DRINKING WATER MASTER PLAN AND CAPITAL FACILITY PLAN

(HAL Project No.: 260.49.100)

August 2020

HANSEN ALLEN & LUCE INC
ENGINEERS

SPRINGVILLE CITY

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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]
CIP	Capital Improvement Plan
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]
IFA	Impact Fee Analysis
IFC	International Fire Code
IFFP	Impact Fee Facilities Plan
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]

CHAPTER 1 INTRODUCTION

PURPOSE AND SCOPE

The purpose of this master plan is to provide direction to the City of Springville 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 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 Springville, as well as all areas serviced outside City limits, including Kelly's Grove and Grindstone subdivision, and all customers along the Left Fork Hobble Creek Canyon Road between Rotary Park and Bartholomew Tank.

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.

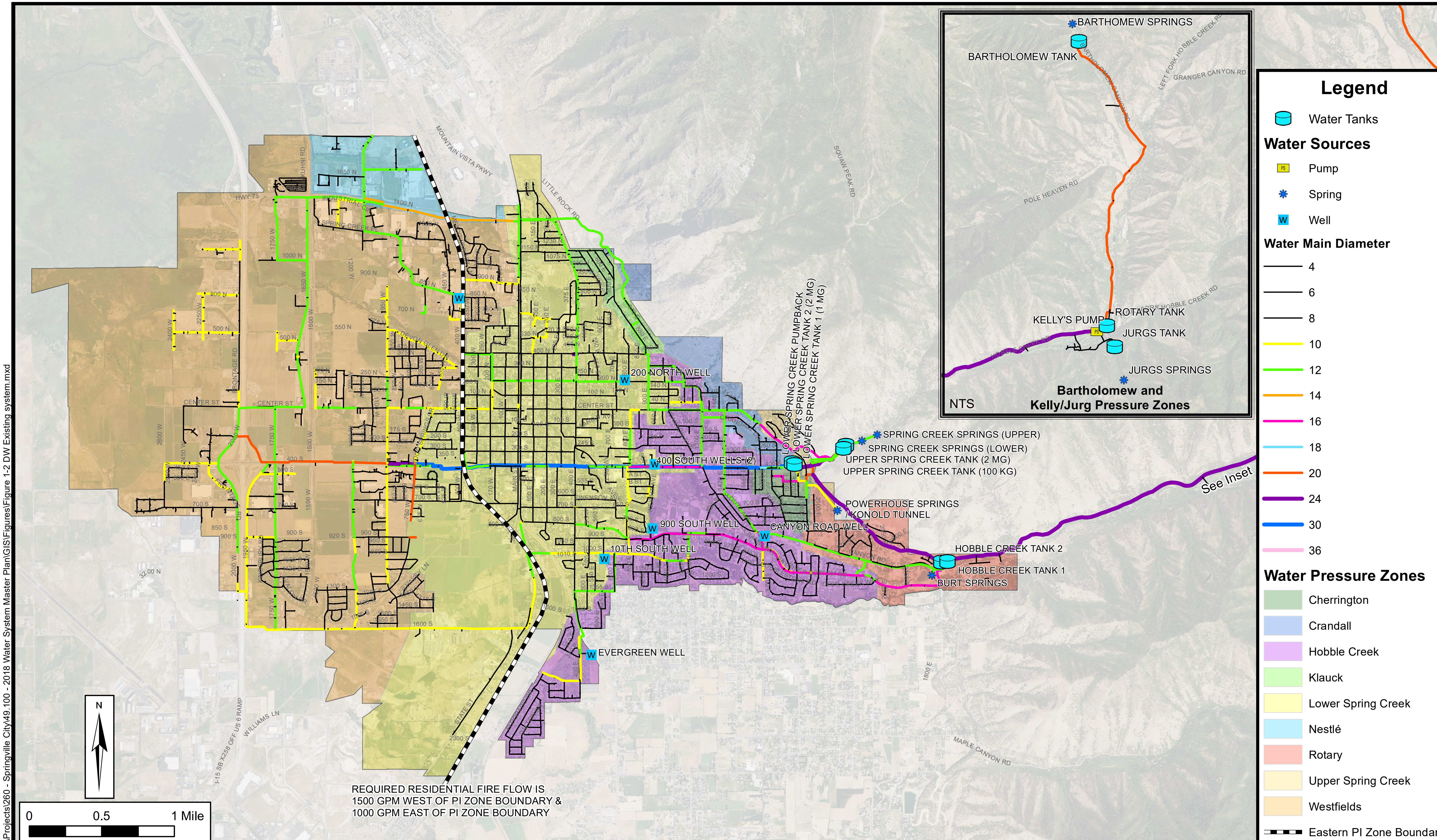
The results of the study are limited by the accuracy of growth projections, data provided by the City, and other assumptions used in preparing the study. It is expected that the City will review and update this master plan every 5–10 years as new information about development, system performance, or water use becomes available. This master plan updates the previous plan completed by the City of Springville and adopted in May 2014.

BACKGROUND

Springville was originally settled in 1850 and had an estimated population of 33,294 in July 2017 (United States Census Bureau, 2017). It is located in central Utah County and has an area of 14.4 square miles. As a result of its location along the I-15 corridor and in the rapidly growing Provo-Orem metropolitan area, Springville is experiencing rapid growth and is expected to grow into the future. See population estimates in Figure 1-1. Data for this figure is shown in Appendix A as Table A-1. In late 2018, the City provided water service to approximately 10,930 units via approximately 8,850 connections.

The City's existing drinking water system includes six wells, seven springs, nine tanks, two pump stations, eleven pressure zones, and about 190 miles of pipe with diameters of 4 to 60 in. Existing facilities are shown on Figure 1-2, Existing Drinking Water System. The City recognizes that its continued growth necessitates proactively planning additional drinking water facilities to maintain the current level of service for indoor water use.

The City also maintains a pressurized irrigation (PI) water system for outdoor use in the newer, western portion of the City, approximately west of 400 West. The eastern boundary of the area served by the PI system is shown on Figure 1-2. The drinking water system meets both indoor and outdoor demands in the portions of the system east of 400 West, and for some customers physically located in the PI system area that have not connected to the PI system yet. The pressurized irrigation water system is addressed in a separate master plan. The findings and conclusions in this master plan are dependent on the PI system being constructed per its separate master plan.



Date: 9/27/2019
Document Path: H:\Projects\260 - Springville City\49.100 - 2018 Water System Master Plan\GIS\Figures\Figure 1-2 DW Existing system.mxd

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SPRINGVILLE CITY	EXISTING DRINKING WATER SYSTEM	FIGURE 1-2

In 2014, the City prepared a Capital Facilities Plan, Impact Fee Facilities Plan (IFFP), and Impact Fee Analysis (IFA) for its drinking and pressurized irrigation water systems. This master plan will provide the bases for updating those studies and providing a basic full system layout design to guide new development.

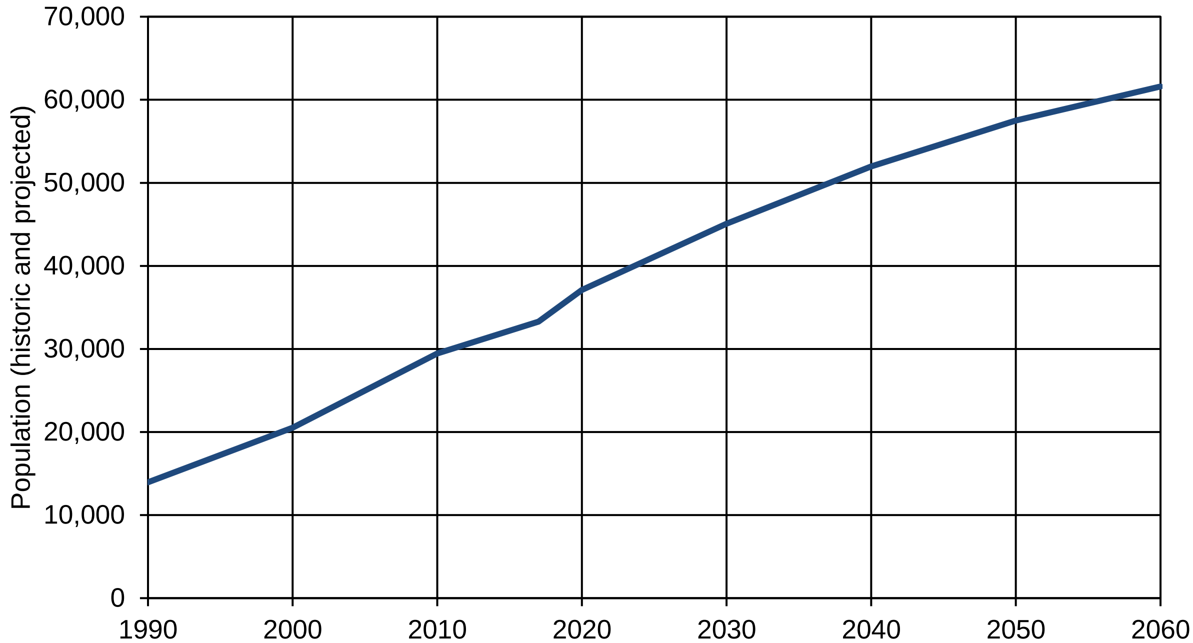


Figure 1-1: Springville Historic and Projected Population
(U.S. Census Bureau 1990, 2000; 2010; GOMB 2017)

MASTER PLANNING METHODOLOGY

Drinking water systems consist of water sources, storage facilities, distribution pipes, pump stations, valves, and other components. Design and operation of the individual components must be coordinated so that they operate efficiently under a range of demands and conditions. The system must be capable of responding to daily and seasonal variations in demand while simultaneously providing sufficient capacity for firefighting and other emergency situations.

Identifying present and future water system needs is essential in the management and planning of a water system. For this study, existing water demands were calculated from billed water use and from production data. The City used this information to determine a responsible level of service for its customers. Future water demands were predicted using this level of service, current zoning and densities 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 Springville’s drinking water system.

Computer models of the City's drinking water system were prepared to simulate the performance of facilities under existing and future conditions. System improvement recommendations were prepared from the analysis and are presented in this report.

LEVEL OF SERVICE (LOS)

HAL analyzed production and billing data provided by Springville 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	Indoor Level of Service (ERC)	Outdoor Level of Service (irr-ac)
Average Yearly Demand	0.3 ac-ft/ERC	4.0 ac-ft/irr-ac
Peak Day Demand	260 gpd/ERC = 0.18 gpm/ERC	12,240 gpd/irr-ac = 8.5 gpm/irr-ac
Peak Instantaneous Demand	1.5 Peaking Factor = 0.27 gpm/ERC	1.5 Peaking Factor = 12.8 gpm/irr-ac
Storage	230 gal/ERC	6,120 gal/irr-ac

For purposes of this master plan, one indoor ERC is defined as 62,800 gallons of indoor water use per year, based on average residential winter usage in the city. One outdoor ERC is considered to be 0.15 irrigated acres for a single family lot ¼-acre or larger. More detailed information on level of service calculations for outdoor use is included in the City's 2018 pressurized irrigation (PI) system master plan. This master plan is based on the majority of customers in the PI system service zone using the PI system for outdoor watering.

DESIGN AND PERFORMANCE CRITERIA

Summaries of the key design criteria and demand requirements for the drinking water system are included in Table 1-2, with additional details in Table A-2 in Appendix A. 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	18,250	29,050
Source			
Peak Day Demand	Section R309-510-7/LOS	12,870 gpm	15,250 gpm
Average Yearly Demand	Section R309-510-7/LOS	9,890 ac-ft	13,350 ac-ft
Storage			
Equalization	Section R309-501-8/LOS	11.0 MG	13.8 MG
Emergency	City Preference	0.4 MG	2.0 MG
Fire Suppression	IFC/Fire Marshal	1.3 MG	2.3 MG
Total		12.7 MG	18.1 MG
Distribution			
Peak Instantaneous	1.5x Peak Day Demand	19,300 gpm	22,900 gpm
Minimum Peak Day Fire Flow	IFC/ Fire Marshal		
Residential (East of 400 W)[1]		1,000 gpm @ 20psi	1,000 gpm @ 20psi
Residential (West of 400 W)[1]		1,500 gpm @ 20psi	1,500 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 – The minimum fire flow requirement is 1,000 gpm east of 400 West/Highway 89/Highway 51, and 1,500 gpm west of this boundary. The boundary coincides with the eastern boundary of the PI service zone, as shown on Figure 1-2.

CHAPTER 2   SYSTEM GROWTH

EXISTING 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 analyzed the City’s water use data from September 2015 to August 2018 along with discussion with the City and determined that the existing system serves 18,250 ERCs for indoor usage. An extended-period hydraulic model was updated with current water use and pipe information to represent existing conditions. A breakdown of the existing ERCs by pressure zone is shown in Table 2-1.

Table 2-1: Existing ERCs by Pressure Zone

Zone	ERCs
Bartholomew	90
Kelly/Jurg	100
Rotary	320
Cherrington	220
Hobble Creek	2,900
Lower Spring Creek	5,770
Westfields	4,660
Upper Spring Creek	60
Crandall	180
Klauck	300
Nestlé	3,650
Total	**18,250**

These existing ERCs are shown by customer type in Table 2-2.

Table 2-2: Existing ERCs by Customer Type

Customer Type	ERCs
City Owned	300
Government/Church	370
Commercial	4040
Residential	10,140
Industrial (Nestlé)	3,400
Total	**18,250**

EXISTING IRRIGATED ACREAGE

The Springville City drinking water system provides water for outdoor irrigation in a portion of the system. The area of the City generally west of 400 West, Highway 51, and Highway 89, which is developing, is master-planned to be served by a separate pressurized irrigation (PI) system. The eastern boundary of the PI system is shown on Figure 1-2. A portion of Plat A near the City Center is served by a separate irrigation system fed by Hobble Creek. A small amount of irrigated acreage in the Nestlé pressure zone is served by a private irrigation system. The remainder of the irrigated acreage in the City (generally east of 400 West, Highway 51, and Highway 89) is served by the drinking water system. Areas served by the PI system and drinking water system are shown in Table 2-3 below.

A portion of the PI system has been constructed and is in use, and is addressed in a separate master plan. It will be expanded as development occurs. Some areas within the planned service area of the PI system are currently being served by the drinking water system because of a lack of available PI infrastructure. As the City develops, they will eventually be served by the PI system.

This master plan is based on all existing and future customers in the PI system service zone using the PI system for outdoor watering, with the exception of a few nominal areas where it is cost prohibitive to connect customers to the system. This will require many existing customers to make connections to the PI system. The City may explore opportunities to provide hardship funding to assist customers in making these connections. This could include the use of grants to reimburse the City. Homes along Camlan Drive and Avalon Drive will not be required to connect to the PI system for outdoor watering of their individual properties. This includes all lots in The Cottages at Camelot Village PD subdivision (lots 1-102 in Plats A-Y). The common areas and church adjacent to these homes will use the PI system for outdoor watering.

It is recommended that all future development within the PI service area should be required to install PI piping and service lines for all customers. It is recommended the PI piping in existing and future developments that cannot currently be supplied by the PI system should temporarily be supplied by the drinking water system to facilitate switching the system over to a PI source when the PI transmission infrastructure and supply become available.

