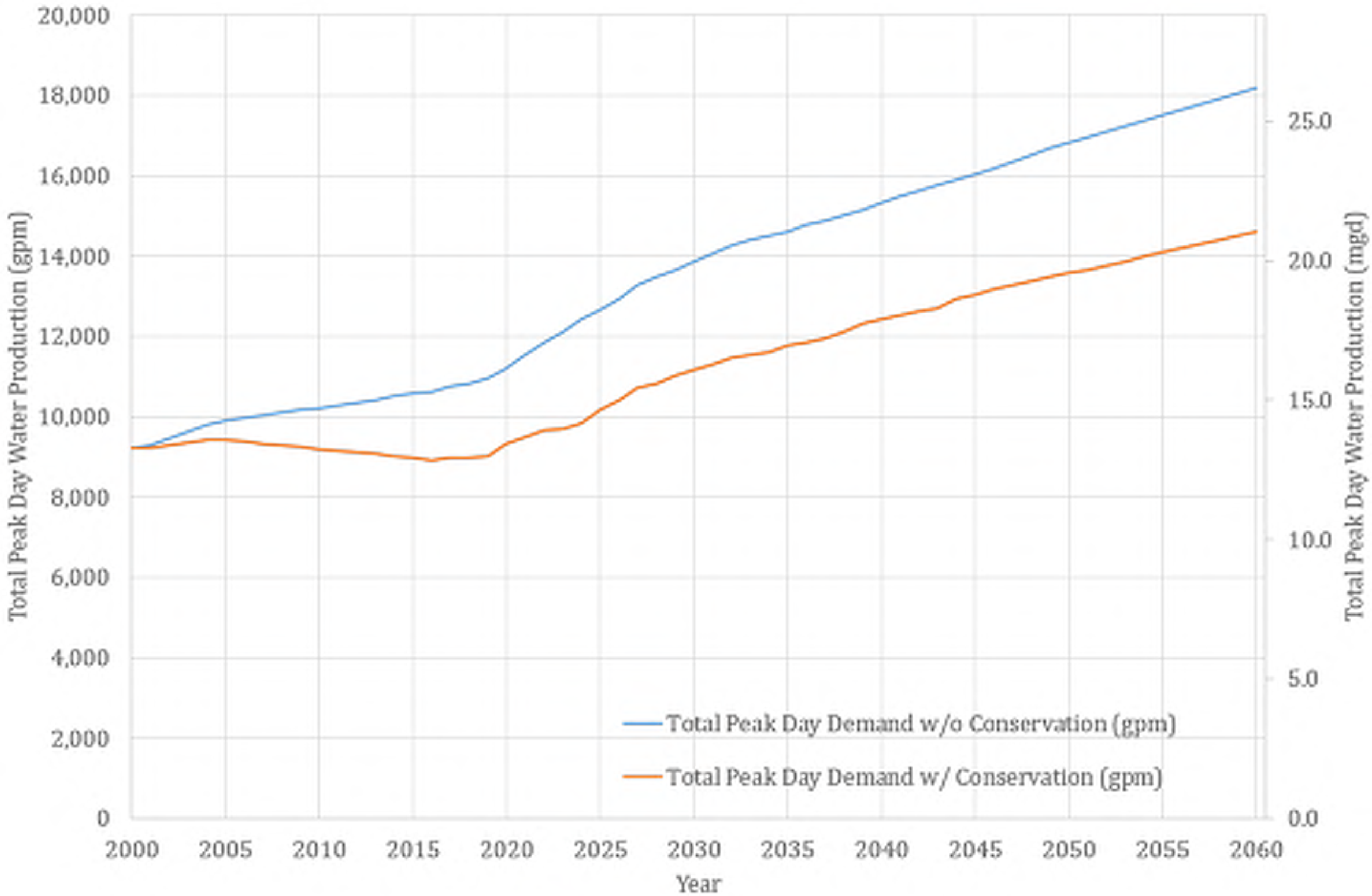


Figure 2-5: Total Peak Day Production Demand Projections

CHAPTER 3
WATER SUPPLY PROJECTIONS

This chapter will describe the District's sources and discuss the adequacy of existing and future supplies to meet the projected demand discussed in Chapter 2. Additional details regarding each of the District's water sources can be found in "Existing Facilities" chapter of the Conveyance and Storage Master Plan.

WATER SUPPLY – EXISTING SOURCES

The District's existing water supply comes from a number of different sources. For planning purposes, the District's sources have been grouped into three categories:

Magna Water District Groundwater Sources – MWD owns water rights for a number of groundwater sources. For evaluation purposes, groundwater sources have been broken into two categories:

- **Deep Groundwater Wells** – The District has two well fields that it uses to meet the majority of District supply needs: the Haynes Well Field and Barton Well Field. Water rights associated with these well fields are in excess of 15,000 acre-ft, but there is some concern regarding the annual sustainable yield. This is based on reports from District personnel that some declines in water table are being observed at existing pumping rates. To better understand the sustainable aquifer yield in this area, the District commissioned a study of the issue, but results to date have been inconclusive. The District is in the process of collecting more data that will hopefully provide a more definitive answer in the future. Until then, District personnel have indicated they do not wish to rely on significantly more yield from these well fields than has been historically observed. Thus, Table 3-1 summarizes the characteristics of the well fields to be used for planning purposes in this document.

Table 3-1
Deep Groundwater Well Field Characteristics

Well Field	Estimated Reliable Annual Yield (acre-ft)	Historic Maximum Annual Yield (acre-ft)	Peak Capacity[1] (gpm / mgd)
Haynes	3,250	3,781	5,450 / 7.8
Barton	4,550	3,656	5,180 / 7.4
Total	**7,800**	**7,437**	**10,630 / 15.2**

[1] Includes the active wells in the well field.

- **EDR Plant** – Both the Haynes and Barton Well Fields are treated at the District's EDR Plant. The plant has a peak treatment capacity of 4,167 gpm (6 mgd), but it is able to blend this treated water with raw well water at a ratio of 1 to 1 and still meet District water quality targets. This results in a total culinary water production capacity from the plant of 8,333 gpm (12 mgd).

  This capacity is typically achieved only when all four of the plants treatment trains run. If a treatment train is lost, the District can to still produce 12 mgd, but can only do so by increasing the ratio of untreated water (treat 4.5 mgd and mix with 7.5 mgd untreated). This results in decreased water quality that does not reliably meet District water quality targets. As a result, the reliable capacity should probably not be considered the full 12 mgd, but somewhere between 9 mgd and 12 mgd. An exact value of reliable capacity is difficult to define because it depends on a large number of variables that change throughout the year (time of year, which wells are being pumped, total system demand, etc.). Thus, for the purposes of this study, the capacity of the EDR Plant will be shown as 12 mgd with the caveat that water quality may be an issue if a treatment train is out of service for any reason during the peak day of demand.

- **Shallow Groundwater** – The District owns and operates three shallow wells as part of its secondary irrigation system. The District has water rights to extract up to 2,200 acre-ft of shallow groundwater. However, existing shallow well capacity is well below the District water right. Maximum production from the existing wells is expected to be about 287 acre-ft (based on seasonal use of the wells). Table 3-2 summarizes the characteristics of the shallow wells to be used for planning purposes in this document.

Table 3-2
Shallow Groundwater Well Characteristics

	Estimated Reliable Annual Yield (acre-ft)	Historic Maximum Annual Yield (acre-ft)	Peak Capacity (gpm / mgd)
Shallow Wells	287	318	605 / 0.87

Jordan Valley Water Conservancy District – The District has two connections to the Jordan Valley Water Conservancy District (JVWCD): one at 7200 West 4100 South (not currently used), and one at 7600 West 4100 South. Each connection includes a flow meter, pressure reducing valve, and isolation valves. Water pressure deliveries from JVWCD fluctuate between a range of 77 psi and 110 psi or with equivalent tank elevations between 4,714 feet and 4790 feet depending on JVWCD pumping operations, tank levels, and pipe friction losses. This pressure is reduced to 35 psi (equivalent tank elevation of 4,630 feet) which flows into the District's Pressure Zone 2 (4100 South Tank). To minimize purchase costs, the District tries to take this water at a constant flow rate from JVWCD. As a result, its planning capacity has been assumed to be limited to constant flow, even though more is potentially available. Table 3-3 summarizes the District's water contract with JVWCD.

Table 3-3
JVWCD Water Contracted Supply

JVWCD Supply	Volume (acre-ft)	Constant Flow (gpm)
Contract Amount	800	496
20% Additional Option	160	99
Total	**960**	**595**

- **Utah & Salt Lake Canal –** The Utah & Salt Lake Canal runs from southeast to northwest along the upper edge of the District's Pressure Zone 2. This source serves only secondary water within the District which is delivered into the District's water system via a pump station constructed along the canal at 3500 South. Table 3-4 summarizes the District's existing shares and approximate capacity based on existing shares.

Table 3-4
Existing Utah & Salt Lake Canal Shares

Canal Shares	Value
Existing Shares	253
Volume per Share (acre-ft/share)	4.59
Total Annual Volume (acre-ft)	1,161
Equivalent Peak Capacity (gpm)	1,728
Equivalent Peak Capacity (mgd)	2.49

- **3500 South Pump Station** – In addition to its shares in the Utah & Salt Lake Canal, the District needs to consider its pumping capacity out of the canal. All water is currently taken from the canal via the existing 3500 South pump station. This pump station includes two sets of pumps. The first set pumps to Pressure Zone 1. The second set pumps off the discharge side of the first set from Pressure Zone 1 to Pressure Zone 2. Table 3-5 summarizes the characteristics of the pump station:

Table 3-5
Existing Utah & Salt Lake Canal Shares

Zone	# of Existing Pumps	# of Possible Pumps	Pump Capacity (each)	Total Planning Capacity[1]
Zone 1 Pumps	2	3	1,000 gpm	2,000 gpm
Zone 2 Pumps	3	3	685 gpm	1,370 gpm

[1] Including 2 duty and 1 standby pump

As shown in the table, Zone 1 does not currently have a standby pump installed but includes provisions to easily add a third pump when needed.

The Utah & Salt Lake Canal has been affected by harmful algal blooms resulting in water quality issues in Utah Lake on a few occasions in the last few years. Water use from the canal has only been interrupted once, but the reliability of this water source is a concern for the District as a result of this past interruption and the increased frequency of algae blooms in recent years.

Culinary / Secondary Summary

Table 3-6 summarizes the District's existing sources based on whether sources are raw, culinary, or secondary sources.

Table 3-6
Summary of Existing Sources Annual and Peak Capacity

	Raw[1]		Culinary		Secondary	
Source	**Annual Capacity (acre-ft)**	**Peak Capacity (gpm)**	**Annual Capacity (acre-ft)**	**Peak Capacity (gpm)**	**Annual Capacity (acre-ft)**	**Peak Capacity (gpm)**
Haynes Well Field	3,250	5,450	--	--	--	--
Barton Well Field	4,550	5,180	--	--	--	--
EDR Plant	--	--	6,240	8,333	--	--
Existing Shallow Wells[2]	--	--	--	--	287	605
JVWCD Contract	--	--	800	496	--	--
JVWCD Option[3]	--	--	160	99	--	--
Canal Shares[4]	--	--	--	--	1,161	1,728
Total	**7,800**	**10,630**	**7,200**	**8,928**	**1,448**	**2,332**

[1] Raw capacity is identified because the source requires treatment through the EDR Plant.
[2] Existing annual capacity is based on a seasonal demand curve of demand and max available capacity.
[3] This optional source is used only as an emergency backup in case there are mechanical problems or other issues at the EDR plant.
[4] Annual capacity is based on full canal share volume. Peak capacity is based on the available capacity based on existing canal shares.

WATER SUPPLY – FUTURE SOURCES

Reuse Water – The District has applied for grants and pursued water rights to reuse water treated at its wastewater treatment plant. This includes the significant amount of brine produced by the EDR plant along with any other wastewater treated at the District's wastewater treatment plant. An additional benefit is that the water quality of treated wastewater is anticipated to be higher than the water quality of the Utah & Salt Lake Canal.

Since the District does not currently have a way to store significant volumes of reuse water, use of this supply will initially be limited to satisfying outdoor demands during the irrigation season only. Based on projected demands, the estimated annual useable yield of reuse will be limited to 1,130 acre-ft. Peak capacity is projected to be 2,500 gpm. Both these values are based on source capacity in the year 2060. Capacity will be slightly less initially, but will increase as wastewater loading (and corresponding reuse flow) increases as the District grows.

Stored Reuse Water – To maximize reuse as a resource, the District has been investigating the potential to construct a storage reservoir that would store reuse water during the winter when the irrigation system is not active. The estimated annual capacity of stored reuse is projected to be 2,700 acre-ft and peak capacity is projected to be 2,500 gpm. Again, both of these numbers are for the year 2060.

Additional Utah & Salt Lake Canal Shares – The District anticipates purchasing sufficient Utah & Salt Lake Canal shares to fully utilize its existing 3500 South pump station. The projected volume needed to fully utilize the 3500 South pump station is an additional 183 acre-ft (based on an assumed seasonal peaking factor of 2.4). This will be adequate to fully utilize the capacity of the 3500 South pump station (~2,000 gpm). This equates to approximately 40 more shares and would add 272 gpm of additional capacity (assuming a yield of 4.59 acre-ft/share)

Additional Shallow Groundwater – The District has sufficient water rights to expand use of shallow water for its secondary water system. Advantages of adding more shallow wells is the ability to disperse supplies throughout the system to reduce transmission piping costs. Disadvantages of shallow wells are a high cost to capacity ratio. Anticipated max capacity of shallow wells is estimated to be 3,450 gpm based on the available water rights (2,200 acre-ft) and an estimated seasonal peaking factor of 2.4. This assumes there is sufficient shallow groundwater and conducive soils to fully utilize existing water rights.

Little Valley Sources – As the Little Valley develops, it is anticipated that Kennecott will have water rights and water sources that become available to supply the Little Valley as mining operations are reduced. This may consist of groundwater (deep/shallow), canal shares, or other sources. For the purpose of this study, it is assumed the Little Valley development area will bring its own water supplies when it develops and that the District will only operate the water and sewer systems.

ANNUAL WATER SUPPLY & DEMAND

Table 3-7 summarizes the existing and potential supplies that the District may be able to use to meet its future annual demands.

Table 3-7
Summary of Existing and Potential Source Annual Capacity

Source	Reliable Annual Capacity (acre-ft)	Reliable Culinary Annual Capacity (acre-ft)	Reliable Secondary Annual Capacity (acre-ft)
Existing			
Haynes Well Field	3,250	--	--
Barton Well Field	4,550	--	--
EDR Plant	--	6,240	--
Existing Shallow Wells	--	--	287
JVWCD Contract	--	800	--
JVWCD Option	--	160	--
Canal Shares	--	--	1,161
Subtotal - Existing	**7,800**	**7,200**	**1,448**
Future			
Reuse Water	--	--	1,130
Stored Reuse Water	--	--	2,700
Additional Canal Shares	--	--	183
Additional Shallow Wells	--	--	1,913
Little Valley 2060	91	91	137
Subtotal - Future	**91**	**91**	**6,063**
Total	**7,891**	**7,291**	**7,511**

The type of sources and timing of development needed by the District is dependent on rate of growth of the various types of demand within the District: raw water demand, culinary water demand, and secondary water demand. Culinary and raw water demands are primarily a function of population or employment growth within the District. The rate of growth of secondary water demand within the District is dependent on available funds for secondary system expansion and the rate of growth within the District. As a result, several phasing scenarios were developed for evaluating the rate of growth of secondary water:

- **No Additional Secondary** – This is not a realistic scenario for the District due to limited culinary water supplies, but was included to help identify potential consequences if the secondary water system is not expanded.
- **Aggressive Expansion of Secondary**– This scenario assumes that secondary water will be expanded to all of the existing service area within Magna Water District by the year 2040. The secondary system will continue to grow at the pace of development thereafter. This scenario is designed to represents what would happen if the District were to make expansion of the secondary system a top priority and invest significantly in expansion through its service area.
- **Priority Expansion of Secondary** – Because expansion of the secondary system is expected to require significant initial investment, it was deemed prudent to consider a scenario with less aggressive expansion of the system. This scenario assumes that secondary water will be expanded only to new growth or as necessary to offset the culinary demands of new growth within the District. Under this scenario, expansion of the secondary into existing developments within the service area would only occur as more cost-effective opportunities arose. This means that the District would connect dry lines already in place but would otherwise wait to install secondary in existing neighborhoods until the County was rebuilding the streets.

Annual Supply Conclusions

Raw water, culinary water, and secondary annual demands are compared to annual supplies through the year 2060 in Figures 3-1 through 3-3 below. Several observations can be made from these figures:

1. **Annual Raw Water.** Raw water sources will not be adequate to meet long-term demands unless the District expands its secondary water system to take some demand off these raw water sources. Even without any kind of buffer for redundancy or reliability, raw water sources will be depleted by the year 2050 without expansion of the secondary system. Note that all scenarios include 35 percent conservation from year 2000 water use rates (25 percent by the year 2025 and an additional 10 percent thereafter). Without conservation, a deficit would begin earlier in the planning window. Priority expansion of the secondary system would be sufficient to reduce raw water demands enough through 2060 to prevent any deficits. Aggressive expansion would further reduce demands but is not needed based on current projections.
2. **Annual Culinary Water.** Observations regarding culinary water are nearly identical to raw water observations. Culinary water sources will not be adequate to meet long-term demands unless the District expands its secondary water system. Even without any kind of buffer for redundancy or reliability, culinary water sources will be depleted by the year 2050 without secondary expansion. Priority expansion of the secondary system would be sufficient to reduce culinary demands enough through 2060 to prevent any deficits. Aggressive expansion would further reduce demands but is not needed based on current projections.

3. **Annual Secondary Water.** The District does not currently have adequate secondary sources to meet the aggressive expansion scenario for more than a few years. Even without any kind of buffer for redundancy or reliability, following this scenario would require developing additional water sources beginning no later than the year 2023. Expansion of secondary water for priority growth only would extend the time the District could serve development for several years.

Based on these observations, the following major conclusion can be made:

1. **Implement the Priority Secondary Expansion Scenario.** Most effectively using District water resources will be a balancing act. The District must continue to expand its secondary system or it will run of culinary water to supply future growth. Conversely, if it grows the secondary system too quickly, it will require major investments in new secondary source. The priority secondary expansion scenario strikes the right balance of pulling enough demand off culinary sources to avoid running out of culinary water while going slow enough to not unnecessarily accelerate secondary source improvements. This scenario has the added benefit that it is the most cost-effective way to implement the secondary system from a transmission and distribution perspective.

Figure 3-1
Raw Water Production Requirements

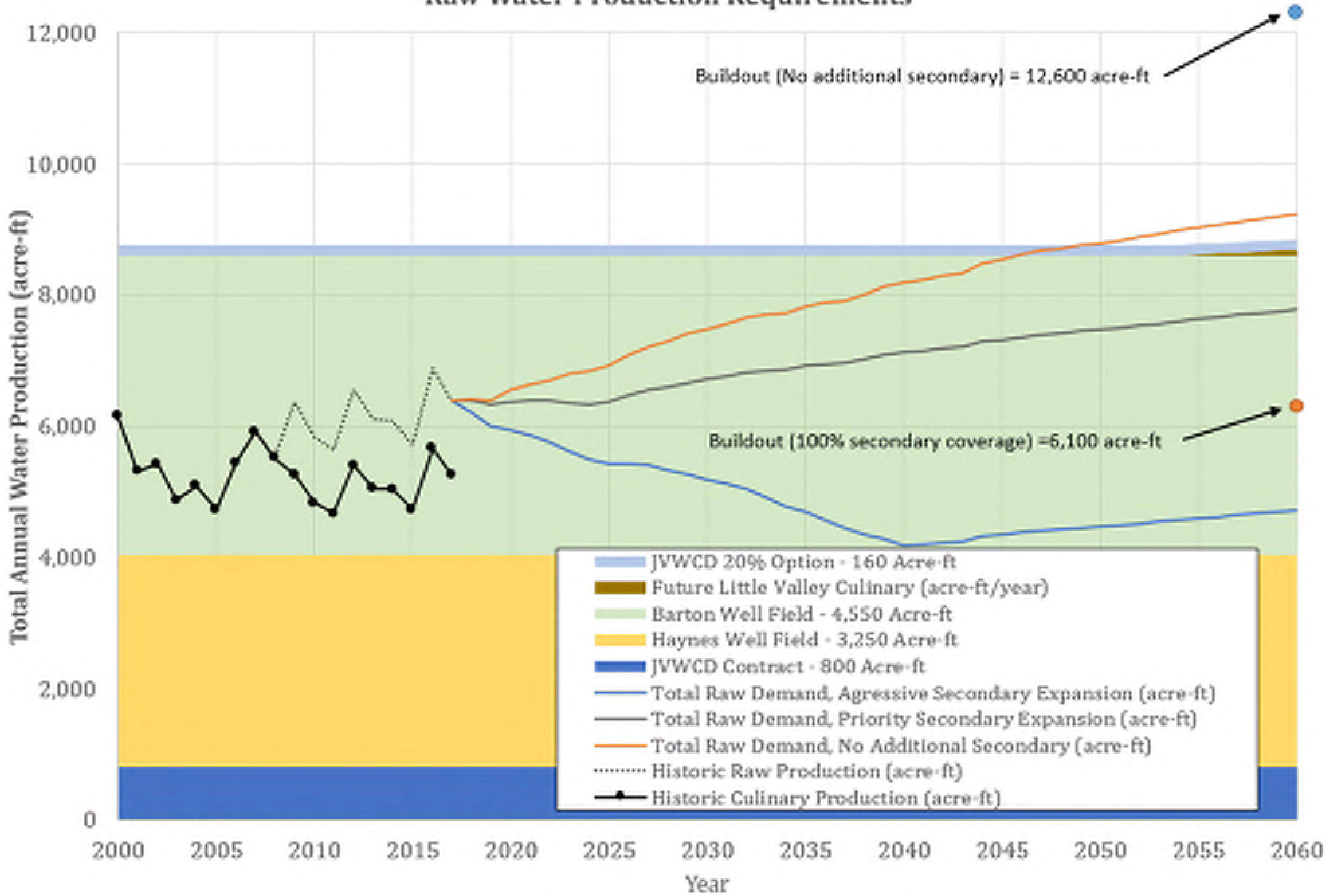


Figure 3-2
Culinary Water Production Requirements

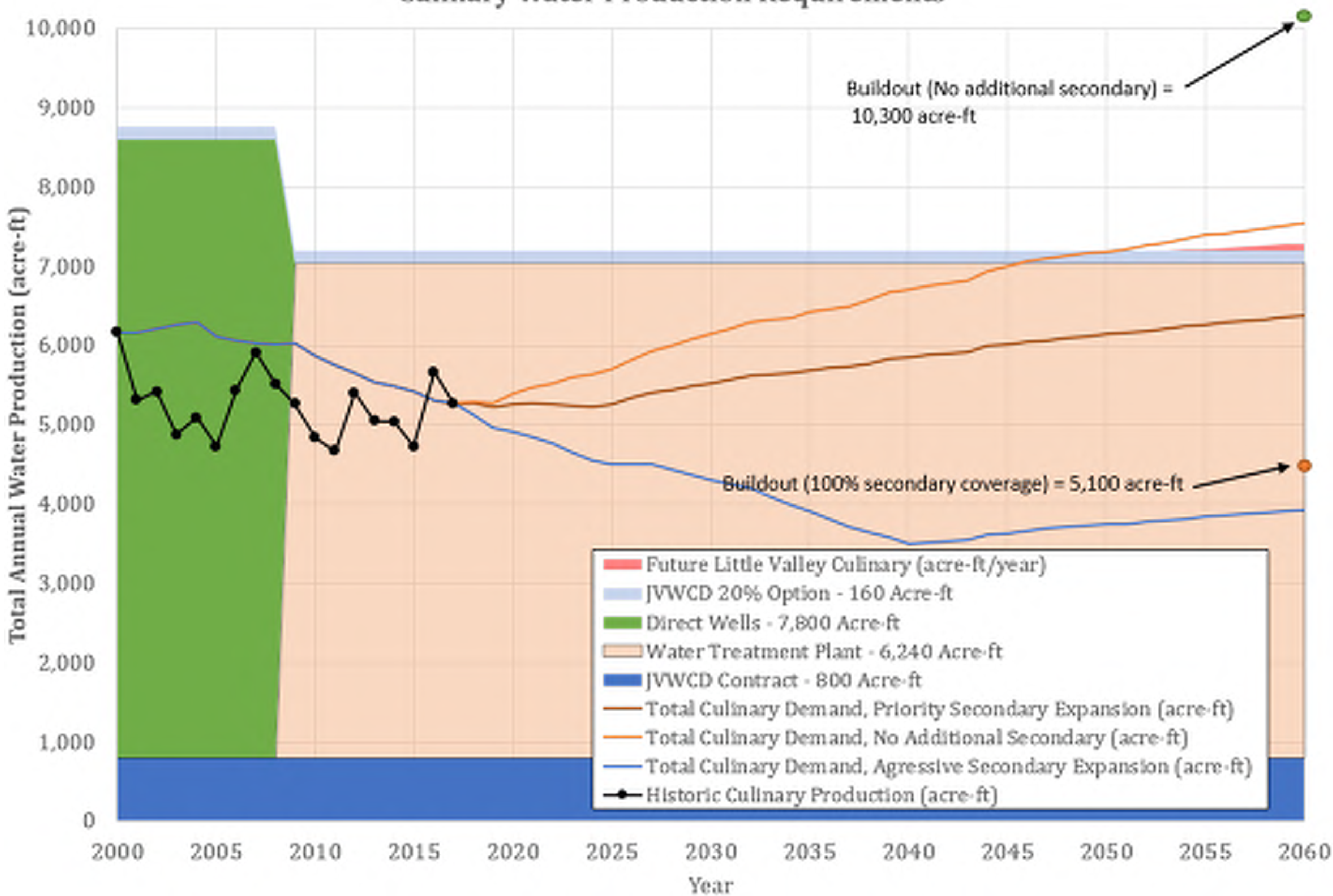
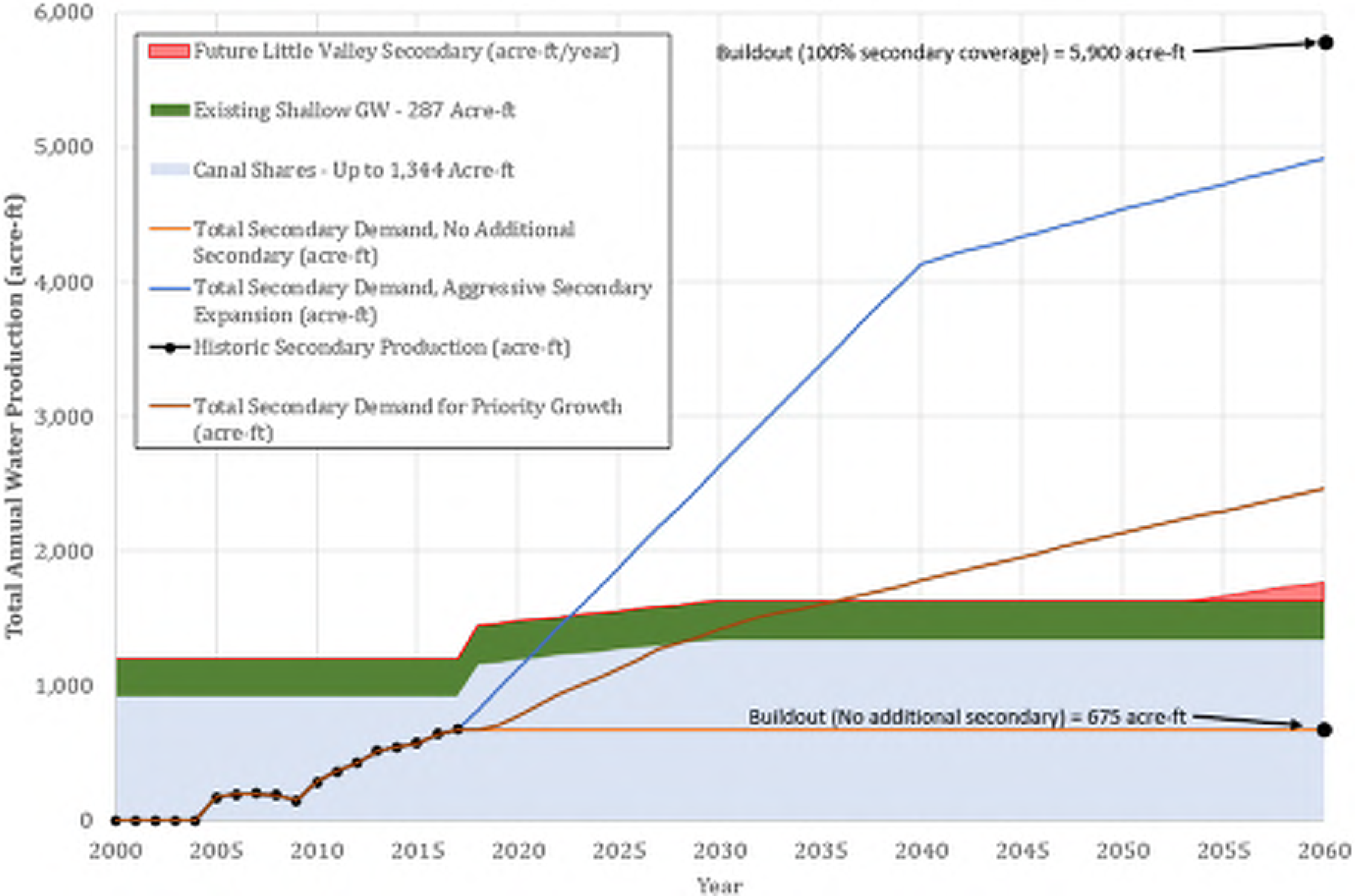


Figure 3-3
Secondary Water Production Requirements



PEAK DAY WATER SUPPLY & DEMAND

Table 3-8 summarizes the existing and potential supplies that the District may be able to use to meet its future annual demands.

Table 3-8
Summary of Existing and Potential Source Peak Capacity

Source	Reliable Raw Peak Capacity (gpm)	Reliable Culinary Peak Capacity (gpm)	Reliable Secondary Peak Capacity (gpm)
Existing			
Haynes Well Field	5,450	--	--
Barton Well Field	5,180	--	--
EDR Plant	--	8,333	--
Existing Shallow Wells	--	--	605
JVWCD Contract	--	496	--
JVWCD Option	--	99	--
Canal Shares	--	--	1,728
Subtotal - Existing	**10,630**	**8,928**	**2,332**
Future			
Reuse Water	--	--	2,500
Stored Reuse Water	--	--	2,500
Additional Canal Shares	--	--	272
Additional Shallow Wells	--	--	2,847
Little Valley 2060	70	70	289
Subtotal - Future	**70**	**70**	**8,408**
Total	**10,700**	**8,999**	**10,740**

Peak Day Supply Conclusions

Peak day raw water, culinary water, and secondary demands are compared to peak supplies through the year 2060 in Figures 3-4 through 3-6 below. Several observations can be made from these figures:

1. **Peak Raw Water.** Raw water sources will not be adequate to meet future demands unless the District expands its secondary water system to take some demand off these raw water sources. Even without any kind of buffer for redundancy or reliability, raw water will not have sufficient capacity to meet peak demands by the year 2030 without expansion of the secondary system. Priority expansion of the secondary system would be sufficient to reduce raw water demands enough through 2060 to prevent any deficits. Aggressive expansion would further reduce demands but is not needed based on current projections.
2. **Annual Culinary Water.** Observations regarding culinary water are nearly identical to raw water observations. Culinary water sources will not be adequate to meet future demands unless the District expands its secondary water system. Even without any kind of buffer for

redundancy or reliability, culinary water sources will not have sufficient capacity to meet peak demands by the year 2030 without secondary expansion. Priority expansion of the secondary system would be sufficient to reduce culinary demands enough through 2060 to prevent any deficits. Aggressive expansion would further reduce demands but is not needed based on current projections. In fact, aggressive expansion would result in approximately 65 percent excess capacity for the District's culinary water sources.

3. **Annual Secondary Water.** The District does not currently have adequate secondary sources to meet the aggressive expansion scenario for more than a year or two. Even without any kind of buffer for redundancy or reliability, following this scenario would require developing additional water sources almost immediately. Expansion of secondary water for priority growth only would extend the time the District could serve development for a few years, but expansion of the secondary system would still be needed by about 2024.

Based on these observations, the following major conclusion can be made:

1. **Implement the Priority Secondary Expansion Scenario.** These observations confirm the conclusion made previously based on annual supply – the District must continue to expand its secondary system or it will run of culinary water to supply future growth and the priority secondary expansion scenario is the recommended approach to accomplish this.

   The only real difference between the peak capacity observations and the annual observations is timing. In looking at annual capacity alone, it may appear that the District has some time before it runs out of culinary water. However, based on peak capacity, it is clear that the District needs to continue to expand its secondary system or face the potential of falling short of peak demands in the near future.

