MIDVALE CITY, UTAH

RESOLUTION NO. No. 2020-R-38

A RESOLUTION APPROVING THE ADOPTION OF THE 2020 MIDVALE CITY WATER MASTER PLAN

WHEREAS, Midvale City (City) has the responsibility and obligation to provide sufficient and safe water delivery to its current customers while adhering to all state and federal regulatory compliance; and

WHEREAS, the City must plan for and provide sufficient and safe water delivery for the projected growth within the City meeting all state and federal regulatory requirements; and

WHEREAS, the City contracted with Hansen, Allen and Luce to perform a Water Master Plan Study to determine water system and facility needs to be able to meet water supply requirements for both existing customers and future growth: and

WHEREAS, City staff has reviewed the 2020 Water Master Plan and agree with its findings, recommendations and direction.

NOW THEREFORE BE IT RESOLVED, that based on the foregoing, the Midvale City Council approves this resolution, authorizing the Mayor to sign the adoption of the 2020 Midvale Water Master Plan.

APPROVED AND ADOPTED this 24th day of August 2020.

Robert M. Hale, Mayor

ATTEST:

Rori L. Andreason,
City Recorder

MIDVALE CITY STATE OF UTAH INCORPORATED JULY 1, 1909 CORPORATE SEAL

Voting by the City Council	"Aye"	"Nay"
Dustin Gettel	✓	
Paul Glover	✓	
Quinn Sperry	✓	
Heidi Robinson	✓	
Bryant Brown	✓	

MIDVALE CITY

DRINKING WATER SYSTEM
MASTER PLAN

(HAL: Project No.: 141.43.100)

July 2020

HANSEN ALLEN & LUCE inc ENGINEERS

MIDVALE CITY

DRINKING WATER MASTER PLAN

(HAL Project No.: 141.43.100)

Katie Gibson Jacobsen, P.E.
Project Engineer

HANSEN ALLEN & LUCE INC
ENGINEERS

July 2020

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GLOSSARY OF TECHNICAL TERMS

Average Daily Flow: The average yearly demand volume expressed in a flow rate.

Average Yearly Demand: The volume of water used during an entire year.

Build-out: When the development density reaches maximum allowed by planned development.

Culinary Water: Water of sufficient quality for human consumption. Also referred to as Drinking or Potable water.

Demand: Required water flow rate or volume.

Distribution System: The network of pipes, valves and appurtenances contained within a water system.

Drinking Water: Water of sufficient quality for human consumption. Also referred to as culinary or Potable water.

Dynamic Pressure: The pressure exerted by water within the pipelines and other water system appurtenances when water is flowing through the system.

Equivalent Residential Connection: A measure used in comparing water demand from non-residential connections to residential connections.

Fire Flow Requirements: The rate of water delivery required to extinguish a particular fire. Usually it is given in rate of flow (gallons per minute) for a specific period of time (hours).

Head: A measure of the pressure in a distribution system that is exerted by the water. Head represents the height of the free water surface (or pressure reduction valve setting) above any point in the hydraulic system.

Head loss: The amount of pressure lost in a distribution system under dynamic conditions due to the wall roughness and other physical characteristics of pipes in the system.

Peak Day: The day(s) of the year in which a maximum amount of water is used in a 24-hour period.

Peak Day Demand: The average daily flow required to meet the needs imposed on a water system during the peak day(s) of the year.

Peak Instantaneous Demand: The flow required to meet the needs imposed on a water system during maximum flow on a peak day.

Pressure Reducing Valve (PRV): A valve used to reduce excessive pressure in a water distribution system.

Pressure Zone: The area within a distribution system in which water pressure is maintained within specified limits.

Service Area: Typically, the area within the boundaries of the entity or entities that participate in the ownership, planning, design, construction, operation and maintenance of a water system.

Static Pressure: The pressure exerted by water within the pipelines and other water system appurtenances when water is not flowing through the system, i.e., during periods of little or no water use.

Storage Reservoir: A facility used to store, contain and protect Drinking water until it is needed by the customers of a water system. Also referred to as a Storage Tank.

Transmission Pipeline: A pipeline that transfers water from a source to a reservoir or from a reservoir to a distribution system.

ABBREVIATIONS AND UNITS

ac	acre [area]
ac-ft	acre-foot (1 ac-ft = 325,851 gal) [volume]
CFP	Capital Facilities Plan
DIP	Ductile Iron Pipe
EPA	U.S. Environmental Protection Agency
EPANET	EPA hydraulic network modeling software
ERC	Equivalent Residential Connection
ft	foot [length]
ft/s	feet per second [velocity]
gal	gallon [volume]
gpd	gallons per day [flow rate]
gpm	gallons per minute [flow rate]
HAL	Hansen, Allen & Luce, Inc.
hr	hour [time]
IFC	International Fire Code
in.	inch [length]
irr-ac	irrigated acre
kgal	thousand gallons [volume]
MG	million gallons [volume]
MGD	million gallons per day [flow rate]
mi	mile [length]
psi	pounds per square inch [pressure]
s	second [time]
SCADA	Supervisory Control And Data Acquisition
yr	year[time]

ACKNOWLEDGMENTS

Successful completion of this study was made possible by the cooperation and assistance of many individuals, including the Mayor of Midvale City, City Council Members, City Staff, and the Midvale Area Inspector as shown below. We sincerely appreciate the cooperation and assistance provided by these individuals.

Midvale City

Mayor

Robert Hale

City Council

Quinn Sperry
Paul Glover
Heidi Robinson
Bryant Brown
Dustin Gettel

City Staff

Lesley Burns, City Planner
Christopher Butte, Economic Development Director
Matt Dahl, Assistant City Manager
Keith Ludwig P.E., City Engineer
Glen Kennedy, Public Works Director
Alan Hoyne, Public Works Operations Superintendent
Curtis Nielsen, Public Utilities Manager
David Stenquist, City Treasurer

Area Inspector

Christen Yee
Unified Fire Authority
(801) 743-7228, (801)750-9476

CHAPTER 1 INTRODUCTION

PURPOSE AND SCOPE

The purpose of this master plan is to provide direction to Midvale City regarding decisions that will be made now and well into the future to provide an adequate drinking water system for its customers at the most reasonable cost. Recommendations are based on demand data, growth projections, standards of the Utah Division of Drinking Water (DDW), city zoning, known and anticipated planned developments, and standard engineering practices. This master plan covers through approximately the year 2060, though full build-out is projected to occur beyond this time period. The service area considered in this master plan is the entire City of Midvale, as well as 45 acres located west of 700 West (Main Street) between approximately 8500 South and 9000 South that could be annexed into the City in the future.

The master plan is a study of the City's drinking water system and customer water use. The following topics are addressed herein: growth projections, source requirements, storage requirements, and distribution system requirements. Based on this study, needed capital improvements have been identified and conceptual-level cost estimates for the recommended improvements have been provided.

The results of the study are limited by the accuracy of growth projections, data provided by the City, and other assumptions used in preparing the study. It is expected that the City will review and update this master plan every 5–10 years as new information about development, system performance, or water use becomes available. This master plan updates the previous plan completed by the City of Midvale in October 2010.

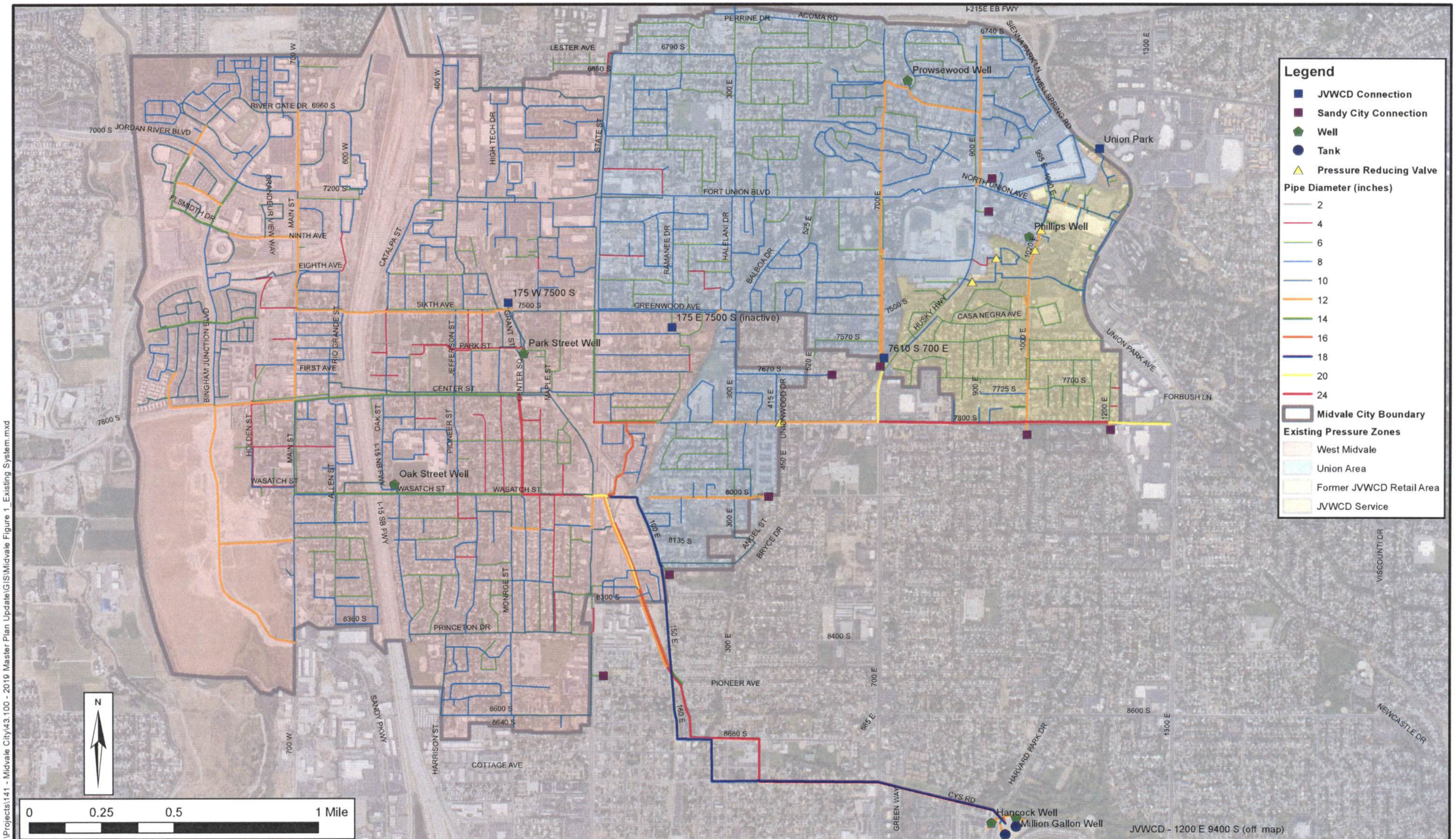
BACKGROUND

Midvale City covers an area of approximately 5.8 square miles in the central area of Salt Lake County and shares borders with Murray City on the north, Sandy City on the south, the Cottonwood area on the east, and West Jordan City on the west. Water is supplied to Midvale City by two separate distribution networks.

The largest of the networks serves water to the western portion of Midvale and includes four wells (three active and one inactive), two water storage tanks, and two inter-agency connections with the Jordan Valley Water Conservancy District (JVWCD). A second network serves water to the Union Area of Midvale, located in the eastern portion of the City. The Union Area network is comprised of two pressure zones which receive water via inter-agency connections with JVWCD and also contains two inactive wells. A portion of this network was previously managed by JVWCD. In 2019, infrastructure projects were completed to allow Midvale to incorporate the former JVWCD retail network into the City's Union Area network.

The City drinking water supplies water for both indoor and outdoor use throughout the service area. There is no secondary/pressurized irrigation water system for outdoor use in the City, nor any significant outdoor watering supplied by irrigation companies.

Figure 1-1 illustrates the extent of the Midvale water system and presents a graphic description of system components. The West Midvale and Union Area pressure zones of the Midvale City water system contain a total of approximately 120 miles of distribution pipe ranging in size from 2 to 24 inches in diameter.



HANSEN ALLEN & LUCE inc ENGINEERS

MIDVALE CITY DRINKING WATER SYSTEM

EXISTING DRINKING WATER SYSTEM

FIGURE 1-1

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Midvale includes a population of approximately 34,000 in 2020. Midvale includes 260 acres of undeveloped land in the Jordan Bluffs area (west of Main Street/700 West, south of Center Street/7800 South). City and State planners expect development of Jordan Bluffs, infill development, and redevelopment to increase the population of Midvale significantly over the next 40 or more years, reaching at least 60,000. Figure 1-2 shows the historic and projected population of Midvale through 2060. Additional detail is shown in Table A-1 in Appendix A. These growth estimates were generated using information from City records, the City Planning Department, and projections from the Governor's Office of Management and Budget (2012), Kem C. Gardner Institute (2016), and Wasatch Front Regional Council (2019).

The planning period of this master plan is through 2060, though Midvale may not reach its peak population by that time.

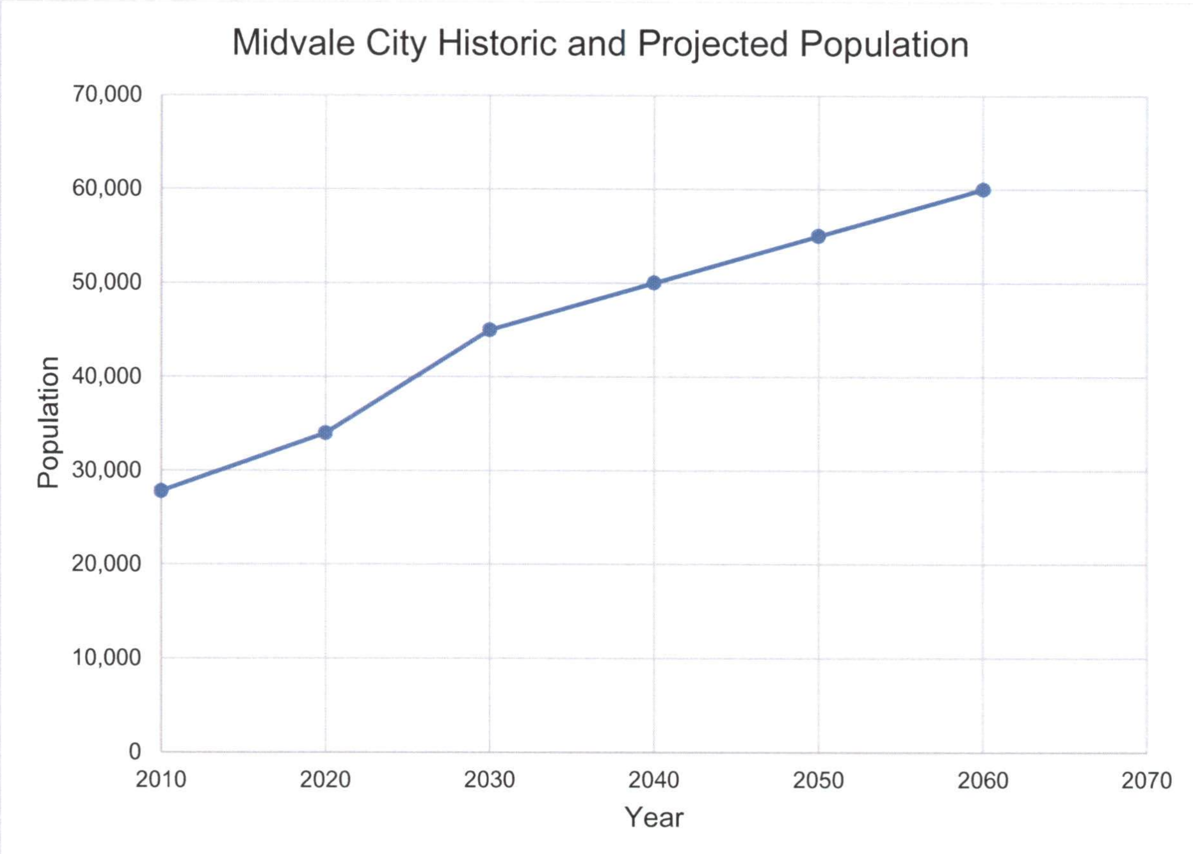


Figure 1-2: Midvale Historic and Projected Population

MASTER PLANNING APPROACH

The Midvale City water distribution network is made up of a variety of components, including pumps, storage facilities, valves, and pipes. Design and operation of the individual components must be coordinated so that they operate efficiently under a range of demands and conditions. The City water system must be capable of responding to daily and seasonal variations in demand while concurrently providing adequate capacity for fire-fighting and other emergency needs. Furthermore, careful planning is required in order to ensure that the distribution system is capable of meeting the City's needs over the next several decades.

Both present and future needs were evaluated in this master plan. Present water needs were calculated using actual water production data and billing record data, according to Utah Division of Drinking Water (DDW) system-specific sizing requirements. These requirements were used to determine a responsible level of service for the system. Future water demands were predicted using this level of service, current zoning and expected development provided by the City, and future estimated population growth.

This report follows the DDW requirements of Rule R309-510 ("Facility Design and Operation: Minimum Sizing Requirements") and Rule R309-105 ("Administration: General Responsibilities of Public Water Systems") of the Utah Administrative Code. The report addresses sources, storage, distribution, minimum pressures, hydraulic modeling, capital improvements, funding, and other topics pertinent to Midvale's drinking water system.

In order to facilitate the analysis of the drinking water system, a computer model of the system was prepared and analyzed in two parts. First, the performance of existing facilities with present water demands was analyzed. Next, projected future demands were added to the drinking water system and the analysis was repeated. Recommendations for system improvement were prepared based on the results of these analyses.

LEVEL OF SERVICE (LOS)

HAL analyzed production and billing data provided by Midvale City for the previous three years. Once water production and demand patterns were well understood, HAL and the City met to establish a level of service (LOS) that is based on this data, and incorporates appropriate safety factors. A summary of the level of service selected by the City is included in Table 1-1. These values are expected to meet the requirements of the DDW.

Table 1-1: System Level of Service

Criteria	Level of Service
Average Yearly Demand	0.56 ac-ft/ERC = 182,500 gal/ERC
Peak Day Demand	1,200 gpd/ERC = 0.83 gpm/ERC
Peak Instantaneous Demand	1.7 Peaking Factor = 1.42 gpm/ERC
Equalization Storage	500 gal/ERC

ERCs are equivalent residential connections, and are discussed in more detail in the next chapter of this report.

DESIGN AND PERFORMANCE CRITERIA

Summaries of the key design criteria and demand requirements for the drinking water system are included in Table 1-2. The design criteria were used in evaluating system performance and in recommending future improvements. Criteria development is described in later chapters.

Table 1-2: System Design Criteria

	Criteria	Existing Requirements	Estimated 2060 Requirements
Equivalent Residential Connections	Calculated from past water use and projected growth	13,940	23,580
Source			
Peak Day Demand	Section R309-510-7/LOS	11,570 gpm	19,570 gpm
Average Yearly Demand	Section R309-510-7/LOS	7,806 ac-ft	13,205 ac-ft
Storage			
Equalization	Section R309-501-8/LOS	7.0 MG	11.8 MG
Emergency	City Preference	1.5 MG	1.5 MG
Fire Suppression	IFC/Fire Code Official	2.3 MG	2.3 MG
Total		10.8 MG	15.6 MG
Distribution			
Peak Instantaneous	1.7x Peak Day Demand	19,669 gpm	33,269 gpm
Minimum Peak Day Fire Flow	IFC/ Fire Code Official		
Residential (typical)		1,000 gpm @ 20psi	1,000 gpm @ 20psi
Non-Residential		2,000 gpm @ 20 psi	2,000 gpm @ 20 psi
Max. Operating Pressure	LOS	110 psi	110 psi
Min. Pressure: Peak Day	Section R309-510-9/LOS	50 psi	50 psi
Peak Instantaneous	Section R309-510-9	30 psi	30 psi

1 – Fire flow requirements are dependent on building size, construction type, and presence of approved sprinkling systems. The values shown here are typical minimums.

CHAPTER 2 SYSTEM GROWTH

EXISTING CONNECTIONS

According to billing records obtained for years 2016 through 2019, the Midvale distribution network serves a total of 7,875 connections. Included in this number are 7,190 residential connections and 685 non-residential connections. Drinking water demands are expressed in terms of equivalent residential connections (ERCs), which for planning purposes are the same as equivalent residential units (ERUs). The use of ERCs is a standard engineering practice to describe the entire system in a common unit of measurement. One ERC is equal to the average demand of an average residential connection. Non-residential demands are converted to ERCs for planning purposes. For example, a commercial building requiring six times as much water as a typical residential connection is assigned an ERC of 6. The entire water demand then can be described with a single ERC count.

HAL extensively analyzed the City's water billing data from January 2016 through December 2018. Billing data from Midvale and JVWCD for all of 2019 was also obtained and used to estimate the number of ERCs added to the Midvale system when Midvale took over a portion of the JVWCD network in 2019. It was determined that the existing system serves 13,940 ERCs.

ERCs representing demands were assigned to nodes within the extended-period hydraulic model based on the billing location. A breakdown of the existing ERCs by pressure zone is shown in Table 2-1.

A primary recommendation of this master plan is to combine the majority of the City into one large pressure zone. The portion of the City in the Union area east of 700 East/900 East will be divided into two additional small zones. Figure 2-1, Recommended Pressure Zones, located at the end of this chapter, shows the recommended new pressure zones. Projects will be required to connect piping across the former zone boundaries. Some valves will be closed to create the new zone boundaries. Pressure and flow settings at JVWCD connections will need to be adjusted. Details of these projects are discussed in Chapter 5, Water Distribution.

Table 2-1 includes the ERC breakdown for the new pressure zones. All remaining tables, charts, and figures in this report will use the recommended new pressure zones.

