Prepared for:

Prepared by:

Water Master Plan

Section 1 – Supply & Demand

Section 2 – Storage & Conveyance

Date: July 2024

HERRIMAN CITY
SUPPLY AND DEMAND MASTER PLAN

MARCH 2024

PROFESSIONAL ENGINEER
5339557-2202
ANDREW T.
McKINNON
STATE OF UTAH

Prepared for:

HERRIMAN CITY

Prepared by:

BOWEN COLLINS & ASSOCIATES

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EXECUTIVE SUMMARY

INTRODUCTION

Herriman City is a rapidly growing community with significant future water needs. It is important that the City prepare an up-to-date water master plan for its population and water demand projections. This "Supply and Demand Master Plan" is the first in a set of two reports that comprise the planning documents for the City's water system.

SYSTEM GROWTH PROJECTIONS

The Herriman City water system service area generally serves all development within the incorporated area of Herriman City. Herriman City also serves some of the demands of the High Country Estate subdivisions (Phases I and II which are not part of Herriman City) as a wholesale supply to the subdivisions.

Total growth projected in the future is based on the City's general plan and growth rate estimates provided by Herriman City planning personnel. Projections exclude the area at the northwest end of the City which was annexed into South Jordan City after the City's general plan was adopted. Table ES-1 summarizes the growth in population and equivalent residential connections projected in the City service area.

Table ES-1
Equivalent Non-Residential Population Projection

Year	Residential Population Projection	Equivalent Non-Residential Population	Residential + Equivalent Residential Population	Percentage of Non-Residential	Total Equivalent Residential Connections
2010	21,785	2,202	23,987	10.1%	6,135
2020	55,144	9,093	64,237	16.5%	15,233
2024	68,861	12,647	81,508	18.4%	22,443
2025	73,089	13,930	87,019	19.1%	24,792
2030	92,854	20,950	113,804	22.6%	32,423
2034	105,655	26,460	132,115	25.0%	37,640
2035	108,342	27,712	136,054	25.6%	38,762
2040	118,820	32,845	151,664	27.6%	43,209
2045	125,221	36,080	161,301	28.8%	45,955
2050	128,892	37,887	166,779	29.4%	47,515
2055	130,921	38,829	169,750	29.7%	48,362
2060	132,020	39,302	171,321	29.8%	48,809
2065	132,608	39,535	172,143	29.8%	49,043

Water Conservation Goals

Based on data collected regarding conservation potential throughout the State, the State of Utah developed region specific conservation goals as part of the State's overall water conservation approach. Herriman City would propose to meet these regional goals as summarized in Table ES-2.

Table ES-2
Conservation Goal with Milestones Through 2065

Year	Percent Conservation	New Salt Lake Region Water Use Goals (gallons per capita per day)
2010	0%	192.8
2015	5.0%	183.2
2018	7.6%	178.1
2020	9.0%	175.4
2025	12.5%	168.7
2030	15.3%	162.0
2065	24.0%	146.5

WATER SUPPLY & DEMAND

Based on the land use and population projections, projected annual water demands (including conservation) are shown through 2065 in Figures ES-1 to ES-4.

Figure ES-1 Annual Culinary Demand & Supply Requirements

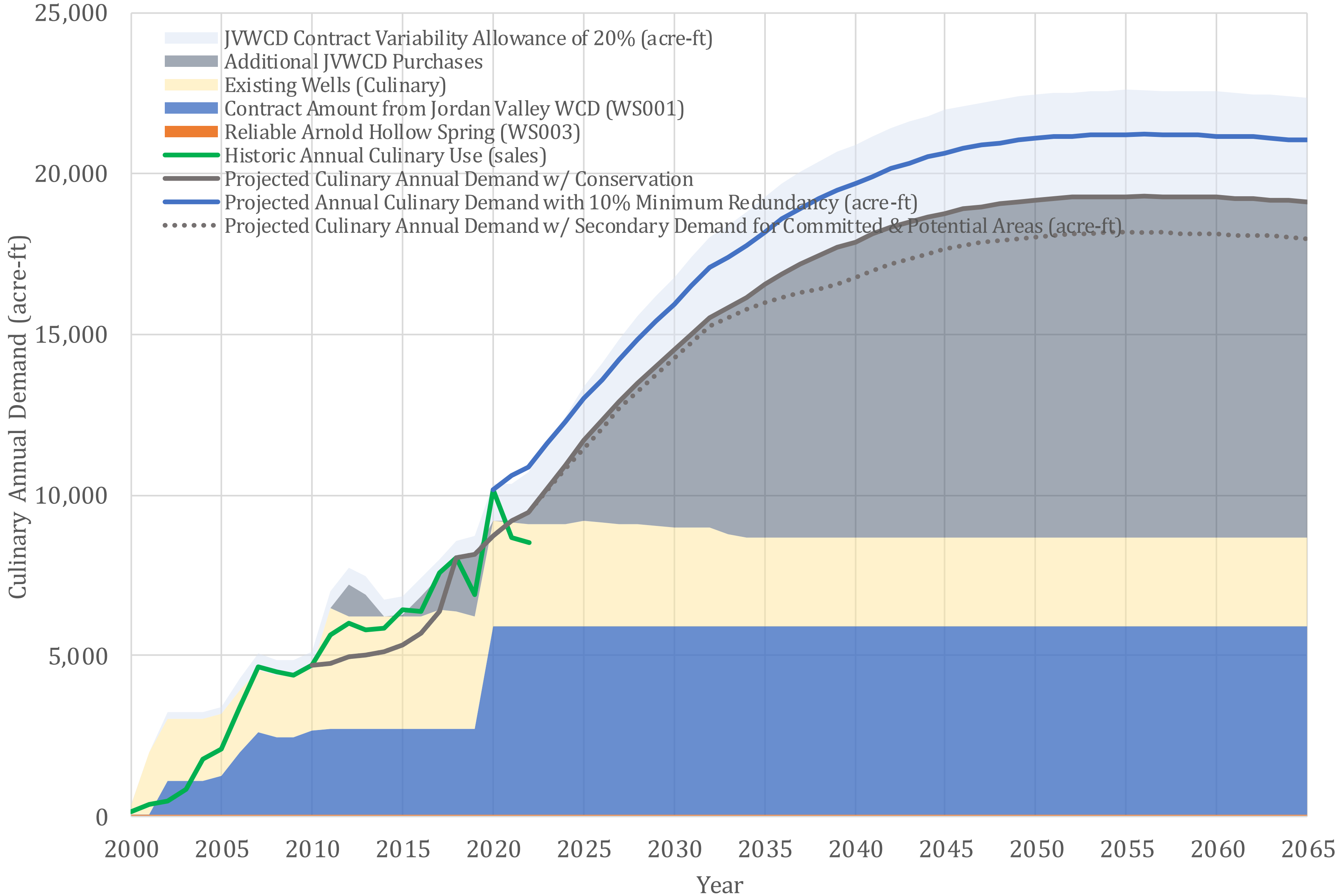


Figure ES-2 Annual Secondary Demand & Supply Requirements

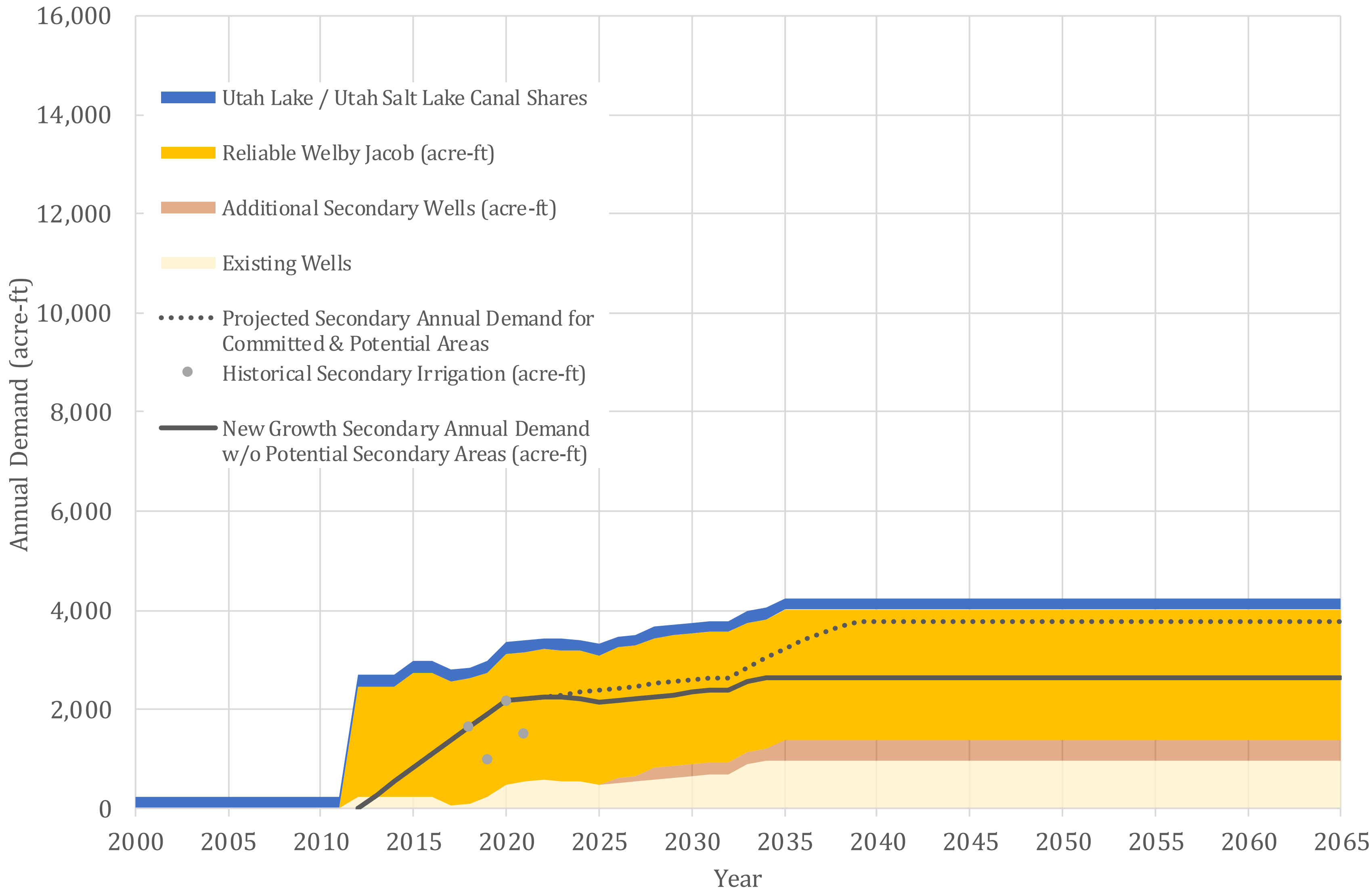
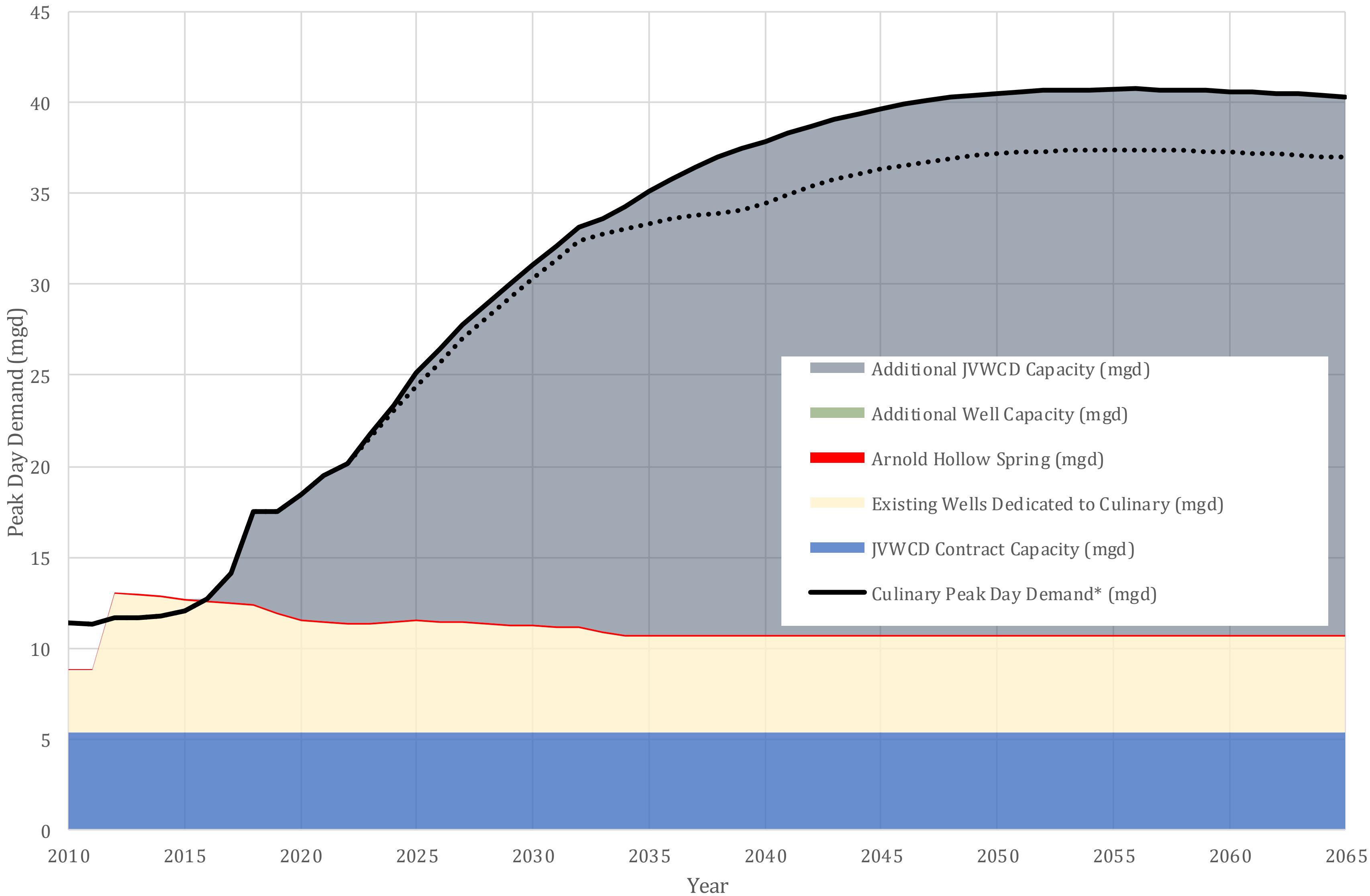
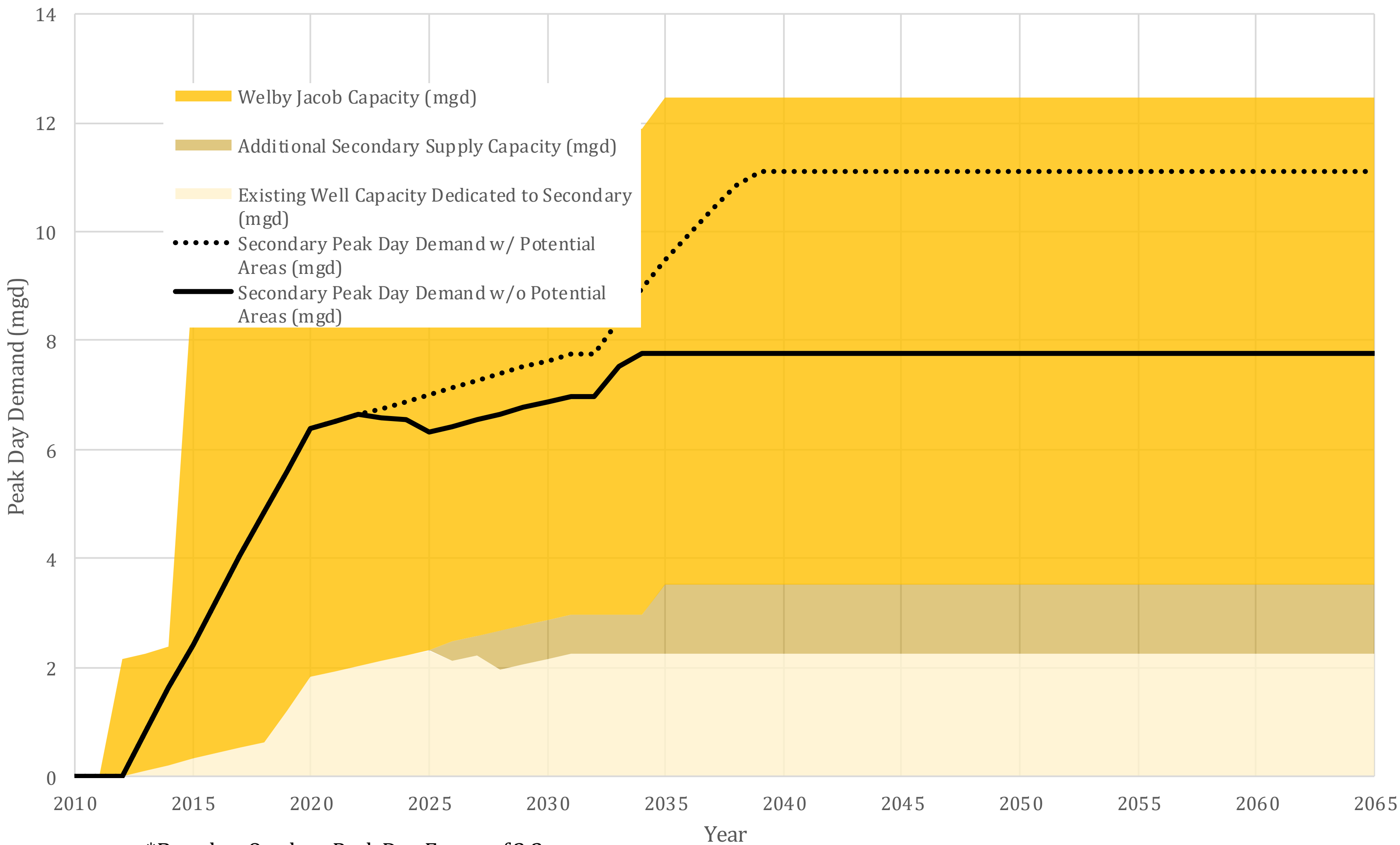


Figure ES-3 Peak Day Culinary Demand & Supply Requirements



*Based on Indoor Peaking Day Demand Factor of 1.25 and Outdoor Peak Day Factor of 3.3

Figure ES-4 Peak Day Secondary Demand & Supply Requirements



*Based on Outdoor Peak Day Factor of 3.3

CONCLUSIONS

A number of principal conclusions can be made regarding Herriman City's water system with respect to projected available supply and demand:

1. **Demand Projections**. Through the planning window of this study (2065), it is projected that the City will see significant growth including within the existing service area.
2. **Conservation.** The City projections of demand include reducing 2010 demands 15 percent by the year 2030 with up to 24 percent by the year 2065. Meeting these conservation goals will be an essential part of the City's overall supply plan.
3. **Culinary Water Supply.** The majority of the City's future culinary water supply will need to be purchased from Jordan Valley Water Conservancy District (JVWCD) through expanded contracts. Approximately ~10,000 acre-ft will need to be acquired. Some expansion of groundwater may be able to supplement existing groundwater rights.
4. **JVWCD Water Budget.** JVWCD has proposed a tentative water budget of 1.35 acre-ft/acre of developable area to support development. The City and/or developers will either need to alter their planned developments to fall within this budget amount or secure additional water (either via fees to JVWCD or by bringing alternate water sources such as Welby Jacob canal shares to JVWCD) to support desired densities and planning. Based on the amount of undeveloped area in the City (~6,000 acres), it is estimated that the City or developers will need to contribute approximately 3,000 acre-ft of additional water sources or pay a fee in lieu of acquiring additional water to JVWCD. It is worth noting that the JVWCD Water Budget has not been adopted and the City should continue to coordinate with JVWCD to mitigate potential impacts to the City.
5. **Secondary Water Expansion.** The City has decided to limit expansion of secondary water based on committed areas and/or potential areas relatively easily connected to secondary based on proximity to existing facilities.
6. **Secondary Water Sources.**
   a. **Canal Shares –** The City has sufficient secondary canal shares for secondary irrigation but may need to continue buying canal shares to exchange with JVWCD to satisfy long-term culinary supply needs. While there may be some excess of canal shares for irrigation, it is recommended the City retain these shares until more of the secondary system is online.

   b. **Groundwater** – If additional groundwater can be developed by acquiring existing points of diversion, the City should pursue options as available to provide additional redundancy for Welby Jacob water and potentially reduce some conveyance needs within the City. The maximum capacity the City anticipates could be developed is approximately 500 acre-ft annually with a peak capacity of 1.5 mgd (900 gpm).

CHAPTER 1
INTRODUCTION

INTRODUCTION

Herriman City desires to develop an updated master plan for its water system. This is the first in a set of two reports that comprise the planning documents for the City's water system. The reports are:

- **Supply and Demand Master Plan** – An examination of water demands expected in the City and the existing and future supplies available to meet these demands.
- **Conveyance and Storage Master Plan** – An evaluation of the City's existing conveyance and distribution system and its ability to deliver water when and where it is needed including long-term capital improvements needed to meet future demands.

BACKGROUND

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

- 2020 Water System Master Plan Update (Bowen Collins & Associates, August 2020). Bowen Collins & Associates

Significant City planning decisions that need to be evaluated and addressed for the City to meet its future water supply commitments include:

- **Land Use –** Land use issues to consider include:
  - **Herriman Hills Open Space Initiative–** Through the joint efforts of the Utah National Guard, a local citizen group, and City leadership, Herriman City adopted a plan to purchase private property for the Herriman Hills area to provide additional buffer to the Camp Williams training facility and to maintain the open space quality of the mountains above Herriman City. Up to 75 percent of funds for this initiative are provided through the Army Compatible Use Buffer program with 25 percent provided by the City or through donations from property owners. This initiative significantly reduces the potential for residential growth and associated water demands in some of the hills above Herriman City while preserving the area for open space.
    - **Southeast Herriman.** While the goal of the initiative is to preserve as much open space as possible, existing City agreements will not allow the entire area to be preserved as open space.
  - **General Plan–** The City adopted a new general plan January 1, 2022.
  - **Annexations –** While the long-term annexation plan for the City has not changed significantly since the last water master plan update, the City officially annexed the "Olympia" area into the City on January 1, 2022.
  - **Remaining Annexation Area –** The remaining annexation area of the City's general plan is primarily owned by Kennecott (Rio Tinto) and has since been annexed into South Jordan City. As a result, the City will no longer plan on supplying water and system facilities to the areas. This will result in a reduction in the City's long term planning population, demand, and facility needs.
- **Secondary Service Area –** Since 2010, the City has been working toward developing a secondary water system in the City with a focus on extending it to the undeveloped areas of

the City. Two major factors have influenced the City to reconsider that approach. First, significant changes in landscape ordinances and projected irrigation demands have reduced the potential demand on the irrigation system. Second, significant increases in construction costs due to higher-than-normal inflation have increased the up-front capital costs of building a parallel secondary system. As a result of these issues, the City has decided to limit secondary water to those areas within the City where there is already a commitment to extend secondary water or where potential irrigated areas are in relatively close proximity to existing secondary facilities. For any undeveloped areas on the extremities of the City where significant infrastructure has yet to be built, the City has elected to provide only culinary water for outdoor irrigation.

- **Water Quality –** One other change that the City would like to make that will affect the City's long-term supply needs is a desire to use JVWCD water through the winter to rely less on City wells for culinary supply. This is due to the higher dissolved mineral content in City groundwater that can reduce the overall water quality relative to treated surface water from JVWCD.
- **JVWCD Water Budget –**The Jordan Valley Water Conservancy District (JVWCD) is planning on adopting a limited water budget for all developing areas within its service area. The tentative water supply budget will limit provided water to no more than 1.35 acre-ft of water per acre of undeveloped area. Any water demand above and beyond the allotted budget will require developers to pay a fee in lieu of (fee to be determined) or to bring additional water rights (underground, Utah Lake, or other) to satisfy demand. This will not affect the planning of demands as part of this water master plan because it is assumed developers will be willing to pay the fee or find water rights. However, the effects of a limited water budget from JVWCD will be important to consider as part of the City's future water supply plans.
- **Conservation –** The State of Utah adopted conservation goals in 2019, customized to various regions throughout the state. This master plan projects demands based on these goals.
- **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 City 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 City needs to consider the potential effects of climate change in its demand and supply planning.

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

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 a combination of City developed projections and Wasatch Front Regional Council (WFRC) projections to project future residential and employment populations in the Herriman City service area thru 2065. Buildout projections will primarily be based on the City's the adopted general plan of land use less the area recently annexed by South Jordan City. The rate of growth of the residential population will be based on City estimates of population growth. The rate of growth for non-residential populations will be proportional to the area of land development. 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 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 – Evaluate Available Water Supply

The report will examine all identified potential water sources for Herriman including wholesale water provided by the Jordan Valley Water Conservancy District, groundwater, springs, 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 City 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 City sources to meet projected demands on an annual volumetric basis will be evaluated.
- The adequacy of City 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 City'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. Of special significance to the City assumptions relative to:

- future growth patterns,
- service area expansion,
- source availability,
- assumed conservation, and
- development densities, especially in annexation areas.

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 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:

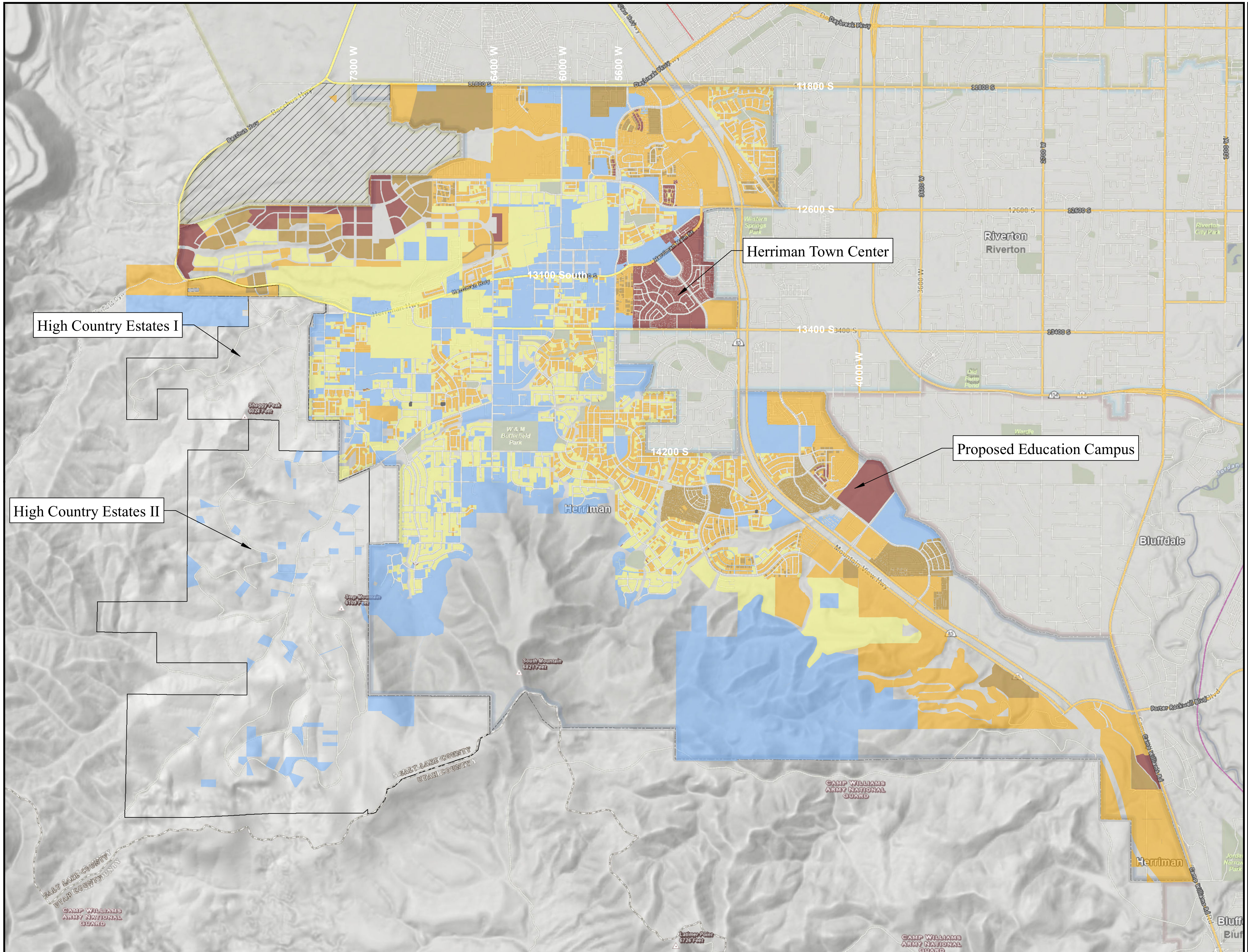
1. Define the service area
2. Project residential populations and non-residential growth for the service area based on existing and projected patterns of development
3. Project equivalent residential connections for the service area based on projected growth of residential population and non-residential growth
4. 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
5. Convert projections of equivalent residential connections and land use to water demands based on their historic contributions
6. 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

The Herriman City water system service area is shown in Figure 2-1. For the most part, the system serves all development within the incorporated area of Herriman City. Herriman City also serves some of the demands of the High Country Estate subdivisions (Phases I and II which are not part of Herriman City) as a wholesale supply to the subdivisions. Included in Figure 2-1 is the approximate density in Herriman City of indoor equivalent residential connections (ERCs) per acre based on the City's general plan. The general plan includes a currently undeveloped and unannexed area on the northwest boundary of the City.

Table 2-1 lists the general plan land use types for the area shown in Figure 2-1. Included in the table are the residential and non-residential development densities planned for each land use type.



Legend

- Alternate Alignments GIS

TotDens

- 0.0 - 0.3
- 0.4 - 2.0
- 2.1 - 4.0
- 4.1 - 8.0
- 8.1 - 12.0
- 12.1 - 22.0
- Existing Corporate Boundary
- Recently Annexed to South Jordan
- High Country Estates

NORTH:

SCALE: 0 2,000 4,000 Feet

HERRIMAN CITY PROJECTED DEVELOPMENT DENSITY

HERRIMAN CITY
WATER SYSTEM MASTER PLAN

BOWEN COLLINS & ASSOCIATES

FIGURE NO. 2-1

P:\Herriman\217-21-03 - Water Master Plan Update\4.0 GIS\Figure 2-1 - Herriman City Landuse.mxd amckinnon 3/12/2024

Table 2-1
Herriman City Zoning Types

Future Land Use	Area (acre)	Average Planning Density of Residential Connections [1]	Buildout Residential population [2]	Non-residential Average Density of Equivalent Residential Connections [3]
Roads/Infrastructure/ROW	449	0.00	0	0.00
Open Space	3,052	0.00	0	0.00
Utilities/Support Services	707	0.00	0	0.00
Parks/Plazas	591	0.00	0	0.00
Mountain/Canyon Residential	4,573	0.29	4,635	0.00
Forest Residential/Recreational Resort	503	0.40	706	0.00
Civic/Community	416	0.00	825	1.05
Hillside/Agricultural Residential	932	1.34	5,824	0.00
Neighborhood Residential One	2,989	3.75	45,354	0.00
Neighborhood Commercial/Node	210	3.03	2,147	1.01
Office Mixed Use	50	4.40	721	0.49
Employment Campus/Business Park	657	0.00	120	5.10
General Retail	372	0.26	599	4.93
Neighborhood Residential Two	1,394	8.00	36,566	0.00
Mixed Use Neighborhood One	570	7.20	17,362	4.80
Mixed Neighborhood Two/Towne Center	378	12.31	18,414	3.69
Educational Village/Campus	88	0.00	0	17.67
	17,929	**2.91**	**133,274**	

[1] Herriman City planning personnel estimate this will be the average density for this type of land use at buildout.
[2] Based on 2020 U.S. Census Population household size of 3.51 persons/household.
[3] Estimated non-residential density based on historical indoor water use for similar land use or from planning information available for the area.

Secondary Water Service Area

Herriman City currently operates a secondary water system that is used to irrigate some portions of the City. Until recently, the City had planned on extending secondary water to most undeveloped parts of the City below an elevation of 5,270 ft. The City has since changed policy to only extend secondary water to areas where the City has previously made firm commitments to extend water or where there is a significant amount of outdoor irrigation demand (parks or open space) that could benefit from secondary water. Most of the undeveloped areas toward the northwest and southeast of the City will no longer have secondary water extended to them. Figure 2-2 summarizes the areas identified by City personnel where secondary water has been, will be, or may be extended along with areas where secondary water will not be extended.