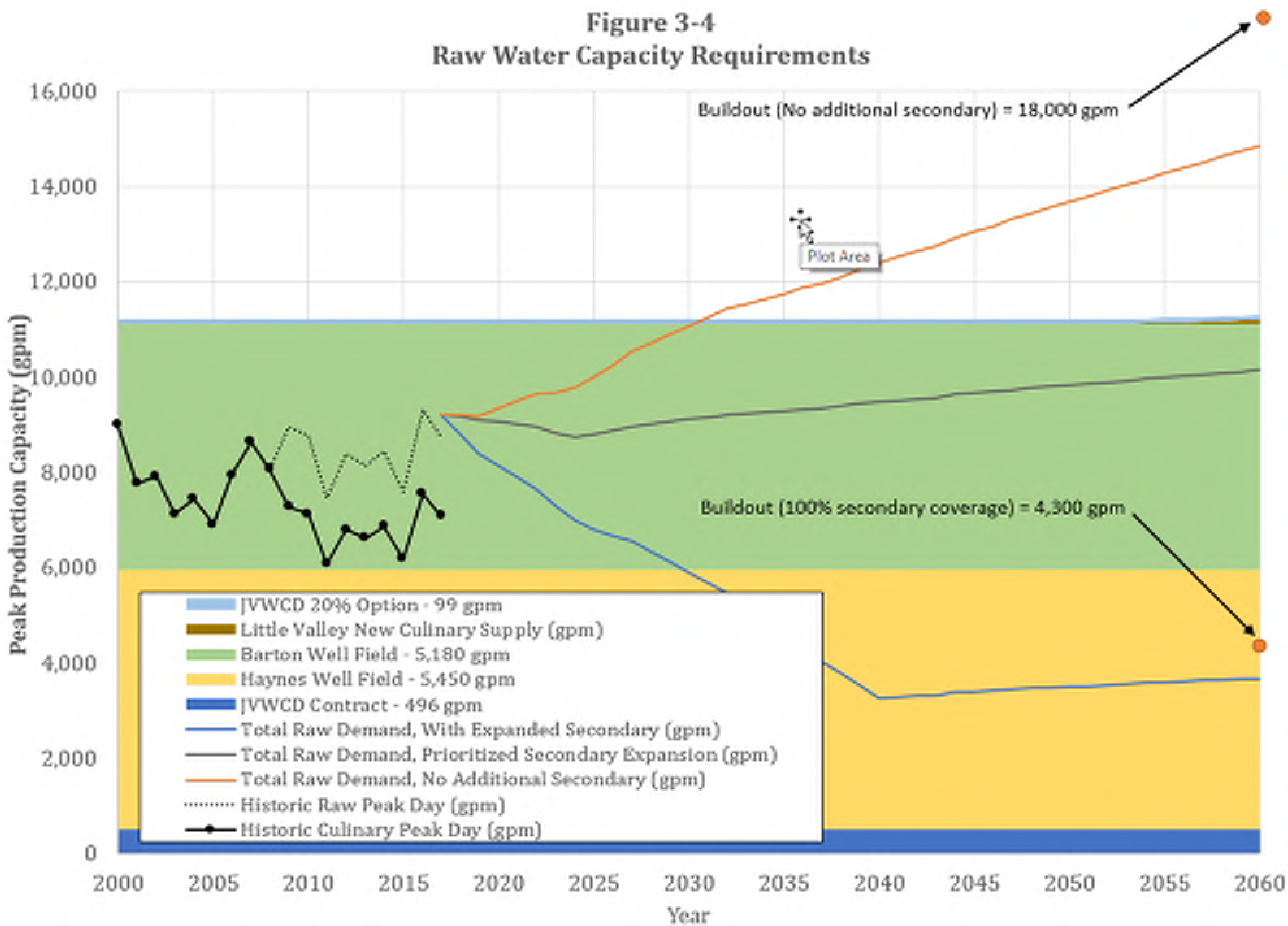


Figure 3-4
Raw Water Capacity Requirements
Buildout (No additional secondary) = 18,000 gpm
Buildout (100% secondary coverage) = 4,300 gpm
Plot Area
JVWCD 20% Option - 99 gpm
Little Valley New Culinary Supply (gpm)
Barton Well Field - 5,180 gpm
Haynes Well Field - 5,450 gpm
JVWCD Contract - 496 gpm
Total Raw Demand, With Expanded Secondary (gpm)
Total Raw Demand, Prioritized Secondary Expansion (gpm)
Total Raw Demand, No Additional Secondary (gpm)
Historic Raw Peak Day (gpm)
Historic Culinary Peak Day (gpm)
Peak Production Capacity (gpm)
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
2000
2005
2010
2015
2020
2025
2030
2035
2040
2045
2050
2055
2060
Year

Figure 3-5
Culinary Water Capacity Requirements

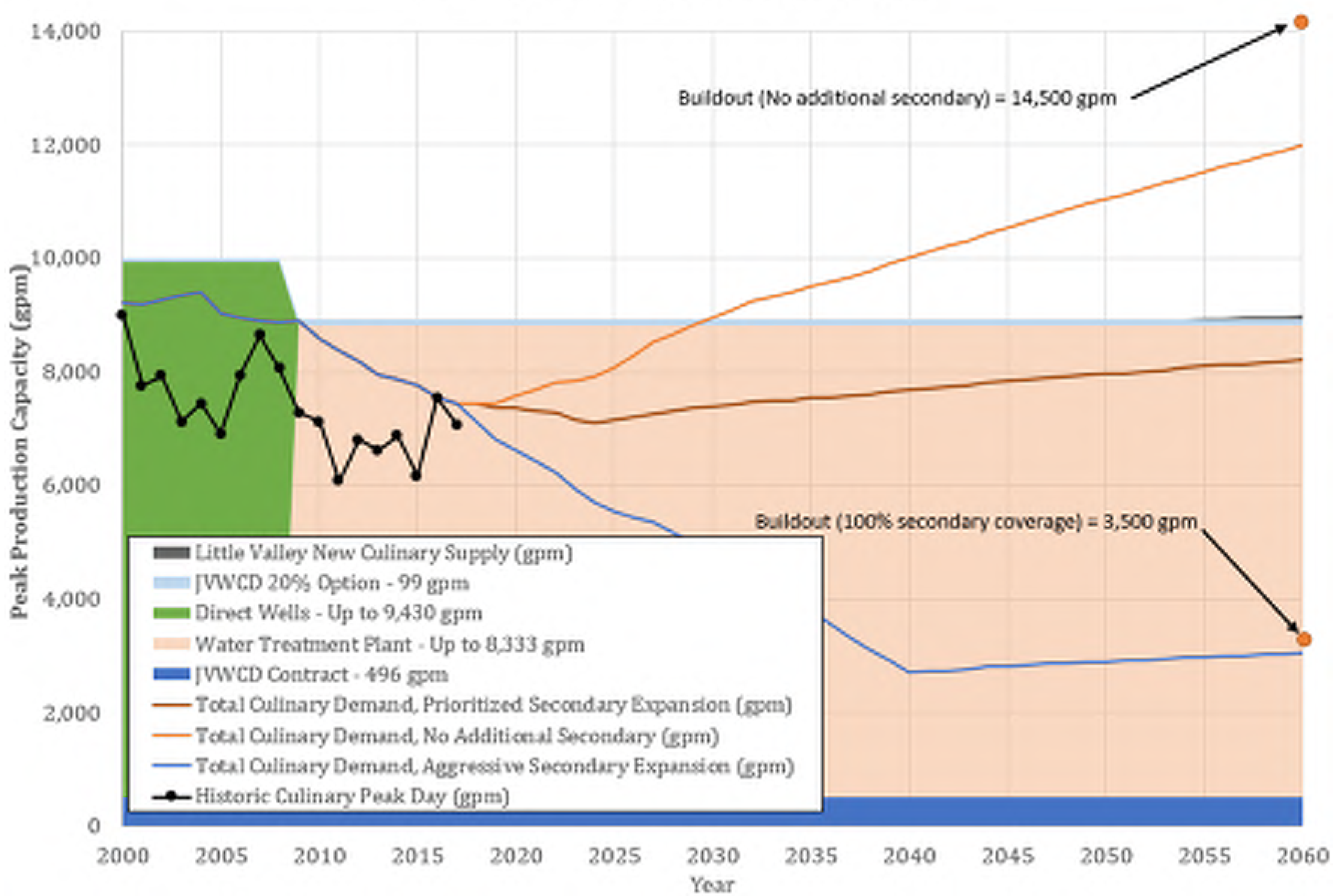
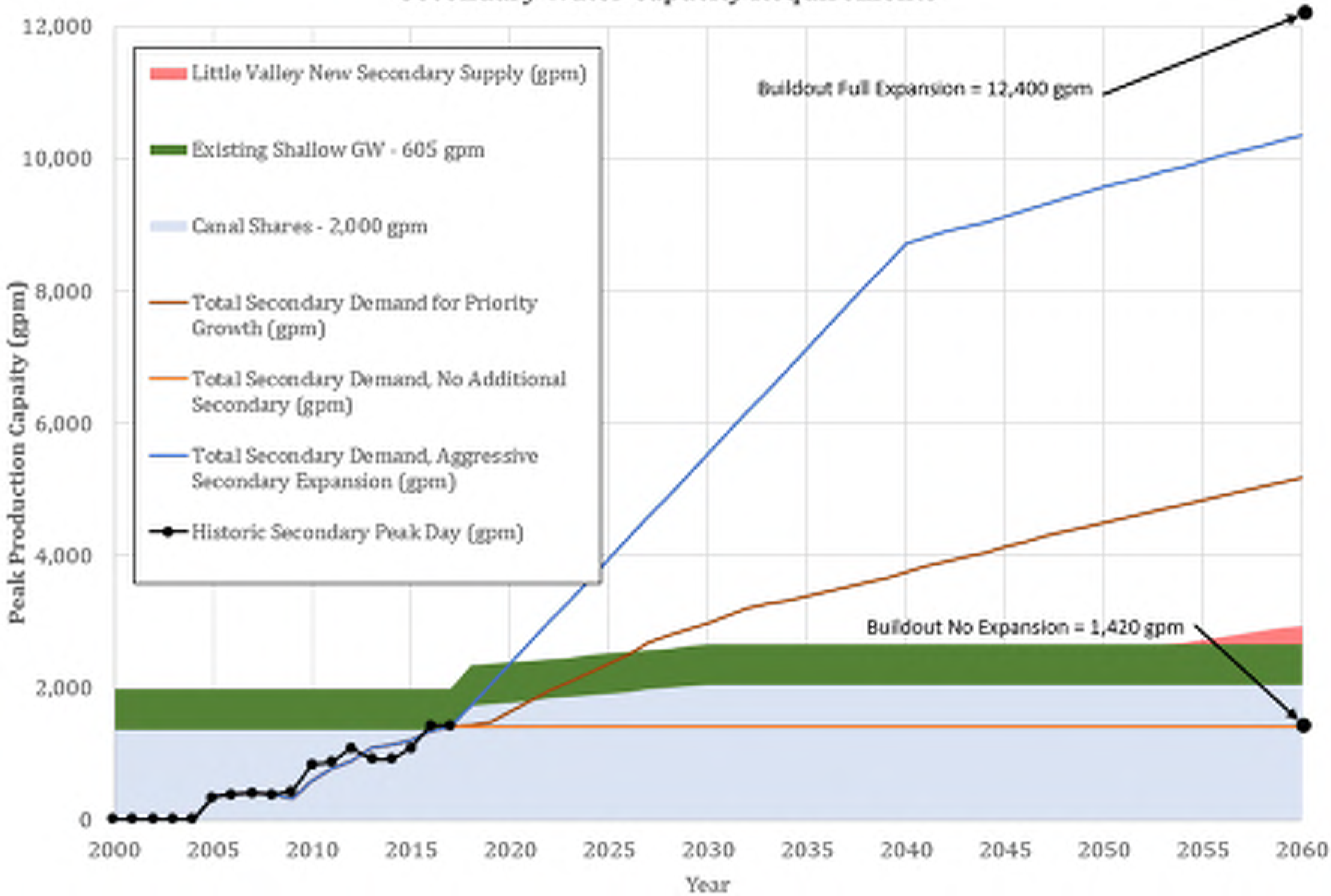


Figure 3-6
Secondary Water Capacity Requirements



CHAPTER 4
WATER SUPPLY VARIATION – NOW AND IN THE FUTURE

The information presented in Chapters 2 and 3 of this report is based on the some of the most up-to-date data available. Intrinsic to this analysis is the assumption that sources are expected to produce well into the future in accordance with past performance. This begs questions such as:

- Is the modern historical record sufficient to account for variation in water availability to be used for planning purposes?
- Will climate change or other factors likely affect water availability or system demands and, if so, in what ways?

This chapter is dedicated to considering these types of questions to better inform the conclusions reached elsewhere in this report, and ultimately to assist the District in understanding the long-term water supply and demand characteristics of their system inclusive of these types of considerations.

GROUNDWATER

The District is intending to complete additional studies regarding groundwater aquifer sustainability to determine if the annual and peak day capacities identified in Chapter 3 are reliable. If a study identifies reliability concerns for the aquifer, one potential remedy may include aquifer storage and recovery (ASR). ASR includes many different methods of taking excess culinary, secondary, or raw water sources and infiltrating them into the ground to amend aquifers. The type of technology used to implement ASR may include using unlined reservoirs, gravity fed shallow or deep wells, injection wells where water is injected into the ground from using pressure pumped systems. The District will consider the need for ASR as more data on the status of the aquifer is collected. For now, the values identified in Chapter 3 appear to be the best available information.

CANALS

There are two potential problems with canal water delivered from Utah Lake: natural variability, and water quality concerns.

- **Natural Variability.** Natural variability may reduce the amount of volume to users per share of irrigation water. The normal volume available per share is 4.59 acre-ft/share. During droughts, canal companies may reduce the volume available per share. In times past, it has not been uncommon for canal companies to reduce their yield per share by up to 20 percent in drought years. In extreme events, yield has been reduced even more.
- **Water Quality.** It is unknown if recent algae blooms in Utah Lake are primarily caused by recent isolated water quality problems, water quality problems that have accumulated over years, or if climate change is impacting temperatures to increase the frequency of algae blooms at Utah Lake. There are two potential alternatives to mitigate potential problems with canal water that comes from Utah Lake: provide treatment or provide sufficient mixing water to dilute issues with water quality. For planning purposes, the District is intending to cap the amount of canal shares used in the secondary water system and provide other secondary water sources as needed to dilute any potential water quality problems from the canal.

JVWCD

The District's existing contract with JVWCD is considered reliable for planning purposes because JVWCD has its own contingencies to account for source interruption and climate variability.

REUSE WATER

Conservation has the potential to reduce available reuse water as a secondary water supply. Supplies identified as part of Chapter 3 already assume the District will meet its 35 percent reduction in water use goal. If conservation rates exceed that goal, available reuse supply could be reduced further. However, demand for irrigation water would likely be reduced more than the reuse supply making this a negligible risk for the District.

CLIMATE CHANGE

The earth is presently undergoing a warming trend. The warming appears to coincide with the results of many climate models predicting global warming. Locally, if you examine Salt Lake City Airport average temperatures in June, July, and August from 1948 to the present it shows an average temperature increase of 4.7 degrees Fahrenheit. Climate change can affect water supplies in a number of different ways. It can cause a change in overall precipitation in the watershed, less precipitation in the form of snow, earlier spring runoffs, and increases in outdoor demand because of the longer and warmer growing season.

The impact of climate change on supply has generally been discussed in the sections above, but the District should also consider the potential impact on system demands. A study was prepared by JVWCD in 2017 titled "Preparing for Climate Change – A Management Plan". In this study, JVWCD hired Western Water Assessment to determine the impacts of climate change on demand. The results of this study showed that demand on their system could increase from between 2 and 17.4 percent. JVWCD used a number of 9.7% for climate change impacts to water demand, which was the midpoint of that range.

While the available data is limited, it appears that climate change could have a significant impact on the District's water supply plan. For planning purposes, the City should consider the potential effect of a net increase in demand of 5 to 10 percent in its long-term demands.

CHAPTER 5
WATER SUPPLY RISK AND PLANNING

Water is one of the most, if not the most, important utilities for all communities. Therefore, it is requisite that water providers, like Magna Water District, consider water supply risk in their planning efforts to provide reasonable assurance of continuity of service in the case of unexpected source loss or failure. This chapter will describe and address water supply risks.

RISK TO ANNUAL WATER SUPPLY

Annual supply has the potential for being adversely affected in several ways. The risk associated with water supply is that it may be reduced so much that it can no longer satisfy minimum annual production requirements.

The District's water supply could be reduced if a source were lost—either temporarily or permanently. While there are many ways this could occur, the most likely imaginable ways at this time are:

- Unexpected mechanical failure of pumps or other system components limit the District's ability to treat or convey water temporarily.
- An earthquake disables conveyance infrastructure, treatment infrastructure, or disturbs water availability by adversely affecting aquifer characteristics.
- A water source becomes suddenly contaminated – either intentionally through an act of terrorism or accidentally though an industrial spill or similar event.
- Climate or other environmental changes reduce water supply, increase water demand, or both. (See Chapter 4 above for a detailed discussion on this topic.)

For discussion purposes, annual water supply risk is categorized into two scenarios: Minor Source Loss and Catastrophic Source Loss. The management of these risk scenarios will define the Recommended Supply Planning Scenario for the District's long term annual water supply planning.

Minor Source Loss Scenario

This scenario covers the vast majority of potential source loss situations such as mechanical failure, pipe breaks, a single well becoming contaminated, etc. For this type of scenario, it has been assumed that the District will have a buffer of water supply that is sufficient to handle this type of loss without disruption to customers, even during peak periods of demand. In other words, the District will always have enough extra supply that it can weather the loss of sources that are the most vulnerable to any of the risks listed above.

Based on an evaluation of potential source failure in the District, the recommended minor source loss buffers to be included for supply planning purposes are as follows:

- **Culinary Annual Supply** – The two most likely events that could affect annual culinary yield are:
    - **Aquifer Yield** – There are a number of events that could negatively affect the yield of the aquifer serving as the primary source for the District. This could include mechanical failure of the well pulling from the aquifer, contamination, reduced recharge as a result of climate change, or simply fall groundwater levels. To account

for these uncertainties, it seems prudent to keep a buffer in the District's supply plan associated with potential reduced yield from the aquifer.

- o **Increased Demands Associated with Climate Change** – As noted in Chapter 4, projected demands are expected to increase between 2 and 17 percent as a result of climate change. Nearly all of this increase will be associated with outdoor demand, but until the secondary system is expanded to all District customers, some buffer for this potential increase will need to be included in the culinary annual supply.

Based on these events, it is recommended that the District provide an annual buffer of at least 10 percent for culinary sources. This equates to a supply buffer of 860 acre-ft by the year 2060 (based on current raw water supply feeding culinary supply). This provide a reasonable safeguard against reduced aquifer yield and is large enough to offset foreseeable increases in demand associated with climate change.

- **Culinary Peak Capacity** – The most likely event that could affect culinary peak capacity is the failure of a well in either the Haynes or Barton wellfield. It is recommended that the District maintain sufficient reliable capacity to allow for the loss of the largest single well and still meet required production requirements (2,250 gpm). It is also possible to expect some kind of interruption to service from JVWCD. However, the amount of water normally delivered from JVWCD connections is less than the capacity of the District's largest well. Thus, an interruption to JVWCD would be covered under the recommended buffer.
- **Secondary Annual Supply** – The secondary source with the greatest vulnerability associated with annual supply is the Utah and Salt Lake Canal. This source has seen reductions in the past and is expected to see reductions in the future as a result of drought and harmful algal blooms (HABs) that affect water quality. The recommended goal for the District is to provide sufficient annual source capacity to meet secondary demands with a volume reduction of 50 percent in the canal based on a long term shut down of the canal due to water quality issues. This equates to a supply buffer of approximately 700 acre-ft (based on projected maximum future canal shares).
- **Secondary Peak Capacity** – The secondary source with the greatest vulnerability associated with peak capacity is also the Utah and Salt Lake Canal, specifically the 3500 South Pump Station. The recommended goal for the District is to provide sufficient peak source capacity to meet demands in the secondary irrigation system with the loss of the 3500 South pump station due to power failure or water quality issues. This equates to a capacity buffer of 2,000 gpm.

Catastrophic Source Loss Scenario

It is conceivable to think that an extremely large earthquake on the Wasatch Front or other extreme event could cause the loss of more supply than discussed in the section above. However, in such a situation, it is not reasonable to expect the District to deliver water at the same level of service as it was prior to the catastrophic event. In these cases, it has been assumed that the District would move to an emergency mode of operation. This would include limiting water delivery to essential indoor functions.

The primary source of concern under this scenario would be the EDR Plant. In the event a pipeline from the plant breaks or the plant itself goes offline, the District plans to provide emergency backup from JVWCD at a rate sufficient to meet indoor only demands (1,700 gpm or 2.4 mgd for existing conditions). The existing connections to JVWCD have the capacity to support this demand. By definition, the emergency operation scenario would not deliver any secondary water. Thus, consideration of secondary source loss under this scenario is not necessary.

RECOMMENDED SUPPLY PLANNING

Based on the discussion above, the recommended supply development plans for the District are shown in Figures 5-1 to 5-6. Each of these figures has been assembled based on the following assumptions:

- **Secondary Expansion will Follow the "Priority Secondary Expansion" Scenario.** Based on the conclusions in Chapter 3, it is recommended that the District pursue a policy of secondary expansion in areas of new growth and other cost-effective areas as needed to offset the growth of culinary demand. Figure 5-7 shows the recommended areas to expand secondary through 2060 to help reduce culinary demands. Aggressive expansion of the secondary system beyond this is not recommended at this time as it would require an expedited schedule for secondary water source development and result in excess culinary capacity in the District's water system within the planning window. Consistent with this recommendation, the baseline demands shown in Figures 5-1 through 5-6 are all based on the Priority Secondary Expansion Scenario as defined in Chapter 3.
- **System Redundancy.** To avoid interruption in service during the most probable source failure events, Figures 5-1 through 5-6 also include a buffer for the Minor Source Loss Scenarios as defined above.

There are several principal conclusions that can be drawn from these figures:

1. **Annual Raw & Culinary (Figure 5-1 and Figure 5-2)**. Even with recommended supply redundancy, there are adequate raw and culinary water supplies to satisfy demands for the recommended secondary expansion scenario.
2. **Annual Secondary (Figure 5-3).** With recommended supply redundancy, secondary sources will be adequate to satisfy projected demands for only the next 3 or 4 years. To meet longer-term needs, the District will need to expand secondary supply in several areas:
    a. **Canal Shares –** Because of its vulnerability to drought and water quality related supply interruptions, securing significant amounts of water from the Utah & Salt Lake Canal is not recommended. However, to take advantage of remaining capacity in the existing 3500 South pump station, it is assumed that the District will accept up to 40 more shares of water from the canal.

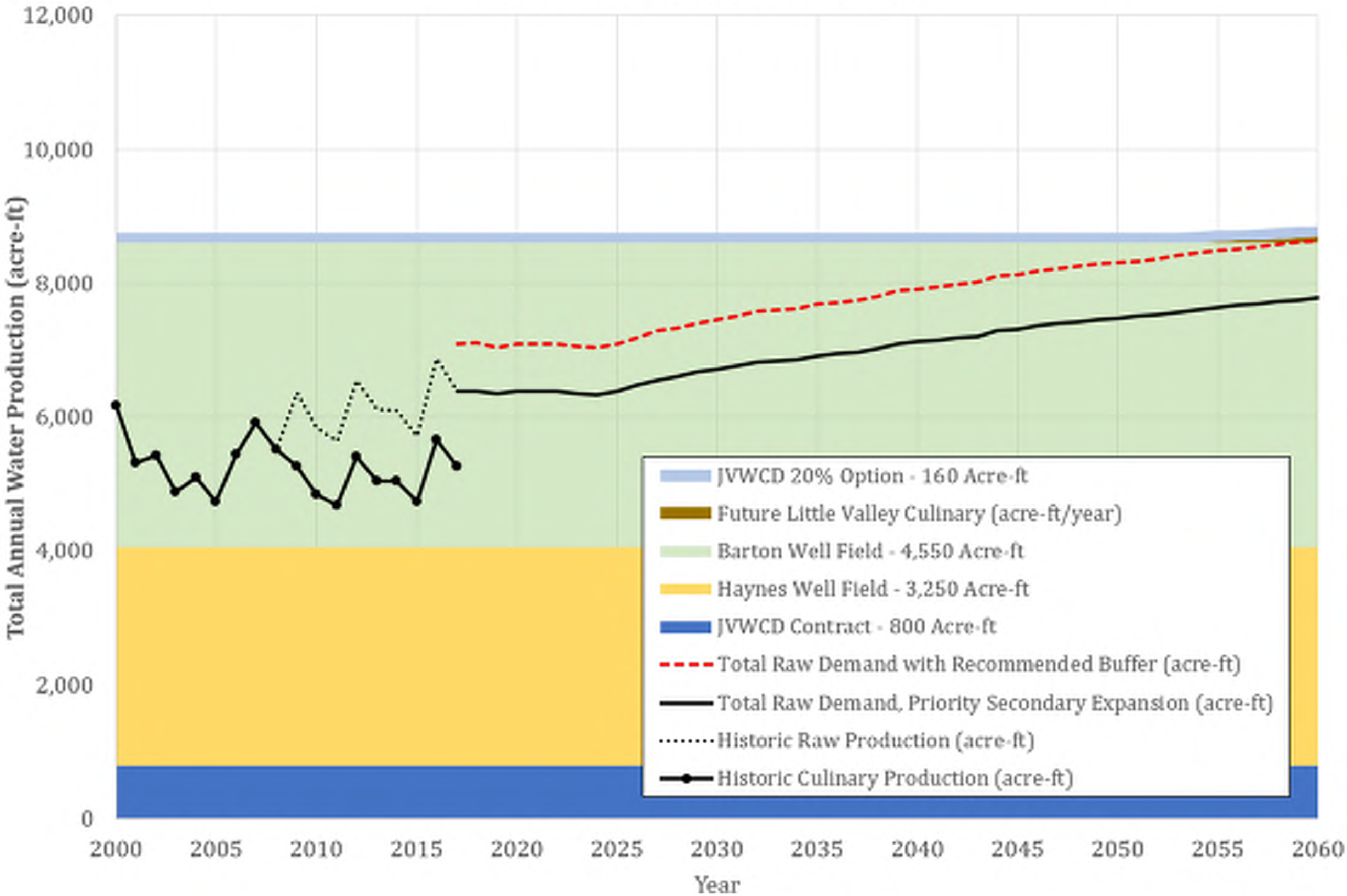
    b. **Reuse Water** – Reuse water is shown being developed and implemented in 2023. The District has already applied for grants relative to obtaining reuse water. If the reuse project cannot be constructed by the year 2023, the District will need to compensate with other sources.

    c. **Shallow Groundwater** – Beyond additional canal shares and reuse, the District will still need more secondary water to meet its projected needs. As discussed in Chapter 3, the likely sources for this additional water is additional shallow groundwater development or reuse storage. For simplicity, Figure 5-3 shows all the needed water coming from shallow groundwater. However, all or some of this water could also come from reuse storage.

    One reason shallow groundwater may be an important part of early secondary source development is that additional secondary water is projected to be needed beginning in 2022. If reuse is delayed for any reason, shallow groundwater development may be the only viable option for meeting demands until reuse can be implemented.

d. **Reuse Storage** – As noted above, Figure 5-3 does not show any future supply coming from reuse storage. However, once reuse is in place, all or some of the District's future needs could come from reuse storage. It is expected that the District will evaluate options and costs for reuse storage and shallow groundwater development in greater detail once these concepts are developed further.

Figure 5-1
Raw Water Production Requirements



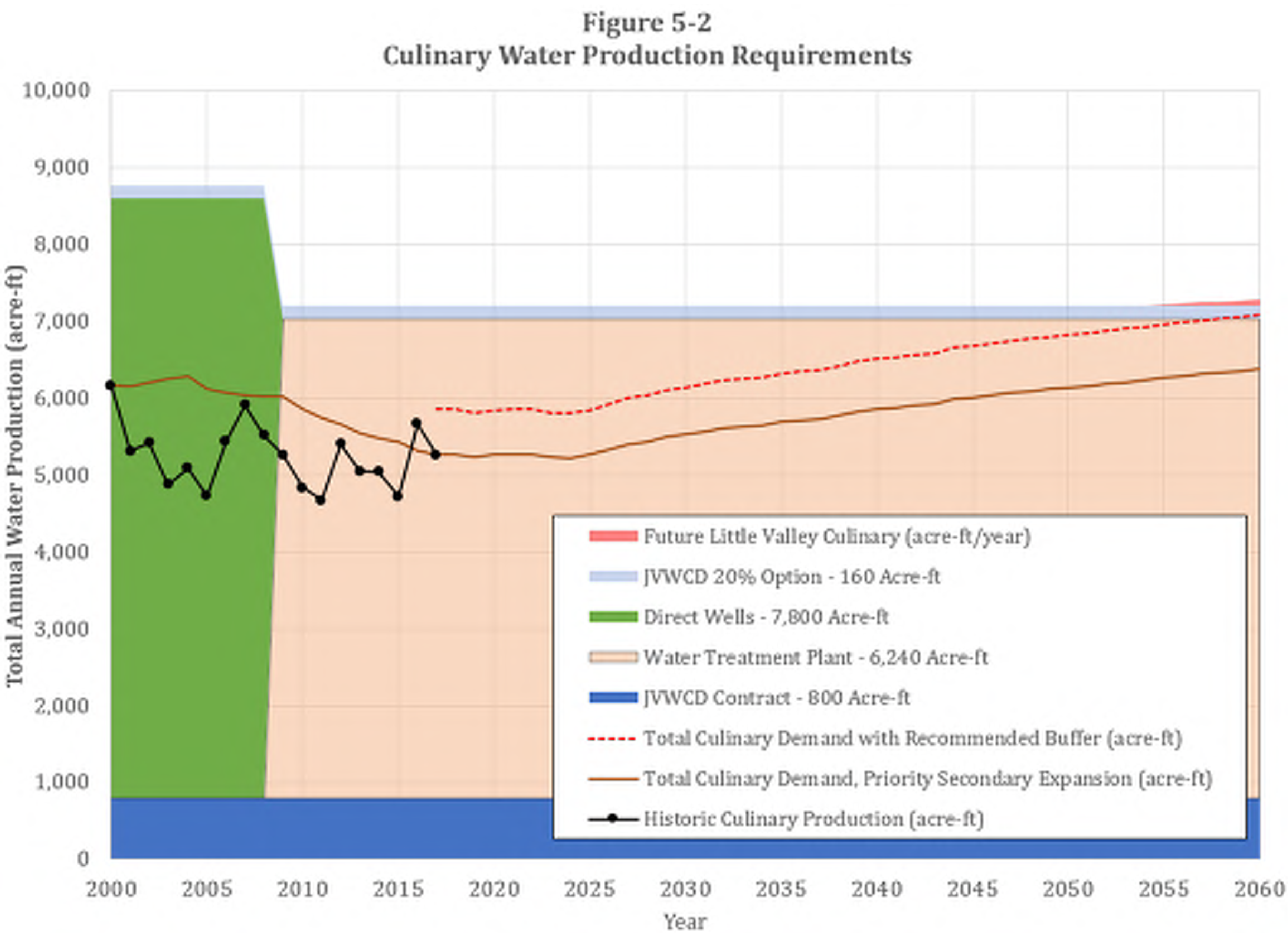


Figure 5-2
Culinary Water Production Requirements
Total Annual Water Production (acre-ft)
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
2000
2005
2010
2015
2020
2025
2030
2035
2040
2045
2050
2055
2060
Year
Future Little Valley Culinary (acre-ft/year)
JVWCD 20% Option - 160 Acre-ft
Direct Wells - 7,800 Acre-ft
Water Treatment Plant - 6,240 Acre-ft
JVWCD Contract - 800 Acre-ft
Total Culinary Demand with Recommended Buffer (acre-ft)
Total Culinary Demand, Priority Secondary Expansion (acre-ft)
Historic Culinary Production (acre-ft)

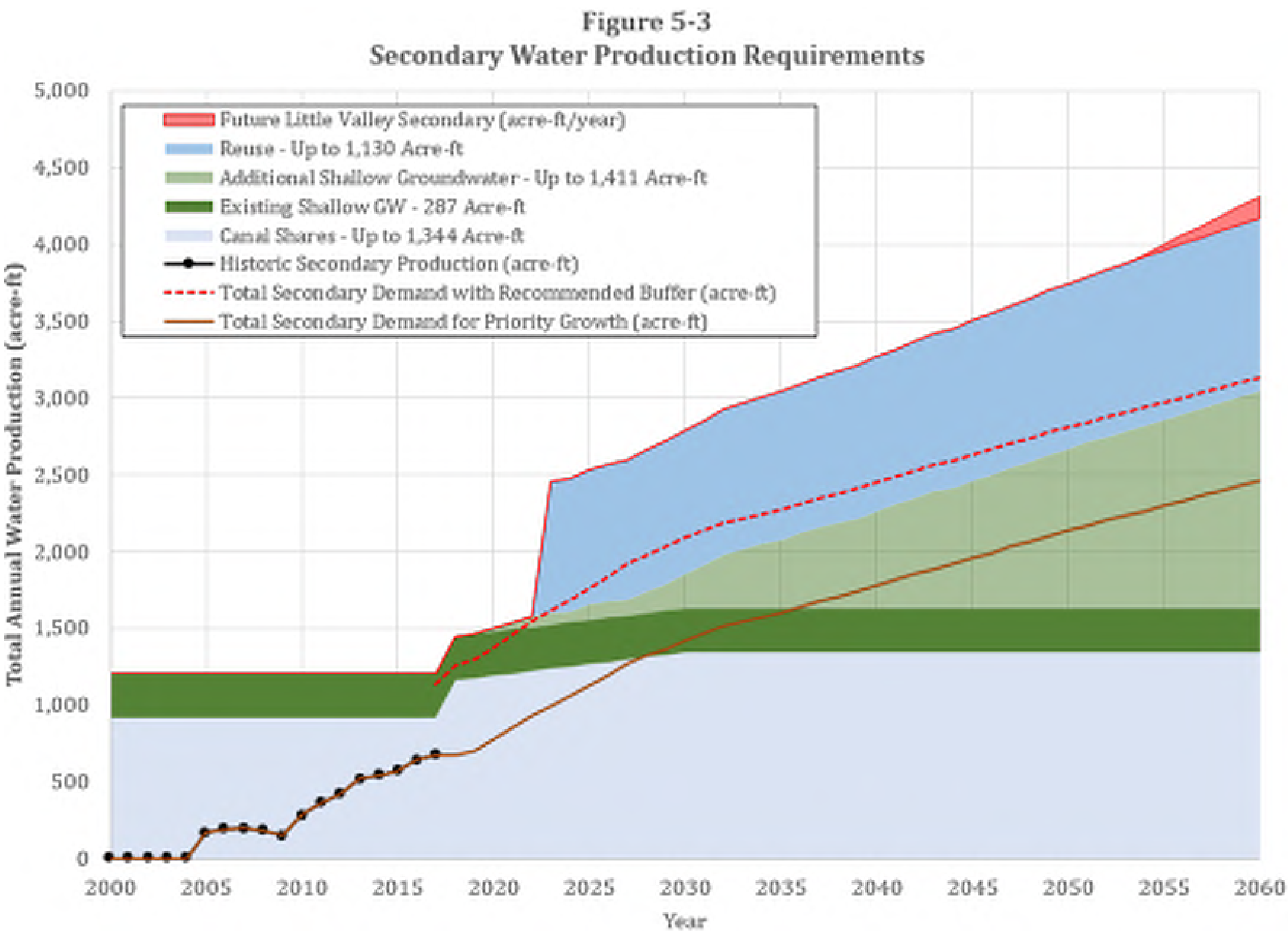


Figure 5-3
Secondary Water Production Requirements
Future Little Valley Secondary (acre-ft/year)
Reuse - Up to 1,130 Acre-ft
Additional Shallow Groundwater - Up to 1,411 Acre-ft
Existing Shallow GW - 287 Acre-ft
Canal Shares - Up to 1,344 Acre-ft
Historic Secondary Production (acre-ft)
Total Secondary Demand with Recommended Buffer (acre-ft)
Total Secondary Demand for Priority Growth (acre-ft)
Total Annual Water Production (acre-ft)
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
2000
2005
2010
2015
2020
2025
2030
2035
2040
2045
2050
2055
2060
Year