Table 2-1: Existing ERCs by Pressure Zone

Existing Pressure Zones		Recommended Pressure Zones	
Zone Name	**ERCs**	**Zone Name**	**ERCs**
West Midvale	7,135	Midvale	11,970
Union Area – North/West	5,490	North Union	630
Union Area – East/South	1,315	South Union	1,340
Total	**13,940**	**Total**	**13,940**

FUTURE CONNECTIONS

Future ERCs were calculated based on proposed development, land use patterns, zoning, and densities allowed by City code or possible in the future. Most of the remaining undeveloped land in Midvale is located in the 260-acre Jordan Bluffs area. City planners expect to see additional development at other locations throughout the City, including within Bingham Junction, near the Fort Union Shopping Area, along State Street and 7200 South, and in transit-oriented development zones. Infill development is possible on small pockets of land throughout the city. The remaining projected growth will likely take place through redevelopment in future decades. All projected growth is expected to be at higher densities than past development has typically been. The level of development expected by 2060 is significantly more than the buildout level of development expected in past master planning efforts.

Water usage for future development was based on existing usage for those same development types, as shown in Table 2-2.

Table 2-2: Water Usage of Future Development Types

Development Type	Usage
Office Buildings	25 ERCs per 100,000 SF
Retail	30 ERCs per 100,000 SF
Hotel	0.3 ERCs per room
Medium to High-Density Residential	0.5 ERCs per unit

Future ERCs were distributed as shown in Table 2-3.

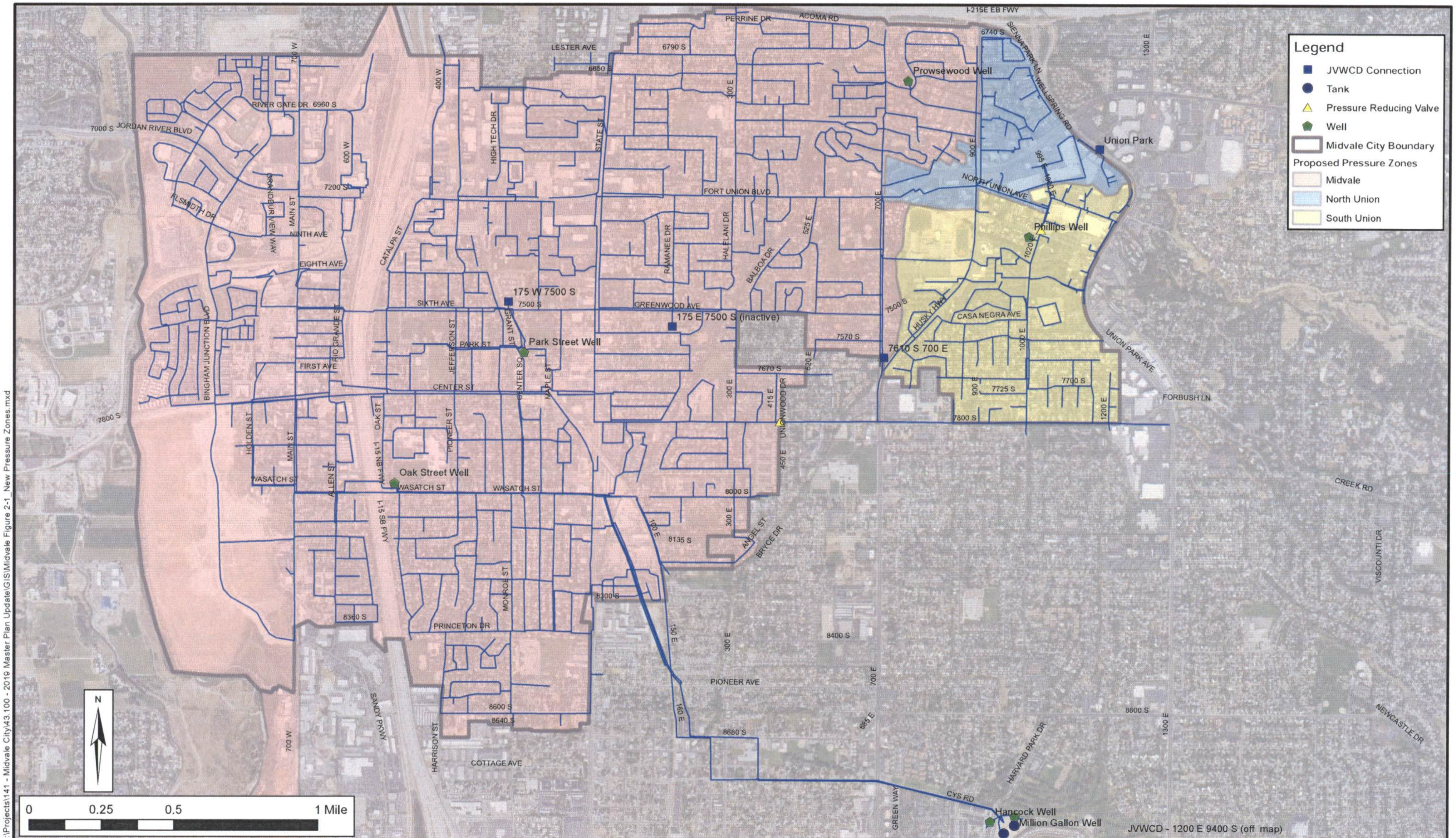
Table 2-3: Future ERCs by Development Location or Type

Development Location or Type	ERCs
Jordan Bluffs area	2,130
Bingham Junction area	275
Fort Union Shopping area	840
8500-9000 S Annexation area	400
Transit-oriented development zones	660
7200 South/State Street area	120
Infill/vacant parcels	1,185
Redevelopment	4,030
Total	**9,640**

These future ERCs were assigned to the proposed pressure zones as shown in Table 2-4 in the "Added" column. This table also shows the existing ERCs and total number of ERCs in each proposed pressure zone in 2060.

Table 2-4: Existing, Added, and Total 2060 ERCs by Pressure Zone

Zone Name	Existing	Added	Total
Midvale	11,970	8,290	20,260
North Union	630	725	1,355
South Union	1,340	625	1,965
Total	**13,940**	**9,640**	**23,580**



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MIDVALE CITY DRINKING WATER SYSTEM

RECOMMENDED NEW PRESSURE ZONES

FIGURE 2-1

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CHAPTER 3 WATER SOURCES AND WATER RIGHTS

EXISTING WATER SOURCES

Midvale City owns six wells, including Hancock, Million Gallon, Oak Street, Park Street, Phillips, and Prowswood. The Phillips, Prowswood, and Park Street wells are currently inactive. Midvale also receives water from JVWCD at four locations. Midvale's sources are summarized in Table 3-1 and shown on Figure 1-1.

Table 3-1: Existing Drinking Water Sources

Source	Zone	Capacity (gpm)
Well Sources		
Hancock Well	Midvale	1,950
Million Gallon Well	Midvale	2,150
Oak Street Well[1]	Midvale	1,200
Park Street Well	Midvale	Inactive
Phillips Well	North Union	Inactive
Prowswood Well	Midvale	Inactive
Total Well Sources		**5,300**
JVWCD Sources		
JVWCD 175 W 7500 S	Midvale	1,000
JVWCD 1200 E 9400 S	Midvale	1,000
JVWCD 7610 S 700 E	Midvale	4,500
JVWCD 1000 E 7800 S	South Union	2,500
Total JVWCD Sources		**9,000**
Total		**14,300**

1 – The Oak Street well has been capable of pumping up to 1,200 gpm but is currently pumping 800 gpm.

Table 3-2 summarizes the existing drinking water sources by pressure zone using the new recommended pressure zones.

Table 3-2: Existing Drinking Water Sources by Pressure Zone

Zone	Capacity (gpm)
Midvale	11,800 gpm
North Union/South Union	2,500 gpm
Total	**14,300 gpm**

The current contract amount available to Midvale from JVWCD is 3,085 acre-feet.

Midvale's system includes inactive interconnections to the Sandy City network. These connections could be used in case of emergency, but are not considered as a Midvale City source.

WATER RIGHTS

A summary of Midvale City's water rights is shown in Table 3-3. In 2019-2020, an adjudication was performed for all Midvale water rights and volumetric restrictions were added to all of the rights that did not already have one. These are reflected in the table. Four of the water rights were solely used in the Phillips, Prowswood, or Park Street wells. Three of the change applications to add the Oak Street well as a point of diversion for these rights were approved and one is still under evaluation. These are indicated in the table.

Table 3-3: Summary of Midvale Water Rights

Water Right Number	Flow cfs (gpm)	Volume acre-feet	Status	Use	Time of Use	Point of Diversion
57-1008	0.61 (274)	118.5	Approved Change Application	Municipal	Jan-Dec	Park, Oak
57-1398	2.20 (987)	126.0	Certificated	Municipal	Jan-Dec	Park, Oak, Million Gallon, Hancock
57-2251	4.47 (2006)	3236.13	Certificated	Municipal	Jan-Dec	Park, Oak, Million Gallon, Hancock
57-3066	1.158 (520)	838.39	Approved Change Application	Municipal	Jan-Dec	Phillips, Oak
57-7909	0.64 (287)	158.50	Certificated	Municipal	Jan-Dec	Million Gallon
57-8248	0.178 (80)	44.00	Approved Change Application	Municipal	Jan-Dec	Prowswood, Oak
57-8505	1.27 (570)	430.20	Unevaluated Change Application	Municipal	Jan-Dec	Prowswood, Oak
57-1492	0.50 (224)	58.438	Certificated	Irrigation Stockwater Domestic	Apr 1-Dec 1 Jan-Dec Jan-Dec	Near 7200 S Cottonwood St.
57-1738	0.056 (25)	6.44	Certificated	Irrigation Stockwater Domestic	Apr 1-Dec 1 Jan-Dec Jan-Dec	Near 7200 S Cottonwood St.
57-2699	0.348 (156)	7.76	Certificated	Stockwater Domestic Commercial	Jan-Dec Jan-Dec Jan-Dec	8200 South Main Street
Total	**11.43 (5,130)**	**5,024**				

The water rights in Table 3-3 sum to 11.43 cfs (5,130 gpm) with an annual limitation of 5,024 acre-feet. However, if only the water rights related to domestic uses are considered, 57-1492, 57-1738, and 57-2699 are removed from consideration. These three water rights total 0.904 cfs (406 gpm) with an annual limitation of 72.6 acre-feet. After removing the water rights that are not available for municipal use, 10.526 cfs (4,724 gpm) with an annual limitation of 4,952 acre-feet remain. This is summarized in Table 3-4.

The point of diversion for water right 57-2699 is located at the City's public works building property, within the Central Region of the Salt Lake Valley Groundwater Management Plan. The Plan is included in Appendix B. The City wells are located in the Eastern Region. Water rights cannot be transferred from the Central region to the existing City wells in the Eastern Region. In addition, the Sharon Steel Restricted Area and the Southwest Remediation Area (Kennecott) are located to the west of the existing point of diversion for right 57-2699. It may be challenging to find a point of beneficial use for this water right within the Central Region. The City may be able to install equipment to use the water at the Public Works property for washing, irrigation, or other similar uses. When a beneficial use is identified, a change application should be filed to change the usage type to municipal. The water right could also be transferred to the Northern Region and exchanged for a right that is usable by the City.

Water right numbers 57-1738 and 57-1492 have the same authorized point of diversion in the Eastern Region (near 7200 South Cottonwood Street). A change application could be filed to move this water to the Oak Street Well. The point of diversion is no longer in use, but at the time of evaluation by the State Engineer in March 2019 as part of the ongoing adjudication, the beneficial use requirement was excused as a condition of being owned by a public water supplier consistent with Utah Code. These water rights are limited to the annual withdrawal of 64.878 acre-feet.

Table 3-4: Water Rights for Municipal Use

Water Rights	Flow Limitation		Volumetric Limitation
	cfs	gpm	acre-feet
All	11.43	5,130	5,024
Not available for domestic use	0.904	406	72.6
Available for domestic use	10.526	4,724	4,952

Because the water rights for the recently approved change applications are in an active adjudication area, the City can elect to have the applications proofed as part of the adjudication. It is recommended the City elect to do this for as much water as they have beneficial use in place.

The Division of Water Rights (DWRi) requires the City to have measuring and totalizing recording devices to meter all water diverted from all sources and to report this data to the DWRi Water Use Program each year.

All of the municipal water rights discussed are available for use in the new larger Midvale pressure zone. Rights associated with the Phillips well could be used in the North Union and South Union pressure zones, but the City does not plan to use the well to supply these zones.

WATER RIGHTS LIMITATIONS

The following tables summarize the water rights that can be used for each well. Table 3-5 is a mass balance based on instantaneous flow rate limitations and Table 3-6 is based on annual volumetric limitations. The values in the table show a possible mass balancing of the water rights. Because several of the water rights have multiple points of diversion, the rights could be assigned in other ways. These examples are based on the current typical operations of the wells.

Table 3-5: Water Rights for Midvale City Wells – Instantaneous Flow Limitation

Water Rights and Limitations		Well (Physical Capacity, gpm)					
Number	Flow (gpm)	Hancock 1,950	Mill. Gal. 2,150	Oak St. 800-1,200	Park St. (inactive)	Phillips (inactive)	Prowswood (inactive)
57-1008	274			274			
57-1398	987	-	987	-			
57-2251	2006	1,280	726	-			
57-3066	520			520			
57-7909	287		287				
57-8248	80			80			
57-8505	570			570			
Flow Rate Used by Water Right (gpm)		3,280		1,444	0	0	0
Remaining Well Flow Capac. (gpm)		820		-244 to -644	0	0	0

Based on flow rate limitations, the combined Hancock and Million Gallon wells are limited to 3,280 gpm. This would not allow both wells to be pumped simultaneously. This leaves 1,444 gpm available to be pumped at the Oak Street well. The Oak Street well is capable of pumping a maximum of 1,200 gpm, but typically pumps 800 gpm.

DWRi requires volumes used to be reported each year, and instantaneous flow rates used are not tracked. It is understood that the annual volumetric water right limitation is more critical than the instantaneous flow rate limitation. However, the wells could be limited to the instantaneous flow limitation if higher use causes excessive drawdown in nearby wells or if other water users are unable to withdraw their rightful flow rates from the aquifer in the future. Table 3-6 shows the volumetric limitations for each water right.

Table 3-6: Water Rights for Midvale City Wells – Annual Volumetric Limitation

Water Rights and Limitations		Well					
Number	Volume (acre-ft)	Hancock	Million Gallon	Oak Street	Park Street	Phillips	Prowswood
57-1008	118.5			118.5			
57-1398	126.0		126				
57-2251	3236.1	1750	1486.1				
57-3066	838.4			838.4			
57-7909	158.50		158.5				
57-8248	44.00			44			
57-8505	430.20			430.2			
Totals		1750	1770.6	1431.1	0	0	0
		3520.6		1431.1	0	0	0
		4951.7					

Using the active wells only, the total volume of 4,952 acre-feet is available to the Hancock, Million Gallon, and Oak Street wells. Of this, 1,431 acre-feet is available to the Oak Street well only. In Table 3-6, this full volume is assigned to Oak Street well. The Oak Street well would need to produce 887 gpm all year to use this volume of water rights. 158.5 acre-feet is available to the Million Gallon well only. The remaining 3,362 acre-feet is available to the Hancock, Million Gallon, and Oak Street wells. Table 3-6 shows the water rights used in the Oak Street well if it could be used all year at 887 gpm with the remainder of the water rights being used in the Hancock and Million Gallon wells, assigned approximately equally to the two wells.

In 2019, the City produced 5,660 acre-feet of water. This is lower than the volume expected to be used in 2020 and beyond because the City served the new JVWCD customers for less than half the year in 2019. The volume used in 2020 will likely increase because these customers will be served the full year. The calculated annual water right requirement presented in this report will nearly always be higher than the volume actually produced because the calculated requirement includes a variability factor and safety factor.

Of the 5,660 acre-feet used in 2019, 3,034 acre-feet was produced by City wells, and the remaining 2,626 acre-feet was purchased from JVWCD. Based on the existing pressure zones in the City, the City is likely incapable of using the entire available water right volume and will continue to underuse the available water rights and be required to supplement with significant volumes of JVWCD water. If the City adjusts the pressure zones as recommended in this master plan, the City can maximize the use of water from the City wells and reduce the amount required to be purchased from JVWCD. Upgrading the Oak Street pump/motor or redeveloping Oak Street well or Park Street well may be necessary in order to fully maximize use of the water rights available.

Because JVWCD water must be paid for whether it is used or not, the City should continue to use all contracted JVWCD water until the City's needs exceed the contract amount. The following example is based on 2019 usage, but these principles will benefit the City as the City's water demands exceed the JVWCD contract amount. At that point, the City can then maximize the use of the City wells before increasing the JVWCD contract amount.

CAPACITY OF WELLS TO MEET DEMANDS – 2019 EXAMPLE WITH NEW PRESSURE ZONES

Based on production data for the three-year period covering April 2016 through March 2019, the City produces approximately 80% of the annual volume of water in April through October, and 20% of the annual volume in the remaining five months of the year.

The City wells are able to supply only the Midvale pressure zone (whether zone boundaries are changed or not) without a booster pump. Approximately 86% of the City's ERCs are located in the new recommended Midvale pressure zone. The remaining 14% of the City's ERCs are located in the new recommended North Union and South Union pressure zones. The new recommended zones are used in this example.

Table 3-7 calculates the average flow rates that were produced for current customers located in the new recommended pressure zones. This calculation is based on the 5,660 acre-feet produced in 2019. Approximately 5% production volume was added to account for the JVWCD customers being served less than half the year in 2019, resulting in an estimated total production volume of 5,960 acre-feet required to serve all current customers for the full year in 2019.

Table 3-7: Average Flow Rates Produced in 2019 with Proposed Pressure Zones

Zone	ERCs	Percent of ERCs	Production Volume (acre-feet)	April-October (213 days) 80% of production		Jan-Mar & Nov-Dec (152 days) 20% of production	
				Volume (acre-feet)	Avg Flow Rate (gpm)	Volume (acre-feet)	Avg Flow Rate (gpm)
Midvale	11,970	86%	5,125	4,100	4,356	1,025	1,526
North Union	630	14%	835	668	709	167	248
South Union	1,340						
Total	**13,940**		**5,960 ac-ft**	**4,768 ac-ft**	**5,065 gpm**	**1,192 ac-ft**	**1,775 gpm**
Total Volume				**5,960 acre-feet**			

As shown in the table, the approximate annual volume that would have been required for the recommended Midvale pressure zone is 5,125 acre-feet. Water rights available for domestic use is 4,952 acre-feet. As shown in Table 3-6, water rights totaling 3,520 acre-feet are available to be used by the Hancock well and Million Gallon well. An additional 1,431 acre-feet are available to be used in the Oak Street well.

The Oak Street well is currently producing approximately 800 gpm. At this flow rate, the 1,431 acre-feet annual volumetric limitation on the water right for this well will not be reached. The City should increase the production on this well to allow the full water right volume to be used. Approximately 887 gpm could be pumped all year to use the full volume of the available annual water right.

The Hancock and Million Gallon wells can provide 4,000 gpm when both are operational. If the Oak Street well is providing 800 gpm, the Hancock and Million Gallon wells could produce 3,560 gpm average (running approximately 21 hours each day) for more than 7 months before the volumetric water rights limitation is met. Water from JVWCD would then be used during the winter to supply the difference between demand and the volume produced by the Oak Street well.

In this 2019 example, the average summer flow rate required to be produced by the City wells is 4,356 gpm. The City wells should be able to provide this flow rate when all wells are in service. JVWCD water would be needed to provide the remaining required volume in the Union zones and to supplement flows if a well is out of service or if demands exceed the production capacity of the wells. In the winter, the average flow rate needed in the Midvale pressure zone was 1,526 gpm, which could be provided by the Oak Street well with supplementation from JVWCD or another well.

In this example, if the flow rate was increased at the Oak Street well, the City wells could be used to supply 4,952 acre feet of the City's annual requirement, using the full volume of the total available annual water rights. If the City desires to maximize the use of the City's water rights, use of the Oak Street well should be maximized all year to use as much of the water right as practical.

The City is charged for peaking from JVWCD connections, which is a concern during the summer. For this reason, it may be more beneficial to prioritize using JVWCD in the winter and reserving the full capacity of the city wells to meet peak demands in the summer. As noted previously, the full contracted volume of JVWCD water should be used each year because the City is required to pay for it whether it is used or not.

The above calculation is only an example based on 2019 production and requirements from year to year will vary. This demonstrates that if the new recommended pressure zones are used, the City will be able to use more City water rights by pumping from the City wells and reducing the volume required from JVWCD correspondingly. For years or months with higher demands than this example, and as development increases, the City will not be able to meet the requirements of the Midvale zone with only the City wells. Purchasing water from JVWCD to supply this zone will be required.

WATER RIGHTS RECOMMENDATIONS

By 2060, the City will require a minimum of 13,205 acre-feet of water rights to meet requirements for the drinking water system (see Table 3-15 in the next section of this report). Compared to the 4,952 acre-feet of existing water rights available, the City is deficient by 8,253 ac-ft. Similar to other components of the water system, water rights should have redundancy. Some water rights may not be able to be used as planned or do not yield the allowed flow. It is recommended that the City use the City wells as much as possible, up to the limits of the water rights, to show beneficial use of these rights. It is recommended that the City pursue opportunities to move the diversion point for water rights 57-1492, 57-1738, and 57-2699 to a location where these rights can be beneficially used in the drinking water system. If all City water rights can be used (5,024 acre-feet), the City will require **8,181 acre-feet** to be provided from JVWCD.

Water rights and JVWCD contract volumes should be evaluated yearly. It is recommended that the City set up a forecasting and tracking system to determine the recommended sources to use each month to ensure that water rights are used to the maximum extent practical while remaining within limitations and minimizing costs.

EXISTING SOURCE WATER REQUIREMENTS

According to DDW standards (Section R309-510-7), water sources must be able to meet the expected water demand for two conditions. First, sources must be able to provide an adequate supply of water for the peak day demand (flow requirement). Second, sources must be able to produce a one-year supply of water, or the average yearly demand (volume requirement).