RATES OF GROWTH

Residential

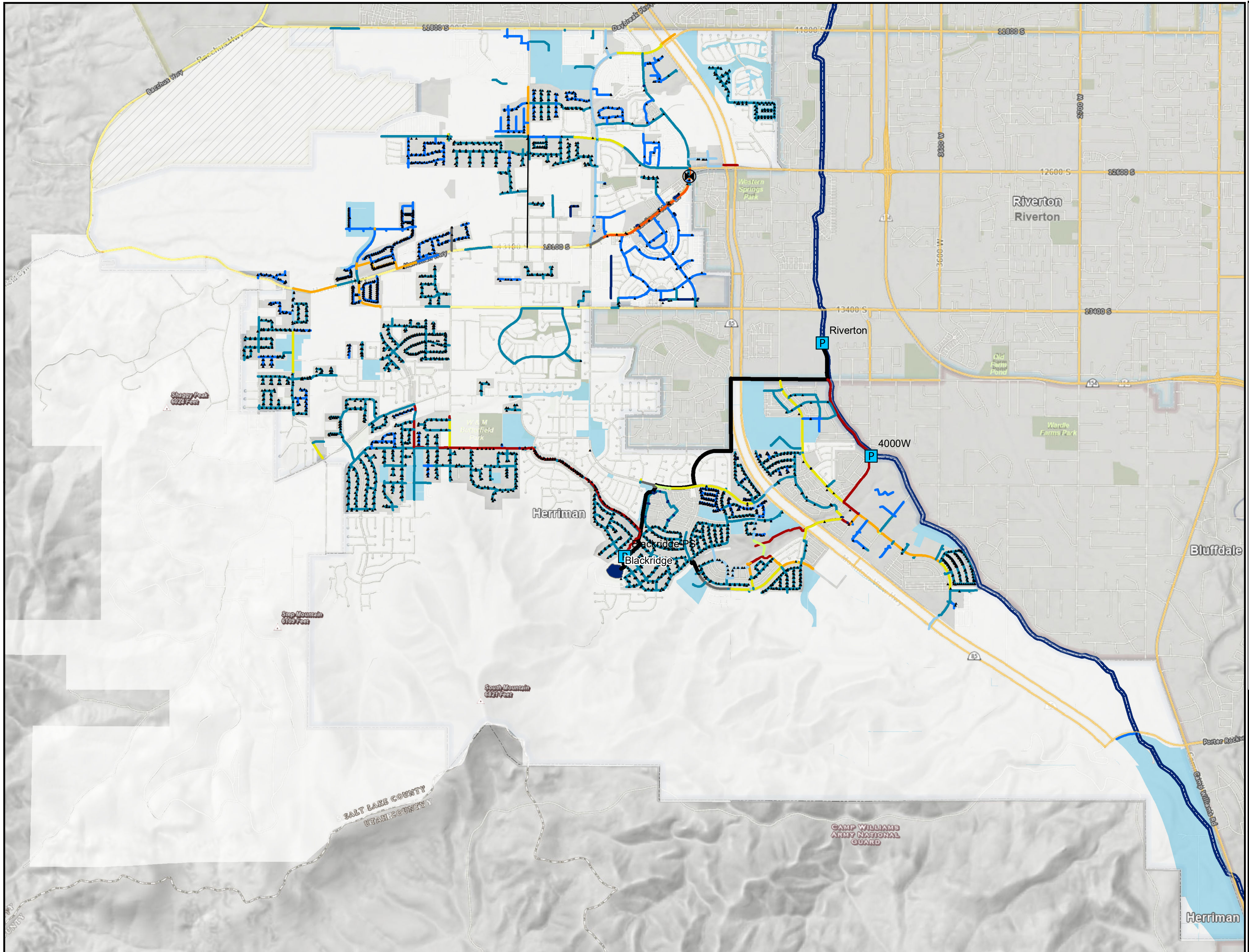
Herriman City has been one of the fastest growing communities in the State of Utah, and growth within the City has consistently been higher than predicted by the State of Utah Governor's Office of Planning and Budget (GOPB) or the WFRC planning values. As a result, the City has prepared its own projections of population based on recent growth rates and as a function of the City's buildout planning population. Figure 2-3 and Table 2-2 summarize the projected growth of the City's residential population through 2065.

Table 2-2
Herriman City Residential Population Projection

Year	Residential Population Projection
2010	21,785
2020	55,144
2024	68,861
2025	73,089
2030	92,854
2034	105,655
2035	108,342
2040	118,820
2045	125,221
2050	128,892
2055	130,921
2060	132,020
2065	132,608

A few of the assumptions used to develop these projections are described below.

- **Household Size –** The most recent US Census (2020) count of population and housing units was used to calculate an average household size of 3.51 persons/household. Although the housing density is increasing in Herriman and there have been historical declines in the household size, the City does not anticipate the total number of persons per unit to significantly decline from current levels. This is based on a number of factors including the passage of an accessory dwelling unit law by the State of Utah legislature as well as housing shortage concerns. While fertility rates and family size may continue to decline, higher utilization of housing units is projected to keep the persons per unit from declining.
- **Land Use Densities –** Herriman City land use types include a range of densities allowed for development. Planning personnel have assumed that densities of future growth will be approximately an average of the range of densities allowed.



Legend

- P Booster Pumps
- 2023 Secondary Account

Existing Secondary Pipe

- 4-inch
- 6-inch
- 8-inch
- 10-inch
- 12-inch
- 14-inch
- 16-inch
- 18-inch
- 20-inch
- 24-inch
- 30-inch
- Secondary Reservoir
- Welby Jacob Canal

Secondary Coverage

- Active or Future Secondary
- No Future Secondary
- Potential Secondary as Available
- Existing Corporate Boundary
- Recently Annexed to South Jordan

NORTH:

SCALE: 0 2,000 4,000 Feet

SECONDARY WATER SERVICE AREA

HERRIMAN CITY

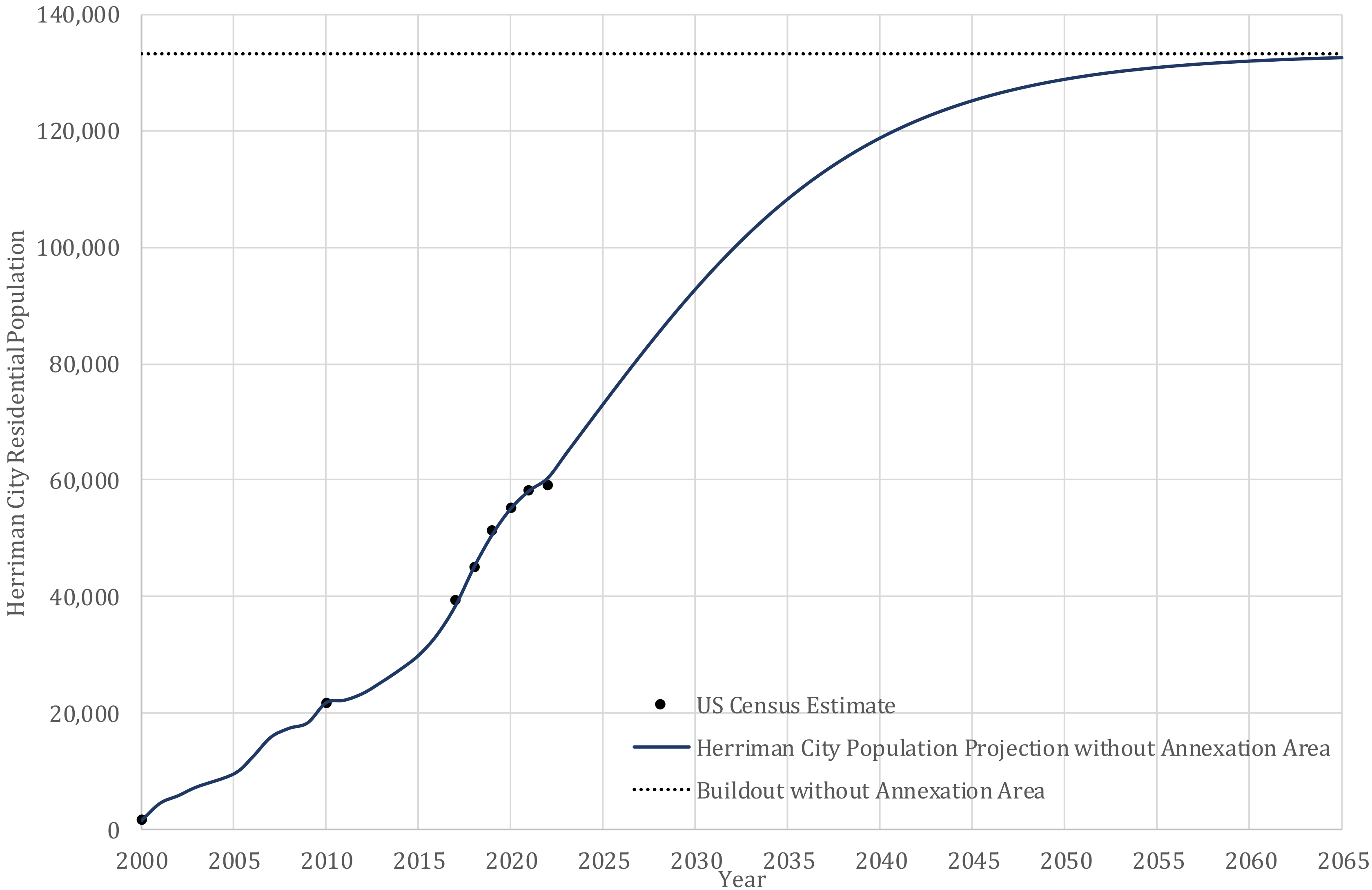
WATER MASTER PLAN

BOWEN COLLINS & ASSOCIATES

FIGURE NO. 2-2

P:\Herriman\217-21-03 - Water Master Plan Update\4.0 GIS\Figure 2-2 Secondary Coverage.mxd amckinnon 3/12/2024

Figure 2-3 Herriman City Residential Population Projection



- **Existing Population –** The last census of Herriman City's population was in 2020. The 2023 estimate of the existing population used the 2022 census estimate and added approved housing permits through 2023.
- **2024 to 2033** – Growth over the next 10 years was estimated by identifying the areas of likely growth based on recent developer provided information and comparisons to historic growth over the last 10 years. A roughly linear growth curve has been used from 2023 to 2033.
- **2034 to 2065 Growth** – A logistical growth curve was identified for remaining growth in the City assuming the City develops to 99.5 percent of its buildout population by 2065.

Non-Residential

Thus far, growth projections have only addressed residential growth. However, non-residential development will also place significant demands on City utilities and must be accounted for. Non-residential growth can sometimes be difficult to quantify because demands associated with non-residential development will vary depending on the type of development. Non-residential growth affects both indoor and outdoor demands differently depending on the type of development. For indoor demands, non-residential growth projections were developed using the following guidelines:

- **Existing Non-Residential Development** – Based on indoor water use records, existing non-residential development used the same amount of water as approximately 2,824 equivalent residential connections (ERCs) in 2021. This is equivalent to a residential population of 9,914.
- **Non-Residential Development at Buildout –** Projected non-residential development at buildout based on land use is summarized in Table 2-3. Non-residential development expressed in terms of both ERCs and equivalent residential population.
- **Projected Non-Residential Growth –** Using similar assumptions to those identified previously for residential growth (e.g. logistic growth curve, buildout as calculated in Table 2-3, etc.), non-residential growth has been projected for the City and is summarized in Table 2-4.

As can be seen in the last column of Table 2-4, the percentage of non-residential contributions to the City's overall water demand is expected to increase significantly through the year 2065. This is not unexpected as the City is still young and currently heavy on residential development. As the City matures, a greater portion of commercial, institutional, and industrial development is expected. Addition of an expected college / education campus in the City will also add significantly to the portion of water used by non-residential development.

Table 2-3
Herriman City Non-Residential Buildout Equivalent Residential Connections

Future Land Use	Area (acre)	Non-residential Average Density of Equivalent Residential Connections[3]	Number of ERCs	Equivalent Residential Population
Roads/Infrastructure/ROW	449	0.00	0	0
Open Space	3,052	0.00	0	0
Utilities/Support Services	707	0.00	0	0
Parks/Plazas	591	0.00	0	0
Mountain/Canyon Residential	4,573	0.00	0	0
Forest Residential/Recreational Resort	503	0.00	0	0
Civic/Community	416	1.05	435	1,526
Hillside/Agricultural Residential	932	0.00	0	0
Neighborhood Residential One	2,989	0.00	0	0
Neighborhood Commercial/Node	210	1.10	232	814
Office Mixed Use	50	0.49	24	85
Employment Campus/Business Park	657	3.95	2,591	9,096
General Retail	372	4.93	1,834	6,438
Neighborhood Residential Two	1,394	0.00	0	0
Mixed Use Neighborhood One	570	4.79	2,732	9,591
Mixed Neighborhood Two/Towne Center	378	3.55	1,340	4,702
Educational Village/Campus	88	17.67	1,556	5,462
Total	**17,929**		**10,745**	**39,756**

Table 2-4
Equivalent Non-Residential Population Projection

Year	Residential Population Projection	Equivalent Non-Residential Population[1]	Residential + Equivalent Residential Population	Percentage of Non-Residential
2010	21,785	2,202	23,987	10.1%
2020	55,144	9,093	64,237	16.5%
2024	68,861	12,647	81,508	18.4%
2025	73,089	13,930	87,019	19.1%
2030	92,854	20,950	113,804	22.6%
2034	105,655	26,460	132,115	25.0%
2035	108,342	27,712	136,054	25.6%
2040	118,820	32,845	151,664	27.6%
2045	125,221	36,080	161,301	28.8%
2050	128,892	37,887	166,779	29.4%
2055	130,921	38,829	169,750	29.7%
2060	132,020	39,302	171,321	29.8%
2065	132,608	39,535	172,143	29.8%

TOTAL ERC PROJECTIONS

For the purpose of water demand modeling, it is also convenient to convert these growth projections into ERCs as summarized in Table 2-5. Residential units were calculated based on household size while nonresidential connections were estimated based on land use and estimated indoor water use data listed in Table 2-4.

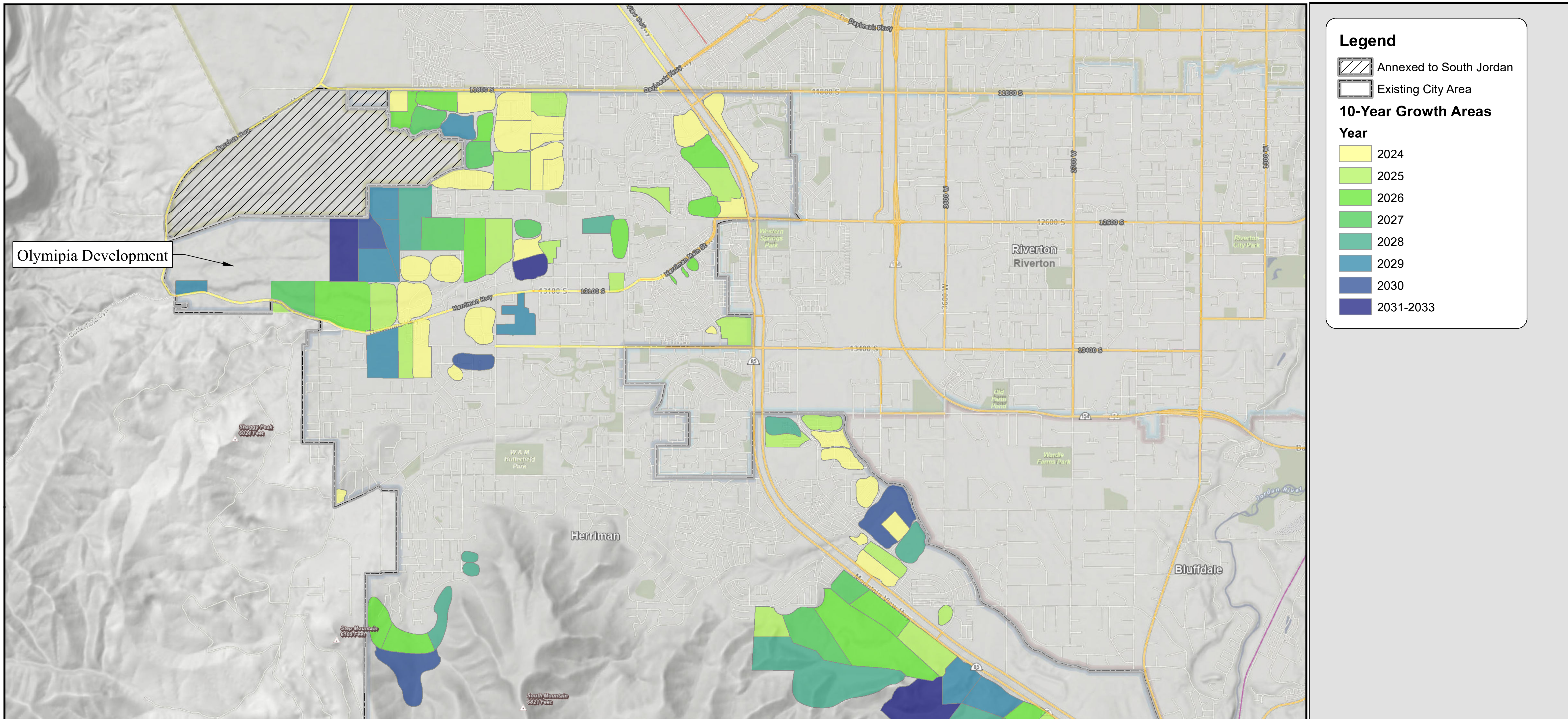
Table 2-5
Total ERC Projection

Year	Residential Connections[1]	Non-Residential ERCs[2]	Total ERCs
2010	5,572	563	6,135
2020	12,686	2,547	15,233
2024	12,776	2,824	15,600
2025	20,823	3,969	24,792
2030	26,454	5,969	32,423
2034	30,101	7,539	37,640
2035	30,867	7,895	38,762
2040	33,852	9,357	43,209
2045	35,676	10,279	45,955
2050	36,721	10,794	47,515
2055	37,299	11,062	48,362
2060	37,612	11,197	48,809
2065	37,780	11,263	49,043

[1] residential connections come from State of Utah reports for 2010, 2020. For future projections, residential connections is based on household size assuming a similar proportion of multifamily units and an average household size of 3.51 persons/unit.
[2]nonresidential units were generally calculated by matching the growth rate of the residential population and tapering toward 2065 similar to the logistic curve for residential growth.

SHORT-TERM GROWTH DISTRIBUTION

In addition to projecting overall growth in the City, planning efforts for City infrastructure must also consider where this growth will occur. Based on information provided by developers and the availability of developable lands, the City's planning department has identified where it anticipates growth will occur within existing City limits over the next 10 years. Figure 2-4 shows the general location and timing of future growth while Table 2-6 summarizes the amount of growth possible within the areas identified based on the land use type.



PROJECTED AREAS OF GROWTH WITHIN 10-YEARS

HERRIMAN CITY

WATER SYSTEM MASTER PLAN

BOWEN COLLINS & ASSOCIATES

FIGURE NO.

2-4

P:\Herriman\217-21-03 - Water Master Plan Update\4.0 GIS\Figure 2-4 - 10-year Growth.mxd amckinnon 3/15/2024

Table 2-6
10-Year Population Growth and Non-Residential Growth
(January 1, 2022 City Limit)

Future Land Use	Area (acres)	Residential Units	Residential Population	Non-Residential Connections	Equivalent Residential Connections
Roads/Infrastructure/ROW	26	0	0	0	0
Open Space	102	0	0	0	0
Utilities/Support Services	23	0	0	0	0
Parks/Plazas	53	0	0	0	0
Mountain/Canyon Residential	139	40	148	0	0
Forest Residential/Recreational Resort	12	5	18	0	0
Civic/Community	83	0	0	87	320
Hillside/Agricultural Residential	543	729	2,699	0	0
Neighborhood Residential One	714	2,663	9,854	0	0
Neighborhood Commercial/Node	91	277	1,024	92	341
Office Mixed Use	42	185	685	21	76
Employment Campus/Business Park	154	0	0	787	2,912
General Retail	229	59	220	1,129	4,177
Neighborhood Residential Two	629	5,028	18,605	0	0
Mixed Use Neighborhood One	263	1,876	6,942	1,251	4,628
Mixed Neighborhood Two/Towne Center	106	1,304	4,824	391	1,445
Educational Village/Campus	84	0	0	1,478	5,468
Total	**3,293**	**12,167**	**45,018**	**5,235**	**19,368**

Based on the areas of expected growth in the next 10 years identified by the City, a few observations about 10-year growth are identified below:

- **Growth Rate Projection –** The City's projected growth rate would predict a total of 15,197additionalERCs by the year 2034 (average growth of 5.3 percent based on projections). This is somewhat less than the growth predicted by the area identified in Figure 2-4. As a result, the areas identified in Figure 2-4 are not anticipated to fully develop by the year 2034.
- **10-Year Areas of Growth –** In addition to the areas identified by the area of growth by the City, there may be other small "in-fill" areas in the City that will continue to grow that have not been specifically identified by the City.

ANNUAL WATER DEMAND BY LAND USE

In addition to helping define the number of residents and nonresidents in the City, the City's general plan of land use is also critical in defining the amount of indoor and outdoor water demand under buildout conditions. Table 2-7 shows the estimated indoor and outdoor demand requirements by land use at buildout. Indoor production is related to both residential and nonresidential populations within the City while outdoor production is more related to the type of land use and irrigation needs.

Table 2-7
Annual Indoor / Outdoor Water Production Requirement by Land Use Type

Zone Type	Total Area (acres)	Indoor Water Use (acre-ft/year) [1]	Outdoor Water Use (acre-ft/year) [1]	Total Water Use (acre-ft/year) [1]
Roads/Infrastructure/ROW	449	0.000	0.000	0.000
Open Space	3,052	0.000	0.000	0.000
Utilities/Support Services	707	0.000	0.061	0.061
Parks/Plazas	591	0.000	2.763	2.763
Mountain/Canyon Residential	4,573	0.072	0.014	0.086
Forest Residential/Recreational Resort	503	0.099	0.028	0.127
Civic/Community	416	0.260	2.456	2.716
Hillside/Agricultural Residential	932	0.334	0.935	1.269
Neighborhood Residential One	2,989	0.933	1.376	2.309
Neighborhood Commercial/Node	210	1.005	0.614	1.619
Office Mixed Use	50	1.218	0.614	1.832
Employment Campus/Business Park	657	1.269	0.461	1.730
General Retail	372	1.293	0.461	1.754
Neighborhood Residential Two	1,394	1.989	1.102	3.091
Mixed Use Neighborhood One	570	2.984	1.087	4.071
Mixed Neighborhood Two/Towne Center	378	3.979	0.614	4.593
Educational Village/Campus	88	4.394	1.300	5.694

[1] Production requirements are based on 2010 average rates of water use. Outdoor water use is based on 3.07 acre-ft/irrigated acre and assumed percentage of irrigation. Conservation effects will reduce water production requirements per acre through buildout.

The primary source of data for residential zoning was either Herriman City residential statistics or max gross allowable densities for zoning types. For the nonresidential zoning types, the primary source of data was other cities in the Wasatch Front area with similar land use types. Many of the proposed zoning types have not historically been used by Herriman City, so water use data from other cities in the Salt Lake Valley with similar land use types to those proposed were used to estimate future growth. Using water sales data from Herriman and other cities, BC&A examined historic water use in areas where full development at a given zoning type has already occurred. It has been assumed that historic water use in these fully developed areas will be a good estimate of future use in similarly zoned areas (without conservation). For zoning types where there was insufficient water use data to calculate a meaningful number, BC&A estimated water use based on the planning density allowed in the general plan, or based on similar zoning types in Herriman City, descriptions of proposed development, and/or estimates for similar zoning types calculated for other communities in Salt Lake County. It should be noted the estimates for all zoning types are based on the total water production requirement and include an adjustment to water sales data to account for system loss.

Regional Conservation Goals

The State of Utah set water conservation goals for different regions of the State in November 2019. Regional goals were set to better represent the diverse geography and region-specific water use requirements in the State. The Regional Conservation Goals identified for the Salt Lake Region recommend reducing year 2015 per capita water use by 11 percent by the year 2030 and 19 percent by the year 2065. This State of Utah Regional goal was used as a guideline to help establish the City's conservation goals even if the City's goal will be based on a 2010 baseline.

Herriman Conservation Goal

For Herriman City, unfortunately, 2015 will not represent the most useful year to begin as a baseline for conservation. Because the City was still in the process of phasing in use of its secondary water system, data irregularities due to the secondary water system made reported water usage in this year less accurate and useful. Data from the year 2010 is considered more reliable because the City had not yet begun using secondary water. Herriman City will match the conservation goal for the Salt Lake Region but use a 2010 baseline for conservation goals with an added 5 percent conservation from 2010 to 2015 assuming 1 percent conservation per year for that period.
Required reductions to meet the City's goal are also summarized in Table 2-8.

Table 2-8
Conservation Goal with Milestones Through 2065

Year	Percent Conservation	New Salt Lake Region Goal Milestones Reduction (gpcd)
2010	0%	192.8
2015	5.0%	183.2
2018	7.6%	178.1
2020	9.0%	175.4
2025	12.5%	168.7
2030	15.3%	162.0
2065	24.0%	146.5

The production rates listed in Table 2-8 are based on 2010 historical water use data. However, Herriman City plans on reducing water use on a per capita and area basis based on new regional conservation goals developed by the State of Utah. Based on the land use and population projections, annual water demands through 2065 were projected with conservation effects as shown in Figure 2-5. It is worth noting that 2020 annual demands were higher than the City's 2010 projected demands without conservation and indicates a need for more aggressive conservation measures.

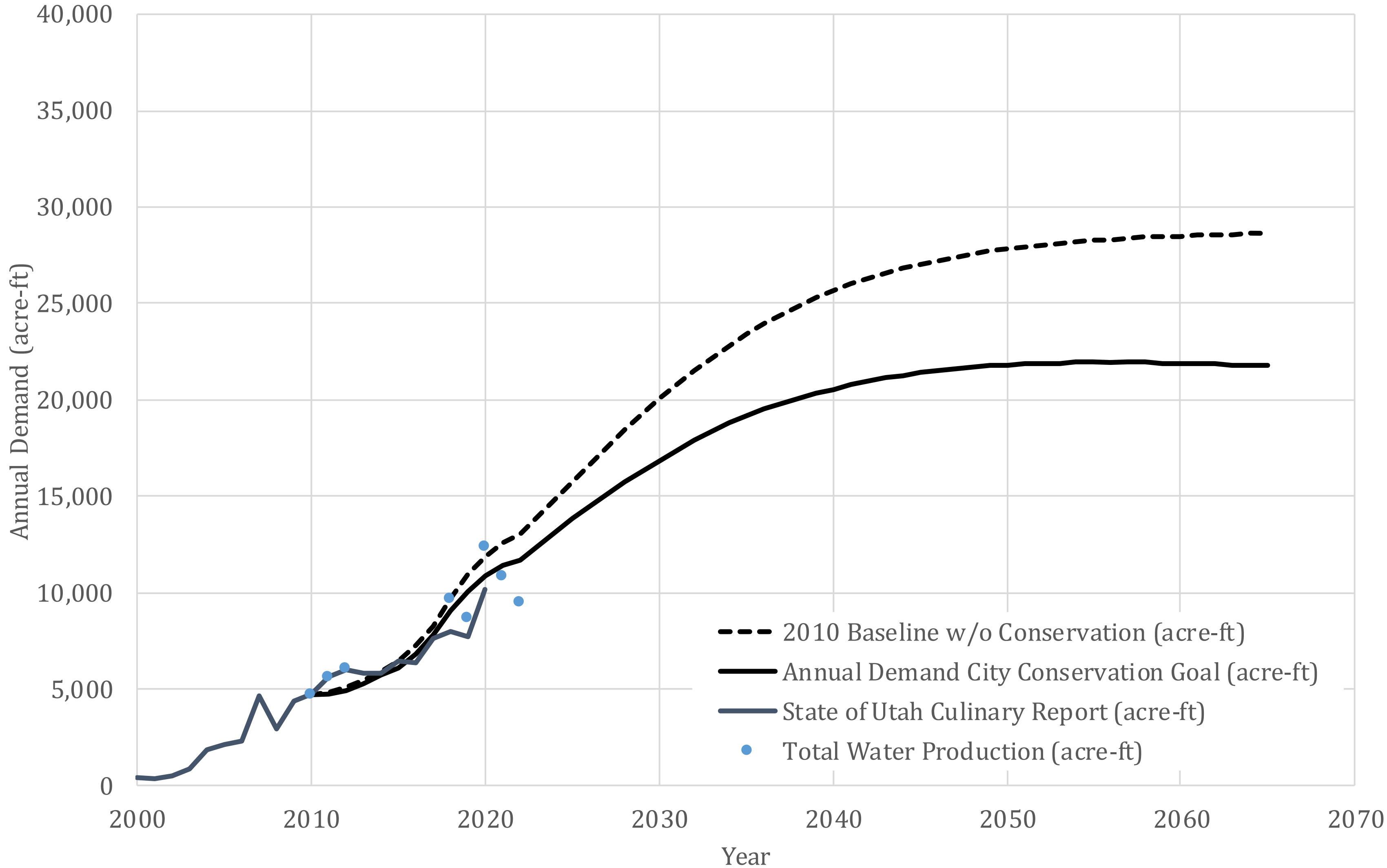
In December 2020, the City adopted a new water efficiency and landscape ordinance that will predominantly apply to future growth. There may be a need to offer incentives to existing water users to adopt water wise standards to avoid exceeding conservation goals as occurred in 2020. 2021 and 2022 annual demands were heavily influenced by drought education efforts and were consequently better than the City's water conservation target. Table 2-9 shows the estimated percent reduction in water use by land use type with the City's new water efficient landscape assumed effects.

Table 2-9
Water Efficient Landscape Effects

Zone Type	2010 Outdoor Water Use (acre-ft/year)	Future Outdoor Use Estimate (acre-ft/year)	Percent Reduction
Roads/Infrastructure/ROW	0.000	0.000	0%
Open Space	0.000	0.000	0%
Utilities/Support Services	0.061	0.036	40%
Parks/Plazas	2.763	2.298	17%
Mountain/Canyon Residential	0.014	0.012	16%
Forest Residential/Recreational Resort	0.028	0.023	16%
Civic/Community	2.456	1.540	37%
Hillside/Agricultural Residential	0.935	0.715	24%
Neighborhood Residential One	1.376	1.046	24%
Neighborhood Commercial/Node	0.614	0.273	56%
Office Mixed Use	0.614	0.273	56%
Employment Campus/Business Park	0.461	0.273	41%
General Retail	0.461	0.273	41%
Neighborhood Residential Two	1.102	0.837	24%
Mixed Use Neighborhood One	1.087	0.821	24%
Mixed Neighborhood Two/Towne Center	0.614	0.469	24%
Educational Village/Campus	1.300	1.008	22%

Percent reduction assumes full compliance for nonresidential zoning types and residential front landscapes with partial compliance for residential backyards. Many zoning types have more or less conservation than the City's conservation goal depending on the amount of existing sod versus required sod. Parks / Plazas could have significantly better performance depending on how much active playfields are used. However, for planning purposes, land use identified as Parks / Plazas were assumed to have 53 percent coverage with turf playfields and 17 percent coverage with water efficient landscape with 30 percent non-irrigated area (parking, hardscape, etc.).

Figure 2-5 Annual Demand Projection and Conservation Effects



PEAK DAY DEMAND PROJECTIONS

Based on annual demand, peak day demands can be estimated using peaking factors. Table 2-10 summarizes the estimated peaking factors and peak day demands projected for the culinary and secondary systems. Peaking factors are primarily based on data compiled in 2010. In 2010, the City had not begun using its secondary system yet, so all data shown is culinary water use. Based on the 2018 and 2020 data, projections of peak day demand appear to match the proposed conservation projection. Until a longer history of accurate secondary data can be documented, however, the peaking factors listed in Table 2-10 are considered prudent for planning purposes.

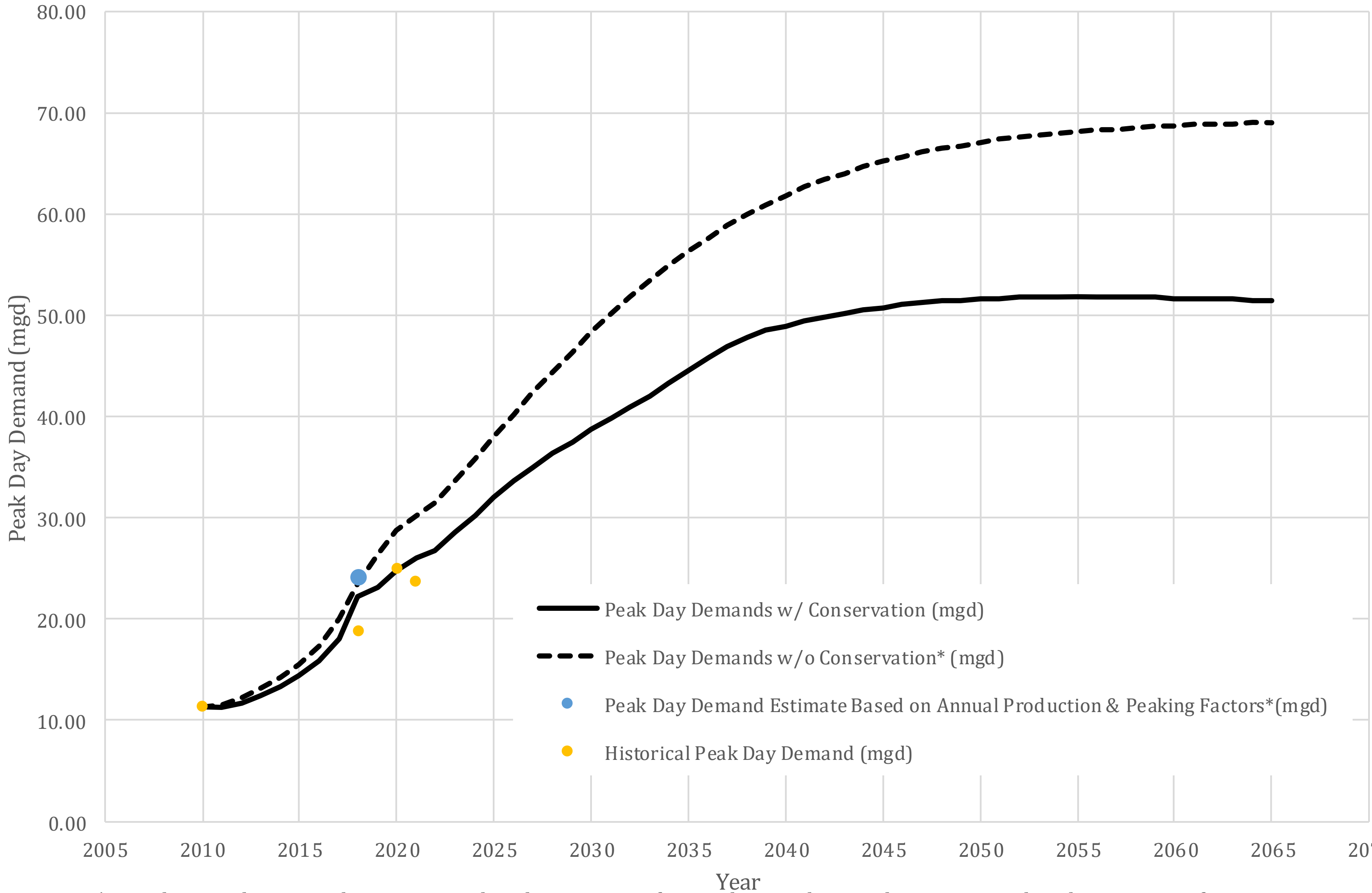
Table 2-10
Peak Day Factors and Build-Out Demand for Culinary and Secondary Water

Service Area	Culinary Peak Day Demand Peaking Factor	Secondary Peak Day Demand Factor
Areas with Secondary Water Service	1.25[a]	3.3[b]
Areas without Secondary Water Service	2.7[c]	0
Total		

[a] Secondary water service was not available in 2010, and there is no reliable data available to estimate the indoor peak day factor for areas with secondary water service. It is estimated that indoor water use during the peak day of demand will be higher than winter water use. The peaking factor shown here has been assumed as a safety factor for planning purposes.
[b] Based on estimate of total outdoor demand for 2010 and outdoor demand on July 12, 2010 (peak day demand).
[c] The peak day factor for culinary indoor/outdoor demand is expected to decline over time as more areas of Herriman City have a dedicated secondary irrigation system. In addition, the development of more non-residential areas will have the effect of reducing the overall peaking factor over time. Recent conservation policies may also affect peaking factors over time. However, to be conservative, this analysis assumes that the peaking factor of 2.7 will remain about the same in the future.