Figure 5-4
Raw Water Capacity Requirements

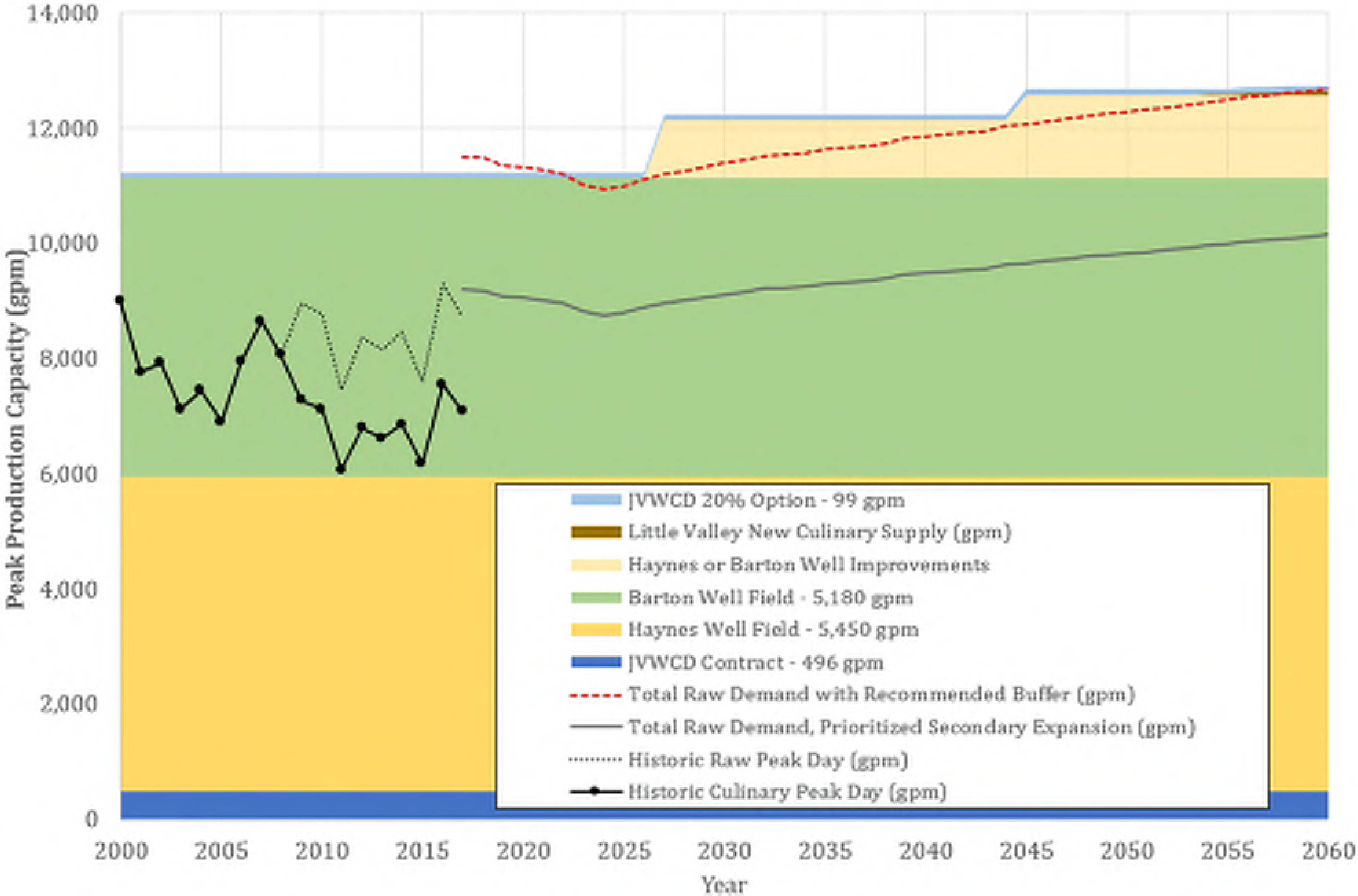


Figure 5-5
Culinary Water Capacity Requirements

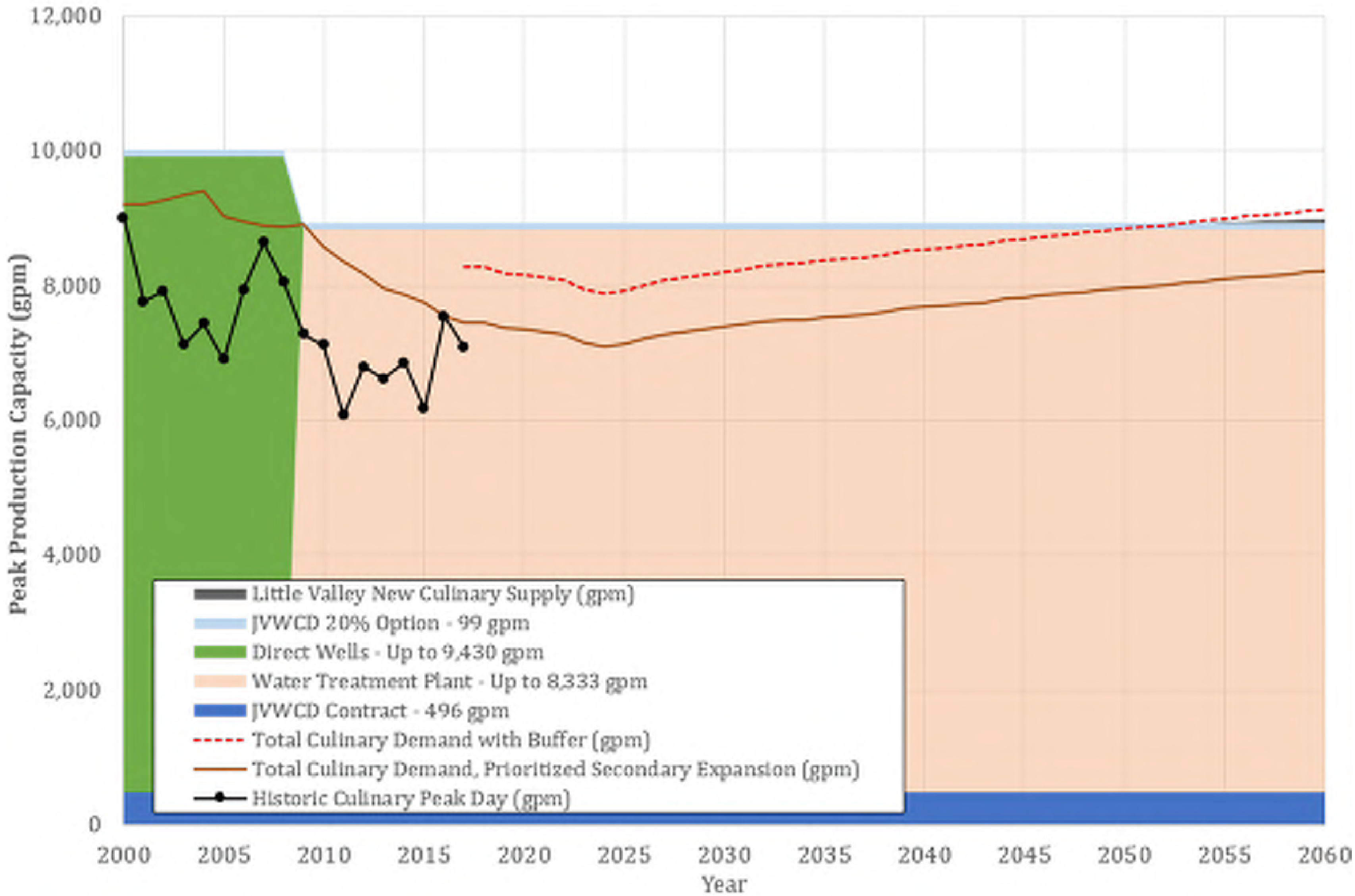
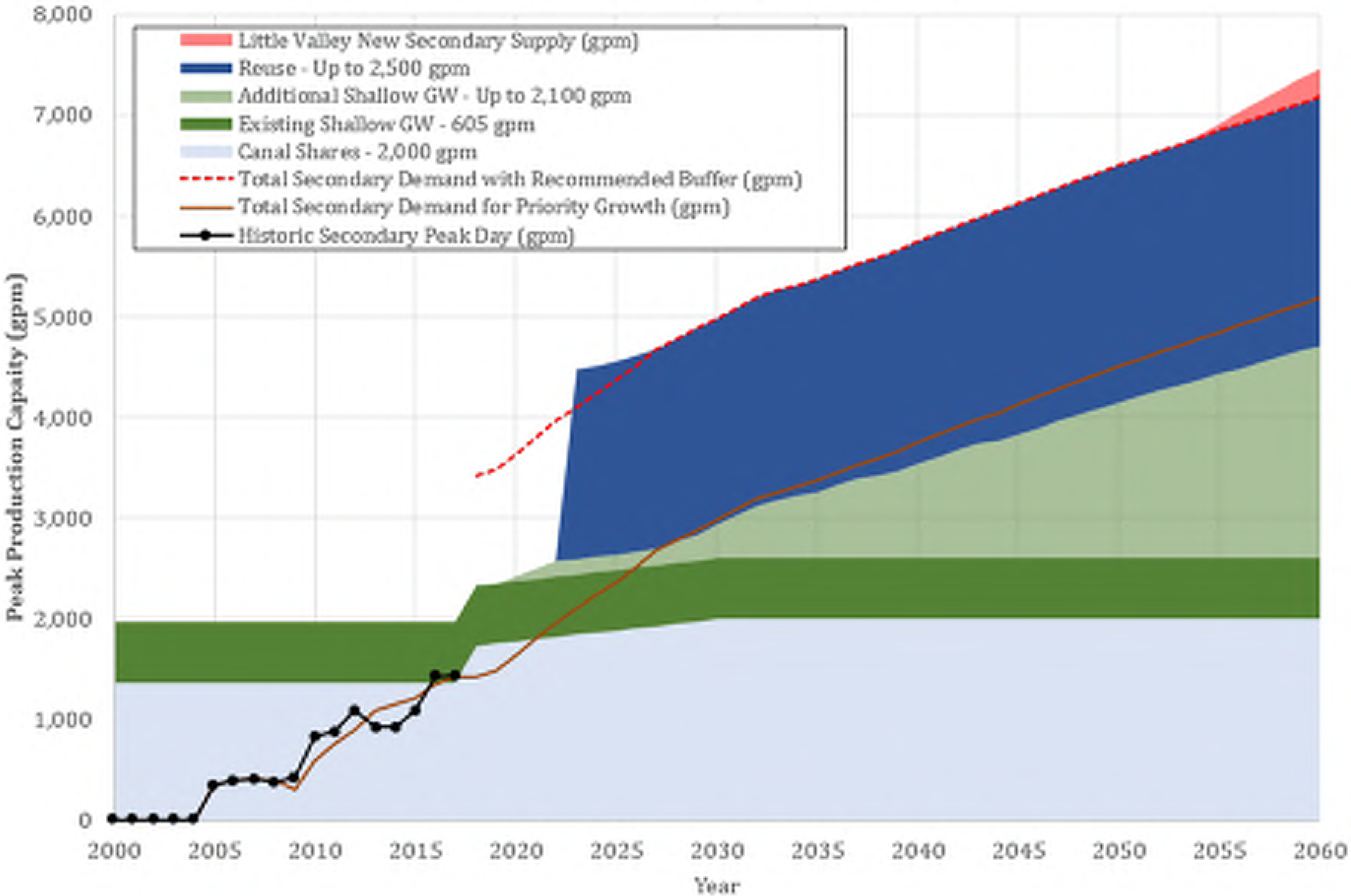


Figure 5-6
Secondary Water Capacity Requirements



3. **Peak Raw Capacity (Figure 5-4)**. Current District raw water supplies are not quite adequate to meet recommended redundancy requirements. This means that the District could see an interruption in service to its customers if it were to lose its largest well during periods of peak demand. With the conversion of some demand to secondary, this deficit is projected to go away for a period of time but will return around 2026 as a result of system growth. The District should consider improvements in the Haynes and/or Barton Well fields to improve the reliability of sources to accommodate mechanical or other failure of existing well sources. At least 1,000 gpm of additional raw water source capacity is recommended in the near future with an additional 500 gpm by about 2033.
4. **Peak Culinary Capacity (Figure 5-5).** The recommended redundancy requirement for culinary demand indicates that some additional culinary capacity may be needed near the end of the planning window. The best solution to this projected deficiency will likely be a little more aggressive expansion of the secondary water system than shown. The District probably doesn't need to worry about this as there will very likely be an opportunity to expand the secondary system into at least one or two existing neighborhoods prior to the time this deficiency is projected.
5. **Peak Secondary Capacity (Figure 5-6).** The District currently has a significant water supply risk associated with its secondary water delivery capacity. If the District were to lose its canal source or 3500 South lift station, it would fall well short of projected demands. While development of some additional shallow groundwater could improve the situation, a true solution will not occur until the reuse project is completed. This emphasizes the importance of completing the reuse project as soon as possible.

   Even after reuse is in place, the District will still need to be aggressive in developing additional supplies to provide continued redundancy. It is estimated that the District will need to develop up to 2,100 gpm of additional capacity beyond reuse by the end of the planning window. As with annual supply, this additional source development has been shown as shallow groundwater for simplicity but might also be reuse storage water.

REQUIRED SUPPLY DEVELOPMENT COSTS

Based on the conclusions above, the District does not need to develop any new culinary sources but will need to develop several new secondary water sources to meet projected District water demands. As shown in Figure 5-3, there are three supply sources for secondary water that are recommended:

1. **Canal Shares –** Because of its vulnerability to drought and water quality related supply interruptions, securing significant amounts of water from the Utah & Salt Lake Canal is not recommended. However, to take advantage of remaining capacity in the existing 3500 South pump station, it is recommended that the District accept up to 47 more shares (215.7 acre-ft) of water from the canal. It is expected that these shares can be obtained through developer contributions. Thus, no out of pocket costs will be incurred by the District for acquisition of this water.
2. **Reuse Water** – Reuse water should be developed as soon as financially feasible to support growth of the secondary water system. Once developed, this source will represent a reliable and relatively high-quality secondary water source to be used to mix with canal water from Utah Lake. Until this source is developed, the District will be vulnerable to secondary water shortages if service from the Utah & Salt Lake Canal is interrupted for any reason. The cost of developing reuse as a secondary source is approximately $12.5 million. For master planning

purposes, this amount has been budgeted and accounted for as part of sewer treatment plant improvements.

3. **Shallow Groundwater and Reuse Storage** – Beyond additional canal shares and reuse, the District will still need more secondary water to meet its projected needs. The likely sources for this additional water is additional shallow groundwater development or reuse storage. It is recommended that the District identify and evaluate options and costs for shallow groundwater development and reuse storage to determine the most cost-effective approach to adding needed capacity. Costs for shallow groundwater development will vary depending on how and where opportunities are identified for its development. For planning purposes, it has been assumed that the District will develop five new well sources with a capacity of approximately 400 to 500 gpm. Estimated construction costs for these wells is $600,000 each. When 15 percent is included for engineering, legal, and administrative costs, this brings the total source development cost to $3,450,000 for all five wells.

Table 5-1 summarizes the cost and timing for these supply development sources.

Table 5-1
Summary of Supply Development Costs

Source	Timing	Cost
Additional Canal Shares	Ongoing	$0*
Reuse	0-5 years	$12,480,900**
Shallow Groundwater	Ongoing	$3,450,000

*Assumed developer contributions

**Budgeted as part of sewer improvement plan

CHAPTER 6
CONCLUSIONS AND RECOMMENDATIONS

A number of principal conclusions can be made regarding Magna Water District's water system with respect to projected available supply and demand.

1. **Demand Projections** – Through the planning window of this study (2060), the District is expected to see significant growth including within the existing service area and within annexation areas adjacent to the District. Growth rates for the annexation areas are anticipated to be significantly higher than for areas within the existing service area.
2. **Conservation.** The District projections of demand include 25 percent reduction of year 2000 per capita demands by the year 2025 with an additional 10 percent reduction in demand by the year 2060. Meeting these conservation goals will be an essential part of the District's overall supply plan.
3. **Secondary Water Expansion.** Most effectively using District water resources will be a balancing act. The District must continue to expand its secondary system or it will run of culinary water to supply future growth. Conversely, if it grows the secondary system too quickly, it will require major investments in new secondary source. Based on available secondary water and culinary water sources, the recommended approach to secondary expansion will be to require secondary service in all new areas but limit initial expansion in existing areas to locations with existing dry secondary lines or larger properties along transmission lines. This strikes the right balance of pulling enough demand off culinary sources to avoid running out of culinary water while going slow enough to not unnecessarily accelerate secondary source improvements.
4. **Raw & Culinary Water Sources.** The District should seek to add at least 1,000 gpm of capacity to the Haynes and/or Barton well fields to provide adequate redundancy for projected demands. This could include construction of a new well or rehabilitation of one or more existing wells. An additional 500 gpm of capacity is projected to be required by 2033 to meet long-term supply needs, but this may not be needed depending on conversion of demands to secondary supply and should be reassessed in the future.
5. **Secondary Supply Development.** The District will need to budget $16 million for future supply development to meet projected secondary demands. This includes additional canal shares, development of wastewater reuse, and new shallow groundwater sources. It should be noted that $12.5 million of this total is for reuse and has been budgeted separately as part of the sewer improvement plan.
6. **Little Valley Sources.** This document assumes that the potential Little Valley annexation area would provide its own water supply. If this is not possible, additional source capacity for both culinary and secondary demands will need to be developed within the District.

CONVEYANCE & STORAGE MASTER PLAN

PART 2 OF WATER MASTER PLAN

MAGNA WATER DISTRICT

BOWEN COLLINS & ASSOCIATES

TABLE OF CONTENTS

Note: This report is the second in a series of three reports comprising the Magna Water District Water Master Plan. Chapters 1 through 6 are located in the first report in this series, and chapters 14 through 16 are in part three.

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CHAPTER 7
INTRODUCTION

INTRODUCTION

The Magna Water District (MWD or District) desires to develop an updated master plan for its water system. This is the second in a series of three expected reports that will comprise the planning documents for the District's water system. The expected reports will be:

- **Supply and Demand Master Plan** – An examination of water demands expected in the District and the existing and future supplies available to meet these demands.
- **Conveyance and Storage Master Plan** – An evaluation of the District's existing conveyance and distribution system and its ability to deliver water when and where it is needed.
- **Implementation and Capital Facilities Plan –** A plan for completing the necessary improvements identified in the supply and conveyance master plans.

As this is the second report in the series, the reader will notice that it starts with Chapter 7. Each report has been given unique chapter numbers to avoid confusion with chapters in one of the other two reports. Chapters 1 through 6 are located in the first report, Supply and Demand Master Plan.

BACKGROUND

The focus of this report is storage and conveyance requirements for the District. Previous studies that have examined the District's storage and conveyance system include:

- Culinary Water, Secondary Water, & Sanitary Sewer Impact Fee Facility Plan – Prepared by Epic Engineering in August 2013

Since the completion of the previous study, a number of changes have occurred. Changes that need to be evaluated and addressed for the District to meet its future water storage and conveyance requirements include:

- **New Infrastructure –** Some new infrastructure has been constructed since the previous master plan, including one new storage reservoir and one additional booster pump station.
- **Land Use Changes –** Since the preparation of the last master plan, several areas adjacent to the District's service area have begun development planning and are either in the process or expected to enter the process in the future to annex into the District. These annexations will affect the long-term storage and conveyance requirements of the District:
    - **Gateway to Little Valley –** This development sits just west of the District's current service area and includes a proposed 1,220 indoor equivalent residential connections to be built within the next 10-years.
    - **Kennecott Foothills –** Additional area directly west of the existing District service area (beyond that identified as part of Gateway to Little Valley) is likely to develop and annex into the District. For the purpose of District planning, all areas directly west of the existing service area that have an elevation of approximately 4,660 feet or lower have been included as potential annexation. This elevation was chosen as the upper boundary of likely development as it is the currently service area limitation of the District's planned Pressure Zone 3.

- **Little Valley –** Kennecott has long term plans for development in the area called "Little Valley". This is a small valley within the Oquirrh Mountains west of the District. Development of this area is not expected in the short-term but should be kept in mind as the District develops its long-term plans.
- **Magna Regional Park –** Salt Lake County will begin constructing the first phase of the Magna Regional Park in late 2019. The long-term plan for the park will include approximately 50 acres of irrigated area with restrooms and a splashpad. The first phase of the park will include approximately 25 acres of irrigated acres with restrooms and a splash pad. This area was previously zoned as an open space park with natural vegetation (non-irrigated). The development of the park into play fields will require a significant amount of additional irrigation in the District with a small increase in anticipated culinary demand from the restrooms and splash pad.

- **Continued Growth and Additional Density –** In addition to areas that will potentially annex into the District, densities for new development have generally been increasing and are higher than densities included in the previous master plan.

To consider these and other issues relative to the District's future water storage and conveyance needs, the District has retained Bowen, Collins & Associates (BC&A) to evaluate its water system.

SCOPE OF SERVICES

The scope of the work documented in this report includes three major tasks:

Task 1 – Update the City's Culinary and Secondary Hydraulic Models

The District already had an existing culinary water model setup. The existing model was updated to include the latest water system peak day demands and pipe construction. The District did not have an existing secondary water model calibrated to existing conditions. A previous buildout secondary model did not include many major components of the existing secondary water system. The secondary water model water updated to address these issues. Existing facilities included in the hydraulic models were documented as part of this report.

Task 2 – Storage Evaluation

Existing and future storage requirements were evaluated based on existing and potential future demand patterns within the District. Storage needs to accommodate mixing requirements were considered for the secondary system.

Task 3 – Major Conveyance Evaluation

Existing and future hydraulic deficiencies were identified within the culinary and secondary water systems. Improvements to address deficiencies were recommended along with cost estimates for the recommended improvements.

CHAPTER 8
EXISTING CULINARY WATER FACILITIES

INTRODUCTION

As part of this Master Plan, BC&A has assembled an inventory of existing infrastructure within the culinary water system. The purpose of this chapter is to present a summary of the inventory of District's existing water distribution system that can be used as a reference for future studies.

EXISTING SERVICE AREA AND TOPOGRAPHY

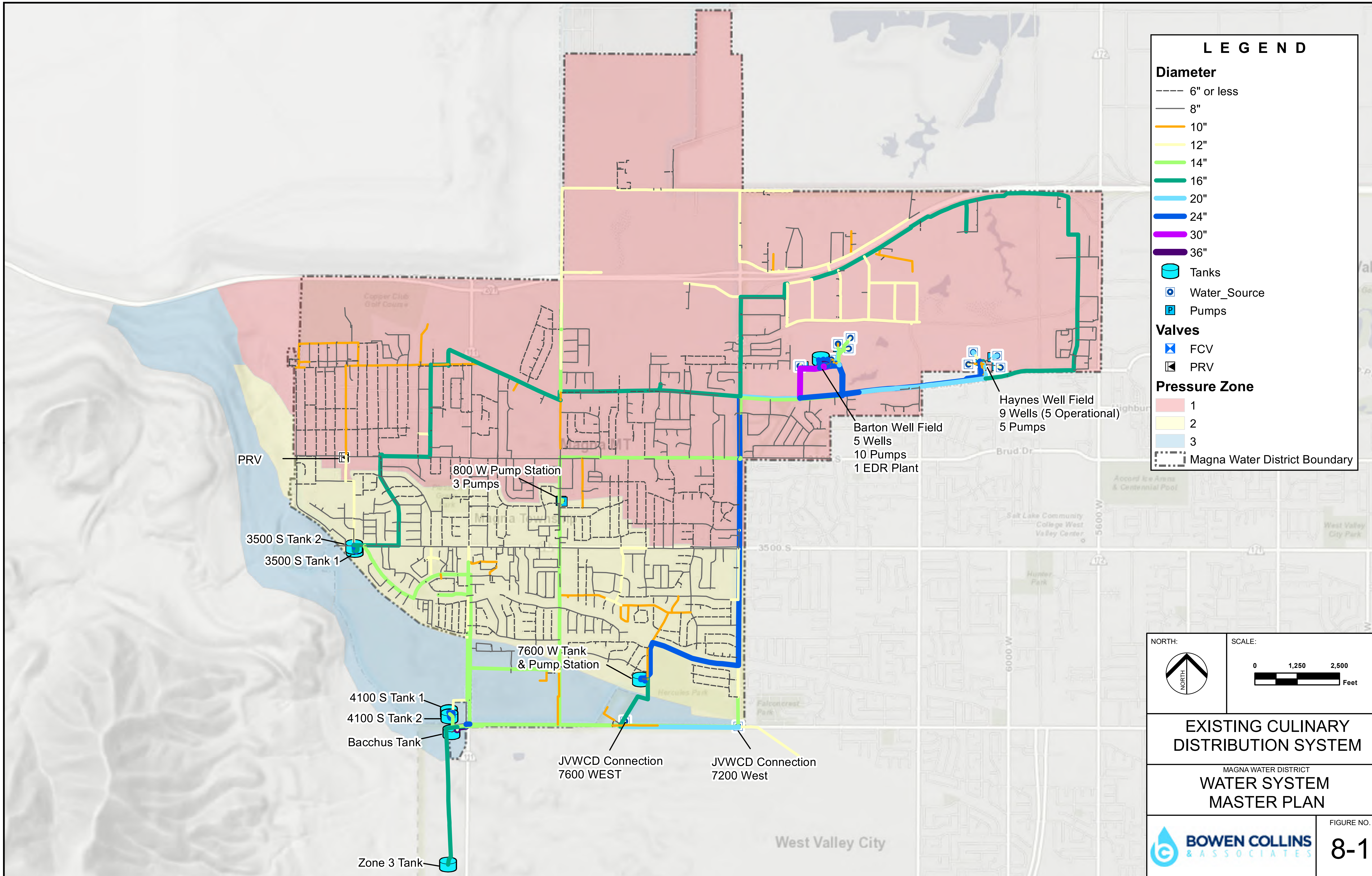
Magna Water District provides culinary water for almost all residents within its corporate boundaries as shown in Figure 8-1. The Magna Water District's existing service area is approximately 9.25 square miles and is bordered by the following: the Oquirrh Mountain Range to the west, Granger-Hunter Improvement District to the southeast, and Salt Lake City Department of Public Utilities to the northeast. The topography of the District generally slopes from southwest to northeast such that most of the District storage reservoirs are located near the southwest corner of the City.

In 2018, the Magna Water District service area included a population of approximately 31,650 permanent residents. In addition to permanent residents, the District also serves many commercial, industrial, and institutional entities. The southwest side of the District is largely residential and is mostly built out. The northeast side of the District is mostly commercial/industrial, with some large areas still available for future development. Figure 8-2 shows a schematic of how the sources, storage reservoirs, and pump stations in the District are connected.

CULINARY SOURCES

Wells

Of the 14 existing historically culinary wells in the District's water system, only nine are actively used in the District's water system and they are not directly used in the culinary system. The active wells are not used directly because they require water treatment to remove harmful metals and salts before they may be used in the District's culinary water system. The remaining six include older wells that have deteriorated over time or produce too much sand for useful production. Table 8-1 lists the historic capacity of each of the wells along with the reliable capacity as determined by the most recent production records.



EXISTING CULINARY DISTRIBUTION SYSTEM

MAGNA WATER DISTRICT
WATER SYSTEM MASTER PLAN

BOWEN COLLINS & ASSOCIATES

FIGURE NO. 8-1

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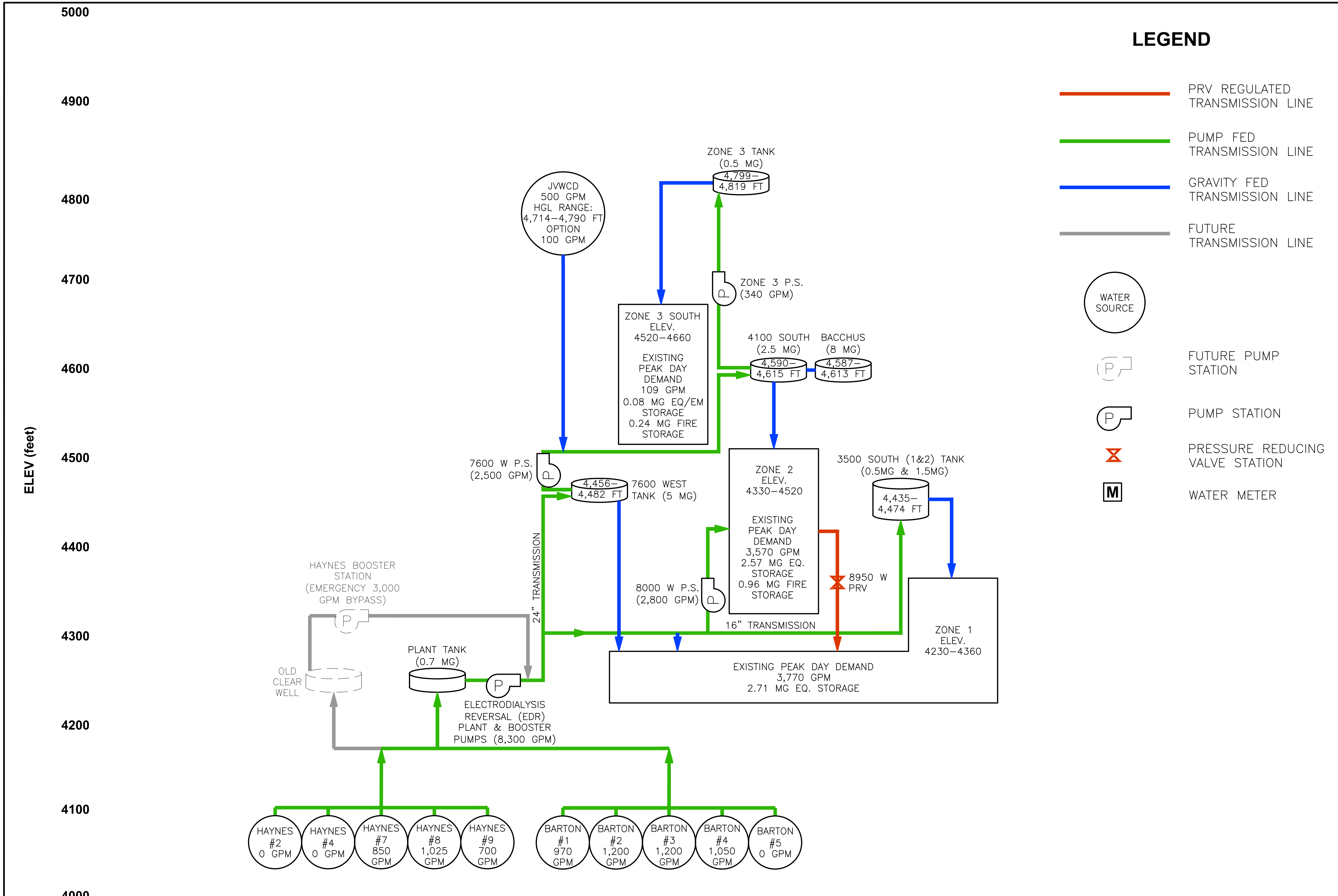

Figure 8-2
MAGNA WATER DISTRICT
CULINARY DISTRIBUTION SYSTEM

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Table 8-1
Existing Raw Water Wells[1]

Name	Historic Capacity (gpm)	Reliable Capacity[2] (gpm)	Pump (HP)	Casing Diameter (in)	Well Depth (ft)
Haynes No. 1	Not Used		-	8	75
Haynes No. 2 Replacement	1,000	1,150	30	20	250
Haynes No. 2 Abandoned	Monitoring Well		-	8	145
Haynes No. 3	Not Used		-	8	150
Haynes No. 4 Replacement	1,500	2,250	125	20	230
Haynes No. 4 Abandoned	Monitoring Well		7	8	143
Haynes No. 5	Not Used		-	4	126
Haynes No. 6	Not Used		-	8	83
Haynes No. 7 Replacement	2,200	1,450	30	20	250
Haynes No. 7 Abandoned	Not Used		-	8	163
Haynes No. 8	800	0	10	12	206
Haynes No. 9	1,000	600	25	8	Unknown
Subtotal Haynes Well Field		**5,450**			
Barton No. 1	1,100	1,100	125	12	200
Barton No. 2	1,200	1,150	200	12	200
Barton No. 3	850	770	100	12	200
Barton No. 4	1,200	1,050	150	12	200
Barton No. 5	1,200	1,000	150	12	200
Subtotal Barton Well Field		**5,070**			
TOTAL ALL WELLS		**10,520**			

[1] Wells are considered raw water wells due to total dissolved solids, arsenic, and perchlorate concentrations in excess of State of Utah maximum contaminant level (MCL) standards.
[2] Based on maximum production from recent data (2018)

Electrodialysis Reversal (EDR) Plant

Electrodialysis reversal uses membrane technology in combination with an electric current to force salt or metal ions to concentrate themselves on one side of a semi-impermeable membrane. For the District's EDR plant, approximately 80 percent of flow through the treatment plant is considered treated while the remaining 20 percent includes all of the concentrated salt or metal ions removed during the treatment process. The concentrated brine byproduct of the treatment process is discharged through a dedicated bypass line (constructed in 2018) directly to the District's wastewater treatment plant. Table 8-2 summarizes a few of the characteristics of the District's EDR plant.

Table 8-2
District EDR Plant Capacity

EDR Plant Component	Quantity
First Year of Operation	2009
Wells Treated	9 to 10
EDR Feed Pumps & Prefilters	3
EDR Treatment Trains	4
Finished Water Tank Size (MG)	0.7
Booster Pumps to Distribution	5
Treatment Capacity (MGD)[1]	12.0

[1] Includes mixing of source and treated water

The rated treatment capacity of the plant includes 12.0 mgd with all four treatment trains operating. Treated flow is mixed with raw water from the wells to reduce treatment costs while still meeting treatment targets. Current mixing rates are approximately 1 to 1 (up to 6 mgd of treated water mixed with up to 6.0 mgd of raw water). The District's treatment goal is 700 mg/L of total dissolved solids. For comparison, JVWCD has a TDS range between 200 and 500 mg/L.

Because capacity is based on mixing and water quality, the loss of one of the four trains of the treatment process does not necessarily reduce the capacity by 25 percent (i.e. a full 3 mgd). If a treatment train is taken offline due to maintenance or mechanical failure, operators make efforts to balance the blending of raw water and treated water to meet water quality target. How much water this is will vary depending on total system demands and the quality of raw water being received from the wells. Flow from the EDR Plant is used throughout the District, but first enters the District system at Pressure Zone 1 (at northeast end of the service area).

Jordan Valley Water Conservancy District

The District has two physical connections to the Jordan Valley Water Conservancy District as summarized by Table 8-3.

Table 8-3
Existing JVWCD Connection Capacity

JVWCD Connection	Size of Connection	Existing Capacity at 5 ft/sec (gpm)	Existing Capacity at Preferred Rate (gpm)	Available Pressure Head[1] (ft)
7200 West 4100 South	24" JVWCD x 14" MWD	2,399	--	4,714 – 4,790
7600 West 4100 South	14" JVWCD x 14" MWD	2,399	496	4,714 – 4,790
Contract Volume (acre-ft)	800		496	
20% Additional Option (acre-ft)	160		99	

[1] Pressure from JVWCD may fluctuate between a pressure head of 4,714 feet and 4,790 feet depending on tank levels and whether JVWCD is operating one of its boosters. The overflow of the JVWCD's nearest storage reservoir has an elevation of 4,740 feet.