Peak day and average yearly demand are calculated using the level of service criteria shown in Table 1-1 of this report by computing the demand from water use data with a factor of safety for variance (Subsection R309-510-7(2)).

The level of service selected is based on the DDW standard, requiring minimum source and storage sizing to be based on system-specific analysis of three years of usage data. Because the DDW may recompute the requirements in the future, these values may vary, but should not increase significantly.

Existing Peak Day Demand

Peak day demand is the water demand on the day of the year with the highest water use. It is used to determine required source capacity under existing and future conditions. Based on the requirements shown in Table 1-1, the total peak day drinking water demand is 11,570 gpm (16.7 MGD), as shown in Table 3-8.

Table 3-8: Existing Peak Day Demand

ERCs	Peak Day Demand (gpm/ERC)	Total Peak Day Demand (gpm)
13,940	0.83	11,570

A breakdown of the existing peak day demand by pressure zone (using the new recommended pressure zones) is shown in Table 3-9. The table also shows the capacity available and remaining in each zone.

Table 3-9: Existing Source Requirements by Pressure Zone

<table>
<tr><th rowspan="2">Zone</th><th rowspan="2">ERCs</th><th rowspan="2">Demand (gpm)</th><th colspan="2">Source Capacity in Zone (gpm)</th></tr>
<tr><th>Available</th><th>Remaining</th></tr>
<tr><td>Midvale</td><td>11,970</td><td>9,935</td><td>11,800</td><td>1,865</td></tr>
<tr><td>North Union</td><td>630</td><td>525</td><td rowspan="2">2,500</td><td rowspan="2">865</td></tr>
<tr><td>South Union</td><td>1,340</td><td>1,110</td></tr>
<tr><td>Total</td><td>13,940</td><td>11,570</td><td>14,300</td><td>2,730</td></tr>
</table>

Approximately 2,730 gpm capacity is remaining in the system. This provides redundancy if one of the City's wells is out of service, but would not provide full redundancy if one of the larger JVWCD connections is out of service.

Existing Average Yearly Demand

Average yearly demand is the volume of water used during an entire year and is used to ensure the sources can supply enough volume to meet demand under existing and future conditions. Based on the requirements shown in Table 1-1, the total existing average yearly demand is 7,850 acre-feet, as shown in Table 3-10.

Table 3-10: Existing Average Yearly Demand

ERCs	Average Yearly Demand (ac-ft/ ERC)	Total Average Yearly Demand (ac-ft)
13,940	0.56	7,805

A breakdown of the existing average yearly demand by pressure zone (using the new recommended pressure zones) is shown in Table 3-11, along with the City water rights and JVWCD contract volume available in each zone. The JVWCD contract volume is not limited by zone. Amounts shown in the table are arbitrary and chosen so that each zone has some remaining supply volume allotted.

Table 3-11: Existing Average Yearly Demand Requirements by Pressure Zone

Zone	ERCs	Demand (acre-feet)	Water Supply Capacity in Zone (acre-feet)			
			Available			Remaining
			City Water Rights	JVWCD[1]	Total	
Midvale	11,970	6,700	4,952	1,875	6,297	127
North Union	630	355	0	1,210	1,210	105
South Union	1,340	750				
Total	**13,940**	**7,805**	**4,952**	**3,085**	**8,037**	**232**

[1] The proportion of the JVWCD contract amount allotted to each zone is arbitrary. The contract does not limit volumes by pressure zone.

Midvale City's water rights are not sufficient to meet the existing average yearly demand. The City requires water from JVWCD to meet these demands. When including the 3,085 acre-feet contract volume available from JVWCD, the current yearly supply available is sufficient to meet the required existing average yearly demand plus 232 acre-feet for future development. As discussed previously in this chapter, the volume used by Midvale City (produced from wells and received at JVWCD connections) is less than the requirements shown herein. Also, the City should maximize use of the City wells before purchasing additional JVWCD water.

FUTURE WATER SOURCE REQUIREMENTS

Future water source requirements were evaluated based on the same criteria as existing water source requirements. To summarize, this includes the following:

1) Sufficient water source capacity is needed to meet peak day flow.
2) Water sources must also be capable of supplying the average yearly demand.
3) Sufficient sources should be available to supply the system even if a well is out of service.
4) Peak day and average yearly demand are calculated using the level of service criteria shown in Table 1-1 of this report by computing the demand from actual water use data with a factor of safety for variance (Subsection R309-510-7(2)).
5) The level of service selected is based on the DDW standard, requiring minimum source and storage sizing to be based on system-specific analysis of three years of usage data. Future DDW standards may vary slightly from year to year.

As discussed in Chapter 2 of this report, this master plan covers the planning period through 2060, when the City is projected to reach 23,580 ERCs. A significant portion of this growth will occur west of I-15, primarily in the Jordan Bluffs area.

Future Peak Day Demand

Following the methodology described for existing conditions and estimating 23,580 ERCs in 2060, the peak day source requirement is projected to be 19,571 gpm (28.2 MGD). See Table 3-12.

Table 3-12: 2060 Peak Day Demand

ERCs	Peak Day Demand (gpm/ERC)	Total Peak Day Demand (gpm)
23,580	0.83	19,571

A breakdown of the 2060 peak day demand by pressure zone (using the new recommended pressure zones) is shown in Table 3-13. The table also shows the capacity available and remaining in each zone.

Table 3-13: 2060 Source Requirements by Pressure Zone

Zone	ERCs	Demand (gpm)	Source Capacity in Zone (gpm)	
			Available	Remaining
Midvale	20,260	16,815	11,800	-5,015
North Union	1,355	1,125	2,500	-255
South Union	1,965	1,630		
Total	**23,580**	**19,570**	**14,300**	**-5,270**

Under 2060 conditions, there is a projected source capacity deficiency of 5,270 gpm based on the capacity of the existing sources, including the current JVWCD connections. This deficiency does not consider the ability to provide redundancy if one of the City's wells or a JVWCD connection is out of service.

It is recommended that Midvale pursue obtaining an additional JVWCD connection at Winchester Street and 700 West. This connection should be capable of providing 4,000 gpm. Approximately 3,000 gpm will be used under typical peak day conditions, and the remaining 1,000 gpm will be used to provide some redundancy. The capacity of the other existing JVWCD connections will need to be increased to meet future peak day requirements. Table 3-14 shows the required source capacities for Midvale wells and JVWCD connections for 2060 peak day conditions.

Table 3-14: 2060 Drinking Water Sources

Source	Zone	Maximum Flow (gpm)
Well Sources		
Hancock Well	Midvale	1,950
Million Gallon Well	Midvale	2,150
Oak Street Well	Midvale	1,200
Park Street Well	Midvale	n/a
Phillips Well	North Union	n/a
Prowswood Well	Midvale	n/a
Total Well Sources		**5,300**
JVWCD Sources		
Winchester St. 700 West	Midvale	4,000
175 W 7500 S	Midvale	4,000
1200 E 9400 S	Midvale	1,000
7610 S 700 E	Midvale	6,500
1000 E 7800 S[1]	South Union	4,500
Total JVWCD Sources		**20,000**
Total		**25,300**
Demand		**19,570**
Remaining		**5,730**

Note: The flow required at the 1000 East 7800 South JVWCD connection may be provided through multiple connections.

The North Union and South Union area of Midvale will continue to be supplied by JVWCD. The new pressure zones recommended in this plan minimize the area of the City that will be supplied by JVWCD. Storage is discussed in Chapter 4 of this plan. If JVWCD supplies the only storage for this area, it will be located hydraulically distant from the City and the JVWCD connection(s) for this area must be capable of providing peak instantaneous flow for the North Union and South Union pressure zones. The majority of this flow will likely be provided at the 1000 East 7800 South JVWCD connection, but it is possible that JVWCD may be able to provide a connection near Union Park Avenue/Fort Union Boulevard to reduce reliance on the 1000 East 7800 South connection and to reduce the amount of transmission required north of the connection. In Table 3-14, all flow is assumed to be provided at the 1000 East 7800 South connection.

As shown in Table 3-14, with the recommended sources in place there is 5,730 gpm source available for redundancy and future demands. It is recommended that the City consider redeveloping Oak Street well and possibly Park Street well to provide full beneficial use of the City's water rights and to provide additional redundancy in the future.

Future Average Yearly Demand

Following the methodology described for existing conditions and estimating 23,580 ERCs in 2060, the average yearly source requirement is projected to be 13,205 ac-ft. See Table 3-15.

Table 3-15: 2060 Average Yearly Demand

ERCs	Average Yearly Demand (ac-ft/ ERC)	Total Average Yearly Demand (ac-ft)
23,580	0.56	13,205

A breakdown of the existing average yearly demand by pressure zone (using the new recommended pressure zones) is shown in Table 3-16.

Table 3-16: 2060 Average Yearly Demand Requirements by Pressure Zone

<table>
<tr><th rowspan="3">Zone</th><th rowspan="3">ERCs</th><th rowspan="3">Demand (acre-feet)</th><th colspan="4">Water Supply Capacity in Zone (acre-feet)</th></tr>
<tr><th colspan="3">Available</th><th rowspan="2">Remaining</th></tr>
<tr><th>City Water Rights</th><th>JVWCD[1]</th><th>Total</th></tr>
<tr><td>Midvale</td><td>11,970</td><td>11,345</td><td>4,952</td><td>1,875</td><td>6,827</td><td>-4,518</td></tr>
<tr><td>North Union</td><td>630</td><td>760</td><td rowspan="2">0</td><td rowspan="2">1,210</td><td rowspan="2">1,215</td><td rowspan="2">-650</td></tr>
<tr><td>South Union</td><td>1,340</td><td>1,100</td></tr>
<tr><td>Total</td><td>23,580</td><td>13,205</td><td>4,952</td><td>3,085</td><td>8,037</td><td>-5,168</td></tr>
</table>

[1]The proportion of the JVWCD contract amount allotted to each zone is arbitrary. The contract does not limit volumes by pressure zone.

Midvale City's water rights and the current JVWCD contract amount are not sufficient to meet future average yearly demand. The City will require approximately 5,170 acre-feet in annual supply from JVWCD to meet these demands.

FUTURE WATER SOURCES AND RECOMMENDATIONS

The City should maximize use of the existing City wells to maximize use of the City's water rights and reduce the volume required to be purchased from JVWCD in the future. If the pressure zones are reconfigured as recommended in this master plan, this will increase the proportion of the system demand that can be provided by the City wells.

As source demand increases over time, the existing City wells and JVWCD connections will not provide sufficient redundancy if the largest well or JVWCD connection is ever out of service. Additionally, older wells can reduce production or stop producing over time due to a variety of reasons including biofouling and chemical encrusting. It is recommended that development of additional wells near the existing City wells should continue to be pursued to provide redundancy and to replace wells as they age.

Future planned drinking water sources include a connection from JVWCD at 700 West Winchester Street and increased capacity at the existing connections at 175 West 7500 South, 7610 South 700 East, and 1000 East 7800 South. Vaults at 700 West Winchester and 175 West 7500 South are currently in design and the desired future connections will be accommodated to the extent possible in the vault designs. The new 700 West Winchester Street connection will require constructing a 20-inch transmission line to 6980 South. The cost for constructing a vault for Midvale outside the JVWCD 700 West vault is approximately **$200,000** and the cost for the transmission line to 6980 South is approximately **$657,000**. These costs are detailed in Chapter 6, Capital Facility Plan.

It is recommended that the City continue to maintain emergency connections with Sandy City to provide redundancy (discussed in Chapter 5, Water Distribution.)

CHAPTER 4 WATER STORAGE

EXISTING WATER STORAGE

The City's existing drinking water system includes two concrete storage facilities with a total capacity of **6.6 MG**. Tank locations are shown on Figure 1-1. Table 4-1 presents a listing of the names and select attributes of the City water storage tanks. Both tanks supply water to the Midvale pressure zone. Storage for the North Union and South Union pressure zones is currently provided by JVWCD, with a contracted volume of **4.8 MG** provided by JVWCD.

Table 4-1: Existing Storage Tanks

Tank Name	Diam. (ft)	Calculated Volume (MG)	Base/ Outlet Elevation	Emergency Storage Volume (gallons)	Fire Suppression Volume (gallons)	Minimum Level (Elevation) of Equalization Volume	Overflow Level (Elevation)
4 MG (East)	188	4.03	4572.1	611,000	770,000	6.65 (4578.75)	19.4 (4591.5)
2.5 MG (West)	150	2.56	4572.1	389,000	490,000	6.65 (4578.75)	19.4 (4591.5)
Total		**6.6**		**1,000,000**	**1,260,000**		

EXISTING WATER STORAGE REQUIREMENTS

According to DDW standards outlined in Section R309-510-8, storage tanks must be able to provide: 1) equalization storage volume to make up the difference between source and demand; 2) fire suppression storage to supply water for firefighting; and 3) emergency storage, if deemed necessary. Each of the requirements is addressed below.

Equalization Storage

As shown in Table 1-1, Midvale has planned for a level of service of 500 gallons per ERC of equalization storage. With 13,940 existing ERCs, the City needs 7.0 MG of equalization storage in its existing drinking water system. Table 4-2 lists the equalization storage requirement by pressure zone.

Table 4-2: Existing Drinking Water Equalization Requirements

Zone	ERCs	Equalization (MG)
Midvale	11,970	6.0
North Union	630	0.3
South Union	1,340	0.7
Total	**13,940**	**7.0**

Fire Suppression Storage

Fire suppression storage is required for water systems that provide water for firefighting (Subsection R309-510-8(3)). HAL has consulted with the local fire authority to determine the requirements for fire suppression storage. The contact information for the Midvale fire code official is as follows:

Fire Code Official: Christen Yee, Area Inspector, Unified Fire Authority
Phone: 801-743-7228, 801-750-9476
Email: cyee@unifiedfire.org

The minimum fire flow requirement is 1,000 gpm for 2 hours. Larger structures require larger fire flows, with all fire flow requirements based on the International Fire Code (IFC) and fire code official recommendations. The largest fire flow requirements for each zone were determined as shown in Table 4-3.

Table 4-3: Existing Fire Suppression Requirements

Zone	Building and Location	Fire Flow Requirement		Fire Suppression Volume (MG)
		Flow (gpm)	Duration (hours)	
Midvale	East Midvale Elem. School 6990 South 300 East	5,250	4	1.3
North Union & South Union[1]	Commercial District 900 East-1300 East	4,000	4	1.0
Total				**2.3**

[1]Storage for the North Union and South Union zones will be provided at a single location.

The water system should be managed so that the storage volume dedicated to fire suppression is available to meet fire flow requirements whenever or wherever needed. This can be accomplished by designating minimum storage tank water levels that provide a reserve storage equal to the fire suppression storage required. Even though it is important to utilize equalization storage, typical daily water fluctuations in the tanks should not be allowed below the minimum established levels, except during fire or emergency situations. The minimum levels for fire and emergency storage are shown in Table 4-1.

Emergency Storage

DDW standards suggest that emergency storage be considered in the sizing of storage facilities. Emergency storage is intended to provide a safety factor that can be used in the case of unexpectedly high demands, pipeline failures, equipment failures, electrical power outages, water supply contamination, or natural disasters. The City selected 1.5 MG of emergency storage level of service. 1.0 MG is assumed for the Midvale pressure zone and 0.5 MG is assumed for the North Union and South Union pressure zones.

Total Storage

A summary of existing storage requirements is included in Table 4-4.

Table 4-4: Existing Storage Requirements

Zone	ERCs	Recommended Storage Requirements (MG)				Existing Storage	Remaining
		Equalization	Fire Suppression	Emergency	Total		
Midvale	11,970	6.0	1.3	1.0	8.3	8.6[1]	0.3
North & South Union	1,970	1.0	1.0	0.5	2.5	2.8[1]	0.3
Total	**13,940**	**7.0**	**2.3**	**1.5**	**10.8**	**11.4**[1]	**0.6**

[1] 4.8 MG of storage is currently provided by JVWCD and can be used in either pressure zone.

JVWCD is currently providing 4.8 MG storage for the existing Union Area pressure zone, which is significantly larger than the recommended North Union and South Union pressure zones. Table 4-5 shows the calculated storage volume required based on the number of ERCs in the existing Union area pressure zone and the requirements detailed in this report.

Table 4-5: Storage Requirements for Union Zone Currently Provided by JVWCD

Zone	ERCs	Recommended Storage Requirements (MG)			
		Equalization	Fire Suppression	Emergency	Total
Union Area	5,491	2.7	1.0	0.5	4.2

Based on the requirements shown, and the volume of storage being provided by JVWCD, the existing storage meets existing requirements. In the future, Midvale will be required to provide their own storage for the entire City or negotiate with JVWCD to continue to provide storage for a portion of the City. Table 4-5 can be used to understand Midvale's current storage requirements if they were required to provide their own storage now, without revising the City pressure zones as recommended in this report.

Midvale City's preferred solution is for the City to construct storage for the recommended Midvale pressure zone and pay JVWCD to construct the volume needed for the recommended North Union and South Union pressure zones. The storage for the North Union and South Union zones is anticipated to be constructed at a JVWCD location (wherever JVWCD determines storage is needed), and Midvale's 1000 East 7800 South connection will provide peak instantaneous flows for the North Union and South Union pressure zones. By revising the pressure zones, Midvale is minimizing the volume of storage required to be provided by JVWCD.

FUTURE WATER STORAGE REQUIREMENTS

Storage requirements through the 2060 planning period were assessed using the same methodology as outlined for existing conditions.

Equalization Storage

Following the methodology described for existing conditions and calculating 23,580 ERCs in 2060, the projected equalization storage requirement per the standards shown in Table 1-1 is 11.8 MG. Table 4-6 lists the equalization storage requirement by pressure zone.

Table 4-6: 2060 Drinking Water Equalization Requirements

Zone	ERCs	Equalization (MG)
Midvale	20,260	10.1
North Union	1,355	0.7
South Union	1,965	1.0
Total	**23,580**	**11.8**

Fire Suppression Storage

Fire suppression storage is assumed to remain similar to current conditions, as shown in Table 4-3. There are no plans to reconstruct East Midvale Elementary, but if it is replaced by new construction, the fire flow volume in the Midvale zone could be reduced.

Some buildings may require approved sprinkling systems to reduce their fire flow requirement to the flow rates available. All new buildings should be constructed to meet these requirements.

Emergency Storage

The same emergency volume of 1.0 MG for the Midvale pressure zone and 0.5 MG for the North Union and South Union pressure zones was maintained for future conditions.

Total Storage

A summary of storage requirements for 2060 is included in Table 4-7.

Table 4-7: 2060 Storage Requirements

Zone	ERCs	Recommended Storage Requirements (MG)				Existing Storage	Remaining
		Equalization	Fire Suppression	Emergency	Total		
Midvale	20,260	10.1	1.3	1.0	12.4	6.6	-5.8
North & South Union	3,320	1.7	1.0	0.5	3.2	0	-3.2
Total	**23,580**	**11.8**	**2.3**	**1.5**	**15.6**	**6.6**	**-9.0**

Approximately 9 MG additional storage (beyond existing) is required to meet 2060 requirements.

Table 4-8 shows the volume of storage that will be needed based on the number of ERCs in the City. Estimated years are included, but these will vary based on growth rate.

Table 4-8: Storage Requirements by ERCs

ERCs	Estimated Year[1]	Required Storage[2] (MG)	Existing Storage (MG)		Additional Storage Needed (MG)	Location of New Storage	
			Midvale	JVWCD[3]		JVWCD System[3]	Midvale
13,940	2020	10.8	6.6	4.8	0.0	0.0	0.0
15,400	2024	11.4	6.6	4.8	0.0	0.0	0.0
17,100	2028	12.3	6.6	4.8	0.9	3.2	0.0
17,600	2029	12.5	6.6	0	5.9	3.2	2.8
18,900	2035	13.2	6.6	0	6.6	3.2	3.5
19,900	2040	13.7	6.6	0	7.1	3.2	4.0
20,800	2045	14.1	6.6	0	7.5	3.2	4.4
21,700	2050	14.6	6.6	0	8.0	3.2	4.9
22,600	2055	15.0	6.6	0	8.4	3.2	5.3
23,600	2060	15.6	6.6	0	9.0	3.2	5.8

[1]Years are estimated based on projected growth rates. ERCs control the volume of storage needed.
[2]Required storage includes 2.3 MG for fire suppression, 1.5 MG for emergency, and 500 gallons per ERC for equalization.
[3]The current storage contract with JVWCD ends in 2029, so JVWCD storage is shown as dropping to 0 in that year. Midvale plans to pursue building 3.2 MG in the JVWCD system.

As shown in the table, additional storage will be required by the time the City adds approximately 1,460 ERCs. Based on projected growth rates, this may happen as soon as 2024. If 3.2 MG is constructed in the JVWCD system for the North Union and South Union pressure zones, an additional 2.8 MG would be needed for the Midvale zone by the time the City reaches 17,600 ERCs (~2029). Volumes needed beyond this are shown in Table 4-8. It is recommended that a 4.0 MG storage tank be constructed by 2029 to meet requirements for the next 20 years. A modular tank design could be used to allow the tank to be expanded in the future. The following section explores storage alternatives.

FUTURE WATER STORAGE ALTERNATIVES

Midvale has the ultimate responsibility to provide storage for the entire City. Midvale will attempt to reach an agreement with JVWCD to supply storage for the North Union and South Union pressure zones. Midvale City would pay for the storage to be constructed and pay ongoing operations and maintenances fees to JVWCD. The storage tank would be located on a JVWCD site and the tank would operate as part of JVWCD's wholesale distribution system. JVWCD would operate the tank and supply peak instantaneous flows to areas of the City supplied by the tank. If Midvale is unable to reach an agreement with JVWCD, the City would need to supply the full storage requirement. The following paragraphs discuss storage alternatives for each pressure zone in the City.