Based on these peaking factors, it is possible to estimate the peak day demands for the system overall. Peak day demands are projected with and without conservation in Figure 2-6. Historic production rates are also shown for 2010 and 2020. Note that historical production data for secondary water has been difficult to accurately assess. The City is still in the process of upgrading its supervisory control and data acquisition systems to document culinary and secondary water uses within the City. For this study, data for secondary water use was only considered reliable for a few years over the last ten.

Figure 2-6 Peak Day Demand Projection and Conservation Effects



*Based on a Culinary Peak Day Demand Peaking Factor of 2.7 and Secondary Peak Day Demand Peaking Factor of 3.3

Future Production Requirements

Based on observed historic production requirements, Table 2-11 summarizes the calculated historic production rates for the City in year 2010 and projected future production rates for the City based on proposed conservation goals.

Table 2-11
Historic and Projected Production Requirement (With Conservation)

Component	Year 2010	Year 2024	Year 2034
Population	21,785	68,861	105,655
Equivalent Residential Connection (ERC) Estimate[1]	6,135	23,222	37,640
Annual Demand (gpd/ERC)	685	505	446
Average Annual Irrigation Rate (acre-ft/irrigated acre)	3.07	2.71	2.53
Indoor Use (gpcd)	60	54	50
Peak Day Demand Per Capita Production[2] (gpcd)	521	461	429
Peak Day Indoor Demand[3] (gpd/ERC)	265	250	231
Peak Day Irrigation Demand (gpd/irrigated acre)	9,044	7,995	7,453

[1] Equivalent residential connection as defined by indoor demands
[2] Includes all system demand, both residential and non-residential divided by the residential population in accordance with the standard for State of Utah conservation goals.
[3] Peak day indoor demands include an estimated 1.25 peaking factor compared to annual.

HIGH COUNTRY ESTATES

One exception to the City's land use plan that required changes to reflect future growth is the High Country Estate service area to the southwest of the City. The High Country Estates is included as part of the land use as part of the City's overall general plan, but is not part of the City and is a wholesale buyer of water from Herriman City. The City's general plan did not completely account for growth in High Country Estates based on the remaining developable lots. For this study, the City's land use was modified from the City's general plan to better reflect the planning for High Country Estates which is summarized in Table 2-12. This modification was incorporated into the tables above but is included for information purposes here.

Table 2-12
High Country Estates Demand Projections

	High Country – Phase I	High Country – Phase II	High Country – Total
Existing Annual Use (acre-ft)	96.5	89.2	186
Existing Peak Day Use Estimate (mgd)	0.134	0.124	0.259
Existing Peak Day Estimate (gpm)	94	86	180
Percentage Developed	100%	25%	64%
Future Annual Use (acre-ft)	96.5	356.6	453
Future Peak Day Use (mgd)	0.134	0.496	0.630
Future Peak Day Use (gpm)	94	344	438

These demands are incorporated into overall growth projections for the City.

CHAPTER 3
WATER SUPPLY PROJECTIONS

This chapter will describe the City'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 City's water sources can be found in "Existing Facilities" chapter of the Conveyance and Storage Master Plan.

WATER SUPPLY – EXISTING SOURCES

The City's existing water supply comes from a number of different sources. For planning purposes, the City's sources have been grouped into three categories: Jordan Valley Water Conservancy District wholesale water, Welby Jacob Canal shares, and groundwater sources.

Jordan Valley Water Conservancy District

The City has several connections to the Jordan Valley Water Conservancy District (JVWCD) where the City can purchase wholesale culinary water for delivery to its distribution system. Table 3-2 summarizes the size and location of JVWCD connections to the Herriman City culinary system.

Table 3-1
Existing JVWCD Connections to Herriman City

Location	Meter Size	Existing Capacity (gpm)	Nearby JVWCD Transmission Pipe Size	Estimated Capacity of Existing Transmission (gpm)
5600 W 13400 S (JV Zone C)	6" & 12"	3,084	30"	15,422
4900 W 11800 S (JV Zone C)	8" & 4"	1,376	20"	6,800
5690 W 12855 S (JV Zone C)	6" & 10"	2,330	20"	6,800
14500 S 5600 W (Rosecrest – JV Zone C)	16" & 6"	4,982	20"	6,800
6000 W 11800 S (JV Zone C)	12"	2,468	48"	30,000
15000 S 3200 W (JV Zone A)	12" & 24"	12,338	36"	22,000
11800 S U111 (JV Zone C)	16"	4,387	24"	9,900
11800 S U111 (JV Zone D)	16"	4,387	20"	6,800
Total		**35,352**		

While the City's connections to JVWCD have a large amount of capacity to draw water, the City's existing contract with JVWCD limits use to 5,867 acre-ft on an annual basis. However, the City does have the option of entering into an agreement to expand this contract. It is expected that the City will expand its JVWCD contract incrementally in the future as needed to meet growth in culinary demand.

Welby Jacob Canal

The City owns water shares in the Welby Jacob Canal. This canal runs along the east boundary of the City near Bluffdale and then through parts of Riverton City just east of the City. This is the City's largest secondary water source. A summary of canal shares owned by the City as of summer 2021 is summarized in Table 3-2.

Table 3-2
Welby Jacob Canal Share Summary

Total Number of Shares	Average Yield of Share	Reliable Yield of Share	Reliable Yield (acre-ft)
3,285	1.0	0.8	2,628

While the average yield of each share in the canal company is 1.0 acre-ft, this can be reduced in dry water years. For planning purposes, a reliable yield of 80 percent has been included in the table.

Peak capacity of the City's use of Welby Jacob water is limited to its 4000 West Secondary Pump Station which has a capacity of 13,200 gpm for buildout conditions. Current equipment capacity is limited to 6,800 gpm.

Groundwater Sources

The City owns water rights for a number of groundwater sources. For evaluation purposes, groundwater sources have been broken into two categories:

- **Springs –** Arnold Hollow Springs is located up Rose Canyon and provides a relatively high-quality culinary water source into the City's Zone 3 pressure zone. The lowest annual yield for the spring over the last 10 years was 76 acre-ft in 2013 with a peak flow of 64 gpm in July of that year. The City redeveloped the springs and built new collection lines in 2020, so the reliable flow may have increased since that project. However, data for reliable flow will not likely be available for several more years.
- **Groundwater Wells** – The City has nine existing groundwater wells that produce either culinary or secondary water depending on water quality. Lower quality wells are used within the secondary water system. Eventually the City intends to transition some of its culinary wells over to its secondary water system as secondary demands continue to increase.

Table 3-3 summarizes the characteristics of all the City's wells as well as the other sources in the City.

Table 3-3
Source Capacity Summary

Source	Source Type	Peak Capacity (gpm)	Reliable Yield (acre-ft)	Water Right[2] (acre-ft)	Planning Yield (acre-ft)
Arnold Hollow Springs[1,2]	Culinary	64	76.2		
HP Well #1[2]	Culinary	194	250.3		
HP Well #2[2]	Secondary	150	95.5		
HP Well #3[2]	Culinary	116	149.7		
HP Well #4[2]	Culinary	124	160.0		
Hamilton Well[2]	Culinary	1,750	2,258.2		
Stokes Well[2]	Culinary	200	258.1		
Tuscany Well[2]	Secondary	400	254.5		
Bodell Well[2]	Secondary	300	190.9		
Stillman Well[2]	Culinary	2,900	3,742.2	6,611	6,611
JVWTP[3]	Culinary	3,717	5,867	5,867	5,867
Welby Jacobs[4]	Secondary	6,800	2,628	3,285	2,628
Total		**16,715**	**15,931**	**15,763**	**15,106**

[1] Reliable yield for the spring is the average production since 2004. Capacity is the average over the year because no recent data is available. The City will also be rehabilitating the spring in 2020 which may increase reliable yields and capacity. For wells, reliable yield is 80 percent of well capacity at full time operation.

[2] Water rights for springs and wells have been consolidated. Approved consolidated rights = 5,438.972 af, Remaining well water rights = 1,172.182 af.

[3] JVWCD peak capacity and max yield is based on a contract. Estimated physical capacity is significantly higher.

[4] Average Welby Jacob shares yield 1 acre-ft/share during an average water year. Maximum reliable yield is estimated to be 80% of average water year. Peak capacity is based on existing equipment capacity at the City's 4000 West Secondary pump station (3,200 to Zone 3, 3,600 gpm to Zone 1).

The City also owns water shares from the Herriman Irrigation Company and Rose Creek Irrigation Company that allows diversion of water from the companies' ditches for a specified amount of time. The City may be able to use these sources to supply a future secondary water reservoir but does not have the ability to use these effectively now. The City also owns shares of the Utah & Salt Lake Canal Company, and the Utah Lake Distributing Company, but the City does not have a reliable turnout from canals associated with those companies.

WATER SUPPLY – FUTURE SOURCES

Annual Supply

Figure 3-1 shows the projected annual production requirements (both culinary and secondary) for Herriman City through 2065. Figure 3-1 also shows the potential sources available to meet the projected annual production requirements. Figures 3-2 and 3-3 show the breakdown of sources between culinary and secondary demand[1]. These figures assume that growth in secondary water use is limited to areas identified as "Active or Future Secondary" in Figure 2-2[2].

Based on these figures, several general conclusions can be made regarding the annual yield of Herriman City sources:

- For the past several years, annual demand from JVWCD exceeded agreed contract amounts. This was also true for peak day demand source capacity. The City will need to increase annual and peak capacity contracts with JVWCD to eliminate shortfalls in agreed supply.
- The City's latest hydrogeologic study indicates the maximum available groundwater available for development by the City could be up to 5,100 acre-ft. This is based on several assumptions.
    - JVWCD will not sell underground rights it currently owns.
    - Riverton City does not use its existing wells in the future based on a 2015 referendum to use JVWCD water.
    - Bluffdale City never develops any groundwater.

  If Riverton City does use its well or Bluffdale City is able to develop groundwater, the available volume would be reduced. Conversely, JVWCD could choose to sell some of its rights to the City. For the purpose of this study and based on a best estimate of expected available groundwater rights, it has been assumed the City will be able to develop approximately 2,000 acre-ft of groundwater via purchasing water from existing landowners that currently irrigate farms in the area.
- Herriman City's existing source production will not be satisfactory to meet production requirements through buildout, and the City will need to acquire more secondary and culinary sources to meet demands. It is expected that most of the culinary demand will be met by additional contractual purchases from JVWCD, with minor expansion of existing groundwater capacity, while secondary demand will be met by purchasing (or exchanging) shares of canal water.

[1] It will be noted that Figure 3-1 and 3-3 include a little more supply than projected demands. This is the result of the expected reduction in reliable yield of Welby Jacob shares during periods of drought. Each figure includes adequate supply to accommodate a reduction of up to 20% in the yield of Welby Jacob during drought years. See Chapter 4 for more discussion of supply variability.

[2] As noted, Figure 3-2 shows the culinary demand and supply assuming that growth of secondary service is limited to only committed areas (i.e. areas of "Active or Future Secondary per Figure 2-2). However, there is also a second demand scenario shown in Figure 3-2 that considers growth of secondary service to some additional "Potential Secondary" areas as identified in Figure 2-2. Similarly, Figure 3-3 primarily focuses on projected secondary annual demand for committed areas only but does include a scenario for potential additional secondary service areas. If the potential secondary areas are developed, the supply plan will generally stay the same except that the additional supply needed to meet demands would come from excess Welby Jacob water and the additional use of well water. This is discussed in greater detail subsequently.

Figure 3-1 Total Annual Demand & Supply Requirements

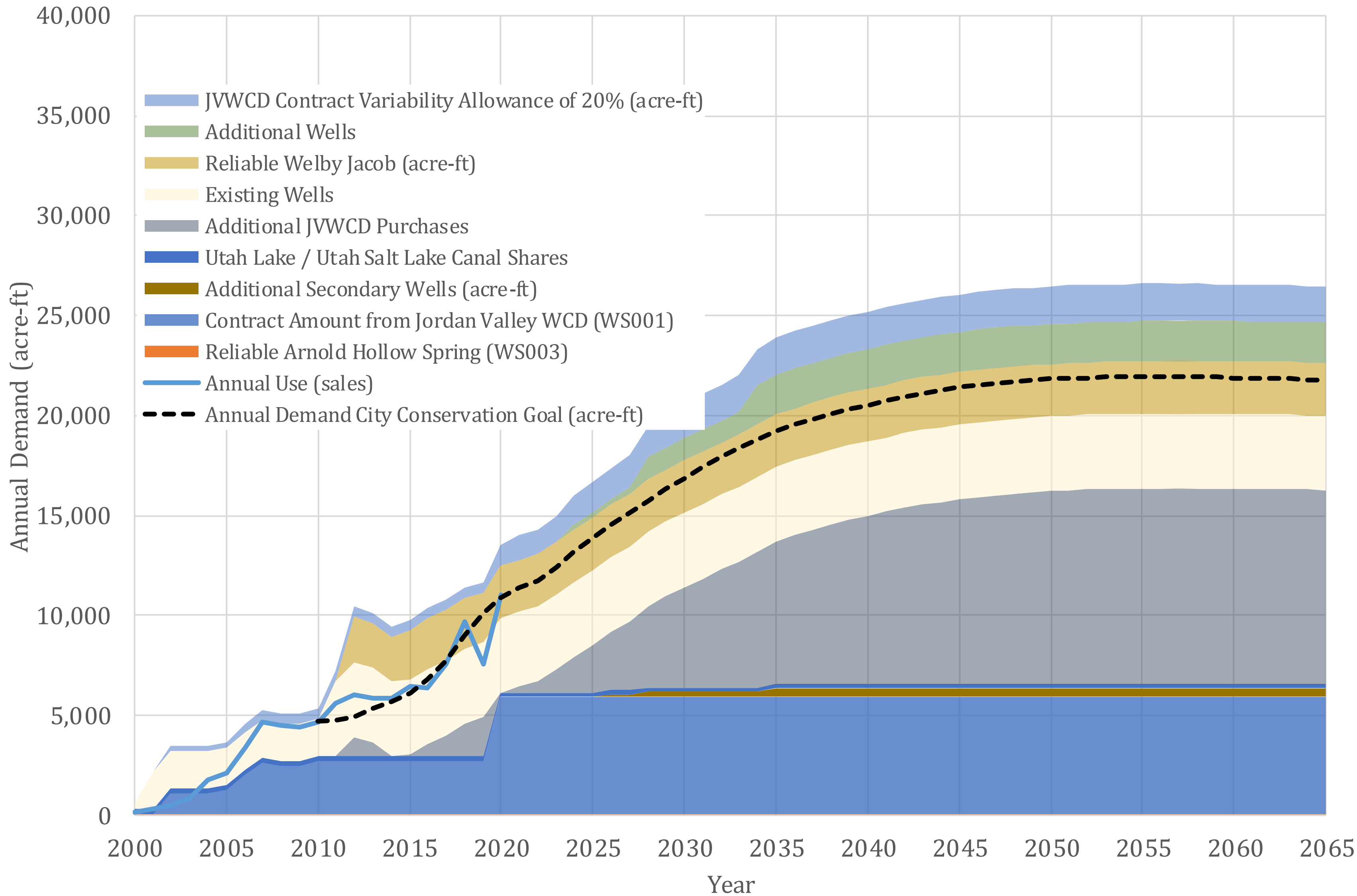


Figure 3-2 Annual Culinary Demand & Supply Requirements

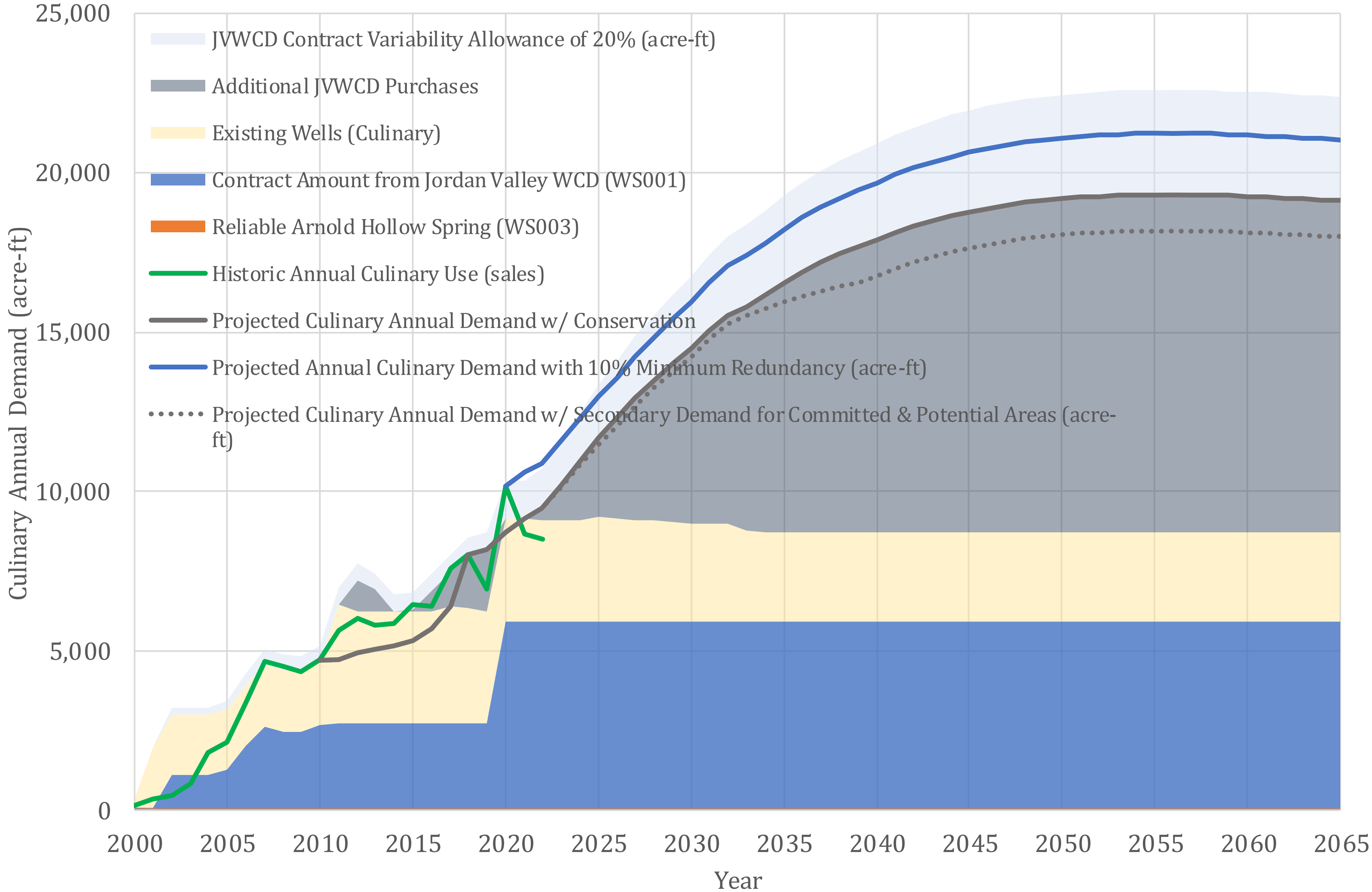
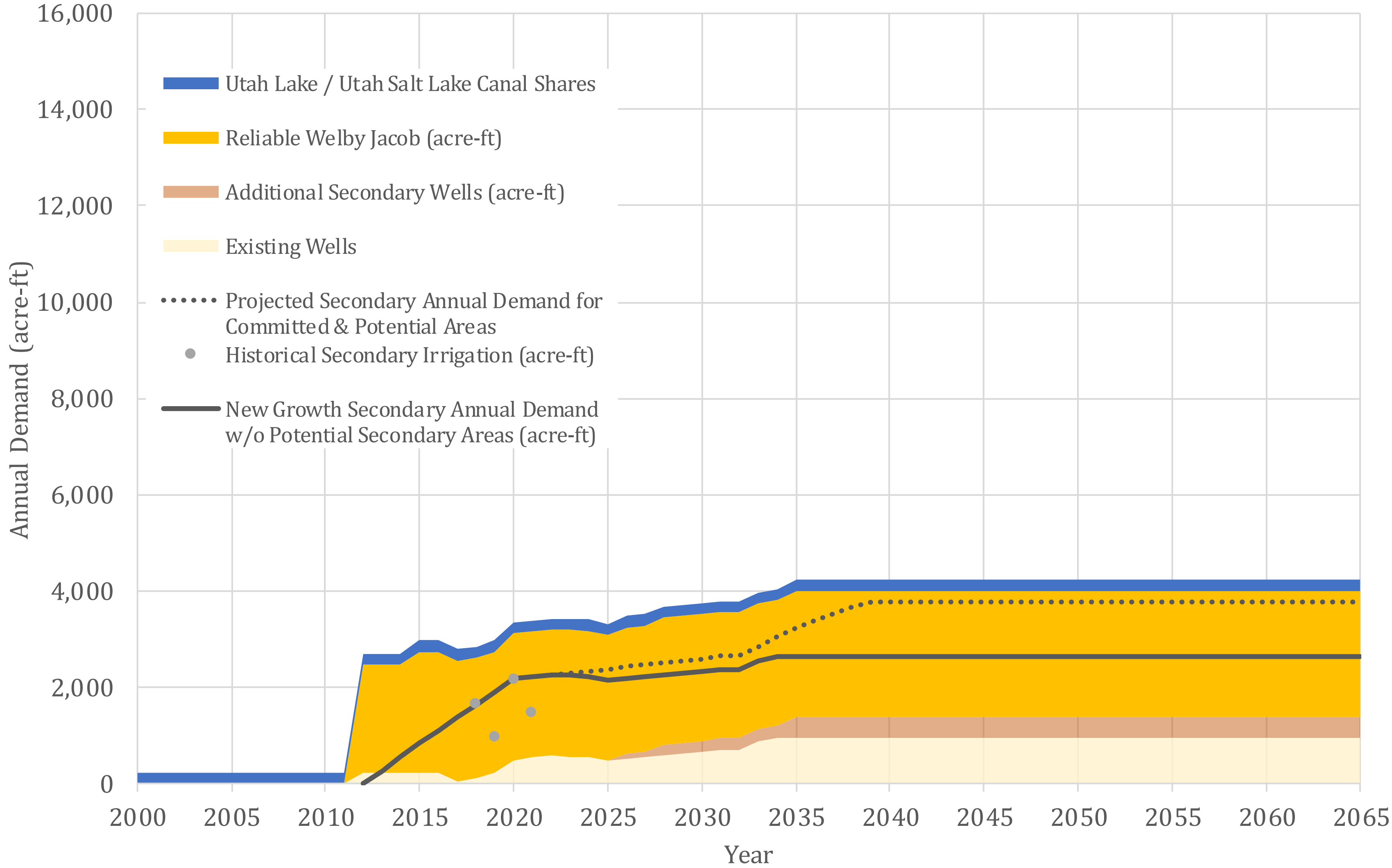


Figure 3-3 Annual Secondary Demand & Supply Requirements



- Bluffdale City currently helps to support a small portion of the City service area at the southeast corner of the City. The City does not currently have any nearby water infrastructure to support existing nonresidential customers in the area. Long term, Herriman City will have available connections for the area. However, Bluffdale has nearby storage and transmission facilities that might be more energy efficient to serve the area. Assuming an agreement could be negotiated, it may be more cost effective for Bluffdale to supply water for the area. Assuming only indoor demands would be supplied by Bluffdale City, a total of 460 acre-ft, 400 gpm (peak day demand), 300,000 gallons of storage would be needed to support this area. Fire storage for this area could be provided by Herriman City once connections to its facilities are available. Herriman would also potentially expand local secondary for this area by building a new pump station to pull off the canal in the vicinity.
- Figures 3-2 and 3-3 show shifting some existing well production capacity from culinary to secondary to meet secondary water needs. This shift may be even greater than shown if the secondary service area is expanded to pick up some or all of the "Potential Secondary" service areas. This shift should be done for several reasons:
  - It will be more cost effective to use wells to support secondary system demands than to get canal water over to the area. The existing Hamilton and Stillman Well already have a reduced pressure backflow preventer connection to support secondary and are currently the only means to support existing secondary water lines in the area. The City will only need to expand connections and conveyance off the Hamilton and Stillman Well to further support secondary water. To support the area with Welby Jacob water would require longer conveyance pipes connected to Blackridge Reservoir.
  - Because the source supply for JVWCD consists mostly of treated surface water that comes predominantly from snowmelt, the water quality is better than the City's existing well water which, while perfectly safe, typically has more dissolved minerals such as calcium and magnesium (which causes hard water and a less preferred taste). As City demands increase, it is assumed that JVWCD will make up the bulk of all culinary water supply in the City because of the relatively higher water quality, while well sources will primarily feed into the secondary system when it is impractical to mix with JVWCD water.

- If the City converts the "Potential Secondary" areas identified in Figure 2-2 to secondary water services, expected impacts are as follows:

  - Well Supply for Culinary – The annual demand shown in Figure 3-2 will decrease to track with the dotted line, but the well supply will also be reduced by a similar amount as the wells will be needed to meet more of the secondary demand. Thus, the net effect on supply requirements (and specifically the need for additional JVWCD water) will remain potentially unchanged, whether or not the potential secondary areas are converted.

  - Well Supply for Secondary - The annual demand shown in Figure 3-3 will increase and track with the dotted line, but the well supply will also increase by a similar amount as more City wells will be used to meet the secondary demand. The mix of Welby Jacob water to well water used to support secondary will depend on the area of the City the potential secondary area lies in. Generally, potential secondary areas in the eastern area of the City that are closer to Blackridge Reservoir will get canal water while other areas of the City will rely on well water.

Table 3-4 shows a summary of required supplies needed to satisfy 2065 demands. Table 3-4 shows a need for additional secondary water even though Figure 3-3 shows that the City already has sufficient source capacity to supply secondary. The additional secondary recommended is associated with groundwater sources that can be used to serve areas that currently have insufficient conveyance capacity to get water from other existing sources (see discussion of peak day demand for additional details).

Table 3-4
Future Annual Supply Requirements

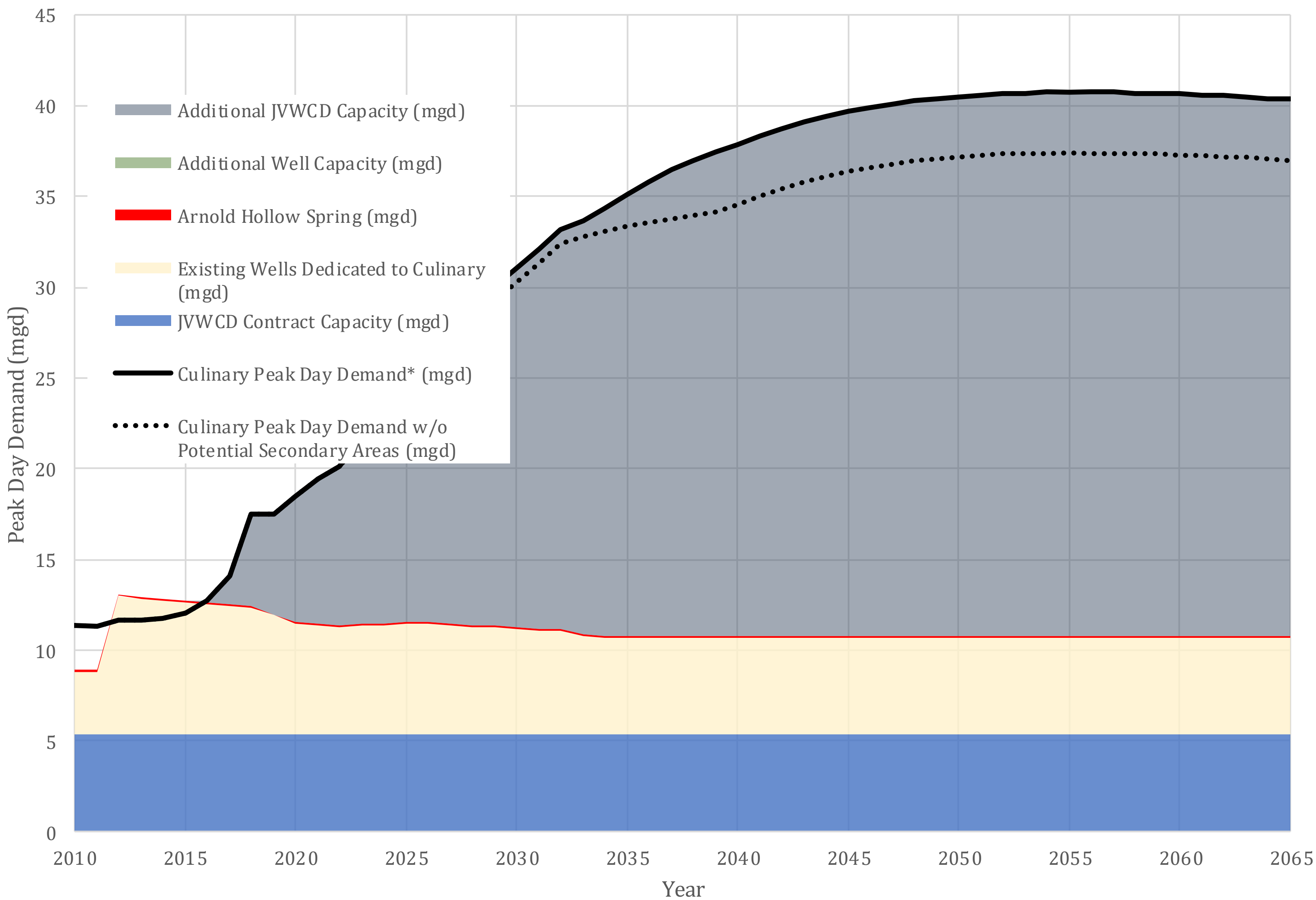
Development Condition	Culinary Demand[1] (acre-ft)	Secondary Demand without Potential Secondary Areas (acre-ft)	Additional Culinary Water Capacity Requirement (acre-ft)	Additional Secondary Water Capacity Requirement (acre-ft)
2065	19,127	2,636	10,423	421

Peak Day Supply

Figures 3-4 and 3-5 show the projected peak culinary and secondary production requirement for Herriman City through 2065. The figure also shows existing and additional sources needed to meet peak demands. Based on these figures, several general conclusions can be made regarding the peak capacity of Herriman City sources:

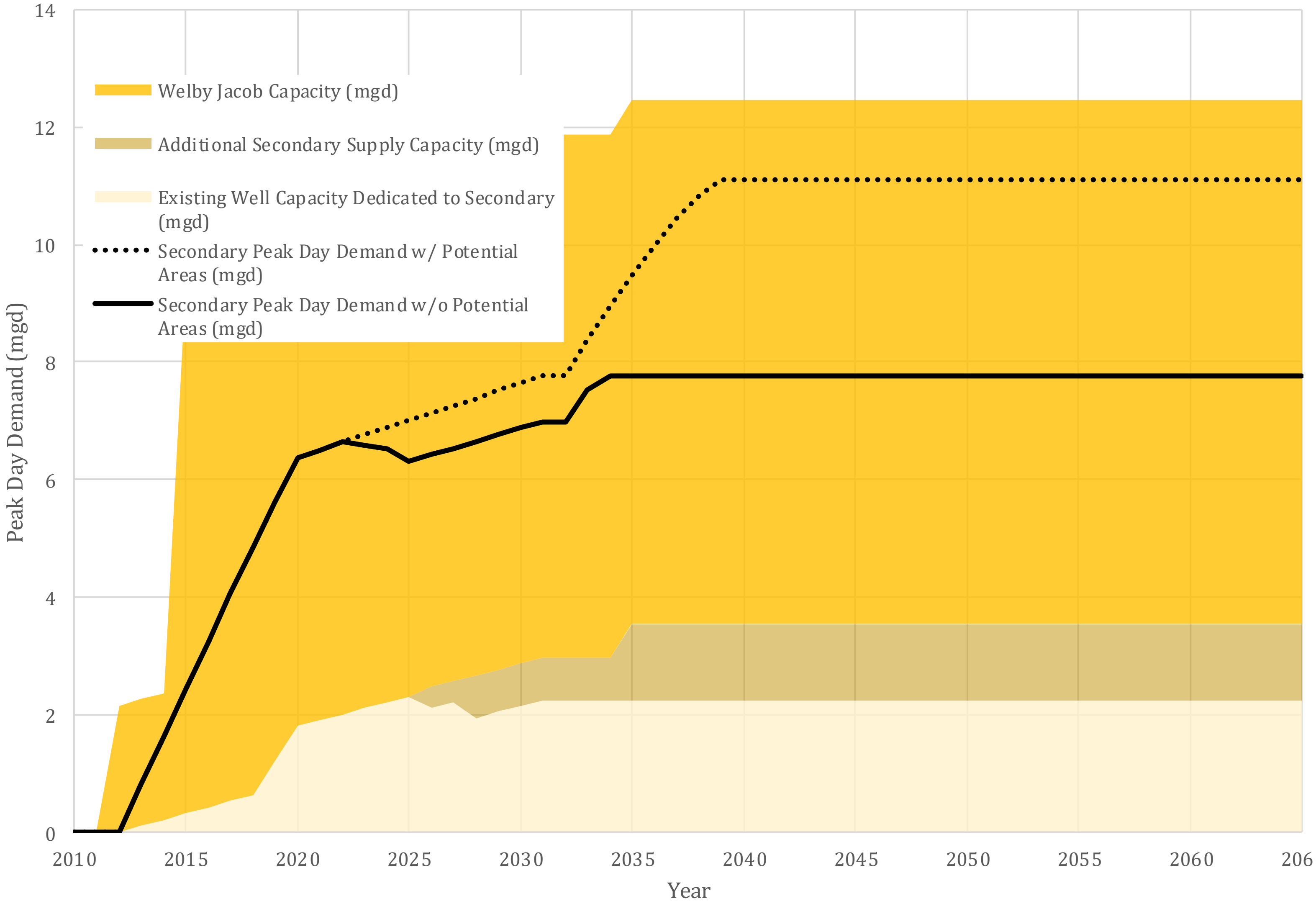
- JVWCD Agreements – Additional agreements with JVWCD will be needed to reduce the potential for exceeding contract amounts. Most of the culinary peak day demands in the future will be met through JVWCD supplies at various connections throughout the City.
- Conversion of Potable Well Capacity – Peak day and peak instantaneous demands will drive the conversion of well capacity to secondary. The City currently does not have transmission capacity to deliver water from the Welby Jacob Canal to the north and west end of the City. It is assumed that all capacity to the north and west end of the City for secondary water will be met with well capacity until additional transmission lines are connected from Blackridge Reservoir. Based on distribution requirements, HP Wells No. 3 & No. 4 will remain on the culinary system during peak day demands.
- Additional Welby Jacobs Capacity – The City's existing pump station on the Welby Jacob Canal has sufficient room to add additional pumping capacity to meet future City secondary demands.
- Conversion Timing – The City hopes to add new wells to its secondary water system within the next 10 years to implement use of secondary in the northwest portion of the City. The City has already begun using culinary wells to supply irrigation needs through reduced pressure backflow preventers.