Outdoor water demands are based on irrigated acreage (irr-ac). The existing irrigated acreage was determined based on water usage and a remote sensing approach. The dataset that was used for this approach was the National Agricultural Imagery Program (NAIP) which is available through the Utah Automated Geographic Reference Center (AGRC). This approach allows for the identification of areas of healthy vegetation growth. Demands and storage requirements were based on the level of service established by the City.

Table 2-3: Existing Irrigated Acreage

Zone	Total Irrigated Acreage	Irrigated Acreage Within Pressurized Irrigation System Boundary[2]		Irrigated Acreage Intended to be Served by Drinking Water System
		Served by PI System	Currently Served by Drinking Water System	
Bartholomew	8	-	-	8
Kelly/Jurg	11	-	-	11
Rotary	36	-	-	36
Cherrington	24	-	-	24
Hobble Creek	316	-	-	316
Lower Spring Creek	373	21	23	329
Westfields	283	117	125	41
Upper Spring Creek	6	-	-	6
Crandall	16	-	-	16
Klauck	22	-	-	22
Nestlé[1]	35	-	-	0
Total	**1,130**	**138**	**148**	**809**

1 – Acreage in Nestlé zone is currently served by a private irrigation system.
2 – The PI system boundary overlaps only with the Lower Spring Creek and Westfields pressure zones.

FUTURE CONNECTIONS

Future ERCs were calculated based on existing land use patterns, current zoning, and densities allowed by City code. Developed and undeveloped areas were evaluated using different methodologies, which are discussed below.

The City has committed to serve 1,500 ERCs that are not yet connected to the system. These ERCs have been accounted for in the future growth areas of this report.

The area of the City generally east of 400 West and S.R. 51, and north of Hobble Creek, has a relatively small amount of undeveloped land remaining. A substantial portion of existing development in this area is built at a lower density than is required by City zoning ordinances. Although a “build-out” condition is often interpreted to be the maximum development based on current zoning and densities, HAL and City personnel did not feel it was appropriate to assume that all existing areas would redevelop to maximum density. Instead, it was assumed that existing land uses would remain similar in the future, and that undeveloped parcels within this area would develop at a similar density to those around them (not to exceed what is allowed by City code). Areas above the Bonneville Shoreline Trail were assumed to remain undeveloped indefinitely.

The area west of 400 West and S.R. 51, and south of Hobble Creek, contains mostly newer development. Residential subdivisions within this area were observed to have been built to about 80% of the maximum density allowed by City code. Personnel in the City's planning department confirmed that most new developments are developed to about 80% of the maximum density allowed, and that they expect this pattern to occur into the future. Thus, for this area, all residential developments were assumed to develop at a density of about 80% of the maximum allowed by City code. The only exception to this was the R1-10 zoning type. Existing areas in the City zoned as R1-10 typically have about 2.8 units per acre, while the maximum density allowed is 3.0 units per acre, about 93% of the maximum allowed under zoning regulations.

City code does not specify a development density in units per acre for commercial and industrial uses. For all commercial and industrial areas of the City, HAL determined the existing development density in ERCs/acre. Future commercial and industrial areas were assumed to have a development density equal to (or slightly greater than) existing areas.

The above analysis of density resulted in the following development densities for future planning, shown in Table 2-4.

Table 2-4: Development Densities

Land Use	ERC Density Per Acre
Agriculture (Placeholder for Future Residential/Mixed Use)	10
Commercial	5
Commercial/Residential Option	5
Industrial Manufacturing	3
Low Density Residential	3
Medium Density Residential	10
Medium High Density Residential	15
Medium Low Density Residential	5
Medium Low Density Residential/Commercial	5
Mixed Use	5
Parks	2

The Nestlé USA campus was excluded from this analysis because of its very high water use. It was assumed that it is not representative of future industrial development in Springville.

In 2060 (the terminus of this master planning period), 29,050 ERCs are expected. This is an increase of 10,800 ERCs beyond the existing 18,250 ERCs. The estimate is based on current zoning and general plan/land use maps (shown in Appendix F), on plans for known future developments which HAL has reviewed, and on the development densities shown above. Springville is projected to reach build-out after 2060. Although actual 2060 conditions may be different if zoning and density change significantly, the basic system layout plan developed by this study will help guide the construction of a responsible system. A breakdown of the expected 2060 ERCs by pressure zone is shown in Table 2-5.

Table 2-5: 2060 ERCs

Zone	ERCs
Bartholomew	90
Kelly/Jurg	100
Rotary	435
Cherrington	220
Hobble Creek	3,090
Lower Spring Creek	7,990
Westfields	12,850
Upper Spring Creek	65
Crandall	200
Klauck	300
Nestlé	3,710
Total	**29,050**

The majority of the anticipated growth is associated with large undeveloped parcels on the western side of the City. They are zoned for a mix of single-family houses and high-density planned communities. From expected locations and densities of new development, HAL prepared an extended-period hydraulic model and engineering calculations to analyze 2060 conditions.

The City will continue to review individual developments through the Development Review Committee (DRC) process, including analyzing water source, storage, and transmission requirements for any usage that does not fit the typical requirements. Developments located in areas where the water system is not well connected should be analyzed individually to determine necessary pipe sizing in the development.

FUTURE IRRIGATED ACREAGE

Future irrigated acreage was calculated based on projected land uses and their associated proportion of irrigated acreage. Methods for computing future irrigated acreage are discussed in detail in the pressurized irrigation system master plan. Based on the level of service chosen, one outdoor ERC is considered to be equivalent to 0.15 irrigated acres for a single family lot ¼-acre or larger, resulting in the percentage irrigated by land use shown in Table 2-6.

Table 2-6: Percentage Irrigated

Land Use	Percent Irrigated
Agriculture (Future Residential/Mixed Use)	27
Commercial	13
Commercial/Residential Option	27
Industrial Manufacturing	10
Low Density Residential	42
Medium Density Residential	27
Medium High Density Residential	27
Medium Low Density Residential	35
Medium Low Density Residential/Commercial	27
Mixed Use	25
Parks	90

Estimated 2060 irrigated acreage is shown in Table 2-7.

Table 2-7: 2060 Irrigated Acreage

Zone	Total Irrigated Acreage	Irrigated Acreage Served by PI System	Irrigated Acreage Served by Drinking Water System
Bartholomew	8		8
Kelly/Jurg	11		11
Rotary	52		52
Cherrington	24		24
Hobble Creek	335		335
Lower Spring Creek	558	216	342
Westfields	773	732	41
Upper Spring Creek	6		6
Crandall	19		19
Klauck	22		22
Nestlé[1]	25		0
Total	**1,833**	**948**	**860**

1 – Acreage in Nestlé zone assumed to continue to be served by a private irrigation system, and acreage will reduce from 2018 due to development of undeveloped areas.

Only the irrigated acreage served by the drinking water system will be considered in this master plan. The irrigated acreage in the master-planned PI service area is addressed in a separate master plan. The findings and conclusions of this master plan are dependent on the PI system being constructed as shown in the PI master plan.

GROWTH PROJECTIONS

The development of impact fees requires growth projections over the next ten years. In addition to impact fee projects, this report will also highlight anticipated projects 10-20 years out in the "Capital Facilities Plan" section of this report. The master planning period covered in this report continues through 2060, when City population is projected to approach the current planning population of 61,600.

Growth rates were determined based on future population estimates by decade from the 2012 Baseline Projections - Utah Governor's Office of Management and Budget. The existing ERCs (other than for Nestlé) were projected at this rate, resulting in the projected ERCs shown in Table A-1 in Appendix A.

CHAPTER 3 WATER SOURCES

EXISTING WATER SOURCES

The Springville City drinking water system is supplied by seven drinking water wells and four springs, shown on Figure 1-2. For planning purposes, the City has requested that the analysis consider the lowest flows on record as the reliable supply to add an extra measure of safety and plan for future drought. Flow from the City's springs for the minimum month on record are included in Table 3-1. Well capacity has not been observed to significantly decrease during drought periods, so typical flows are shown from the wells.

Table 3-1: Existing Drinking Water Sources

Source	Zone	Average Flow, Lowest Month on Record [2003] (gpm)	Typical Flow (gpm)	Annual Source Capacity[1] (ac-ft)
Bartholomew Springs	Rotary	448	n/a	723
Jurg[2]	Jurg	n/a	n/a	n/a
Spring Canyon Springs	Upper Spring Creek	764	n/a	1232
Konold Springs	Lower Spring Creek	188	n/a	303
Burt Springs	Hobble Creek	766	n/a	1235
200 North Well	Lower Spring Creek	n/a	2,400	1,935
400 South Well #1	Lower Spring Creek	n/a	3,000	2,420
400 South Well #2[3]	Lower Spring Creek	n/a	4,000	3,225
900 South Well	Hobble Creek	n/a	3,000	2,419
1000 South Well	Hobble Creek	n/a	570	460
Canyon Road Well	Hobble Creek	n/a	1,500	1,210
Evergreen Well[4]	Hobble Creek	n/a	350	283
Total		**16,986 gpm**		**15,445 ac-ft**

1. Annual well capacity assumes about half of the year-round flow at the given flow rate which matches the current drinking water right diversion capacity. Actual volume may be limited by demand or hydrologic constraints.
2. Jurg Springs is located near the Grindstone subdivision and Jurg tank, but the source is discharged directly into Hobble Creek. Flows are not metered.
3. Development of the 400 South Well #2 is complete and the well will be introduced into the City system soon. The well is currently producing 4,000 gpm.
4. Evergreen Well is not currently used, but could be reintroduced into the system if needed.

A summary of the water rights owned by Springville is included in Chapter 6. Existing water right capacity for the drinking water system is approximately 18,600 acre feet. Thus, water rights available exceed water available in the case shown in Table 3-1.

PUMP STATIONS

Pump stations allow the City to supply water to zones that do not have their own sources and to supply zones from lower head zones. Springville has two pump stations whose service zones and pump capacity are summarized in Table 3-2.

Table 3-2: Springville City Pump Stations

Name	From	To	Total Capacity
Kelly's	Rotary Zone	Kelly Zone Jurg Tank	200 gpm
Spring Creek Pumpback	Lower Spring Creek Tank	Upper Spring Creek Tank	3,300 gpm
		Rotary Tank	

EXISTING WATER SOURCE 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 also be able to produce one year's supply of water, or the average yearly demand (volume requirement).

Because the pressurized irrigation system only provides water for a portion of the city's outdoor use, both indoor demand and outdoor demand are included in the drinking water system for areas outside the PI service boundary. Areas inside the PI service boundary are assumed to be served by the PI system, even if they are not physically connected to that system yet.

Outdoor demand for existing development is calculated using an outdoor ERC, based on a level of service of 0.15 irrigated acres per quarter-acre lot, with the percentage irrigated for other land uses shown in Table 2-5. Irrigated acreage in areas that could be serviced by the existing PI system are not included in these calculations. These connections can be considered to be borrowing capacity from the drinking water system. If they are not serviced by the PI system in approximately the next five to ten years, the drinking water system may experience deficiencies not addressed by this report.

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

The level of service selected is based on the upcoming DDW standard, requiring minimum source and storage sizing to be based on system-specific analysis of three years of usage data. Final DDW standards may vary slightly from these assumptions.

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, and based on actual peak usage for the Nestlé zone, the total peak day drinking water demand is 12,900 gpm (18.6 MGD). Table 3-3 summarizes the indoor and outdoor components of this demand.

Table 3-3: Existing Peak Day Demand

Indoor Connections (ERCs)	Peak Day Demand (gpm/ERC)	Indoor Peak Day Demand[1] (gpm)	Irrigated Acres	Outdoor ERCs	Peak Day Outdoor Demand (gpm/ irr-ac)	Peak Outdoor Demand[2] (gpm)	Total Peak Day Demand (gpm)
18,250	0.18	3,490	809	7,356	8.5	9,380	12,870

1 – Indoor peak day demand for the Nestlé facility (3400 ERCs) is based on flow records instead of the system Peak Day Demand rate per ERC. Indoor demand = (14,850 ERC * 0.18 gpm/ERC) + (814 gpm for Nestlé) = 3,487 gpm.
2 – Peak Outdoor Demand is based on Outdoor ERCs, the City level of service of 0.15 irrigated acres per ERC, and the Peak Day Outdoor Demand rate of 8.5 gpm per irrigated acre. 7,356 ERC * 0.15 irr-ac/ERC * 8.5 gpm/irr-ac = 9,379 gpm.

A breakdown of the existing peak day demand by pressure zone is shown in Table 3-4.

Table 3-4: Existing Source Requirements by Pressure Zone

Zone	ERCs	Demand (gpm)
Bartholomew	90	110
Kelly/Jurg	100	145
Rotary	320	475
Cherrington	220	320
Hobble Creek	2,900	4,185
Lower Spring Creek	5,770	4,850
Westfields	4,660	1,315
Upper Spring Creek	60	80
Crandall	180	220
Klauck	300	310
Nestlé[1]	3,650	860
Total	**18,250**	**12,870**
Total Supply Available (gpm)		**16,986**

1 – Indoor peak day demand for the Nestlé facility (3400 ERCs) is based on flow records (814 gpm) instead of the system Peak Day Demand rate per ERC.

Not all sources are available to all pressure zones in the City. A mass balance matching sources to pressure zones is included in Appendix A as Table A-3. The mass balance shows that the existing sources can supply the existing peak day demand for each zone, with approximately 4,118 gpm capacity remaining in the system if the 400 South #2 well currently being developed is included. The City desires a level of redundancy that will allow the system to have sufficient source even if any of the wells is out of service. Even with the largest (4,000 gpm) well out of service, there is sufficient source to supply the existing peak day demand.

Each pressure zone will experience different impacts if a source is out of service. Table A-4 in Appendix A shows which sources are available to each zone. This table can be used to evaluate the effect of the loss of each source.

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. As with peak day demand, areas inside the PI service boundary are assumed to be served by the PI system, even if they are not physically connected to that system yet.

Based on the requirements shown in Table 1-1, the total existing average yearly demand is 9,890 acre-feet. Table 3-5 summarizes the indoor and outdoor components of this demand.

Table 3-5: Existing Average Yearly Demand

Indoor Connections (ERCs)	Average Yearly Indoor Demand (ac-ft/ ERC)	Average Indoor Yearly Demand (ac-ft)	Irrigated Acres	Outdoor ERCs	Average Yearly Outdoor Demand (ac-ft/ irr-ac)	Average Yearly Outdoor Demand[1] (ac-ft)	Total Average Yearly Demand (ac-ft)
18,250	0.3	5,475	809	7,356	4.0	4,415	9,890

1 – Average Yearly Outdoor Demand is based on Outdoor ERCs, the City level of service of 0.15 irrigated acres per ERC, and the Average Yearly Outdoor Demand rate of 4.0 acre-feet per irrigated acre. 7,356 ERC * 0.15 irr-ac/ERC * 4.0 ac-ft/irr-ac = 4,414 gpm

A breakdown of the existing average yearly demand by pressure zone is shown in Table 3-6.