The 7600 West connection is the District's preferred connection for supply, but both connections are equipped with flow meters and pressure reducing valves. The JVWCD supply is connected to the Zone 2 pressure zone (4100 South and Bacchus Tanks). While peak capacity through the connections could exceed 2,000 gpm, the District rarely operates over 500 gpm to minimize peaking costs from JVWCD.

CULINARY STORAGE FACILITIES

The District has storage reservoirs in all three of its culinary water pressure zones numbered 1 to 3 from lowest to highest. Table 8-4 summarizes the characteristics of each storage facility. Figure 8-1 indicates the location of storage facilities for Magna Water District, and Figure 8-2 shows how each of the storage facilities is connected within the District's water system.

Table 8-4
Culinary Storage Facilities

Tank Name	Reservoir Location	Volume (MG)	Dimensions	Bottom Elevation (ft)	Overflow Level (ft)	Source	Description
3500 South Tank 1	3500 South 8920 West (Zone 1)	1.5	100 ft Diameter	4,435	39.2	EDR Plant / 8000 W Booster	Above ground steel
3500 South Tank 2	3500 South 8920 West(Zone 1)	0.5	45 ft Diameter	4,435	39.2	EDR Plant / 8000 W Booster	Above ground steel
7600 West Tank	7600 West Valley Forge Rd. (Zone 1)	5	184 ft Diameter	4,455.5	26.0	EDR Plant / 8000 W Booster	Buried Concrete
4100 South Tank 1	4100 South 8400 West (Zone 2)	0.5	58 ft Diameter	4,590	24.5	JVWCD / 7600 W Booster	Above ground steel
4100 South Tank 2	4100 South 8400 West (Zone 2)	2	129 ft Diameter	4,590	24.5	JVWCD / 7600 W Booster	Above ground steel
Bacchus Tank	4100 South 8400 West (Zone 2)	8	200 ft Diameter	4,587.8	25.0	JVWCD / 7600 W Booster	Buried Concrete
Zone 3 Tank	4120 S Bacchus Highway (Zone 3)	0.5	65.7 ft Diameter	4,798.5	20.0	Zone 3 Booster	Buried Concrete
Total		18.0					

CULINARY BOOSTER PUMPING FACILITIES

Table 8-5 summarizes the characteristics of the booster pumps within the District's water system. Booster pumps are required to pump water from the EDR plant into the District's conveyance system as well as pump water between pressure zones.

Table 8-5
Culinary Booster Pump Station Equipment

Booster Stations	Capacity (gpm)	Number of Pumps	Motor Type[1]	Emergency Backup Power	Pressure Zone Delivery
EDR Plant	8,333	4 duty, 1 backup	VFD	Stationary 1750 KW	1
8000 West	2,800	2 duty, 1 backup (75HP)	Constant	Future Mobile	2
7600 West	2,500	2 duty, 1 backup (75HP)	Constant	Stationary 375 KW(3)	2
Zone 3	340	1 duty, 1 backup (25HP)	VFD	No	3
Haynes Clearwell[2]	2,400	2 duty, 1 backup	Constant	No	1

[1] VFD = variable frequency drive. This type of control allows for finer adjustment of flow or pressure.
[2] The Haynes Clearwell booster is a catastrophic emergency backup that bypasses the EDR plant and pumps well water directly into the system. The water quality from these wells will not meet current State of Utah maximum contaminant level standards.

CULINARY DISTRIBUTION PIPING

Table 8-6 lists the reported pipe diameters and corresponding lengths in the Magna Water District distribution system. Pipe materials include PVC, ductile iron, cast iron, and steel. Location and sizing of distribution pipes are shown in Figure 8-1.

Table 8-6
Culinary Distribution Piping

Diameter (inch)	Length (ft)	Length (miles)	Percentage
<=4	47,434	8.98	6.4%
6	211,597	40.08	28.4%
8	269,921	51.12	36.2%
10	38,602	7.31	5.2%
12	45,992	8.71	6.2%
14	50,373	9.54	6.8%
16	48,035	9.10	6.5%
18	1,622	0.31	0.2%
20	9,355	1.77	1.3%
24	21,188	4.01	2.8%
30	231	0.04	0.0%
36	352	0.07	0.0%
	744,703	141.0	100%

CULINARY PRESSURE ZONES

The Magna Water District water distribution system is divided into 3 major pressure zones as shown in Figure 8-1. Table 8-7 lists the approximate hydraulic grade setting for each pressure zone along with the approximate service percentage of the zone based on current demands.

Table 8-7
Culinary Pressure Zone Summary

Pressure Zones	Approximate Static Hydraulic Grade Line (ft)	Existing Peak Day Demand[1] (gpm)	Existing Percentage of Peak Day Demand (%)
1	4,435 ft - 4,482 ft	3770	50.6%
2	4,587 ft - 4,615 ft	3570	47.9%
3	4,799 ft - 4,819 ft	109	1.5%

[1]Estimated peak day demand distribution for 2018 based on water billing data.

CHAPTER 9
EXISTING SECONDARY WATER FACILITIES

INTRODUCTION

As part of this Master Plan, BC&A has assembled an inventory of existing infrastructure within the secondary water system. The purpose of this chapter is to present a summary of the inventory of District's existing secondary water distribution system that can be used as a reference for future studies.

BACKGROUND

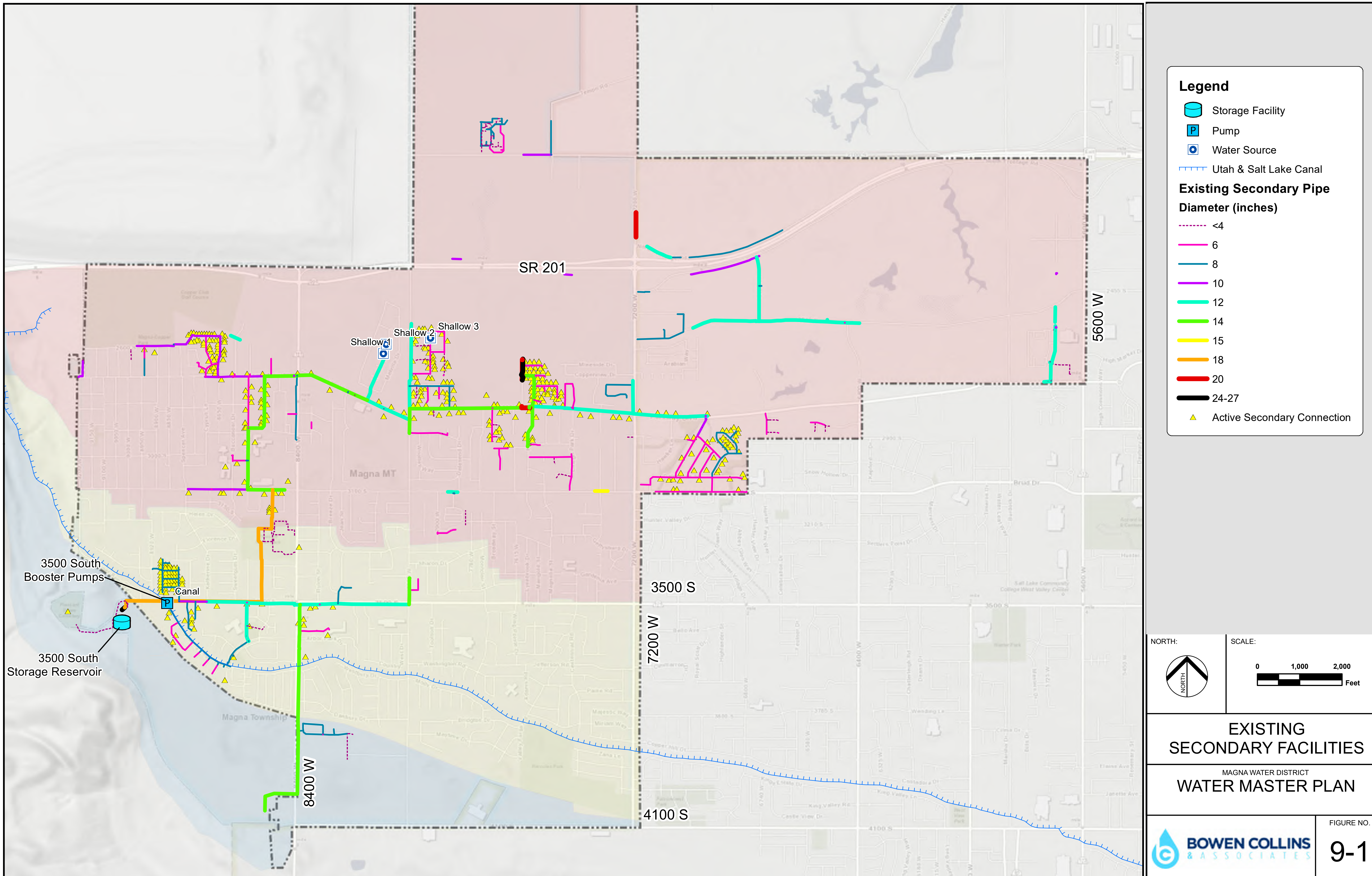
Magna Water District's first began testing of its secondary water system in 2004. The District pressure tested the first components of its secondary water system and some schools received secondary water for a couple weeks. Since then, the District has continued to expand its existing secondary water pipelines to provide secondary water to more users within the District. As identified in the supply and demand portion of this master plan, additional expansion of the secondary water system is critical to long-term water source supply needs within the District. Table 9-1 summarizes the estimated number of irrigated acres served by the District since it first began seasonal operation in 2005.

Table 9-1
Existing Secondary Water Service Area

Year	Total Secondary Irrigation (acre-ft)	Estimated Irrigated Area[1](acres)
2005	169	44.7
2006	190	50.7
2007	197	53.1
2008	185	53.1
2009	148	53.1
2010	283	78.9
2011	364	102.5
2012	422	120.4
2013	518	149.2
2014	545	159.0
2015	573	169.0
2016	640	191.4
2017	674	204.3

[1] Estimated based on irrigation volume produced and irrigation rates with conservation.

The District currently has approximately 370 active connections served by the existing irrigation system as identified in Figure 9-1. Figure 9-2 shows a schematic of how the sources, storage reservoirs, and pump station in the District are connected.



EXISTING SECONDARY FACILITIES

MAGNA WATER DISTRICT

WATER MASTER PLAN

BOWEN COLLINS & ASSOCIATES

FIGURE NO.

9-1

P:\Magna Water District\483-18-01 Master Plan\4.0 GIS\4.1 Projects\Water-Figure 9-1 - Existing Secondary Water.mxd AMcKinnon 5/1/2019

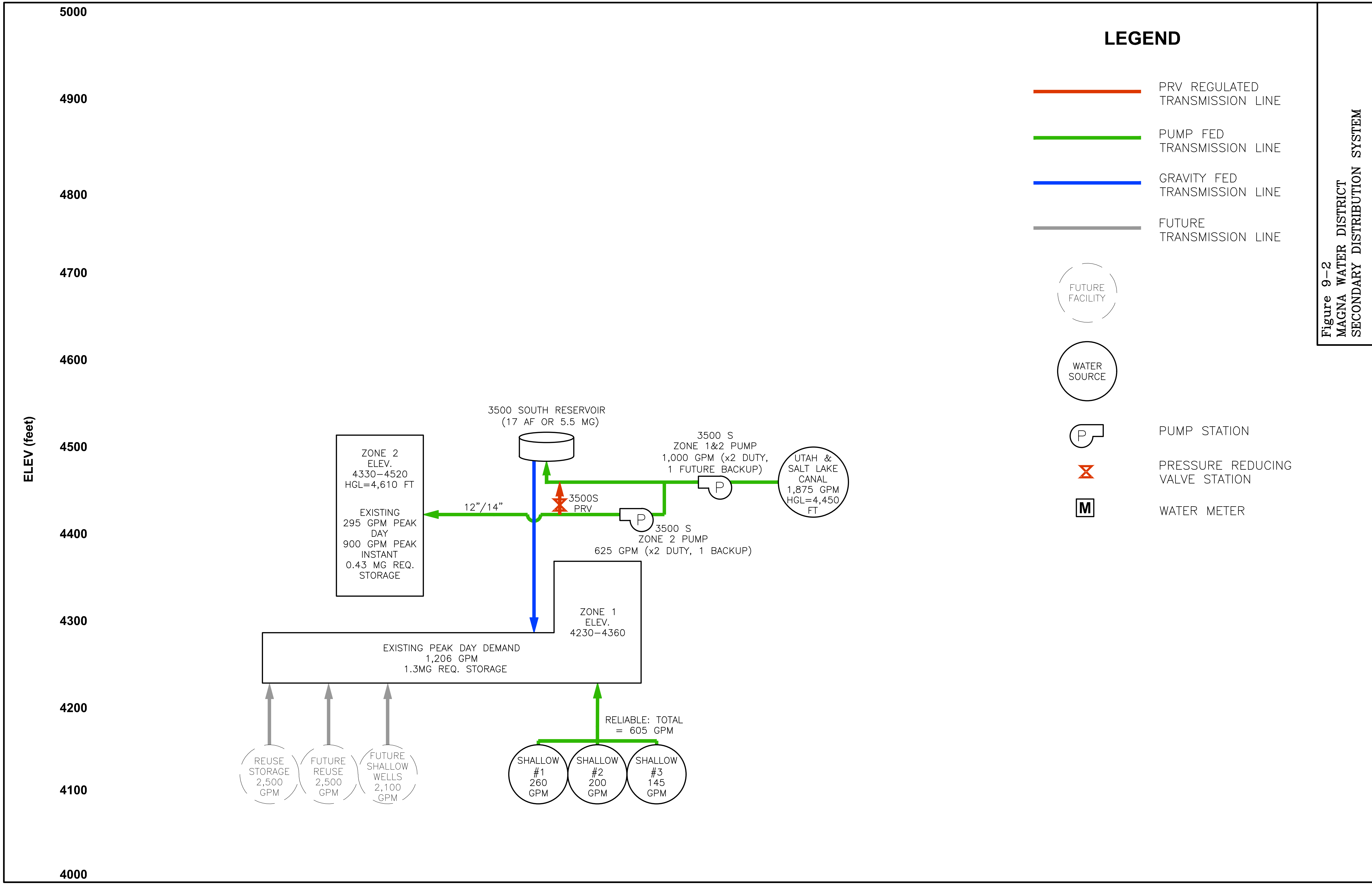


Figure 9-2
MAGNA WATER DISTRICT
SECONDARY DISTRIBUTION SYSTEM

EXISTING SECONDARY SOURCES

Wells

The District drilled and equipped three shallow wells in 2004 as part of its initial secondary water system. Table 9-2 summarizes the characteristics of the three shallow wells in the District's secondary distribution system.

Table 9-2
Existing Secondary Wells

Name	Capacity (gpm)	Historic Static Water Level Below Ground Surface (ft)	Casing Diameter (in)	Well Depth (ft)
Shallow Well #1	260	Artesian	10" Steel	127
Shallow Well #2	200	3	8" PVC	143
Shallow Well #3	145	Artesian	8" PVC	143

Utah & Salt Lake Canal

The District uses its existing canal shares at a pump station on the Utah & Salt Lake Canal at 3500 South. The 3500 South Booster Station includes 5 existing pumps with room for one more as summarized in Table 9-3.

Table 9-3
Utah & Salt Lake Canal Boosting Capacity

Booster Stations	Capacity (gpm)	Number of Pumps	Motor Type[1]	Emergency Backup Power Available	Pressure Zone Delivery
3500 South - Zone 1 & 2 Pumps (Lower)	2,000	2 duty (1,000 gpm each), 1 Future Backup (20HP)	Constant	No	1
3500 South - Zone 2 Pumps (Upper)	1,300	2 duty (650 gpm each), 1 backup (650 gpm) (25HP)	VFD	No	2

[1] VFD = variable frequency drive. This type of control allows for finer adjustment of flow or pressure.

SECONDARY STORAGE FACILITIES

The District has one existing secondary storage reservoir located off 3500 South near 9000 West. The existing reservoir has dimensions as summarized in Table 9-4. Figure 9-2 shows how the storage facility is connected within the District's water system.

Table 9-4
Secondary Storage Facilities

Storage Facility Name	Reservoir Location	Volume (MG)	Dimensions	Bottom Elevation (ft)	Overflow Level (ft)	Source	Description
3500 South Reservoir	3500 South 9000 West	5.05	Irregular	4,435	39.2	Wells / 3500 S Booster	Clay Lined Open Reservoir

A stage storage curve for the 3500 South Reservoir is shown in Table 9-5.

Table 9-5
Approximate Stage Storage Curve[1]

Elevation[1,2]	Area (sf)	Cumulative Volume (af)	Cumulative Volume (MG)
4,475.0	14,635		0.00
4,476.0	40,000	0.6	0.20
4,477.0	43,429	1.6	0.52
4,478.0	46,857	2.6	0.85
4,479.0	50,286	3.7	1.22
4,480.0	53,714	4.9	1.61
4,481.0	57,143	6.2	2.02
4,482.0	60,571	7.6	2.46
4,483.0	64,000	9.0	2.93
4,484.0	67,429	10.5	3.42
4,485.0	70,857	12.1	3.94
4,486.0	74,286	13.7	4.48
4,487.0	77,714	15.5	5.05
4,487.5	79,429	16.4	5.34
4,488.0	81,143	17.3	5.64
4,489.0	84,571	19.2	6.26
4,490.0	88,000	21.2	6.91

[1] Storage curve estimated using design drawings. No stage-storage curve was provided in design data.
[2] High water elevation is 4,487.0 ft. The overflow elevation is at 4,487.5 ft Top of bank is 4,490 ft.

SECONDARY DISTRIBUTION PIPING

Table 9-6 lists the reported pipe diameters and corresponding lengths in the Magna Water District distribution system. Pipe materials include PVC, ductile iron, and steel. Location and sizing of distribution pipes are shown in Figure 9-1. Of the installed pipe in the District, approximately 30 percent is currently inactive pending connection to the active secondary lines. For comparison, the active length of secondary pipe is roughly 12 percent of the length of pipe in the culinary system.

Table 9-6
Secondary Distribution Piping

Diameter (inch)	Length (ft)	Length (miles)	Percentage
<=4	14,458	2.49	10%
6	30,404	5.76	24%
8	26,124	4.95	20%
10	10,671	2.02	8%
12	21,971	4.16	17%
14	14,006	2.65	11%
15	307	0.06	0%
18	6,785	1.29	5%
20	1,276	0.24	1%
24	3,262	0.62	3%
Total	129,264	24.23	100%

SECONDARY PRESSURE ZONES

The Magna Water District secondary distribution system currently only includes two pressure zones but will be expanding into a third pressure zone shortly. Table 9-7 lists the approximate hydraulic grade setting for each pressure zone along with the approximate service percentage of the zone based on current demands.

Table 9-7
Secondary Pressure Zone Summary

Pressure Zones[2]	Approximate Static Hydraulic Grade Line (ft)	Existing Peak Day Demand[1] (gpm)	Existing Percentage of Peak Day Demand (%)
1	4,435 ft - 4,482 ft	1,206	80.3%
2	4,610 ft	295	19.7%
3	4,820 ft	0	0%

[1] Estimated peak day demand distribution for 2018 based on water billing data.
[2] There is no existing Zone 3 infrastructure for secondary water yet.

CHAPTER 10
STORAGE AND BOOSTING EVALUATION

The purpose of this chapter is to evaluate the District's water storage capacity. This chapter provides an overview of State rules and regulations pertaining to public water system storage facilities. As part of this evaluation, the size and location of existing storage reservoirs was analyzed to determine if the District has sufficient storage to adequately meet peak demands and to provide emergency and fire flow storage.

STORAGE EVALUATION CRITERIA

Regulations regarding required system storage are found in Section R309-510-8 of the Utah Administrative Code. The first portion of the code outlines the types of storage required:

> "(1) General. Each public water system, or storage facility serving connections within a specific area, shall provide:
>
> > (a) equalization storage volume, to satisfy average day demands for water for indoor use and irrigation use,
> >
> > (b) fire flow storage volume, if the water system is equipped with fire hydrants intended to provide fire suppression water or as required by the local fire code official, and
> >
> > (c) emergency storage, if deemed appropriate by the water supplier or the Director."

Each of these storage components is discussed below for both culinary and secondary water.

Culinary Water Storage

The State of Utah is in the midst of adopting new regulations for defining equalization storage with respect to drinking water (culinary water). Under these new regulations, system-specific source and storage requirements will be defined for each system. Under historic regulations, equalization storage requirements were defined in the code as follows:

> "(2) Equalization Storage.
>
> > (a) All public drinking water systems shall provide equalization storage. The amount of equalization storage varies with the nature of the water system, the extent of irrigation use, and the location and configuration of the water system.
> >
> > (b) Table 510-4 lists required equalization storage for indoor use. Storage requirements for non-community systems not listed in this table shall be determined by calculating the average day demands from the information given in Table 510-2.

TABLE 510-4
Storage Volume for Indoor Use

Type	Volume Required (gallons)
Community Systems	
Residential; per single resident service connection	400
Non-Residential; per Equivalent Residential Connection (ERC)	400
Non-Community Systems	
Modern Recreation Camp; per person	30
Semi-Developed Camp; per person	
a. with Pit Privies	2.5
b. with Flush Toilets	10
Hotel, Motel and Resort; per unit	75
Labor Camp; per unit	25
Recreational Vehicle Park; per pad	50
Roadway Rest Stop; per vehicle	3.5
Recreational Home Development (i.e., developments with limited water use); per connection (See Note 2 in Table 510-1)	400

(c) Where a drinking water system provides water for irrigation use, Table 510-5 shall be used to determine the minimum equalization storage volumes for irrigation. The procedure for determining the map zone and irrigated acreage for using Table 510-5 is outlined in R309-510-7(3).

TABLE 510-5
Storage Volume for Irrigation Use

Map Zone	Volume Required (gallons/irrigated acre)
1	1,782
2	1,873
3	2,528
4	2,848
5	4,081
6	4,964

Calculated Need for Drinking Water Equalization Storage. From this section of code, there are two important issues to highlight. The first is described in the following sentence:

> "The amount of equalization storage varies with the nature of the water system, the extent of irrigation use, and the location and configuration of the water system."

Staff at the Division of Drinking Water have interpreted this to mean that the need for equalization storage will vary between systems. This means that, where reliable water use data exists, the volume of equalization storage needed should be calculated based on actual water use patterns. Based on District storage tank levels and source production records, Magna Water District calculated a demand pattern for its system. Table 10-1 and Figure 10-1 shows the dominant demand pattern for the District. As can be seen in the figure, water demands peak in the early morning hours when most people are irrigating their lawns. Demand then drops off significantly during the day as water use is primarily limited to smaller indoor uses.

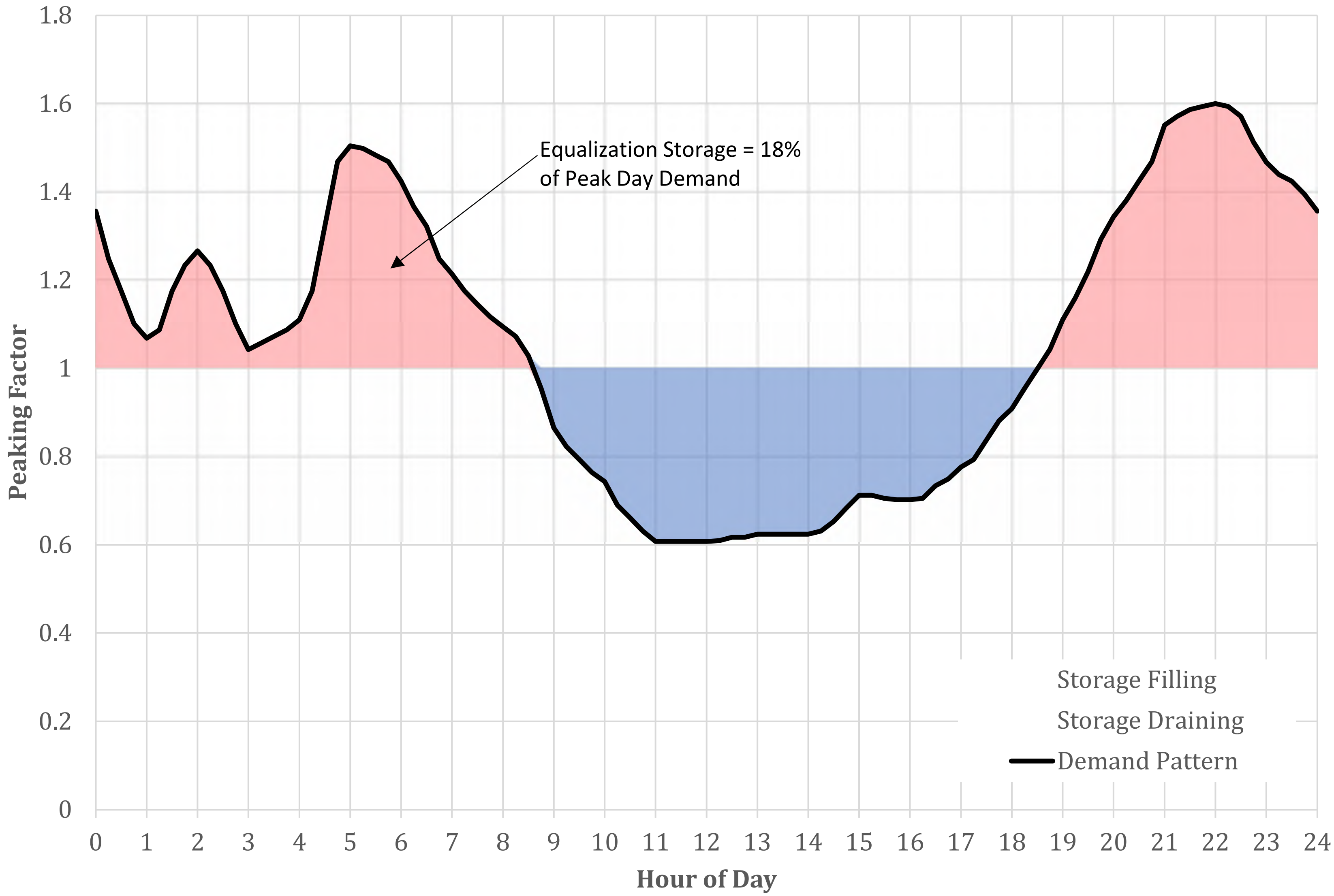
While demands vary significantly during the day, the same is not true for most supplies. It is usually most economical to size sources, major conveyance pipelines, and pump stations to produce water at a relatively constant rate. This is especially true for the District's water system that relies on a constant supply from JVWCD and has a treatment plant with limited storage capacity. As a result, most systems (MWD's included) are designed supply to water at a relatively constant rate throughout the day. Storage is then used to satisfy any demands above the rate of supply.

Table 10-1
Existing Culinary Demand Pattern

Hour	Peaking Factor
0	1.356
1	1.068
2	1.266
3	1.042
4	1.11
5	1.504
6	1.424
7	1.214
8	1.094
9	0.865
10	0.743
11	0.608
12	0.608
13	0.624
14	0.624
15	0.712
16	0.702
17	0.776
18	0.908
19	1.11
20	1.343
21	1.551
22	1.6
23	1.467
24	1.356

With this in mind, Figure 10-1 shows the difference between demand and supply throughout a peak day of demand. During the hours of greatest demand, water from storage is used to meet demand in excess of supply (as shown in red). During periods of lower demand, supply continues at its steady pace to refill storage reservoirs in preparation for peak demands the next day (as shown in blue). Based on the measured flows and as shown in the figure, the required equalization storage for the District was calculated to be approximately 18 percent of average peak day demands. Due to potential changes in the District's demand pattern resulting from variations in irrigation patterns from day to day, the District plans on using a minimum value of 25 percent of its average peak day demands to define required equalization storage for existing conditions. Based on projections of current peak day demand, this equates to 2.7 million gallons.

Figure 10-1
Existing Culinary Water Demand Pattern



Fire Flow Storage. Fire flow storage requirements are defined in the code as follows:

"(3) Fire Flow Storage.

(a) Fire flow storage shall be provided if fire flow is required by the local fire code official or if fire hydrants intended for fire flow are installed.

(b) Water systems shall consult with the local fire code official regarding needed fire flows in the area under consideration. The fire flow information shall be provided to the Division during the plan review process.

(c) When direction from the local fire code official is not available, the water system shall use Appendix B of the International Fire Code, 2015 edition, for guidance. Unless otherwise approved by the local fire code official, the fire flow and fire flow duration shall not be less than 1,000 gallons per minute for 60 minutes."

As stated in the code, the primary authority responsible for establishing needed fire flows and fire flow storage is the local fire code official. The Unified Fire Authority is the fire marshal for the District. In a recent ISO survey, the maximum fire flow requirements vary by development type and size and ranges from 1,500 gpm in predominantly residential areas to 4,000 gpm in commercial areas. For the purposes of this master plan, fire flows in residential areas have been established as 1,500 gpm for 2 hours, while commercial areas require 4,000 gpm for 4 hours. Although not specifically outlined in the code, State Division of Drinking Water officials have historically allowed for fire flow for individual water pressure zones to come from storage within the zone itself or from storage in higher zones in the system. For the system as a whole, the required fire flow volume is equal to the largest single fire flow demand. For the District, this is assumed to be 4,000 gpm for 4 hours (960,000 gallons) based on the maximum fire flow demand required for fire sprinklered buildings.

Emergency Storage. Emergency storage is the volume of water required to meet water demand during an emergency situation. Emergency storage requirements are defined in the code as follows:

"(4) Emergency Storage.
Emergency storage shall be considered during the design process. The amount of emergency storage shall be based upon an assessment of risk and the desired degree of system dependability. The Director may require emergency storage when it is warranted to protect public health and welfare."

It will be noted that no specific requirement is given for emergency storage in the code. The determination of required emergency storage is left largely to the entity designing and operating the water system.

For the District, the most common water supply emergencies relative to storage analysis are power outages. During power outages, water supplies are unable to produce needed water. In the event of an extended District-wide outage, all wells and the treatment plant would not be able to operate. While some water delivery during a power outage can be accomplished through auxiliary power to selected water system facilities, it is also wise to include some additional emergency water at storage reservoirs. This also gives system operators the benefit of a little extra buffer for system operations. The District's water supply is also heavily dependent on water from the its EDR Plant. If some or all of the treatment trains were to go offline unexpectedly, it would be difficult for the District to meet demands.

Based on conversations with District personnel and common practice in the industry, it is recommended that all zones include emergency storage adequate to supply the system during a 6 hour power outage during peak day demands (or roughly 25 percent of peak day demand). This results in an existing emergency storage need of 2.7 million gallons for existing conditions.

State Minimum Requirements for Culinary Storage. As noted previously, there is a second important issue in the section of the Utah Administrative Code regarding equalization storage that needs to be discussed. This is highlighted in the following section of the code:

> "Table 510-4 lists required equalization storage for indoor use. Storage requirements for non-community systems not listed in this table shall be determined by calculating the average day demands from the information given in Table 510-2."

This section is then followed by a series of tables that can be used to estimate average demands if a system does not have reliable flow data. While the tables provide some interesting information regarding typical average day water demands, the most important issue to note is that the minimum equalization storage allowed by the State is equal to the average day demand. Where reliable data exists, the entity is not required to use the values in the table (which are conservatively high in most cases) but may use actual average day demands.

Based on historic use patterns, the expected average day demand for the District is 4.7 million gallons (5,300 acre-ft/year, 2018 estimate). Therefore, this is the minimum culinary storage the District may have and still meet State requirements. As will be noted in the excerpt above, this is for equalization storage only, but since the State does not specifically require emergency storage, this becomes the defacto minimum for all storage excluding fire flow storage which is always addressed separately.

Total Recommended Storage. The combined equalization/emergency storage required for the District is 50 percent of peak day demand or 5.4 million gallons (existing conditions). This can be compared against the State's minimum storage requirement based on average day demand (4.7 million gallons). For the District, it appears that the recommended volume with both equalization and emergency storage is adequate to meet State minimum requirements. In addition to the recommended equalization/emergency storage, 960,000 gallons is recommended for fire flow bringing the total recommended storage to 6.4 million gallons.

As the District's demand patterns change as the secondary system expands, the District intends to use the greater of average day demands or 50 percent of peak day demand as its required storage (plus fire flow storage).

Secondary Water Storage

The State of Utah does not have any requirements for secondary storage sizing. However, similar requirements for equalization storage would apply to sizing of secondary facilities. Figure 10-2 illustrates an ideal demand curve for secondary demands in terms of reducing evapotranspiration effects and energy costs. In this curve, irrigation is limited to the hours between 9pm and 9am. In reality, the peaking factor for irrigation is usually somewhat less and the duration of irrigation is longer. The ideal demand pattern is potentially more difficult to size facilities for because the higher peak requires both larger conveyance and storage facilities for the same volume of water used for irrigation. However, for the purpose of this evaluation, it represents an ideal method of calculating required equalization storage for the District's water system. Based on this pattern, equalization storage must be equal to at least 50 percent of peak day demands.

If emergency storage is provided at the same rate as culinary emergency storage, an additional 50 percent of peak day demand would be required. Thus, total combined equalization and emergency storage volume would therefore be equal to the same volume as one peak day of demand.

Source Reliability & Mixing Storage. In addition to accounting for the daily operating storage volumes for the District's peaking needs and short-term emergency needs, the District would like to develop long-term storage capacity in the event of a long-term outage of one or more of its sources. This long-term storage could be constructed as part of a reuse storage facility or could be added at one or more of the storage facilities being used for equalization storage. Long-term storage facilities could also be used to improve water quality for secondary water by mixing lower quality sources with higher quality sources.

To provide additional long-term storage and improve mixing capabilities, it is recommended that the District expand storage at the existing 3500 South reservoir. It is estimated that the District could potentially double the size of the existing 3500 South reservoir by expanding to the south and/or west. This expansion would help to improve both reliability and mixing capabilities within the District's secondary water system.

TOTAL EXISTING AND FUTURE STORAGE REQUIREMENTS

The evaluation of equalization and emergency water storage facilities for existing and future conditions is shown in Tables 10-2 to 10-7 for culinary and secondary facilities. Note that source reliability and mixing storage are treated separately from equalization and emergency storage.