Figure 3-4 Peak Day Culinary Demand & Supply Requirements



*Based on Indoor Peaking Day Demand Factor of 1.25 and Outdoor Peak Day Factor of 3.3

Figure 3-5 Peak Day Secondary Demand & Supply Requirements



*Based on Outdoor Peak Day Factor of 3.3

Table 3-5 summarizes the required source development or conversion needed to meet peak day demands. The City intends to develop additional secondary water wells as soon as possible to facilitate secondary distribution.

Table 3-5
Future Peak Day Supply Requirements

Development Condition	Culinary Peak Day Demand (mgd)	Secondary Peak Day Demand (mgd)	Additional JVWCD Capacity (mgd)	Additional Secondary Water Capacity (mgd)
2065 – Current Planning Values	37.0	11.1	28.2	3.28

Table 3-6 summarizes the required capacity from various JVWCD connections to meet 2065 peak day demands. These capacities are critical to meeting City needs.

Table 3-6
Required Capacity of JVWCD Connections to Herriman City

Location	Meter Size	Nearby JVWCD Transmission Pipe Size	Required Capacity for Herriman 2065 Demands (gpm)
5600 W 13400 S (JV Zone C)	6” & 12”	30”	3,200
4900 W 11800 S (JV Zone C)	8” & 4”	20”	0*
5690 W 12855 S (JV Zone C)	6” & 10”	20”	900
14500 S 5600 W (Rosecrest – JV Zone C)	16” & 6”	20”	4,200
6000 W 11800 S (JV Zone C)	12”	48”	0*
15000 S 3200 W (JV Zone A)	12” & 24”	36”	9,100
11800 S U111 (JV Zone C)	16"	24”	8,000
11800 S U111 (JV Zone D)	16”	20”^	8,000
Total			**33,400**

*These connections will be maintained as emergency backup connections, but the City is better able to reduce peak demands using storage tanks at other locations.

^The JVWCD Zone D connection may need upgrades to support the City’s buildout demand capacity based on the 20” existing connection size. A 48” pipe is in the vicinity and could support a parallel connection to Herriman Zone 4.

WATER SUPPLY – RECOMMENDED SOURCE DEVELOPMENT

Culinary Water (JVWCD) – JVWCD will represent the City’s primary source of culinary water expansion in the future. This is primarily due to the high quality of JVWCD water compared to groundwater in the Herriman City area. In addition, the City already has many connection points to JVWCD that makes wholesale purchase relatively simple. It is recommended that the City add water as needed in increments. Approximately 10,400 acre-ft may ultimately be needed. Based on JVWCD’s available water budget of 1.35 acre-ft/acre for developing area, it is estimated that the City or developers will need to bring approximately 2,700 acre-ft of outside water or to pay a fee in lieu of bringing additional water to JVWCD. This is based on an undeveloped area in Herriman City of approximately 5,700 acres which means JVWCD would only support about 7,700 acre-ft without additional assistance.

Groundwater – The City has more groundwater rights that could be developed. However, points of diversion are limited as a result of the Salt Lake Valley Groundwater Management Plan that is directed by the State of Utah Division of Water Rights. If existing points of diversion can be acquired by the City, these can help reduce secondary conveyance requirements across the City. The City is aware of some promising location that could expand groundwater capacity within the City. The maximum capacity the City considers developable is approximately 500 acre-ft annual volume and 1.3 mgd peak day capacity (or approximately 900 gpm), though more could be developable depending on State Engineer approval and neighboring groundwater water right holders. New wells are likely to be secondary water but could help offset the use of existing wells that are culinary water quality that would be used in the secondary system.

Welby Jacob Canal – The Welby Jacob Canal follows the east edge of the City and represents a relatively accessible water source for the City's secondary water system. Based on the change in secondary policy in the City, there may be some excess Welby Jacob Canal water depending on how much well capacity can be expanded at the northwest end of the City. Based on existing supply of existing Welby Jacobs water, the City has sufficient supply and no longer needs to acquire additional canal shares for the purpose of supplying the City's secondary water system. There may be value in buying additional Welby Jacob shares to help offset water needs of future development that may be above and beyond the JVWCD water budget of 1.35 acre-ft/acre.

Jordan Basin Re-Use Water – Re-use water was once considered a potential source of water for the City's secondary system, but has since been eliminated as a result of legislation to help support return flows to the Great Salt Lake.

CHAPTER 4
WATER SUPPLY VARIATION – NOW AND IN THE FUTURE

The information presented in Chapters 2 and 3 of this report is based on 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 City in understanding the long-term water supply and demand characteristics of their system inclusive of these types of considerations.

GROUNDWATER

As with most other system assets, wells can deteriorate over time and need rehabilitation or replacement. Most of Herriman City's wells are relatively new due to the young age of the City overall. Based on recent groundwater studies, the City is not concerned with depletion of the groundwater aquifer within the City limits. As a result, it would be expected that the City's existing wells should have an approximately 80 – 100 year life (for the groundwater well), with a 50 year life cycle for the building/piping, and 20-year life for pumps. This would be expected with regular maintenance of the well. Additional redevelopment or new wells may require restoring initial well capacity in the future.

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. For the Welby Jacob Canal, the normal volume available per share is 1.0 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. The City intends to provide a 20 percent buffer in share capacity to account for this variability.
- **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 City is intending to include groundwater as a mixing source into the secondary water system. As a worst case, it would also be possible to use culinary water to dilute Welby Jacobs water as a last resort that could be used on a temporary basis.

JVWCD

The City'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. It is likely that any cutback that JVWCD needs to do as a result of drought or loss of water would need to be passed through to Herriman City.

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 the 10-year running average temperature has increased approximately 5 degrees Fahrenheit (Utah Climate Center Station ID USW00024127). 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 City 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 City's water supply plan. For planning purposes, the City should consider the potential effect of a net increase 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 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 City'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 City's ability convey water temporarily.
- An earthquake disables conveyance 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 City'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 City 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 City 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 City, 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 City. This could include mechanical failure of the well pulling from the aquifer, contamination, reduced recharge as a result of climate change, or simply declining groundwater levels. To account for these uncertainties, it seems prudent to keep a buffer in the City's supply plan associated with potential reduced yield from the aquifer.

  - **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 this increase will be associated with outdoor demand, and with recent decisions to scale back secondary water, the buffer for this potential increase will need to be included in the culinary annual supply.

  Based on these events, it is recommended that the City consider a minimum annual buffer of at least 10 percent for culinary sources. This provides 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 pump or booster pump within the City. It is recommended that the City maintain sufficient reliable capacity to allow for the loss of the largest single well and still meet required production requirements (2,900 gpm). The City currently has several culinary connections to JVWCD that could be turned up to make up for the loss of a well or an alternate supply connection. The City should consider approaching JVWCD to add language to future contracts that would include short-term emergency increases to peaking rates at each JVWCD connection. Most of the City's booster stations are also designed with one redundant pump. Thus, it appears that existing facilities already have sufficient internal redundancy and no additional redundancy buffer is needed for culinary peak capacity.
- **Secondary Annual Supply and Peak Capacity** – The secondary source with the greatest vulnerability associated with annual supply is the Utah Lake and Welby Jacob 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 that affect water quality.

  Because this is the City's primary source of secondary water, it is not practical to add extra capacity to be fully redundant to this source. Because all the water is conveyed to Blackridge Reservoir, the City is able to chemically treat the water for harmful algal blooms as needed. The City may also be able to meet some reduced secondary demands with its available groundwater capacity. Based on these several considerations, it was decided that no additional redundancy buffer would be included for secondary annual supply or peak capacity.

As summarized above, only culinary annual supply has a recommended buffer to account for reliability and redundancy concerns. This 10 percent contingency is included in Figure 3-2.

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 City 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 City would move to an emergency mode of operation. This would include limiting water delivery to essential indoor functions.

CHAPTER 6
CONCLUSIONS AND RECOMMENDATIONS

A number of principal conclusions can be made regarding Herriman City's water system with respect to projected available supply and demand:

1. **Demand Projections**. Through the planning window of this study (2065), it is projected that the City will see significant growth within the existing service area.
2. **Conservation.** The City projections of demand include reducing 2010 demands 15 percent by the year 2030 with up to 24 percent by the year 2065. Meeting these conservation goals will be an essential part of the City's overall supply plan.
3. **Culinary Water Supply.** The majority of the City's future culinary water supply will need to be purchased from JVWCD through expanded contracts. Approximately ~10,000 acre-ft will need to be acquired. Some expansion of groundwater may be able to supplement existing groundwater rights.
4. **JVWCD Water Budget.** The JVWCD proposed water budget of 1.35 acre-ft/acre of developable area is not enough to support planned development patterns. The City and/or developers will either need to alter their planned development or secure additional water (either via fees to JVWCD or by bringing alternate water sources such as Welby Jacob canal shares to JVWCD) in exchange for the ability to develop to desired densities. Based on the amount of undeveloped area in the City (~6,000 acres), it is estimated that the City or developers will need to contribute approximately 3,000 acre-ft of additional water sources or pay a fee in lieu of acquiring additional water to JVWCD. Update to match…!!!
5. **Secondary Water Expansion.** The City has decided to limit expansion of secondary water based on committed areas and/or potential areas relatively easily connected to secondary based on proximity to existing facilities.
6. **Secondary Water Sources.**
   a. **Canal Shares –** The City has sufficient secondary canal shares for secondary irrigation but may need to continue buying canal shares to exchange with JVWCD to satisfy long-term culinary supply needs. While there may be some excess of canal shares for irrigation, it is recommended the City retain these shares until more of the secondary system is online.
   b. **Groundwater** – If additional groundwater can be developed by acquiring existing points of diversion, the City should pursue options as available to provide additional redundancy for Welby Jacob water and potentially reduce some conveyance needs within the City. The maximum capacity the City anticipates could be developed is approximately 500 acre-ft annually with a peak capacity of 1.5 mgd (900 gpm).

HERRIMAN CITY STORAGE AND CONVEYANCE MASTER PLAN

APRIL 2024

PROFESSIONAL ENGINEER
5339557-2202
ANDREW T.
McKINNON
7-19-24
STATE OF UTAH

Prepared for:

HERRIMAN CITY

Prepared by:

BOWEN COLLINS & ASSOCIATES

TABLE OF CONTENTS

Note: This report is the second in a set of two reports comprising the Herriman City Water Master Plan. Chapters 1 through 6 are located in the first report in this series.

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EXECUTIVE SUMMARY

INTRODUCTION

Because Herriman City is a rapidly growing community, it is important that the City prepare an up-to-date water master plan for its water system facilities to meet City level of service criteria. This "Storage and Conveyance Master Plan" is the second in a set of two reports that comprise the planning documents for the City's water system.

EXISTING SERVICE AREA AND TOPOGRAPHY

Herriman City provides culinary water for all residents within its corporate boundaries as well as the High Country Estates. The City's secondary water system is still growing and first began operation in 2012. The City built the first pieces of the secondary system in conjunction with Riverton City by constructing the Blackridge Reservoir. The City has a secondary water system for a portion of the city, but recently determined that the secondary system will be limited due to recent conservation ordinances and high capital construction costs (as described more in Chapter 9). Table ES-1 summarizes the overall facilities for the City's culinary and secondary water systems.

Table ES-1
Existing Culinary & Secondary Water System Facilities

Water System Component	Culinary	Secondary	Total
Existing Pressure Zones	6	4	6
Pipe Length (miles)	236	74	310
Water Storage (Million Gallons)	16.88	9.8	26.68
Well Capacity (gpm)	5,284	850	6,134
Pump Station Capacity (gpm)	19,394	8,150	27,544
JVWCD Capacity (gpm)	35,352		35,352

The topography of Herriman City generally slopes away from the Oquirrh Mountains (i.e. slopes downward to the east or north depending on the location in the City). Most of the water within the City needs to be pumped from east to west as the topography ascends the foothills of the Oquirrh Mountains. The City has steadily constructed facilities to support the growth of the City by building new water storage facilities, pump stations, and pipelines to deliver water further west and higher in elevation.

STORAGE AND BOOSTING EVALUATION

The City's existing culinary water and secondary water facilities were sized to accommodate future growth and are adequate for existing demands within the City. Most growth within the City is developing in the upper pressure zones in the City. As a result, the City needs to construct many new water storage facilities and booster stations to accommodate growth in the upper elevation areas of Herriman City. Table ES-2 summarizes the additional storage and booster station capacity that needs to be added to the City to expand the City's water system to meet the demands of future growth.

Table ES-2
Additional Future Water Storage & Booster Station Facilities

Water System Component	Culinary	Secondary	Total
Water Storage (Million Gallons)	9.85	5	14.85
Pump Station Capacity (gpm)	26,900	6,350	33,250

It is worth noting that the pump station capacity needs to increase significantly in the future because capacity often needs to be repeated as water is delivered to higher elevations.

DISTRIBUTION SYSTEM EVALUATION

The City's water distribution system was evaluated using the service level criteria as summarized in Table ES-3.

Table ES-3
Water System Level of Service Standards

Distribution System Service Level	Culinary	Secondary
Desired Operating Pressure Range (psi)	60-120	55-115
Minimum Peak Hour System Pressure (psi)	45	40
Maximum System Pressure (psi)	150	150
Minimum Pressure with Fire Flow (psi)	20	--
Maximum Pipe Velocity Distribution* (ft/sec)	7	7
Maximum Pipe Velocity Transmission (ft/sec)	5	5

*max velocity for peak hour demand. Max velocity for fire flow conditions should be 10 ft/sec

Herriman City's existing distribution system has very few existing deficiencies. To continue providing a high level of service, the City will need to construct pump stations and pipelines to provide additional conveyance capacity to higher elevation service areas. Table ES-4 summarizes the 10-year costs that are needed to service the growth identified by City planning personnel.

Table ES-4
10-Year Culinary & Secondary Water System Costs

Category	Culinary 10-Year Costs	Secondary 10-Year Costs	Total 10-Year Project Costs
Source Purchases	$0	$1,050,000	$1,050,000
Storage	$34,833,000	$11,628,000	$46,461,000
Booster Pumps	$11,779,500	$8,006,000	$19,785,500
Pipes*	$61,305,000	$38,034,000	$99,339,000
Planning	$50,000	$50,000	$100,000
Total	**$107,967,500**	**$58,768,000**	**$166,735,500**

*Includes potential developer contributions for pipe construction.

CHAPTER 7
INTRODUCTION

INTRODUCTION

Herriman City (City) desires to develop an updated master plan for its water system. This is the second in a set of two reports that comprise the planning documents for the City's water system. The reports are:

- **Supply and Demand Master Plan** – An examination of water demands expected in the City and the existing and future supplies available to meet these demands.
- **Conveyance and Storage Master Plan** – **Conveyance and Storage Master Plan** – An evaluation of the City's existing conveyance and distribution system and its ability to deliver water when and where it is needed including long term capital improvements needed to meet future demands.

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 the other report. 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 City. Previous studies that have examined the City's storage and conveyance system include:

- 2020 Water System Master Plan Update (Bowen Collins & Associates, August 2020)

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

- **New Infrastructure –** Some new infrastructure has been constructed since the previous master plan, including two booster pump station upgrades.
- **Land Use Changes –** Several changes to historic land use planning have occurred within the City:
  - **Herriman Hills Open Space Initiative–** Through the joint efforts of the Utah National Guard, a local citizen group, and City leadership, Herriman City adopted a plan to purchase private property for the Herriman Hills area to provide additional buffer to the Camp Williams training facility and to maintain the open space quality of the mountains above Herriman City. Up to 75 percent of funds for this initiative are provided through the Army Compatible Use Buffer program with 25 percent provided by the City or through donations from property owners. This initiative significantly reduces the potential for residential growth and associated water demands in some of the hills above Herriman City while preserving the area for open space.
    - **Southeast Herriman.** While the goal of the initiative is to preserve as much open space as possible, existing City agreements will not allow the entire area to be preserved as open space.
  - **General Plan–** The City adopted a new general plan January 1, 2022. The impacts of the general plan changes have been captured in this master plan.

  - **Olympia Annexation –** Since the last water master plan update, the City officially annexed the "Olympia" area into the City on January 1, 2022.
  - **Remaining Annexation Area –** The remaining annexation area previous identified in the City's general plan is primarily owned by Kennecott (Rio Tinto) and has since been annexed into South Jordan City. As a result, the City will no longer plan on supplying water and system facilities to those areas. This will result in a reduction in the City's long-term planning population, demand, and facility needs.
- **Conservation –** The State of Utah recently adopted new conservation goals, customized to various regions throughout the state. This master plan updates projected demands based on these new goals.
- **Secondary Service Area –** Since 2010, the City has been working toward developing a secondary water system in the City with a focus on extending it to the undeveloped areas of the City. Two major factors have influenced the City to reconsider that approach. First, significant changes in landscape ordinances and projected irrigation demands have reduced the potential demand on the irrigation system and its potential cost/benefits. Second, significant increases in construction costs due to higher-than-normal inflation have increased the up-front capital costs of building a parallel secondary system. As a result, the City has decided to restrict secondary water to those areas within the City where there is already a commitment to extend secondary water or where potential irrigated areas are in relatively close proximity to existing secondary facilities (see Figure 2-2 in Section 1). For any undeveloped areas on the extremities of the City where significant infrastructure has not yet been built, the City has elected to provide only culinary water for outdoor irrigation.

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

SCOPE OF SERVICES

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

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

The City maintains an existing culinary water model and secondary model. As part of this study, the existing models were updated to include the latest water system peak day demands and pipe construction. 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 projected future demand patterns within the City.

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

EXISTING SERVICE AREA AND TOPOGRAPHY

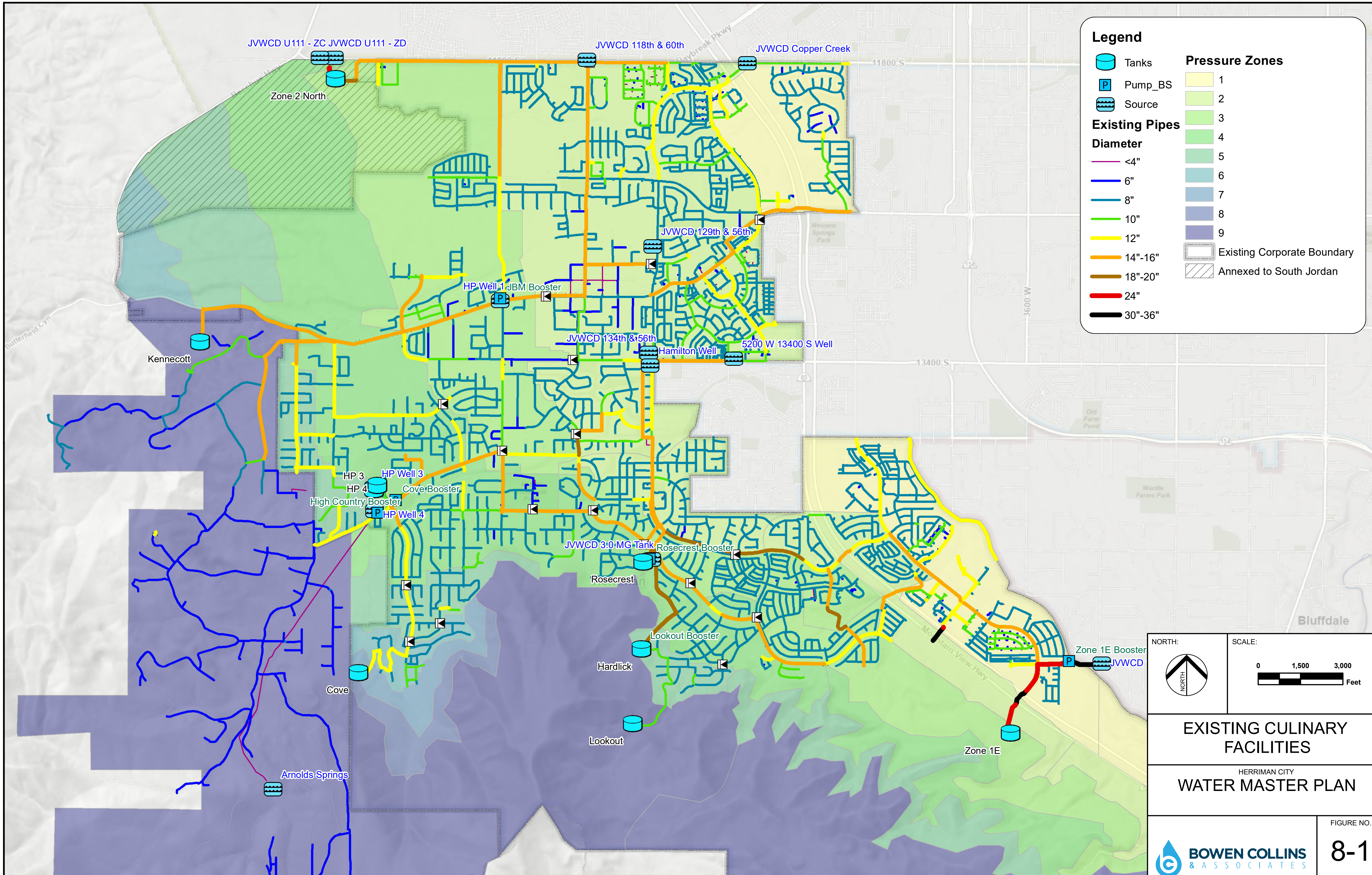
Herriman City provides culinary water for all residents within its corporate boundaries as well as the High Country Estates. Herriman City's existing service area is approximately 22 square miles and is bordered by the following: the unincorporated part of Salt Lake County and the Oquirrh Mountain Range to the west, Bluffdale City to the southeast, Riverton City directly east, and South Jordan City to the north. The City's corporate boundary extends west to existing State Route 111. Areas directly south of the City are owned by or managed by the Utah National Guard. The topography of the City generally slopes away from the Oquirrh Mountains (i.e. slopes downward to the east or north depending on the location in the City).

In 2023, the Herriman City estimated population included 62,000 residents. In addition to permanent residents, the City also serves commercial, industrial, and institutional entities. Figure 8-1 shows all of the City's existing culinary water facilities. Figures 8-2 and 8-3 show schematics of how the City's culinary sources, storage reservoirs, and pump stations are connected and identifies pressure zones associated with water service. Future pressure zones and facilities are also shown in these schematics and will be discussed in more depth later in this report.

CULINARY FACILITIES

Existing Pipe

Herriman City's inventory of pipes includes pipes owned and operated by the City and the pipes owned by the High Country Estates. The City has a maintenance agreement with High Country Estates to provide maintenance for pipes in its distribution system, but the City does not own the pipes and is not responsible for the level of service within High Country Estates. Table 8-1 shows the total inventory of pipes in the City's inventory. Table 8-2 summarizes the pipes owned by High Country Estates.



EXISTING CULINARY FACILITIES

HERRIMAN CITY

WATER MASTER PLAN

FIGURE NO.

8-1

BOWEN COLLINS & ASSOCIATES

P:\Herriman\217-21-03 - Water Master Plan Update\4.0 GIS\Figure 8-1 Existing Facilities.mxd amckinnon 3/20/2024

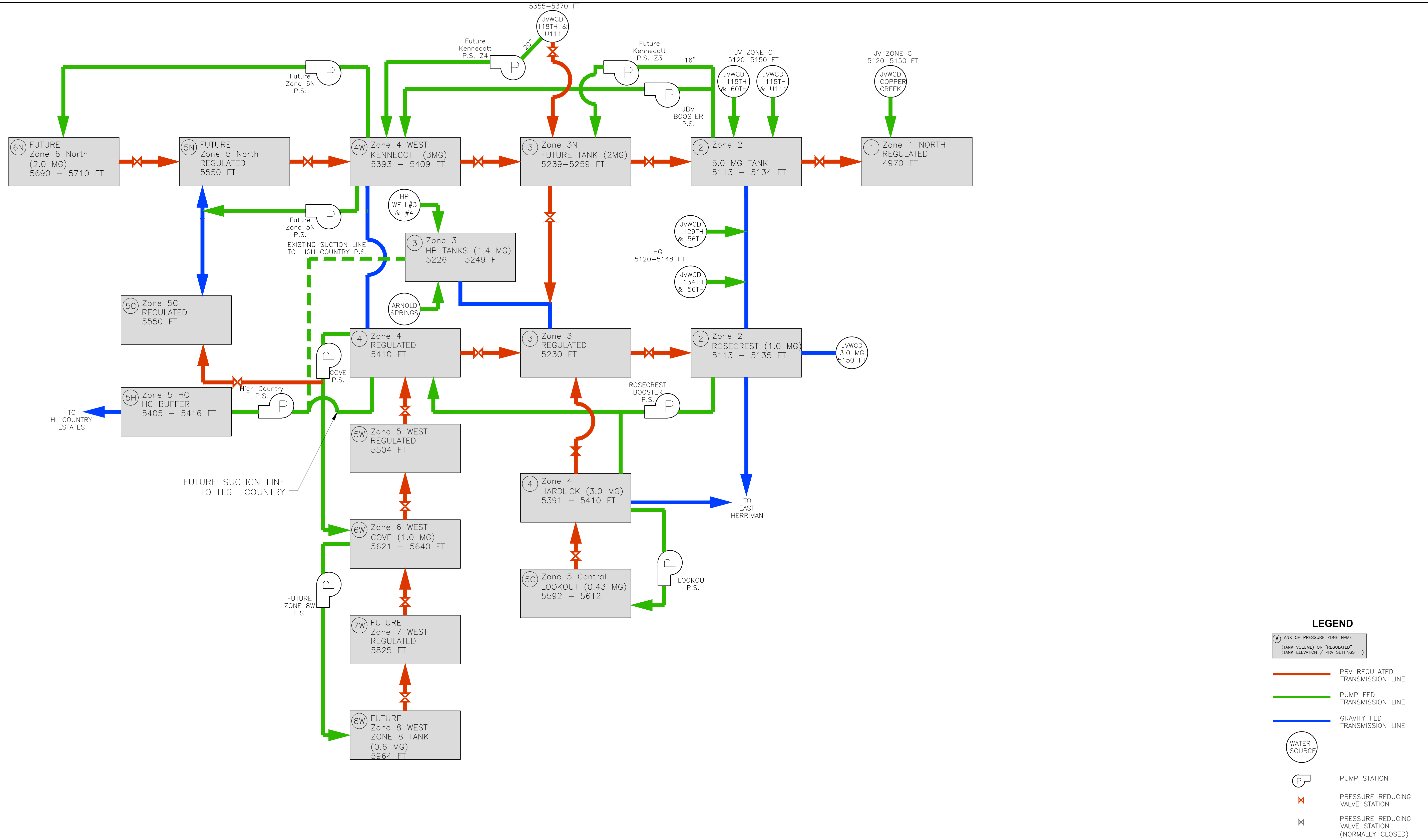


Figure 8–2
HERRIMAN WEST SCHEMATIC

WATER MASTER PLAN
HERRIMAN CITY

BOWEN COLLINS & ASSOCIATES

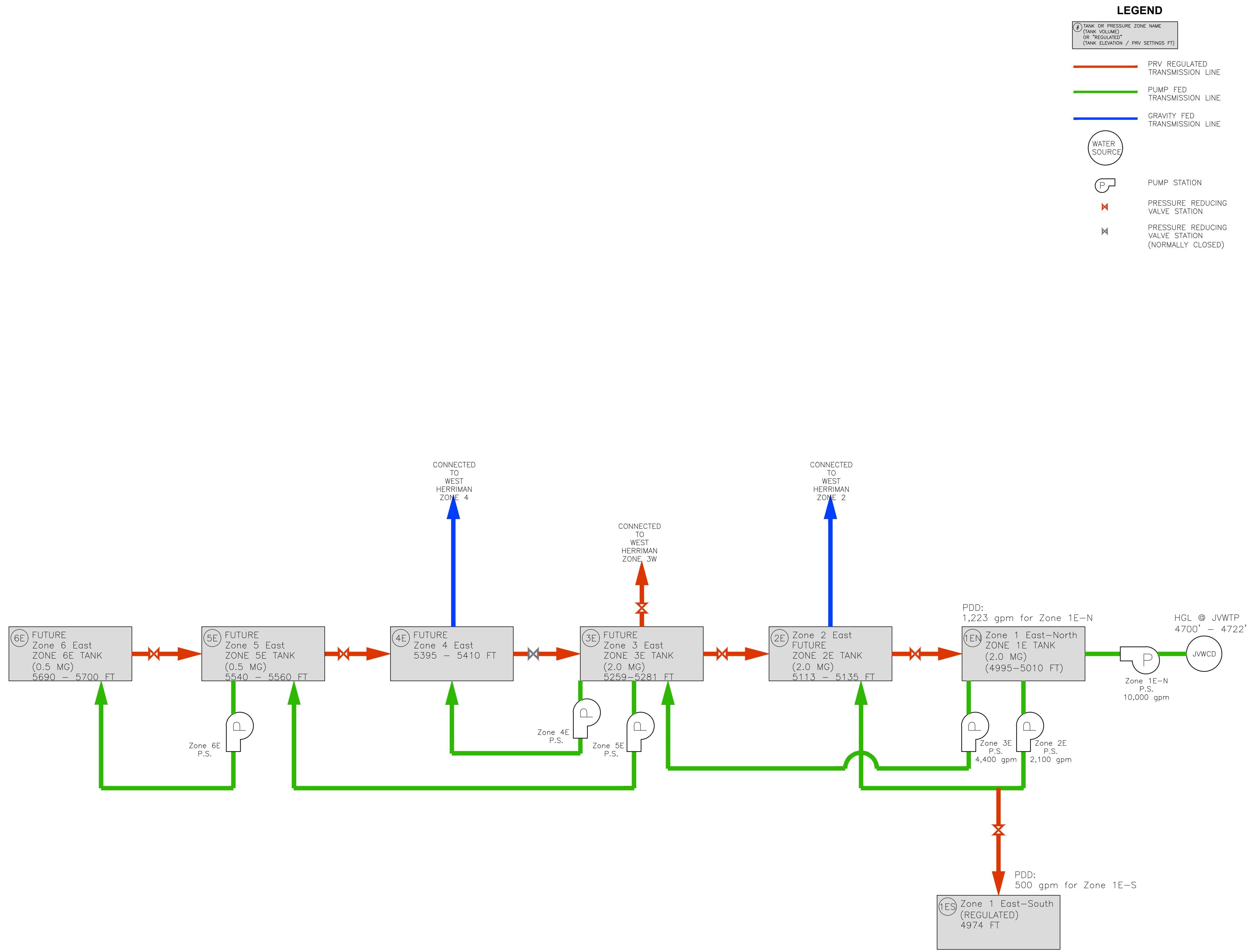


Figure 8–3
HERRIMAN EAST SCHEMATIC

WATER MASTER PLAN
HERRIMAN CITY

BOWEN COLLINS & ASSOCIATES

Table 8-1
Total Culinary Pipes in Herriman City's Inventory

	Length (ft)					
Diameter (in)	**PVC**	**Ductile Iron**	**HDPE**	**Other**	**Total (ft)**	**Total (mi)**
4	8,213	14,831	433	1,125	24,601	4.7
6	22,851	36,599	0	11,816	71,265	13.5
8	556,106	221,055	605	12,171	789,937	149.6
10	76,772	27,358	1,816	5,666	111,612	21.1
12	27,307	77,572	0	0	104,879	19.9
14	434	5,562	2,148	5,704	13,848	2.6
16	4,846	99,043	0	991	104,880	19.9
18	0	878	0	0	878	0.2
20	13	16,201	1,269	0	17,483	3.3
24	0	5,017	0	0	5,017	1.0
30	0	0	591	0	591	0.1
32	0	0	0	672	672	0.1
36	0	0	0	350	350	0.1
Total	**696,541**	**504,117**	**6,862**	**38,494**	**1,246,014**	**236.0**

Table 8-2
High Country Estate Pipe Ownership

Diameter (in)	High Country I (ft)	High Country II (ft)	Total (ft)	Total (mi)
4	648	554	1,202	0.2
6	11,621	86,710	98,331	18.6
8	12,066	231	12,297	2.3
10	4,840	3,161	8,000	1.5
12	0	101	101	0.0
14	5,704	0	5,704	1.1
Total	**34,879**	**90,758**	**125,637**	**23.8**

Existing Storage Facilities

Table 8-3 lists the available storage capacity of tanks and reservoirs in the City. Storage will be evaluated in more detail in a subsequent section.