Several location alternatives for the Midvale zone were evaluated. Storage for this zone should be located at the same elevation as the existing storage, with the base at elevation 4572. The blue contour (4590) on Figure 4-1 Storage Alternatives (located at the end of this chapter) shows the approximate desired elevation for a buried storage tank.

Near Existing Tank Site – Quarry Bend Drive/Harvard Park Drive

Storage could be added near the location of the existing tanks. Midvale may be able to purchase a piece of the Pebblebrook Golf Course. A piece of property behind a church just north of the golf course would be at the correct elevation for a partially-exposed tank. The property includes a pavilion and softball backstops and is likely unavailable for purchase. The City could also purchase home lots at the correct elevation. A transmission line could be constructed on Harvard Park Drive and 1000 East and could utilize the existing Midvale 24-inch transmission line on 7800 South.

Encompass Health Rehabilitation Hospital of Utah – 8074 South 1300 East

Approximately 2.2 acres west of the hospital is used for landscaping and could be used to construct a buried tank. The available shape is long and somewhat narrow, but could accommodate a rectangular tank. Transmission would likely be provided in 1300 East and would utilize the existing 24-inch City transmission line in 7800 South.

Commercial Parking Lots – 7800-8000 South 1300 East

The commercial parking lots in the Macey's/Vasa Fitness complex are at the correct elevation for a buried tank. It would be extremely difficult to use these areas for construction during the time period required for tank construction. Transmission would likely be provided in 1300 East and would utilize the existing 24-inch City transmission line in 7800 South.

Storage for North Union and South Union Zones

Storage for the North Union and South Union zones should be located with the base at approximately elevation 4705. The red contour (4725) shows the desired elevation for a buried storage tank. Specific locations were not evaluated. If JVWCD can provide storage for these zones, it would be located at 2800 East 9400 South or at 2300 East 9800 South. These locations are shown on Figure 4-1. The 2800 East 9400 South location is occupied by aging steel tanks that will need to be replaced. Larger tanks could be constructed at this location. There is space available at the 2300 East 9800 South location and this location is also in need of storage for the JVWCD system to function optimally. Both JVWCD sites are several miles from Midvale City boundaries and transmission from the tank sites to Midvale would be through the existing or future JVWCD system.

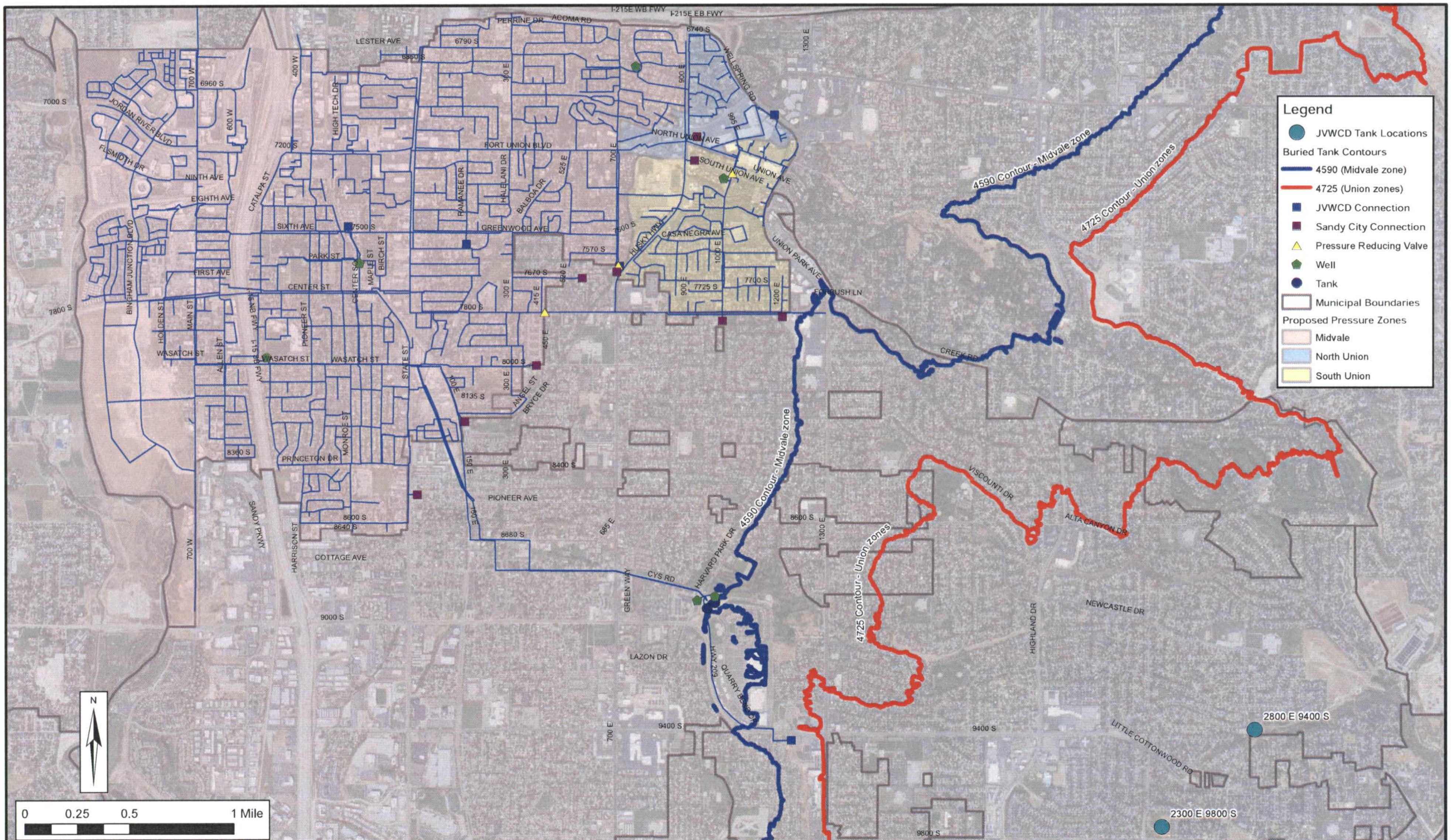
A tank constructed by Midvale City for the North Union and South Union pressure zones could also serve the Midvale zone through PRVs, but would not be the most energy efficient solution. A tank to serve the entirety of these zones would need to be located at an approximate elevation of 4725. The red contour on Figure 4-1 shows the approximate desired elevation for a buried storage tank to serve these zones. Specific locations have not been evaluated. As shown on Figure 4-1, the 4725 contour is located some distance away from the City and a transmission pipeline between the service area and the tank would likely be 2-2.5 miles long. The line would be required to be large (approximately 36") to avoid significant pressure losses.

EXISTING AND FUTURE WATER STORAGE RECOMMENDATIONS

The City currently requires 10.8 MG drinking water storage. The City will need a total of 15.6 MG of drinking water storage in 2060. The City currently owns a total of 6.6 MG storage. An additional 9 MG of storage is needed to meet 2060 requirements. Potential locations for future drinking water storage tanks are shown on Figure 4-1.

It is recommended that the City pursue obtaining property to construct a tank capable of serving the Midvale pressure zone. The City should begin feasibility studies and design of a 4 MG tank. This will supply storage needs until the City reaches 19,900 ERCs (~2040). A modular tank design could be used to allow the tank to be expanded in the future. A possible location for this storage and associated transmission is shown on Figure 5-2, Recommended Capital Facility Projects. It is also recommended that the City continue discussions with JVWCD concerning participation in an agreement for JVWCD to supply storage to the North Union and South Union pressure zones.

The cost for adding new storage facilities varies based on the costs of land, labor, and construction materials. However, $1.15 per gallon of storage has been found to be a reasonable, conservative estimate. In addition, it is recommended that 20% of the estimated cost should be added for contingency and 15% for engineering. Therefore, the total cost that should be planned for providing adequate storage by 2060 is approximately **$14,300,000**. The cost of transmission lines is in addition to tank costs and will likely total at least **$2,800,000**. Costs for storage and associated transmission are included in Chapter 6, Capital Facility Plan.



HANSEN ALLEN & LUCE inc ENGINEERS

MIDVALE CITY DRINKING WATER SYSTEM

STORAGE ALTERNATIVES

FIGURE 4-1

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Document Path: H:\Projects\141 - Midvale City\43.100 - 2019 Master Plan Update\GIS\Midvale Figure 4-1_Storage Alternatives.mxd

CHAPTER 5 WATER DISTRIBUTION

HYDRAULIC MODEL

Development

A computer model of the City's drinking water distribution system was developed to analyze the performance of the existing and future distribution system and to prepare solutions for existing facilities not meeting distribution system requirements. The model was developed with the software InfoWater 12.4 (Innovyze, 2018). InfoWater simulates the hydraulic behavior of pipe networks. Sources, pipes, tanks, valves, controls, and other data used to develop the model were obtained from GIS data of the city's drinking water system and other updated information supplied by the City. The model has been transferred to EPANET to allow the City to use it as desired.

HAL developed models for two phases of drinking water system development. The first phase was a model representing the existing system (existing model). This model was used to calibrate the model and identify deficiencies in the existing system. Calibration was performed by comparing model results to system performance gathered by City personnel. Calibration data is included in Appendix C.

The second phase was a model representing future conditions and improvements necessary to accommodate growth. The future model represents the level of growth projected to be reached by 2060 (2060 model), and includes 23,580 ERCs.

Model Components

The two basic elements of the model are pipes and nodes. A pipe is described by its inside diameter, length, minor friction loss factors, and a roughness value associated with friction head losses. A pipe can contain elbows, bends, valves, pumps, and other operational elements. Nodes are the endpoints of a pipe and can be categorized as junction nodes or boundary nodes. A junction node is a point where two or more pipes meet, where a change in pipe diameter occurs, or where flow is added (source) or removed (demand). A boundary node is a point where the hydraulic grade is known (a reservoir, tank, or PRV). Other components include tanks, reservoirs, pumps, valves, and controls.

The model is not an exact replica of the water system, although efforts were made to make the model as complete and accurate as possible. Pipeline locations used in the model are approximate and not every pipeline may be included in the model. Moreover, it is not necessary to include all distribution system pipes in the model to accurately simulate its performance. The model includes all known distribution system pipes of all sizes, sources, storage facilities, pump stations, pressure reducing valves, control valves, controls, and settings.

<u>Pipe Network</u>

The pipe network layout originated from GIS data provided by the City. Projects completed in recent years were added/updated in the model. Elevation information was obtained from the GIS data provided by the City. Smaller 8-inch and 10-inch pipes are generally PVC. The Darcy-Weisbach method was used, and roughness coefficients for pipes in this model ranged from 0.4-1.01, which is typical for these pipe materials in modeling software (Rossman 2000, 31).

The existing water system contains approximately 120 miles of pipe with diameters of 2 inches to 24 inches. Figure 5-1 presents a summary of pipe length by diameter.

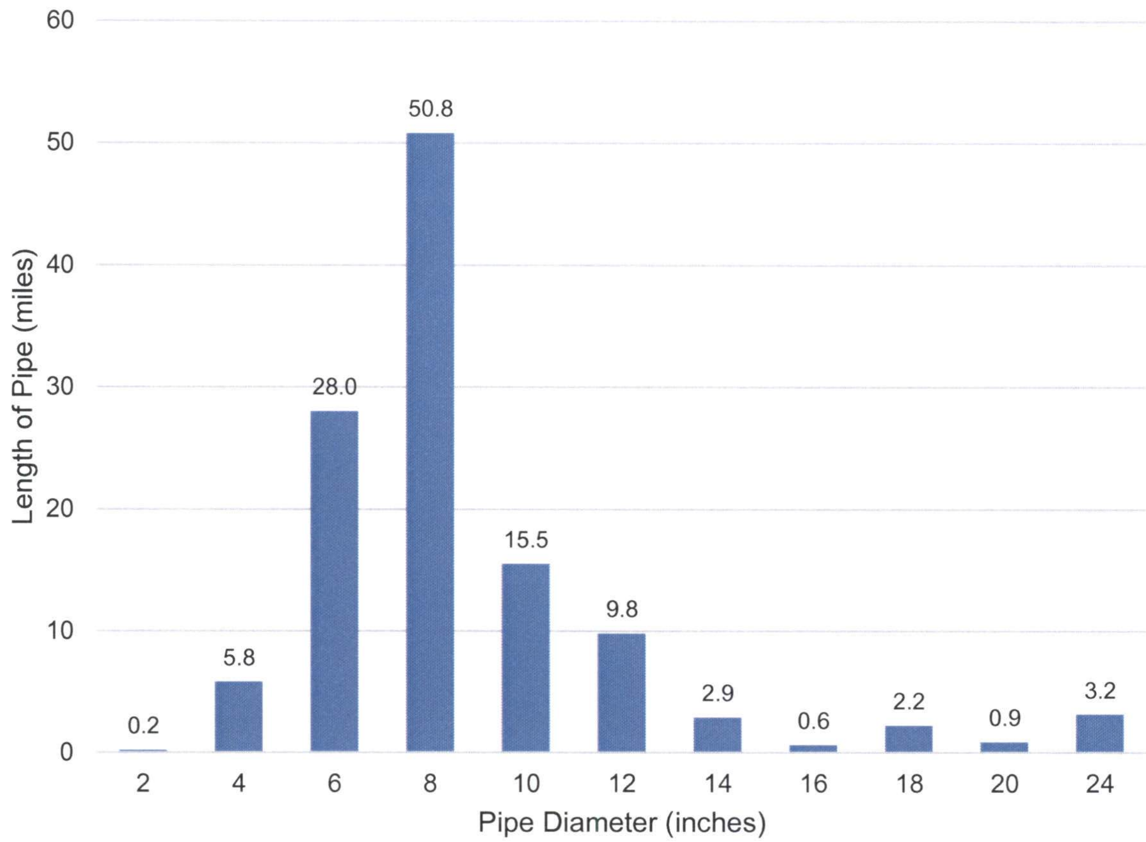


Figure 5-1: Summary of Pipe Length by Diameter

Water Demands

Water demands were allocated in the model based on billed usage and billing locations. Peak month demand was determined for each billing location and linked to the geocoded physical locations for each customer. The geocoded demands were then assigned to the closest model node. With the proper spatial distribution, demands were scaled to reach the peak day demand determined in Chapter 3. For the 2060 model, future demands were estimated as described previously in this report. Future demands were assigned to new nodes representing the expected location of new development in each pressure zone.

The pattern of water demand over a 24-hour period is called the diurnal curve, or daily demand curve. The diurnal curve for this master plan was taken from past SCADA data from the City. The diurnal curve for this study has a peaking factor of 1.7. The diurnal curve was input into the model to simulate changes in the water system throughout the day.

In summary, the spatial distribution of demands followed geocoded water use data, the flow and volume of demands followed the level of service standards described in Chapter 1, and the temporal pattern of demand followed a diurnal curve developed from SCADA data.

Water Sources and Storage Tanks

The sources of water in the model are the wells and JVWCD connections. A well is represented by a reservoir and pump. A JVWCD connection is represented by a reservoir and a flow control valve. Tank location, height, diameter, and volume are represented in the model. The extended-period model predicts water levels in the tanks as they fill from sources and as they empty to meet demand in the system.

RECOMMENDED PRESSURE ZONES

HAL recommends that Midvale expand the existing West Midvale pressure zone to encompass the majority of the city. The remainder of the City east of 700 East/900 East will be divided into two additional small pressure zones. Figure 2-1 shows the recommended new pressure zones. Several projects are required to combine these zones.

- Increase connectivity within the new Midvale pressure zone by constructing or upsizing connecting pipes at the following locations:
  - State Street/7200 South
  - State Street/Inglenook Drive
  - 7800 South, Sandra Way to 200 East
  - 8000 South, 100 East to 150 East
  - Greenwood Avenue, 270 East to Regent Park Lane
- Add PRV/check valve vaults to provide interconnections and redundancy between zones:
  - 900 East Fairmeadows Drive
  - 700 East 7200 South
- Close pipes that cross the proposed pressure zone boundaries to isolate the North Union and South Union zone from the Midvale zone.
- Increase flow at JVWCD 700 East connection and adjust pressure settings.

Midvale City is still paying for storage within the JVWCD system. Flow at the JVWCD 700 East connection will be allowed to peak until Midvale City constructs new storage. Pressure at this connection will need to be set to maximize pressure for residents at the top of the new pressure zone (just west of 900 East) and prevent the existing City tanks from overtopping. Until additional storage is constructed, flow from the 700 East JVWCD connection should not be encouraged to flow westerly, in order to allow the existing City tanks to function properly. This means that several of the zone connections may not be required until development increases in the future. Finalizing the exact settings is beyond the scope of this master plan and additional analysis will be required before creating the new pressure zones. Capital projects required to modify the zone boundaries are shown in Table 5-1.

All costs shown in this master plan are based on the 2019 RS Means Heavy Construction Cost Data, as shown in the unit costs table in Appendix D. All costs shown in all following tables include 20% for contingency and 15% for design. Costs are discussed in more detail in Chapter 6, Capital Facility Plan.

Table 5-1: Projects to Modify Zone Boundaries

Location		Pipe Diameter (inches)	Length of Pipe (feet)	Cost
1	State Street/7200 South	12	100	$50,000
2	State Street/Inglenook Drive	12	100	$50,000
3	7800 South, Sandra Way to 200 East	12	300	$105,000
4	8000 South, 100 East to 150 East	12	250	$88,000
5	Greenwood Ave, 270 East to Regent Park Lane	12	330	$66,000
6	900 East Fairmeadows Drive PRV/Check Valve			$50,000
7	700 East 7200 South PRV/Check Valve			$50,000
Total Cost for Projects to Modify Zone Boundaries				**$459,000**

SYSTEM ANALYSIS METHODOLOGY

HAL used extended-period and steady-state modeling to analyze the performance of the water system with current and projected future demands. An extended-period model represents system behavior over a period of time: tanks filling and draining, pumps turning on or off, pressures fluctuating, and flows shifting in response to demands. A steady-state model represents a snapshot of system performance. The peak day extended period model was used to set system conditions for the steady-state model, calibrate zone to zone water transfers, analyze system controls and the performance of the system over time, and to analyze system recommendations for performance over time. The steady-state model was used for analyzing the peak day plus fire flow conditions.

Two operating conditions were analyzed with the extended period model: peak day conditions and peak instantaneous conditions. Peak day plus fire flow conditions were analyzed using a steady-state model. Each of these conditions is a worst-case situation so the performance of the distribution system may be analyzed for compliance with DDW standards and City preferences.

Existing Peak Day Conditions

The DDW requires that a minimum pressure of 40 psi must be maintained during peak day demand (Subsection R309-105-9(2)). Midvale City's designated level of service indicates that 50 psi should be maintained. Peak day demand was evaluated at the level of service shown in Table 1-1. This amounts to an existing peak day demand of 11,570 gpm. The hydraulic model indicates that the system is capable of providing at least 40 psi at nearly every point of connection in the system at this level of demand. The paragraphs below describe all locations not meeting Midvale's current designated level of service. All points of connection meet DDW requirements, and there are no existing deficiencies for this demand condition.

Pressure Swings

The westerly portion of the existing Union pressure zone located between State Street and 300 East, from I-215 to 7200 South experiences pressure swings of 20 psi during the peak day. This is not considered a serious deficiency and no mitigation projects are recommended. Pressure swings in all other areas of the City are less than 20 psi on the peak day.

High Velocity
Several pipes experience high velocities during peak day conditions. These high velocities do not appear to be causing unacceptable pressure drops or pressure swings.. As demands increase, these pipes will need to be upsized or parallel pipes added.

700 East, JVWCD Connection to Downing Lane – velocities in the 700 East pipes are as high as 7.6 feet per second at the peak instantaneous condition. Buildout requirements are discussed below.

Fort Union Boulevard, Pearl Circle to 525 East – this short length of pipe is a bottleneck and experiences velocities up to 5.6 fps. Buildout requirements are discussed below.

1000 East, JVWCD Connection to Casa Roja Street – velocities in the 1000 East pipe reach 6.1 fps. Buildout requirements are discussed below.

Greenwood Avenue, 270 East to Regent Park Lane – This short length of pipe experiences velocities as high as 8.7 fps. This pipe is located at the boundary of the existing pressure zones and would serve as a good location to connect the zones in the future.

Existing High Pressure Conditions

The area west of I-15 experiences high pressures, which are greatest during the lowest demand times. This area experiences pressures up to 135 psi during typical operating conditions. The City should require individual PRVs for each new customer connection, particularly in these areas. No pressure changes are recommended, because this would reduce pressures in the upper portions of those zones to levels below the minimum desired. No capital projects are recommended to mitigate high pressures.

Existing Peak Instantaneous Conditions

A minimum pressure of 30 psi must be maintained during peak instantaneous demand (Subsection R309-105-9(2)). Peak instantaneous demand was defined based on SCADA data for the peak day demand in Midvale. The highest peaking factor present on the peak day was 1.7, resulting in a peak instantaneous demand of 19,795 gpm. The hydraulic model indicates that the system is capable of providing at least 30 psi at every point of connection in the system at this level of demand. There are no existing deficiencies in the system for this demand condition.

Existing Peak Day plus Fire Flow Conditions

A minimum pressure of 20 psi must be maintained while delivering fire flow to a particular location within the system and supplying the peak day demand to the entire system (Subsection R309-105-9(2)). As specified by the Midvale Fire Fire code official, a minimum fire flow of 1,000 gpm is required in all areas of the City. In 2010, an extensive review was made of all large buildings in the City to determine fire requirements. This review was updated as part of this master plan. Recent reconstruction of several schools has reduced fire flow requirements at those schools, because the new construction uses more fire-resistant materials and includes approved sprinkling systems. Most new construction of large/commercial building includes approved sprinkling systems, allowing the fire flow requirements for these buildings to be minimized. Based on the results of the review, fire flows typically around 1,500-2,500 gpm are required for commercial and industrial areas. The largest required fire flows in the City reach 4,000-5,250 gpm. Required fire flows are shown throughout the City on the Available Fire Flow map (Figure E-1) in Appendix E.