Table 3-6: Existing Average Yearly Demand Requirements by Pressure Zone

Zone	ERCs	Demand (acre-feet)
Bartholomew	90	70
Kelly/Jurg	100	90
Rotary	320	290
Cherrington	220	195
Hobble Creek	2,900	2,600
Lower Spring Creek	5,770	3,525
Westfields	4,660	1,625
Upper Spring Creek	60	50
Crandall	180	140
Klauck	300	210
Nestlé	3,650	1,095
Total	**18,250**	**9,890**
Total Yearly Supply Available (ac-ft)		**15,445**

The current yearly supply available is sufficient to meet existing average yearly demand.

FUTURE WATER SOURCE REQUIREMENTS

Future water source requirements were evaluated based on the same criteria as discussed above for 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, based on 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 upcoming DDW standard, requiring minimum source and storage sizing to be based on system-specific analysis of three years of usage data. Final DDW standards may vary slightly from these assumptions.
6) For all future development scenarios, the pressurized irrigation system is assumed to provide all outdoor demand for any areas within the PI service boundary.
7) Outdoor demand for existing development is calculated using an outdoor ERC, based on a level of service of 0.15 irrigated acres per quarter-acre lot, with the percentage irrigated for other land uses shown in Table 2-5.

As discussed in Chapter 2 of this report, this master plan covers the planning period through 2060, when the City is projected to reach 29,050 ERCs and approximately 61,600 population. The majority of this growth will occur in the Lower Spring Creek and Westfields pressure zones, with relatively little growth occurring in the areas east of 400 West. The majority of future development is located within the PI service zone boundary, resulting in very little increase in the outdoor irrigated acreage served by the drinking water system.

As noted previously, customers located within the PI service zone boundary that are not being serviced by the PI system for outdoor watering are currently borrowing capacity from the drinking water system. As these customers make connections to the PI system, total usage in the drinking water system will reduce to the levels shown in this report.

The City will likely continue to expand beyond the projected 2060 level of development by annexing and developing land currently included in the City's annexation declaration boundary. The boundary is shown on Figure 4-1, Drinking Water Master Plan Map and Capital Facilities Map, located at the end of Chapter 4. Detailed analysis of development in the annexation areas is beyond the scope of this master plan, but these areas were considered conceptually as future requirements and recommendations were considered.

Future Peak Day Demand

Following the methodology described for existing conditions and estimating 29,050 ERCs in 2060, the peak day source requirement is projected to be 15,250 gpm (22.0 MGD). See Table 3-7.

Table 3-7: 2060 Peak Day Demand

Indoor Connections (ERCs)	Peak Day Demand (gpm/ERC)	Indoor Peak Day Demand[1] (gpm)	Irrigated Acres	Outdoor ERCs	Peak Day Outdoor Demand (gpm/ irr-ac)	Peak Outdoor Demand[2] (gpm)	Total Peak Day Demand (gpm)
29,050	0.18	5,430	860	7,698	8.5	9,820	15,250

1 – Indoor peak day demand for the Nestlé facility (3400 ERCs) is based on existing flow records instead of the system Peak Day Demand rate per ERC. Indoor demand = (25,650 ERC * 0.18 gpm/ERC) + (814 gpm for Nestlé) = 5,431 gpm.
2 – Peak Outdoor Demand is based on Outdoor ERCs, the City level of service of 0.15 irrigated acres per ERC, and the Peak Day Outdoor Demand rate of 8.5 gpm per irrigated acre. 7,698 ERC * 0.15 irr-ac/ERC * 8.5 gpm/irr-ac = 9,815 gpm.

A breakdown of the 2060 peak day demand by pressure zone is shown in Table 3-8.

Table 3-8: 2060 Source Requirements by Pressure Zone

Zone	ERCs	Demand (gpm)
Bartholomew	90	110
Kelly/Jurg	100	145
Rotary	435	635
Cherrington	220	320
Hobble Creek	3,090	4,380
Lower Spring Creek	7,990	4,360
Westfields	12,850	2,790
Upper Spring Creek	65	85
Crandall	200	245
Klauck	300	310
Nestlé[1]	3,710	870
Total	**29,050**	**15,250**
Total Supply Available (gpm)		**16,986**

1 – Indoor peak day demand for the Nestlé facility (3400 ERCs) is based on existing flow records (814 gpm) instead of the system Peak Day Demand rate per ERC.

Under 2060 conditions there is a projected source capacity excess of 1,740 gpm based on the capacity of the existing sources, including the Evergreen Well and 400 South Well #2. This capacity is sufficient to meet the requirements stated herein, but is not sufficient to provide redundancy if one of the City's wells pumping larger than 1,500 gpm is out of service. An additional well or increased flow from an existing source is required to provide this redundancy.

As with existing conditions, not all sources are available to all pressure zones in the City. The general pattern of the source mass balance shown as Table A-3 in Appendix A for existing conditions will continue to function for 2060 conditions, with 400 South Well #2 being used to provide source capacity for the Lower Spring Creek and Westfields zones. Similarly, Table A-4 in Appendix A will still apply for future conditions and can be used to evaluate the effect of the loss of each source.

Future Average Yearly Demand

Following the methodology described for existing conditions and estimating 29,050 ERCs in 2060, the average yearly source requirement is projected to be 13,350 ac-ft. See Table 3-9.

Table 3-9: 2060 Average Yearly Demand

Indoor Connections (ERCs)	Average Yearly Indoor Demand (ac-ft/ ERC)	Average Indoor Yearly Demand (ac-ft)	Irrigated Acres	Outdoor ERCs	Average Yearly Outdoor Demand (ac-ft/ irr-ac)	Average Yearly Outdoor Demand[1] (ac-ft)	Total Average Yearly Demand (ac-ft)
29,050	0.3	8,720	860	7,698	4.0	4,630	13,350

1 – Average Yearly Outdoor Demand is based on Outdoor ERCs, the City level of service of 0.15 irrigated acres per ERC, and the Average Yearly Outdoor Demand rate of 4.0 acre-feet per irrigated acre. 7,698 ERC * 0.15 irr-ac/ERC * 4.0 ac-ft/irr-ac = 4,619 gpm.

A breakdown of the 2060 average yearly demand by pressure zone is shown in Table 3-10.

Table 3-10: 2060 Average Yearly Demand Requirements by Pressure Zone

Zone	ERCs	Demand (acre-feet)
Bartholomew	90	75
Kelly/Jurg	100	95
Rotary	435	390
Cherrington	220	195
Hobble Creek	3,090	2,730
Lower Spring Creek	7,990	4,245
Westfields	12,850	4,080
Upper Spring Creek	65	55
Crandall	200	160
Klauck	300	210
Nestlé	3,710	1,115
Total	**29,050**	**13,350**
Total Yearly Supply Available (ac-ft)		**15,445**

The current yearly supply available is sufficient to meet existing average yearly demand. However, the City is encouraged to keep acquiring water rights at levels required in City Code and to develop sources to provide redundancy. Metered two-way emergency interconnections with Mapleton, Spanish Fork, and Provo could also provide redundancy.

FUTURE WATER SOURCES AND RECOMMENDATIONS

The City plans to continue to use spring sources to the maximum extent possible, including redeveloping springs as needed. The City is considering moving water rights to Bartholomew Springs to allow the City to fully utilize the flow from Bartholomew Springs when it is available in high water years. If this effort is successful, this will reduce the need for future wells. It is recommended that the City continue to pursue the transfer of water rights to Bartholomew Springs.

The City has completed development of a new well named 400 South Well #2, located near the existing 400 South well. The well is currently producing 4,000 gpm with very little drawdown. As shown previously, the City's existing source capacity is sufficient to meet the requirements discussed herein, but with little redundancy. With the new 400 South Well #2 completed, the City has just enough source capacity to meet peak day requirements even if the largest well is out of service. As source demand increases over time, the existing sources will not provide sufficient redundancy. 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 budgeting for and development of additional wells should continue to be pursued to provide redundancy and to replace wells as they age.

Future planned drinking water sources include wells at 200 North and/or 900 South, near the existing wells shown on Figure 1-2. One or more wells in the Westfields zone may be beneficial, allowing the city to avoid pumping water higher than necessary and wasting energy as the water flows through PRVs to the Westfields zone. However, past experience suggests that well production decreases moving westward in Springville. If a good producing well can be located in the Westfields zone, it would be beneficial as a peaking source on high demand days.

It is recommended that the City pursue installing metered two-way emergency interconnections with Mapleton, Spanish Fork, and Provo, to provide redundancy and increase fire flow in the far reaches of the system (discussed in Chapter 5.)

CHAPTER 4 WATER STORAGE

EXISTING WATER STORAGE

The City's existing drinking water system includes eight concrete storage facilities with a total capacity of **12.65 MG**. Their locations are shown on Figure 1-2. Table 4-1 presents a listing of the names and select attributes of the City water storage tanks. Tanks are grouped into four service areas, and volume for fire suppression and emergency storage is distributed among the four tank groups. Fire suppression storage is balanced among the tanks so that the maximum fire flow is available at any point in the city from a tank in the same pressure zone or upstream.

Table 4-1: Existing Storage Tanks

Tank Name	Diameter (ft)	Nominal Volume (MG)	Base/ Outlet Elevation	Emergency Storage Volume (gallons)	Fire Suppression Volume (gallons)	Lowest Level (Elevation) of Equalization Volume	Overflow Elevation
Bartholomew	137	1.4	6237.0	100,000	500,000	5.4 6242.4	6250.6
Jurg Springs	50	0.25	5262.0	20,000	120,000	9.5 5271.5	5282.0
Rotary	135	2.0	5091.9	100,000	240,000	3.2 5095.1	5114.4
Upper Spring Creek	135	2.0	5111.1	50,000	240,000	2.7 5113.8	5132.6
Lower Spring Creek 1	110	1.0	4804.8	0	0	0 4804.8	4818.9
Lower Spring Creek 2	124	2.0	4794.3	50,000	0	0.6 4794.9	4817.3
Hobble Creek 1	140	2.0	4878.2	0	0	0 4878.2	4898.2
Hobble Creek 2	140	2.0	4874.2	100,000	220,000	2.8 4877.2	4898.0
Total		**12.65**		**420,000**	**1,320,000**		

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. Because the pressurized irrigation system only provides water for a portion of the city's outdoor use, both indoor demand and outdoor demand are included in the drinking water system for areas outside the PI service boundary. Areas inside the PI service boundary are assumed to be served by the PI system, even if they are not physically connected to that system yet.

Equalization Storage

As shown in Table 1-1, Springville has planned for a level of service of 230 gpd/ERC of equalization storage for indoor use and 6,120 gpd/irr-ac of equalization storage for outdoor use, with irrigated acreage based on 0.15 irrigated acres for a single family lot. With 18,250 ERCs, 7,356 outdoor ERCs, and 809 irrigated acres under existing conditions, Springville needs 10.95 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)
Bartholomew	90	0.09
Kelly/Jurg	100	0.11
Rotary	320	0.37
Cherrington	220	0.25
Hobble Creek	2,900	3.31
Lower Spring Creek	5,770	4.07
Westfields	4,660	1.42
Upper Spring Creek	60	0.06
Crandall	180	0.17
Klauck	300	0.25
Nestlé	3,650	0.84
Total	**18,250**	**10.95**

Fire Suppression Storage

Fire suppression storage is required for water systems that provide water for firefighting (Subsection R309-510-8(3)). The local fire authority determines the need for fire suppression storage. Springville's Fire Chief and Fire Marshal have consulted with City Engineering staff and have provided fire flow rate and duration requirements based on the International Fire Code (IFC). The contact information for the Springville Fire department is as follows:

Fire Marshal: Calvin Christiansen
Phone: 801-491-5600
Address: 75 West Center Street, Springville, Utah

Storage was allocated to each tank according to requirements for fire suppression flow during peak day conditions, considering that fire flow may be supplied by storage in upstream zones. Fire suppression storage was determined based on the following assumptions:

- Typical residential fire flow east of 400 West/Highway 89/Highway 51 (boundary shown on Figure 1-2) – 1,000 gpm for 2 hours (0.12 MG)
- Typical residential fire flow west of 400 West/Highway 89/Highway 51 (boundary shown on Figure 1-2) – 1,500 gpm for 2 hours (0.18 MG)
- Hobble Creek Canyon residential fire flow for in-home sprinkling systems– 300 gpm for 15 minutes (0.005 MG)
- Non-Residential Fire Flow – minimum 2,000 gpm for 2 hours (0.24 MG), and can increase depending on building size, building type, and sprinkling system

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.

Table 4-3 summarizes the fire suppression storage assumed in each storage facility. As described in the Source chapter of this report, one tank group can supply multiple pressure zones in the City. The table shows which pressure zones are directly supplied by which tank and which tank groups are downstream. For example, the Rotary tank and Hobble tank group are located downstream of the Bartholomew tank, so it is assumed that fire requirements in the Hobble pressure zone can be met by a combination of fire storage from all these tanks. In a fire situation, water will be pulled from multiple tanks as the system demands increase.

An interconnect from the Westfields zone to the Nestlé zone is required to provide high fire flows to the Nestle zone. This is discussed in Chapter 5 of this report.

The Upper Spring Creek, Crandall, Klauck, Rotary, and Cherrington pressure zones contain only residential zoning, and storage for these zones is based on the residential fire flow requirements above, as well as storage needed for other zones downstream. The largest fire flow requirement in the Hobble Creek pressure zone is for Springville High School. Based on IFC requirements, 8,000 gpm fire flow would be required for the school. The school will be rebuilt by Nebo School District in the near future, and will be constructed to a standard allowing a 50% reduction in fire flows. Most other large buildings in the City include fire sprinkler systems and would not require flows larger than 4,000 gpm. Storage for the Hobble Creek, Nestlé, and Westfields pressure zones is based on a 4,000 gpm fire suppression requirement. The largest fire flow requirement in the Lower Spring Creek pressure zone is 5,000 gpm, and storage for this zone was provided to meet this higher flow rate.

The distribution system evaluation in commercial and industrial areas is generally based on the 2,000 gpm non-residential requirement noted above, except at specific locations where larger required fire flows have been identified. The distribution system is discussed in Chapter 5 of this report.

Table 4-3: Existing Fire Suppression Storage by Tank Group

Tank	Pressure Zones Supplied	Other Tank Groups Downstream	Fire Suppression Storage (MG)
Bartholomew[1]	Bartholomew	All	0.50
Jurg Springs	Kelly's, Jurg	None	0.12
Rotary[1]	Rotary, Cherrington	Hobble Creek, Lower Spring Creek	0.24
Upper Spring Creek[2]	Upper Spring Creek, Crandall, Klauck, Nestlé[3]	Lower Spring Creek	0.24
Lower Spring Creek 1[4]	Lower Spring Creek, Westfields	None	0
Lower Spring Creek 2[4]			
Hobble Creek 1[1]	Hobble	None	0.22
Hobble Creek 2[1]			
Total			**1.32 MG**

Notes:
1 – Combined fire storage in the Bartholomew, Rotary, and Hobble Creek tanks totals 0.96 MG (4,000 gpm for 4 hours).
2 – Fire storage provided in the Upper Spring Creek tank totals 0.24 MG (2,000 gpm x 2 hours). Only 0.12 MG (1,000 gpm x 2 hours) is required for the zone, but a total of 0.24 MG is provided to supplement other zones.
3 – Fire storage for the Nestlé zone is provided in the Upper Spring Creek, Hobble, Rotary, and Bartholomew tanks via interconnects to the Lower Spring Creek and Westfields zones.
4 – Fire storage for the Lower Spring Creek and Westfields zones is provided in the Upper Spring Creek, Bartholomew, Rotary, and Hobble Creek tanks, totaling 1.2 MG (5,000 gpm for 4 hours).