Table 8-3
Existing Culinary Storage Facilities

Tank Name	Year Built	Size (gallons)	Pressure Zone	Floor Elevation	Overflow Elevation
Zone 1 East	2017	2,000,000	1	4995.5	5010
Rosecrest	2004	1,000,000	2	5113	5135
Zone 2 North – 5 MG	2016	5,000,000	2	5113	5135
HP Tanks 1.0		1,000,000	3	5226	5249
HP Tanks 0.4	1987	400,000	3	5229	5249
Hardlick	2004	3,000,000	4	5391	5410
Kennecott	2008	3,000,000	4	5393	5409
Arnold Hollow Springs*		9,600	4	--	5700
Lookout Ridge	2010	425,000	5C	5592	5612
Cove	2007	1,000,000	6W	5621	5640
Total		**16,884,600**			

*The spring collection box does not provide storage for system equalization and is primarily used for connecting to spring collection lines.

Wells

Table 8-4 summarizes characteristics of each of the City's existing wells.

Table 8-4
Existing Well Characteristics

Well	Source Type	Completion Date	Age (yrs)	Well Diameter (in)	Well Depth (ft)	Water Level at time of completion (ft bgs[1])	Capacity (gpm)
HP Well #1	Culinary	4/29/1955	65	12	615	135	194
HP Well #2	Secondary	12/2/1954	66	12	300	200	150
HP Well #3	Culinary	8/1/1988	32	8	300	137.5	116
HP Well #4	Culinary	12/1/1993	27	0'-100' - 12" 100'-350' - 10"	350	39	124
Hamilton Well	Culinary	12/14/2003	17	0'-390' - 12" 390'-700' - 10"	700	92	1,750
Stokes Well	Culinary	5/22/2007	13	16	530	109	200
Tuscany Well	Secondary	8/20/1971	49	16	420	185	400
Bodell Well	Secondary	6/25/1961	59	12	391	196	300
Stillman Well	Culinary	12/15/2012	8	20	820	181	2,900

[1] **ft bgs** – feet below ground surface

Booster Pumps

Table 8-5 summarizes characteristics of each of the City's existing culinary booster pumps.

Table 8-5
Existing Culinary Pump Capacities

Pump Facilities	Source	Destination Storage	Flow (gpm)[1]	Pump Head (ft)	Emergency Backup (kW)
HP Well #1	HP Wells	HP Tanks (Zone 3)	194	340	300 (JBM)
HP Well #3	HP Wells	HP Tanks (Zone 3)	240	10	400 Portable
HP Well #4	HP Wells	HP Tanks (Zone 3)	230	100	400 Portable
Hamilton Well	Well Aquifer	Rosecrest Tank	1,750	500	400
Stillman Well	Well Aquifer	Rosecrest Tank	2,900	700	750
Zone 4 Hardlick Booster	Rosecrest	Hardlick / Kennecott	4,800	330	455
JBM Booster	Zone 2 JVWCD	Kennecott (Zone 4)	2,450 (3,780)	320	300
Zone 5 boosters	Hardlick Tank	Lookout Ridge (Zone 5)	240	210	80
Hi-Country Booster	HP Tanks	HC Buffer Tank	180	250	400 Portable
Cove Booster (Zone 6W)	HP Wells/Zone 4	Cove (Zone 6)	1,800	340	300
Zone 1E Booster	JVWCD Zone A	Zone 1E	2,700	330	750

[1] Capacity listed is without backup pump. Capacity in parentheses lists the capacity with all pumps running.

Jordan Valley Water Conservancy District

The City has seven physical connections to the Jordan Valley Water Conservancy District as summarized by Table 8-6.

Table 8-6
Existing JVWCD Connections to Herriman City

Location	Meter Size	Existing Capacity (gpm)	Nearby JVWCD Transmission Pipe Size	Estimated Capacity of Existing Transmission (gpm)
5600 W 13400 S (JV Zone C)	6" & 12"	3,084	30"	15,422
4900 W 11800 S (JV Zone C)	8" & 4"	1,376	20"	6,800
5690 W 12855 S (JV Zone C)	6" & 10"	2,330	20"	6,800
14500 S 5600 W (JV Zone C)	16" & 6"	4,982	20"	6,800
6000 W 11800 S (JV Zone C)	12"	2,468	48"	30,000
15000 S 3200 W (JV Zone A)	12" & 24"	12,338	36"	22,000
11800 S U111 (JV Zone C)	16"	4,387	24"	9,900
11800 S U111 (JV Zone D)	16"	4,387	20"	6,800
Total		**35,352**		

*The connection is nearby and readily accessible for Herriman's future connection.

CULINARY PRESSURE ZONES

The Herriman City water distribution system is currently divided into six generalized pressure zones within the City corporate boundary. Each pressure zone is approximately identified in Figure 8-1 with hydraulic grades as identified in Figures 8-2 and 8-3. While the City generally only refers to six pressure zones with respect to elevations within Herriman City, the City is hydraulically divided into several additional pressures zones as a result of relatively large transmission distances from one side of the City to the other and minor variations in pressure zones due to various pressure reducing valve separations between zones. In addition, as the City continues to develop, additional pressure zones may be added as development extends up the mountains at the south end of the City.

CHAPTER 9
EXISTING SECONDARY WATER FACILITIES

Herriman City first began operation of its secondary water system in 2012. The City built the first pieces of the secondary system in conjunction with Riverton City by constructing the Blackridge Reservoir. The City leased capacity from Riverton City to utilize a pump station off the Welby Jacob Canal before constructing its own secondary pump station off the Welby Jacob Canal near 4000 West. In addition to the Welby Jacob Canal, the City utilizes some of its groundwater wells to support the secondary system.

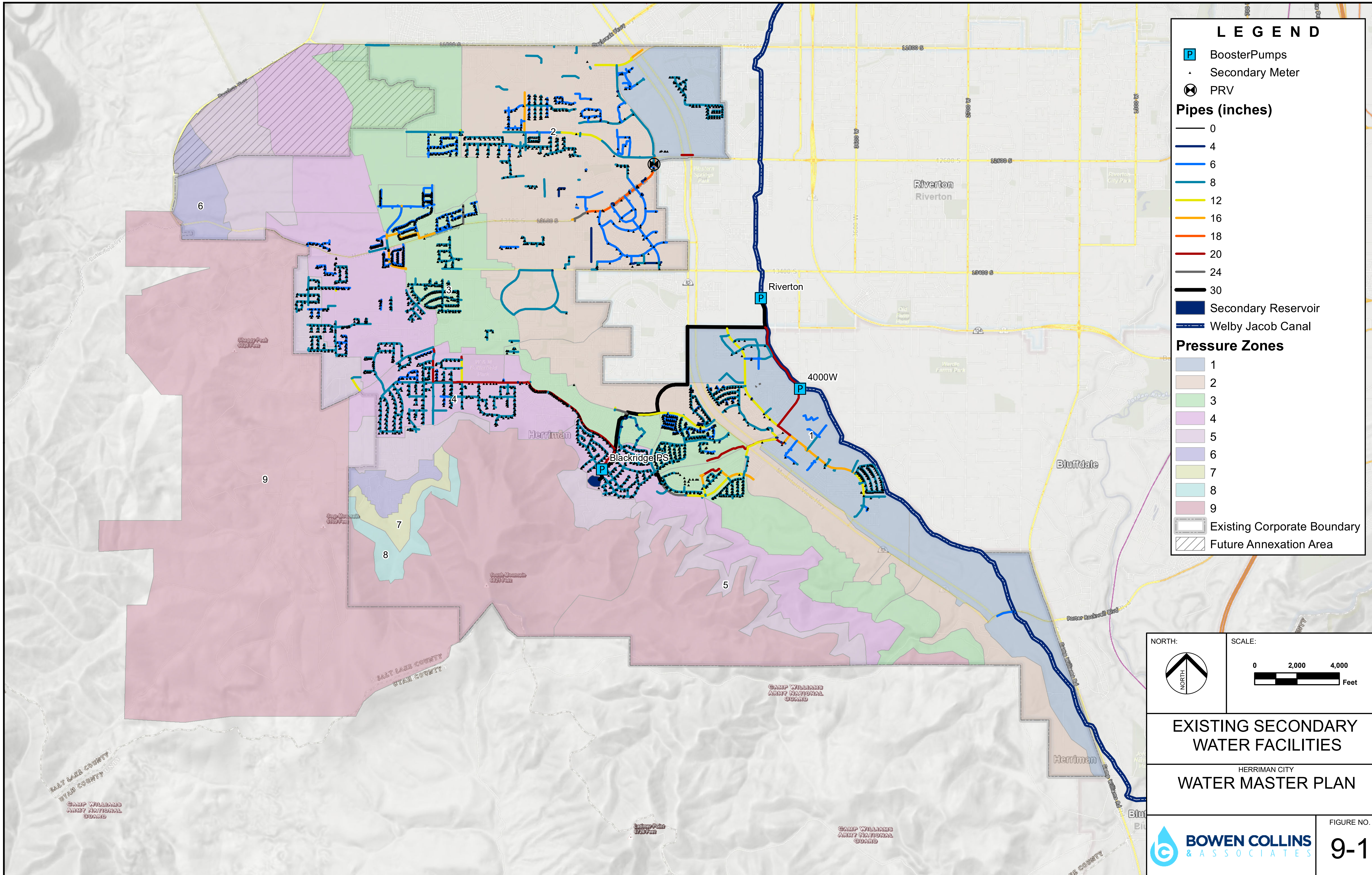
The City has primarily focused on extending pipelines to areas for future development, but has added secondary pipelines to some existing roads in limited cases. Figure 9-1 shows all of the existing facilities in the City's secondary distribution system. The City's intent with most of the proposed improvements is to expand secondary water to areas the City has already committed to provide water and to potential areas in close proximity to the secondary system with significant open space that can be irrigated by secondary water. Figure 9-2 shows a schematic of the City's long-term operation plan for its secondary water system.

Existing Pipe

Table 9-1 summarizes the amount of secondary pipe in the City's inventory. For comparison, the total length of secondary pipe in the City is approximately 33 percent of the total length of culinary pipelines.

Table 9-1
Total Secondary Pipes in Herriman City's Inventory

	Length by Material Type (ft)						
Diameter (in)	**PVC**	**Ductile Iron**	**HDPE**	**Other**	**Unknown**	**Total (ft)**	**Total (mi)**
4	4,693	0	82	69	0	4,844	0.9
6	98,795	161	0	0	0	98,956	18.7
8	258,158	335	0	0	0	258,492	49.0
10	15,721	149	1,236	0	0	17,106	3.2
12	6,851	13,100	2,120	0	0	22,071	4.2
14	0	95	1,944	0	0	2,040	0.4
16	3,809	10,179	0	0	0	13,988	2.6
18	0	4,652	0	0	0	4,652	0.9
20	4	19,263	5,310	0	0	24,577	4.7
24	986	995	1,068	0	0	3,050	0.6
30	0	16,020	0	87	0	16,107	3.1
Total	**389,017**	**64,949**	**11,761**	**157**	**0**	**465,883**	**88.2**



EXISTING SECONDARY WATER FACILITIES

HERRIMAN CITY

WATER MASTER PLAN

BOWEN COLLINS & ASSOCIATES

FIGURE NO. 9-1

P:\Herriman\217-21-03 - Water Master Plan Update\4.0 GIS\Figure 9-1 Secondary Existing Facilities.mxd amckinnon 3/4/2024

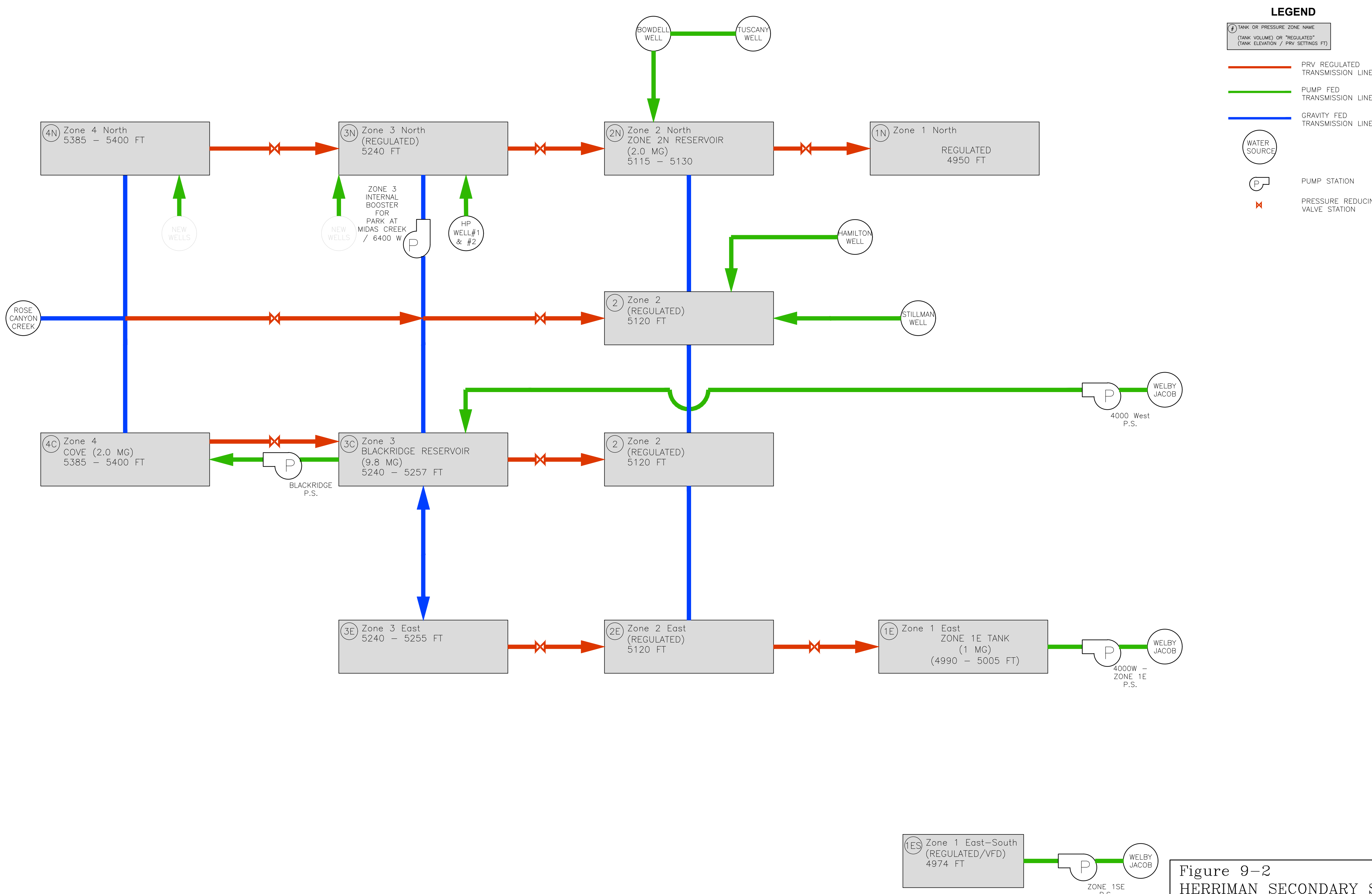


Figure 9–2
HERRIMAN SECONDARY SCHEMATIC

WATER MASTER PLAN
HERRIMAN CITY

BOWEN COLLINS & ASSOCIATES

Existing Storage Facilities

The Blackridge Secondary Reservoir is the only secondary storage facility in Herriman City and has a capacity of 19.6 million gallons (9.8 million gallons for Herriman). Table 9-2 shows the stage storage curve for the reservoir (per design drawings).

Table 9-2
Blackridge Reservoir Stage Storage

Elevation	Area (sf)	Storage (acre-ft)	Storage (MG)
5238.25	0	0	0.0
5240	2,399	0.33	0.1
5242	90,694	2.8	0.9
5244	129,595	8.1	2.6
5246	138,486	14.3	4.7
5248	147,652	20.8	6.8
5250	160,691	27.9	9.1
5252	178,112	35.6	11.6
5254	196,486	44.2	14.4
5256	215,801	53.7	17.5
5257.25 - Spillway	**228,266**	**60.1**	**19.6**
5258	236,068	64.1	20.9
5260	257,278	75.4	24.6
5260.25 – Top of Dam	**259,008**	**76.9**	**25.1**

Wells

Table 9-3 and 9-4 summarize characteristics of each of the City's existing secondary only wells.

Table 9-3
Secondary Well Characteristics

Well	Source Type	Completion Date	Age (yrs)	Well Diameter (in)	Well Depth (ft)	Water Level at time of completion (ft bgs[1])
HP Well #2	Secondary	12/2/1954	66	12	300	200
Tuscany Well	Secondary	8/20/1971	49	16	420	185
Bodell Well	Secondary	6/25/1961	59	12	391	196

[1] **ft bgs** – feet below ground surface

Table 9-4
Secondary Well Pump Characteristics

Source[1]	Destination Storage	Capacity (gpm)	Pump Head (ft)
HP Well #2	Future Zone 2[3]	150	400
Tuscany Well	Future Zone 2[2]	400	240
Bodell Well	Future Zone 2[3]	300	400
Hamilton Well[1]	Zone 2	1,750	500
Stillman Well[1]	Zone 2	2,900	700

[1] It is worth noting that the Hamilton & Stillman Wells that currently used as culinary are expected to be primarily secondary in the future.
[2] This well will eventually pump to the Zone 2 Northwest Reservoir, but operates with a variable frequency drive (VFD) currently.
[3] Well is currently inactive.

Existing Booster Stations

Table 9-5 lists the characteristics of the City's existing secondary booster stations.

Table 9-5
Existing Secondary Pump Station Characteristics

Pump Station	Phase 1 Flow Rate (gpm)	Buildout Flow Rate[1] (gpm)	Head (ft)	Type[2]
Blackridge Pump Station	3,500	4,000	211	VFD
4000 West Pump Station – To Blackridge Reservoir	3,200	6,000	600	VFD
4000 West Pump Station – To Juniper Canyon Reservoir	--	5,200	360	VFD

[1] The buildout flow noted is the capacity the pump station is capable of being expanded to and not the capacity required at buildout. Required capacity will be discussed later in the report.
[2] Most existing pumps are equipped with variable frequency drives to accommodate fluctuating demand in a closed pressure zone or fluctuating supply.

The Blackridge Reservoir is supplied through a jointly owned Herriman/Riverton 30-inch transmission main and two pump stations:

- The Riverton City Pump Station is located adjacent to the Welby Jacob Canal (also known as the Provo River Canal) at approximately 13600 South 4200 West. The Riverton City Pump Station has a capacity of 6,000 gpm and total pump lift of 596 ft. Through 2014, Herriman had an agreement with Riverton City to use up to 1,500 gpm of this pump station's capacity to provide secondary water for its secondary water users and reimbursed Riverton City for associated costs.
- In 2015, the City completed construction and began operation of its own secondary pump station at approximately 4000 West near the Welby Jacob Canal to connect to the 30-inch transmission line so that Herriman is no longer reliant on Riverton City's pump station. The 4000 West pump station connects to the 30-inch Blackridge pipeline with a new 20-inch transmission line. The 4000 West Pump Station is a dual pressure zone pump station that

can pump both to the Blackridge Reservoir and to a future Juniper Canyon Reservoir (Pressure Zone 1E). The Juniper Canyon side of the pump station has not yet been equipped.

The City also has a Blackridge pump station that includes a VFD pump that supplies water to Zone 4 portions of Herriman City. This pump station pumps into a dead-end zone that will eventually have its own storage reservoir to meet peaking demands. Peaking demands are currently supplied by the pump station.

SECONDARY PRESSURE ZONES

The City's secondary pressure zones will be limited to the four lowest pressure zones in the City. The City has no plans to extend secondary water above pressure zone four.

CHAPTER 10
STORAGE AND BOOSTING EVALUATION

The purpose of this chapter is to evaluate the City'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 City 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 *(State of Utah Director of Division of Drinking Water)*."

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

Culinary Water Storage

State of Utah Storage Requirements

Equalization storage requirements are defined in State of Utah 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."

The code then proceeds to provide some minimum sizing standards in the absence of detailed water use data. However, since Herriman does have detailed use data, this first section of code is most pertinent. Staff at the Division of Drinking Water have interpreted this section 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.

In addition to the guidance provided in State of Utah regulations on minimum sizing requirements, the Division of Drinking Water has also issued "Detailed Guidance for Water Use Data Reporting and Setting System-Specific Source and Storage Minimum Sizing Requirements". In those standards, total storage (excluding fire flow) must be greater than the average day demand for the system. A variability factor is also recommended but is not required depending on the underlying data used for sizing. Table 10-1 summarizes the minimum storage requirements that would be required based on the three most recent years of available data.

Table 10-1
State of Utah Culinary Required Storage

Highest Annual Average Day Demand per ERC for Past Three Years (gallons/day)[1]	591

[1]– ERC as defined by State of Utah reporting requirements. Value uses 2020 average annual demand.

For existing conditions, the City can demonstrate that its existing storage facilities exceed this recommended requirement (while also meeting fire storage requirements). The City's required storage based on Table 10-1 is 13.7 MG. The City has 16.3 MG of available storage when discounting fire storage from the total.

While the City does meet current storage requirements under State of Utah guidelines, the City may not want to design around this same standard. It is recommended that the City calculate equalization and emergency storage using its own water use patterns and emergency storage assumptions. This has been done in the following sections.

Equalization Storage

Herriman City calculated a demand pattern for its system based on City storage tank levels and source production records. Table 10-2 and Figure 10-1 shows the dominant demand pattern for the City. 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. The City currently relies on peaking capacity from JVWCD for many of its connections which essentially uses JVWCD storage capacity. The City is in the process of constructing additional storage to satisfy its internal demand fluctuations such that capacity from JVWCD and its other sources can be relatively constant.

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 City was calculated to be approximately 18 percent of average peak day demands. At this level of volume, storage would fill and drain completely with daily demands. Potential variability in demand patterns could exceed the calculated 18 percent. To account for variability in irrigation patterns from day to day, it is recommended that the City use a minimum value of 25 percent of its peak day demands to define required equalization storage for existing conditions.

Emergency Storage

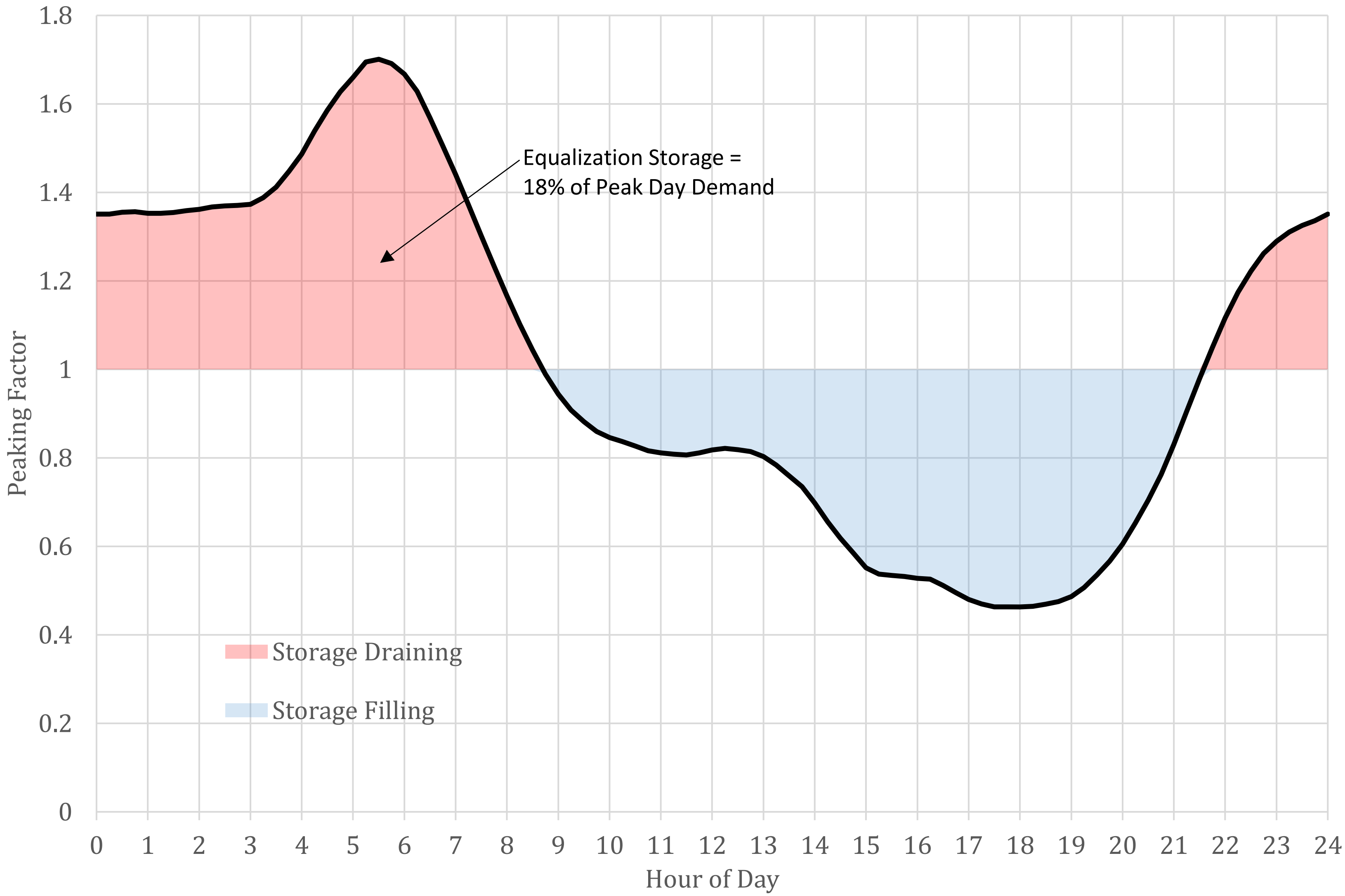
Emergency storage is the volume of water required to meet water demand during an emergency situation. Emergency storage requirements are defined in the code as follows:

Table 10-2
Existing Culinary Demand Pattern*

Hour	Peaking Factor
0	1.34
1	1.35
2	1.36
3	1.37
4	1.47
5	1.7
6	1.65
7	1.4
8	1.15
9	0.94
10	0.85
11	0.8
12	0.82
13	0.8
14	0.7
15	0.55
16	0.5
17	0.48
18	0.46
19	0.48
20	0.6
21	0.83
22	1.12
23	1.28
24	1.35

*Demand pattern developed by City's energy optimization study

Figure 10-1 Existing Culinary Demand Pattern



"(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 City, 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 City-wide outage, all wells and many booster stations 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.

A common practice in the industry is to provide sufficient storage in all zones to supply the system during a 6-hour power outage during peak day demands (or roughly 25 percent of peak day demand). Table 10-3 lists the equalization and emergency storage based on these practices.

Table 10-3
Herriman City Calculated Equalization & Emergency Storage for Peak Day Demand

Single-Family Connection Water Use	Demand (gpd)
Peak Day Indoor Demands (gpd)[1]	252
Peak Day Outdoor Demands (gpd)[2]	1065
Total Peak Day Demand (gpd)	1,317
Equalization Volume at 25% (gallons)	329
Emergency Volume at 25% (gallons)	329
Total Equalization & Emergency Volume (gallons)	658

[1] Based on indoor water use for single family connection
[2] Based on an estimated 0.13 acres of irrigated area for single family with conservation using City conservation goals.

By comparison, the calculated storage for a single-family unit using the City's equalization storage and planned emergency storage is more than the State of Utah requirement based on average day demand described in Table 10-1 that requires 591 gallons/ERC. The additional storage identified here equates to a variability factor of approximately 1.11 as compared to the State of Utah Division of Drinking Water approach for the last three years of data. This appears to be a reasonable planning value for storage.

While the City does not assign ERCs to each of its pressure zones, the City measures peak month demand within each zone with its water meters and can estimate peak day demand. This allows the City to calculate required storage for each zone as a function of peak day demand. Equalization/Emergency storage will therefore be calculated using 50 percent of peak day demand in each tank service area.

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, latest 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 City. In a recent ISO survey, the maximum fire flow requirements varies 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 some commercial areas may require up to 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 City, 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. Generally, Zone 4 in the City carries most of this volume and some of the higher zones have reduced fire storage (540,000 gallons or 240,000 gallons) depending on local fire demand needs.

Secondary Water Storage

As part of the City's energy optimization study, a secondary demand pattern was developed for portions of the system based on storage data. Figure 10-2 shows the secondary demand pattern for the City. Table 10-3 lists the peaking factors for this service area. Based on this demand pattern, equalization storage was calculated to be 35 percent of the peak day secondary demand. Since demand patterns can change, the City would like to plan for equalization storage around the current water use pattern, but include a safety factor of 2.0 to account for potential changes in the demand pattern and to provide operational flexibility. Based on the safety factor and 35 percent equalization storage requirement, the minimum storage requirement for secondary would be 70 percent of secondary peak day demand.

Figure 10-2 Existing Secondary Demand Pattern

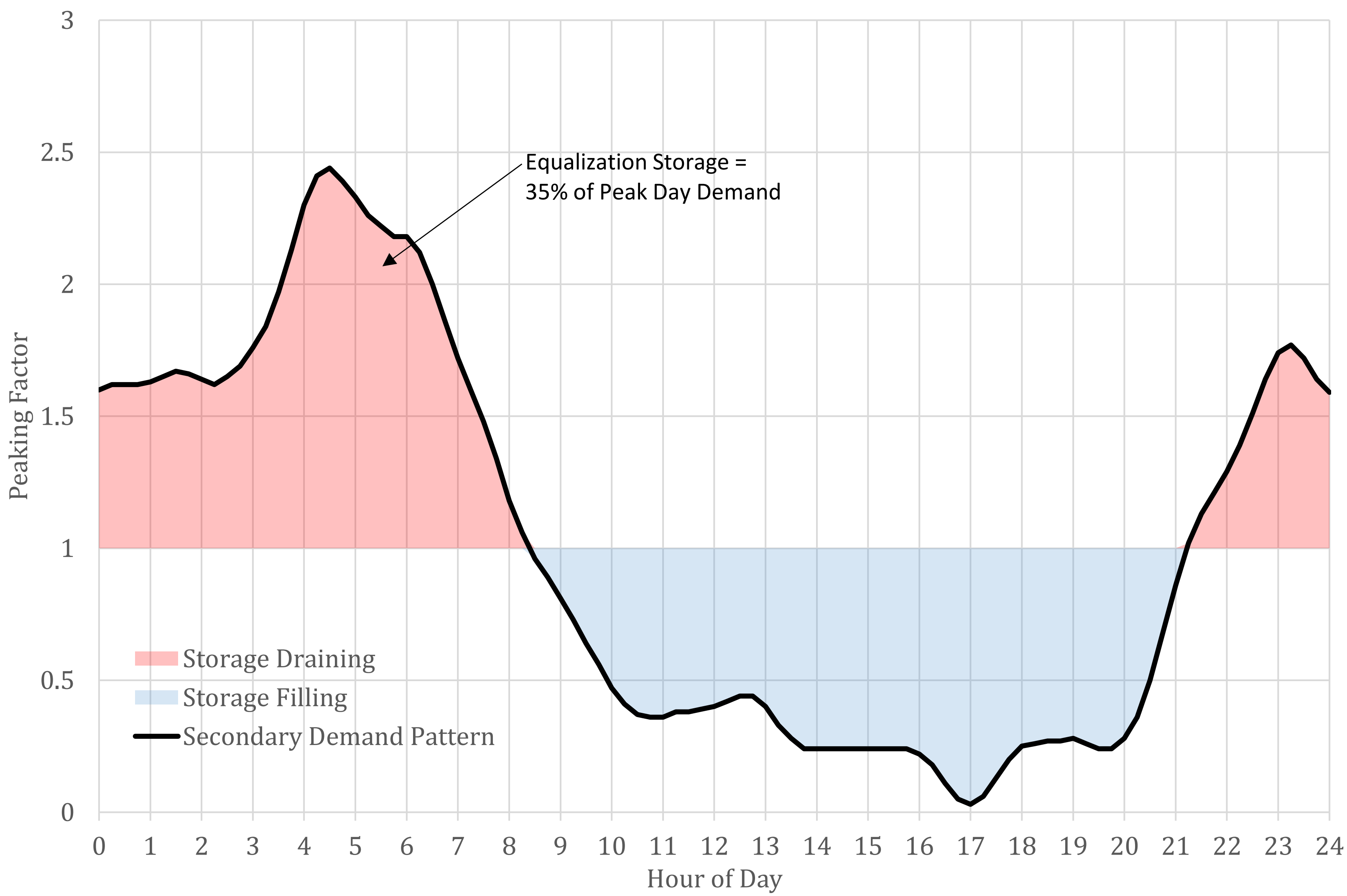


Table 10-3
Secondary Demand Pattern*

Hour	Peaking Factor
0	1.6
1	1.6
2	1.65
3	1.75
4	2.3
5	2.44
6	2.1
7	1.7
8	1.1
9	0.8
10	0.45
11	0.35
12	0.4
13	0.4
14	0.24
15	0.24
16	0.2
17	0
18	0.24
19	0.28
20	0.28
21	0.85
22	1.29
23	1.74
24	1.6

*Based on Herriman City Energy Optimization Study

Table 10-4 summarizes recommended storage based on the criteria discussed above.