Figure E-1 also shows fire flow available at nodes throughout the entire system. Future construction should be required to use building materials and sprinkling systems to reduce the required fire flows to the amount the system can provide. Identifying every pipe incapable of supplying the required fire flow is beyond the scope of this study. The computer analysis should not replace physical fire flow tests at fire hydrants as the primary method of determining fire flow capacity.

Several locations throughout the City experience fire flows below the desired level of service. The majority of these are cul-de-sacs or long, dead-end lines with 4-inch or 6-inch pipe sizes. Several of the locations are discussed below. Recommended projects to increase fire flow are shown in Table 5-2 and numbered on Figure 5-2, Recommended Capital Facility Projects, at the end of this chapter.

East Midvale Elementary

The largest fire flow required in the City is at East Midvale Elementary School (6990 South 300 East). There are no plans to reconstruct this school. The required fire flow is 5,250 gpm and only4,500 gpm is available. The fire department may be unable to use significantly more than 4,000 gpm during fire suppression efforts. Connecting Splendor View Circle (6815 South) to 6850 South would improve connectivity and raise the available fire flow at the school to 4,900 gpm. This project was recommended in the 2010 Master Plan and is shown in the table below. Reconfiguring the pressure zones as recommended will further improve connectivity and raise the available fire flow to at least 5,250 gpm.

300 East 8000 South

A building at 300 East 8000 South requires 4,250 gpm fire flow. 2,450 gpm is available from the Midvale City system. Additional flow is available from the Sandy City system at a fire hydrant immediately east of the building. No project to increase fire flow is recommended. When the pressure zones are reconfigured, a connection can be added on 8000 South from approximately 100 East to 150 East. This would increase flows significantly at this location. The 8000 South zone connection is included in Table 5-1.

Other Locations

Projects are not recommended to increase fire flows at the ends of very short cul-de-sacs if sufficient fire flow is available at the adjacent street. Emergency interconnections with Sandy City should be maintained where possible and would benefit both cities.

Table 5-2: Projects to Resolve Low Fire Flow

Location		Description	Solution	Length (feet)	Cost
8	Splendor View Circle (6815 South) to 6850 South	Lack of connectivity between two dead-end lines	Connect lines	210	$42,000
9	6825 South, 650 West to 700 West	6-inch line	Construct 8-inch	700	$112,000
10	Depot Street, Holden Street to Main Street	4-inch line	Construct 8-inch	410	$66,000
11	Center Street, Main Street to LePage Street	Hydrants connected to 4-inch line	Connect two hydrants to 12" line in Center St.	-	$20,000
12	Cooper Street, south of Center Street	6-inch line	Construct 8-inch	450	$72,000
13	Alta View Drive, east of Chapel Street	4-inch line	Construct 8-inch	390	$63,000
14	Olympus Circle, north of Garden View Dr.	4-inch line	Construct 8-inch	630	$101,000
15	7100 South, State Street to 150 East and 150 East, 7100 South to 7200 South	4-inch lines	Construct 8-inch	1540	$247,000
16	Cox Street, State Street to Rusty Drive	4-inch line	Construct 8-inch	820	$160,000
Cost for Fire Flow Projects			**$855,000**		

REPLACEMENT PROJECTS

Transite Pipes

City records indicate there are approximately 5,000 linear feet of asbestos-cement (transite) piping in the City system. This pipe material can contaminate water if it starts to break down and should be replaced. The locations of these pipes are shown in Figure 5-2 and the cost of replacing these lines is shown in Table 5-3.

Reroute Tank Transmission Line

The existing 24-inch transmission line from the tanks to the City travels under an industrial area, including the Altaview Concrete plant and RelaDyne facility tank farm. The pipe cannot be easily accessed for operations and maintenance and should be rerouted. A proposed alignment north of Resaca Street and on State Street is shown on Figure 5-2. This project is included in Table 5-3.

Table 5-3: Replacement Projects

	Location	Description	Pipe Diameter (inches)	Length (feet)	Cost
17	Southcrest Circle, west of 900 East	Transite	8	100	$16,000
18	900 East, Casa Negra to Lyndy Drive	Transite	8	100	$16,000
19	Casa Blanca Drive, 7575 South, and Casa Verde Street	Transite	8	1,000	$160,000
20	7575 South (not in street), Casa Negra Circle to 1000 East	Transite	8	1,350	$216,000
21	Mecham Lane (7575 South), east of 1000 East	Transite	8	350	$56,000
22	Wood Street, Marquette Dr. (north) to Princeton Drive	Transite	8	1,300	$208,000
23	North of Resaca Street and State Street, Resaca to 8000 South	Transmission realignment	30	2,000	$700,000
Total Cost for Replacement Projects					**$1,500,000**

Aging Pipes

The City should continue replacing aging pipes on a regular basis. Table 5-4 shows the cost of all existing pipes and the cost to replace them over a 50-year service life. Replacement of 4-inch pipes should be of high priority when road replacement projects are completed.

Table 5-4: Replacement Program for Existing Pipes

Pipe Diameter (inches)	Length of Pipe (feet)	Cost
2	1,100	$176,000
4	30,800	$4,928,000
6	147,900	$23,664,000
8	268,300	$42,928,000
10	82,000	$14,760,000
12	51,800	$10,360,000
14	15,400	$3,388,000
16	3,400	$816,000
18	11,900	$2,975,000
20	4,700	$1,269,000
24	16,600	$5,146,000
Total Cost for Replacement of All Existing Pipes		**$110,410,000**
Annual Cost for Replacement of All Pipes Over 50 Years		**$2,208,000**

FUTURE (2060) WATER DISTRIBUTION SYSTEM

2060 Peak Day and Peak Instantaneous Conditions

A minimum pressure of 40 psi must be maintained at all connections during peak day demand (Subsection R309-105-9(2)). All but a few locations maintain a minimum of 50 psi under peak instantaneous demand. Future peak day demand is discussed in Chapter 3 of this report. With 23,580 ERCs projected, the system's 2060 peak day demand is estimated at 19,571 gpm. A significant portion of the increased future demand will be required in the 260-acre Jordan Bluffs area. City planners expect to see additional development at other locations throughout the City, including within Bingham Junction, near the Fort Union Shopping Area, along State Street and 7200 South, and in transit-oriented development zones. Infill development is possible on small pockets of land throughout the City. The remaining projected growth will likely take place through redevelopment in future decades.

Peak instantaneous demands were calculated in a similar manner to existing conditions. The peak day to peak instantaneous peaking factor is 1.7 and the total peak instantaneous demand is 33,484 gpm.

The 2060 peak day and peak instantaneous conditions were evaluated using the recommended new pressure zones. The following projects are required to meet peak day and peak instantaneous requirements in 2060:

- Increase transmission capacity on 700 East
- Increase transmission capacity on 1000 East
- Increase transmission capacity on 7200 South (Fort Union Boulevard)
- Increase transmission capacity on North Union Boulevard
- Add separate service line on 7800 South if existing line is used for lower zone transmission
- Construct storage for Midvale pressure zone and transmission to City
- Increase flow rate and contract volume from JVWCD sources at 175 West, 700 East, 1000 East
- Add new JVWCD source at Winchester Street/700 West
- Add 20-inch transmission line from Winchester Street/700 West to 6980 South
- Connect existing pressure zones at the following locations (costs previously shown in Table 5-1):
    - State Street/7200 South
    - State Street/Inglenook Drive
    - 7800 South, Sandra Way to 200 East
    - 8000 South, 100 East to 150 East
    - Greenwood Avenue, 270 East to Regent Park Lane
- Add PRV/check valve vaults to provide interconnections and redundancy between zones (costs previously shown in Table 5-1):
    - 900 East Fairmeadows Drive
    - 700 East 7200 South

Details of improvements for source and storage have been discussed in previous sections of this report. Recommended transmission projects are shown in Table 5-5 and on Figure 5-2, Recommended Capital Facility Projects. Costs for source and storage are included in the Capital Facility Plan in Chapter 6.

Table 5-5: Transmission Projects for 2060 Conditions

	Location	Pipe Diameter (inches)	Length of Pipe (feet)	Cost
	Increase existing transmission capacity			
24	700 East, JVWCD Connection (7600 South) to 7200 South	30	2,920	$906,000
25	700 East, 7200 South to Downing Street	16	850	$204,000
26	7200 South, 300 East to 700 East	20	2,650	$716,000
27	7200 South, Ramanee Drive to 300 East	16	1,100	$264,000
28	7200 South, State Street to Ramanee Drive	12	1,360	$272,000
29	1000 East, JVWCD Connection to Casa Roja Street	20	550	$149,000
30	1000 East, Casa Roja Street to Union Creek Way	16	1,800	$432,000
31	North Union Avenue	12	1,320	$264,000
	Add parallel service line			
32	7800 South, Devin Place to 1200 East	8	3,000	$480,000
	Add transmission for new source			
33	700 West, Winchester Street to 6980 South	20	2,430	$657,000
	Add transmission for new storage tank			
34	Transmission from proposed tank to City[1]	30	8,000	$2,800,000
	Total Cost for 2060 Transmission Projects			**$7,144,000**

1 – Transmission costs for the proposed storage tank could be as much as $6,000,000 if the tank must be located several miles from the City.

2060 Peak Day plus Fire Flow Conditions

The same fire requirements used in the existing condition have been used in the 2060 condition. Fire flow requirements may decrease at some areas in the City (including Midvale Elementary and the building at 300 East 8000 South) as older buildings are removed and new buildings are constructed using more fire-resistant materials and approved fire sprinkling systems. Fire flow available does not significantly decrease in the 2060 condition and even increases in some areas as better connectivity is achieved. A site-specific analysis of available fire flow should be performed for each new development early in the development review process. All new construction should be required to use building materials and sprinkling systems to reduce the required fire flows to the amount the system is capable of providing. The PRV/check valves vaults previously recommended between the Midvale and Union pressure zones will provide redundancy and increase available fire flow in the 2060 condition.

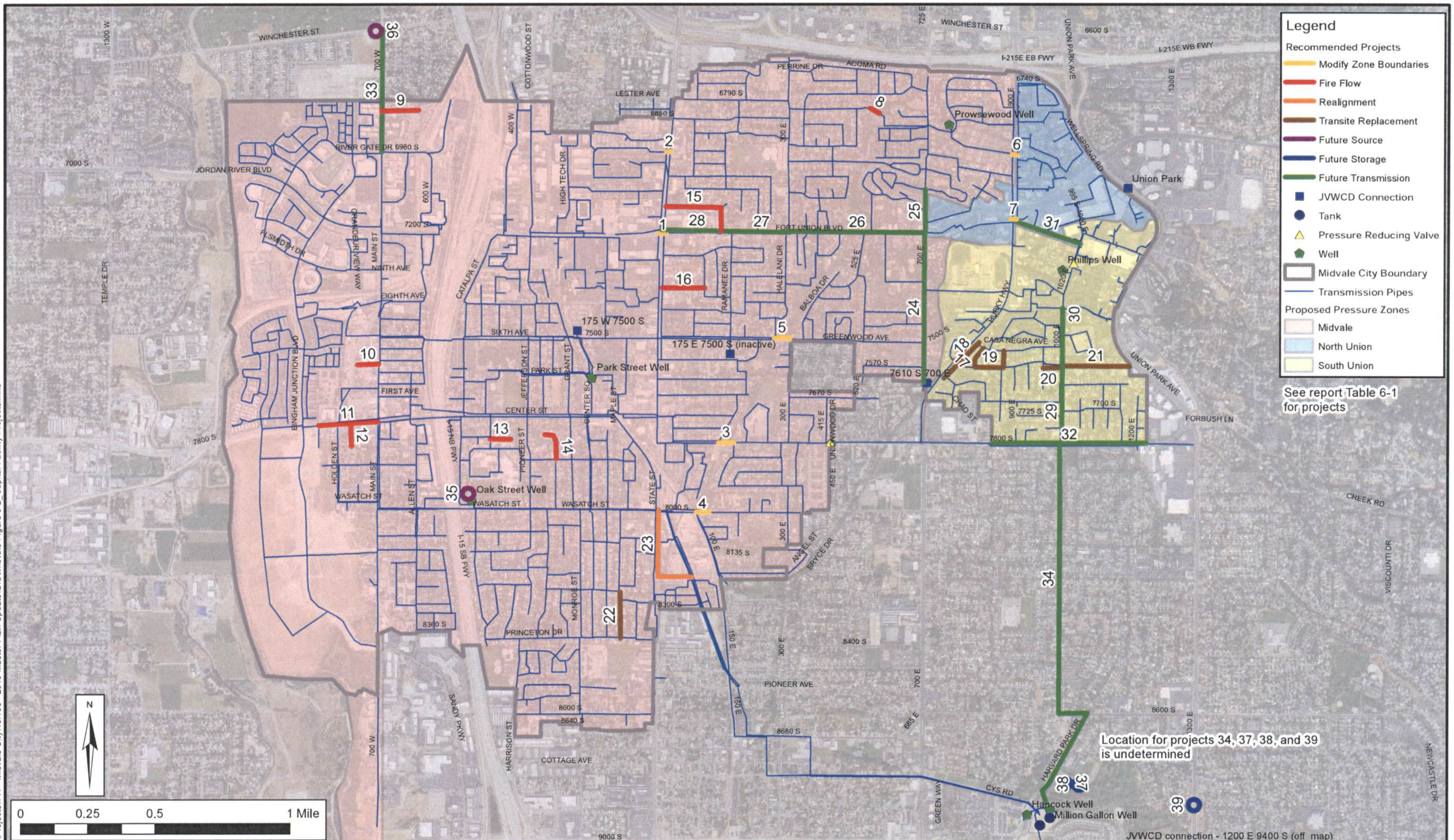
CONTINUED USE OF THE MODEL

The model output primarily consists of the computed pressures at nodes and flow rates through pipes. The model also provides additional data related to pipeline flow velocity and head loss to help evaluate the performance of the various components of the distribution system. Results from the model are available on a CD in Appendix F. Due to the large number of pipes and nodes in the model, it is impractical to prepare a figure which illustrates pipe numbers and node numbers. The reader should refer to the CD to review model output.

The model should continue to be updated as the water system changes. The City can use the model as a tool for determining the effect of changes to the system and capacity of the system to provide fire flows for new developments. Fire flow tests should be completed on an ongoing basis to refine the model calibration as system conditions change.

WATER DISTRIBUTION SYSTEM RECOMMENDATIONS

In addition to all projects recommended in Tables 5-2 through 5-5, additional localized transmission pipelines are expected to be installed as the City develops. The locations and lengths of these transmission pipelines will vary depending on the final location of future streets and the majority will be minimum sized pipes constructed by developers. The City will continue to review individual developments through the Development Review Committee (DRC) process. This should include analyzing transmission line size requirements, particularly for developments in areas where the water system is developing or not well connected, such as in the Jordan Bluffs area, or in the future annexation south of Jordan Bluffs. Pipe sizes in these developments may need to be increased for initial service, even if the ultimate size requirement is smaller when developments are well connected.



HANSEN ALLEN & LUCE inc ENGINEERS	MIDVALE CITY DRINKING WATER SYSTEM	RECOMMENDED CAPITAL FACILITY PROJECTS	FIGURE 5-2

Date: 5/5/2020
Document Path: H:\Projects\141 - Midvale City\43.100 - 2019 Master Plan Update\GIS\Midvale Figure 5-2_ Capital Facility Projects.mxd

CHAPTER 6 CAPITAL FACILITY PLAN

GENERAL

Throughout the master planning process, the three main components of the City's water system (source, storage, and distribution) were analyzed to determine the system's ability to meet existing demands and anticipated future demands. System deficiencies identified in the master planning process and described previously in this report were presented to City staff. Possible solutions were discussed for system deficiencies, maintenance and other system needs not identified in the system analysis.

The purpose of this section is to summarize all drinking water facilities required for the 40-year planning period to meet the demands placed on the system by future development. Projects required to meet existing level of service criteria are also included in this section, including desired fire flow, replacement of transite pipes, existing pipe realignment, and replacement of aging pipes.

Cost estimates have been prepared for the recommended projects and are included in Table 6-1. Unit costs for the construction cost estimates are based on conceptual level engineering and are shown in the unit costs table in Appendix D. Sources used to estimate construction costs include:

1. "Means Heavy Construction Cost Data, 2019"
2. Price quotes from equipment suppliers
3. Recent construction bids for similar work

All costs are presented in 2020 dollars. Costs shown below include 20% for contingency and 15% for design. Recent price and economic trends indicate that future costs are difficult to predict with certainty. Engineering cost estimates provided in this study should be regarded as conceptual level for use as a planning guide.

PRECISION OF COST ESTIMATES

When considering cost estimates, there are several levels or degrees of precision, depending on the purpose of the estimate and the percentage of detailed design completed. The following levels of precision are typical:

Type of Estimate	Precision
Master Planning	±50%
Preliminary Design	±30%
Final Design or Bid	±10%

For example, at the master planning level, if a project is estimated to cost $1,000,000, then the precision or reliability of the cost estimate would typically be expected to range between approximately $500,000 and $1,500,000. While this may seem imprecise, the purpose of master planning is to develop general sizing, location, cost, and scheduling information on a number of individual projects that may be designed and constructed over a period of many years. Master planning also typically includes the selection of common design criteria to help ensure uniformity and compatibility among future individual projects. Details such as the exact capacity of individual projects, the level of redundancy, the location of facilities, the alignment and depth of pipelines, the extent of utility conflicts, the cost of land and easements, the construction methodology, the types of equipment and material to be used, the time of construction, interest and inflation rates, permitting requirements, etc., are typically developed during the more detailed levels of design.

SYSTEM IMPROVEMENT PROJECTS

All projects recommended in previous chapters of this report are summarized in Table 6-1 (table continues on to page 6-3). The Map ID corresponds to the project number on Figure 5-2, Recommended Capital Facility Projects, located at the end of Chapter 5.

Table 6-1: Recommended Capital Facility Projects

Type	Map ID	Project Description	Cost
Projects to Revise Pressure Zones			
Internal Zone Connectivity	1	State Street/7200 South	$50,000
	2	State Street/Inglenook Drive	$50,000
	3	7800 South, Sandra Way to 200 East	$105,000
	4	8000 South, 100 East to 150 East	$88,000
	5	Greenwood Ave, 270 East to Regent Park Lane	$66,000
Connection Between Zones	6	900 East Fairmeadows Drive PRV/Check Valve	$50,000
	7	700 East 7200 South PRV/Check Valve	$50,000
Total Cost, Projects to Revise Pressure Zones			**$459,000**
Projects to Mitigate Existing Fire Flow Deficiencies			
Fire Suppression Flow	8	Splendor View Circle (6815 South) to 6850 South	$42,000
	9	6825 South, 650 West to 700 West	$112,000
	10	Depot Street, Holden Street to Main Street	$66,000
	11	Center Street, Main Street to LePage Street	$20,000
	12	Cooper Street, south of Center Street	$72,000
	13	Alta View Drive, east of Chapel Street	$63,000
	14	Olympus Circle, north of Garden View Dr.	$101,000
	15	7100 South, State Street to 150 East & 150 East, 7100 South to 7200 South	$247,000
	16	Cox Street, State Street to Rusty Drive	$132,000
Total Cost, Projects to Mitigate Existing Fire Flow Deficiencies			**$855,000**

(Table continues...)

Type	Map ID	Project Description	Cost
Projects to Replace Existing Transmission Lines			
Transite Pipe Replacement	17	Southcrest Circle, west of 900 East	$50,000
	18	900 East, Casa Negra to Lyndy Drive	$50,000
	19	Casa Blanca Drive, 7575 South, and Casa Verde Street	$105,000
	20	7575 South (not in street), Casa Negra Circle to 1000 East	$88,000
	21	Mecham Lane (7575 South), east of 1000 East	$66,000
	22	Wood Street, Marquette Dr. (north) to Princeton Drive	$208,000
Transmission Realignment	23	North of Resaca Street and State Street, Resaca to 8000 South	$700,000
Total Cost, Replacement Projects			**$1,267,000**
Projects to Accommodate Future Demand			
Transmission	24	700 East, JVWCD Connection (7600 South) to 7200 South	$906,000
Transmission	25	700 East, 7200 South to Downing Street	$204,000
Transmission	26	7200 South, 300 East to 700 East	$716,000
Transmission	27	7200 South, Ramanee Drive to 300 East	$264,000
Transmission	28	7200 South, State Street to Ramanee Drive	$272,000
Transmission	29	1000 East, JVWCD Connection to Casa Roja Street	$149,000
Transmission	30	1000 East, Casa Roja Street to Union Creek Way	$432,000
Transmission	31	North Union Avenue	$264,000
Transmission	32	7800 South, Devin Place to 1200 East	$480,000
Transmission	33	700 West, Winchester Street to 6980 South	$657,000
Transmission	34	Transmission from proposed tank to City[1]	$2,480,000
Source Redundancy	35	Replace/redevelop Oak Street or Park Street well	$2,000,000
Source	36	Vault for JVWCD connection at 700 West Winchester Street	$200,000
Storage	37	4.0 MG tank for Midvale pressure zone	$6,300,000
Storage	38	1.8 MG tank for Midvale pressure zone	$2,800,000
Storage	39	3.2 MG tank for North Union & South Union pressure zones	$5,100,000
Total Cost, Projects for Future Demand			**$23,224,000**
Annual Replacement of Aging Pipes			
Annual Cost to Replace Aging Pipes (pipes over 50-year cycle)			**$2,308,000**

[1] - Transmission costs for the proposed storage tank will increase if the tank is located farther from the City.

The following recommendations shown in Table 6-2 were discussed in this plan, but no costs have been evaluated.