Emergency Storage

While there are no specific DDW requirements for emergency storage (Subsection R309-510-8(4)), most water systems maintain emergency storage to mitigate risks, provide system reliability, and protect public health and welfare. Emergency storage may be used in case of pipeline failures, equipment failures, power outages, source contamination, and natural disasters.

Under existing conditions, Springville has planned for approximately 100,000 gallons of emergency storage in each of the tank groups, for a total of 400,000 gallons within the City. This will be increased as future tanks are constructed.

Total Storage

A total of 12.7 MG equalization, fire suppression, and emergency storage is required, as shown in Table 4-4.

Table 4-4: Existing Storage Requirements

Component	Volume (MG)
Equalization	10.95
Fire Suppression	1.32
Emergency	0.40
Total	**12.67**

The current tanks have a capacity of 12.65 MG, and there is considered to be **no additional storage required** to meet current requirements. Similar to the source mass balance shown in Chapter 3 of this report, not all storage tanks are able to serve all pressure zones in the City. An existing storage mass balance is included as Table A-5 in Appendix A.

The Bartholomew Springs tank (1.4 MG) requires replacement due to age and condition. The City plans to construct the tank with 1.4 MG or greater volume, and the mass balance is based on this assumption. Increasing the tank volume to serve lower pressure zones was evaluated. It was determined it would not be efficient for storage to be so far physically removed from the service pressure zone. Additionally, the Bartholomew tank has no source other than the Bartholomew tanks, so filling this tank is dependent on flows at the springs, which will be low in drought years and may not be able to keep pace with downstream demand. Construction at the Bartholomew tank location is more expensive than construction at the lower (valley) tank sites, and it is more cost efficient to reconstruct a smaller (1.4 MG) Bartholomew tank and keep emergency storage and new storage for the other pressure zones in their respective zones, as shown in the mass balance in Appendix A.

Because the existing requirements are just barely met by the existing storage, it is recommended that a 2-4 MG storage tank be constructed now to meet future requirements. A 2 MG tank would provide sufficient storage through approximately 2026, a 3 MG tank would be sufficient through 2035, and a 4 MG tank would provide storage through approximately 2045. The Westfields zone is currently supplied entirely through PRVs from the Lower Spring Creek zone, and any storage constructed for the Lower Spring Creek zone could also serve the Westfields zone. Tank recommendations are discussed in more detail at the end of this chapter.

STORAGE FOR LOWER SPRING CREEK ZONE (AND WESTFIELDS ZONE)

Multiple locations for storage for the Lower Spring Creek zone were evaluated. A tank constructed for the Lower Spring Creek zone could also serve the Westfields zone through the existing PRVs, but may not be the most energy efficient solution.

Existing Lower Spring Creek Tank Site – 400 South 1950 East

Previous master plans have recommended adding storage at the site of the existing Lower Spring Creek tanks. The City already owns property at this location. The tank is near the newly-developed 400 South Well #2, which can be used as a filling source. A primary benefit of a tank in this location is that there are already large transmission lines to the Lower Spring Creek zone in 400 South. A 30-inch line extends from the tanks to the Westfields zone. A 16-inch to 12-inch line extends from the tanks to Main Street. Computer modeling indicates that adding storage at this location does not overburden these existing lines. If the City wanted to provide a dedicated transmission line to the Westfields zone, it is possible one of these lines could be used, and the existing 12-inch line extended from Main Street to the Westfields zone, approximately 4,000 feet. Distance for transmission lines from proposed tank locations to each of the Lower Spring Creek and Westfields pressure zones is included in Table 4-5.

Eastern Bench, 400 North to South Provo
A new storage tank can be located anywhere along the eastern bench from 400 North to south Provo. Specific locations of interest where property may be available include 400 North 1000 East, 1400 North 400 East, and the gravel pit east of the Utah County Public Works building in south Provo. Each of these locations would function similarly in the system. All existing storage in the city is located at or south of 400 South, and constructing a tank at a more northerly location would help provide diversification and redundancy in the case of a major line break near an existing storage tank. The City does not own property at the locations evaluated and would need to work with private owners, the United States Forest Service, and/or Provo City to pursue any of these locations. Additionally, construction may be challenging due to the steep terrain.

A primary benefit of a tank along the bench is the relatively close distance to the service zone. A tank on the bench could include a transmission line only to the Lower Spring Creek zone, serving the Westfields zone through PRVs, or could also include a separate dedicated transmission line to the Westfields zone. Distance to the Lower Spring Creek zone ranges from 1,000 – 4,000 feet, and distance to the Westfields zone ranges from 2,500 to 7,500 feet.

STORAGE FOR WESTFIELDS ZONE

The possibility of supplying a dedicated storage tank for the Westfields zone was explored. A tank for the Westfields zone would need to be located at elevation 4680 or higher to allow the tank to be buried while maintaining 50 psi or higher in the Westfields zone. The Westfields zone currently operates at a pressure of 75 psi or higher, so a tank at the following locations would require a reduction in pressure in the zone. The following locations were evaluated:

Child Park/Nebo School District Property/Springville Junior High – 200 South 1470 East
A tank at one of these locations would require 12,500 feet of transmission piping to reach the Westfields zone via 400 South. The tank could be buried and Child Park restored on top of the tank to maintain park space. The Nebo School District property west of the intersection of 300 South 1470 East is slightly higher in elevation and would allow slightly higher pressures in the Westfields zone. A third option would be to locate the tank in the hill east of Springville Junior High. This would allow still higher pressures in the Westfields zone.

There is already a major transmission line into the Westfields zone on 400 South. Adding a transmission line for the tank on 400 South would reduce usage of the existing 400 South transmission line. It is possible that one of the existing transmission lines could be used to supply the Westfields zone from this tank.

The tank is 3,600 feet away from the 400 South wells and 4,500 feet from the 200 North well. The tank could be filled from either of these sources, with a new transmission line from the well to the tank, or a new source could be located near the tank.

Evergreen Cemetery/Big Hollow Park – 400 East 2000 South
A tank in the eastern portion of the city-owned property at the cemetery would provide sufficient pressure in the Westfields zone, and would require 8,500 feet transmission piping to reach the zone via Evergreen Road and 1600 South. Big Hollow Park, located just south of the cemetery near 400 East Evergreen Road, is another possible tank location, and would require approximately 7,600 feet transmission piping to the Westfields zone.

The tank could be partially filled from the existing Evergreen well, but customers supplied from this well have experienced aesthetic concerns. Ideally, another source would be used to fill the tank, or to dilute water from the Evergreen well. It is likely that a new well drilled near the existing well would experience the same concerns. The tank is 5,300 feet away from the existing 1000 South well, which is also low producing. The tank is 8,500 feet from the 900 South well, which has a higher production rate.

Table 4-5: Transmission Line Distance to Service Zones

Tank Location		Distance to Service Zone (ft)	
		Lower Spring	Westfields
Existing Lower Spring Creek Tank Site	400 South 1950 East	Not Required	N/A
Eastern Bench	400 North 1000 East	1,000	7,500
Eastern Bench	1400 North 400 East	1,000	2,500
Eastern Bench	South Provo	4,000	6,000
Child Park/Nebo/Springville Junior High	200-300 South 1470 East	N/A	12,500
Evergreen Cemetery/Big Hollow Park	400 East 2000 South	N/A	7,600-8,500

FUTURE WATER STORAGE REQUIREMENTS

As described previously in this report, all area within the PI service zone boundary is assumed to be serviced by the PI system for outdoor watering in all future scenarios. The future requirements cover the planning period through 2060, which primarily occurs in the Lower Spring Creek and Westfields pressure zones, with scattered development in other pressure zones. The City will likely continue to expand beyond the projected 2060 level of development. Detailed analysis of storage for this development is beyond the scope of this master plan, but was considered conceptually as future requirements and recommendations were considered.

Equalization Storage

Following the methodology described for existing conditions, and calculating 29,050 ERCs in 2060, the projected indoor equalization storage requirement per the standards shown in Table 1-1 is 6.7 MG. The projected equalization storage requirement for outdoor use is 7.1 MG, for a total of 13.8 MG of storage. Table 4-6 lists the equalization storage requirement by pressure zone.

Table 4-6: 2060 Drinking Water Equalization Requirements

Zone	ERCs	Equalization (MG)
Bartholomew	90	0.09
Kelly/Jurg	100	0.11
Rotary	435	0.50
Cherrington	220	0.25
Hobble Creek	3,090	3.46
Lower Spring Creek	7,990	4.66
Westfields	12,850	3.30
Upper Spring Creek	65	0.07
Crandall	200	0.19
Klauck	300	0.25
Nestlé	3,710	0.85
Total	**29,050**	**13.75**

Fire Suppression Storage

Fire suppression storage is assumed to remain similar to current conditions, as shown in Table 4-3. Volumes may be shifted among tanks, as long as the tank can supply the zones indicated. Up to 1 MG volume for fire suppression should be provided in each new tank, even if other tanks can provide fire flow, so that fire suppression is available close to the area of need.

Emergency Storage

It is recommended that new tanks provide 500,000 gallons or more emergency storage in each tank.

Total Storage

A total of 18.1 MG equalization, fire suppression, and emergency storage is required in 2060, as shown in Table 4-7.

Table 4-7: 2060 Storage Requirements

Component	Volume (MG)
Equalization	13.75
Fire Suppression	2.33
Emergency	2.0
Total	**18.1**

As described in the existing storage section of this report, not all storage tanks are available to serve all pressure zones in the city. A mass balance for 2060 storage requirements is included in Appendix A as Table A-6.

The mass balance shows that 5.85 MG additional storage (beyond existing) is required to meet 2060 requirements. The mass balance shows that a volume of 1.4 MG in the reconstructed Bartholomew tank is sufficient to meet equalization requirements for the Hobble Creek Canyon zone, and to provide a portion of the City's fire and emergency storage. As noted in the discussion of existing storage requirements, if the Bartholomew tank is sized larger than the recommended 1.4 MG, it could be used to provide emergency storage for the entire city, which would reduce the amount of future required storage.

EXISTING AND FUTURE WATER STORAGE RECOMMENDATIONS

The City currently requires 12.67 MG drinking water storage. The City will need a total of 18.1 MG of drinking water storage in 2060. A total of 12.65 MG storage has already been constructed. An additional 5.85 MG of storage is needed to meet 2060 requirements. Potential locations for future drinking water storage tanks are shown on the Figure 4-1, Drinking Water Master Plan Map and Capital Facilities Plan, located at the end of this chapter.

The Bartholomew Tank must be reconstructed, and it is recommended that the new tank be sized with 1.4 MG or more volume, to meet requirements for the Bartholomew (Hobble Creek Canyon) pressure zone, for other adjacent zones, and to provide emergency storage for the City.

The next new tank constructed should be capable of serving both the Lower Spring Creek and Westfield zones. Constructing a new 3 MG tank at the existing Lower Spring Creek tanks site is recommended for the next tank. This will allow the City to minimize immediate costs and utilize existing transmission lines. A 3 MG tank would supply storage needs through 2035, with a new tank being required by 2036. Table 4-8 shows the projected year each size tank would fulfill estimated future storage requirements. A modular tank design could be used to allow the tank to be expanded in the future.

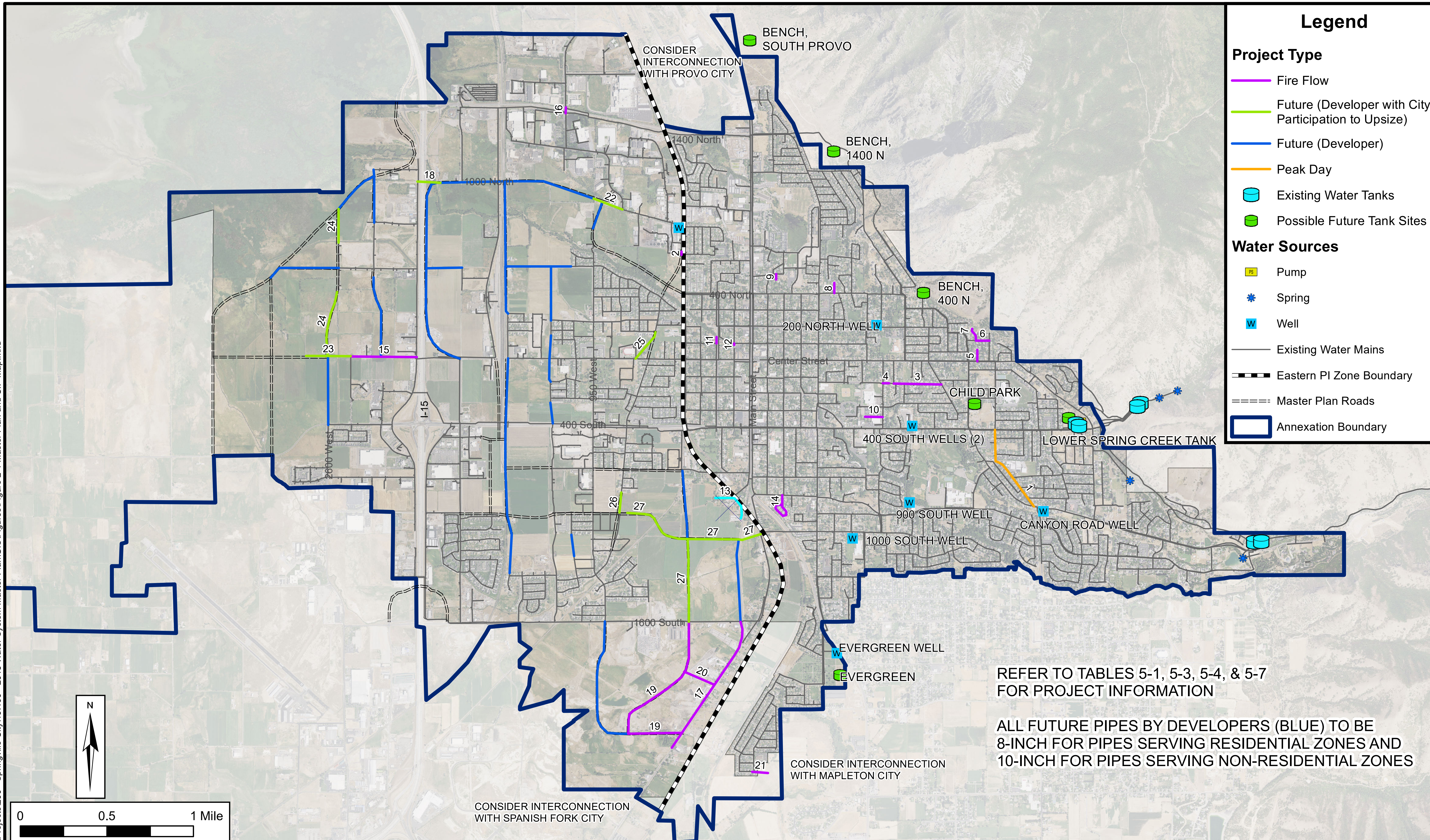
Table 4-8: Tank Service Year by Size

Tank Volume	Projected Development Year Serviced
2.0 MG	2026
3.0 MG	2035
4.0 MG	2046
6.0 MG	~2063

A 3 MG tank is recommended to meet near-term storage needs.