Figure 10-2
Ideal Secondary Water Demand Pattern to Minimize Evapotranspiration

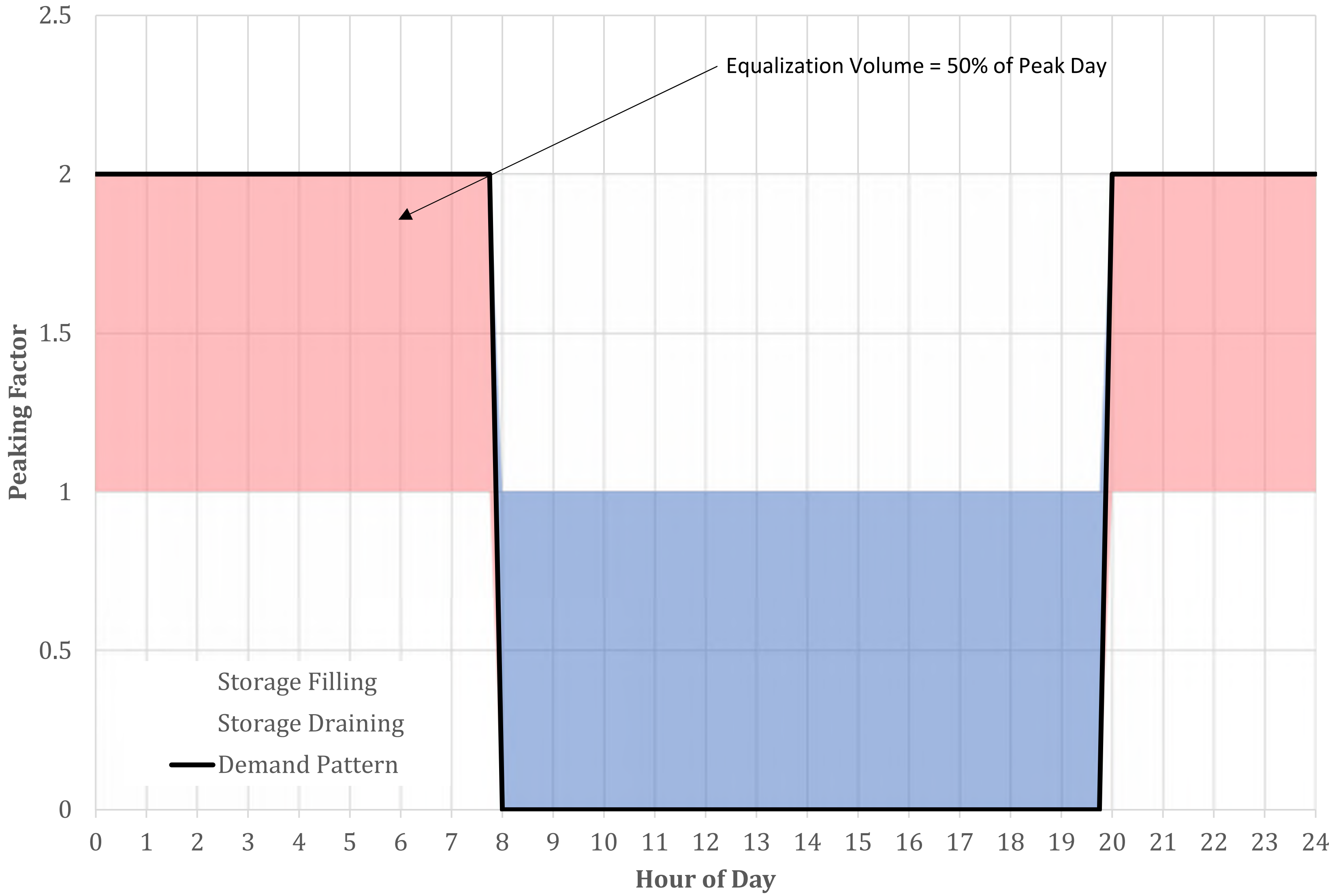


Table 10-2
2018 Culinary Storage Facilities Evaluation

Tank Service Area	2018 Peak Day Demand (gpm)	PDD Equalization & Emergency Storage Requirement (MG)	Average Day Equalization Requirement (MG)	Require d Fire Flow Storage (MG)	Total Required Storage (MG)	Available Storage (MG)	Equalization Storage Surplus by Service Area (deficit) (gallons)	Total Storage Surplus by Service Area (deficit) (gallons)	Storage Surplus Total (deficit) (gallons)
Zone 3 Tank	109	0.078	0.073	0.180	0.258	0.5	0.422	0.242	0.242
4100 South & Bacchus	3570	2.570	2.402	0.540	3.110	10.5	7.930	7.390	7.631
3500 South & 7600 West	3770	2.714	2.537	0.960	3.674	7.0	4.286	3.326	10.957
Total	7449	5.363	5.012	1.680	7.043	18.0	12.637	10.957	10.957

Table 10-3
2018 Secondary Storage Facilities Evaluation

Storage Reservoir	2018 Peak Day Demand (gpm)	Equalization Storage Requirement (MG)	Emergency Storage Requirement (MG)	Total Required Storage (MG)	Available Storage (MG)	Equalization Storage Surplus by Service Area (deficit) (gallons)	Total Storage Surplus by Service Area (deficit) (gallons)	Storage Surplus Total (deficit) (gallons)
Zone 2 VFD	295	0.212	0.212	0.425	--			
3500 South	1,206	0.868	0.868	1.736	5.05	3.97	2.887	2.887
Total	1,501	1.080	0.646	1.727	5.05	3.967	2.887	2.887

Table 10-4
2028 Culinary Storage Facilities Evaluation

Storage Reservoir	2028 Peak Day Demand (gpm)	2028 Average Day Demand (gpm)	Required Equalization / Emergency Storage	Fire Flow Storage (MG)	Total Required Storage (MG)	Available Storage (MG)	Equalization Storage Surplus by Service Area (deficit) (gallons)	Total Storage Surplus by Service Area (deficit) (gallons)	Storage Surplus Total (deficit) (gallons)
Zone 3 Tank[1]	402	293	0.421	0.540[2]	0.961	0.5	0.08	(0.46)	(0.46)
Z2 - 4100 South & Bacchus	3,314	1,535	4.421	0.540	4.961	10.5	6.08	5.54	5.08
Z1 - 3500 South & 7600 West	3,500	1,621	4.669	0.960	5.629	7.0	2.33	1.37	6.45
Total	7,216	3,342	9.511	2.040	11.551	18.0	8.49	6.45	6.45

[1] Equalization / Emergency storage for this zone governed by State of Utah average day demand calculation.
[2]Large increase in fire flow storage is the result of new school in pressure zone.

Table 10-5
2028 Secondary Storage Facilities Evaluation

Storage Reservoir	2028 Peak Day Demand (gpm)	Equalization Storage Requirement (MG)	Emergency Storage Requirement (MG)	Total Required Storage (MG)	Available Storage (MG)	Equalization Storage Surplus by Service Area (deficit) (gallons)	Total Storage Surplus by Service Area (deficit) (gallons)	Storage Surplus Total (deficit) (gallons)
Zone 3[1]	1,212	0.873	0.873	1.746	0.0	(0.87)		1.75
Zone 2	493	0.355	0.178	0.533	0.0	(0.36)		2.63
Z1 - 3500 South	1,914	1.378	0.689	2.067	5.05	3.67	2.98	2.98
Total	**3,619**	**1.228**	**1.050**	**4.345**	**5.05**	**2.442**	**0.702**	

[1]The District intends to meet demands in Zone 3 using booster pumps from Zones 1 and 2 until storage can be constructed.

Table 10-6
2060 Culinary Storage Facilities Evaluation

Storage Reservoir	2060 Peak Day Demand (gpm)	2060 Average Day Demand (gpm)	Required Equalization / Emergency Storage	Fire Flow Storage (MG)	Total Required Storage (MG)	Available Storage[1] (MG)	Equalization Storage Surplus by Service Area (deficit) (gallons)	Total Storage Surplus by Service Area (deficit) (gallons)	Storage Surplus Total (deficit) (gallons)
Future Little Valley	54	43	0.062	0.180	0.242		(0.06)	(0.24)	(0.24)
Zone 3 Tank	862	690	0.993	0.540	1.533	0.50	(0.49)	(1.03)	(1.03)
4100 South & Bacchus	3,314	2,651	3.818	0.540	4.358	10.5	6.68	6.14	5.11
3500 South & 7600 West	3,593	2,875	4.140	0.960	5.100	7.0	2.86	1.90	7.01
Total	7,824	4,745	8.951	2.220	11.171	18.0	8.99	6.77	7.01

Table 10-7
2060 Secondary Storage Facilities Evaluation

Storage Reservoir	Buildout Peak Day Demand (gpm)	Equalization Storage Requirement (MG)	Emergency Storage Requirement (MG)	Total Required Storage (MG)	Available Storage[1] (MG)	Equalization Storage Surplus by Service Area (deficit) (gallons)	Total Storage Surplus by Service Area (deficit) (gallons)	Storage Surplus Total (deficit) (gallons)
Future Little Valley	58	0.042	0.042	0.083		(0.04)	(0.08)	(0.08)
Future Zone 3 Reservoir	2,128	1.532	1.532	3.064		(1.53)	(3.06)	(3.39)
Future Zone 2 Reservoir	607	0.437	0.437	0.874		(0.44)	(0.87)	(0.33)
3500 South Reservoir	3,124	2.249	2.249	4.499	5.05	2.80	0.55	0.55
Total	6,057	4.260		8.520	5.047	0.8	19.576	

Based on the distribution of future growth and the storage requirements discussed previously, several new storage facilities will be required within the District as summarized in Tables 10-8 and 10-9 and shown in Figure 10-3. It should be noted that tank locations are approximate only.

Table 10-8
Future Culinary Storage Facilities Required by 2060

Project No.	Storage Location & Type	Volume (MG)	Volume (Acre-Feet)	Approximate Year of Construction	Construction Cost	Land Cost	Total Project Cost
CS-1	Zone 3 II Culinary	0.75	2.30	2021	$1,035,000	$175,000	$1,210,000[1]
CS-2	Zone 3 III Culinary	0.50	1.53	2035	$690,000	$120,000	$810,000
CS-3	Little Valley Culinary	1.00	3.07	2055	$1,380,000	$235,000	$1,615,000

[1] Developer to pay for 70% of the total project cost for this project.

Table 10-9
Future Secondary Storage Facilities Required by 2060

Project No.	Storage Location & Type	Volume (MG)	Volume (Acre-Feet)	Approximate Year of Construction	Construction Cost	Land Cost	Total Project Cost
SS-1	Zone 3 Secondary	3.00	9.21	2024	$3,450,000	$700,000	$4,150,000
SS-2	Zone 1 Mixing Secondary	5.00	15.34	2035	$4,312,500	$0[1]	$4,312,500
SS-3	Little Valley Secondary	2.00	6.14	2055	$2,300,000	$465,000	$2,765,000

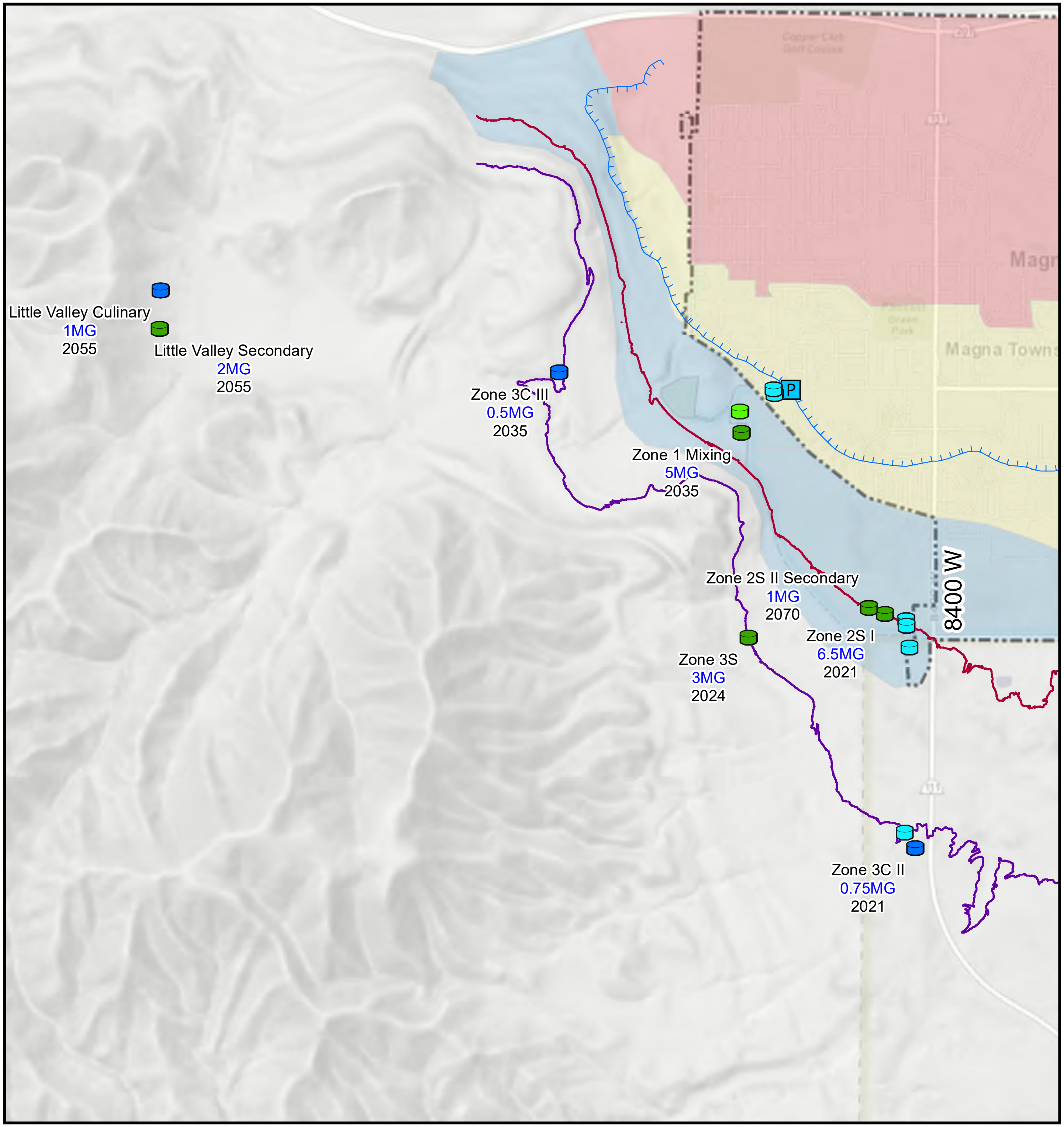
[1] District purchased land for $845,000.

BOOSTING EVALUATION

Most of the District's water sources are delivered into its lowest pressure zone and will require boosting facilities to deliver water into upper pressure zones. In order to postpone required construction of future storage facilities in the higher pressure zones, some of these booster station facilities may need to be sized to accommodate peak instantaneous demands. Tables 10-10 to 10-14 show pressure zone demands for culinary and secondary pressure zones along with required boosting capacities needed for each zone. In some cases, the demand shown is the peak instantaneous demand needed to accommodate postponement of storage facilities.

Table 10-10
Existing Culinary Booster Facilities Evaluation

Booster Capacity	Zone Demand (gpm)	Combined Boosting Demand (gpm)	Existing Source / Boosting Capacity (gpm)	Source/Boosting Surplus Total (deficit) (gpm)
Zone 3	109	109	340	231
Zone 2	3570	3,679	5800	2,121
Zone 1	3,770	7,449	8300	851



Legend

Future Storage Facility

Type

- Secondary
- Culinary
- Existing Culinary Tanks
- Existing Secondary Reservoir

Pressure Zone

- 1
- 2
- 3
- Elevation 4600
- Elevation 4810

NORTH:

NORTH

SCALE:

0 1,500 3,000 Feet

FUTURE STORAGE FACILITIES

MAGNA WATER DISTRICT

WATER MASTER PLAN

BOWEN COLLINS & ASSOCIATES

FIGURE NO.

10-3

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Table 10-11
Existing Secondary Booster Facilities Evaluation

Booster Capacity	Zone Demand (gpm)	Combined Boosting Demand (gpm)	Existing Source / Boosting Capacity (gpm)	Source/Boosting Surplus Total (deficit) (gpm)
Zone 3	0	0	0	0
Zone 2 VFD[1]	885	885	1200	315
Zone 1	1,206	2,091	2605	514

[1] Zone 2 does not currently have storage to meet peak instantaneous demands, and the peaking factor for existing conditions include a peaking factor of approximately 3.0

Table 10-12
2028 Culinary Booster Facilities Evaluation

Booster Capacity	Zone Demand (gpm)	Combined Boosting Demand (gpm)	Existing Source / Boosting Capacity (gpm)	Source/Boosting Surplus Total (deficit) (gpm)
Zone 3	402	402	340	-62
Zone 2	3,314	3,716	5,800	2,084
Zone 1	3,500	7,216	8,300	1,084

Table 10-13
2028 Secondary Booster Facilities Evaluation

Booster Capacity	Zone Demand (gpm)	Combined Boosting Demand (gpm)	Existing Source / Boosting Capacity (gpm)	Source/Boosting Surplus Total (deficit) (gpm)
Zone 3 VFD[1]	2,424	2,424	0	-2,424
Zone 2[2]	493	2,918	1200	-1,718
Zone 1	1,914	4,831	2605	-2,226

[1] The District does not plan on construction of Zone 3 storage within 10-years and will build pumping capacity as required to meet short-term demand requirements of Zone 3.
[2] Demands for Zone 2 are less in 2028 than for existing conditions because a storage facility will be constructed to accommodate peak instantaneous demands.

Table 10-14
2060 Culinary Booster Facilities Evaluation

Booster Capacity	Zone Demand (gpm)	Combined Boosting Demand (gpm)	Existing Source / Boosting Capacity (gpm)	Source/Boosting Surplus Total (deficit) (gpm)
Little Valley	54	54	0	-54
Zone 3	862	916	340	-576
Zone 2	3,314	4,230	5,800	1,570
Zone 1	3,593	7,824	8,300	476

Table 10-15
2060 Secondary Booster Facilities Evaluation

Booster Capacity	Zone Demand (gpm)	Combined Boosting Demand (gpm)	Existing Source / Boosting Capacity (gpm)	Source/Boosting Surplus Total (deficit) (gpm)
Little Valley	60	60	0	-60
Zone 3[1]	2,130	2,190	0	-2,190
Zone 2	610	2,800	1,200	-1,600
Zone 1	3,130	5,930	2,605	-3,325

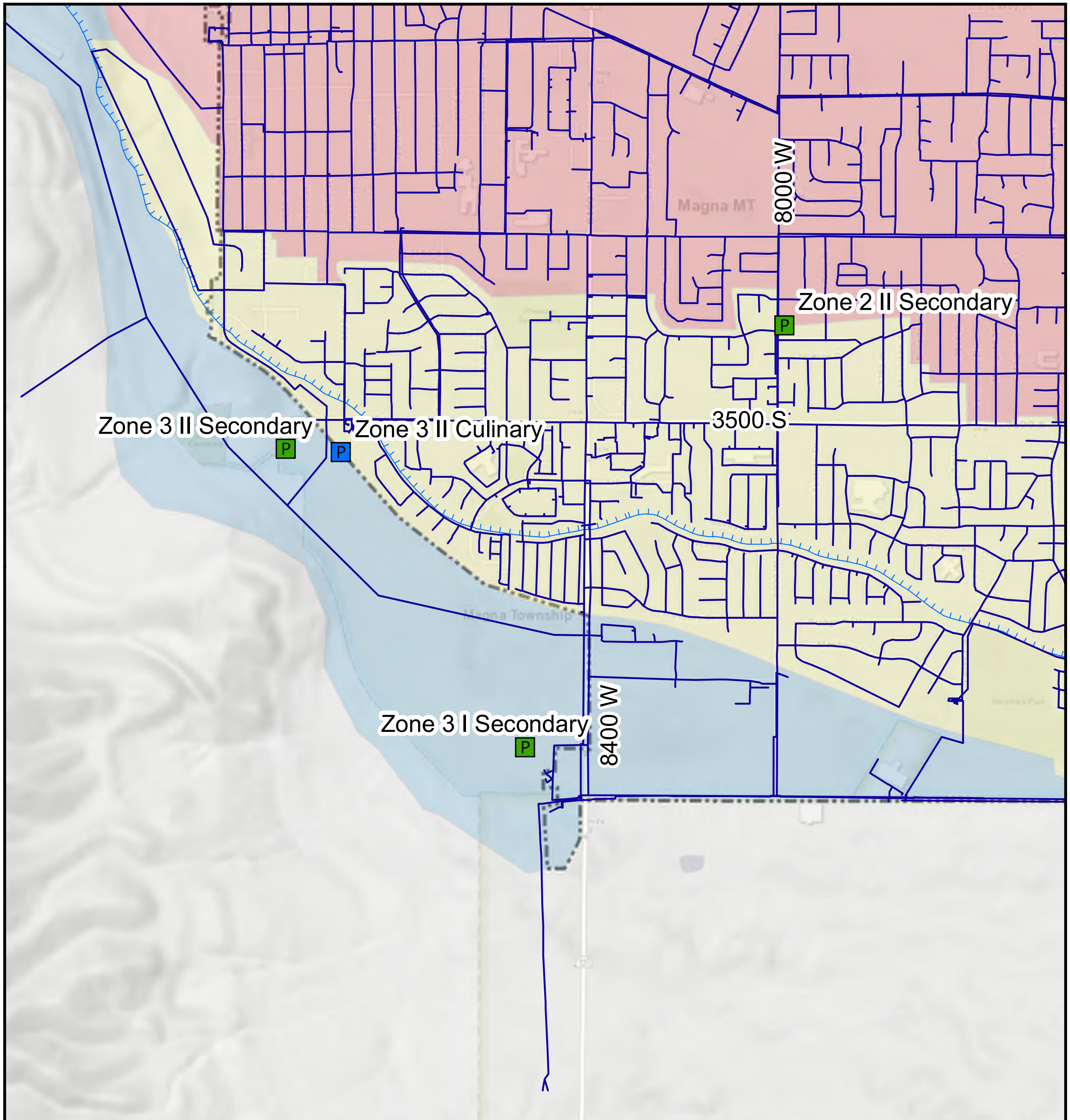
[1] Demands for Zone 3 are less in 2060 than for 2028 conditions because a storage facility will be constructed to accommodate peak instantaneous demands.

Based on the boosting demands listed in Table 10-10 to 10-15, a number of boosting facilities will be required to satisfy future demands. For redundancy purposes, the District would like to maintain two separate booster stations to each pressure zone within the District. In the event pump stations lose power or a critical pipeline is unavailable, this will provide alternate paths to deliver water. Table 10-16 shows a summary of future pump stations needed to meet future demands and Figure 10-4 shows the location of proposed pump stations.

Table 10-16
Future Booster Station Facilities

Project No.	Boosting Facility & Type	Source	Destination	Flow Capacity (gpm)	Lift (ft)	Power Requirement (HP)	Motor Type	Approximate Year of Construction	Project Cost
CBS-1	Zone 3 II Culinary[1]	Zone 2 Tanks	Zone 3 Tanks	600	205	43	Constant	2021	$775,000
SBS-1	Zone 3 I Secondary	Zone 2 Tank	Zone 3	800	210	59	VFD	2021	$575,000
SBS-2	Zone 3 II Secondary[2]	Zone 1 (3500S)	Zone 3	1600	344	193	VFD	2024	$1,000,000
SBS-3	Zone 2 II Secondary[3]	Zone 1 (8000W)	Zone 2	1200	120	51	Constant	2030	$287,500

[1] The cost estimate for this pump station assumes the new pump station is constructed to boost from Zone 2 pipes near the 3500 South culinary tanks. The booster could also be designed to lift from the Zone 1 tanks which would potentially reduce the boosting requirements for the 8000 West booster station. It is also worth noting that JVWCD is one of the likely sources of water for future Little Valley development. The District should consider oversizing some of the facilities or property purchases for Zone 2 to Zone 3 pumping facilities to make expansion from Zone 2 to Zone 3 feasible in the event Little Valley needs to purchase water from JVWCD. It should be noted that the cost for this pump station includes a standby generator and 3-phase power.
[2] This is the recommended balance of capacity between the Zone 3 I Secondary and Zone 3 II Secondary pump stations. Adjustments to the balance may be possible.
[3] The capacity shown includes full redundancy for the existing Zone 2 I Secondary pump station.



Legend

Future Pump Station

- P Culinary
- P Secondary
- 2060PHD_Pipes

Pressure Zone

- 1
- 2
- 3

NORTH:

SCALE: 0 1,000 2,000 Feet

FUTURE PUMPING FACILITIES

MAGNA WATER DISTRICT

WATER MASTER PLAN

BOWEN COLLINS & ASSOCIATES

FIGURE NO.

10-4

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CHAPTER 11
HYDRAULIC MODEL HISTORY

The purpose of this chapter is to document the development and history of the District's culinary and secondary hydraulic water models. A hydraulic computer model is a digital representation of physical features and characteristics of the water system, including sources, pipes, valves, storage tanks, and pumps. Key physical components of a water system are represented by a set of user-defined parameters that represent the characteristics of the system. The computer model utilizes the digital representation of physical system characteristics to mathematically simulate operating conditions of a water distribution system. Computer model output includes pressures at each node, flow rate for each pipe in the water system, and water surface levels in storage tanks.

There are several well-known computer programs for modeling water distribution systems. The District's models have been developed as EPANET models and using InfoWater software developed by Innovyze.

MODEL HISTORY

The following is a history of the development process of the hydraulic models used as part of this water master plan.

Drinking Water Model

- **2013 Water Master Plan** – A hydraulic model of the culinary water system was setup for the 2013 water master plan or possibly prior to the 2013 water master plan. Geometric inputs into the model included the following:
    - Sources – Including wells and the Jordan Valley Water Conservancy District (JVWCD) connections.
    - Tanks – Including the floor and overflow elevations for tanks along with the storage volume for each tank.
    - Valves – Including pressure reducing valves and their associated settings along with a flow control valve for the JVWCD connection.
    - Pumps – Including pump locations and approximate pump curve characteristics.
    - Pipes – Including pipe diameters, lengths, and roughness values.

- **2014 Optimization Study** – The District prepared an energy optimization study to evaluate potential improvements in operations to reduce overall energy and power costs. As part of this study, pump curves and control operations were identified and calibrated within the hydraulic model. Pipe roughness values also were updated as part of this study based on 2012 observed demands.

- **2020 Geometry and Demand Update** – As part of this master plan the following updates were completed:
    - Pipe Network Update - The pipe network was reviewed to determine how up to date the model was to represent existing conditions. A large number of discrepancies were identified where neighborhoods were missing and/or pipe network locations did not appear to represent current looping conditions. As a result, BC&A updated the pipe network for the District using the District's latest geographic information system

(GIS) data. This was performed by deleting all existing pipes while maintaining all other geometry types and then importing the latest pipe GIS data provided by the District and re-establishing connections to the other geometry types (tanks, pumps, etc.). Pipe roughness values from the original model were replicated in the updated pipe network to provide consistency with prior optimization work.

    - Peak Demands – Billing data from the summer of 2017 was spatially distributed into the hydraulic model and adjusted to match peak production demands for existing conditions. No changes were made to the diurnal pattern previously developed.

- **Future Facilities** – Future facilities and demands were created in the model as skeletonized connections to simulate major conveyance facilities.

Secondary Water Model

- **Historic Secondary Model** – The District's secondary water system hydraulic model was originally developed assuming complete conversion to secondary water for irrigation within the District's historic service boundary. Secondary pipelines included in the model extended to most streets within the existing service area with limited pipes extending to the north and east ends of the District. Geometric inputs into the model included:
    - Sources – Including wells, reuse, and canal sources.
    - Tanks – Two storage facilities were simulated in the initial model. The 3500 South reservoir was simulated as an infinite storage facility and source supply. A 3 million gallon Zone 2 storage facility was included in the model near 4100 South.
    - Pumps – Two pump stations were included in the model, one pumping from the 3500 South reservoir to Zone 2 and one pumping from Zone 1 to Zone 2 at 8000 West.
    - Valves – No valves were included in the model.
    - Pipes – Pipes in the model include various sizes with a roughness value of 120.

- **Updated Existing & 2060 Model** –To better reflect the supply strategy developed in this master plan, the model was updated based on existing infrastructure. The hydraulic model was updated as follows:
    - Existing Pipes – The District's existing secondary pipes were imported into the hydraulic model based on the District's most recent GIS data.
    - Existing Sources – The District's existing shallow wells and canal connection were created to match existing locations and capacities. Sources were simulated as reservoirs with associated pumps limited to the capacity of existing equipment.
    - Existing Tanks – A stage-storage curve of the 3500 South reservoir was developed based on available design drawings and entered into the model.
    - Existing Pumps – Existing design flow and head parameters at each pump station were entered into the hydraulic model. Pump curves were unavailable for calibration of the model.
        - VFD – The existing Zone 1 to Zone 2 pumps at the canal pump station include VFD motors to maintain a system pressure. To simulate the VFD, a pressure reducing valve set to the desired system hydraulic grade was used downstream of oversized pumps to mimic the effects of a VFD. This was done

due to the limited information about existing pump curves or VFD capabilities.

- Existing Valves – There are no valves or proposed valve in the hydraulic model except for the VFD as described above.
- Existing Demands – Existing demands included in the hydraulic model were distributed based on 2017 summer billing data and factored to match existing condition peak production demands. The pattern of demand in the hydraulic model was set to match the ideal irrigation pattern between 9pm and 9am with a peak instantaneous demand factor of 2.0. It is worth noting that observed peak instantaneous demands within Zone 2 have a peaking factor closer to 3.0 based on pumping data and production data records. However, this is likely the result of a large ratio of schools or parks within the pressure zone and would be expected to decline through District education efforts and as additional residential customers are added.
- Future Demands – Future peak day demands within the District are anticipated to increase to approximately 6,100 gpm by 2060 with a peak instantaneous demand of approximately 12,200 gpm. Demands were distributed in the model based on land use type, undeveloped area, and estimates of where existing culinary demands will be converted. The effects of conservation were neglected in hydraulic modeling of demands to be conservative.
- Future Pipes – Pipes were extended to undeveloped areas and priority areas for expansion of secondary water. The buildout model was used as a guide for pipe sizes and alignments.
- Future Shallow Wells – Based on District knowledge of local groundwater levels, it is assumed new shallow wells will be spread from east to west along approximately 2500 South at roughly equal spacing between 9200 West and 5600 West within Pressure Zone 1.
- Future Re-Use Water – Additional reuse and storage reuse water will need to be conveyed from the wastewater treatment plant up to storage facilities within the District.
- Future Tanks – Future tanks were sized per the storage criteria established in the previous chapter. Approximate locations for tanks were identified based on required elevation and hydraulic grade requirements.

CHAPTER 12
DISTRIBUTION SYSTEM EVALUATION

The purpose of this chapter is to document the results of the culinary and secondary distribution system evaluations based on hydraulic modeling.

MODEL SCENARIOS

The District's hydraulic models are setup to run extended period simulations. The model results that are most useful for evaluating the distribution system performance include operating conditions for several conditions: static or winter time demands, peak day demands with fire flow, and peak instantaneous demands. Model results for the following scenarios have been documented to aid in evaluating system performance.

- Static or Low Demand – This scenario is used primarily to identify potentially high system pressures. Although not examined as part of this master plan, this scenario may also be useful in the future for evaluating water quality issues.
- Peak Day Demand –This scenario represents the average daily demands on the system during the peak usage day of the year. This scenario is primarily used to simulate fire flows to identify areas that do not meet fire flow requirements. It can also be used to identify source deficiencies within tank service areas to determine if sufficient production and conveyance capacity exists to fill and drain tanks properly during peak demands.
- Peak Hour Demands – The purpose of this scenario is to identify existing pressure deficiencies under peak hour demand conditions. For the culinary water system, a peak hour to peak day peaking factor of 1.6 was used based on the data provided by the District. A peak hour to peak day peaking factor of 2.0 was applied to the secondary water system.

EVALUATION CRITERIA

The performance of the system was evaluated using the following criteria:

- **Culinary pressure within the system during peak demands** - The State of Utah requires that a public water system maintain a minimum pressure standard of 30 psi during peak hour demands and 40 psi during peak day demands. This is the minimum design standard the District maintains. However, the District tries to maintain pressures between 60 psi and 120 psi for most of the distribution system and only makes exceptions for areas with topography challenges that would require excessive additional pressure zones to otherwise resolve.
- **Secondary Pressure within the system during peak demands** - For the secondary water system, the District would like to keep secondary water pressures 5 psi less than culinary system pressures with a minimum not less than 30 psi during peak hour demand. The target pressure the District will ideally maintain within the secondary system will be between 55 psi and 115 psi. Tanks for the secondary system will be located at elevations approximately 10 feet lower than their corresponding culinary tanks to help maintain the relative difference in pressure. In some cases, secondary source connections that are substantially different from the culinary system may lead to some areas of the secondary distribution system with higher pressures than the culinary system.
- **Pressure within the system during peak day demands with fire flow –** The State of Utah requires that a public water system be capable of conveying required fire flow with a residual pressure of 20 psi. Any node in a residential area incapable of supplying 1,500 gpm with a 20 psi residual was identified as deficient. Commercial areas were evaluated with a fire flow of

at least 3,000 gpm with a 20 psi residual. In some industrial areas with large structures, up to 4,000 gpm of fire flow was used as the standard.

- **Maximum pipe velocities –** While high instantaneous velocities in a pipeline are not generally as much of a concern to the system as low pressures, they can cause damage to pipes and potentially lead to pipe failure. High velocities alone do not generally require improvements to eliminate the velocity issues, but indicate areas where additional conveyance improvements will have the most benefit. Pipelines with velocities above 7 ft/sec indicated areas where additional conveyance improvements would be beneficial. Any pipeline which displayed a maximum velocity greater than 10 ft/sec was flagged as a deficient pipe.