Table 6-2: Additional Recommendations

Recommendation
Determine beneficial use for water right 57-2699
File change application to add Oak Street well as point of diversion to water rights 57-1738 and 57-1492
Proof recent change orders as part of the ongoing adjudication
Create forecasting/tracking system for JVWCD water and water rights and evaluate annually
Maintain emergency interconnections with Sandy City

SUMMARY OF COSTS

Table 6-3 includes projects shown in Table 6-1 and is a summary of project costs through 2060. This cost represents a best estimate for total cost in 2020 dollars to maintain the desired level of service while accommodating future growth through 2060 conditions. This table does not include any financing costs associated with funding options.

Table 6-3: Summary of Costs

Project Type	Cost
Revise Pressure Zones	$459,000
Mitigate Existing Fire Flow Deficiencies	$855,000
Replace Existing Transmission Lines	$1,267,000
Accommodate Future Demand	$23,224,000
Total	**$25,805,000**
Plus Annual Replacement of Aging Pipes	**$2,308,000**

FUNDING OPTIONS

Funding options for the recommended projects, in addition to water use fees, could include general obligation bonds, revenue bonds, State/Federal grants and loans, and impact fees. The City may need to consider a combination of these funding options. The following discussion describes each option.

General Obligation Bonds

This form of debt enables the City to issue general obligation bonds for capital improvements and replacement. General Obligation (G.O.) bonds would be used for items not typically financed through the Water Revenue Bonds. For example, the purchase of water source to ensure a sufficient water supply for the City in the future. G.O. bonds are debt instruments backed by the full faith and credit of the City, which would be secured by an unconditional pledge of the City to levy assessments, charges or ad valorem taxes necessary to retire the bonds. G.O. bonds are the lowest-cost form of debt financing available to local governments. G.O. bonds can be combined with other revenue sources, such as specific fees, or special assessment charges to form a dual security through the City's revenue generating authority. These bonds are supported by the City as a whole, so the amount of debt issued for the water system is limited to a fixed percentage of the real market value for taxable property within the City.

Revenue Bonds

Revenue Bonds are another form of debt financing available for utility-related capital improvements. Unlike G.O. bonds, revenue bonds are not backed by the City as a whole, but constitute a lien against the water service charge revenues of a water utility. Revenue bonds are riskier to the investor than G.O. bonds, since repayment of debt depends on an adequate revenue stream, legally defensible rate structure and sound fiscal management by the issuing jurisdiction. Due to this increased risk, revenue bonds generally require a higher interest rate than G.O. bonds. Interest rates are currently at historic lows. This type of debt also has very specific coverage requirements in the form of a reserve fund specifying an amount, usually expressed in terms of average or maximum debt service due in any future year. This debt service is required to be held as a cash reserve for annual debt service payment to the benefit of bondholders. Typically, voter approval is not required when issuing revenue bonds.

State/Federal Grants and Loans

Historically, both local and county governments have experienced significant infrastructure funding support from state and federal government agencies in the form of block grants, direct grants in aid, interagency loans, and general revenue sharing. State/federal grants and loans should be further investigated as a possible funding source for needed water system improvements.

As with the revenue bonds discussed earlier, the ability of infrastructure programs to wisely manage their finances will be a key element in evaluating whether many secondary funding sources, such as federal/state loans, will be available to the City.

Impact Fees

Impact fees can be applied to water related facilities under the Utah Impact Fees Act. The Utah Impacts Fees Act is designed to provide a logical and clear framework for establishing new development assessments. It is also designed to establish the basis for the fee calculation which the City must follow in order to comply with the statute. However, the fundamental objective for the fee structure is the imposition on new development of only those costs associated with providing or expanding water infrastructure to meet the capacity needs created by that specific new development. Also, impact fees cannot be applied retroactively. Though Midvale City has not imposed impact fees in recent years, it may be a possibility for future development.

SUMMARY OF RECOMMENDATIONS

Several recommendations were made throughout the master plan report. The following is a summary of the recommendations.

1. Reconfigure the existing pressure zones to create a larger Midvale pressure zone, with the area east of 700 East/900 East remaining an upper zone (two sub-zones) served by JVWCD.
2. Determine a beneficial use for water right 57-2699 or exchange it for a right usable by the City.
3. Amend water rights 57-1738 and 57-1492 to include the Oak Street well as a point of diversion.
4. Elect to have recently approved change applications proofed as part of the ongoing water rights adjudication.
5. Monitor the Average Yearly Demand and use a forecasting and tracking system to ensure the JVWCD contract is neither too high or too low to responsibly meet the needs of the City's drinking water system.
6. Obtain a JVWCD connection at Winchester Street and 700 West.
7. Increase the capacity of the JVWCD connection at 175 West 7500 South, 700 East 7610 South, and 1000 East 7800 South.
8. Consider redeveloping Oak Street well and/or possibly Park Street well to provide full beneficial use of City water rights and provide additional redundancy.
9. Maintain connections from the Sandy City system for emergency use.
10. Pursue negotiations with JVWCD to continue to provide storage volume for the City (at a minimum for the new North Union and South Union pressure zones).
11. Pursue acquiring property appropriate for a storage tank for the Midvale pressure zone.
12. Complete the Existing and Future Recommended Projects.
13. Continue to update the model as the water system changes (including verification of pipe diameters) and use the model as a tool for determining the effect of changes to the system and capacity of the system to provide fire flows.
14. Continue to conduct fire flow tests on an ongoing basis to refine the model calibration as system conditions change.

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APPENDIX A
Growth Projections and Projected ERCs

Table A-1
Growth Projections and Projected ERCs

Year	Projected ERCs	Annual ERC Growth
2020	13,940	-
2021	14,298	2.8%
2022	14,667	2.8%
2023	15,045	2.8%
2024	15,435	2.8%
2025	15,836	2.8%
2026	16,248	2.8%
2027	16,672	2.8%
2028	17,108	2.8%
2029	17,556	2.8%
2030	18,017	2.8%
2031	18,194	1.1%
2032	18,372	1.1%
2033	18,552	1.1%
2034	18,735	1.1%
2035	18,919	1.1%
2036	19,105	1.1%
2037	19,293	1.1%
2038	19,483	1.1%
2039	19,676	1.1%
2040	19,870	1.1%
2041	20,047	1.0%
2042	20,226	1.0%
2043	20,407	1.0%
2044	20,590	1.0%
2045	20,774	1.0%
2046	20,961	1.0%
2047	21,149	1.0%
2048	21,338	1.0%
2049	21,530	1.0%
2050	21,723	1.0%
2051	21,901	0.9%
2052	22,081	0.9%
2053	22,262	0.9%
2054	22,445	0.9%
2055	22,630	0.9%
2056	22,816	0.9%
2057	23,004	0.9%
2058	23,193	0.9%
2059	23,384	0.9%
2060	23,577	0.9%

APPENDIX B
Water Rights

State of Utah
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WATER RIGHTS

Michael O. Leavitt
Governor
Robert L. Morgan
Executive Director
Jerry D. Olds
State Engineer

1594 West North Temple, Suite 220
PO Box 146300
Salt Lake City, Utah 84114-6300
(801) 538-7240 telephone
(801) 538-7467 fax
www.nr.utah.gov

June 25, 2002

Salt Lake Valley Groundwater Users:

Enclosed is the final Salt Lake Valley Groundwater Management Plan which replaces the interim plan implemented in 1991. Although we are implementing this management plan on a "permanent" rather than on an interim basis, we are allowing for the prospect of modifying this plan in the future as conditions change. Modification to this management plan would occur in consultation with water users and other interested parties.

We have received numerous comments and a lot of input during the development of this plan. We would like to thank all of those who have contributed to this process. Many of the provisions in this plan reflect the concerns and issues raised by many of you.

In addition, we have relied heavily on data, information, and computer models which were developed by the United States Geological Survey. The publications containing much of this data and information and other related documents are available on the division's website - waterrights.utah.gov.

The water rights configuration in Salt Lake Valley is complex and offers many unique challenges for both water users and water managers. We believe that this management plan adequately addresses these challenges. We also believe that this will be a useful tool in helping water users plan for future development as well as help this division in the administration and management of this precious resource. We ask for your continued support.

Sincerely,

Jerry D. Olds

Jerry D. Olds, P.E.
Utah State Engineer

Introduction

This document presents the state engineer's policy for the management of the ground-water resources of Salt Lake Valley. The objectives of this ground-water management plan are to promote wise use of the ground-water resource, to protect existing water rights, and to address water quality issues and over-appropriation of ground water in the valley. In implementing this ground-water management plan, the state engineer is using his statutory authority to administer the measurement, appropriation, and distribution of the ground water of Salt Lake Valley. The intent of this plan is to provide specific management guidelines under the broader statutory provisions within Title 73 of the Utah Code.

For the purposes of this plan, the Salt Lake Valley consists of the unconsolidated basin-fill material generally bounded by the Wasatch Range to the east, Oquirrh Range to the west, Great Salt Lake to the north, and Traverse Mountains to the south. This area is shown in Figure 1.

Salt Lake Valley Ground-Water Management Plan

The following policy guidelines are hereby implemented effective June 25, 2002:

1.0 Appropriations

The Salt Lake Valley is closed to new appropriations of ground water from the principal aquifer including fixed-time appropriations. This action is necessary because of the over-appropriation of water resources of the valley. All pending unapproved applications in the principal aquifer will be rejected. In addition, the state engineer will hold all applications to appropriate water from the shallow aquifer until further review and study of this source is conducted.

2.0 Ground-Water Withdrawal Limits

In order to fulfill the objectives of this management plan, guidelines are being implemented to help distribute ground-water withdrawals. If excessive withdrawals occur, the state engineer will distribute the water in accordance with the priority dates of the applicable water rights using the following guidelines:

2.1 Safe Yield from the Principal Aquifer

Salt Lake Valley has been divided into four regions: western, eastern, central, and northern as shown in Figure 1. The state engineer may limit the quantity of water withdrawn in these regions so that the average amount of water withdrawn over the long term does not exceed the safe yield. The safe yield of each region has been estimated and is shown in Table 1 below.

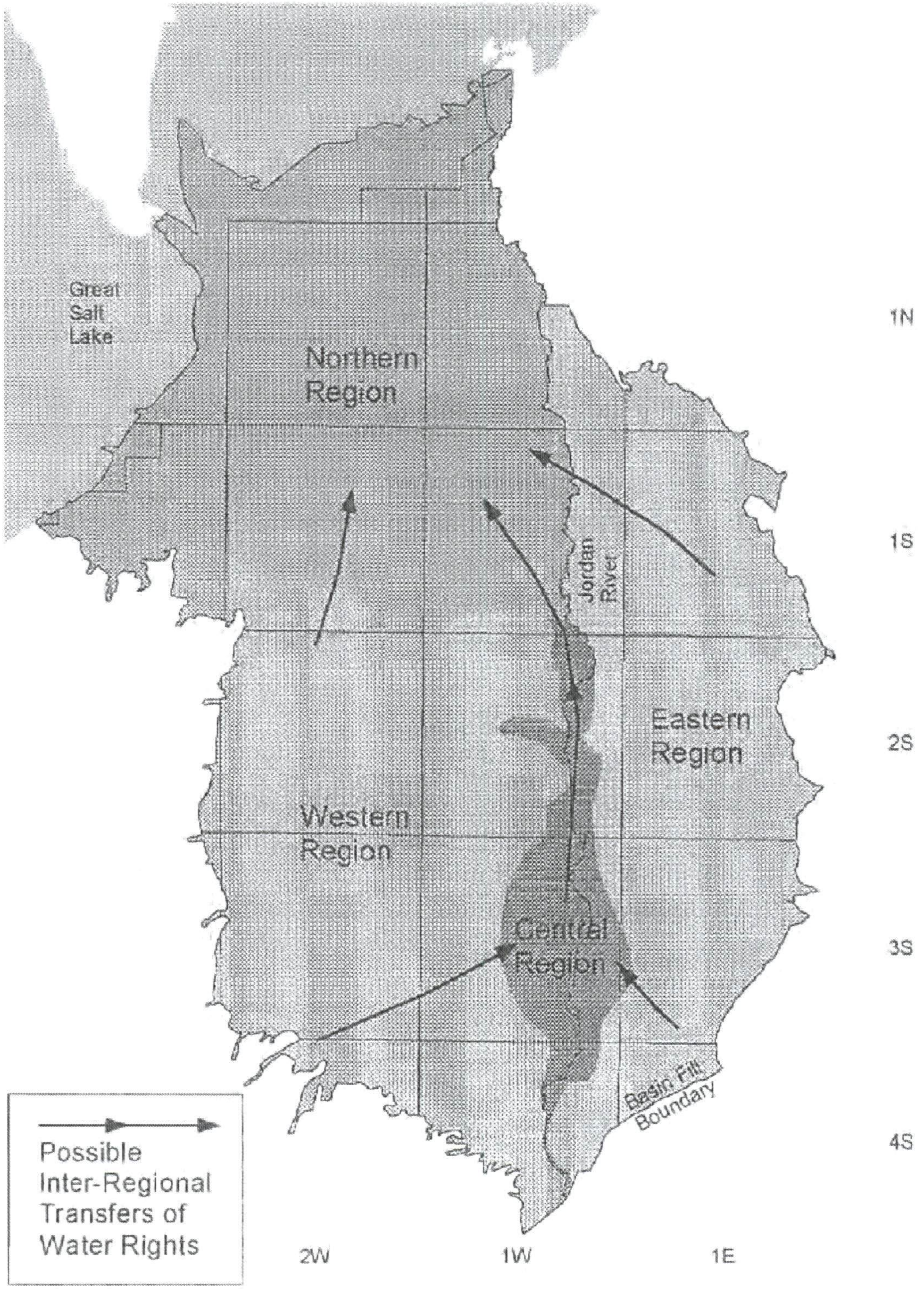

Figure 1. Salt Lake Valley Ground-Water Management Plan Regions

Table 1. Regional Safe Yields

Region	Safe Yield (acre-feet per year)
Western	25,000
Eastern	90,000
Central	20,000
Northern	30,000

2.2 Localized Ground-Water Withdrawals

The state engineer may limit withdrawals in any area of the valley where excessive withdrawals are causing definite and significant harm to the ground-water system. The state engineer recognizes that there are many different factors to consider in determining when and where this is occurring. Some of the relevant factors to consider are:

- ground-water level trends
- trends in the amount of ground-water withdrawals
- changes in water quality
- recent climatic conditions
- local hydro-geologic conditions

Upon identifying areas where excessive withdrawals are causing harm to the aquifer and after public review and commentary on applicable data, the state engineer may limit the withdrawals in that area according to the priority dates of each applicable water right and in harmony with all applicable state statutes. The total quantity of ground water restricted from withdrawal will correspond to at least the quantity necessary to preclude further harm to the aquifer system. Further pumping restrictions may be imposed if harm to the ground-water system worsens. Pumping restrictions may also be lifted in part or in whole after the ground-water system has recovered to an acceptable level, provided no future reoccurrences of the conditions which caused the harm are anticipated.

2.3 Ground-Water Withdrawals From the Southwestern Portion of the Valley

A portion of the aquifer in the Southwestern part of the valley is being remediated by the removal of contamination associated with past mining practices. As part of the remediation effort, Kennecott Utah Copper Corporation (KUCC) has committed to assist affected water users obtain adequate replacement water if adversely affected. Applications in this area which propose to change the point of diversion or drill a replacement well will be critically reviewed so as not to interfere with the remediation process. In conjunction with this, KUCC has committed to work with applicants to determine if there is a feasible well location, depth, and pumping rate for future wells in the contaminated area. The contaminated area is defined as extending 3000 feet from the known 250 mg/l sulfate isoconcentration contour. The approximate boundary for this area is shown in Figure 2.

3.0 Applications to Change the Point of Diversion, Place of Use, and/or Purpose of Use
Each change application will be evaluated based upon its own merits. Within the statutory requirements, the evaluation may consider – but will not necessarily be limited to – potential impacts on: existing water rights, the ground-water system, and overall water quality. In addition, the following guidelines will be used when evaluating change applications:

1) Change applications that propose to transfer water rights historically supplied from the shallow aquifer to the principal aquifer will not be approved.
2) Change applications that propose to transfer water rights into the eastern region, into the western region, or out of the northern region will not be approved. (See Figure 1.)
3) Change applications that propose to transfer water rights into a restricted area[1] will not be approved. (See Figure 2 and endnotes for details.)
4) Change applications that propose to transfer water rights into a section where the Transfer Index Number (TIN[2])under the current water rights exceed the limits set forth in Table 2 below will only be considered if the applicant can show that.
   a) There is sufficient reason to believe that existing water rights will not be impaired.
   b) Compensation and/or adequate replacement water will be provided to existing water right holders if impairment occurs.
   c) Additional ground-water withdrawals will not significantly reduce water levels, degrade the water quality, or otherwise negatively impact the ground-water system.

Table 2. Regional Transfer Index Number Limits

Region	TIN Limits (acre-feet per year)
Western	4,000
Eastern	12,000
Central	6,000
Northern	6,000

5) Change applications that propose to transfer water rights between sections that have Transfer Index Numbers exceeding the limits set forth in Table 2 may be approved provided that the TIN in the hereafter section is at most 75% of the TIN of the heretofore section and the criteria listed under items 1-4 above have been met.
6) Change applications that propose to drill a replacement well within a distance of 2,640 feet from the original point of diversion may be approved provided that the criteria listed under items 1 and 3, above, have been met.

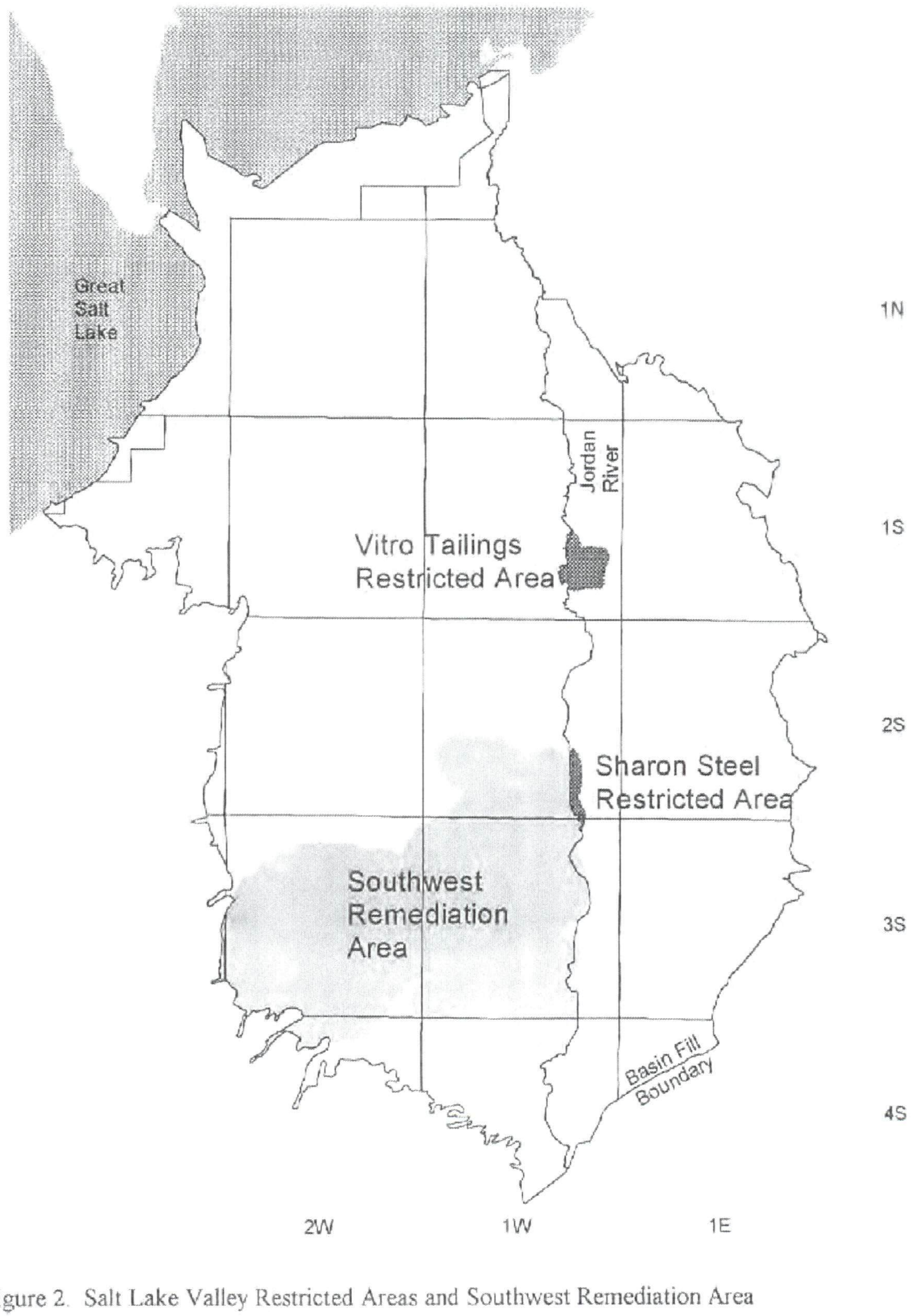

Figure 2. Salt Lake Valley Restricted Areas and Southwest Remediation Area

4.0 Well Spacing
Each new well should be designed, constructed, and operated so that, when pumped at its maximum flow rate, it will not cause more than 12 feet of draw down on an existing well unless the owner of the new well provides just compensation to the affected well owner(s).

5.0 Extensions of Time for Water Right Applications
The state engineer will critically review all future extension requests on approved applications to appropriate or change water pursuant to Section 73-3-12 of the Utah Code. When reviewing extension requests, if unjustified delays or a lack of due diligence is found, the state engineer may reduce the priority date, grant the request in part, or deny the extension of time request.

6.0 Ground-Water Remediation Projects
The state engineer will evaluate each proposed ground-water remediation project based upon its own merits. In order to allow for remediation of ground water the state engineer may support withdrawal amounts in excess of the regional safe yield values outlined in Section 2.1 above or allow changes that would exceed the limits set forth in Section 3.0 above if it is determined to be in the best interest of the public and has a specific project life.