As development increase in the Westfields zone, the next tank recommended is a 3+ MG tank located at/near Evergreen Cemetery, due to its proximity to the Westfields zone and new development in the south portion of the city. The tank may need to be larger than 3 MG to account for post-2060 development that is not part of the scope of this master plan.

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 (in addition to the cost of reconstruction of the Bartholomew Tank) that should be planned for providing adequate storage by 2060 is approximately $9,315,000. The cost of transmission lines is in addition to tank costs.



HANSEN ALLEN & LUCE INC ENGINEERS

SPRINGVILLE CITY

DRINKING WATER MASTER PLAN MAP AND CAPITAL FACILITIES PLAN

FIGURE 4-1

Date: 9/27/2019
Document Path: H:\Projects\260 - Springville City\49.100 - 2018 Water System Master Plan\GIS\Figures\Figure 2-1 Master Plan and CIP Map.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 the distribution system requirements. The model was developed with the software InfoWater 12.4 (Innovyze, 2018). InfoWater simulates the hydraulic behavior of pipe networks. It was selected as the preferred modeling software for this study because Springville City personnel have used it for some time and are familiar with its functionality. 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.

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 information gathered by City personnel. Calibration data is included in Appendix B.

The second phase was a model representing future conditions and the improvements necessary to accommodate growth. The future model represents the level of growth projected to be reached by 2060 (2060 model), and includes 29,050 ERCs and 860 irrigated acres.

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 actual water system. Pipeline locations used in the model are approximate and not every pipeline may be included in the model, although efforts were made to make the model as complete and accurate as possible. Moreover, it is not necessary to include all of the distribution system pipes in the model to accurately simulate its performance. The model includes all known distribution system pipes of all sizes, as well as all 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. Elevation information was obtained from the GIS data provided by the City. Smaller 8-inch and 10-inch pipes are generally PVC. Hazen-Williams roughness coefficients for pipes in this model ranged from 130 - 150, which is typical for these pipe materials in modeling software (Rossman 2000, 31).

The existing water system contains approximately 190 miles of pipe with diameters of 4 inches to 60 inches. Figure 5-1 presents a summary of pipe length by diameter.

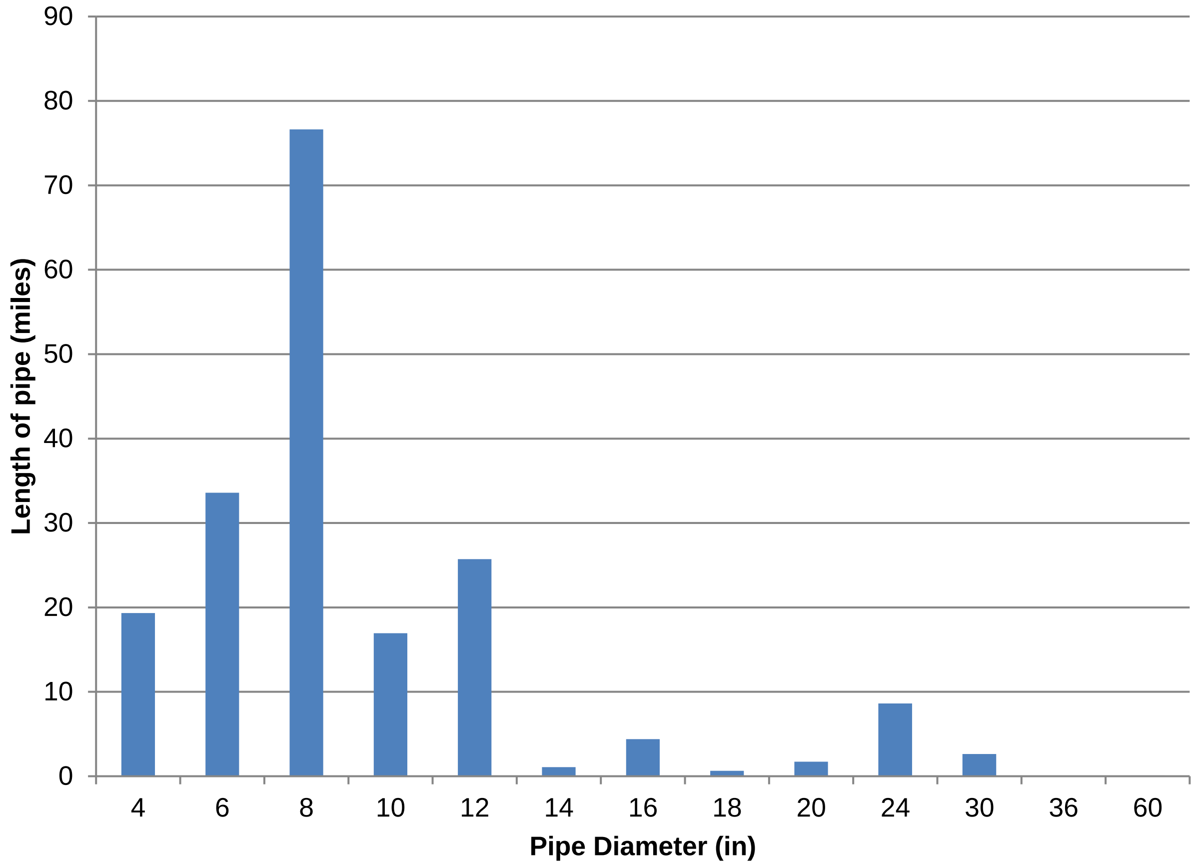


Figure 5-1: Summary of Pipe Length by Diameter

<u>Water Demands</u>

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 according to current zoning and densities and the established level of service, 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 a system optimization study done in 2014. The City has since changed its SCADA system, making it more difficult to access data and produce an updated diurnal curve. The diurnal curve for this study has a peaking factor of 1.5. 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 springs. A well is represented by a reservoir and pump. A spring is represented by a reservoir and a flow control valve, or a reservoir and a pump in cases where that is more appropriate. 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.

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 static 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)). Springville City's designated level of service indicates that 50 psi should be maintained. Peak day demand was evaluated at the level of service of 0.18 gpd/ERC for indoor use and 8.5 gpm/irr-ac for outdoor use, as shown in Table 1-1. This amounts to an existing peak day demand of 12,870 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 Springville's current designated level of service, though these projects met the level of service at the time they were constructed. All points of connection meet DDW requirements, and there are no existing deficiencies for this demand condition.

Peak Day Pressure < 50 psi

1650 East, 350 South to 550 South – These points of connection are at the top of the Hobble Creek pressure zone. Each point achieves 47-48 psi. No improvements are recommended.

Spring Oaks Drive – Points of connection on the highest switchback in the Spring Oaks subdivision achieve 44-48 psi. No improvements are recommended to improve pressure, though possible improvements are discussed in the fire flow section below.

Pressure Swings
Houtz Avenue and 1470 East from Canyon Road to 400 South experience high velocities when the Canyon Road well is used to fill the Lower Spring Creek tanks. See Location 1 on Figure 4-1. If this practice continues, the pipe size should be increased from 12-inch to 16-inch for 2800 LF. This condition can be mitigated by controlling system operations, and is not required to be constructed. The project is included in Table 5-1, but the cost is not included in subsequent summaries.

All costs shown in this master plan are based on the 2018 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.

Table 5-1: Transmission Projects for Peak Day Conditions

Location		Description	Solution	Cost
1	Houtz Avenue and 1470 East	High velocity when Canyon Road well is used to fill Lower Spring Creek tanks.	Upsize 2800 LF of 12-inch pipe to 16-inch if continuing to use Canyon Road well to fill Lower Spring Creek tanks	$660,000
Total Cost for Peak Day Improvement Projects				**$660,000**

Note: Cost not included in Summary (Table 5-5).

Existing High Pressure Conditions

Some areas in the system experience high pressures, which are greatest during the lowest demand times. The lower (typically downhill/westerly) portions of several zones experience pressures over 110 psi during typical operating conditions, as shown in Table 5-2.

Table 5-2: High Pressure Conditions

Pressure Zone	Maximum Pressure
Rotary	120 psi
Cherrington	115 psi
Hobble	120 psi
Upper Spring Creek	115 psi
Nestlé	115 psi
Lower Spring Creek	120 psi

The City should continue to require individual PRVs for each new customer connection, particularly in these areas. No pressure changes are recommended for the zones experiencing high pressures, 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 Springville. The highest peaking factor present on the peak day was 1.5, resulting in a peak instantaneous demand of 19,300 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 Springville Fire Marshal, a minimum fire flow of 1,000 gpm is required for all fire hydrants in residential areas east of 400 West, and 1,500 gpm is required for all residential areas west of 400 West. A fire flow of 2,000 gpm is required for all commercial and industrial areas.

The Available Fire Flow map in Appendix C shows fire flow available at nodes throughout the entire system. Identifying every pipe which is not capable 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. The following locations did not meet the desired flows.

Non-residential < 500 gpm
Fire hydrants for the Whitehead Power Plant at 450 West between 650 and 850 North are served by a 4-inch line coming from the Lower Spring Creek Zone via a 4-inch line on 400 South that continues northerly on 400 West to the power plant. See Location 2 on Figure 4-1. The City is aware of the low flows at this location and have previously asked HAL to evaluate the area. The plant can be served by a 10-inch line in the Westfields zone that is supplied from 850 North and continues southerly along 400 West to the power plant. A valve will need to be installed in the 4-inch line on 400 West south of the power plant and the line closed at this location. The existing fire hydrant line will need to be reconnected to the 10-inch line.

Residential <1,000 or 1,500 gpm; Non-Residential < 2,000 gpm
Locations throughout the City experiencing fire flows below desired level of service (less than 1,000 for residential areas east of 400 West, less than 1,500 gpm for residential areas west of 400 West, or less than 2,000 gpm for commercial/industrial areas) are shown on the Available Fire Flow map. The majority of these are cul-de-sacs or long dead-end lines with 4-inch or 6-inch pipe sizes. Projects to increase fire flow at these locations are shown in Table 5-3 and numbered on Figure 4-1. The costs for projects shown as alternates are not included in table totals.

Table 5-3: Projects to Resolve Low Fire Flow
Residential East of 400 West < 1,000 gpm
Residential West of 400 West < 1,500 gpm
Non-Residential < 2,000 gpm

Location		Description	Solution	Length	Cost
2	Whitehead Power Plant	Low fire flow from 4-inch line from Lower Spring Creek Zone	Open valve from 10-inch pipe in Westfields zone. Add closed valve on 4-inch south of power plant and open valve to Westfields.	Valve	$14,000
Projects 3 or 4 mitigate several locations between 800 East and 1300 East, from Center Street to 400 South					
3	100 South, 860 East to Canyon Avenue	4-inch line	Upsize to 8-inch	1500	$243,000
Project 4 is an alternative to Project 3. Costs for project 4 are not included in the total.					
Alt 4	100 South 800 East	4-inch line	Add check valve to allow flow from lower zone during fire.	Valve	$14,000
5	1360 East, Center Street to 90 North	4-inch cul-de-sac	Upsize to 8-inch if hydrant is installed	350	$57,000
6	130 North, 1350 East to 1440 East	4-inch line	Upsize to 8-inch	400	$65,000
7	1350 East, 130 North to 220 North	4-inch cul-de-sac	Upsize to 8-inch if hydrant is installed	400	$65,000
8	500 East, 400 North to 450 North	4-inch cul-de-sac	Upsize to 8-inch if hydrant is installed	305	$50,000
9	150 East, 500 North to 530 North	4-inch line	Upsize to 8-inch if hydrant is installed	170	$28,000
10	330 South (Chase Lane), 700 East to 800 East	4-inch dead end	Upsize to 8-inch if hydrant is installed	550	$90,000
Projects 11-12 increase flow to hydrants where higher flow is available nearby. However, it is ideal to upgrade every hydrant so the fire department can use any hydrant.					
11	200 West, 100 North to fire hydrant	4-inch line	Upsize to 8-inch	200	$33,000
12	100 West, 100 North to fire hydrant	4-inch line	Upsize to 8-inch	50	$9,000
13	800 South and 50 West	No hydrants on lines	Upsize to 8-inch if hydrants are installed	1110	$180,000
14	Artistic Circle	4-inch lines	Upsize to 8-inch	1370	$222,000
15	2450 West Center Street	Long 6-8-inch dead end	Upsize to 16-inch per previous master plan	2200	$520,000
16	PRV or Check Valve, Westfields to Nestlé	Low flows in Nestlé zone	Add PRV or check valve from Westfields zone for added fire flow	PRV	$68,000
17	2000 S SR-51	8-inch long dead end	Upsize to 12-inch. Alternately, flow will increase as development provides additional connectivity in the area.	3900	$764,000
Cost for Fire Flow Projects (Up to 1,000 gpm or 1,500 gpm required for residential and 2,000 gpm for non-residential)			**$2,410,000**		

Locations Requiring Fire Flow Greater Than 2,000 gpm

The City fire marshal has identified selected buildings in each pressure zone requiring the largest fire flows. This does not include an exhaustive analysis of all large buildings in the City, but is intended to be representative of maximum needs in each area. Required flows range from 1,750 gpm for relatively smaller buildings with sprinkler systems to 4,000 gpm for large warehouse or industrial buildings. This includes a reduction of 50% for buildings with approved fire sprinkler systems. The locations that did not meet the desired fire flow are shown in Table 5-4 along with a discussion of possible projects to meet the desired flow.