SYSTEM EVALUATION RESULTS

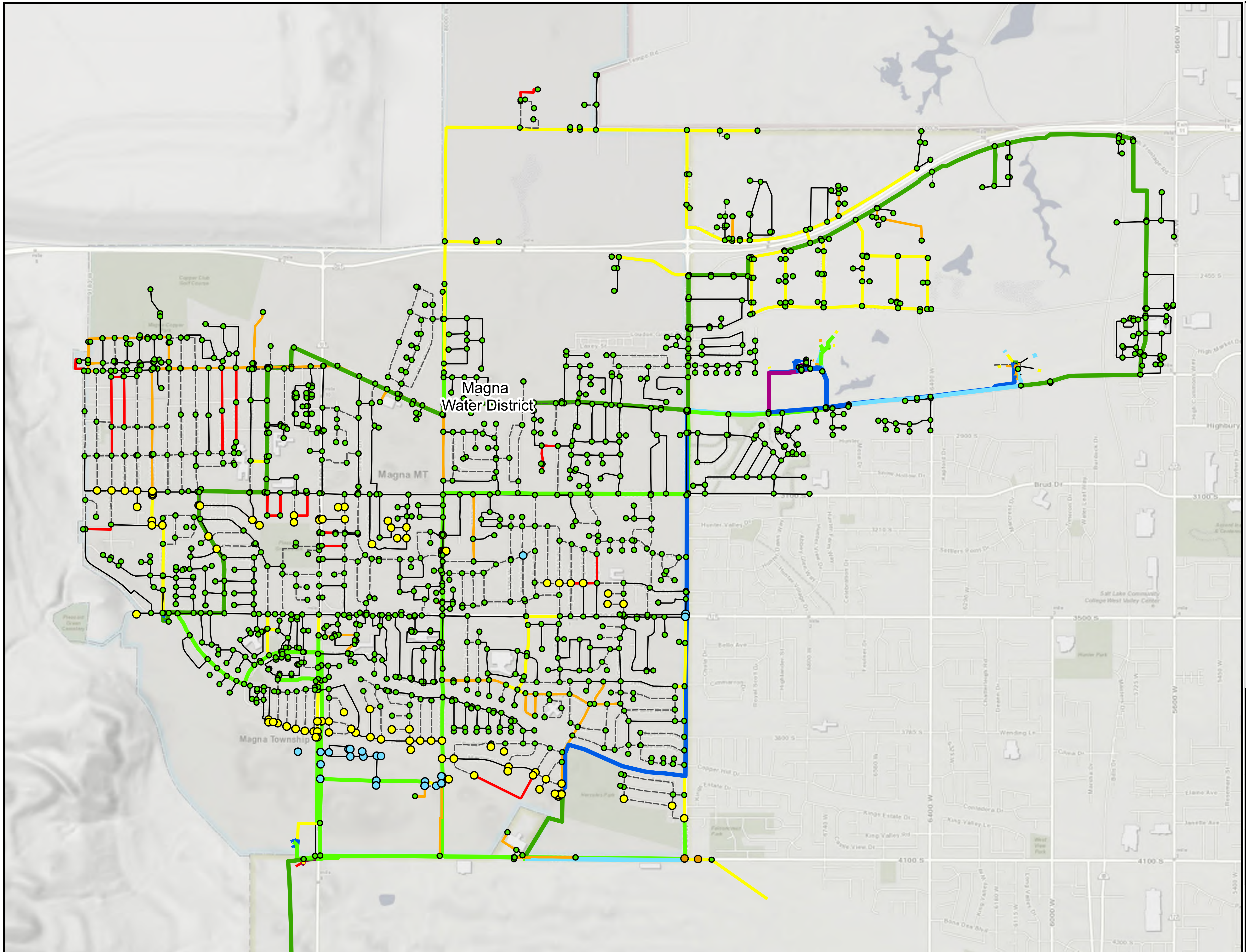
Existing Culinary Distribution Evaluation

The hydraulic computer model was used to simulate system conditions for the Existing Winter (Static), Peak Day Demands with Fire Flow, and Peak Hour Demands. Model results for critical model scenarios under existing demands are included in the following figures:

1. Figure 12-1 shows pressures for the Existing Winter Demand Scenario
   a. Based on the evaluation criteria, there are no deficiencies related to static demand conditions within the culinary system.

2. Figure 12-2 shows pressures for the Existing Peak Hour Demand Scenario
   a. 9000 West 3100 South - Based on the evaluation criteria, there is an existing area of low pressures west of 9000 West along 3100 South. The area meets State of Utah peak hour demand requirements, but falls below 40 psi, well below the District's target minimum system pressure of 60 psi. The deficiency is primarily caused by the area being too high in elevation to be served within Pressure Zone 1. Even under static or winter demands, pressures are not much greater than 40 psi.
   b. Other Scattered Low Pressures – There are also other scattered areas with pressures below the District target of 60 psi. However, all these areas still meet State of Utah Standards and exceed 40 psi.

3. Figure 12-3 shows the available fire flow in conjunction with Existing Peak Day Demands
   a. There are many areas of the distribution system that do not meet fire flow requirements. In general, most fire flow deficiencies are caused by the following concerns:
      i. High Elevation – Junctions near the upper end of pressure zones will have difficulty meeting fire flow requirements without large supply pipes and looping.
      ii. Dead-Ends – Dead end connections often have fire flow deficiencies because high velocities through a single pipe cause higher pressure losses. Dead-end connections frequently require oversized pipes to meet fire flow requirements unless the connection can be looped another way.
      iii. 4-inch Pipes – The District has a number of areas with 4-inch pipes that cannot meet fire flow demands.



Legend

Junctions

Pressure (psi)

- <= 30
- 30.1 - 40.0
- 40.1 - 60.0
- 60.1 - 120.0
- 120.1 - 150.0
- 150.1 - 200.0

Water Lines

RUN_DIAM

- 4" or less
- 6"
- 8"
- 10"
- 12"
- 14"
- 16"
- 20"
- 24"
- 30"
- 36"

NORTH:

SCALE: 0 1,000 2,000 Feet

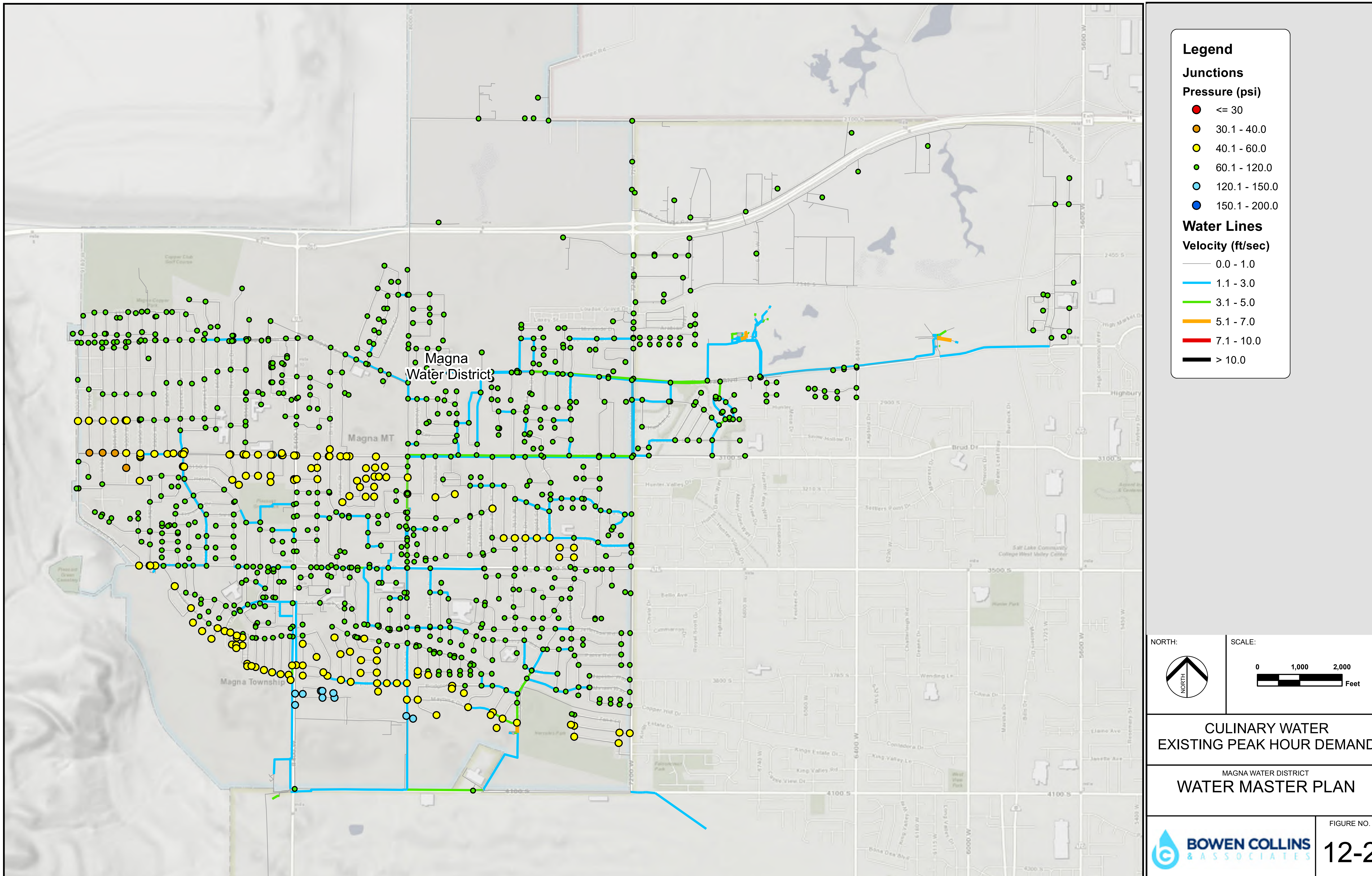
CULINARY WATER
EXISTING STATIC DEMAND

MAGNA WATER DISTRICT
WATER MASTER PLAN

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
12-1

P:\Magna Water District\483-18-01 Master Plan\4.0 GIS\4.1 Projects\Water-Figure 12-1 Static.mxd wandersen 3/27/2020



CULINARY WATER
EXISTING PEAK HOUR DEMAND

MAGNA WATER DISTRICT
WATER MASTER PLAN

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
12-2

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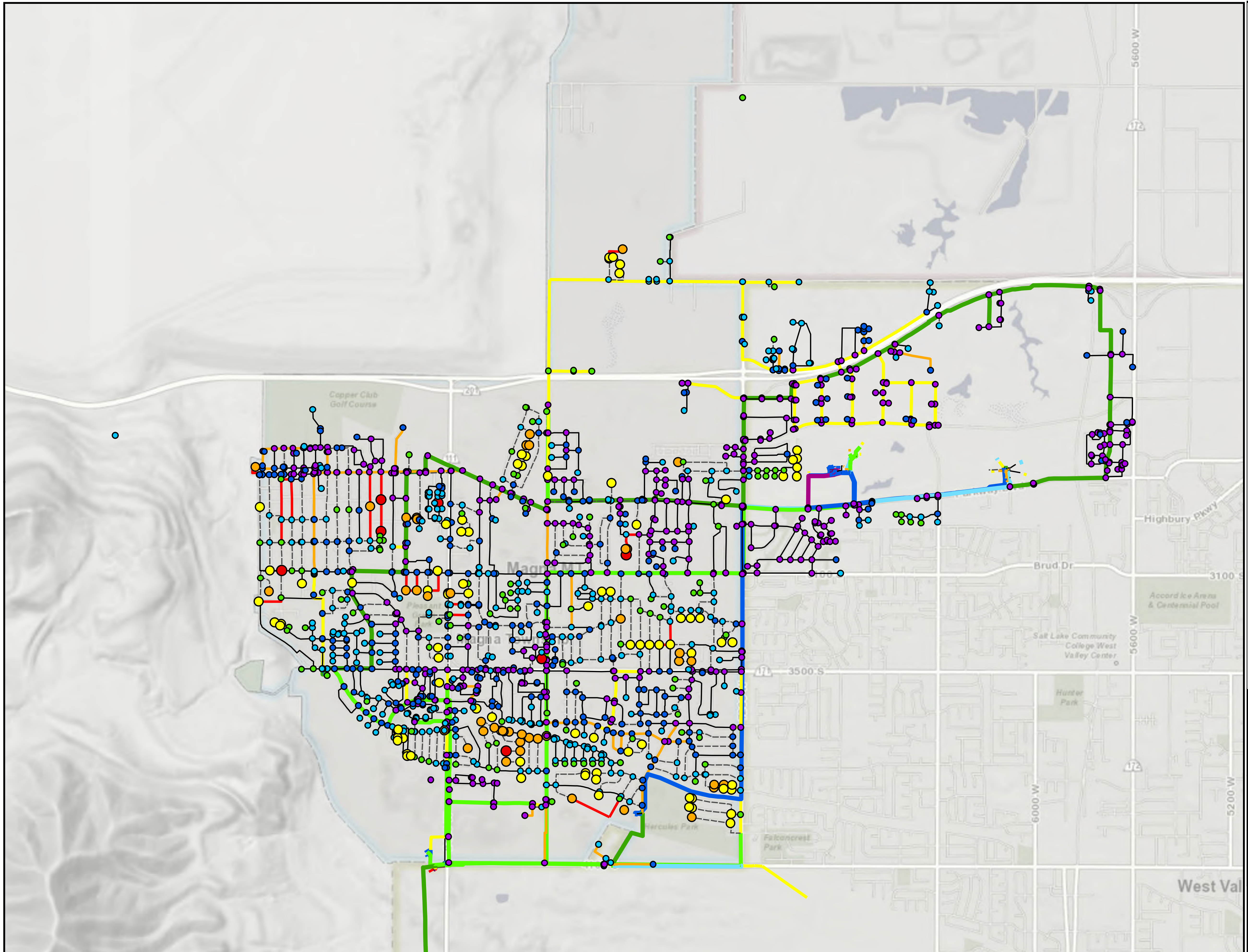


Legend

Junctions

Available Fire Flow at 20 psi (gpm)

- 0.0 - 500.0
- 500.1 - 1000.0
- 1000.1 - 1500.0
- 1500.1 - 2000.0
- 2000.1 - 3000.0
- 3000.1 - 4000.0
- > 4000

Water Lines

Diameter

- 4" or less
- 6"
- 8"
- 10"
- 12"
- 14"
- 16"
- 20"
- 24"
- 30"
- 36"

NORTH:

SCALE:

0 1,250 2,500 Feet

AVAILABLE FIRE FLOWS ON PEAK DAY OF DEMAND

MAGNA WATER DISTRICT

WATER MASTER PLAN

BOWEN COLLINS & ASSOCIATES

FIGURE NO.

12-3

P:\Magna Water District\483-18-01 Master Plan\4.0 GIS\4.1 Projects\Water-Figure 12-3 PDD.mxd wandersen 3/19/2020

Existing Secondary Distribution Evaluation

The hydraulic computer model was used to simulate Existing Peak Hour Demands on the secondary system. Figure 12-4 shows the results for the peak hour demand scenario. For existing conditions, there are no existing deficiencies. The lowest pressure at a service connection is 38 psi.

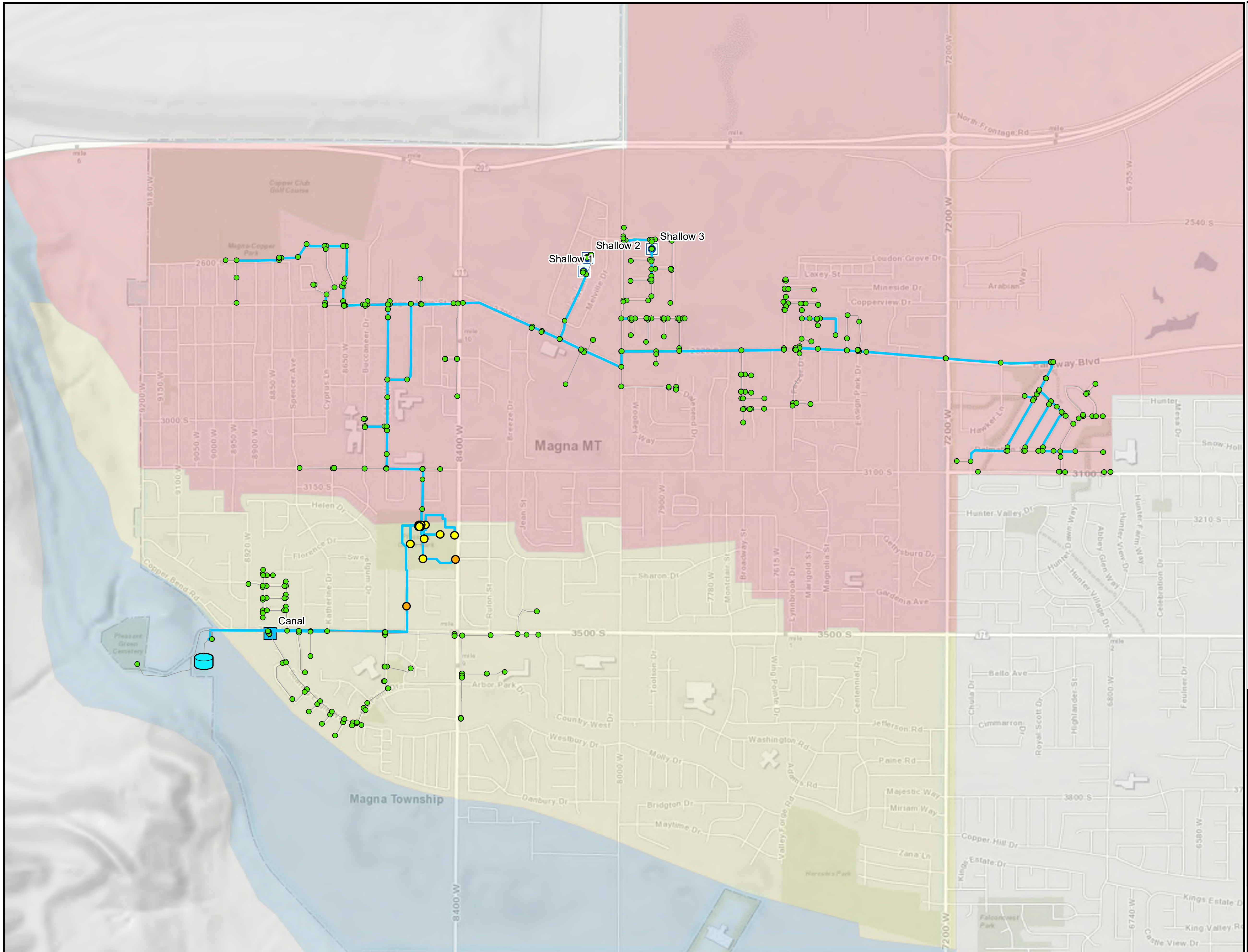
2060 Culinary Distribution Evaluation

The hydraulic computer model was used to simulate system conditions for the 2060 development conditions using primarily existing facilities. A few new facilities were added, but only as needed to extend pipe to developing areas. The new pipes themselves have been sized to avoid deficiencies for developing areas, but no other improvements to the system were included in the model results. Figure 12-5 and 12-6 show 2060 peak hour and peak day demands with fire flow, respectively:

1. Figure 12-5 shows pressures for the 2060 Peak Hour Demand Scenario.
    a. 9000 West 3100 South - Some of the existing peak hour deficiencies along 3100 South near 9000 West get worse as demands increase west of 9200 West.
    b. Belfast Drive – Belfast Drive (near 3900 South) at 7800 West has a relatively high elevation to be served within Pressure Zone 2. Pressure at this location drops below 40 psi during peak hour demands. This still meets State of Utah pressure requirements, but the District may want to consider improvements to increase pressure for this area.
2. Figure 12-6 shows pressures for the 2060 Peak Day Demand with Fire Flow. Fire flow deficiencies in 2060 are very similar to existing conditions. As a result, most of the improvements needed for existing conditions will resolve the future fire flow deficiencies as well.

2060 Secondary Distribution Evaluation

Figure 12-7 shows pressures and peak velocities for peak hour demand conditions with existing major conveyance pipelines. Based on model result, the annexation and expanded service area of the District will lead to significant pressure deficiencies or high velocities in pipes leading to Pressure Zone 3 without additional pipelines. This is not unexpected as the District's secondary system is still relatively new and is missing many critical transmission components.



Legend

Pressure (psi)

- <= 30
- 30.1 - 40.0
- 40.1 - 55.0
- 55.1 - 115.0
- 115.1 - 150.0
- 150.1 - 200.0

Velocity (ft/sec)

- 0.0 - 1.0
- 1.1 - 3.0
- 3.1 - 5.0
- 5.1 - 7.0
- 7.1 - 10.0
- > 10.0

- Storage Facility
- Pump
- Water Source

Pressure Zone

Pressure Zone

- 1
- 2
- 3

NORTH:

SCALE: 0 750 1,500 Feet

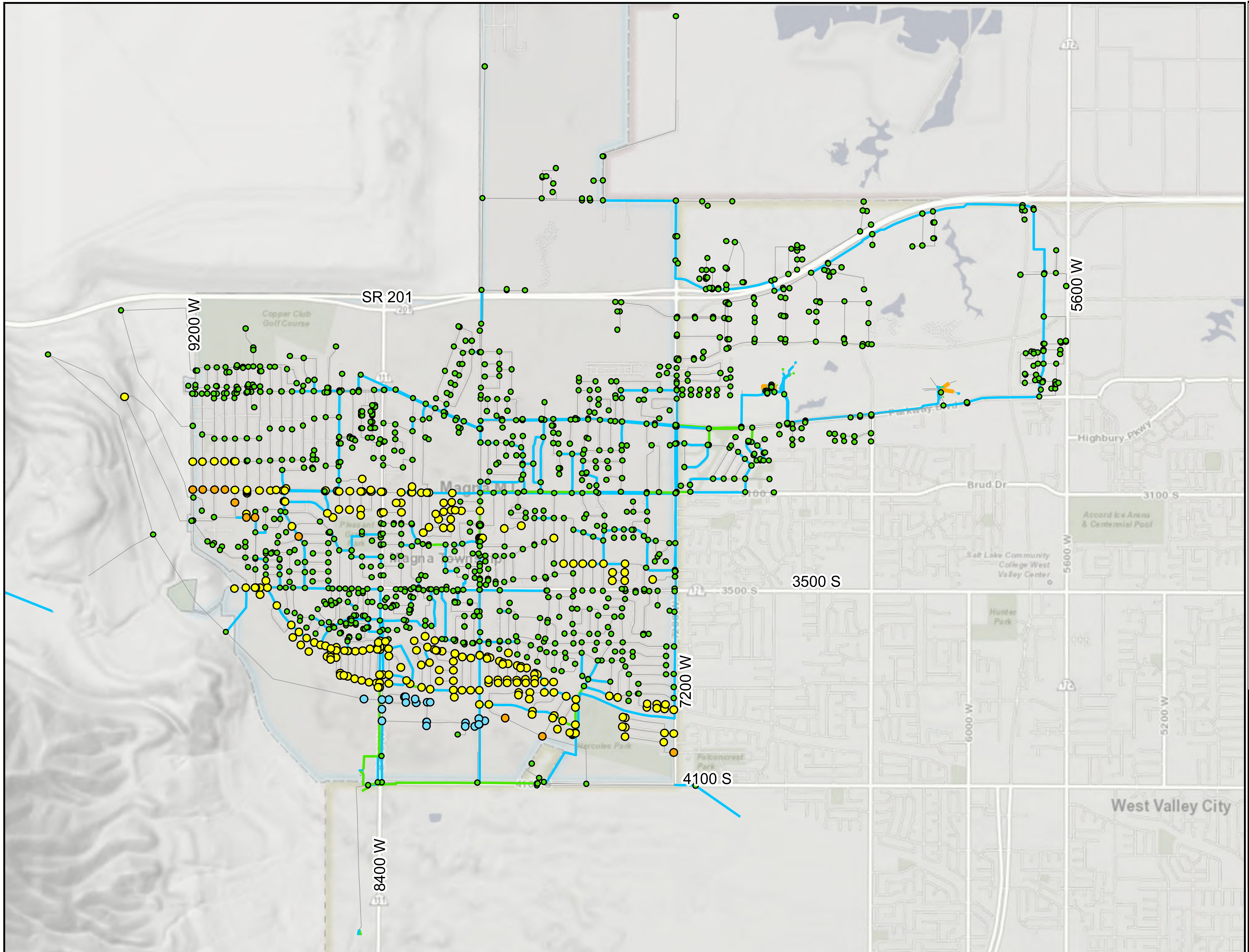
SECONDARY WATER
EXISTING PEAK HOUR DEMAND

MAGNA WATER DISTRICT
WATER MASTER PLAN

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
12-4

P:\Magna Water District\483-18-01 Master Plan\4.0 GIS\4.1 Projects\Water-Figure 12-4 SPHD.mxd wandersen 3/16/2020



Legend

Pressure (psi)

- <= 30
- 30.1 - 40.0
- 40.1 - 60.0
- 60.1 - 120.0
- 120.1 - 150.0
- 150.1 - 200.0

Water Lines

Velocity (ft/sec)

- 0.0 - 1.0
- 1.1 - 3.0
- 3.1 - 5.0
- 5.1 - 7.0
- 7.1 - 10.0
- > 10.0

NORTH:

SCALE: 0 1,000 2,000 Feet

CULINARY WATER
2060 PEAK HOUR DEMAND

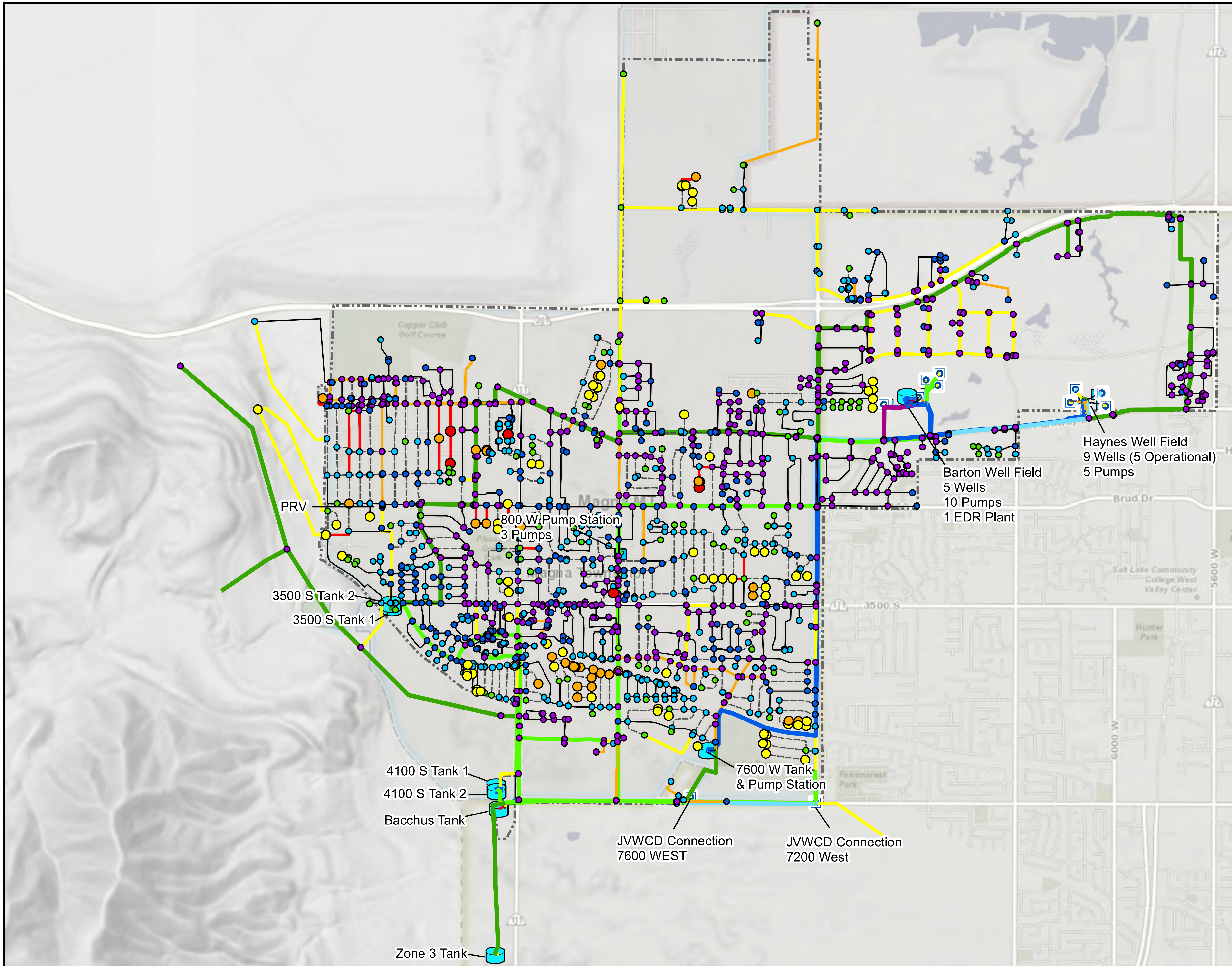
MAGNA WATER DISTRICT

WATER MASTER PLAN

BOWEN COLLINS & ASSOCIATES

FIGURE NO.

12-5



LEGEND

Junctions

Available Fire Flow at 20 psi (gpm)

- 0.0 - 500.0
- 500.1 - 1000.0
- 1000.1 - 1500.0
- 1500.1 - 2000.0
- 2000.1 - 3000.0
- 3000.1 - 4000.0
- > 4000

Water Lines

Diameter

- 4" or less
- 6"
- 8"
- 10"
- 12"
- 14"
- 16"
- 20"
- 24"
- 30"
- 36"

Tanks

Water_Source

Pumps

Magna Water District Boundary

NORTH:

SCALE: 0 1,250 2,500 Feet

2060 PEAK DAY DEMAND WITH FIREFLOW

MAGNA WATER DISTRICT

WATER SYSTEM MASTER PLAN

BOWEN COLLINS & ASSOCIATES

FIGURE NO. 12-6

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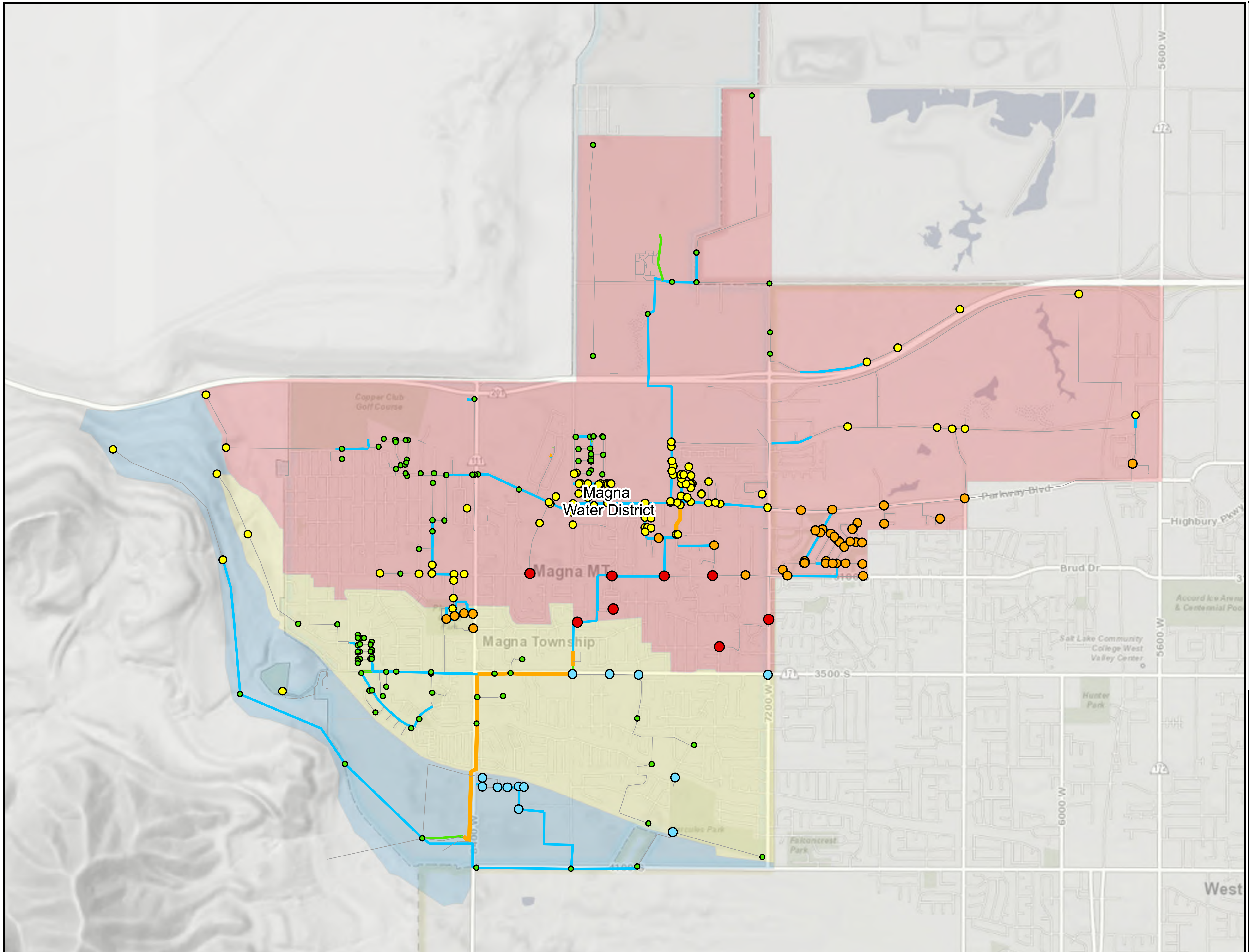


Legend

Junctions

Pressure

- <= 30
- 30.1 - 40.0
- 40.1 - 55.0
- 55.1 - 115.0
- 115.1 - 150.0
- 150.1 - 200.0

Water Lines

Velocity (ft/sec)

- 0.0 - 1.0
- 1.1 - 3.0
- 3.1 - 5.0
- 5.1 - 7.0
- 7.1 - 10.0
- > 10.0

Pressure Zone

Pressure Zone

- 1
- 2
- 3

NORTH:

SCALE: 0 1,000 2,000 Feet

SECONDARY WATER
2060 PEAK HOUR DEMAND
LIMITED CONVEYANCE PIPING

MAGNA WATER DISTRICT

WATER MASTER PLAN

BOWEN COLLINS & ASSOCIATES

FIGURE NO. 12-7

P:\Magna Water District\483-18-01 Master Plan\4.0 GIS\4.1 Projects\Water-Figure 12-7-SBO-PHD.mxd wandersen 3/16/2020

CHAPTER 13
DISTRIBUTION SYSTEM IMPROVEMENTS

The purpose of this chapter is to document recommended distribution system improvements for both the culinary and secondary water system.