7.0 Aquifer Storage Recovery (ASR)
The state engineer will evaluate each proposed ASR project based upon its own merits. In general, withdrawals credited from aquifer recharge will not count towards the safe yield values outlined in Section 2.1 above. Some of the factors that will be considered in the evaluation of potential ASR projects are:

- hydro-geologic properties of the aquifer
- ground-water velocities
- amount of time between recharge and recovery
- potential effect on other water rights

Applicants may be required to monitor the effects of ASR projects to ensure that no unreasonable impact to the ground-water system or other water rights occurs.

8.0 Monitoring Activities and Aquifer Status Update
The Division of Water Rights will monitor water quality reports submitted by water users to the Department of Environmental Quality and periodically produce an updated, valley-wide water quality summary. Additionally, the division will provide water use information. Also, the division will review new pertinent data that further, or more accurately, defines the ground-water flow system and hydro-geology of Salt Lake Valley and will modify the plan if necessary. Any modifications to the plan will occur in consultation with water users and other interested parties.

June 25, 2002
Date

Jerry D. Olds
Jerry D. Olds, P.E.
Utah State Engineer

Endnotes

1. Restricted Areas

There are two restricted areas currently in the plan associated with the following contaminated sites as shown in Figure 2:

- Vitro Tailings Site
- Sharon Steel Site

In order to protect the quality of the water by preventing changes in the hydraulic gradient and mobilization of contaminants at these contaminated sites, the transfer of water rights into these areas will not be allowed. Restricted areas are based on available data and may change as new data is obtained. New restricted areas may be added to the plan upon request to the state engineer if an evaluation of the data supports such designation, and the public has had an opportunity to review the data and comment on the proposed designation.

2. Transfer Index Number (TIN)

Under the U.S. Public Land Survey system, the land is divided into township, range, and section. Each section is a square measuring approximately one mile on each side. In this management plan, each section in the valley fill of the Salt Lake Valley is assigned a Transfer Index Number which is based on the index values of every water use within that and each of the eight adjacent sections.

There are specific rules for calculating a section's TIN, which has units of acre-feet per year. A TIN may change over time as the water rights situation changes. The primary rules for calculating a section's TIN are outlined below.

1. Only approved and perfected, i.e. certificated, water rights are evaluated. Approved (but unperfected) changes on perfected water rights are not evaluated because of double accounting issues. Water rights under active litigation are not evaluated.
2. Only wells (both flowing and pumped) are evaluated. Tunnels, springs, drains, and other types of non-well, "underground" diversions are not evaluated.
3. Index values for indoor domestic uses are calculated at 0.45 acre-feet per family.
4. Index values for stock-watering uses are calculated at 0.028 acre-feet per equivalent livestock unit (ELU).
5. Index values for irrigation uses are calculated at 5 acre-feet per acre of irrigated land. If there is a sole supply acreage listed, the irrigation index value is equal to the number of sole supply acres multiplied by an irrigation duty of 5.
6. Index values for domestic, stock-watering, and irrigation uses are calculated by dividing the index value of a claims group by the number of supplemental rights in that group.
7. Index values for municipal uses are calculated by multiplying the flow rate (cfs) by 362.
8. Index values for industrial, mining, and other uses are calculated by multiplying the flow rate (cfs) by 181.

9. The total index value for a water right is the sum of the index values of all listed uses but will not exceed the maximum diversion volume (if listed on the right) nor the maximum flow rate (cfs) multiplied by 724.
10. The total index value for a particular water right is divided evenly between each point of diversion listed under that water right.
11. Index values are calculated for each point of diversion in a section and summed up for the section in question and every adjacent section. This has been done for section 11 in the example below. *(Note: The TIN for section 11 is not 500.)*

3 800	**2** 1600	**1** 2100
10 2600	**11** 500	**12** 1200
15 3300	**14** 1100	**13** 900

Figure A. Evaluating water rights in all adjacent sections

12. A section's TIN is the *maximum sum* of any four adjacent section index values. In the figure below, section 11 has a TIN of 7,500 acre-feet per year.

3 800	**2** 1600	**1** 2100
10 2600	**11** 500	**12** 1200
15 3300	**14** 1100	**13** 900

Sum = 5500

3 800	**2** 1600	**1** 2100
10 2600	**11** 500	**12** 1200
15 3300	**14** 1100	**13** 900

Sum = 5400

3 800	**2** 1600	**1** 2100
10 2600	**11** 500	**12** 1200
15 3300	**14** 1100	**13** 900

Sum = 7500

3 800	**2** 1600	**1** 2100
10 2600	**11** 500	**12** 1200
15 3300	**14** 1100	**13** 900

Sum = 3700

Figure B. Determining the TIN for a particular section by calculating the maximum sum

APPENDIX C
Calibration Data

Month July Year 2019 Million Gallon

Date	Time	Pump Level	Static Level	Tank AM	Tank Noon	Tank PM	Meter Reading (OOO)	GPM On/Off	Remarks	By
1		419.8		14.5			2295752.2	2142		RG/BS
2	8:28	410.9		16.2			3288325	2145		BS/RG
3	8:24	414.3		14.0			4463058	2156		AA/RG
4	10:00	411.7		17.4		18.1	7756275	2136		BB
5	8:39	424.4		15.1			8027089	0		AA/RG
6	10:30	419		15.4		17.7	9328206	2145		BB
7	10:50	418.1		15.8		17.5	4977876	2148		BB
8	8:47	418.1		14.0			1282969	0		ER/MC
9	8:41	413.1		13.7			3760240	2148		BS/ER
10	8:27	411.8		15.4			6797294	2145		RG/AA
11	8:58	415.7		14.5			7944090			BS/ER
12	8:46	415.9		13.9			8633900			ER/BS
13	10:09	408.0		15.8		18.0	1015493	2129		Lalo
14	8:59	411.8		14.5		17.3	1854009			Lalo
15	8:32	409.2		13.6						RG/BS
16	8:24	402.7		14.7			4887857	2126		BS/RG
17	8:49	459.3		11.5	11.11	10.1	8216814	2184		AA/Lalo
18	7:39	463.3		5.9	6.9	8.5	1187876	2169	9.7	BS/TF
19	7:15	427.1		9.3	14.1	16.4	4232780	2164		TF
20	[illegible]	[illegible]		17.3	18.7	16.6	7413702	2185		TF
21	8:50	412.6		15.[illegible]	18.9	17.6	245 5015	2127	8:15	TF
22	8:36	412.7		15.0	17.8	17.5	6562245	2128		
23	8:34	403.8		14.2			9654662	2146	17.7	AA/TF
24	7:59	398.5		15.0		17.2	2637695	2136	17.2	MC
25	8:30	400.1		15.0			5819745	2133		AA/RG
26	8:36	399.9		14.1			9021986	2122		ER/BS
27	9:24	400.6		15.5		17.7	2189186	2134		MC
28	8:41	402.1		14.8		17.4	5274289	2137	17.4	MC
29	8:42	400.0		14.0			8389758	2127		BS/RG
30	8:50	396		15.2			~~1461~~ 1462533	~~2125~~	2123	TF
31	8:38	397.6		14.0			4740837	2119		ER/AA
~~August 1~~	~~8:21~~	~~[illegible]~~		~~[illegible]~~			~~[illegible]~~	~~[illegible]~~		~~[illegible]~~

Month August Year 2019 Million Gallon

Date	Time	Pump Level	Static Level	Tank AM	Tank Noon	Tank PM	Meter Reading (OOO)	GPM On/Off	Remarks	By	
1	8:21	399.4		15.4			7863582	2138		AA	
2	8:24	399.7		14.5			1171196	2132		AA	
3	9:00	346.4		14.7		CH	2122.9	2132	16.5 8pm	CH	
4	6:30	349		16.6		CH	2268646	2122	[illegible]	CH	18.9
5	9:09	399.2		15.0			433744	2139		ER/TF	
6	8:30	394.8		16.6			3402666	2126		ER/TF	
7	8:54	397.2		15.1			6523894	2118		BS/RG	
8	8:18	391.3		16.0			9510538	2121		RG/ER	
9	9:06	397.7		15.8			2647000	2119		Lelo	
10	8:03	400.4		16.3		JW	5589155	2118		JW	17.0
11	8:34	457.1		11.9			8761472	2168		JW	13.4
12	8:50	402.0		12.7			1886735	2134		BS	
13	8:39	397.9		18.3			4904916	2120		BS	
14	8:45	402.4		15.3			8068400	2125		ER/BS	
15	8:16	404.0		16.4			987684	2115		ER/RG	
16	9:10	402.0		15.7			4436556	2118		ER/BS	
17	9:57	399.8		16.8		18.6	7636815	2108		RG	
18	12:05	397.9		17.6		19.0	1130958	2107		RG	
19	7:37	399.1		15.1			3730352	2124		ER/TF	
20	7:45	396.7		16.2			6813526	2116		RG/BS	
21	7:50	391.4		15.2			9889836	2123		BS/RG	
22	7:50	389.0		15.7			2947856	2136		MP/TF	
23	7:55	390.1		15.3			6025996	2138		BS	
24	9:27	386.9		16.5		19.0	9404822	2131		BS	
25	9:35	387.1		16.3		18.9	2483022	2125		BS	
26	7:59	387.1		14.9			5211332	2134		BS	
27	8:00	382.7		17.3			8242997	2105.2		TF	
28	8:05	387.7		14.2			1189971	2125		AA/BS	
29	7:31	442.6		16.1			4199932	2165		AA	
30	7:19	451.3		14.5			7089713	2163		MC	
31	8:17	397.7		17.2			116050.5	2120	14.7	MC	

Hancock Welll Report **Midvale City**

Month July Year 2019

Date	Time	Meter Reading (OOO)	Mag Meter Total	Flow Rate	Peak	Pump Gpm	Pump Level	Static Level	Remarks	By
1	8:35	6219301	8143K	4760		1948	342.2		14.5	RG
2	8:30	8984158	8049K	5130		1935	334.3		16.2	RG
3	8:26	1779887	9031K	5760		1943	336.7		14.0	RG
4	10:00	11760760	8039K	4060		1930	335		17.4	BB
5	8:43	7404987	8378K	4250		1945	345.9		15.1	RG
6	10:33	11574335	81713	3484		1940	341		15.4	BB
7	10:50	3390778	89723	3302		1943	340.1		15.8	
8	8:51	5822997	89723	4546		1946	339.3		14.0	BS CR
9	8:44	8589074	8838K	4770		1942	333.9		13.7	RG
10	8:29	1339224	10089K	5320		1937			15.4	ER BS
11	9:03	4196197	8828K	4560		1926	337.3		14.6	ER BS
12	8:48	6960309	8828K	6440		1936	336.3		13.9	EN
13	10:42	9891092	9134K	4640		1929	330.4		15.8 18.0	ER
14	9:02	2551560	8559K	4520		1926	333.4		14.5 17.3	RG
15	8:34	5281147	8559K	6120		1935	330.2		13.6	RG
16	8:25	8032900	9195K	5280		1935	323.2		14.7	AA
17	8:53	69749.84	9380K	5010		1976	—	375.4	15.0 15.0	
18						1976	375.4		15.0 14.1	RG
19	8:25	1610956	9380K	5000		1917	327.8		17.3 18.7	TF
20	8:45	4216416	1062K	3850		1926	337.6		15.8 18.9 17.5	TF
21	8:55	5571498	7145K	3330		1930	338.1		15.0 17.8	BS CR
22	8:35	7150150	7145K	4520		1940	327.5		14.2	AA TF
23	8:40	9941493	7819K	5800		1427	322.6		15.0 17.2	MC
24	8:03	2639873	9029K	6053		1935	323.9		15.	RG
25	8:34	5475236	9334K	5020		1929	322.6		14.1	BS CR
26	8:39	8264816	8697K	5810		1928	323.2		15.5 17.7	MC
27	9:26	1137887	8063K	3520			324.3		14.8 17.4	MC
28	8:44	3838554	8386K	4567		1936	321.4		14.0	RG
29	8:45	6618792	8439K	5560			317.7		15.7	TF
30		9401516	9281K	4500		1931	319.0		14.0	AA/ER
31	8:40	21468943	9281K	5604						

Hancock Welll Report **Midvale City**

Month August Year 2019

Date	Time	Meter Reading (OOO)	Mag Meter Total	Flow Rate	Peak	Pump Gpm	Pump Level	Static Level	Remarks	By
1	8:24	4896102	9324K	4360		1934	320.2		15.4	RG
2	8:27	7687981	7809K	6610		1933	320.3		14.5	RG
3	9:29	29	6769	4750		1931	312.6		14.7	CH
4	8:39	4442209	8240	4534		1916	318		16.6 18.9	CH
5	9:12	4702838	44709076	4970		1935	322.0		15.0	ER
6	8:34	7393338	9076K	4930		1917	317.7		16.6	RG
7	8:56	9063216	8934K	4720		1934	320.1		15.1	RG
8	8:20	1034319	8933	4740		1931	315.2		16.0	ER
9	9:09	3028630	7183K	3710		1919	320.5		15.8	JW
10	8:10	647.935	7430	4460		1931	323.6		16.3 17.0	JW
11	8:40		99K	0		1926			11.9	BS
12	8:53	5913438	8059K	4990		1943	324.2		12.7	BS
13	8:42	8651056	8547K	4610		1922	321.7		18.3	ER
14	8:47	2284604	8289K	4610		1917	325.5		15.3	RG
15	8:19	2225588	8895K	5320		1924	327.1		16.4	BS ER
16	9:18	4186525	8569K	4790		1930	324.7		15.8	RG
17	10:00	6724371	8037K	3980		1930	322.7		16.8 17.2	RG
18	12:07	8360165	8259K	3980		1921	321.2		17.6 19.0	TF ER
19	2:41	9784646	8259K	6930		1924	321.6		15.1	RG BS
20	7:48	1475659	8872K	5650		1926	320.5		16.2	BS RG
21	7:52	3094954	9007K	5680		1933	314.7		15.2	MO TF
22	7:53	5160392	8600K	5810		1934	314.8		15.2	BS
23	7:59	6878877	8518K	6270		1928	313.9		15.3	BS
24	9:30	9168172	8380K	4110		1926	311.3		16.5 19.0	BS
25	9:38	9494550	8430K	3580		1923	311.1		16.4 18.9	BS
26	8:02	2601149	8430K	6050		1929	310.5		14.9	TF
27	8:05	5360341	9043K	4990		1920	309.0		12.3	AA/BS
28	8:12	7194876	8380K	5480		1933	310.1		14.2	AA
29	7:35	7798338	6143	4760		0	615.7		16.1	MC
30	7:24	7798338	6106K	5439		0	625.8		14.5	MC
31	8:20	9604444	5855K	3725				321.2	17.2 18.7	

13.4

OAK Strt **Welll Report** **Midvale City**

Month July Year 2019

Date	Time	Meter Reading	Pump Level	Static Level	Oil 6-8DPM	PSI	GPM	Remarks	By
1	8:19	2035650	264		✓	95.0	822.38	1620RPM	BS/RG
2	8:15	2036690	262		✓	95.5	794.44	1605RPM	RG/BS
3	8:14	2037668	264		✓	95.4	822.41	1620RPM	RG/AA
4	9:04	2039637	261		✓	95.6	717.41	1566 RPM	RG/AA
5	↓	↓	↓		↓	↓	↓	↓	↓
6	10:20	2040678	261		✓	95.4	643.1	1542	BB
7	1040	2041717	264		✓	95.5	610	1522	BB
8		POWER OUT				95		1620	B
9	8:26	2042532	263		✓	95.5	813	1620	ER/BS
10	8:15	2043600	269		✓	95.5	818.74	1620	RG/AA
11	8:33	2044635	263		✓	95.5	821.74	1620 RPM	BS/ER
12	8:32	2045658	263		✓	94.8	818.86	1620 RPM	BS/ER
13	9:55	2046794	262		✓	95.5	695.10	1566 RPM	Lalo
14	8:46	2047730	262		✓	95.5	762.47	1602 RPM	Lalo
15	8:21	2048740	264		✓	94.2	828.89	1620 RPM	BS/RG
16	8:12	2049827	263		✓	95.2	812.74	1620 RPM	RG/BS
17	8:35	2050888	263		✓	94.4	829.19	1620 RPM	AA/LALO
18	8:25	2052080	263		✓	95.5	838.63	1620	TF/BS
19	9:37	2053345	269		✓	94.8	817.36	1620	RG
20	5:38	2054511	260		✓	95.5	714.35	1431	TF
21	9:15	2055196	266		✓	95.5	670.17	1521	TF
22	8:24	2056021	263		✓	95.6	790.58	1605 RPM	BS/ER
23	8:20	2057020	264		✓	95.5	831.71	1620	TF/AA
24	8:31	2058083	265		✓	95.5	815.06	1620	MC
25	8:21	2059040	263		✓	95.3	817.52	1620	RG/AA
26	8:24	2060095	264		✓	93.8	835.48	1620 RPM	BS/ER
27	9 11	2061114	260		✓	95.5	656.86	1557	MC
28	8:31	2062067	262		✓	95.5	803.64	1614	MC
29	8:30	2063073	264		✓	94.7	818.56	1620RPM	BS/RG
30	8:20	2064139	266		✓	95.5	781.66	1614	TF
31	8:25	2065133	263		✓	94.9	818.70	1620	AA/LALO

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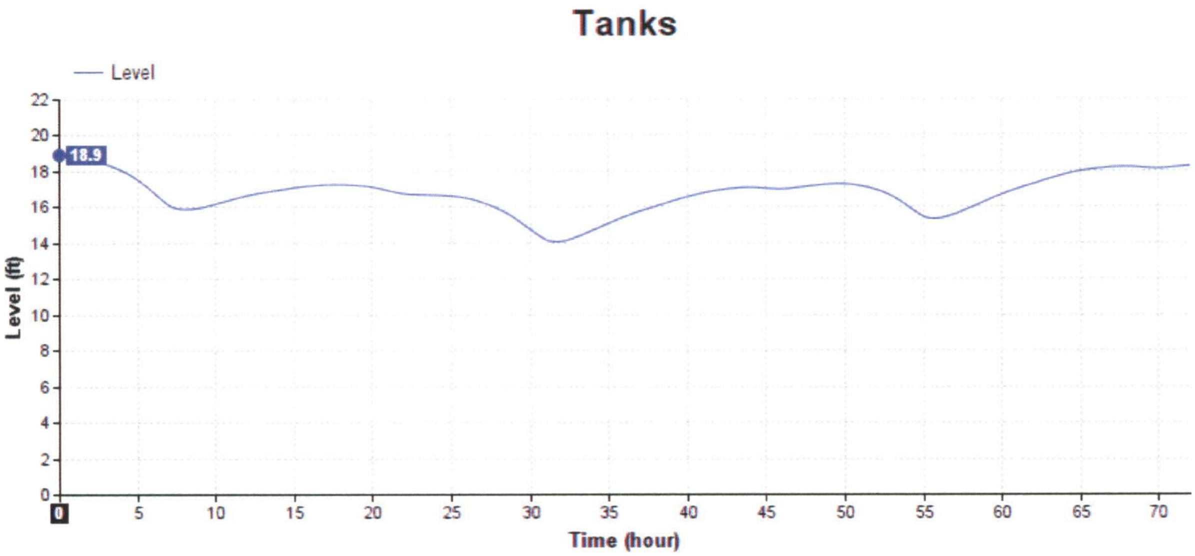
Oak Strt Welll Report Midvale City

Month August Year 2019

Date	Time	Meter Reading	Pump Level	Static Level	Oil 6-8DPM	PSI	GPM	Remarks	By
1	9:17	2066171	263		✓	95.6	662.77	1545	RG
2	8:13	2067087	264		✓	97.5	822.75	1620	RG
3	9:10	2066812	263		✓	95.5	724.66	1614	CH
4	8:11	2069011	263		✓	9.54	711.54	1576	CH
5	8:55	2070047	263		✓	95.5	772.79	1596	TF/Lad
6	8:20	2071018	264		✓	95.5	721.45	1581	ER/TF
7	8:42	2071932	265		✓	95.6	717.85	1581 RPm	BS/RG
8	8:07	2072873	262		✓	95.5	736.62	1581	RG/LR
9	8:46	2073764	262		✓	95.5	663.72	1557	ER
10	7:45	2074595	265		✓	95.5	670.75	1566	JW
11	10:30	2075692	263		✓	95.4	809.2	1608	JW
12	8:32	2076750	262		✓	94.4	820.89	1620 RPm	BS
13	8:28	2077774	263		✓	95.5	658.54	1551 RPm	BS
14	8:30	2078703	262		✓	95.6	741.90	1605 RPm	BS/ER
15	8:04	2079619	262		✓	95.5	691.48	1566	RG
16	9:00	2080570	263		✓	95.5	738.47	1587	ER/BS
17	9:46	2081508	260		✓	95.5	596.00	1527	RG
18	11:54	2082503	259		✓	95.5	495.08	1500	RG
19	7:25	2083264	262.		✓	95.5	824.50	1620	TF LR
20	7:30	2084247	262		✓	95.2	811.16	1620	RG/BS
21	7:37	2085151	263		✓	94.6	818.11	1620 RPm	BS/RG
22	7:35	208618	266		✓	95.5	816.08	1620	MP/TF
23	7:39	2087043	262		✓	94.5	818.87	1620 RPm	BS
24	9:15	2088110	261		✓	95.6	587.76	1530 RPm	BS
25	9:18	2089032	262		✓	95.5	649.56	1548 RPm	BS
26	7:42	2089880	263		✓	94.0	822.95	1620 RPm	BS
27	7:45	2090871	264		✓	95.5	743.99	1587	TF
28	7:51	2091782	263		✓	94.2	831.56	1620 RPm	BS/AA
29	7:57	2092711	262		✓	95.6	589.85	1533 RPm	AA
30	9:26	~~262~~ 2093584	264		✓	95.5	642.00	1554	MC
31	8:05	2094315	260		✓	95.5	526.48	1509 RPM	MC