Table 5-4: Projects to Resolve Low Fire Flow Locations Requiring > 2,000 gpm

<table>
<tr><th colspan="2">Location</th><th>Required Flow (gpm)</th><th>Available Flow (gpm)</th><th>Solution</th><th>Length</th><th>Cost</th></tr>
<tr><td rowspan="2">18</td><td>2115 West 1150 North Infomercials</td><td>1,875</td><td>1,500</td><td>Add 12-inch transmission line under I-15</td><td colspan="2">See Table 5-7</td></tr>
<tr><td colspan="6">This flow can be met by constructing a 12-inch transmission line under I-15, on 1000 North, from 1750 West to West Frontage Road. This project is required for transmission redundancy and is discussed in Table 5-7 in this chapter.</td></tr>
<tr><td rowspan="2">16</td><td>815 West Raymond Klauck Way, Nestlé</td><td>4,000</td><td>1,570</td><td>Add PRV or check valve from Westfields zone</td><td colspan="2">See Table 5-3</td></tr>
<tr><td colspan="6">Nestlé has a private storage tank with fire pump that can meet some of the required fire flow. The remainder of the required flow can be met by installing a PRV or check valve from the Westfields zone to the Nestlé zone at 1400 North Mountain Springs Parkway. This project provides a minimum of 2,000 gpm level at all locations in the Nestlé pressure zone. The interconnection between the Nestlé zone and the Lower Spring Creek zone at 1400 North Main Street will also provide a minimum of 2,000 gpm at all locations within the Nestlé zone. Future buildings must be constructed to meet available flows. An individual analysis can be performed for new buildings to determine the fire flow available at each location.</td></tr>
<tr><td rowspan="2">19
20</td><td>1990 South State, Intermountain Lift</td><td>5,000</td><td>1,600</td><td>12-inch loop from end of dead end back to 1600 South</td><td>7,000</td><td>$1,400,000</td></tr>
<tr><td colspan="6">The transmission line on 1600 South is a 10-inch line, which limits flow in the pipe to less than 5,000 gpm. To achieve maximum flows, the 8-inch pipe on SR-51 should be upsized to a 12-inch (included as project 17 in Table 5-3), and a 12-inch pipe should be constructed westerly on 2300 South from the end of the dead end line, and continue back northerly to loop to 1600 South (project 19). Because the pipes in this loop are still very long, a cross-pipe should be constructed near Intermountain Lift (project 20). Projects 19 and 20 will eventually be constructed by developers as development fills in. Other solutions would likely be more feasible and include compartmentalizing buildings, adding fire sprinklers, or constructing a private tank and pump. However, it is cautioned that other buildings on SR-51 also require high fire flows and must be considered. An emergency/fire flow interconnection with Spanish Fork City at the south City limit of SR-51 would benefit all development along SR-51.</td></tr>
<tr><td rowspan="2">21</td><td>2555 South Dalton, Church</td><td>1,750</td><td>1,650</td><td colspan="3">None recommended;
Consider interconnect with Mapleton City</td></tr>
<tr><td colspan="6">This church is located at the south end of the Sunrise Ridge subdivision. There is no reasonable transmission line project that could increase the flow at this location. This location is directly adjacent to new development in Mapleton City, and it may be possible to construct an interconnection with Mapleton to improve flows at this location, at least during fire conditions.</td></tr>
<tr><td colspan="4">Cost for Fire Flow Projects
(Locations requiring >2,000 gpm)</td><td colspan="3">$1,400,000</td></tr>
</table>

Summary of Recommended Projects

Table 5-5 is a summary of costs for recommended projects to mitigate existing transmission deficiencies in the drinking water system.

Table 5-5: Transmission Projects Summary

Project Type	Cost
Fire to 1,500-2,000 gpm	$2,410,000
Fire > 2,000 gpm	$1,400,000
Total Cost for Transmission Projects	**$3,810,000**

As noted in Table 5-4, emergency interconnections with Mapleton City and Spanish Fork City would help increase fire flows in some areas of the City system, and would provide benefit to all three cities. No costs for these interconnections were included in the recommended projects.

Replacement

In addition to completing projects to resolve deficiencies, the City should continue replacing aging pipes throughout the city on a regular basis. Table 5-6 shows the cost of all pipes in the city (not including pipes previously recommended for replacement), and the cost to replace all of them over a 50-year service life.

Table 5-6: Replacement Program for All Existing Pipes

Pipe Diameter (inches)	Length of Pipe (feet)	Cost
4	95,000	$11,400,000
6	122,000	$14,640,000
8	377,000	$45,240,000
10	97,000	$13,095,000
12	138,000	$20,010,000
14	6,000	$930,000
16	26,000	$4,550,000
18	4,000	$760,000
20	34,000	$6,800,000
24	36,000	$8,280,000
30	15,000	$3,750,000
Total Cost for Replacement of All Existing Pipes		**$129,500,000**
Annual Cost for Replacement of All Pipes Over 50 Years		**$2,600,000**

FUTURE (2060) WATER DISTRIBUTION SYSTEM

2060 Peak Day Conditions

A minimum pressure of 40 psi must be maintained at all connections during peak day demand (Subsection R309-105-9(2)). Future peak day demand is discussed in Chapter 3 of this report. With 29,050 ERCs projected, the system's 2060 peak day demand is estimated at 15,250 gpm. Hydraulic modeling indicated that the future system can meet this requirement with the future pipelines shown on the Master Plan Map, Figure 4-1.

The majority of growth in the city is occurring in the western portion of the city. The deficiencies listed above for the existing system are primarily east of 400 West and will not be affected by future growth. The areas of lower than desired pressure listed above for the existing system will persist if the suggested projects are not constructed.

2060 Peak Instantaneous Conditions

Peak instantaneous demands were calculated in a similar manner to existing conditions. The peak day to peak instantaneous peaking factor is 1.5 and the total peak instantaneous demand is 22,900 gpm. Hydraulic modeling indicated that the future system can meet this requirement with the future pipelines shown on the Figure 4-1. As with the 2060 peak day conditions, the existing areas of lower than desired pressure during peak instantaneous conditions will persist if the suggested projects are not constructed.

2060 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)). The same fire requirements of 1,000 – 1,500 gpm for residential areas and 2,000 gpm for commercial areas are used for future conditions. Hydraulic modeling indicated that new areas of the future system can meet the future fire flow requirements with the 2060 pipelines shown on Figure 4-1. All of the fire flow deficiencies listed above for existing residential areas are located in areas that will experience little growth in the future. These deficiencies will persist if the suggested projects are not constructed.

WATER DISTRIBUTION SYSTEM RECOMMENDATIONS

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 E. 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.

Recommendations for distribution improvement projects were based on the modeling, as outlined above, guidance provided by Springville personnel, and the 2014 Drinking Water System Optimization Analysis. HAL still recommends implementing the distribution and operational recommendations given in the 2014 Analysis, including:

- Pump 900 South well into the Lower Spring Creek zone
- Set PRVs connecting Hobble Creek and Lower Spring Creek zones so that no flow is allowed through during normal operating conditions
- Set tank and well controls to allow Lower Spring Creek tank to drawn down more

In addition to these recommendations, it is also recommended that the city avoid using Canyon Road Well to fill Lower Spring Creek tanks. With the new 400 South Well #2 capacity added to the system, it will be more efficient to fill the tanks from the 400 South wells.

The I-15 freeway corridor is a major bottleneck for transmission lines. There are currently three transmission lines under I-15. The system functions well with these lines, but level of service would be compromised if one of the transmission lines was out of service. A fourth transmission line under I-15 for redundancy is recommended in the northerly part of the city, near 1000 to 1400 North.

Major future distribution projects associated with providing transmission capacity to and from future storage tanks and sources may be required depending on the locations chosen for tanks and sources. It is expected that these projects may change somewhat as compared to current projections depending on the availability of land and other considerations that may affect the final locations of the proposed storage tanks. These projects are not shown on Figure 4-1 because they are not recommended within the 0-20 year growth period.

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 (8-inch in residential zones and 10-inch in commercial zones). Anticipated future pipes larger than the minimum required size have been located following proposed road alignments and are summarized in Table 5-7. The cost included in the table includes only the cost of upsizing from the developer-required 8-inch or 10-inch pipe to the size required in the table. The locations of these pipes are illustrated on the Drinking Water Master Plan Map, Figure 4-1. The City will continue to review individual developments through the Development Review Committee (DRC) process, including analyzing transmission line size requirements, particularly for developments located in areas where the water system is not well connected. Pipe sizes in these developments may need to be increased for initial service, even if the ultimate size requirement (when developments are well connected) is smaller.

Table 5-7: 2060 Transmission Pipes Larger than 8 Inch in Residential Zones or Larger than 10 Inch in Non-Residential Zones

Location		Description	Length	Total Cost	Developer Cost	City Cost
18	1000 North, 1750 West under I-15 to West Frontage Road	Extend existing 12-inch in commercial zone under I-15 and connect to 10-inch in West Frontage Road [includes cost to bore under I-15]	1350	$602,000	$247,000	$355,000
22	Spring Creek Road, 850 West to 950 West	Extend 12-inch in commercial zone westerly to 950 West and connect to 10-inch in 950 West as development fills in	1020	$200,000	$186,000	$14,000
23	Center Street, west of 2450 West	Extend 16-inch in residential zone westerly as far as development continues	1350	$319,000	$219,000	$100,000
24	2400/2600 West, 800 North to Center Street	Construct 10-inch in residential zone because this area is adjacent to commercial zones	3,600	$657,000	$584,000	$73,000
25	500 West, Center Street to 150 North	Extend existing 10-inch main in residential zone	900	$165,000	$146,000	$19,000
26	750 West, 750 South to 900 South	Extend existing 20-inch main in residential zone	630	$171,000	$103,000	$68,000
27	900 South/1000 South, Main Street to 700 West; 400 West, 900 South to 1600 South	Construct 12-inch in residential zone to use as main line (connects to 20-inch main)	7,000	$1,371,000	$1,134,000	$237,000
Total Cost for Upsizing Future Transmission Projects				**$3,485,000**	**$2,619,000**	**$866,000**

Fire Suppression Flow

As discussed in the storage and water distribution chapters of this report, minimum available fire flow typically ranges from 1,000 gpm to 2,000 gpm, though higher flows are available in many locations. A site-specific analysis of available fire flow should be performed for each new development early during the development review process. New buildings should be constructed with appropriate materials or approved fire sprinkler systems so that their fire flow requirement does not exceed the available flow.

CHAPTER 6 WATER RIGHTS

EXISTING WATER RIGHTS

Springville City currently owns water rights designated for municipal use in the drinking water system. Table 6-1 is a summary of the drinking water rights owned by the City with assumed flow and volume capacities.

Table 6-1: Existing Drinking Water System Municipal Water Rights

Water Right Number(s)	Flow (gpm)	Volume (ac-ft)	Source
51-111 (a26443) Includes 51-6666, 51-6990, 51-7242	198	103	City Wells
51-1455 (a28365) Includes 51-1486, 51-1493	4,937	7,964*	City Wells
51-2530 (a29656) Includes 51-3679	2,703	144	City Wells
51-2780 (a28366)	1,346	439	City Wells
51-5450 (a40919)	1,333	14#	City Wells
51-6970 (a28367) Includes 51-1024, 51-1025, 51-1088	1,472	1,746	City Wells
51-8641	35	33	City Wells
51-8793 (a43986)	9	14	City Wells
51-5329	1,300	2,069**	Burt Springs
51-5330	180	290*	Konold Springs
51-5520	662	1,068##	Bartholomew Springs
51-6027	1,200	1,947***	Spring Creek Canyon Springs
Total	**15,375**	**15,831**	

* Potential volume if sources are able to produce designated flow rate year-round. Actual volume may be limited by either source capacity (i.e. a spring may not be able to produce the designated flow rate year round) or by demand.
** W.U.C. indicates that 8 cfs is diverted 24 hours for 5 days out of each 8-1/3 days from April 1 to October 31. This would equal 128.45 days with an estimated volume of 2,038.24 ac-ft.
Springville Irrigation Company water right used by Springville City based on City ownership of 267 shares. Each share equals 4 ac-ft resulting in an annual volume of 1,068 ac-ft.
*** 10-year average yield of the spring from 1999 – 2009

Springville City has a total of 15,831 ac-ft of water rights available for use in its drinking water system. Compared to the existing level of service water requirement of 9,890 ac-ft, the City currently owns a surplus of 5,941 ac-ft in municipal water rights.

By 2060, the City will require a minimum of 13,350 ac-ft of water rights to meet requirements for the drinking water system. Compared to the existing water rights available, the City currently owns a surplus of 2,481 ac-ft; however, buildout requirements for the City will likely be significantly higher than the predicted 2060 requirements. Similar to other components of the water system, water rights should have redundancy. Typically, some water rights cannot be used as planned or do not yield the allowed flow, and the City will need to acquire more than the minimum rights calculated in order to have the usable flow and volume required. Table 6-2 is a summary of unapproved change application that propose converting water from City owned irrigation shares to drinking water municipal water rights in the City wells. If these water rights are approved the City would have additional redundancy recommended for the predicted 2060 requirements. However, it is recommended that the City commission a groundwater capacity study to determine the physically available flow and volume of the water rights the City owns. Other studies in southern Utah Valley have indicated that the physical capacity can be lower than the allowable water right flow or volume. It is also recommended that the City pursue opportunities to move the diversion point for Springville Irrigation Company Hobble Creek water rights to Bartholomew Springs where the water can be used in the drinking water system.

Table 6-2: Potential Drinking Water System Municipal Water Rights

Water Right Number	Flow * (gpm)	Volume (ac-ft)	Irrigation Company	Proposed Source
51-8368 (a35091)	800	834	Springville	City Wells
51-8369 (a35092)	300	322	Mill Pond	City Wells
51-8366 (a35086)	200	227	Wood Springs	City Wells
51-8367 (a35088)	100	42	Coffman Springs	City Wells
51-5790 (a44540)	2,400	2,471	Springville	City Wells
51-8791 (a43637)	400	357	Mill Pond	City Wells
51-8792 (a44541)	200	234	Wood Springs	City Wells
Total	**4,400**	**4,487**		

* Flow assumption based on existing well water rights.

CHAPTER 7 CAPITAL FACILITY PLAN

GENERAL

The purpose of this section is to identify the drinking water facilities that are required, for the 20-year planning period, to meet the demands placed on the system by future development. Projects required to meet existing level of service criteria, including desired fire flow, are not included in this section. Proposed facility capacities were sized to adequately meet the 20-year growth projections and were compared to current master planned facilities. A detailed design analysis will need to be provided before construction of the facilities to ensure that the location and sizing is appropriate for the actual growth that has taken place since this capital facility plan (CFP) was developed. Specific projects with costs are presented at the end of this chapter.

METHODOLOGY

The future water demands were added incrementally by year to the facility analysis. For facilities reaching capacity at any time within 20 years, a solution was identified that will accommodate growth for the 20-year planning period. A hydraulic model was developed for the purpose of assessing the system operation and capacity with future demands added to the system. The model was used to identify problem areas in the system and to identify the most efficient way to make improvements to transmission pipelines, sources, pumps, and storage facilities. The future system was evaluated in the same manner as the existing system, by modeling (1) Peak Instantaneous Demands and (2) Peak Day Demands plus fire flow conditions.

Currently the Drinking Water System supplements the Pressurized Irrigation Water System via customers in the PI service area using drinking water for their outdoor watering. These customers should all be connected to the PI system within approximately 5 years. The Drinking Water System CFP was analyzed assuming that all possible customers in the PI service area have connected to the PI system within 5 years and no capacity from the drinking water system is used for outdoor watering in the PI zone, other than a small area (The Cottages at Camelot Village PD subdivision) as described previously.

FUTURE WATER SOURCE

Future growth projections indicate that the City will be able to meet demands with its existing sources, but additional drinking water source must be provided for redundancy and to replace aging wells. The following source project is prioritized to meet the source requirements for future growth:

- Move water rights to Bartholomew Springs to allow the City to utilize the full flow available

If efforts to transfer water rights to Bartholomew Springs are unsuccessful, the following source project is selected as an alternative to meet source requirements for future growth:

- 900 South well, with 200 North or other suitable location as an alternate

It is recommended that the City continue to budget for well development.

FUTURE WATER STORAGE

The future 20-year growth projection requires approximately 3.5 MG additional storage in one or more tanks to supply storage for future growth. Two 3 MG tanks are recommended. The first tank is anticipated to meet future demands through 2035, and the second tank is anticipated to meet demands through 2063.