2060 CULINARY DISTRIBUTION IMPROVEMENTS

Figures 13-1 to 13-3 show pipe improvements recommended for the culinary distribution system within the District. In Figure 13-1, pipes are color coded based on the following improvement types:

- **Developing Improvements**
- **Major Conveyance Improvements**
- **Pressure Zone Changes**
- **Dead-End Improvements**
- **Looping Improvements**
- **Four-Inch Pipes Improvements**
- **Maintenance or Age-Related Improvements**

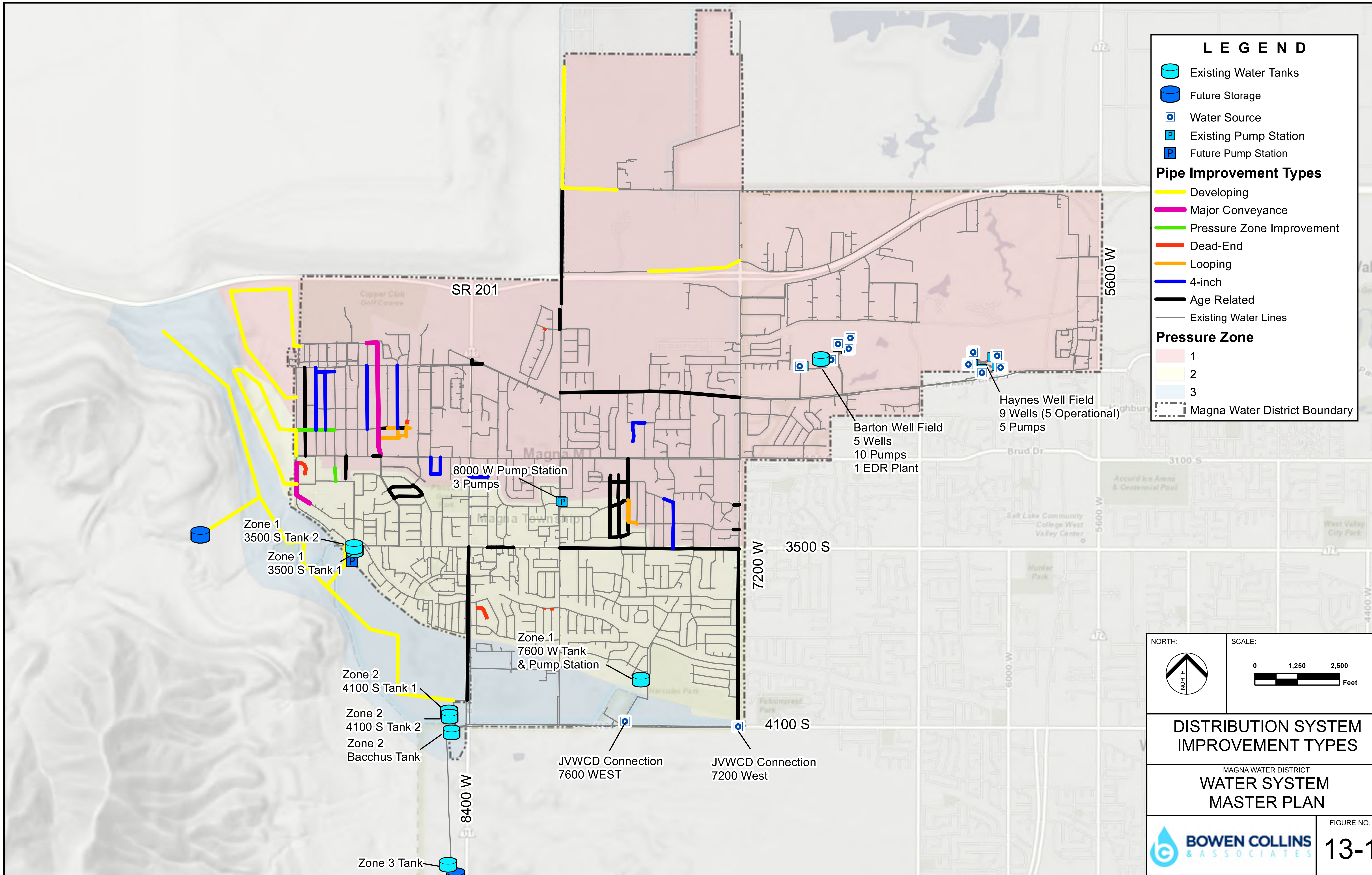
Figure 13-2 identifies the pipe diameter of pipe improvements. Figure 13-3 numbers each project with a different color and labels each project.

The following sections identify the proposed improvement projects for each of the seven improvement types mentioned above.

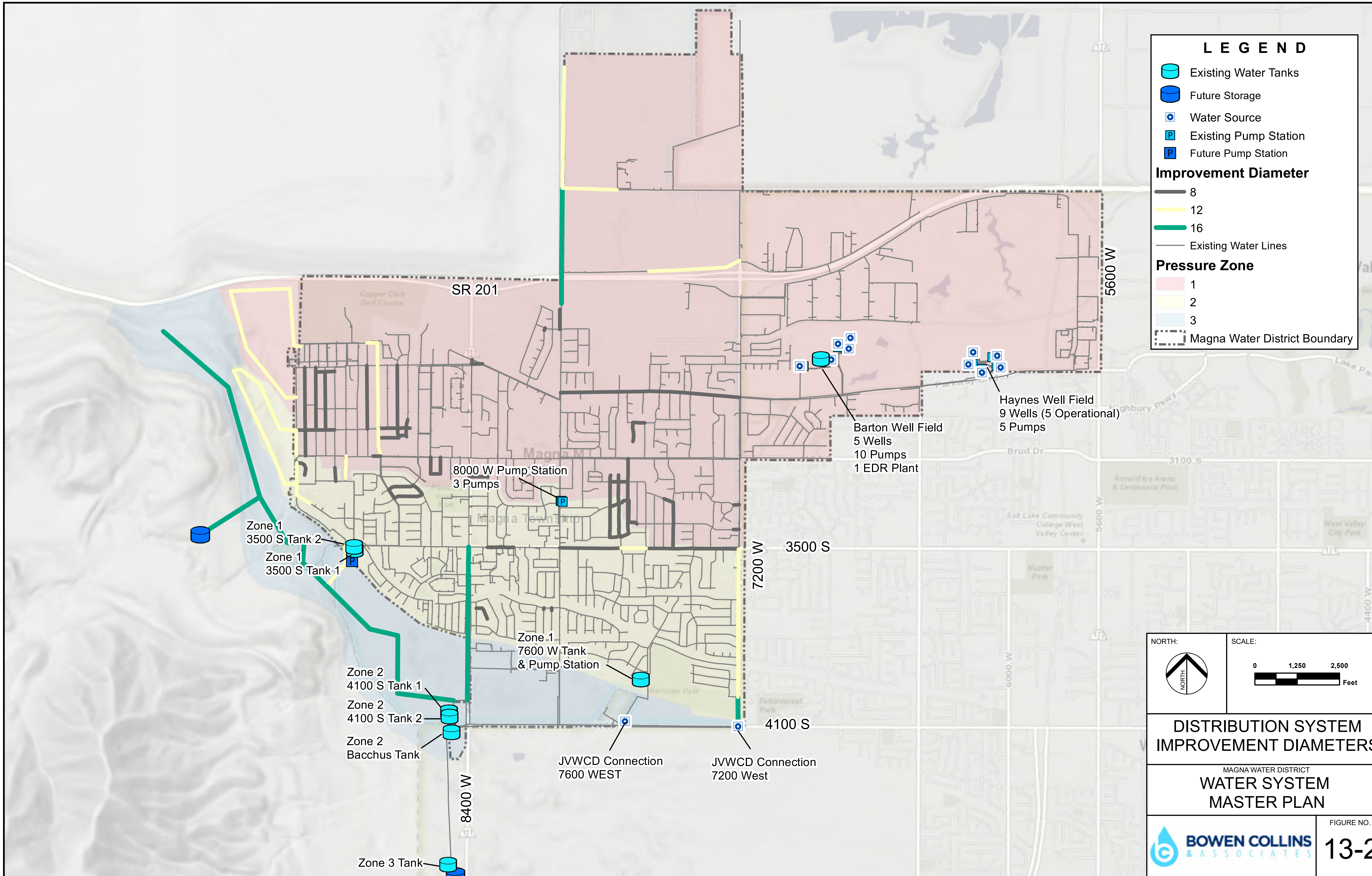
Developing Improvements

These improvements include new pipes necessary to serve new growth for developing areas. It is worth noting that the location for Developing projects are schematic and it is anticipated that the alignments will change to match frontage roads or road alignments as areas develop. Table 13-1 outlines design details for each of these improvements.

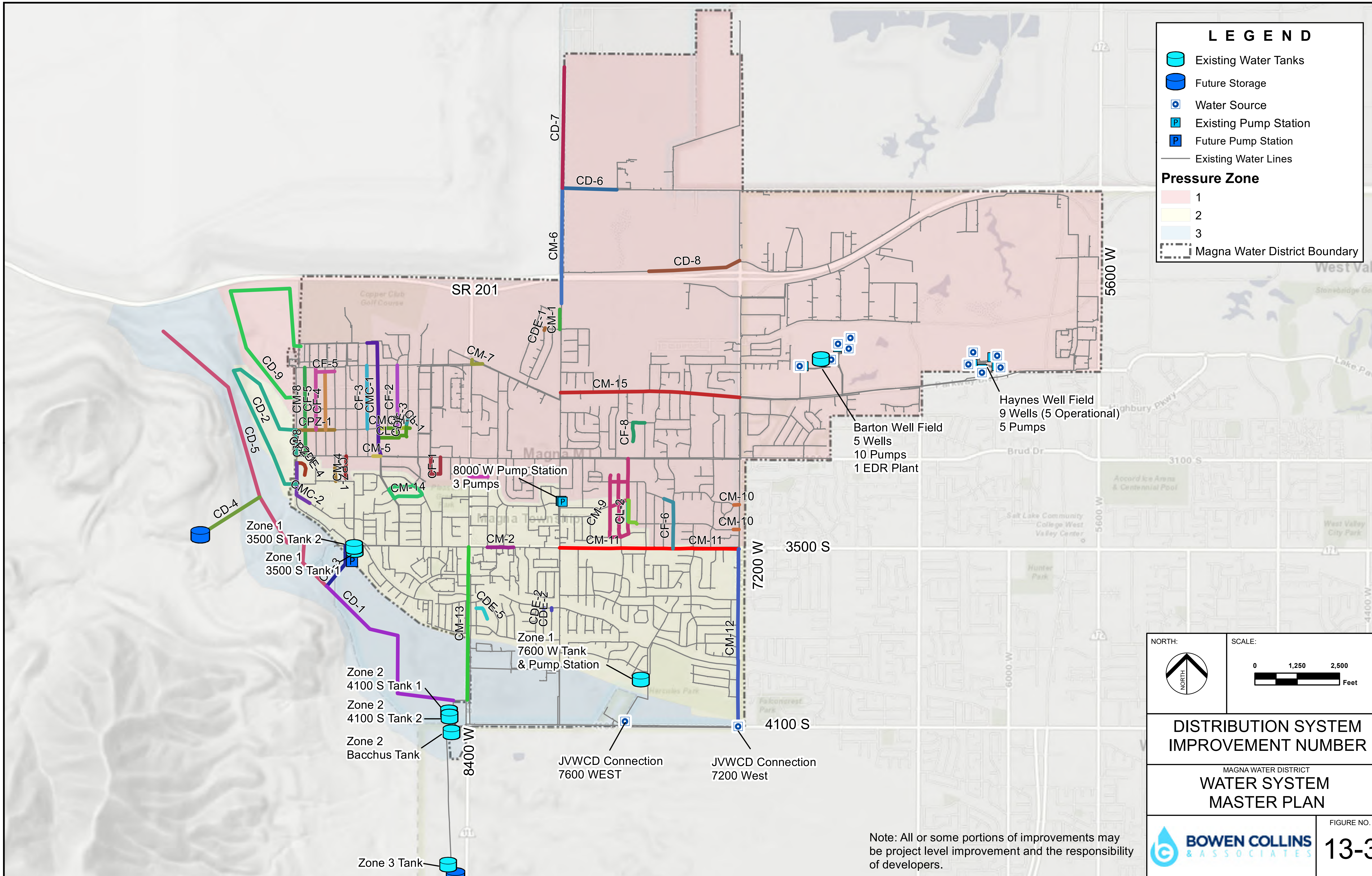
Appendix 1-A includes detailed project worksheets for each of the projects listed in this chapter. Included in the worksheets is more detailed information for each project including maps, extended descriptions, and cost estimates. The worksheets also include an explanation of project timing, including identification of any events that will trigger the need for each project (if not already needed to solve existing deficiencies), and the potential consequences of not completing the projects with the time recommended.



P:\Magna Water District\483-18-01 Master Plan\4.0 GIS\4.1 Projects\Water-Figure 13-1-System Improvement Type.mxd wandersen 6/24/2020



P:\Magna Water District\483-18-01 Master Plan\4.0 GIS\4.1 Projects\Water-Figure 13-2-System Improvement Diameter.mxd wandersen 6/24/2020



DISTRIBUTION SYSTEM IMPROVEMENT NUMBER

MAGNA WATER DISTRICT

WATER SYSTEM MASTER PLAN

BOWEN COLLINS & ASSOCIATES

FIGURE NO. 13-3

P:\Magna Water District\483-18-01 Master Plan\4.0 GIS\4.1 Projects\Water-Figure 13-3-System Improvement Number.mxd wandersen 6/24/2020

Table 13-1
Culinary Developing Distribution System Improvements

Project No.	Length (ft)	Pipe Diameter Range[1] (inch)	Description	Project Cost
CD-1	4,824	16	Zone 3 Conveyance	$1,339,000
CD-2	7,652	12	Zone 2 Conveyance	$1,906,000
CD-3	1,393	12	Zone 3, Zone 3 Pump Connection	$347,000
CD-4	2,086	16	Zone 3 Tank II Connection	$579,000
CD-5	9,563	16	Zone 3 Conveyance	$2,654,000
CD-6	1,610	12	2100 S, 8000 W to WWTP	$401,000
CD-7	3,575	12	8000 W, 2100 S to North	$890,000
CD-8	4,134	12	SR201 North, 7600 W to 7200 W	$1,030,000
CD-9	7,574	12	Zone 1 Conveyance	$1,887,000
			Total	$11,033,000

[1] Some projects include more than one pipe diameter. In these cases, the range of pipe diameters of pipes included in the project scope is listed.

Major Conveyance Improvements

These improvements include large diameter pipelines required to deliver water to storage reservoirs or pressure zones without excessive velocities or pressure losses. Table 13-2 outlines design details for each of these improvements.

Table 13-2
Culinary Major Conveyance Distribution System Improvements

Project No.	Length (ft)	Pipe Diameter Range[1] (inch)	Description	Project Cost
CMC-1	3,603	12	8800 W, 3100 S to 2600 S Pipe Upsize	$897,000
CMC-2	1,413	12	9200 W, 3100 S to 3300 S	$352,000
			Total	$1,249,000

[1] Some projects include more than one pipe diameter. In these cases, the range of pipe diameters of pipes included in the project scope is listed.

Pressure Zone Changes

Pressure zone changes includes projects to move connections to a higher or lower pressure zone. Table 13-3 outlines design details for each of these improvements.

Table 13-3
Culinary Pressure Zone Changes Distribution System Improvements

Project No.	Length (ft)	Pipe Diameter Range[1] (inch)	Description	Project Cost
CPZ-1	1,549	8	3000 S, 9200 W to 9000 W Zone Change	$353,000
			Total	$353,000

[1] Some projects include more than one pipe diameter. In these cases, the range of pipe diameters of pipes included in the project scope is listed.

Dead-End Improvements

Dead-end improvements include looping pipes at dead-ends to alleviate fire flow deficiencies or improve water quality concerns. Table 13-4 outlines design details for each of these improvements.

Table 13-4
Culinary Dead-End Distribution System Improvements

Project No.	Length (ft)	Pipe Diameter Range[1] (inch)	Description	Project Cost
CDE-1	71	8	Twain Dr & Thoreau Dr Dead-End	$22,000
CDE-2	109	8	Westbury Dr,8070 W & 8035 W	$31,000
CDE-3	129	8	8950 W 3100 S 10 Valves	$30,000
CDE-4	551	8	Copper Cove Cir	$126,000
CDE-5	527	8	Sage Brook Cir	$120,000
			Total	$329,000

[1] Some projects include more than one pipe diameter. In these cases, the range of pipe diameters of pipes included in the project scope is listed.

Looping Improvements

Looping projects aim to improve distribution and fire flow for a wider area by making more connections amongst pipes. Table 13-5 outlines design details for each of these improvements.

Table 13-5
Culinary Looping Distribution System Improvements

Project No.	Length (ft)	Pipe Diameter Range[1] (inch)	Description	Project Cost
CL-1	1,895	8	2900 S 8700 W Loop	$430,000
CL-2	687	8	7700 W to Broadway, 3100 S to 3500 S	$157,000
CL-3	942	8	Broadway St, 3240 S Loop	$215,000
			Total	$802,000

[1] Some projects include more than one pipe diameter. In these cases, the range of pipe diameters of pipes included in the project scope is listed.

Four-Inch Pipe Improvements

Four-Inch pipes often have fire flow deficiencies associated with them and should be upgraded to 8-inch pipes as funding is available. Table 13-6 outlines design details for each of these improvements.

Table 13-6
Culinary Four-Inch Distribution System Improvements

Project No.	Length (ft)	Pipe Diameter Range[1] (inch)	Description	Project Cost
CF-1	1,271	8	8520 W 3100 S	$290,000
CF-2	1,859	8	8950 W 3100 S 10 Valves	$425,000
CF-3	1,874	8	8850 W, 3000 S to 2600 S	$427,000
CF-4	1,718	8	9000 W, 2700 S to 3150 S	$392,000
CF-5	2,406	8	9100 W, 2700 S to 3150 S	$549,000
CF-6	1,665	8	Upsize Magnolia	$380,000
CF-7	551	8	Aleen Ave	$126,000
CF-8	916	8	Melanie Ann Ct	$209,000
			Total	$2,798,000

[1] Some projects include more than one pipe diameter. In these cases, the range of pipe diameters of pipes included in the project scope is listed.

Maintenance or Age-Related Improvements

These improvements are primarily pipe projects identified by MWD personnel where excessive leaks have occurred. Table 13-7 outlines design details for each of these improvements.

Table 13-7
Culinary Maintenance or Age-Related Distribution System Improvements

Project No.	Length (ft)	Pipe Diameter Range[1] (inch)	Description	Project Cost
CM-1	586	8	2"" Lateral - 8000 Melville Houses	$134,000
CM-2	775	8	3500 S, Rulon to Oquirrh	$229,000
CM-3	539	8	8950 W 3100 S 10 Valves	$123,000
CM-4	650	8 to 12	8950 W 3100 S 10 Valves	$162,000
CM-5	224	8	8900 W 3100 S, Abandon 6" Steel	$51,000
CM-6	3,408	16	8000 W, 2600 S to 2100 S (Transite)	$1,110,000
CM-7	452	8	2700 S 8400 W, Intersection Valve Replacement	$103,000
CM-8	2,604	8	9150 W, 3000 S to 3100 S Valve Replacements	$594,000
CM-9	6,866	8	7700 W to Broadway, 3100 S to 3500 S	$1,566,000
CM-10	330	8	Replace Valves	$81,000
CM-11	5,275	8 to 12	3500 S, 7200 W to 8000 W Replace 8	$1,876,000
CM-12	5,274	12 to 16	7200 W, 3500 S to 4100 S Replace Transite	$1,731,000
CM-13	4,526	16	8400 W, 3500 S to 3900 S Replace 14inch Transite	$1,884,000
CM-14	2,306	8	Florence & Edith, Helen to Katherine	$526,000
CM-15	5,291	8	2820 S, 8000 W to 7200 W 1960s Cast Iron	$1,207,000
			Total	$11,377,000

[1] Some projects include more than one pipe diameter. In these cases, the range of pipe diameters of pipes included in the project scope is listed.

2060 SECONDARY DISTRIBUTION IMPROVEMENTS

Figure 13-4 shows the diameter of secondary distribution improvements needed for 2060 development conditions. Figure 13-5 shows project numbers for each reach of pipe. Secondary distribution improvements only have one project type, which is developing improvements, since all the improvements are intended for major conveyance to future developing areas or areas converted from culinary water to secondary water. In developing the recommended improvements, several alternative major conveyance strategies were considered. A technical memorandum describing the various alternatives considered for providing major conveyance is included in the Appendix.

Table 13-8 shows estimated costs for projects shown in Figure 13-4.

Table 13-8
Secondary Distribution System Improvements

Project No.	Length (ft)	Pipe Diameter Range[1] (inch)	Description	Project Cost
SD-1	2,728	12 to 20	3100 S, Dayton St to 7900 W	$717,000
SD-2	3,384	6 to 20	3100 S, 7900 W to 7600 W	$931,000
SD-3	543	16	Zone 2 Tank & Pump Station Piping	$143,000
SD-4	7,627	20	Zone 3 Gateway Piping	$1,265,000
SD-5	3,232	8 to 16	Zone 3 Magna Regional Park	$340,000
SD-6	5,177	8 to 16	Scott Matheson Jr & Copper Hills Elementary	$1,214,000
SD-7	3,404	8	Gateway to Little Valley Piping	$454,000
SD-8	3,339	12	3100 S, 7600 W to 7200 W	$832,000
SD-9	340	12	7600 W Connections	$85,000
SD-10	6,156	8 to 16	2540 S, 6500 W to 5600 W	$1,422,000
SD-11	6,032	12	S. Frontage, 6800 W to 5600 W	$1,503,000
SD-12	3,603	20	SR201 Crossing Transmission	$1,059,000
SD-13	3,712	8	8000 W, 2100 S to North	$847,000
SD-14	4,716	16	SR201 Southside, 7600 W to 8400 W	$782,000
SD-15	2,047	12	8400 W, 2600 S to SR201	$300,000
SD-16	3,775	6 to 20	8000 W Booster Piping	$1,021,000
SD-17	3,510	10	3500 S, Montclair to 7200 W	$1,249,000
SD-18	3,405	10	Lake Ridge Elementary	$878,000
SD-19	4,875	8 to 16	2600 S, 7600 W to 7200 W	$955,000
SD-20	10,693	6 to 16	Parkway Blvd Piping	$2,635,000
SD-21	3,555	10	6000 W, 2600 S to SR201	$844,000
SD-22	3,611	8	Zone 3, 8200 W Pipe	$704,000
SD-23	2,641	16	Zone 3 Tank Pipe	$438,000
SD-24	13,763	12	Zone 1 Transmission at Golf Course	$2,070,000
SD-25	4,536	12	Zone 1 Kennecott Foothills	$663,000
SD-26	2,562	12	3400 S, 9000 W to 9200 W	$639,000
SD-27	4,051	12	Zone 2 Kennecott Foothills	$593,000

Project No.	Length (ft)	Pipe Diameter Range[1] (inch)	Description	Project Cost
SD-28	8,164	8 to 16	2100 S, 8000 W to 7000 W	$1,962,000
SD-29	2,477	8	SR201 North, 6400 W to 6000 W	$566,000
SD-30	3,938	8	Belfast Dr Connection	$899,000
SD-31	6,165	8 to 12	Northeast of WWTP	$1,463,000
SD-32	2,025	12	8000 W, 2100 S to SR201	$505,000
SD-33	8,727	12	Zone 3 Kennecott Foothills	$1,276,000
			Total	$31,254,000

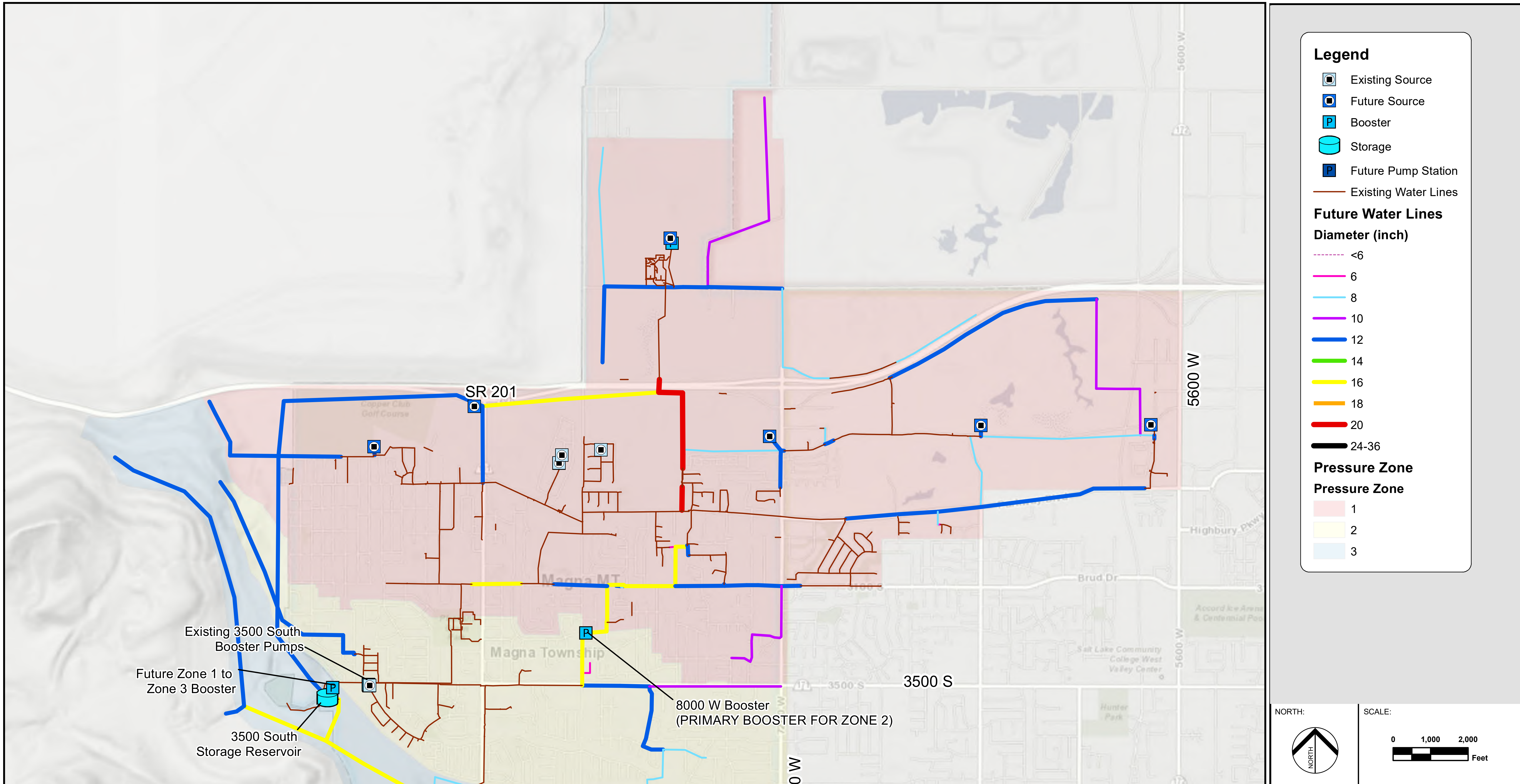
[1] Some projects include more than one pipe diameter. In these cases, the range of pipe diameters of pipes included in the project scope is listed.

SUMMARY OF 2060 CULINARY AND SECONDARY DISTRIBUTION IMPROVEMENTS

Table 13-9 shows a combined summary table of the proposed improvements from Table 10-8, Table 10-9, Table 10-16, and from Tables 13-1 to 13-8.

Table 13-9
Culinary Distribution System Improvements

Project No.	Construction Timeframe	Description	Project Cost
Culinary Storage Facilities			
CS-1	0-5	Zone 3 II Culinary	$1,210,000
CS-2	>10	Zone 3 III Culinary	$810,000
CS-3	>10	Little Valley Culinary	$1,615,000
		Subtotal	**$3,635,000**
Secondary Storage Facilities			
SS-1	0-5	Zone 3 Secondary	$4,150,000
SS-2	>10	Zone 1 Mixing Secondary	$4,312,500
SS-3	>10	Little Valley Secondary	$2,765,000
		Subtotal	**$11,227,500**
Booster Stations			
CBS-1	0-5	Zone 3 II Culinary	$775,000
SBS-1	0-5	Zone 3 I Secondary	$575,000
SBS-2	0-5	Zone 3 II Secondary	$1,000,000
SBS-3	>10	Zone 2 II Secondary	$287,500
		Subtotal	**$2,637,500**
Culinary Distribution Improvements			
CD-1	0-5	Zone 3 Conveyance	$1,339,000
CD-2	>10	Zone 2 Conveyance	$1,906,000
CD-3	0-5	Zone 3, Zone 3 Pump Connection	$347,000
CD-4	>10	Zone 3 Tank II Connection	$579,000

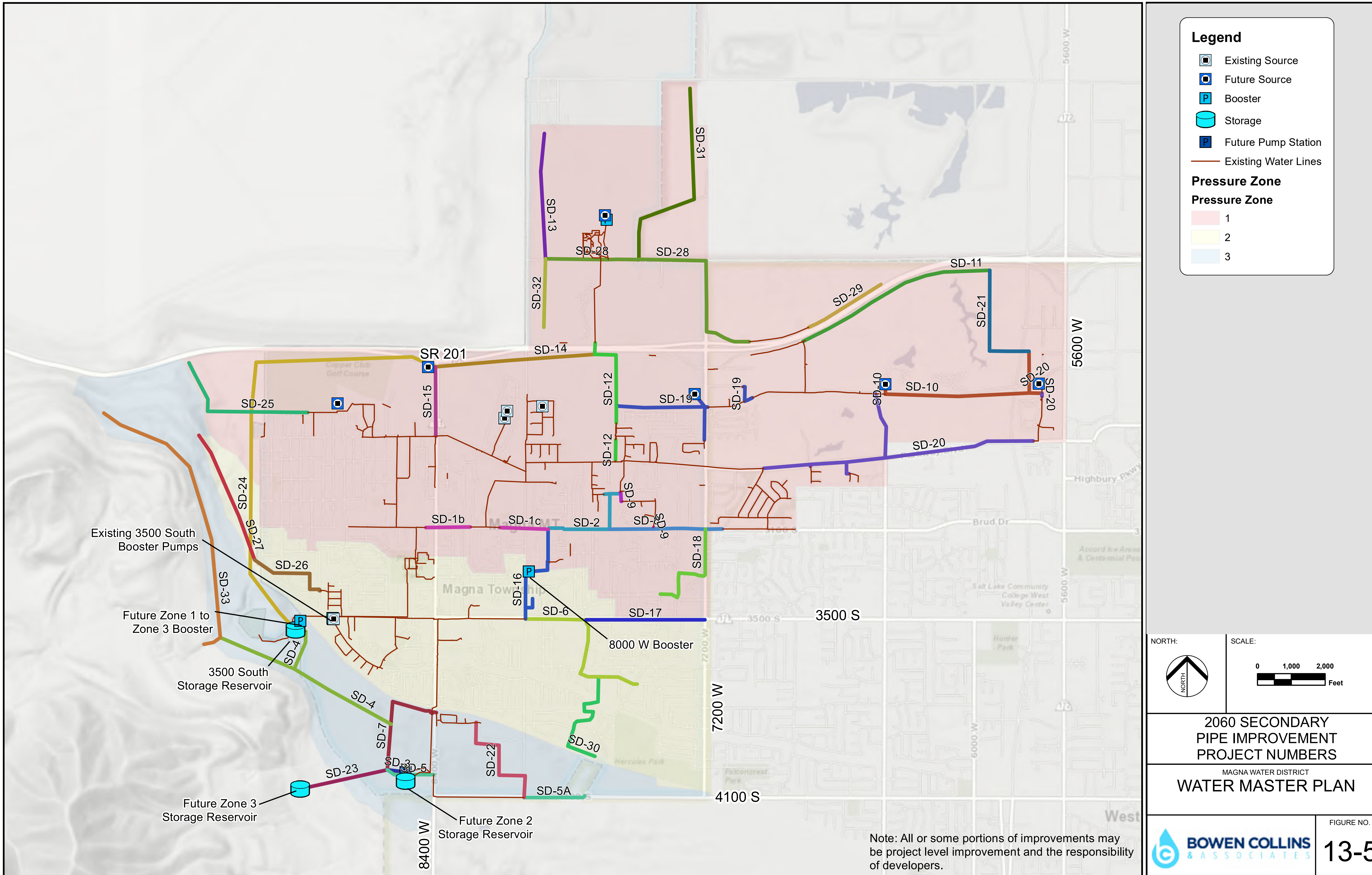


2060 SECONDARY
PIPE IMPROVEMENT
DIAMETERS

MAGNA WATER DISTRICT
WATER MASTER PLAN

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
13-4



2060 SECONDARY
PIPE IMPROVEMENT
PROJECT NUMBERS

MAGNA WATER DISTRICT

WATER MASTER PLAN

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
13-5

P:\Magna Water District\483-18-01 Master Plan\4.0 GIS\4.1 Projects\Water-Figure 13-5-Secondary Pipe Nos.mxd wandersen 6/8/2020

Project No.	Construction Timeframe	Description	Project Cost
CD-5	>10	Zone 3 Conveyance	$2,654,000
CD-6	>10	2100 S, 8000 W to WWTP	$401,000
CD-7	>10	8000 W, 2100 S to North	$890,000
CD-8	>10	SR201 North, 7600 W to 7200 W	$1,030,000
CD-9	>10	Zone 1 Conveyance	$1,887,000
CMC-1	0-5	8800 W, 3100 S to 2600 S Pipe Upsize	$897,000
CMC-2	>10	9200 W, 3100 S to 3300 S	$352,000
CPZ-1	5-10	3000 S, 9200 W to 9000 W Zone Change	$353,000
CDE-1	0-5	Twain Dr & Thoreau Dr Dead-End	$22,000
CDE-2	0-5	Westbury Dr,8070 W & 8035 W	$31,000
CDE-3	0-5	8950 W 3100 S 10 Valves	$30,000
CDE-4	5-10	Copper Cove Cir	$126,000
CDE-5	5-10	Sage Brook Cir	$120,000
CL-1	0-5	2900 S 8700 W Loop	$430,000
CL-2	0-5	7700 W to Broadway, 3100 S to 3500 S	$157,000
CL-3	0-5	Broadway St, 3240 S Loop	$215,000
CF-1	5-10	8520 W 3100 S	$290,000
CF-2	5-10	8950 W 3100 S 10 Valves	$425,000
CF-3	5-10	8850 W, 3000 S to 2700 S	$427,000
CF-4	5-10	9000 W, 2700 S to 3150 S	$392,000
CF-5	>10	9100 W, 2700 S to 3150 S	$549,000
CF-6	5-10	Upsize Magnolia	$380,000
CF-7	5-10	Aleen Ave	$126,000
CF-8	5-10	Melanie Ann Ct	$209,000
CM-1	0-5	2" Lateral - 8000 Melville Houses	$134,000
CM-2	0-5	3500 S, Rulon to Oquirrh	$229,000
CM-3	0-5	8950 W 3100 S 10 Valves	$123,000
CM-4	0-5	8950 W 3100 S 10 Valves	$162,000
CM-5	0-5	8900 W 3100 S, Abandon 6" Steel	$51,000
CM-6	0-5	8000 W, 2600 S to 2100 S (Transite)	$1,110,000
CM-7	0-5	2700 S 8400 W, Intersection Valve Replacement	$103,000
CM-8	0-5	9150 W, 3000 S to 3100 S Valve Replacements	$594,000
CM-9	>10	7700 W to Broadway, 3100 S to 3500 S	$1,566,000
CM-10	0-5	Replace Valves	$81,000
CM-11	5-10	3500 S, 7200 W to 8000 W Replace 8	$1,876,000
CM-12	>10	7200 W, 3500 S to 4100 S Replace Transite	$1,731,000
CM-13	>10	8400 W, 3500 S to 3900 S Replace 14inch Transite	$1,884,000
CM-14	5-10	Florence & Edith, Helen to Katherine	$526,000
CM-15	5-10	2820 S, 8000 W to 7200 W 1960s Cast Iron	$1,207,000
		Subtotal	**$27,941,000**
Secondary Distribution Improvements			

Project No.	Construction Timeframe	Description	Project Cost
SD-1	0-5	3100 S, Dayton St to 7900 W	$717,000
SD-2	5-10	3100 S, 7900 W to 7600 W	$931,000
SD-3	0-5	Zone 2 Tank & Pump Station Piping	$143,000
SD-4	0-5	Zone 3 Gateway Piping	$1,265,000
SD-5	5-10	Zone 3 Magna Regional Park	$340,000
SD-6	0-5	Scott Matheson Jr & Copper Hills Elementary	$1,214,000
SD-7	0-5	Gateway to Little Valley Piping	$454,000
SD-8	>10	3100 S, 7600 W to 7200 W	$832,000
SD-9	5-10	7600 W Connections	$85,000
SD-10	>10	2540 S, 6500 W to 5600 W	$1,422,000
SD-11	>10	S. Frontage, 6800 W to 5600 W	$1,503,000
SD-12	0-5	SR201 Crossing Transmission	$1,059,000
SD-13	>10	8000 W, 2100 S to North	$847,000
SD-14	>10	SR201 Southside, 7600 W to 8400 W	$782,000
SD-15	>10	8400 W, 2600 S to SR201	$300,000
SD-16	5-10	8000 W Booster Piping	$1,021,000
SD-17	>10	3500 S, Montclair to 7200 W	$1,249,000
SD-18	>10	Lake Ridge Elementary	$878,000
SD-19	0-5	2600 S, 7600 W to 7200 W	$955,000
SD-20	>10	Parkway Blvd Piping	$2,635,000
SD-21	>10	6000 W, 2600 S to SR201	$844,000
SD-22	5-10	Zone 3, 8200 W Pipe	$704,000
SD-23	0-5	Zone 3 Tank Pipe	$438,000
SD-24	>10	Zone 1 Transmission at Golf Course	$2,070,000
SD-25	>10	Zone 1 Kennecott Foothills	$663,000
SD-26	>10	3400 S, 9000 W to 9200 W	$639,000
SD-27	>10	Zone 2 Kennecott Foothills	$593,000
SD-28	>10	2100 S, 8000 W to 7000 W	$1,962,000
SD-29	>10	SR201 North, 6400 W to 6000 W	$566,000
SD-30	>10	Belfast Dr Connection	$899,000
SD-31	>10	Northeast of WWTP	$1,463,000
SD-32	>10	8000 W, 2100 S to SR201	$505,000
SD-33	>10	Zone 3 Kennecott Foothills	$1,276,000
		Subtotal	**$31,254,000**
		Total	**$76,695,000**

IMPLEMENTATION & CAPITAL FACILITIES PLAN

PART 3 OF WATER MASTER PLAN

TABLE OF CONTENTS

Note: This report is the third in a series of three reports comprising the Magna Water District Water Master Plan. Chapters 1 through 6 are located in the first report in this series, and chapters 7 through 13 are in part two.