Table 10-4
Secondary Required Storage

Existing Storage Equalization Requirement (gallons/irrigated acre)[1]	2,867
Herriman City Safety Factor (gallons/irrigated acre)	2,867
Total Herriman City Secondary Storage Requirement (gallons/irrigated acre)	5,733

[1]Based on 2.78 acre-ft per irrigated acre in accordance with the City's conservation goal, an annual to peak day factor of 3.3, and an equalization ratio of 35%.

TOTAL EXISTING AND FUTURE STORAGE REQUIREMENTS

Existing Storage Requirements

The evaluation of equalization and emergency water storage facilities for existing conditions is shown in Tables 10-5 and 10-6 for culinary water and secondary water respectively. Storage reservoirs that serve multiple pressure zones have been grouped using double lines in the table. In most cases, storage reservoirs in the highest-pressure zone (increasing number denotes higher elevation) provide storage to lower pressure zones. For the secondary system, sometimes the reservoir in a lower pressure zone may pump to higher pressure zones to provide equalization requirements via variable frequency drive (VFD) pumps. It should be noted that storage requirements for secondary water have increased since the last water master plan update as a result of observed demand patterns which have indicated more aggressive water demand patterns that utilize more storage.

Table 10-5
Existing Culinary Storage Requirements[1]

Zone	Dry Year 2020 Peak Day Demand (gpm)	Required Storage (gallons)	Cumulative Required Volume (MG)	Associated Tank(s)	Tank	Cumulative Tank Volume (MG)
North Zones						
Zone - 1N	966	696,000	0.696			
Zone - 2	5,852	4,213,000	4.909	Rosecrest, JVWCD, Zone 2 North	1, 5.0	6
Zone - 3	2,125	1,530,000	6.439	HP Tanks,	1.45	7.45
Zone - 4	2,586	1,862,000	8.301	Hardlick, Kennecott	3.0, 3.0	13.45
Zones 1N – 4 Fire Flow		960,000	9.261			13.45
Lookout Ridge						
Zone - 5S	203	146,000	0.146	Lookout Ridge	0.425	0.425
Zone 5S Fire Flow		120,000	0.266			0.425
Cove						
Zone – 5W	722	520,000	0.52			
Zone - 6W	185	133,000	0.653	Cove	1	1
Zone 5W -6W Fire Flow		180,000	0.833			1
East Zone						
Zone - 1E	816	588,000	0.635	Zone 1E	2	2
Zone 1E Fire Flow		540,000	1.175			2

[1] Pressure zones have been grouped together where access to other pressure zones is readily available via larger transmission mains and pressure reducing valves.

Table 10-6
Existing Secondary Storage Requirements

Pressure Zones	Existing Peak Day Demand (gpm)	Required Storage (MG)	Associated Tanks	Available Storage (MG)
Zone - 1N	0	0.00		
Zone - 2	623	0.63		
Zone - 3	0	0.00		
Zone – 4*	423	0.43		
Zone - 1E	2	0.00		
Zone - 1E-SE	0	0.00		
Zone - 2E	501	0.51		
Zone - 3E	381	0.38		
Zone – 4E*	290	0.29		
Total	**2,219**	**2.24**	**Blackridge**	**9.80**

*Zone 4 is dependent on the VFD pump from the Blackridge Booster.

As shown in the tables, the City has adequate storage to meet existing demands in each tank service area for both the culinary and secondary systems.

Future Storage Requirements

Table 10-7 and 10-8 show the required storage at buildout for the culinary and secondary systems respectively.

Table 10-7
Buildout Culinary Storage Requirements

Zone	Buildout Peak Day Demand (gpm)	Required Storage Volume[1] (gallons)	Cumulative Required Volume (MG)	Associated Tank(s)	Tank Volume (MG)	Cumulative Tank Volume (MG)
		North Zones				
Zone - 1N	1,266	911,754	0.91			
Zone - 2	8,068	5,808,695	6.72	Rosecrest, JVWCD, Zone 2 North	1, 5.0	6
Zone - 3	4,626	3,330,955	10.05	HP Tanks,	1.45, ***2.0***	9.45
Zone - 4	5,169	3,721,982	13.77	Hardlick, Kennecott	3.0, 3.0	15.45
Zones 1N – 4 Fire Flow		960,000 [a]	14.73			15.45

Zone	Buildout Peak Day Demand (gpm)	Required Storage Volume[1] (gallons)	Cumulative Required Volume (MG)	Associated Tank(s)	Tank Volume (MG)	Cumulative Tank Volume (MG)
Northwest Zones						
Zone 5N	1,243	895,019	0.895			
Zone 6N	483	347,947	1.243	***Zone 6N***	***2***	2
Zone 5N - 6N Fire Flow		540,000 [a]	1.783			2
Lookout Ridge						
Zone - 5S	273	196,582	0.197	Lookout Ridge	0.425	0.425
Zone 5S Fire Flow		120,000 [a]	0.317			0.425
Cove						
Zone – 5W	478	343,986	0.34			
Zone - 6W	254	183,182	0.53	Cove	1	1
Zone 5W -6W Fire Flow		180,000 [a]	0.707			1
Cove Upper						
Zone – 7W	211	151,920	0.152			
Zone – 8W	329	236,880	0.389	***Zone 8W***	***0.6***	0.6
Zone 7W – 8W Fire Flow		180,000	0.569			0.6
East Zones						
Zone – 1E	2,529	1,820,731	1.821	Zone 1E	2	2
Zone 1E Fire Flow		[a]	1.821			
Zone – 1E-SE	509	366,450	0.366			
Zone – 2E	1,377	991,667	1.358	***Zone 2E***	***2***	2
Zone 1E – 2E Fire Flow		240,000 [a]	1.598			2
Zone – 3E	2,016	1,451,485	1.451	***Zone 3E***	***2***	2
Zone 3E Fire Flow		540,000 [a]	1.991			2
Zone – 4E	434	312,206	0.312	***Zone 5E***	***0.75***	0.75
Zone – 5E	253	182,160	0.494			
Zone 4E – 5E Fire Flow		180,000 [a]	0.674			0.75
Zone – 6E & Up	184	132,800	0.133	***Zone 6E***	***0.5***	0.5
6E Fire Flow		180,000 [a]	0.313			0.5

[a] – fire storage for each tank service area was estimated using the International Fire Code based on the general plan landuse and potential development of residential / commercial structures. Areas for residential only have storage requirements of 180,000 gallons (1,500 gpm for 2 hours). Areas with commercial, schools, or large industrial have storage estimates up to 960,000 gallons depending on the relative size of the tank service area and their respective land use types. In some cases, it may be possible to reduce fire storage in lower tank service areas if fire storage from higher elevation tanks is readily accessible by lower zones.

Table 10-8
2065 Secondary Storage Requirements (only committed areas)

Pressure Zones	Buildout Peak Day Demand (gpm)	Required Storage (MG)	Cumulative Required Storage (MG)	Associated Tanks	Available Storage (MG)	Pressure Zone HGL
Zone – 1N	42	0.04	0.04			4950
Zone – 2	1,249	1.26	1.30	***Zone 2***	***1.5***	5115-5130
Zone – 2E	571	0.58	0.58			5115-5130
Zone – 3E	370	0.37	0.95			5240-5257
Zone – 3	911	0.92	1.87	Blackridge	9.8	5240-5257
Zone – 4	1,311	1.32	1.32			5385-5400
Zone – 4E	369	0.37	1.69			5395-5410
Zone 5C	189	0.19	1.88	***Cove***	***2.00***	5,550.00
Zone – 1E	695	0.70	0.70	***VFD Pump / Zone 1E***	***1.00***	4950
Zone – 1SE	0	0.000	0			4950
Total	**5,706**	**5.75**	**5.75**		**14.3**	

Table 10-9 shows required secondary storage if the City were to expand secondary to additional potential areas that include large irrigated areas such as Herriman High School. Areas of additional new storage are shown in bold italics. As can be seen the City will need to construct a significant amount of additional storage as growth continues throughout the City. Figures 10-3 and 10-4 show the future storage and major conveyance facilities that will need to be constructed to accommodate future growth in Herriman City.

Table 10-9
2065 Secondary Storage Requirements (including potential secondary areas)

Pressure Zones	Buildout Peak Day Demand (gpm)	Required Storage (MG)	Cumulative Required Storage (MG)	Associated Tanks	Available Storage (MG)	Pressure Zone HGL
Zone - 1N	324	0.33	0.33			4950
Zone - 2	1,812	1.83	2.15	***Zone 2***	***2.5***	5115-5130
Zone - 2E	607	0.61	0.61			5115-5130
Zone - 3E	577	0.58	1.19			5240-5257
Zone - 3	1,008	1.02	2.21	Blackridge	9.8	5240-5257
Zone - 4	1,621	1.63	1.63			5385-5400
Zone – 4E	419	0.42	2.06			5395-5410

Pressure Zones	Buildout Peak Day Demand (gpm)	Required Storage (MG)	Cumulative Required Storage (MG)	Associated Tanks	Available Storage (MG)	Pressure Zone HGL
Zone 5C	189	0.19	2.25	***Cove***	***2.5***	5,550.00
Zone - 1E	1,250	1.26	1.26	***VFD Pump / Zone 1E***	***1.5***	4950
Zone - 1SE	220	0.222	0.222	***VFD Pump***		4950
Total	8,027	8.09	8.09		**16.3**	

Zone 3 East Culinary Storage Service Area

Most of the pressures zones within the City are designed with approximately 140 feet of elevation difference (equal to about 60 psi). This allows for the optimal pressure range of between 60 psi to 120 psi for each pressure zone. The existing Zone 3 pressure zone on the western side of the City, however, only has 110 feet of separation from the Zone 2 pressure zone. As a result, it would potentially increase the number of pressure zones to match the elevation of the existing Zone 3 storage tanks and service area. To provide more standardized separation for the service area toward the east side of Herriman City, the City would like to separate Zone 3 West from Zone 3 East. The proposed Zone 3 East storage facility has been proposed to be approximately 30 feet higher than the existing HP tanks and will be separated from the Zone 3 area to the northwest by PRVs, check valves, and isolation valves.

Zone 3 North Culinary Storage Service Area

Herriman's Zone 3 pressure zone has several hydraulic challenges relative to storage that will need to be resolved by the City over time.

Source Supply

HP#3 and HP#4 Wells supply Herriman's Zone 3 along with Arnold Springs. However, most of the water supply into Herriman's Zone 3 pressure zone is boosted from its Zone 2 source connections up to Zone 4 and then reduced in pressure to Zone 3 via pressure reducing valves. This wastes energy as water pressure is boosted and then dropped in pressure. JVWCD has two source connections into Herriman City near 11800 South and 7200 West: a JVWCD Zone C (water elevation of 5120-5150) source connection, and a JVWCD Zone D (water elevation of 5355-5370). JVWCD's Zone C is just a little higher than Herriman's Zone 2 while JVWCD's Zone D is just a little less than Herriman's Zone 4. Ideally, most demands in the Zone 3 West zone could be supplied via the JVWCD Zone C connection via a lower horsepower pump to reduce power and energy costs for the City. However, the capital costs to construct a dedicated pump station into Zone 3 exceed the 20-year energy costs such that it is not recommended in the short-term due to the other capital infrastructure costs that are higher priorities. The City will need to rely on JVWCD's Zone D connection to supply Zone 3 using a flow control valve to maintain a constant flow rate into Zone 3 until the City has sufficient funds to construct an energy saving booster station.

Storage Volume

The existing HP Tanks in Zone 3 are not adequately sized for all of Zone 3 demands. Zone 3 currently relies on Zone 4 storage to support the bulk of its storage needs. In addition, there will be a small deficit in storage in Zone 2 at buildout that will likely rely on Zone 3 to meet peak instantaneous demands under some conditions. The City would like to construct new storage in Zone 3 to free up available storage in Zone 4 for the needs of future development in that pressure zone of the City and help resolve local storage deficits.

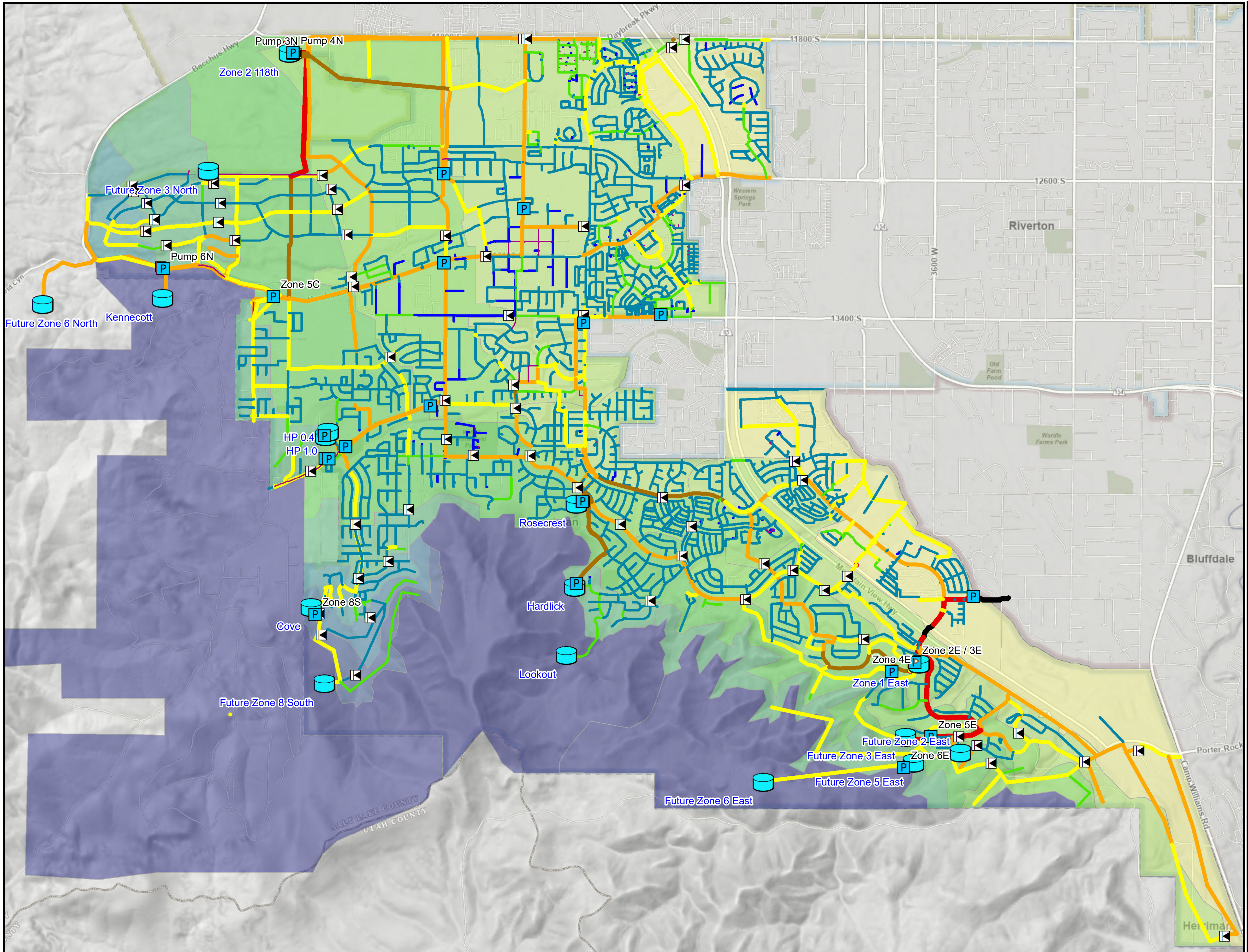
Storage Elevation

The proposed Zone 3 North Tank in the Olympia development is recommended to be constructed with an overflow elevation 10 feet higher than the existing HP Tanks. This elevation is recommended for several reasons:

- **Existing Service Area –** The existing HP Tanks are a little lower than desirable for pressure zone breaks.
- **Water Quality –** In the winter, when demands are lower, the new tank could be operated at a lower elevation to reduce water age concerns while still meeting storage requirements in the summer without exceeding the overflow of the HP Tanks.
- **Transmission –** It will be easier to convey water to the HP Tanks across the City with existing pipe diameters if the new Zone 3 North Tank is a little higher in elevation. The City will eventually replace the HP Tanks and upsize transmission lines in the zone and can construct the future HP Tanks at the same elevation as the new Zone 3 North Tank. This concept should be revisited during design of the Zone 3 North Tank.
- **Zone Boundaries –** No zone boundaries are recommended between the new tank and HP Tanks at this time. A supervisory controlled (SCADA controlled) valve at the new Zone 3N Tank will be needed to isolate the tank under lower demand conditions to avoid causing overflows at the HP tanks assuming the tank is constructed 10 feet higher than the HP Tanks. Design of the new Zone 3N Tank will need to consider lower demand operating conditions and how filling / draining will be accomplished under current pipe configurations leading to the HP Tanks.

Storage Conveyance

The City has conveyance restrictions that prevent flow from the 11800 South 7200 West connection from reaching the HP Tanks (existing Zone 3 storage) without excessive pressures at the bottom of the Zone 3 Pressure Zone. A 16-inch pipe is recommended from 13400 South & Rose Canyon Road up to the HP Tanks to resolve this major conveyance restriction. However, this is not recommended until the existing pipes from the HP Tanks need replacement or the tanks themselves need replacement. Until the pipe is replaced, some parts of Zone 3 will continue to be supported by Zone 4 to Zone 3 pressure reducing valves. The primary PRV should be 6400 West 13900 South. Once the new Zone 3 tank is constructed, most other Zone 4 to Zone 3 PRVs should be turned down such that they only open if needed for fire protection.



Legend

- Pumps
- Tanks
- Source
- PRVs

Diameter

- <4"
- 6"
- 8"
- 10"
- 12"
- 14"-16"
- 18"-20"
- 24"
- 30"-36"

Pressure Zones

- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9

NORTH:

SCALE: 0 1,500 3,000 Feet

BUILDOUT CULIUNARY FACILITIES

HERRIMAN CITY

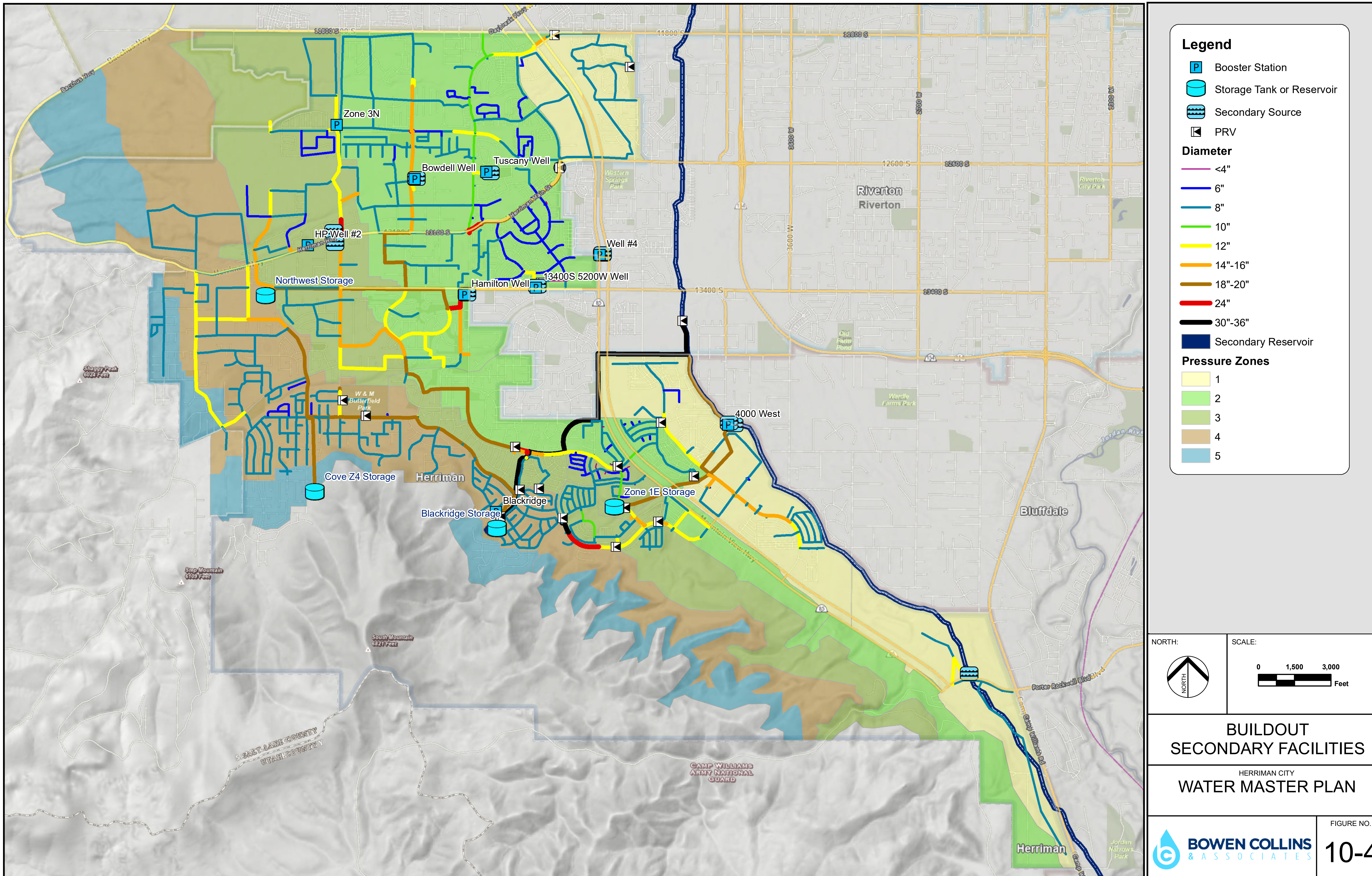
WATER MASTER PLAN

BOWEN COLLINS & ASSOCIATES

FIGURE NO.

10-3

P:\Herriman\217-21-03 - Water Master Plan Update\4.0 GIS\Figure 10-3 Future Culinary Facilities.mxd amckinnon 5/2/2024



BUILDOUT SECONDARY FACILITIES

HERRIMAN CITY

WATER MASTER PLAN

BOWEN COLLINS & ASSOCIATES

FIGURE NO. 10-4

P:\Herriman\217-21-03 - Water Master Plan Update\4.0 GIS\Figure 10-4 Future Secondary Model.mxd amckinnon 3/30/2024

BOOSTING EVALUATION

The City's culinary water sources are primarily delivered in Pressure Zones 1 to 3 from JVWCD, groundwater wells, or springs. All of the water for Pressure Zones 4 and up are boosted to those pressure zones. The City also has several booster stations with somewhat overlapping service areas which is desirable to provide a degree of redundancy in the event one pump station is unavailable due to power or equipment failure. Table 10-10 lists existing culinary boosting capacity along with future booster stations that will be constructed to meet future needs. Additional future capacity needed through either the construction of new or expansion of existing booster stations is shown in bold italics.

Table 10-10
Existing and Future Culinary Booster Stations

Booster Pump	Source	Destination Storage	Flow (gpm)	Pump Head (ft)
HP Well #3	HP Wells	HP Tanks (Zone 3)	240	10
HP Well #4	HP Wells	HP Tanks (Zone 3)	230	100
Zone 3N	Zone 2N 5MG	HP Tanks (Zone 3)	***3,600***	***160***
Zone 4 Hardlick	Rosecrest	Hardlick / Kennecott (Zone 4)	4,800	330
Zone 4 N	JVWCD Zone D 118th	Kennecott (Zone 4)	***7,000***	***80***
JBM Booster	Zone 2	Kennecott (Zone 4)	2,200	320
Zone 5 boosters	Hardlick Tank	Lookout Ridge (Zone 5)	240	210
Hi-Country Booster	HP Tanks	HC Buffer Tank	180	250
Cove (Zone 6W)	Zone 4	Cove (Zone 6)	1,800	340
Zone 1E	JVWCD Zone A	Zone 1E	2,700 ***(Expand to 10,000 at buildout)***	330
Zone 2E	***Zone 1E***	***Zone 2E***	***2,100***	***145***
Zone 3E	***Zone 1E***	***Zone 3E***	***4,400***	***257***
Zone 4E	***Zone 3E***	***Zone 4E***	***1,000***	***137***
Zone 5E	***Zone 3E***	***Zone 5E***	***600***	***416***
Zone 6E	***Zone 5E***	***Zone 6E***	***300***	***137***
Zone 6N	***Zone 4 (Kennecott)***	***Zone 6N / 5N***	***1,700***	***315***
Zone 8W	***Cove***	***Zone 8W***	***600***	***350***
Total (Including Future)			***41,490***	

The majority of the City's secondary water sources are in Pressure Zone 1 and 2 and are boosted to Zones 3 and 4. Table 10-11 lists existing secondary boosting capacity along with future booster stations that will be constructed to meet future needs. Additional future capacity needed through either the construction of new or expansion of existing booster stations is shown in bold italics.

Table 10-11
Existing and Future Secondary Booster Stations

Booster Pump	Source	Destination Storage	Flow (gpm)	Pump Head (ft)
4000 West - Blackridge	Welby Jacob	Blackridge	3,200 ***(Expand to 6,000)***	600
4000 West - Juniper Canyon	Welby Jacob	Zone 1E Juniper Canyon	***1,600***	360
Blackridge Pump Station	Blackridge	Zone 4 VFD / Future Zone 4 storage	3,500	211
Zone 1SE	***Welby Jacob***	***Zone 1SE VFD***	***550***	***185***
Zone 3N	***Blackridge***	***Zone 3N VFD***	***500***	***67***
Future Well 1*	***Groundwater***	***Zone 3N***	***250***	***200***
Future Well 2*	***Groundwater***	***Zone 3N***	***250***	***200***
Future Well 3*	***Groundwater***	***Zone 4***	***400***	***200***
Total			***13,050***	

**These projects are not shown on Figure 10-4 because the final location of wells has not yet been determined. Destination storage is approximate. Capacities listed are based on estimates associated with similar wells in Herriman City.*

Secondary Pumping Strategy

Sizing conveyance pipelines within pressure zones to minimize pressure losses can help to reduce overall energy costs. However, many of Herriman's pressure zones are long and parts of pressures zones can be very far from the available sources or existing storage facilities. This can make it challenging to provide water to all parts of the pressure zone without additional pumping. For Herriman's secondary water system, there are several cases where pump stations will be installed to assist in moving water to other parts of the service area:

- **Welby-Jacob to Zone 3N –** The Welby-Jacob Canal is one of the City's largest secondary sources and delivers water to the Blackridge Reservoir via a 30-inch diameter pipeline. To deliver additional Welby-Jacob water to the northwest end of the City with adequate pressure to meet irrigation demands may require conveying the flow northwest from the Blackridge Reservoir via Zone 3 pipes. An additional booster pump with a variable frequency drive may be needed to serve the future park at Midas Creek and 6400 West. The estimated peak instantaneous demand of the park may be as high as 500 gpm depending on the amount of irrigated turf or playfields likely to be installed.
- **Zone 1SE Pump Station –** The area at the very southeast end of the City directly abuts the Welby Jacob Canal. This allows the options of individual users adjacent to the canal build ing pumps to irrigate individual properties or the City building a pump station to distribute Welby Jacob water to nearby properties using a variable frequency drive booster pump without a long distribution line.

CHAPTER 11
HYDRAULIC MODEL HISTORY

The purpose of this chapter is to document the development and history of the City'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 available computer programs for modeling water distribution systems. The City maintains a Bentley WaterGEMs hydraulic model license, but also utilizes EPANET versions of the model when working with stakeholders (developers, engineers) outside of the City.

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

- **2018 Optimization Study** – The City prepared an energy optimization study in 2018 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 2018 observed demands.
- **2019 Update** – The original optimization study did not include some production data from JVWCD as a result of some supervisory control and data acquisition (SCADA) concerns. The model was updated as part of this study to reflect SCADA data provided by JVWCD. The culinary diurnal pattern reflected in Chapter 10 is based on an updated mass balance using both Herriman and JVWCD culinary water production data.
- **2021 Update** – The model was updated using 2020 billing data in combination with 2021 billing data. Drought mitigation efforts in 2021 reduced demands such that demands were significantly lower in 2021 than in 2020. To accurately account for many newly constructed home and neighborhoods, 2021 demands were needed to better estimate the distribution of demand for 2021. Overall demands were adjusted up to reflect the peak day 2020 demand.
- **2024 Update** – The City's general plan was adopted in January 2022 and included changes to planning densities, park/plaza spaces, and water conservation. The City also eliminated large areas of future secondary water service so that most outdoor irrigation will be supplied by the culinary water system.
- **Future Facilities** – Future facilities and demands were created in the model as skeletonized connections to simulate major conveyance facilities unless lot layouts were provided by developers for the area.

Secondary Water Model

- **SCADA & Data Limitations** – The data available for use in the secondary model was based on billing data and SCADA data.

- Stillman / Hamilton Well Transmission Line – All of the City's Zone 2 secondary pipes north of Herriman Parkway and including some areas south of Herriman Parkway are all supplied via the Hamilton, Stillman, and Tuscany Wells.
    - Rosecreek Park - Herriman City personnel identified some data gaps at Rosecreek Park that were not included in billing data as part of 2018. Based on a rough open space area estimate of 23 acres, unmetered peak day secondary demand for the Rosecreek area could account for approximately 0.2 mgd of the discrepancy.
- Billing Data Calibration – There are often significant difference between billing data and production data for peak demands, system demands were calibrated in two steps.
    - Blackridge Service Area – The Blackridge Service area includes all of the billing areas that are served by the 4000 West pump station. Peak day demands for this area for the period of record were primarily measured via the Blackridge Pump Station. So the billing data for areas in this area could be scaled up to match the measured data through the pump station.
    - Stillman Well Service Area – Production for the areas that are served exclusively by Stillman Well, Hamilton Well, Tuscany Well can be measured as the net decrease in production from the wells and a flow meter at the Rosecrest Booster. This service area is hydraulically disconnected from the Blackridge Reservoir and can be treated separately. The billing data for this area was scaled up to match peak day production data for the area with the modification noted above for the Rosecreek area.
    - Future Calibration Areas – As the City expands service, it will be possible to better calibrate the model by further breaking up the secondary system into production areas that can be documented by flow meters or the net difference from flow meters.
- Riverton City – Riverton City pumps flow up to the Blackridge Reservoir, but also pulls water out earlier than Herriman City. For the purpose of calibrating the model, demands from Riverton City have been left out with the assumption any net pumping from Riverton City will be reduced by demand. This cannot be entirely accurate, but there is insufficient data to identify how Riverton City demands fluctuate and may affect storage in the Blackridge Reservoir.

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 City's hydraulic models are setup to run extended period simulations and steady state simulations as needed. The model results that are most useful for evaluating the distribution system performance include operating conditions for several conditions: static or wintertime 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 to identify potentially high system pressures when demands are low and pipe friction losses are minimal. This scenario can also be used to look for high system velocities which could indicate a cross connection between different pressure zones.
- ***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 existing to fill and drain tanks properly during peak demands.
- ***Peak Hour Demand*** – 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 1.7 was used based on the data provided by the City. A peak hour to peak day peaking factor of 2.44 was applied to the secondary water system based on pattern data developed as part of the City's energy optimization study.

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. The City's level of service goal for the City is a minimum pressure of 45 psi during peak instantaneous demands. However, the City 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 City would like to keep secondary water pressures 5 psi less than culinary system pressures with a minimum total pressure of not less than 40 psi during peak hour demand. The target pressure the City 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, however, 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 due to pumping and conveyance requirements.

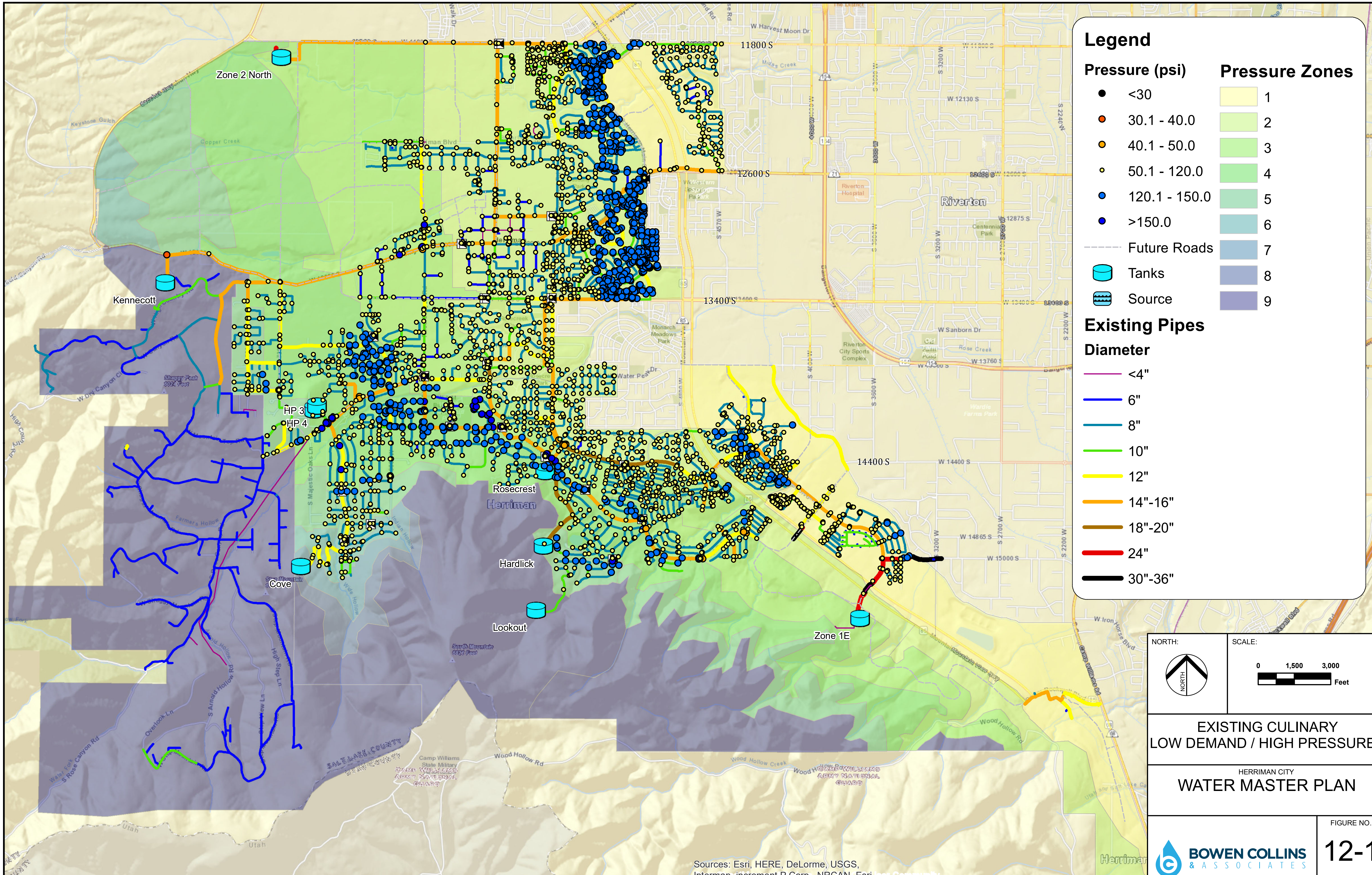
- **Pressure within the system during peak day demands with fire flow –** The State of Utah requires that a public water system be capable of conveying required fire flow with a residual pressure of 20 psi. Minimum fire flows have been defined as 1,500 gpm with a residual pressure of 20 psi for residential connections. Note that historic fire flow standards allowed for 1,000 gpm for some residential areas. As a result, existing developed connections with fire flows above 1,000 gpm were considered less desirable, but low priority for improvement. Commercial areas were evaluated with a fire flow of between 3,000 and 4,000 gpm with a 20 psi residual.
- **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. The target velocity for pump transmission lines is less than 5 ft/sec to reduce energy requirements on pumps.