The following tank location is anticipated to incur the least cost, due to no additional transmission lines being required:

- Lower Spring Creek existing tank site, 1950 East 400 South (3 MG+)

The second tank may be located to serve the Westfields zone, with associated transmission piping to a source and to the service zone. If site conditions allow, the tank could be located at the Lower Spring Creek existing tank site, or the following location is one possible alternative:

- Evergreen Cemetery/Big Hollow Park, 400 East 2000 South (3 MG+)

As discussed in the Storage section of this report, other tank locations are possible to fulfill necessary storage requirements.

A different location may be required for one or both of the tanks due to constraints at the chosen sites. All locations other than the Lower Spring Creek existing tank site will require additional transmission piping.

FUTURE TRANSMISSION PIPING

A significant portion of the major transmission lines in the growth areas of the City (west of 400 West) are already constructed. A few additional transmission lines would need to be constructed to allow for future growth in these areas. The majority of the waterline projects in the growth areas will be constructed by developers. Only lines larger than 8 inches in residential zones or larger than 10 inches in non-residential zones are included below. No additional transmission lines are required to connect sources to storage tanks if the Lower Spring Creek Tank site is chosen for the next storage tank. If a different site is chosen, additional transmission lines will be required.

- 1000 North, 1750 West to West Frontage Road – 12-inch
- Spring Creek Road, 850 West to 950 West – 12-inch
- Center Street, 2450 West to limits – 16-inch
- 2400/2600 West, 800 North to Center Street – 10-inch
- 500 West, Center Street to 150 North – 10-inch
- 750 West, 750 South to 900 South – 12-inch
- 900/1000 South, Main St. to 700 West; 400 West, 900 South to 1600 South – 12-inch
- Transmission line for tank location if not selecting Lower Spring Creek site – 16-inch

MASTER PLANNING

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 also the anticipated future demands. This section of the report will specifically detail development over the next 20 years. System deficiencies identified in the master planning process and described previously in this report were presented and discussed in an alternatives workshop with City staff. After the workshop, HAL studied the feasibility of the solution alternatives and developed conceptual costs.

One important method of paying for system improvements is through impact fees. Impact fees are collected from new development and should only be used to pay for system improvements related to new development. For this reason, it is important to identify which projects are related to resolving existing deficiencies, and which projects are related to providing anticipated future capacity for new development.

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 that has been 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 (or conceptual or feasibility design 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 very 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.

At the preliminary or 10% design level, some of the aforementioned information will have been developed. Major design decisions such as the size of facilities, selection of facility sites, pipeline alignments and depths, and the selection of the types of equipment and material to be used during construction will typically have been made. At this level of design the precision of the cost estimate for a $1,000,000 project would typically be expected to range between approximately $700,000 and $1,300,000.

After the project has been completely designed, and is ready to bid, all design plans and technical specifications will have been completed and nearly all of the significant details about the project should be known. At this level of design, the precision of the cost estimate for the same $1,000,000 project would typically be expected to range between approximately $900,000 and $1,100,000.

SYSTEM IMPROVEMENT PROJECTS

As discussed in previous chapters, source, storage and distribution system capacity expansion will be needed to meet the demands of future growth. The City's Drinking Water Master Plan Map and Capital Facilities Plan, Figure 4-1 includes recommended projects over the period from existing conditions through 20 years into the future. The recommended projects that are expected to be needed through 2038 are presented in Table 7-1.

Cost estimates have been prepared for the recommended projects and are included in Table 7-1. 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, 2018"
2. Price quotes from equipment suppliers

3. Recent construction bids for similar work
4. Springville City records of past project bids/costs

All costs are presented in 2018 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. Only during final design can a definitive and more accurate estimate be provided for each project.

Table 7-1: Recommended 20 Year Projects

Type	Map ID[1]	Recommended Project	Cost
Growth Projects, 0-10 Year Phasing (2018-2028)			
Source	900 S Well[2], 200 N Well	Drill and develop 4,000 gpm well(s)[2] Possible locations: 900 South, 200 North, Westfields zone	$2,000,000
Storage	Lower Spring Creek Tank	3 MG tank Lower Spring Creek tanks site	$4,700,000
Transmission	18	1000 North, 1750 West to West Frontage Road 1350 LF 12-inch ductile iron pipe bored under I-15 [cost to upsize and bore]	$355,000
Transmission	22	Spring Creek Road, 850 West to 950 West 1,020 LF 12-inch ductile iron pipe [cost to upsize]	$14,000
Transmission	23	Center Street, 2450 West to 2700 West 1,350 LF 16-inch ductile iron pipe [cost to upsize]	$100,000
Transmission	24	2400/2600 West, 800 North to Center Street 3,600 LF 10-inch ductile iron pipe [cost to upsize]	$73,000
Transmission	25	500 West, Center Street to 150 North 900 LF 10-inch ductile iron pipe [cost to upsize]	$19,000
Transmission	26	750 West, 750 South to 900 South 630 LF 20-inch ductile iron pipe [cost to upsize]	$68,000
Transmission	27	900 South/1000 South, Main Street to 700 West; 400 West, 900 South to 1600 South 7,000 12-inch ductile iron pipe [cost to upsize]	$237,000
Total Cost, Growth Projects, 0-10 Year Phasing (2018-2028)			**$7,566,000**
Growth Projects, 10-20 Year Phasing (2028-2038)			
Storage	Evergreen Tank	3 MG tank Evergreen Cemetery site	$4,700,000
Transmission		Evergreen Cemetery to 900 South well 8,500 LF 16-inch ductile iron pipe	$2,000,000
Transmission		Evergreen Cemetery to Westfields zone 8,500 LF 16-inch ductile iron pipe	$2,000,000
Total Cost, Growth Projects, 10-20 Year Phasing (2028-2038)			**$8,700,000**
Total Cost, Growth Projects, 0-20 Year Phasing (2018-2038)			**$16,266,000**

1. The Map ID corresponds to the project number on the Master Plan Map and Capital Facilities Plan, Figure 4-1.
2. This well project is included as an alternate if efforts to transfer water rights to Bartholomew Spring are unsuccessful.
3. Costs include 20% for contingency and 15% for design.

ADDITIONAL PROJECTS THROUGH 2060

If source, storage, and transmission projects are constructed as shown in the 0-20 year phasing, no additional source, storage, or major transmission projects are anticipated to be required through 2060.

SUMMARY OF COSTS

Table 7-2 includes projects shown in Table 7-1 and is a summary of project costs attributed to future growth through 2060. This cost represents a best estimate for total cost in 2018 dollars to the City 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 7-2: Summary of Costs

Project Type	Cost
Source	$2,000,000
Storage	$9,400,000
Transmission	$4,867,000
Total	**$16,266,000**

REFERENCES

DDW (Utah Division of Drinking Water). 2014. "Laws and Rules: Drinking Water." Accessed Aug. 13. http://www.deq.utah.gov/Laws_Rules/ddw/index.htm.

DWR (Utah Division of Water Rights). 2018. Public Water Supplier Information, Saratoga Springs City. Accessed Sept. 17. https://www.waterrights.utah.gov/cgi-bin/wuseview.exe?Modinfo=Pwsview&SYSTEM_ID=1343.

EPA (U.S. Environmental Protection Agency). 2014. "EPANET: Software that Models the Hydraulic and Water Quality Behavior of Water Distribution Piping Systems." EPA. Accessed Oct. 14. http://www.epa.gov/nrmrl/wswrd/dw/epanet.html.

GOMB (Utah Governor's Office of Management and Budget). 2017. "2012 Baseline Projections: Sub-County Population Projections." Accessed Sept. 5, 2018. http://governor.utah.gov/DEA/projections.html.

Rossman, Lewis A. 2000. *EPANET 2 Users Manual.* EPA/600/R-00/057. Cincinnati, Oh.: U.S. Environmental Protection Agency, National Risk Management Research Laboratory. http://nepis.epa.gov/Adobe/PDF/P1007WWU.pdf.

State of Utah. 2014a. Utah Administrative Code, Section R309-105: Administration: General Responsibilities of Public Water Systems. In effect Aug. 1. Accessed Oct. 10. http://www.rules.utah.gov/publicat/code/r309/r309-105.htm.

———. 2014b. Utah Administrative Code, Section R309-510: Facility Design and Operation: Minimum Sizing Requirements. In effect Aug. 1. Accessed Oct. 10. http://www.rules.utah.gov/publicat/code/r309/r309-510.htm.

———. 2014c. Utah Code Annotated, Section 11-36: Impact Fees Act. Accessed Oct. 14. http://le.utah.gov/UtahCode/section.jsp?code=11-36a.

United States Census Bureau, 2017. Retrieved from https://www.census.gov/quickfacts/fact/table/springvillecityutah/RHI225217

APPENDIX A
Water System Data and Calculations

Table A-1
Growth Projections and Projected ERCs

Year	Projected ERCs				Annual ERC Growth
	Residential	Other	Nestlé	Total	
2018	10,140	4,710	3,400	18,250	-
2019	10,374	4,819	3,400	18,593	1.9%
2020	10,614	4,930	3,400	18,944	1.9%
2021	10,821	5,026	3,400	19,247	1.6%
2022	11,032	5,124	3,400	19,556	1.6%
2023	11,247	5,224	3,400	19,871	1.6%
2024	11,466	5,326	3,400	20,192	1.6%
2025	11,690	5,430	3,400	20,520	1.6%
2026	11,918	5,536	3,400	20,854	1.6%
2027	12,150	5,644	3,400	21,194	1.6%
2028	12,387	5,754	3,400	21,541	1.6%
2029	12,629	5,866	3,400	21,895	1.6%
2030	12,875	5,980	3,400	22,255	1.6%
2031	13,057	6,065	3,400	22,521	1.2%
2032	13,241	6,150	3,400	22,791	1.2%
2033	13,427	6,237	3,400	23,064	1.2%
2034	13,617	6,325	3,400	23,342	1.2%
2035	13,809	6,414	3,400	23,623	1.2%
2036	14,003	6,505	3,400	23,908	1.2%
2037	14,201	6,596	3,400	24,197	1.2%
2038	14,401	6,689	3,400	24,490	1.2%
2039	14,604	6,784	3,400	24,788	1.2%
2040	14,810	6,879	3,400	25,089	1.2%
2041	14,960	6,949	3,400	25,308	0.9%
2042	15,111	7,019	3,400	25,529	0.9%
2043	15,263	7,090	3,400	25,753	0.9%
2044	15,417	7,161	3,400	25,979	0.9%
2045	15,573	7,234	3,400	26,207	0.9%
2046	15,730	7,307	3,400	26,437	0.9%
2047	15,889	7,381	3,400	26,670	0.9%
2048	16,050	7,455	3,400	26,905	0.9%
2049	16,212	7,530	3,400	27,142	0.9%
2050	16,376	7,606	3,400	27,382	0.9%
2051	16,486	7,658	3,400	27,544	0.6%
2052	16,597	7,709	3,400	27,707	0.6%
2053	16,709	7,761	3,400	27,871	0.6%
2054	16,822	7,814	3,400	28,036	0.6%
2055	16,935	7,866	3,400	28,202	0.6%
2056	17,050	7,920	3,400	28,369	0.6%
2057	17,165	7,973	3,400	28,538	0.6%
2058	17,280	8,027	3,400	28,707	0.6%
2059	17,397	8,081	3,400	28,878	0.6%
2060	17,514	8,135	3,400	29,050	0.6%

Table A-2
System Requirements Summary, 2018-2060

	Service			Peak Day Source (gpm/ERC)	Peak Day Source (gpm/irr-ac @ 0.15 ac/ERC)	Avg. Yearly Source (ac-ft/ERC)	Avg. Yearly Source (ac-ft/irr-ac @ 0.15 ac/ERC)	Equalization Storage (MG/ERC)	Equalization Storage (MG/irr-ac @ 0.15 ac/ERC)
	ERC	Outdoor ERC	Irrigated acres						
Unit Req.				0.18	8.5	0.3	4.0	0.000230	0.006120
2018	18,250	7,356	809	3,487	9,379	5,475	4,414	4.2	6.8
Total				12,866		9,889		10.95	
2028 (10-yr)	21,917	7,397	815	4,147	9,432	6,575	4,438	5.0	6.8
Total				13,579		11,013		11.83	
2038 (20-yr)	24,287	7,397	815	4,574	9,432	7,286	4,438	5.6	6.8
Total				14,005		11,725		12.38	
2060	29,041	7,698	860	5,429	9,815	8,712	4,619	6.68	7.07
Total				15,245		13,331		13.75	

Table A-3
Existing System Source Mass Balance by Pressure Zone

Pressure Zone	Peak Day Source Required (gpm)	Source and Available Flow During Lowest Month on Record (gpm)										
		Bartholomew Springs	Burt Springs	Konold Springs	Spring Creek Springs	200 North Well	400 South Well #1	400 South Well #2	900 South Well	1000 South Well	Canyon Road Well	Evergreen Well
		448	766	188	764	2400	3000	4000	3000	570	1500	350
Bartholomew	110	110										
Kelly/Jurg	145	145										
Rotary	475	193				282						
Cherrington	320					320						
Hobble Creek	4,185		766						1948	570	901	
Lower Spring Creek	4,850			188		1100	1915		1052		599	
Westfields	1,315						1085					232
Upper Spring Creek	80				80							
Crandall	220				220							
Klauck	310				310							
Nestlé	860				154	706						
Total (gpm)	**12,870**	448	766	188	764	2400	3000	0	3000	570	1500	232
Remaining in Source (gpm)	**4,118**	0	0	0	0	0	0	4000	0	0	0	118

Legend:	Most preferred source(s). Typically closest proximity.	Next preferred.	Less preferred. May be routed through other pressure zones or require pumping.	Not preferred or not physically connected.

The values shown in the mass balance are an example, and other scenarios will also function appropriately. The table is color coded to prioritize which sources are used in each pressure zone. Prioritization is based primarily on proximity and cost effectiveness in pumping.