Existing Model Output



APPENDIX D
Unit Costs

AVERAGE WATER PIPE COST PER FOOT

Diameter (in)	Diameter (ft)	Outside Diameter (ft)	Pipe Material & Installation (1)	Excavation	Imported Bedding Installed	Hauling Excess Native Mat'l	Trench Backfill Installed (3)	Trench Box per Day (2)	Average Daily Output	Trench Box Cost	Top Trench Width (ft)	Road Repair Width (ft)	Asphalt Cost	Service Lateral Cost	Fire Hydrant Cost	Valves & Fittings Cost	Pipeline Connection Costs	Conflicts (9)	Trench Dewatering (4)	Total Cost per Foot of Pipe	Adjusted Cost per foot	Cost Out of Street (3)	Diameter (in)
4	0.3	0.39	26.00	2.84	9.61	1.20	3.83	210.00	400	0.53	2.99	6.99	28.94	18.11	2.37	0.34	1.20	0.00	8.48	103	90	77	4
6	0.5	0.58	30.50	3.17	11.19	1.43	4.11	210.00	333	0.63	3.18	7.18	29.59	18.11	2.37	0.46	1.36	0.00	9.51	112	98	86	6
8	0.7	0.78	48.00	3.52	12.81	1.68	4.40	210.00	200	1.05	3.38	7.38	30.25	18.11	2.37	0.72	1.53	0.00	12.27	137	119	109	8
10	0.8	0.97	61.50	3.88	14.45	1.95	4.69	210.00	182	1.15	3.57	7.57	30.91	18.11	2.37	1.13	2.23	0.00	13.31	156	136	128	10
12	1.0	1.17	67.00	4.26	16.14	2.24	4.98	210.00	160	1.31	3.77	7.77	31.57	18.11	2.37	0.73	2.94	0.00	14.63	166	145	138	12
14	1.2	1.36	71.00	4.65	17.86	2.55	5.27	210.00	133	1.58	3.96	7.96	32.23	18.11	2.37	1.27	3.22	0.00	16.52	177	154	148	14
16	1.3	1.56	77.00	5.07	19.61	2.88	5.56	210.00	114	1.84	4.16	8.16	32.89	18.11	2.37	1.63	3.52	9.44	18.42	198	173	159	16
18	1.5	1.75	86.50	5.50	21.40	3.23	5.84	210.00	100	2.10	4.35	8.35	33.55	18.11	2.37	2.04	3.80	10.24	20.32	215	187	175	18
20	1.7	1.94	93.00	5.95	23.23	3.60	6.13	210.00	89	2.36	4.54	8.54	34.21	18.11	2.37	2.65	4.10	10.90	22.21	229	200	188	20
24	2.0	2.33	112.00	6.89	26.99	4.41	6.71	210.00	77	2.73	4.93	8.93	35.52	18.11	2.37	4.10	4.68	12.48	25.14	262	229	218	24
30	2.5	2.92	139.50	8.44	32.90	5.76	7.57	210.00	70	3.00	5.52	9.52	37.50	18.11	2.37	5.99	5.54	14.73	27.99	309	270	262	30
36	3.0	3.50	167.00	10.14	39.12	7.29	8.44	210.00	65	3.23	6.10	10.10	39.48	18.11	2.37	8.93	6.40	17.06	30.62	358	312	307	36

Reference: 2018 RS Means Heavy Construction Cost Data   Updated by: JKN

Costs:

$ 20.85	/CY Native Trench backfill - sec. 31 23 23.16 (0200): Fill by borrow [sand, dead or bank x 1.21 O&P] w/o materials (27.94-18.6) and convert from loose to compacted volume. $11.20/LCY * 1.39 LCY/ECY (see Note 5)
$ 59.08	/CY Imported Select Fill - sec. 31 23 23.16 (0200), 31 23 23.20 (4266), 31 23 23.23 (8050): Sand, dead or bank w/ hauling and compaction. ($33.50/LCY + $5.10/LCY)*1.39 LCY/ECY + $5.50/ECY (see Note 5)
$ 6.10	/CY Excavation - sec. 31 23 16.13 (6372): 10-14 ft deep, 1 CY excavator, Trench Box.
$ 30.49	/SY 4" Asphalt Pavement - sec. 32 11 23.23 (0390), 31 23 23.20 (4268), 32 12 16.13 (0120), 32 12 16.13 (0380): 9" Bank Run GravelBase Course ($7.10/SY), 2" Binder ($9.30/SY), 2" Wear ($10.40/SY [4"=$19.80/SY]) and Hauling [Item 4268] ($7.35/LCY * 1.39LCY/ECY * 0.361CY/SY) (see Note 5)
$ 2.63	/LF 4" Asphalt cutting - sec. 02 41 19.25 (0015, 0020): Saw cutting asphalt up to 3" deep ($1.68/LF), each additional inch of depth ($0.95/LF)
$ 1,811.32	/EA Service Lateral Connection (see Note 7)
$ 4,734.51	/EA Fire hydrant assembly including excavation and backfill (see Note 8)
$ 7.16	/CY Hauling - sec. 31 23 23.20 (4262): 20 CY dump truck, 6 mile round trip and conversion from loose to compacted volume. $4.13/LCY * 1.39 LCY/ECY (see Note 5)
$ 210.00	/day Trench Box - sec. 31 52 16.10 (4500): 7' deep, 16' x 8'
$ 63.32	/CY Stabilization Gravel - sec. 31 23 23.16 (0050), 31 23 23.20 (4266), 31 23 23.23 (8050): Bank Run Gravel ($36.50/LCY * 1.39 LCY/ECY) plus compaction ($5.50/ECY) and hauling ($5.10/LCY * 1.39 LCY/ECY) (see Note 5)
$ 1,152.00	/day Dewatering - sec. 31 23 19.20 (1000, 1020): 4" diaphram pump, 8 hrs attended ($1,025/day). Second pump ($127/day)

NOTES:

(1) Assumes: class 50, 18' lengths, tyton push-on joint for DIP (33 11 13.15 3000-3180); Pressure Pipe class 150, SDR 18, AWWA C900 for PVC <14" & AWWA C905, PR 100, DR 25 for 14" and larger (33 11 13.25 4520-4550 3030-3200); butt fusion joints SDR 21, 40' lengths for HDPE ().
DIP and HDPE costs only go up to 24". PVC costs only go up to 48". All costs for pipe larger than 48" are Prestressed Concrete pipe (PCCP), 150 psi, 24' length (Pg 315).

(2) 7' deep trench box (16' x 8') - on page 263

(3) Backfill Material & Installation assumes in street. For out of street unit costs, the backfill material cost has been added in place of base course and asphalt.

(4) Dewatering assumes 1' stabilization gravel at the bottom of the trench plus dewatering pumps

(5) Conversion from loose to compacted volumes assumes 125 PCF for compacted density and 90 PCF for loose density. Or (125 PCF/ECY)/(90 PCF/LCY) = 1.39 LCY/ECY

(6) Conversion from cubic yards to square yards for hauling of asphalt paving assumed a total thickness of 13". 3 ft x 3 ft x (13 in)/(12 in/ft) = 0.361 CY/SY

(7) Service Lateral costs are based on Beaver Dam short and long service connections average ($1,660.98/connection), with 45.40 for curb replacement, 40.20 for sidewalk replacement, and 158.19 for additional asphalt all added to the short service connection. Used historical cost index to update to current dollars.

(8) Fire Hydrant assembly costs are based on Beaver Dam Water Projects plus 45.40 for curb replacement and 158.19 for additional asphalt ($4341.55 per FH). Used historical cost index to update to current dollars.

(9) Conflicts amounted to be 2% of the cost on the Springville 400 South Pipeline project. Use 5% of total cost per ft.

(10) Joint Restraint has NOT been included in this spreadsheet.

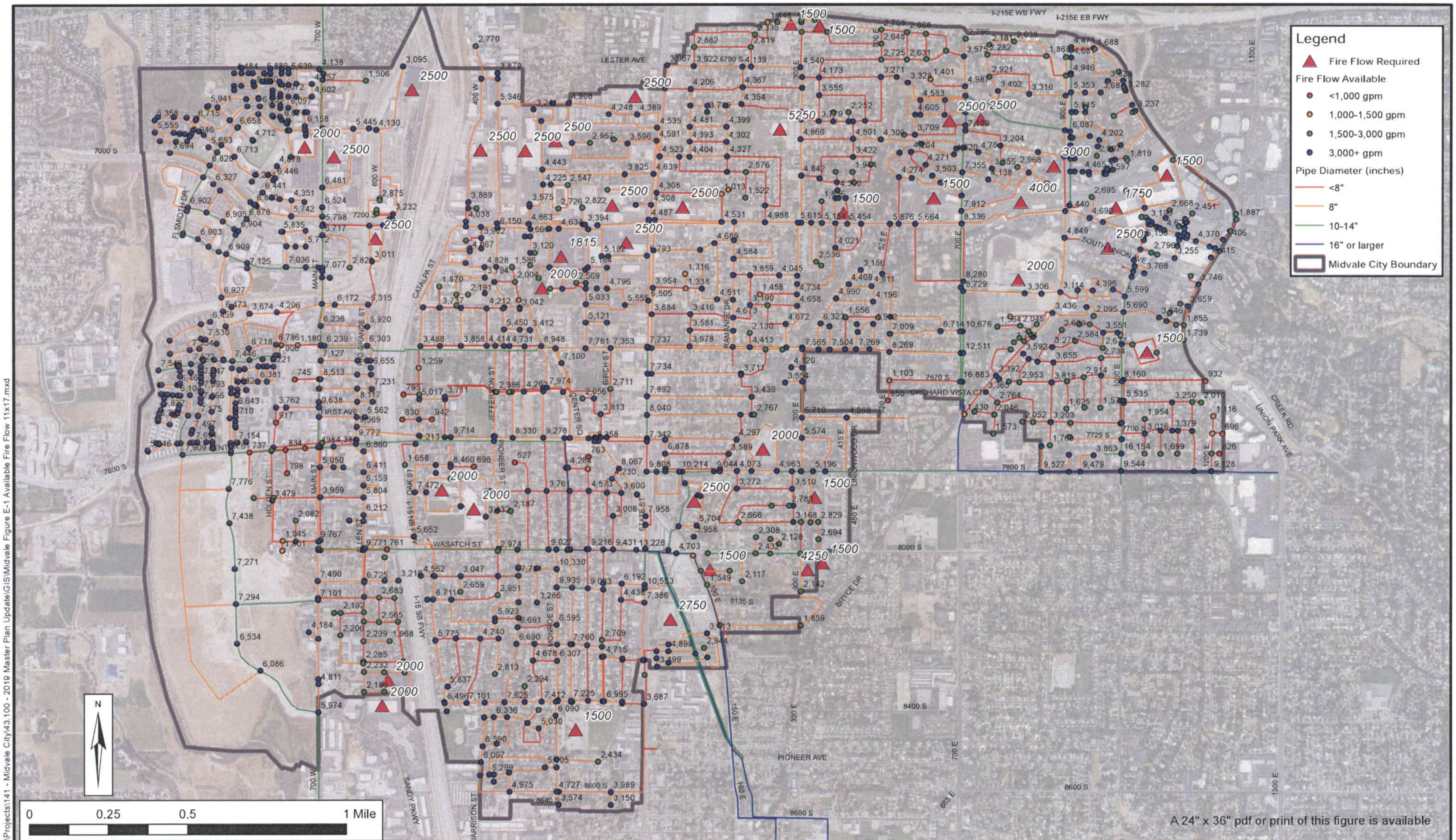
Abbreviations:

VLF	vertical lineal foot
PCF	pounds per cubic foot
LCY	loose cubic yard
ECY	embankment cubic yard

Utah City Cost Indices

SLC	88.5
Ogden	85.8
Logan	87
Price	85
Provo	87.2

APPENDIX E
Available Fire Flow
(Existing System)



HANSEN ALLEN & LUCE inc ENGINEERS

MIDVALE CITY DRINKING WATER SYSTEM

EXISTING SYSTEM
AVAILABLE FIRE FLOW

FIGURE
E-1

Date: 5/5/2020
Document Path: H:\Projects\141 - Midvale City\43.100 - 2019 Master Plan Update\GIS\Midvale Figure E-1 Available Fire Flow 11x17.mxd

APPENDIX F
InfoWater Hydraulic Models
(Compact disc)

APPENDIX G
Checklist for Hydraulic Model Design Elements Report

CHECKLIST FOR HYDRAULIC MODEL DESIGN ELEMENTS REPORT

The hydraulic model checklist below identifies the components included in the Hydraulic Model Design Elements Report for

Midvale City Drinking Water Master Plan
(Project Name or Description)

1093
(Water System Number)

Midvale City Public Water System
(Water System Name)

April 24, 2020
(Date)

The checkmarks and/or P.E. initials after each item indicate the conditions supporting P.E. Certification of this Report.

1. The Report contains:

(a) A listing of sources including: the source name, the source type (i.e., well, spring, reservoir, stream etc.) for both existing sources and additional sources identified as needed for system expansion, the minimum reliable flow of the source in gallons per minute, the status of the water right and the flow capacity of the water right. *[R309-110-4 "Master Plan" definition]* ☒ KJ

(b) A listing of storage facilities including: the storage tank name, the type of material (i.e., steel, concrete etc.), the diameter, the total volume in gallons, and the elevation of the overflow, the lowest level (elevation) of the equalization volume, the fire suppression volume, and the emergency volume or the outlet. *[R309-110-4 "Master Plan" definition]* ☒ KJ

(c) A listing of pump stations including: the pump station name and the pumping capacity in gallons per minute. Under this requirement one does not need to list well pump stations as they are provided in requirement (a) above. *[R309-110-4 "Master Plan" definition]* ☒ KJ

(d) A listing of the various pipeline sizes within the distribution system with their associated pipe materials and, if readily available, the approximate length of pipe in each size and material category. A schematic of the distribution piping showing node points, elevations, length and size of lines, pressure zones, demands, and coefficients used for the hydraulic analysis required by (h) below will suffice. *[R309-110-4 "Master Plan" definition]* ☒ KJ

(e) A listing by customer type (i.e., single family residence, 40 unit condominium complex, elementary school, junior high school, high school, hospital, post office, industry, commercial etc.) along with an assessment of their associated number of ERCs. *[R309-110-4 "Master Plan" definition]* ☒ KJ

(f) The number of connections along with their associated ERC value that the public drinking water system is committed to serve, but has not yet physically connected to the infrastructure. *[R309-110-4 "Master Plan" definition]* ☒ KJ

(g) A description of the nature and extent of the area currently served by the water system and a plan of action to control addition of new service connections or expansion of the public drinking water system to serve new development(s). The plan shall include current number of service connections and water usage as well as land use projections and forecasts of future water usage. *[R309-110-4 "Master Plan" definition]* ☒ KJ

(h) A hydraulic analysis of the existing distribution system along with any proposed distribution system expansion identified in (g) above. *[R309-110-4 "Master Plan" definition]* ☒ KJ

(i) A description of potential alternatives to manage system growth, including interconnections with other existing public drinking water systems, developer responsibilities and requirements, water rights issues, source and storage capacity issues and distribution issues. *[R309-110-4 "Master Plan" definition]* ☒ KJ

2. At least 80% of the total pipe lengths in the distribution system affected by the proposed project are included in the model. *[R309-511-5(1)]* ☒ KJ

3. 100% of the flow in the distribution system affected by the proposed project is included in the model. If customer usage in the system is metered, water demand allocations in the model account for at least 80% of the flow delivered by the distribution system affected by the proposed project. *[R309-511-5(2)]* ☒ KJ

4. All 8-inch diameter and larger pipes are included in the model. Pipes smaller than 8-inch diameter are also included if they connect pressure zones, storage facilities, major demand areas, pumps, and control valves, or if they are known or expected to be significant conveyers of water such as fire suppression demand. *[R309-511-5(3)]* ☒ KJ

5. All pipes serving areas at higher elevations, dead ends, remote areas of a distribution system, and areas with known under-sized pipelines are included in the model. *[R309-511-5(4)]* ☒ KJ

6. All storage facilities and accompanying controls or settings applied to govern the open/closed status of the facility for standard operations are included in the model. *[R309-511-5(5)]* ☒ KJ

7. Any applicable pump stations, drivers (constant or variable speed), and accompanying controls and settings applied to govern their on/off/speed status for various operating conditions and drivers are included in the model. *[R309-511-5(6)]* ☒ KJ

8. Any control valves or other system features that could significantly affect the flow of water through the distribution system (i.e. interconnections with other systems, pressure reducing valves between pressure zones) for various operating conditions are included in the model. *[R309-511-5(7)]* ☒ KJ

9. Imposed peak day and peak instantaneous demands to the water system's facilities are included in the model. The Hydraulic Model Design Elements Report explains which of the Rule-recognized standards for peak day and peak instantaneous demands are implemented in the model (i.e., (i) peak day and peak instantaneous demand values per *R309-510, Minimum Sizing Requirements*, (ii) reduced peak day and peak instantaneous demand values approved by the Director per *R309-510-5, Reduction of Sizing Requirements*, or (iii) peak day and peak instantaneous demand values expected by the water system in excess of the values in *R309-510, Minimum Sizing Requirements*). The Hydraulic Model Design Elements Report explains the multiple model simulations to account for the varying water demand conditions, or it clearly explains why such simulations are not included in the model. The Hydraulic Model Design Elements Report explains the extended period simulations in the model needed to evaluate changes in operating conditions over time, or it clearly explains (e.g., in the context of the water system, the extent of anticipated fire event, or the nature of the new expansion) why such simulations are not included in the model. *[R309-511-5(8) & R309-511-6(1)(b)]* ☒ KJ

10. The hydraulic model incorporates the appropriate demand requirements as specified in *R309-510, Minimum Sizing Requirements*, and *R309-511, Hydraulic Modeling Requirements*, in the evaluation of various operating conditions of the public drinking water system. The Report includes:
    - the methodology used for calculating demand and allocating it to the model;
    - a summary of pipe length by diameter;
    - a hydraulic schematic of the distribution piping showing pressure zones, general pipe connectivity between facilities and pressure zones, storage, elevation, and sources; and
    - a list or ranges of values of friction coefficient used in the hydraulic model according to pipe material and condition in the system. In accordance with

Rule stipulation, all coefficients of friction used in the hydraulic analysis are consistent with standard practices.
[R309-511-7(4)] ☒ KJ

11. The Hydraulic Model Design Elements Report documents the calibration methodology used for the hydraulic model and quantitative summary of the calibration results (i.e., comparison tables or graphs). The hydraulic model is sufficiently accurate to represent conditions likely to be experienced in the water delivery system. The model is calibrated to adequately represent the actual field conditions using field measurements and observations. *[R309-511-4(2)(b), R309-511-5(9), R309-511-6(1)(e) & R309-511-7(7)]* ☒ KJ

12. The Hydraulic Model Design Elements Report includes a statement regarding whether fire hydrants exist within the system. Where fire hydrants are connected to the distribution system, the model incorporates required fire suppression flow standards. The statement that appears in the Report also identifies the local fire authority's name, address, and contact information, as well as the standards for fire flow and duration explicitly adopted from *R309-510-9(4), Fireflow*, or alternatively established by the local fire suppression agency, pursuant to *R309-510-9(4), Fireflow.* The Hydraulic Model Design Elements Report explains if a steady-state model was deemed sufficient for residential fire suppression demand, or acknowledges that significant fire suppression demand warrants extended model simulations and explains the run time used in the simulations for the period of the anticipated fire event. *[R309-511-5(10) & R309-511-7(5)]* ☒ KJ

13. If the public drinking water system provides water for outdoor use, the Report describes the criteria used to estimate this demand. If the irrigation demand map in *R309-510-7(3), Irrigation Use,* is not used, the report provides justification for the alternative demands used in the model. If the irrigation demands are based on the map in *R309-510-7(3), Irrigation Use,* the Report identifies the irrigation zone number, a statement and/or map of how the irrigated acreage is spatially distributed, and the total estimated irrigated acreage. The indicated irrigation demands are used in the model simulations in accordance with Rule stipulation. The model accounts for outdoor water use, such as irrigation, if the drinking water system supplies water for outdoor use. *[R309-511-5(11) & R309-511-7(1)]* ☒ KJ

14. The Report states the total number of connections served by the water system including existing connections and anticipated new connections served by the water system after completion of the construction of the project. *[R309-511-7(2)]* ☒ KJ

15. The Report states the total number of equivalent residential connections (ERC) including both existing connections as well as anticipated new connections associated with the project. In accordance with Rule stipulation, the number of ERC's includes high as well as low volume water users. In accordance with Rule

stipulation, the determination of the equivalent residential connections is based on flow requirements using the anticipated demand as outlined in *R309-510, Minimum Sizing Requirements*, or is based on alternative sources of information that are deemed acceptable by the Director. *[R309-511-7(3)]* ☒ KJ

16. The Report identifies the locations of the lowest pressures within the distribution system, and areas identified by the hydraulic model as not meeting each scenario of the minimum pressure requirements in *R309-105-9, Minimum Water Pressure*. *[R309-511-7(6)]* ☒ KJ

17. The Hydraulic Model Design Elements Report identifies the hydraulic modeling method, and if computer software was used, the Report identifies the software name and version used. *[R309-511-6(1)(f)]* ☒ KJ

18. For community water system models, the community water system management has been provided with a copy of input and output data for the hydraulic model with the simulation that shows the worst case results in terms of water system pressure and flow. *[R309-511-6(2)(c)]* ☒ KJ

19. The hydraulic model predicts that new construction will not result in any service connection within the new expansion area not meeting the minimum distribution system pressures as specified in *R309-105-9, Minimum Water Pressure. [R309-511-6(1)(c)]* ☒ KJ

20. The hydraulic model predicts that new construction will not decrease the pressures within the existing water system such that the minimum pressures as specified in *R309-105-9, Minimum Water Pressure* are not met. *[R309-511-6(1)(d)]* ☒ KJ

21. The velocities in the model are not excessive and are within industry standards. ☒ KJ