SYSTEM EVALUATION RESULTS

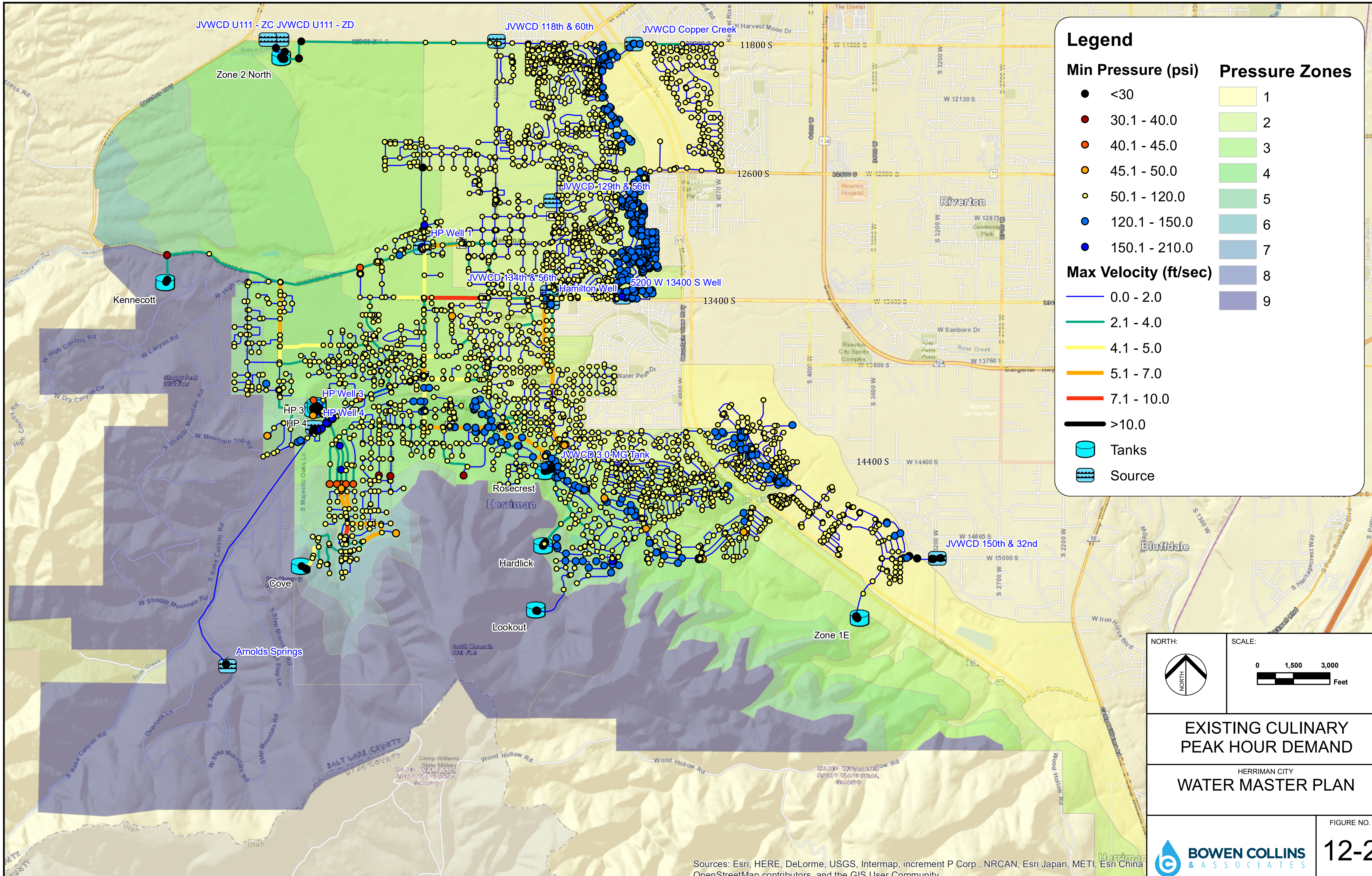
Existing Culinary Distribution Evaluation

The hydraulic computer model was used to simulate system conditions for the three critical modeling scenarios listed above. Model results under existing demands are included in the following figures:

1. Figure 12-1 shows pressures for the low demand scenario:
    a. There are many areas in the City with pressures higher than 120 psi related to historical pressure zone boundaries. Fort Herriman Middle school and a nearby church building have pressures in the range of 160 psi. Because these are non-residential connections with their own pressure reducing valves and the pipe material is ductile iron, these pressures may be considered tolerable. The City could consider adding a PRV near these connections and connecting the school to the Butterfield Park system which already has a pressure reducing valve for service.
2. Figure 12-2 shows pressures for the peak hour demand scenario:
    a. Long Ridge Dr / Palo Alto Dr – The upper edge of Pressure Zone 4 near these few streets has lower than desired delivery pressure. Connections still meet State of Utah requirements, but do not meet the City's pressure goal. There are several causes for low pressures near this location:
        i. Elevation – These locations are at the upper end of Pressure Zone 4.
        ii. Conveyance Capacity – This location is one of the furthest locations away from existing Zone 4 storage tanks and more pressure is lost to convey to this distant location.



P:\Herriman\217-21-03 - Water Master Plan Update\4.0 GIS\Figure 12-1 Static Demand.mxd amckinnon 11/5/2021



EXISTING CULINARY
PEAK HOUR DEMAND

HERRIMAN CITY
WATER MASTER PLAN

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
12-2

P:\Herriman\2019 Water Master Plan Update\4.0 GIS\4.1 Projects\Figure 12-2 Ex PHD.mxd AMcKinnon 7/29/2020

iii. Cove Pumping and Zone 5 Demands – The model shows that the nearby Zone 5C area including areas between Summit Crest Lane and Herriman Hwy (Butterfield Creek) are using a significant amount of the Cove Pump Station's capacity leading to reduced head and flow to the Cove storage tank. Model results indicate that the Cove Pump station recirculates some flow under existing conditions due to the lack of available pressure. This results in some high velocities along Spring Canyon Dr pipes as flow is delivered from Zone 5 to Zone 4 via pressure reducing valves under peak conditions.

As demands increase into the future, the Cove pump station will not be able to keep up with demands and the tank will drain without additional conveyance improvements to this location.

b. Herriman View Cove – Herriman View Cove has relatively low pressures that are primarily related to a high elevation. This location is not that far from the Hardlick storage tank and pipe velocities in the area are not a significant concern. If this connection can be connected to Zone 5 in the future, that would be the best solution to remedy low pressures at this location.

c. Most other low pressures identified in Figure 12-2 are related to transmission lines near storage tanks that do not have any demands or service connections and are subsequently not of concern to the City.

3. Figure 12-3 shows the available fire flow in conjunction with existing peak day demands:

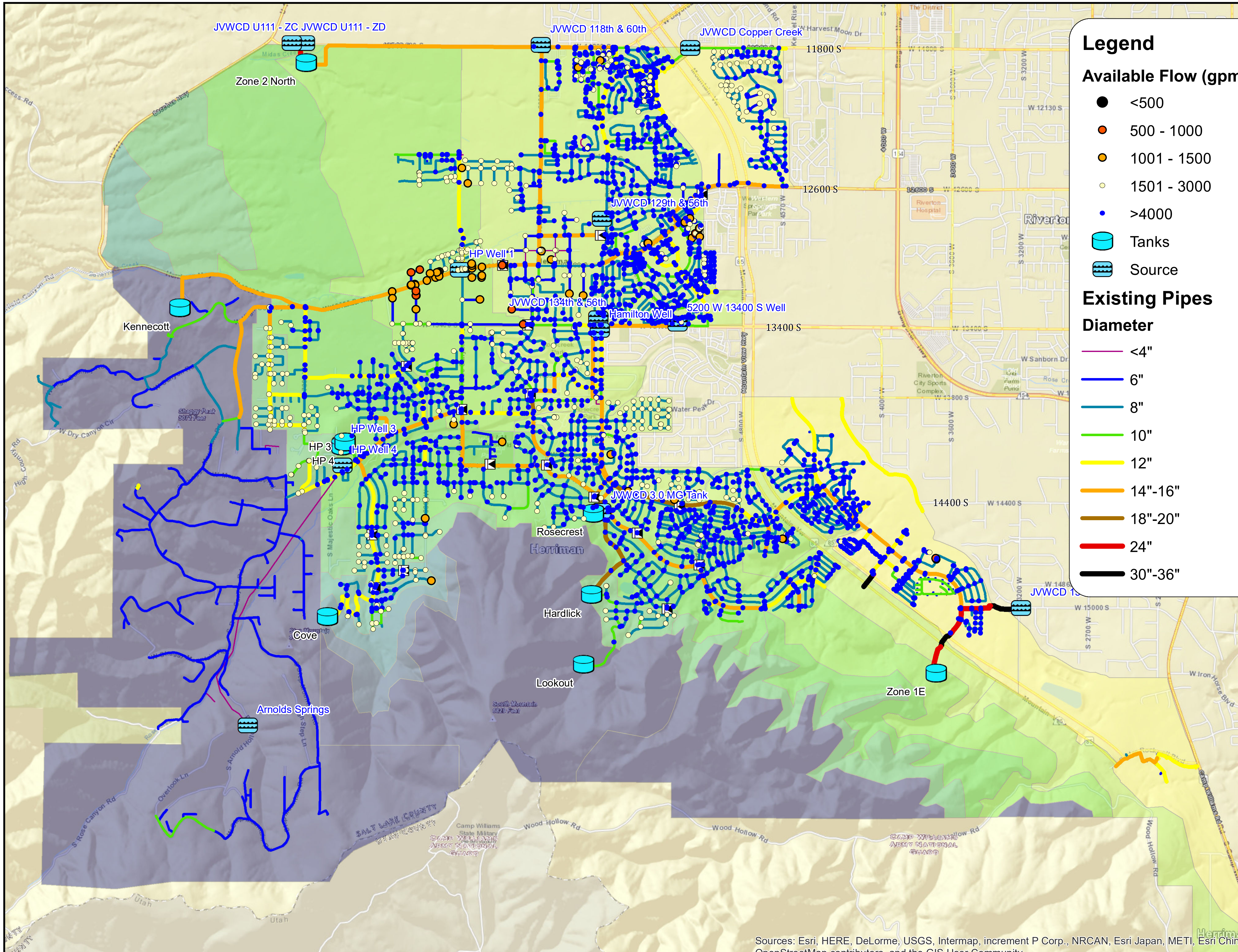
a. Most of Herriman City's distribution system meets fire flow requirements. This is primarily because much of the City's water distribution system is newer and meets more recent international fire code requirements. The few fire flow deficiencies in the City are caused by the following concerns:

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.

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, the northwestern parts of the connected Pressure Zone 2 have pressures below the City's desired level of service. However, there are few active secondary accounts in those areas and those pressure issues will resolve when Herriman begins operating its Tuscany and Bodell Wells which have not been operated much in the secondary system yet.



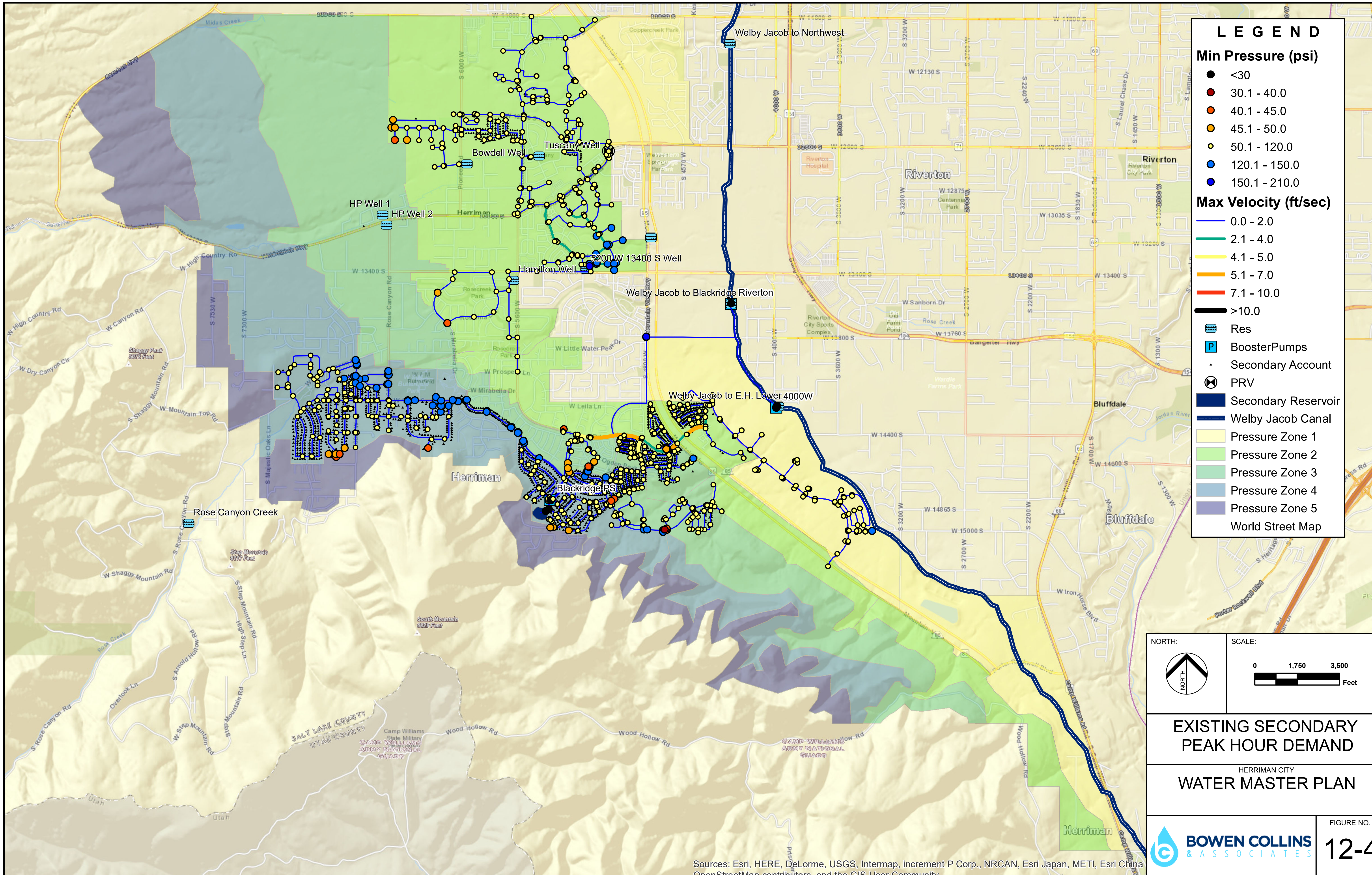
EXISTING CULINARY
PEAK DAY DEMAND
AVAILABLE FIRE FLOW AT 20 PSI

HERRIMAN CITY
WATER MASTER PLAN

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
12-3

P:\Herriman\2019 Water Master Plan Update\4.0 GIS\4.1 Projects\Figure 12-3 Ex PDFF.mxd AMcKinnon 7/29/2020



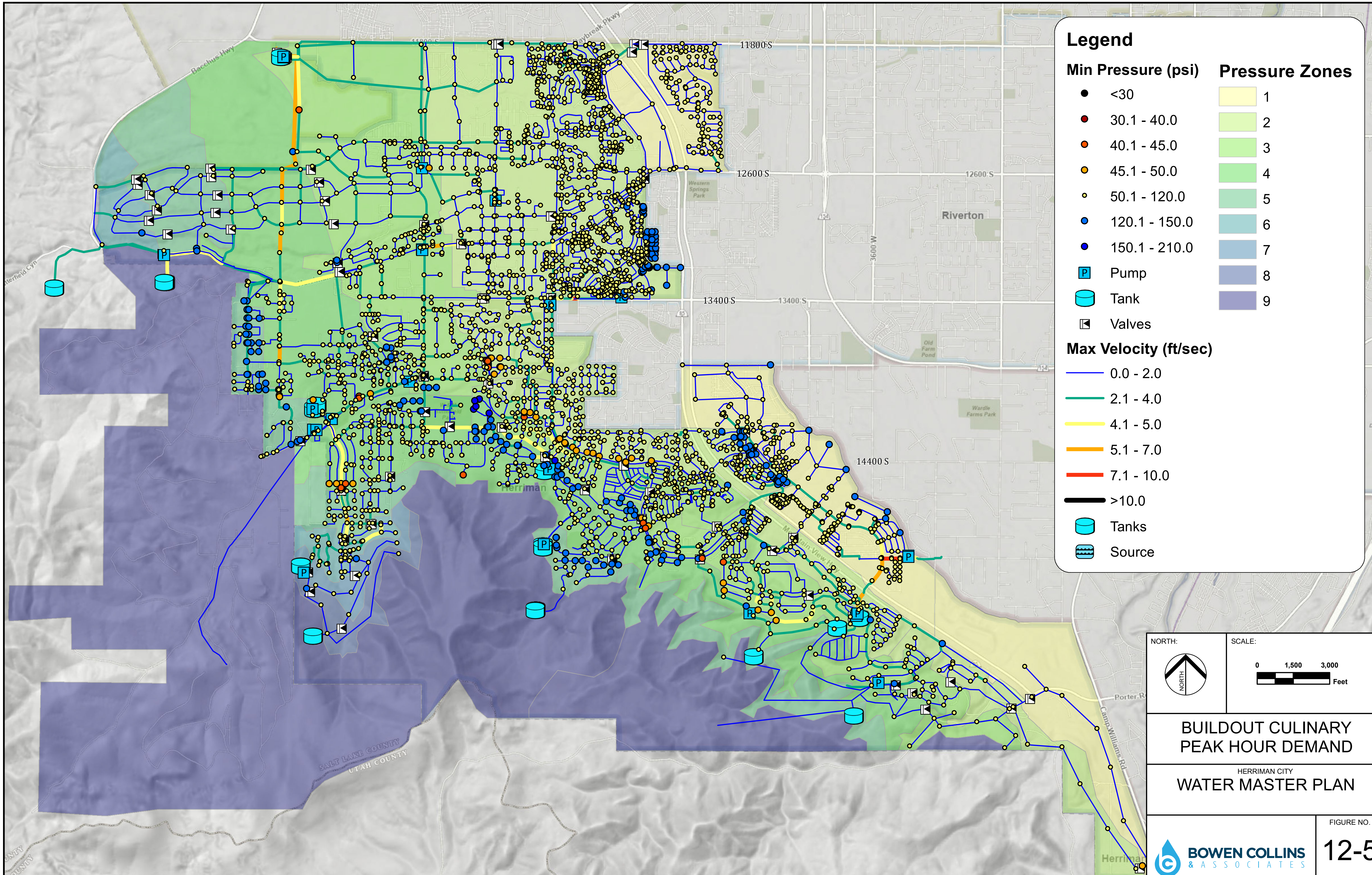
P:\Herriman\2019 Water Master Plan Update\4.0 GIS\4.1 Projects\Figure 12-4 Secondary ExPHD.mxd AMcKinnon 7/29/2020

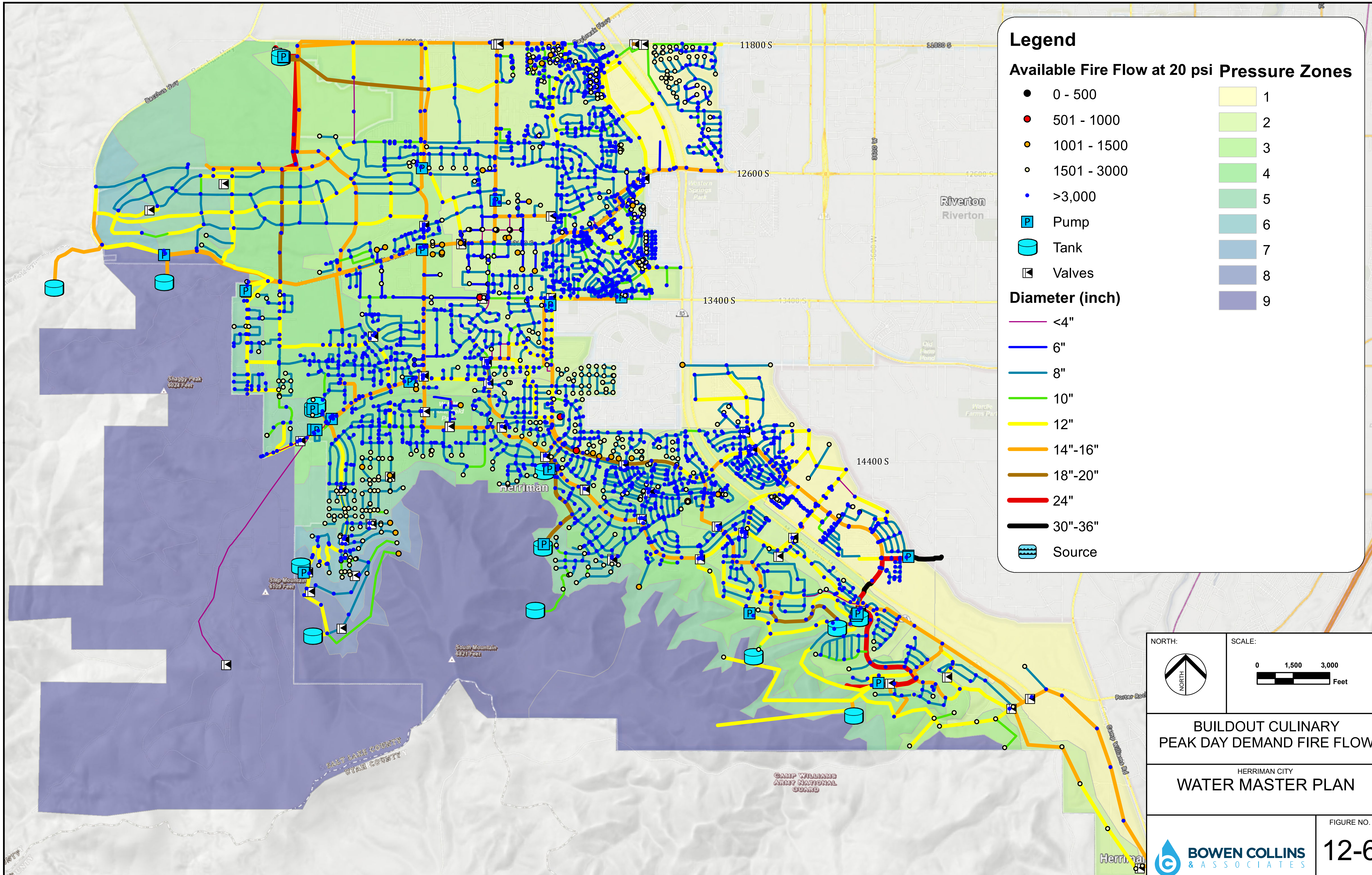
Future Culinary Distribution Evaluation

1. The hydraulic computer model was used to simulate system conditions for 2065 development conditions. New facilities were added as a skeleton system to serve developing areas. The skeleton system is intended to represent looping that should be part of the future system. As areas develop, additional looping could reduce needed pipe sizes or conversely limited looping would require larger pipe sizes. The new facilities themselves have been sized to avoid deficiencies for developing areas. Figure 12-5 and 12-6 show peak hour demands and peak day demands with fire flow:Figure 12-5 shows pressures for the buildout peak hour demand scenario:
   a. In some cases, there continue to be some areas that do not meet the City's desired delivery pressure today. These are primarily related to elevation issues. In all cases, the system meets State of Utah pressure delivery requirements.
2. Figure 12-6 shows available flow at 20 psi for the 2065 peak day demand scenario. There are no significant changes in fire flow deficiencies in 2065 compared to existing conditions. As a result, most of the improvements needed for existing conditions will resolve the future fire flow deficiencies as well.

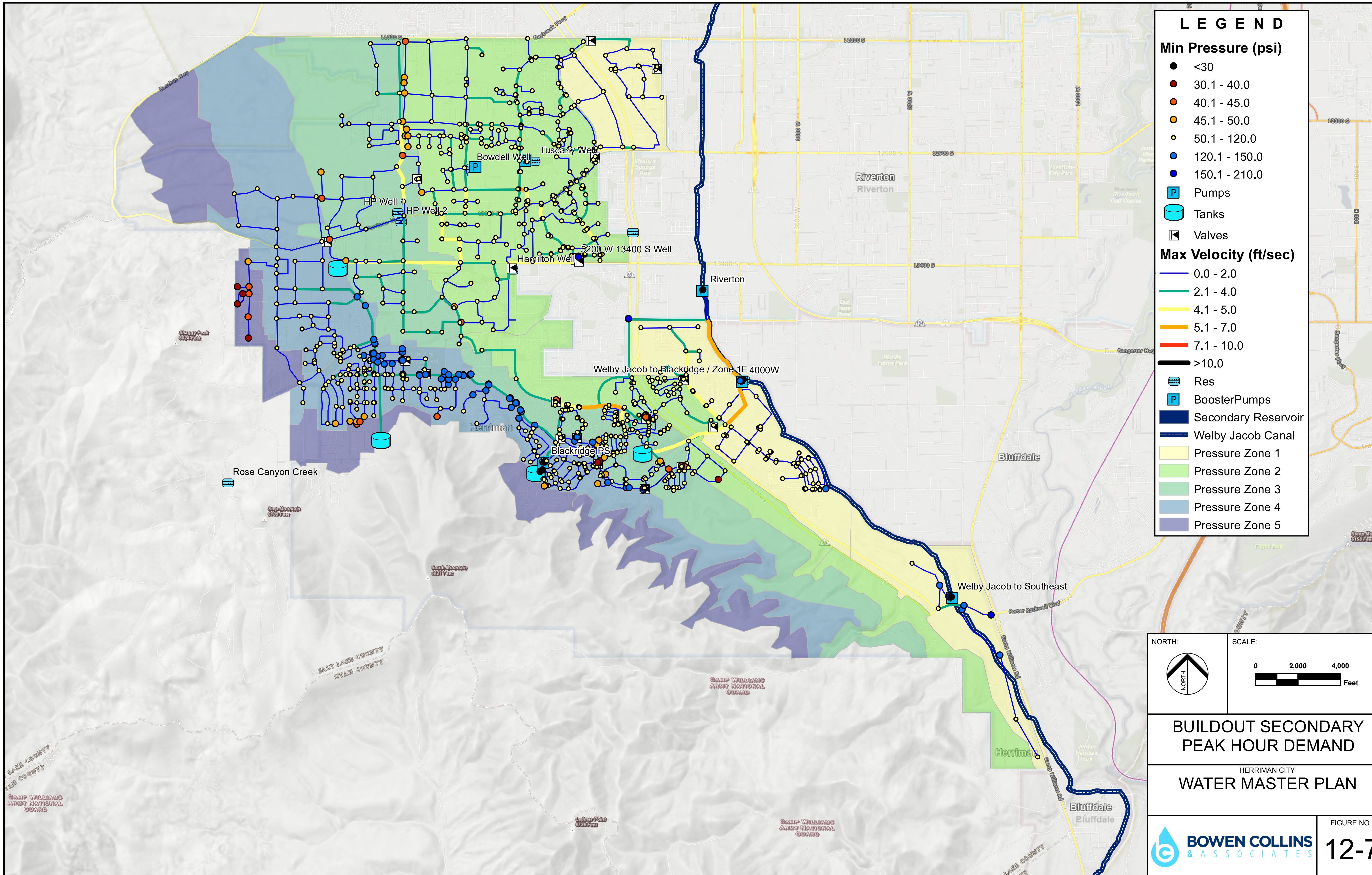
2065 Secondary Distribution Evaluation

Figure 12-7 shows pressures and peak velocities for peak hour demand conditions. Based on model results, there is one area of the City with pressures below the City's desired level of service at buildout. The area is actually part of Pressure Zone 5 and is higher in elevation than originally planned for service by the secondary system. As a result, an exception for pressure delivery to this area will be allowed so that pressures at the upper system may be as low as 30 psi during peak demands. These lower pressures could be mitigated by altering demand patterns for the local area to reduce the peak hour demand and increase available pressure for secondary use. Basically, the City could make an exception to the normal watering times for these lower pressure areas so that users can irrigate in later morning or earlier evening time frames when more pressure would be available.


Legend
Min Pressure (psi)
<30
30.1 - 40.0
40.1 - 45.0
45.1 - 50.0
50.1 - 120.0
120.1 - 150.0
150.1 - 210.0
Pump
Tank
Valves
Pressure Zones
1
2
3
4
5
6
7
8
9
Max Velocity (ft/sec)
0.0 - 2.0
2.1 - 4.0
4.1 - 5.0
5.1 - 7.0
7.1 - 10.0
>10.0
Tanks
Source
11800 S
12600 S
13400 S
14400 S
Riverton
Herriman
Bacchus Hwy
3600 W
Porter Rockwell
Camp Williams Rd
Salt Lake County
Utah County
NORTH:
SCALE:
0
1,500
3,000
Feet
BUILDOUT CULINARY PEAK HOUR DEMAND
HERRIMAN CITY
WATER MASTER PLAN
BOWEN COLLINS & ASSOCIATES
FIGURE NO.
12-5



P:\Herriman\217-21-03 - Water Master Plan Update\4.0 GIS\Figure 12-6 BO PDDFF.mxd amckinnon 3/20/2024



BUILDOUT SECONDARY PEAK HOUR DEMAND

HERRIMAN CITY
WATER MASTER PLAN

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
12-7

P:\Herriman\217-21-03 - Water Master Plan Update\4.0 GIS\Figure 12-7 Secondary BoPHD.mxd amckinnon 3/13/2024

CHAPTER 13
WATER SYSTEM IMPROVEMENTS

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

CULINARY STORAGE AND BOOSTER IMPROVEMENTS

Project costs for culinary storage and booster stations are summarized in Tables 13-1 and 13-2.

Table 13-1
Future Culinary Storage Tanks

Tank	Size (MG)	Project Cost	Estimated Year of Construction
Zone 2E	2	$6,504,000	2025
Zone 3E	2	$6,504,000	2025
Zone 3N	2	$7,000,000	2026
Zone 5E	0.75	$3,135,000	2030
Zone 6E	0.5	$2,181,000	2032
Zone 6N	2	$7,000,000	2028
Zone 8W	0.6	$2,509,000	2028
10-Year Total		**$34,833,000**	
Buildout Total		**$34,833,000**	

*unit costs for tanks vary between $3.25/gallon and $4.36/gallon depending on variables such as size, location.

It is worth noting that there is potential for variation in the location of future storage tanks. The Zone 5E and 6E Tanks could potentially be combined into a single storage facility depending on the timing of development in higher pressure zones. The size and cost of tanks may also fluctuate depending on development plans.

Table 13-2
Future Culinary Booster Stations

Booster Pump	Flow (gpm)	Head (ft)	Power (HP)	Project Cost*	Estimated Year of Construction
Zone 1E (expansion to 5,400 gpm)	5,400	150	284	$287,500	2035
Zone 2E	2,100	150	111	$1,005,000	2026
Zone 3E	4,400	290	448	$2,849,000	2026
Zone 3N	3,600	160	202	$1,644,000	2035
Zone 4N	7,000	80	197	$1,279,000	2028
Zone 4E	1,000	141	50	$845,000	2030
Zone 5E	700	280	69	$845,000	2030
Zone 6E	300	141	15	$507,000	2032
Zone 6N/5N	1,700	267	56	$1,504,000	2028
Zone 8W	600	350	74	$1,014,000	2028
10-Year Total				**$9,848,000**	
Buildout Total				**$11,779,500**	

*Costs for pump stations vary and depend on whether pump stations are expansions, dual zone pump stations, low lift (pressure increase) pump stations; but approximately cost between $5,000/HP to $11,000/HP depending on noted variables.