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CHAPTER 14
IMPLEMENTATION PLAN INTRODUCTION

INTRODUCTION

Magna Water District (MWD or District) desires to develop an updated master plan for its water system. This is the third in a series of three reports that will comprise the planning documents for the District's water system. The reports are:

- **Supply and Demand Master Plan** – An examination of water demands expected in the District and the existing and future supplies available to meet these demands.
- **Conveyance and Storage Master Plan** – An evaluation of the District's existing conveyance and distribution system and its ability to deliver water when and where it is needed.
- **Implementation and Capital Facilities Plan –** A plan for completing the necessary improvements identified in the supply and conveyance master plans.

As this is the third report in the series, the reader will notice that it starts with Chapter 14. Each report has been given unique chapter numbers to avoid confusion with chapters in one of the other two reports.

BACKGROUND

The purpose of the last part of this water master plan is to discuss rehabilitation and replacement projects that the District would like to accomplish in the next ten years then provide a recommended implementation plan for all the recommended culinary and secondary improvements. Chapter 14 summarizes the recommended improvements identified in the previous two reports. Chapter 15 will discuss the recommended rehabilitation and replacement projects and Chapter 16 will discuss the recommended implementation plan.

CULINARY AND SECONDARY DISTRIBUTION SYSTEM IMPROVEMENTS

Based on existing water demand and projected growth in water demand, the existing and future demands were simulated in a hydraulic model of the District's distribution system. For existing demands, model results indicate that there are some small existing deficiencies in a few main lines in the system. For future demands, some significant deficiencies are predicted in high growth areas of the District. While much of the system has some excess capacity for future growth, several transmission lines serving high growth areas will need to be replaced or paralleled with larger pipes to meet future demands. Most of the projected deficiencies are a result of growth on Kennecott property at the southwest corner of the District.

To resolve potential deficiencies identified as part of the system evaluation, several projects have been proposed. Table 14-1 summarizes the recommended projects and associated costs for these projects. More detailed descriptions of the projects are contained in the Supply and Demand and Conveyance and Storage Master Plans as discussed above.

Table 14-1
Summary of 2060 Culinary and Secondary Improvements

Improvement Type	Project Cost
Culinary Storage Facilities	$3,635,000
Secondary Storage Facilities	$11,227,500
Booster Stations	$2,637,500
Culinary Distribution	$27,941,000
Secondary Distribution	$31,254,000
Total	**$76,695,000**

CHAPTER 15
REHABILITATION AND REPLACEMENT

INTRODUCTION

Most of the projects recommended in the Supply and Demand and Conveyance and Storage Master Plans have been focused on meeting the capacity needs of the District's overall water systems. However, a few of the projects also address the rehabilitation or replacement of existing facilities due to age or condition related concerns. The purpose of this chapter is examine the recommend rehabilitation and replacement investment needed to sustainably maintain the District's waster systems and then discuss compare this budget to recommended improvements from the other plans. This is not a comprehensive evaluation of system conditions, nor is it a complete asset management plan. Instead, it is a collection of general observations assembled during the master planning process relative to system rehabilitation and replacement.

REHABILITATION AND REPLACEMENT – CONVEYANCE AND STORAGE

While it is beyond the scope of this study to identify a detailed list of all rehabilitation projects that will be required by the District, it is important that future financial planning include a sustainable budget that can then be used for rehabilitation as specific projects are identified. One of the best ways to identify a recommended level of system renewal funding is to consider system service life. As with all utilities, each component of a water system has a finite service life. Therefore, it is necessary to continually spend money towards the rehabilitation or replacement of these components. If adequate funds are not set aside for regular system renewal, the water system will fall into a state of disrepair and be incapable of providing the level of service that customers expect.

The District's culinary and secondary conveyance systems are composed of about 141 miles of pipe and 24 miles of pipe, respectively. The District has seven existing culinary tanks that comprise of 18.0 million gallons of storage and they also have one secondary reservoir that is 5.05 million gallons. The total cost to replace all of the pipes and storage facilities in the District's water systems would be approximately $181 million based on 2019 construction costs.

Table 15-1 shows a comparison of the required annual budget based on service life for the District's water conveyance and storage.

Table 15-1
Recommended Conveyance and Storage Renewal Budget

System Component	Replacement Value	Service Life (years)	Annual Investment Range	
Pipes	$148,776,522	60 - 80	$2,479,609	$1,859,707
Storage	$31,809,000	80 - 100	$397,613	$318,090
Total	**$180,585,522**	**-**	**$2,877,221**	**$2,177,797**

The current proposed budget for improvements associated with rehabilitation and replacement of water conveyance and storage that the District would like to complete in the next ten years is summarized in Chapter 13. Types of projects that would be considered rehabilitation and replacement include: dead end, looping, 4-inch, and age related projects. The total cost of rehabilitation and replacement projects in Chapter 13 that the District would like to complete in the next ten years is $15,518,000. This means that the District should be spending about $1.55 million annually for conveyance and storage related rehabilitation and replacement projects over ten years. The District is also planning to spend about $400,000 per year on the regular replacement of valves ($100,000/year), hydrants ($50,000/year), and meters ($250,000/year). This brings the proposed rehabilitation and replacement budget for the District to just shy of $2.0 million.

Comparing the budgeted value proposed by District staff to the recommended long-term level of renewal funding as identified in Table 15-1 would suggest the District should be spending between $200,000 and $900,000 more annually for its water conveyance and storage renewal. However, because the District is still expanding and much of its infrastructure is still relatively new, it may be acceptable to keep rehabilitation and replacement funding a little lower than long-term recommended levels for a period of time. For planning purposes, it has been assumed that the District will keep the proposed budget of approximately $2.0 million for this 10-year planning window. After that, it is expected that the budget will gradually increase until it reaches the recommended $2.2 to $2. 8 million (adjusted for inflation).

REHABILITATION AND REPLACEMENT – SOURCE AND TREATMENT

A similar process as described above can be followed to calculate a recommended level of renewal funding for the District's water sources and treatment. The total cost to replace all of the District's existing water sources would be approximately $53 million based on 2019 construction costs.

Table 15-2 shows a comparison of the required annual budget based on service life for the District's water sources and treatment.

Table 15-2
Recommended Source and Treatment Renewal Budget

System Component	Replacement Value	Service Life (years)	Annual Investment Range	
Wells	$27,200,000	60 - 80	$453,333	$340,000
Treatment Plant	$23,674,530	40 - 50	$591,863	$473,491
Membranes	$1,710,000	5	$342,000	$342,000
Total	**$52,584,530**	**-**	**$1,387,197**	**$1,155,491**

The current proposed budget for improvements associated with rehabilitation and replacement of water sources that the District would like to complete in the next ten years is summarized in Table 15-3.

Table 15-3
District Proposed Water Source Rehabilitation and Replacement Improvements

Project Name	Project Cost (2019 $'s)
Haynes Well #8	$1,600,000
Well Field Rehabilitation	$250,000
Well Field Property Purchase	$2,000,000
Well Field SCADA	$250,000
Immediate EDR Project (Add 3rd Stage)	$2,754,500
EDR Membrane Replacement	$3,420,000
Brine Pump Station	$250,000
Standby Generator	$120,000
SCADA Upgrades	$250,000
Total	**$10,894,500**

The District's proposed budget for water source and treatment rehabilitation and replacement projects for the next ten years suggests that they would need to spend about $1.1 million annually. Comparing the budgeted value proposed by District staff in Table 15-3 to the recommended long-term level of renewal funding as identified in Table 15-2 would suggest the proposed District is consistent with at least the lower end of recommended investment for its water source and treatment renewal. Thus, it has been assumed that the District will keep its recommended budget of $1.1 million for the current planning window (adjusted for inflation).

TOTAL RECOMMENDED INVESTMENT

Based on this analysis, the recommended District budget for the 10-year planning window of this implementation plan is approximately $2.0 million towards rehabilitation and replacement activities for the water conveyance and storage facilities each year and an additional $1.1 million towards rehabilitation and replacement activities in the source and treatment facilities each year. These values are reported in 2019 dollars and should be adjusted for construction inflation over time. These budget levels should be revisited from time to time and adjusted as part of future asset management planning.

CHAPTER 16
IMPLEMENTATION PLAN

Previous chapters of this water master plan have identified improvements to resolve future deficiencies and to accommodate water demand from future growth while providing an acceptable level of service. The purpose of this chapter is to assemble a 10-year capital improvement program to implement the recommended improvements. This plan should be updated at least every five years to re-prioritize system improvements to achieve District goals.

CAPITAL IMPROVEMENT PRIORITIZATION

A discussion of each of the major budget categories and how they will be prioritized in the 10-year implementation plan is included below:

- **Culinary and Secondary Source, Distribution, Storage, and Booster Station Capacity Improvements –** BC&A used the growth projections discussed in the Supply and Demand Master Plan of this report and the existing system hydraulic models to determine when system capacity improvements are needed. There is not much flexibility with the scheduling of many of these projects. While moving a project a few years forward or a few years back may be a possibility, major changes in timing cannot be accommodated. Unless growth occurs at rates significantly different that those projected, failure to complete the projects at the recommended dates will result in the District running out of available capacity and being forced to implement restrictions on development.
- **Rehabilitation and Replacement Improvements -** A recommended budget level for source rehabilitation and replacement improvements was developed in Chapter 15. Although this budget amount does not need to be spent in every single year, failure to invest in this system at approximately this level over time will result in system degradation and costly system failures. Because the District does have some flexibility with these expenditures, projects from this category have been distributed through the planning window based on expected available budget. Replacement of treatment plant membranes will be dictated by water quality and may be a little less flexible than some of the other rehabilitation and replacement projects.

RECOMMENDED 10-YEAR CAPITAL IMPROVEMENT PROGRAM

Based on the system improvements identified in Chapter 13 and the recommended prioritization approach discussed above, Table 16-1 lists improvement projects that are recommended within the next 10-years, the budget required to complete those projects, and the recommended timing of those projects. For budgeting purposes, capital costs for most major capital improvements have been split up into at least two years; the first year usually includes about 10% of the total project cost for design services, while future years include the remaining budget for actual construction.

Table 16-1
Recommended 10-Year Capital Improvement Plan

Project ID	Project Description	Project Total (2019 $s)	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	10-yr Total
Culinary Storage Improvements													
CS-1	Zone 3 II Culinary	$1,210,000	$124,630	$1,155,320									$1,279,950
Subtotal		***$1,210,000***	***$124,630***	***$1,155,320***	***$0***	***$0***	***$0***	***$0***	***$0***	***$0***	***$0***	***$0***	***$1,279,950***
Secondary Storage Improvements													
SS-1	Zone 3 Secondary	$4,150,000				$467,086	$4,329,889						$4,796,975
Subtotal		***$4,150,000***	***$0***	***$0***	***$0***	***$467,086***	***$4,329,889***	***$0***	***$0***	***$0***	***$0***	***$0***	***$4,796,975***
Culinary and Secondary Booster Stations													
CBS-1	Zone 3 II Culinary	$775,000	$79,825	$739,978									$819,803
SBS-1	Zone 3 I Secondary	$575,000	$59,225	$549,016									$608,241
SBS-2	Zone 3 II Secondary	$1,000,000				$112,551	$1,043,347						$1,155,898
Subtotal		***$2,350,000***	***$139,050***	***$1,288,994***	***$0***	***$112,551***	***$1,043,347***	***$0***	***$0***	***$0***	***$0***	***$0***	***$2,583,941***
Culinary Distribution Improvements													
CD-1	Zone 3 Conveyance	$1,339,000	$137,917	$1,278,491									$1,416,408
CD-3	Zone 3, Zone 3 Pump Connection	$347,000		$368,132									$368,132
CMC-1	8800 W, 3100 S to 2600 S Pipe Upsize	$897,000				$100,958	$935,882						$1,036,840
CPZ-1	3000 S, 9200 W to 9000 W Zone Change	$353,000										$447,170	$447,170
CDE-1	Twain Dr & Thoreau Dr Dead-End	$22,000			$24,040								$24,040
CDE-2	Westbury Dr,8070 W & 8035 W	$31,000			$33,875								$33,875
CDE-3	8950 W 3100 S 10 Valves	$30,000			$32,782								$32,782
CDE-4	Copper Cove Cir	$126,000							$154,964				$154,964
CDE-5	Sage Brook Cir	$120,000							$147,585				$147,585
CL-1	2900 S 8700 W Loop	$430,000			$469,873								$469,873
CL-2	7700 W to Broadway, 3100 S to 3500 S	$157,000			$171,558								$171,558
CL-3	Broadway St, 3240 S Loop	$215,000			$234,936								$234,936
CF-1	8520 W 3100 S	$290,000								$367,363			$367,363
CF-2	8950 W 3100 S 10 Valves	$425,000								$538,377			$538,377
CF-3	8850 W, 3000 S to 2700 S	$427,000							$52,516	$486,820			$539,335
CF-4	9000 W, 2700 S to 3150 S	$392,000										$526,815	$526,815
CF-6	Upsize Magnolia	$380,000								$48,137	$446,232		$494,370
CF-7	Aleen Ave	$126,000										$169,333	$169,333
CF-8	Melanie Ann Ct	$209,000										$280,879	$280,879

Project ID	Project Description	Project Total (2019 $s)	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	10-yr Total
CM-1	2" Lateral - 8000 Melville Houses	$134,000			$146,425								$146,425
CM-2	3500 S, Rulon to Oquirrh	$229,000			$250,234								$250,234
CM-3	8950 W 3100 S 10 Valves	$123,000			$134,405								$134,405
CM-4	8950 W 3100 S 10 Valves	$162,000			$177,022								$177,022
CM-5	8900 W 3100 S, Abandon 6" Steel	$51,000			$55,729								$55,729
CM-6	8000 W, 2600 S to 2100 S (Transite)	$1,110,000			$121,293	$1,124,383							$1,245,676
CM-7	2700 S 8400 W, Intersection Valve Replacement	$103,000			$112,551								$112,551
CM-8	9150 W, 3000 S to 3100 S Valve Replacements	$594,000		$63,017	$584,172								$647,189
CM-10	Replace Valves	$81,000			$88,511								$88,511
CM-11	3500 S, 7200 W to 8000 W Replace 8	$1,876,000							$230,724	$2,138,815			$2,369,539
CM-14	Florence & Edith, Helen to Katherine	$526,000						$62,807	$582,222				$645,029
CM-15	2820 S, 8000 W to 7200 W 1960s Cast Iron	$1,207,000									$157,486	$1,459,896	$1,617,382
Subtotal		***$12,512,000***	***$137,917***	***$1,709,640***	***$2,637,406***	***$1,225,341***	***$935,882***	***$62,807***	***$1,168,011***	***$3,579,512***	***$603,719***	***$2,884,093***	***$14,944,329***
Secondary Distribution Improvements													
SD-1	3100 S, Dayton St to 7900 W	$717,000					$83,120	$770,522					$853,642
SD-2	3100 S, 7900 W to 7600 W	$931,000						$111,166	$1,030,511				$1,141,678
SD-3	Zone 2 Tank & Pump Station Piping	$143,000	$147,290										$147,290
SD-4	Zone 3 Gateway Piping	$1,265,000	$130,295	$1,207,835									$1,338,130
SD-5	Zone 3 Magna Regional Park	$340,000									$44,362	$411,238	$455,601
SD-6	Scott Matheson Jr & Copper Hills Elementary	$1,214,000			$132,657	$1,229,731							$1,362,388
SD-7	Gateway to Little Valley Piping	$454,000		$481,649									$481,649
SD-9	7600 W Connections	$85,000								$107,675			$107,675
SD-12	SR201 Crossing Transmission	$1,059,000	$109,077	$1,011,144									$1,120,221
SD-16	8000 W Booster Piping	$1,021,000									$133,217	$1,234,925	$1,368,142
SD-19	2600 S, 7600 W to 7200 W	$955,000	$98,365	$911,844									$1,010,209
SD-22	Zone 3, 8200 W Pipe	$704,000						$84,061	$779,248				$863,309
SD-23	Zone 3 Tank Pipe	$438,000				$492,973							$492,973
Subtotal		***$9,326,000***	***$485,027***	***$3,612,471***	***$132,657***	***$1,722,704***	***$83,120***	***$965,749***	***$1,809,759***	***$107,675***	***$177,580***	***$1,646,163***	***$10,742,906***
Source Rehabilitation and Replacement Improvements													
1	Haynes Well #8	$1,600,000			$174,836	$1,620,733							$1,795,569

Project ID	Project Description	Project Total (2019 $s)	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	10-yr Total
2	Well Field Rehabilitation	$250,000		$132,613					$153,734				$286,347
4	Well Field SCADA	$250,000		$26,523	$245,864								$272,386
5	Immediate EDR Project (Add 3rd Stage)	$2,754,500		$292,225	$2,708,925								$3,001,150
6	EDR Membrane Replacement	$3,420,000					$99,118	$1,939,738					$2,038,856
7	Brine Pump Station	$250,000		$26,523	$245,864								$272,386
8	Standby Generator	$120,000			$131,127								$131,127
9	SCADA Upgrades	$250,000			$273,182								$273,182
Subtotal		***$8,894,500***	***$0***	***$477,882***	***$3,779,797***	***$1,620,733***	***$99,118***	***$1,939,738***	***$153,734***	***$0***	***$0***	***$0***	***$8,071,003***
Shallow Groundwater Development													
1	Shallow Groundwater Development	$3,450,000					$79,990	$741,506					$821,496
Subtotal		***$3,450,000***	***$0***	***$0***	***$0***	***$0***	***$79,990***	***$741,506***	***$0***	***$0***	***$0***	***$0***	***$821,496***
Valve, Hydrant, and Meter Replacement													
1	Valve, Hydrant, and Meter Replacement	-	$400,000	$423,211	$447,277	$471,781	$496,969	$511,878	$527,234	$543,051	$559,343	$576,123	$4,956,867
Subtotal		***$0***	***$400,000***	***$423,211***	***$447,277***	***$471,781***	***$496,969***	***$511,878***	***$527,234***	***$543,051***	***$559,343***	***$576,123***	***$4,956,867***
TOTAL		**$41,892,500**	**$1,286,624**	**$8,667,518**	**$6,997,137**	**$5,620,196**	**$7,068,314**	**$4,221,679**	**$3,658,739**	**$4,230,239**	**$1,340,641**	**$5,106,380**	**$48,197,467**

Note: Costs include 3% inflation per year

CAPITAL IMPROVEMENT PROGRAM FUNDING SOURCE

Using the projects listed in Table 16-1, BC&A and the District classified each project based on their respective funding source, which are:

- System Level Improvement (cash) – These projects will be funded by the District using cash on hand.
- System Level Improvement (impact fee credits) – These projects will be funded by the Developer, but the developer will be reimbursed through impact fee credits by the District.
- Project Level Improvement (no credits) – These projects will be funded by the Developer at no cost to the District.

Table 16-2 shows each project and its respective funding source.

Table 16-2
Recommended 10-Year Capital Improvement Plan by Funding Source

Project ID	Project Description	Project Total (2019 $s)	System Level (cash)	System Level (impact fee credits)	Project Level	10-yr Total
Culinary Storage Improvements						
CS-1	Zone 3 II Culinary	$1,210,000	$0	$266,200	$943,800	$1,210,000
Subtotal		***$1,210,000***	***$0***	***$266,200***	***$943,800***	***$1,210,000***
Secondary Storage Improvements						
SS-1	Zone 3 Secondary	$4,150,000	$4,150,000	$0	$0	$4,150,000
Subtotal		***$4,150,000***	***$4,150,000***	***$0***	***$0***	***$4,150,000***
Culinary and Secondary Booster Stations						
CBS-1	Zone 3 II Culinary	$775,000	$775,000	$0	$0	$775,000
SBS-1	Zone 3 I Secondary	$575,000	$575,000	$0	$0	$575,000
SBS-2	Zone 3 II Secondary	$1,000,000	$1,000,000	$0	$0	$1,000,000
Subtotal		***$2,350,000***	***$2,350,000***	***$0***	***$0***	***$2,350,000***
Culinary Distribution Improvements						
CD-1	Zone 3 Conveyance	$1,339,000	$0	$145,226	$1,193,774	$1,339,000
CD-3	Zone 3, Zone 3 Pump Connection	$347,000	$347,000	$0	$0	$347,000
CMC-1	8800 W, 3100 S to 2600 S Pipe Upsize	$897,000	$897,000	$0	$0	$897,000
CPZ-1	3000 S, 9200 W to 9000 W Zone Change	$353,000	$353,000	$0	$0	$353,000
CDE-1	Twain Dr & Thoreau Dr Dead-End	$22,000	$22,000	$0	$0	$22,000
CDE-2	Westbury Dr,8070 W & 8035 W	$31,000	$31,000	$0	$0	$31,000
CDE-3	8950 W 3100 S 10 Valves	$30,000	$30,000	$0	$0	$30,000
CDE-4	Copper Cove Cir	$126,000	$126,000	$0	$0	$126,000
CDE-5	Sage Brook Cir	$120,000	$120,000	$0	$0	$120,000
CL-1	2900 S 8700 W Loop	$430,000	$430,000	$0	$0	$430,000
CL-2	7700 W to Broadway, 3100 S to 3500 S	$157,000	$157,000	$0	$0	$157,000
CL-3	Broadway St, 3240 S Loop	$215,000	$215,000	$0	$0	$215,000

Project ID	Project Description	Project Total (2019 $s)	System Level (cash)	System Level (impact fee credits)	Project Level	10-yr Total
CF-1	8520 W 3100 S	$290,000	$290,000	$0	$0	$290,000
CF-2	8950 W 3100 S 10 Valves	$425,000	$425,000	$0	$0	$425,000
CF-3	8850 W, 3000 S to 2700 S	$427,000	$427,000	$0	$0	$427,000
CF-4	9000 W, 2700 S to 3150 S	$392,000	$392,000	$0	$0	$392,000
CF-6	Upsize Magnolia	$380,000	$380,000	$0	$0	$380,000
CF-7	Aleen Ave	$126,000	$126,000	$0	$0	$126,000
CF-8	Melanie Ann Ct	$209,000	$209,000	$0	$0	$209,000
CM-1	2" Lateral - 8000 Melville Houses	$134,000	$134,000	$0	$0	$134,000
CM-2	3500 S, Rulon to Oquirrh	$229,000	$229,000	$0	$0	$229,000
CM-3	8950 W 3100 S 10 Valves	$123,000	$123,000	$0	$0	$123,000
CM-4	8950 W 3100 S 10 Valves	$162,000	$162,000	$0	$0	$162,000
CM-5	8900 W 3100 S, Abandon 6" Steel	$51,000	$51,000	$0	$0	$51,000
CM-6	8000 W, 2600 S to 2100 S (Transite)	$1,110,000	$1,110,000	$0	$0	$1,110,000
CM-7	2700 S 8400 W, Intersection Valve Replacement	$103,000	$103,000	$0	$0	$103,000
CM-8	9150 W, 3000 S to 3100 S Valve Replacements	$594,000	$594,000	$0	$0	$594,000
CM-10	Replace Valves	$81,000	$81,000	$0	$0	$81,000
CM-11	3500 S, 7200 W to 8000 W Replace 8	$1,876,000	$1,876,000	$0	$0	$1,876,000
CM-14	Florence & Edith, Helen to Katherine	$526,000	$526,000	$0	$0	$526,000
CM-15	2820 S, 8000 W to 7200 W 1960s Cast Iron	$1,207,000	$1,207,000	$0	$0	$1,207,000
Subtotal		***$12,512,000***	***$11,173,000***	***$145,226***	***$1,193,774***	***$12,512,000***
Secondary Distribution Improvements						
SD-1	3100 S, Dayton St to 7900 W	$717,000	$717,000	$0	$0	$717,000
SD-2	3100 S, 7900 W to 7600 W	$931,000	$931,000	$0	$0	$931,000
SD-3	Zone 2 Tank & Pump Station Piping	$143,000	$143,000	$0	$0	$143,000
SD-4	Zone 3 Gateway Piping	$1,265,000	$215,050	$115,495	$934,456	$1,265,000
SD-5	Zone 3 Magna Regional Park	$340,000	$340,000	$0	$0	$340,000

Project ID	Project Description	Project Total (2019 $s)	System Level (cash)	System Level (impact fee credits)	Project Level	10-yr Total
SD-6	Scott Matheson Jr & Copper Hills Elementary	$1,214,000	$1,214,000	$0	$0	$1,214,000
SD-7	Gateway to Little Valley Piping	$454,000	$0	$61,466	392533.847	$454,000
SD-9	7600 W Connections	$85,000	$85,000	$0	$0	$85,000
SD-12	SR201 Crossing Transmission	$1,059,000	$1,059,000	$0	$0	$1,059,000
SD-16	8000 W Booster Piping	$1,021,000	$1,021,000	$0	$0	$1,021,000
SD-19	2600 S, 7600 W to 7200 W	$955,000	$955,000	$0	$0	$955,000
SD-22	Zone 3, 8200 W Pipe	$704,000	$0	$0	$704,000	$704,000
SD-23	Zone 3 Tank Pipe	$438,000	$438,000	$0	$0	$438,000
Subtotal		***$9,326,000***	***$7,118,050***	***$176,961***	***$2,030,989***	***$9,326,000***
Source Rehabilitation and Replacement Improvements						
1	Haynes Well #8	$1,600,000	$1,600,000	$0	$0	$1,600,000
2	Well Field Rehabilitation	$250,000	$250,000	$0	$0	$250,000
4	Well Field SCADA	$250,000	$250,000	$0	$0	$250,000
5	Immediate EDR Project (Add 3rd Stage)	$2,754,500	$2,754,500	$0	$0	$2,754,500
6	EDR Membrane Replacement	$3,420,000	$3,420,000	$0	$0	$3,420,000
7	Brine Pump Station	$250,000	$250,000	$0	$0	$250,000
8	Standby Generator	$120,000	$120,000	$0	$0	$120,000
9	SCADA Upgrades	$250,000	$250,000	$0	$0	$250,000
Subtotal		***$8,894,500***	***$8,894,500***	***$0***	***$0***	***$8,894,500***
Shallow Groundwater Development						
1	Shallow Groundwater Development	$3,450,000	$3,450,000	$0	$0	$3,450,000
Subtotal		***$3,450,000***	***$3,450,000***	***$0***	***$0***	***$3,450,000***
TOTAL		**$41,892,500**	**$37,135,550**	**$588,387**	**$4,168,563**	**$41,892,500**

Note: Costs include 3% inflation per year

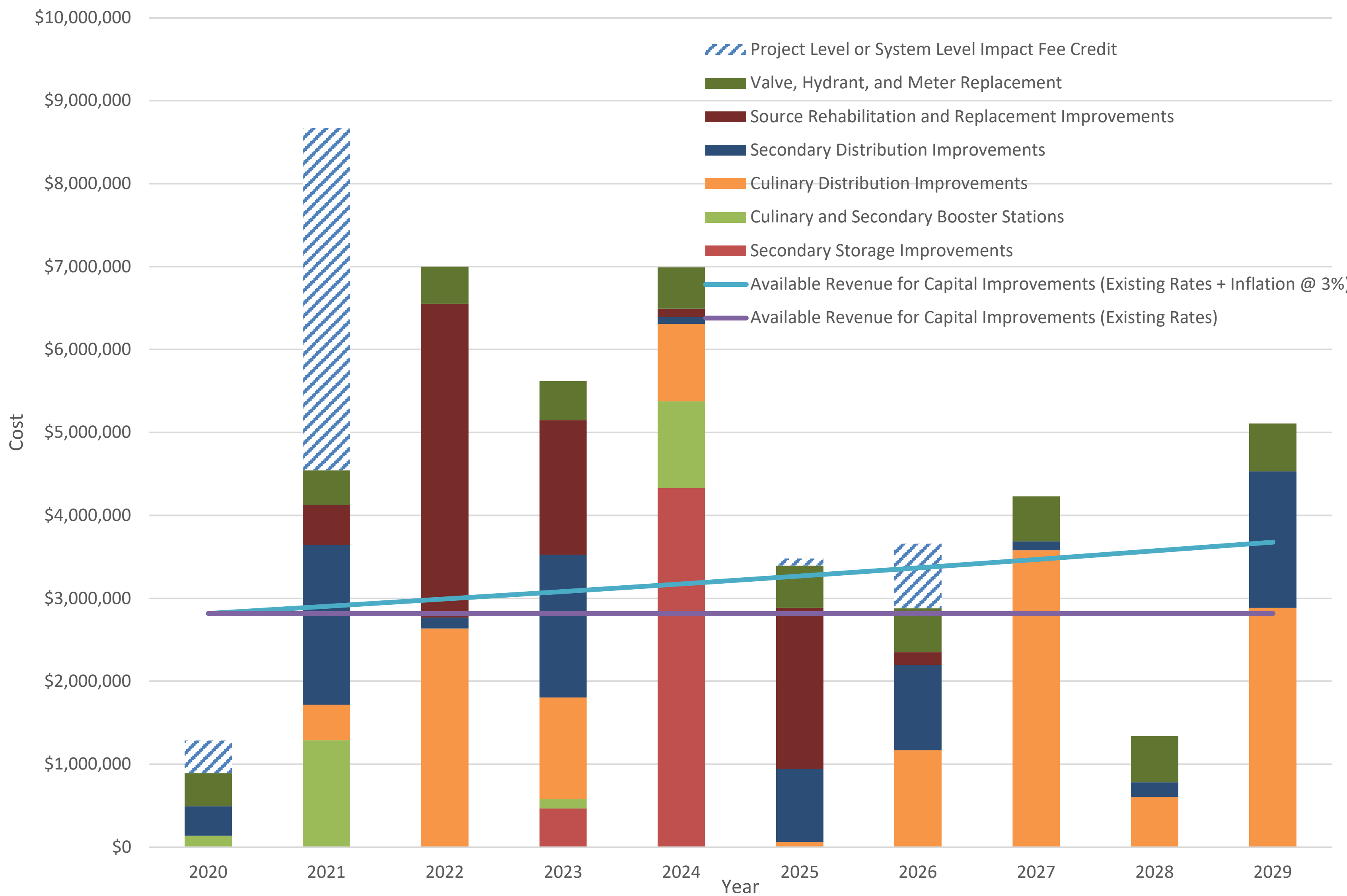
Figure 16-1 summarizes the annual capital expenditures that will be required to support the recommended capital improvement plan. Expenditures have been grouped by major category for reference.

For comparison purposes, Figure 16-1 also includes the historic level of funding available for capital improvements based on data from the District for budgets in 2017, 2018, and 2019. The average inflation adjusted revenue for capital improvements in the District during this period was $2.8 million as shown in the figure. The figure also includes an estimate of annual available revenue if historic revenues are increased at 3% per year to account for inflation.

A few conclusions can be made based on Table 16-1 and Figure 16-1:

- **Short-term Level of Funding** – The District is facing some significant expenditures in the near future. This is the result of two factors. First, significant growth will require several expensive distribution system and storage improvements in the next five years. Second, there are a significant number of high priority projects that are recommended for completion in the next few years. These projected expenditures are significantly greater than historic funding levels.
- **Long-term Level of Funding –** The District's historic level of available funding for capital projects will not sustainably meet recommended long-term levels. As can be seen in the later years of Figure 16-1, even once the District addresses several short-term needs, historic levels of funding will still need a substantial increase to meet projected project needs moving forward.

Figure 16-1
10-Year Revenue and Expenditures - MWD Capital Improvements



RECOMMENDATIONS

Based on the analysis contained in this report and the conclusions above, the following actions are recommended:

- **Adopt the Proposed Implementation Plan –** The 10-year capital improvement plan summarized in Table 16-1 represents the best available assessment of District capital needs in the upcoming years. It is recommended that this plan be adopted for budgeting, staffing, rate making and impact fee calculation purposes.
- **Complete a Rate Study –** As noted above, historic funding levels will not be adequate to address projected District needs over the next several years. The District will need to explore options for funding the recommended projects. This will likely include increasing rates, bonding for projects, or some combination of the two. It is recommended that the District complete a detailed rate study to explore their options.
- **Develop a Plan for Project Completion –** In addition to having adequate funding to complete the needed projects in upcoming years, the District will also need to make sure it has adequate help to manage and execute the needed projects. There may be too many capital projects for the District's existing staff to manage. It is recommended that the District identify a plan for increasing its capacity in this regard, either through the acquisition of additional staff or securing assistance from a consultant.
- **Update this Water Master Plan Regularly –** This water master plan should be viewed as a living document. The conclusions contained herein are based on several assumptions that will assuredly change from time to time. Examples of this include assumptions associated with development patterns, regulatory requirements, economic conditions, etc. As changes occur in these areas, the conclusions and recommendations in this report may need to be revised. For this reason, it is recommended that this report be updated on a regular basis. This should be at least once every 5 years and more often if necessitated by a major change in the District (e.g. major new regulatory requirement, annexation of a new area, etc.)