Like some of the City's future storage tanks, future booster stations could potentially be combined or maintained independent depending on timing of future development:

- Zone 2E / 3E Pump Station – The Zone 2E and 3E pumps will be combined into a single building based on proximity to each pressure zone from its source water (Zone 1 East).
- Zone 6N Pump Station – The Zone 5C area currently draws demand from the Cove Tank, but this will eventually lead to demands too high for the Cove Pump Station and local conveyance pipes to keep up with demand. As a result, Zone 5C needs to be connected to Zone 5N. A Zone 5 pipeline will need to be constructed along Herriman Main street to connect the 5C area to the 5N area. There has been some concern from maintenance staff regarding the existing High Country Estates booster station condition. The 6N pump station could also be used to support some or all of High Country Estates demand. Additional capacity would need to be added to those listed in Table 13-2 for this to be possible. It would also be possible to make the Zone 6N a dual zone pump station (one suction header with two discharge headers) to reduce energy / power costs to deliver water to Zone 5.
- Zone 3N / 4N Booster Station – The Zone 3N Booster Station is intended to serve future growth and to increase source capacity directly to Zone 3 that currently is boosted to Zone 4 and then passed through pressure reducing valves to Zone 3. BC&A performed a simplified power / energy cost analysis for the Zone 3N booster station and determined it will take more than 20 years to pay off any capital costs to construct the booster. As a result, it is recommended that the City purchase sufficient property to construct the Zone 3N pump station when it builds the Zone 4N booster station. However, for the near future, the recommendation will be to use a flow control valve connected to JVWCD's Zone D pressure zone to supply Zone 3. The Zone 4N Booster will increase conveyance capacity to the Kennecott storage reservoir for use in Zones 5C, 5N, and 6N.

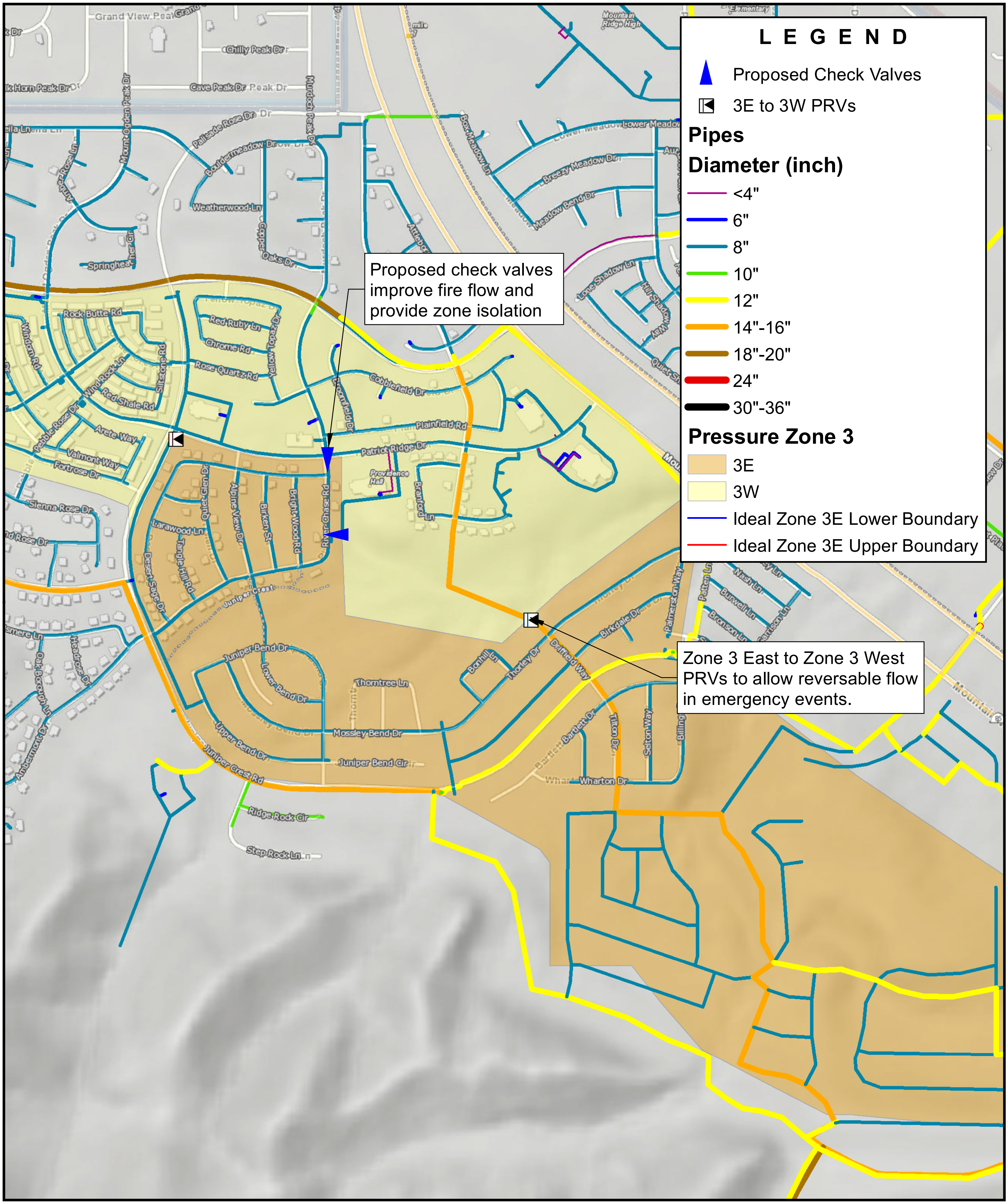
- Other Future Pump Stations – The construction and arrangement of most other future pump stations will depend on the timing of future growth.

CULINARY DISTRIBUTION IMPROVEMENTS

Culinary water system improvements for the City's culinary distribution system can generally be grouped into one of three categories as follows:

- **Development Related –** The majority of system improvements in the City will be related to development and extending new waterlines to meet the needs of future growth.
- **Dead-End Fire Flow Improvements –** There are limited areas where additional looping is needed to better meet fire flow requirements for existing conditions. All of the fire flow dead-ends identified for existing conditions could likely be looped as part of extensions to future growth. As a result, looping improvement projects for these deficiencies have not been separated from the developing pipe category.
- **Pressure Zone Changes –**
    a. Zone 3E - The City will be modifying Pressure Zone 3 somewhat to better serve some neighborhoods that sometimes have lower pressures during peak hour conditions and to better serve areas of East Herriman. The new Zone 3 East culinary storage tank will be positioned approximately 30 feet (13 psi) higher than the existing HP Tanks in Zone 3 West. This will require the construction of two new PRVs and several check valves at key locations as identified in Figure 13-1 to separate Zone 3 West from Zone 3 East. This will increase pressures at upper elevations in Zone 3 while preventing lower elevations in Zone 3 West from exceeding desired pressure limits.
    b. Zone 3N – The City should also consider the locations of PRVs to separate the proposed Zone 3N storage reservoir zone from the existing Zone 3 HP Tanks. The proposed difference in elevation will be less for the 3N tank (10-feet) than for the Zone 3E Tank. The Zone 3N storage reservoir is much closer to the City's sources and will by default fill much earlier than the HP Tanks. This will eventually be remedied via conveyance improvements to the HP Tanks but will require operational modifications until those improvements can be made.

While Figure 10-4 shows many of the pipes that City or developers will need to construct at buildout, detailed costs for projects have only been developed for those pipelines expected in the 10-year window. A detailed list of pipes needed over the next 10-years is included in Chapter 14.



BOWEN COLLINS & ASSOCIATES

Pressure Zone 3 East Boundary

HERRIMAN CITY

WATER MASTER PLAN

NORTH:

SCALE: 0 500 1,000 Feet

FIGURE NO. 13-1

P:\Herriman\217-21-03 - Water Master Plan Update\4.0 GIS\Figure 13-1 - Zone 3E Modifications.mxd amckinnon 11/5/2021

SECONDARY STORAGE AND BOOSTER IMPROVEMENTS

Project costs for secondary storage and booster stations are summarized in Tables 13-3 and 13-4.

Table 13-3
Future Secondary Storage Tanks

Future Secondary Storage Costs	Size (MG)	Project Cost	Estimated Year of Construction
Zone 1 - Juniper Canyon	1	$3,634,000	2036
Zone 2	2	$5,814,000	2034
Zone 4 - Cove	2	$5,814,000	2026
10-Year Total		**$5,814,000**	
Buildout Total		**$15,262,000**	

Table 13-4
Future Secondary Booster Stations

Booster Pump	Flow (gpm)	Head (ft)	Project Cost	Estimated Year of Construction
4000 West Blackridge (expansion)	4,900	600	$300,000	2035
4000 West - Juniper (1E)	1,600	360	$231,000	2026
Zone 1SE	550	155	$675,000	2034
Zone 3N	500	67	$400,000	2030
Future Well 1	200	200	$2,400,000	2027
Future Well 2	200	200	$4,300,000	2028
Future Well 3	450	200	$2,400,000	2035
10-Year Total			**$8,006,000**	
Buildout Total			**$10,706,000**	

The following should be noted regarding secondary booster station recommendations:

- 4000 West – Juniper – The connection to the Welby Jacob Canal, the pump house, and all of the pumps to the Blackridge Reservoir were constructed previously. Pumps to a future Zone 1E reservoir up Juniper Canyon will need to be constructed to begin delivering water to Pressure Zone 1E.
- Zone 1SE – A dedicated irrigation pump for the area at the Southeast end of the City is recommended based on the relatively close proximity to the Welby Jacob canal.
- Zone 3N – This pump station is needed to meet conveyance needs at the north end of Pressure Zone 3. Blackridge Reservoir is too far away from the north end of the City to adequately provide pressure for irrigation to the north end of Zone 3. This pump will be dedicated to providing adequate pressure to irrigate the future park by Midas Creek & 6400 West.
- Future Wells – Future secondary wells are likely to be located in Zone 3 and 4. The wells should discharge to those pressure zones to minimize required distribution piping and potentially reduce conveyance needs for those pressure zones.

SECONDARY DISTRIBUTION IMPROVEMENTS

Secondary water system improvements for the City's secondary distribution are primarily intended to serve areas of committed secondary and/or potential secondary areas. In some cases, conveyance requirements will require building through existing roads where customers adjacent to the pipeline may be connected incidental to the primary purpose of the project. With this in mind, projects can be generally grouped into two categories:

- **Development Related –** The majority of system improvements in the City will be related to dry pipes, areas with previous City commitments for secondary, and other limited areas with significant potential irrigated areas.
- **Conveyance –** The City will need to construct some major conveyance pipes to improve supply from some of its existing and future sources.

Detailed costs for individual projects that need to be constructed over the next 10-years will be included in the Chapter 14.

WATER RIGHT & PLANNING IMPROVEMENTS

Based on the City's existing supply and projected demand for secondary water, the City has no additional need for more Welby Jacob canal shares or underground well water to meet secondary water demands. The City may need to purchase water rights specific to new points of diversions (underground wells), but additional water right purchases are not needed for supply. Future supply needed to support culinary water demands will be provided by JVWCD. However, JVWCD recently adopted a water budget of 1.35 acre-ft/acre for any developing area within its service area that requires more than 50 acre-ft of water. These developing areas will need to secure additional water rights or shares where projected demands are higher than 1.35 acre-ft/acre. As a result, the City may consider purchasing more Welby Jacob shares and/or underground water rights to offset any deficit in culinary supply related to the JVWCD water budget.

Table 13-5
Water Right Projects

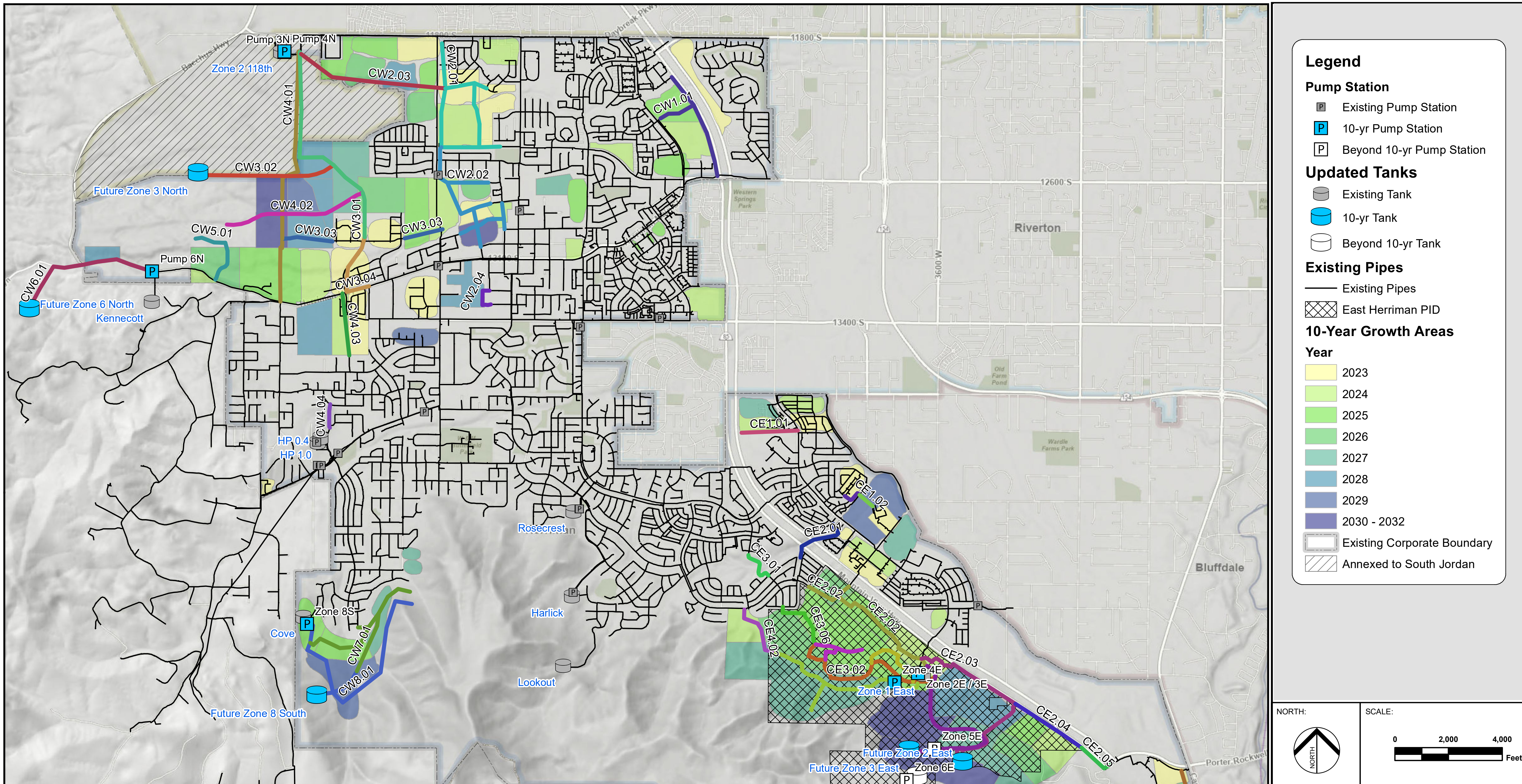
Water Right Project	Cost	Year
Future Well 1 Point of Diversion Purchase	$350,000	2027
Future Well 2 Point of Diversion Purchase	$350,000	2028
Future Well 3 Point of Diversion Purchase	$350,000	2035
Total	**$1,050,000**	

The City will also need to regularly update its water master plan to keep up with the fast pace of growth within the City. This should include updates to the City's impact fees and water rates. Estimated costs for planning updates should be approximately $100,000 every five years.

CHAPTER 14
10-YEAR CULINARY & SECONDARY PIPE IMPROVEMENTS

Figures 14-1 and 14-2 identify all of the distribution, pump, and tank improvements that will need to be constructed within the next 10-years based on growth identified by Herriman City planning personnel. These projects are also summarized in Tables 14-1 and 14-2.

Included in Tables 14-1 and 14-2 are estimated project costs. The costs shown are the total construction cost for the improvements. In many cases, development will be paying for the base cost of project level improvements and the City will only be paying the costs to upsize the pipelines for system level needs. In other cases, the City will fund the full project. The percent expected to be paid by the City based on expected use of capacity is shown in the tables.



SHORT-TERM (10-YEAR) CULINARY IMPROVEMENTS

HERRIMAN CITY

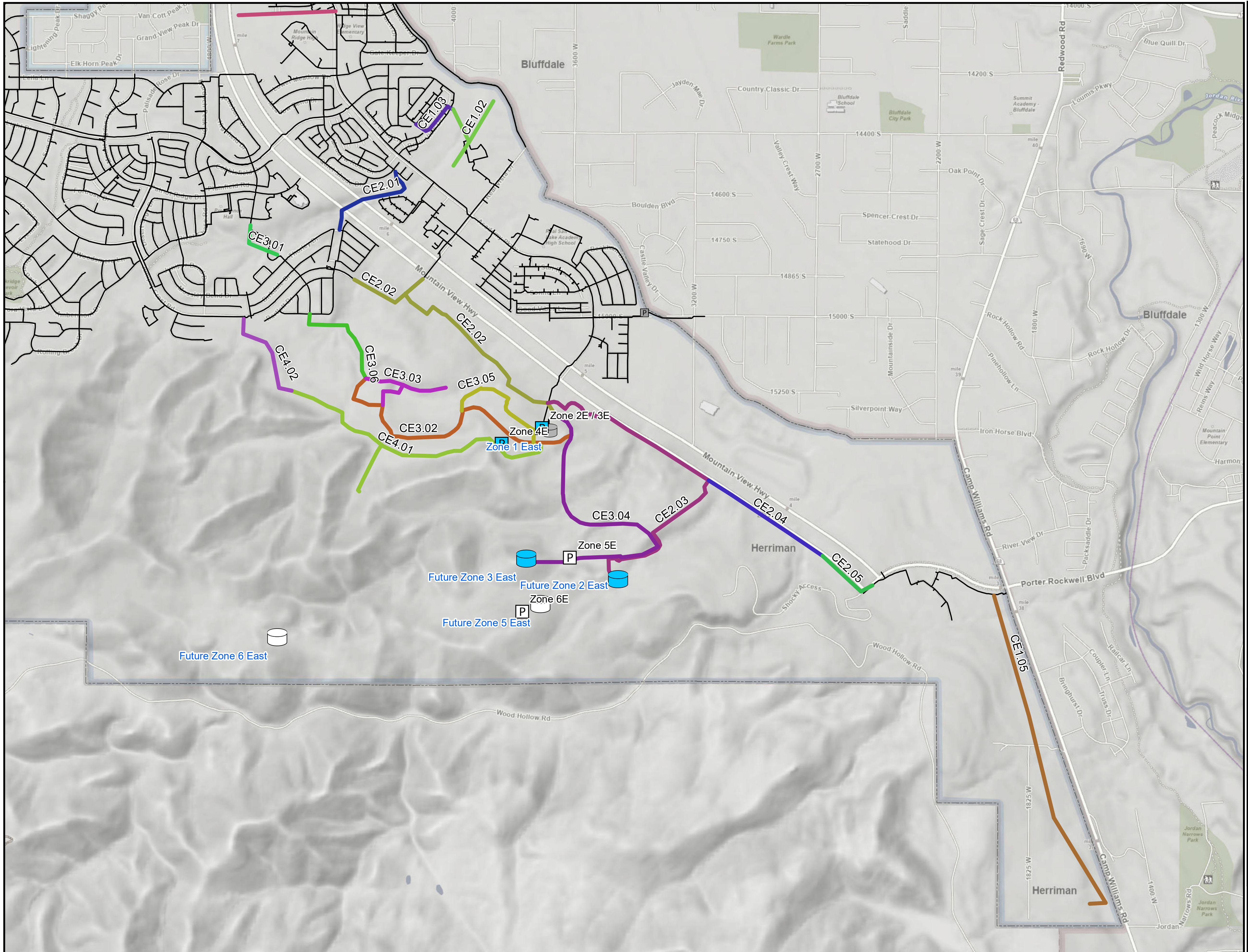
WATER MASTER PLAN

BOWEN COLLINS & ASSOCIATES

FIGURE NO.

14-1

P:\Herriman\217-21-03 - Water Master Plan Update\4.0 GIS\Figure 14-1 - Culinary Improvements.mxd amckinnon 5/2/2024



Legend

Pump Station

- Existing Pump Station
- 10-yr Pump Station
- Beyond 10-yr Pump Station

Updated Tanks

- Existing Tank
- 10-yr Tank
- Beyond 10-yr Tank

Existing Pipes

- Existing Pipes
- Existing Corporate Boundary
- Annexed to South Jordan

NORTH:

SCALE: 0 1,000 2,000 Feet

SHORT-TERM (10-YEAR) CULINARY IMPROVEMENTS (EAST)

HERRIMAN CITY

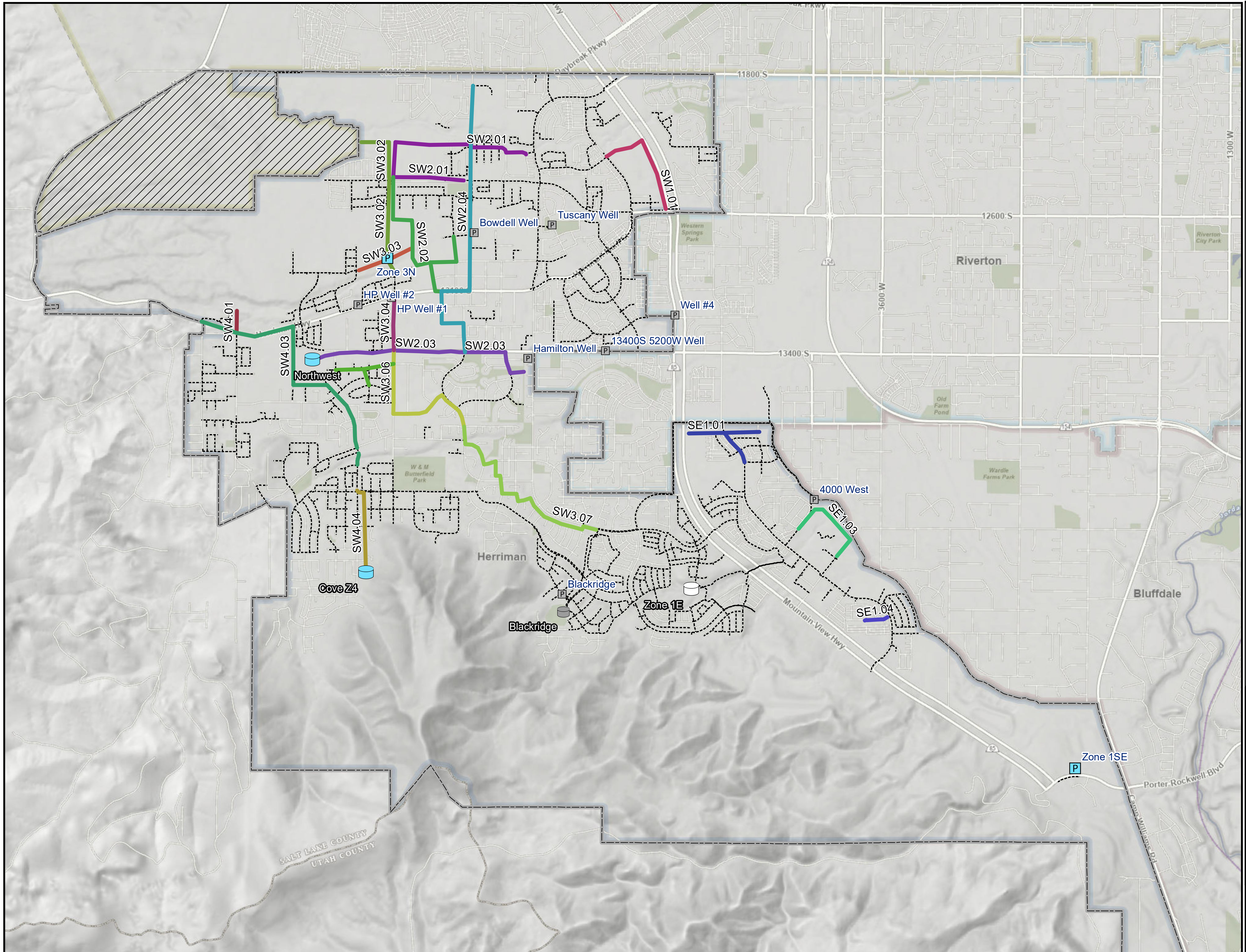
WATER MASTER PLAN

BOWEN COLLINS & ASSOCIATES

FIGURE NO.

14-1E

P:\Herriman\217-21-03 - Water Master Plan Update\4.0 GIS\Figure 14-1E - Culinary Improvements.mxd amckinnon 4/29/2024



Legend

- Existing Pump Station
- 10-yr Pump Station
- Beyond 10-yr Pump Station
- Existing Tank
- 10-yr Tank
- Beyond 10-yr Tank
- Existing Secondary Pipes
- Annexed to South Jordan
- Existing City Area

NORTH:

SCALE: 0 2,000 4,000 Feet

SHORT-TERM (10-YEAR) SECONDARY IMPROVEMENTS

HERRIMAN CITY

WATER MASTER PLAN

BOWEN COLLINS & ASSOCIATES

FIGURE NO.

14-2

P:\Herriman\217-21-03 - Water Master Plan Update\4.0 GIS\Figure 14-2 - Secondary Improvements.mxd amckinnon 5/2/2024

Table 14-1
10-Year Culinary Pipe Projects

Project No.	Length (ft)	Min Diameter (inch)	Max Diameter (inch)	Description	Project Cost	Estimated Year of Construction	Percent by City
CP					$50,000	2023	100.0%
CE1.01	2,106	12	12	Distribution pipes for growth in Zone 1 East	$681,000	2023	0.0%
CE1.02	655	12	12	Distribution pipes for growth in Zone 1 East	$212,000	2022	8.6%
CE1.03	720	12	12	Distribution pipes for growth in Zone 1 East	$233,000	2023	8.6%
CE1.04	3,189	12	12	project deleted based on other looping*		2023	0.0%
CE1.05ph1	3,246	16	16	Transmission line pipes for growth in Zone 1 South East	$2,351,000	2023	10.8%
CE1.05ph2	3,246	16	16	Transmission line pipes for growth in Zone 1 South East	$2,351,000	2023	10.8%
CE2.01	2,330	12	12	Transmission line across Juniper Canyon for Zone 2 East (completed)*		2023	0.0%
CE2.02ph1	3,149	12	16	Transmission/Distribution lines for Zone 2 East	$2,042,000	2023	0.0%
CE2.02ph2	3,149	12	16	Transmission/Distribution lines for Zone 2 East	$2,042,000	2023	0.0%
CE2.03	10,342	8	16	Transmission/Distribution lines for Zone 2 East	$3,705,000	2023	0.0%
CE2.04	2,966	16	16	Transmission/Distribution lines for Zone 2 East	$1,074,000	2023	10.8%
CE2.05	1,417	16	16	Transmission/Distribution lines for Zone 2 East	$514,000	2023	18.5%
CE3.01	0	16	16	Pipeline completed previously, PRVs 3E to 3	$391,000	2023	100.0%
CE3.02	6,523	16	24	Transmission/Distribution lines for Zone 3 East	$2,647,000	2023	22.0%
CE3.03	2,619	12	12	Transmission/Distribution lines for Zone 3 East	$846,000	2023	18.0%
CE3.04	8,076	20	24	Transmission/Distribution lines for Zone 3 East	$3,728,000	2028	22.0%
CE3.05	2,653	12	12	Transmission/Distribution lines for Zone 3 East	$857,000	2028	9.0%
CE3.06	2,321	16	16	Transmission/Distribution lines for Zone 3 East	$841,000	2028	18.0%
CE4.01	7,497	10	12	Transmission/Distribution lines for Zone 4 East	$2,416,000	2029	8.6%
CE4.02	2,183	12	12	Transmission/Distribution lines for Zone 4 East	$705,000	2029	8.6%
CW1.01	5,498	12	12	Distribution pipes for growth in Zone 1 North	$1,776,000	2023	0.0%
CW2.01ph1	4,073	8	16	Transmission/Distribution lines for Zone 2 North	$1,294,000	2023	6.2%
CW2.01ph2	4,073	8	16	Transmission/Distribution lines for Zone 2 North	$1,294,000	2023	6.2%

Project No.	Length (ft)	Min Diameter (inch)	Max Diameter (inch)	Description	Project Cost	Estimated Year of Construction	Percent by City
CW2.01ph3	4,073	8	16	Transmission/Distribution lines for Zone 2 North	$1,294,000	2023	6.2%
CW2.02ph1	4,812	8	12	Transmission/Distribution lines for Zone 2 North	$1,485,000	2024	3.8%
CW2.02ph2	4,812	8	12	Transmission/Distribution lines for Zone 2 North	$1,485,000	2024	3.8%
CW2.03	5,688	20	20	Transmission Line for Zone 2	$2,309,000	2023	100.0%
CW2.04	1,117	8	8	Distribution and Fire Flow Loop	$330,000	2024	0.0%
CW3.01	8,480	16	16	Transmission/Distribution lines for Zone 3 North	$3,071,000	2023	13.6%
CW3.02	5,128	16	16	Transmission/Distribution lines for Zone 3 North	$1,857,000	2023	0.0%
CW3.03	3,714	8	12	Transmission/Distribution lines for Zone 3 North	$1,179,000	2024	0.0%
CW3.04	3,070	16	16	Transmission/Distribution lines for Zone 3 North	$1,206,000	2024	18.5%
CW4.01ph1	4,910	20	24	Transmission/Distribution lines for Zone 4 North	$2,146,000	2025	20.9%
CW4.01ph2	4,910	20	24	Transmission/Distribution lines for Zone 4 North	$2,146,000	2025	20.9%
CW4.02	5,319	12	12	Transmission/Distribution lines for Zone 4 North	$1,717,000	2025	0.0%
CW4.03	2,322	16	16	Transmission/Distribution lines for Zone 4 North	$841,000	2023	18.5%
CW4.04	885	10	10	Transmission/Distribution lines for Zone 4	$271,000	2023	3.8%
CW5.01	2,720	16	16	Transmission/Distribution lines for Zone 5 North	$986,000	2025	30.0%
CW6.01	5,900	0	0	Transimission to Zone 6 North Tank	$1,174,000	2025	45.6%
CW7.01	7,840	8	10	Transmission/Distribution lines for Zone 7W	$2,333,000	2026	0.0%
CW8.01	11,001	8	12	Transmission/Distribution lines for Zone 8W	$3,425,000	2027	0.0%
Total					**$61,305,000**		

*Some of the project numbers are "not used" to preserve some of the numbering / naming convention used previously for consistency with previous master plan naming conventions.

Table 14-2
10-Year Secondary Pipe Projects

Project No.	Length (ft)	Min Diameter (inch)	Max Diameter (inch)	Description	Project Cost	Estimated Year of Construction	Percent by City
SP				Planning documents (master plans, rate studies, etc.)	$50,000	2025	100%
SE1.01	4,055	8	8	Distribution pipes for growth in Zone 1 East	$1,197,000	2024	0%
SE1.02	0	0	0	Transmission line to Zone 1 Storage	$0	2024	0%
SE1.03	3,634	8	8	Distribution pipes for growth in Zone 1 East	$1,073,000	2024	0%
SE1.04	890	8	8	Distribution pipes for growth in Zone 1 East	$263,000	2024	0%
SW1.01	6,819	8	8	Distribution pipes for growth in Zone 1 North	$2,014,000	2024	0%
SW2.01	9,242	8	8	Transmission/Distribution lines for Zone 2 North	$2,728,000	2024	0%
SW2.02	7,904	8	8	Transmission/Distribution lines for Zone 2 North	$2,333,000	2024	0%
SW2.03ph1	2,903	20	24	Transmission line for Zone 2 North	$1,689,333	2024	100%
SW2.03ph2	5,807				$3,378,667	2024	100%
SW2.04	10,260	16	20	Transmission/Distribution lines for Zone 3 North	$5,101,000	2024	100%
SW3.01				Transmission/Distribution lines for Zone 3 North (not used)*			
SW3.02ph1	4,066	8	16	Transmission/Distribution lines for Zone 3 North	$1,365,333	2023	18.5%
SW3.02ph2	2,033				$682,667	2023	100%
SW3.03	5,919	8	16	Transmission/Distribution lines for Zone 3 North	$1,799,000	2024	2.5%
SW3.04	2,127	12	12	Transmission/Distribution lines for Zone 3 North	$976,000	2024	8.6%
SW3.05	2,879	8	8	Transmission/Distribution lines for Zone 3 North	$850,000	2024	0.0%
SW3.06ph1	2,021	16	20	Transmission/Distribution lines for Zone 3 North	$1,013,000	2024	100%

Project No.	Length (ft)	Min Diameter (inch)	Max Diameter (inch)	Description	Project Cost	Estimated Year of Construction	Percent by City
SW3.06ph2	4,042				$2,026,000	2024	100%
SW3.07	8,095	20	20	Transmission/Distribution lines for Zone 3 North	$4,501,000	2024	100%
SW4.01	840	8	8	Transmission/Distribution lines for Zone 4	$248,000	2026	0%
SW4.02	0	0	0	Transmission/Distribution lines for Zone 4 (not used)*	$0	2026	0%
SW4.03	8,909	8	20	Transmission/Distribution lines for Zone 4	$3,634,000	2024	100%
SW4.04	3,320	20	20	Zone 4 Tank Connection	$1,112,000	2024	100%
Total					**$38,034,000**		

*Some of the project numbers are "not used" to preserve some of the numbering / naming convention used previously for consistency with previous master plan naming conventions.

DRAPER, UTAH OFFICE
154 E 14075 S
DRAPER, UTAH 84020
PHONE: 801.495.2224

BOISE, IDAHO OFFICE
776 E RIVERSIDE DRIVE
SUITE 250
EAGLE, IDAHO 83616
PHONE: 208.939.9561

ST. GEORGE, UTAH OFFICE
20 NORTH MAIN
SUITE 107
ST.GEORGE, UTAH 84770
PHONE: 435.656.3299

OGDEN, UTAH OFFICE
2036 LINCOLN AVENUE
SUITE 104
OGDEN, UTAH 84401
PHONE: 801.495.2224

BOWEN COLLINS
& ASSOCIATES

WWW.BOWENCOLLINS.COM