Table A-4
Existing System Sources Available to Each Pressure Zone

<table>
<tr><th>Pressure Zone</th><th>Sources Available Direct or by Gravity</th><th>Sources Available by Pumping</th></tr>
<tr><td>Hobble Creek Canyon</td><td>Bartholomew Springs</td><td>none</td></tr>
<tr><td>Kelly</td><td>none</td><td>Rotary Tank (Bartholomew Spring)
Lower Spring Tank (Konold Springs, Spring Creek Springs, Canyon Road, 200 North, 400 South)</td></tr>
<tr><td>Rotary</td><td rowspan="2">Rotary Tank (Bartholomew Springs)</td><td rowspan="3">Lower Spring Tank (Konold Springs, Spring Creek Springs, Canyon Road, 200 North, 400 South)</td></tr>
<tr><td>Cherrington</td></tr>
<tr><td>Hobble</td><td>900 South, 1000 South, Canyon Road, Evergreen,
Hobble Tank (Burt Springs),
Rotary Tank (Bartholomew Spring)</td></tr>
<tr><td>Lower Spring</td><td rowspan="2">200 North, 400 South,
Lower Spring Tank (Konold Springs, Spring Creek Springs),
Hobble zone [900 South, 1000 South, Canyon Road, Evergreen, Hobble Tank (Burt Springs), Rotary Tank (Bartholomew Spring)]</td><td rowspan="2">none</td></tr>
<tr><td>Westfields</td></tr>
<tr><td>Upper Spring</td><td rowspan="4">Spring Creek Springs</td><td rowspan="4">Lower Spring Tank (Konold Springs, Spring Creek Springs, Canyon Road, 200 North, 400 South), Rotary Tank (Bartholomew Spring)</td></tr>
<tr><td>Crandall</td></tr>
<tr><td>Klauck</td></tr>
<tr><td>Nestlé</td></tr>
</table>

Table A-5
Existing System Storage Mass Balance by Pressure Zone

Pressure Zone	Equalization Storage Required (MG)	Tank and Capacity (MG)								
		Bartholomew	Rotary	Jurg	Hobble Creek 1	Hobble Creek 2	Upper Spring Creek	Lower Spring Creek 1	Lower Spring Creek 2	Needed in Zone
		1.4	2.0	0.25	4.0		2.0	3.0		
Bartholomew	0.09	0.09								
Kelly/Jurg	0.11			0.11						
Rotary	0.37		0.37							
Cherrington	0.25		0.25							
Hobble Creek	3.31	0.71	1.04		1.56					
Lower Spring Creek	4.07				1.40		0.38	2.28		
Westfields	1.42				0.72			0.67		0.02
Upper Spring Creek	0.06						0.06			
Crandall	0.17						0.17			
Klauck	0.25						0.25			
Nestlé	0.84						0.84			
Equalization Total (MG)	**10.95**	0.80	1.66	0.11	3.68		1.71	2.96		0.02
Fire Suppression (MG)	**1.33**	0.50	0.24	0.12	0.22		0.24	0		
Emergency (MG)	**0.42**	0.10	0.10	0.02	0.10		0.05	0.05		
Remaining in Tank (MG)		0	0	0	0		0	0		

Legend:	Most preferred source(s). Typically closest proximity.	Next preferred.	Less preferred. May be routed through other pressure zones or require pumping.	Not preferred or not physically connected.

Table A-6
2060 System Storage Mass Balance by Pressure Zone

Pressure Zone	Equalization Storage Required (MG)	Tank and Capacity (MG)								
		Bartholomew	Rotary	Jurg	Hobble Creek 1	Hobble Creek 2	Upper Spring Creek	Lower Spring Creek 1	Lower Spring Creek 2	Needed in Zone
		1.4	2.0	0.25	4.0		2.0	3.0		
Bartholomew	0.09	0.09								
Kelly/Jurg	0.11			0.11						
Rotary	0.50		0.50							
Cherrington	0.25		0.25							
Hobble Creek	3.46	0.15	0.55		2.76					
Lower Spring Creek	4.66				0.93		0.30	0.90		2.53
Westfields	3.30									3.30
Upper Spring Creek	0.07						0.07			
Crandall	0.19						0.19			
Klauck	0.25						0.25			
Nestlé	0.85						0.85			
Equalization Total (MG)	**13.75**	0.24	1.30	0.11	3.69		1.66	2.90		5.85
Fire Suppression (MG)	**1.32**	0.50	0.25	0.12	0.21		0.24	1.00		
Emergency (MG)	**1.02**	0.40	0.30	0.02	0.10		0.10	1.10		
Remaining in Tank (MG)		0.26[1]	0.15[1]	0	0		0	0		

Legend:	Most preferred source(s). Typically closest proximity.	Next preferred.	Less preferred. May be routed through other pressure zones or require pumping.	Not preferred or not physically connected.

1 – Remaining volume in Bartholomew and Rotary tanks is needed for post-2060 growth in the canyon, Rotary, & Cherrington zones

The values shown in the mass balance are an example, and other scenarios will also function appropriately. The table is color coded to prioritize which sources are used in each pressure zone. Prioritization is based primarily on proximity and cost effectiveness in pumping.

APPENDIX B
Calibration Data

Tank Level Log

Recorded By Austin on call from ________ to ________

Date	6/27/18	6/27	6/27	6/28	6/28	6/28	6/29	6/29	6/29	6/29
Time	430 pm	930 pm	11 pm	6 am	1230 pm	440 am/pm	1 am	6 am	430 pm	730 pm
Bartholomew	9.10	9.20	8.95	9.24	~~12.30~~ 9.24	9.24	9.26	8.98	8.92	9.20
Rotary	14.06	14.49	14.53	13.54	12.66	13.79	15.02	14.81	15.58	16.16
HC east HC west	12.46	14.24	12.98	11.12	12.77	14.87	13.13	11.49	15.5	14.97 ~~18.27~~
Upper S.C.	18.72	19.16	18.93	15.67	16.08	17.41	16.92	14.46	17.01	18.21
Lower S.C.	16.67	17.65	16.41	11.52	15.08	20.66	15.52	7.35	18.83	21.03
Jurd spring	8.57	9.84	10.11	11.87	12.61	12.57	10.54	9.97	7.79	8.52
Burt Springs	On	On	On	On	On	On	On	On	On	On
10th	On	On	On	On	On	On	On	On	On	On
9th	On	Off	On	On	On	Off	On	On	Off	Off
2nd	On	On	On	On	On	On	On	On	On	Off
4th	On	On	On	On	On	On	On	On	On	On
Jurd pump	On	On	On	On	On	Off	Off	Off	On	On
Evergreen well	Off	Off	Off	Off	Off	Off	Off	Off	Off	Off
P.B. #1	Off	Off	Off	Off	Off	Off	Off	Off	Off	Off
P.B.#2	Off	Off	Off	Off	Off	Off	Off	Off	Off	Off
Canyon Rd. well	On	On	On	On	On	Off	On	On	On	On
H.C. Valve	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
S.C. Bypass	9.4 T	9.4	9.4	9.4	1.8	1.8	1.8	1.8	1.8	1.8
4th So. Valve	-3.2	776	987.1	931.4	1214	-3.2	847	746	1195	425

Tank Level Log

Recorded By Austin on call from ______________ to ______________

Date	6/29	6/30	6/30	6/30	6/30	7/1	7/1	7-1	7/1	7/1
Time	945 pm	8 am	2 pm	5.35 pm	7 pm	8 am	12 pm	3 pm	5 pm	10:15 pm
Bartholomew	9.22	8.87	8.90	9.23	8.90	8.9	9.19	9.02	9.02	9.17
Rotary	16.35	16.92	16.41	16.98	17.29	17.56	17.42	18.47	19.19	19.85
HC east HC west	15.06	13.45	15.04	13.91	13.43	10.30	11.84	14.22	15.52	13.92
Upper S.C.	18.53	17.30	19.56	19.73	19.71	17.4	19.17	19.76	19.74	19.66
Lower S.C.	19.83	17.23	19.59	21.30	21.20	11.94	16.27	21.75	21.65	20.62
Jurd spring	9.13	11.56	12.23	12.80	13.05	10.8	9.85	8.86	8.33	7.68
Burt Springs	On	On	On	On	On	On	On	On	On	On
10th	On	On	On	On	On	On	On	On	On	On
9th	On	On	Off	Off	Off	On	On	On	Off	On
2nd	Off	On	On	Off	Off	On	On	On	Off	On
4th	On	On	On	On	On	On	On	On	Off	On
Jurd pump	On	On	On	On	Off	Off	Off	Off	Off	On
Evergreen well	Off	Off	Off	Off	Off	Off	Off	Off	Off	Off
P.B. #1	Off	On\off	Off	Off	Off	Off	Off	Off	Off	Off
P.B.#2	Off	Off	Off	Off	Off	Off	Off	Off	Off	Off
Canyon Rd. well	On	Off	Off	Off	Off	On	On	On	On	On
H.C. Valve	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	23.5
S.C. Bypass	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8
4th So. Valve	923	1167	-3.2	-3.2	-3.2	1053	1172.6	128	1160	1050

Sat 6/30
8 pm 400E 136S

Tank Level Log

Recorded By Austin on call from ______________ to ______________

Date	7/2	7/2	7/2	7/3	7/3					
Time	7 **am**/pm	1 am/**pm**	11 am/**pm**	630 **am**/pm	3 am/**pm**	am/pm	am/pm	am/pm	am/pm	am/pm
Bartholomew	8.88	9.15	9.99	9.22	9.20					
Rotary	17.21	16.61	17.73	17.36	17.70					
HC east HC west	12.32	14.06	14.45	12.78	15.76					
Upper S.C.	18.94	19.70	19.59	19.37	19.74					
Lower S.C.	13.96	18.58	17.41	11.58	20.37					
Jurd spring	9.98	10.55	12.88	11.86	9.78					
Burt Springs	**On**\off	**On**\off	**On**\off	**On**\off	**On**\off	On\off	On\off	On\off	On\off	On\off
10th	**On**\off	**On**\off	**On**\off	**On**\off	**On**\off	On\off	On\off	On\off	On\off	On\off
9th	**On**\off	**On**\off	**On**\off	**On**\off	**On**\off	On\off	On\off	On\off	On\off	On\off
2nd	**On**\off	**On**\off	**On**\off	**On**\off	**On**\off	On\off	On\off	On\off	On\off	On\off
4th	**On**\off	**On**\off	**On**\off	**On**\off	**On**\off	On\off	On\off	On\off	On\off	On\off
Jurd pump	**On**\off	**On**\off	**On**\off	On**off**	On**off**	On\off	On\off	On\off	On\off	On\off
Evergreen well	On**off**	On**off**	On**off**	On**off**	On**off**	On\off	On\off	On\off	On\off	On\off
P.B. #1	On**off**	On**off**	On**off**	On**off**	On**off**	On\off	On\off	On\off	On\off	On\off
P.B.#2	On**off**	On**off**	On**off**	On**off**	On**off**	On\off	On\off	On\off	On\off	On\off
Canyon Rd. well	**On**\off	On**off**	**On**\off	**On**\off	On**off**	On\off	On\off	On\off	On\off	On\off
H.C. Valve	0.1	0.1	0.1	0.1	0.1					
S.C. Bypass	1.8	1.8	1.8	1.8	1.8					
4th So. Valve	928.7	-3.1	944.1	944.8	-3.1					

Tank Level Log

Recorded By Kent on call from 7-12-18 to 7-18-18

Date	7/12	7/12	7/13	7/13	7/14	7/16	7/16	7/17	7/17	7-18
Time	7 am/pm	3 am/pm	7 am/pm	3:30 am/pm	8:30 am/pm	7 am/pm	3:30 am/pm	8:30 am/pm	3:30 am/pm	7 am/pm
Bartholomew	10.69	9.20	9.19	10.69	10.71	10.64	9.14	9.09	9.21	9.24
Rotary	13.27	14.35	18.47	18.58	17.63	14.28	18.00	18.55	19.20	15.69
HC east HC west	11.87	14.85	10.57	13.83	14.69	11.91	14.05	11.52	15.48	12.64
Upper S.C.	13.56	14.97	14.54	16.69	19.65	17.45	19.04	16.10	17.90	15.77
Lower S.C.	11.10	18.47	8.36	18.08	20.84	11.96	19.04	18.85	20.54	5.77
Jurd spring	8.22	9.48	12.95	10.49	9.23	11.54	9.74	7.12	8.73	12.48
Burt Springs	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off
10th	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off
9th	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off
2nd	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off
4th	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off
Jurd pump	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off
Evergreen well	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off
P.B. #1	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off
P.B.#2	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off
Canyon Rd. well	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off
H.C. Valve	0	0	0	0		0	0	20	20	0
S.C. Bypass	0	0	0	0		0	0	0	0	32
4th So. Valve	1082	0	933	0		958	0	1118	0	944
pond Level							13.24	12.20	~~[illegible]~~ 12.15	11.01

Tank Level Log

Recorded By Kent on call from 7-11-18 to ______________

Date	7/11	7/11	7/11	7/13	7/14	7-15	7-15	7-16	7-18	7-19
Time	6:30 am/pm	3 am/pm	9:30 am/pm	8 am/pm	7 am/pm	8 am/pm	5 am/pm	8:30 am/pm	9 am/pm	10 am/pm
Bartholomew	9.21	9.58	10.70	10.70	10.71	10.68	10.65	9.02	9.21	9.12
Rotary	17.51	15.47	14.13	19.06	17.27	14.36	13.98	20.38	14.41	20.80
HC east HC west	9.34	12.12	14.94	15.45	12.34	11.06	15.42	14.48	13.70	13.36
Upper S.C.	15.51	16.79	17.85	18.05	17.17	16.54	19.75	19.44	17.62	16.55
Lower S.C.	5.40	15.76	19.27	20.63	13.04	12.31	21.87	19.74	20.26	19.91
Jurd spring	12.40	10.43	9.27	10.29	8.23	12.14	12.57	8.79	11.10	8.41
Burt Springs	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off
10th	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off
9th	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off
2nd	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off
4th	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off
Jurd pump	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off
Evergreen well	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off
P.B. #1	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off
P.B.#2	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off
Canyon Rd. well	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off
H.C. Valve	0	0	0	0	0	0	0	18	0	25
S.C. Bypass	37	0	0	0	0	0	0	0	0	0
4th So. Valve	850	1219	900	1013	1042	1055	1166	0	1105	1095

11.10

Tank Level Log

Recorded By Kent on call from 7-18-18 to ____________

Date	7-18	7-19	7-19	7-20	7-21	7-22				
Time	3 am/pm	7 am/pm	3 am/pm	6 am/pm	9 am/pm	11:30 am/pm	am/pm	am/pm	am/pm	am/pm
Bartholomew	8.97	9.00	9.22	8.90	8.97	9.22				
Rotary	15.22	18.59	20.55	21.45	21.21	18.53				
HC east HC west	15.21	10.75	14.00	15.04	13.83	14.96				
Upper S.C.	16.55	13.74	15.74	15.10	18.84	18.09				
Lower S.C.	18.04	12.93	21.10	19.94	20.80	20.41				
Jurd spring	12.30	9.22	6.99	12.83	7.14	10.42				
Burt Springs	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off
10th	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off
9th	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off
2nd	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off
4th	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off
Jurd pump	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off
Evergreen well	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off
P.B. #1	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off
P.B.#2	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off
Canyon Rd. well	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off
H.C. Valve	0	0	0	39	30	9				
S.C. Bypass	0	0	0		0	0				
4th So. Valve		997	0		1086	0				

Burt Springs pond | 9.69 | 10.06 12.81 14.27 14.22

Tank Level Log

Recorded By Kurt on call from 7-23-18 to 7-24-18

Date	7-23	7-23	7/24							
Time	12 am/pm	3 am/pm	10 am/pm	am/pm	am/pm	am/pm	am/pm	am/pm	am/pm	am/pm
Bartholomew	9.14	9.00	9.14							
Rotary	19.70	20.16	18.82							
HC east HC west	12.77	14.72	12.88							
Upper S.C.	19.33	19.74	16.24							
Lower S.C.	16.88	20.92	14.12							
Jurd spring	9.85	8.93	9.28							
Burt Springs	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off
10th	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off
9th	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off
2nd	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off
4th	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off
Jurd pump	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off
Evergreen well	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off
P.B. #1	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off
P.B.#2	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off
Canyon Rd. well	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off
H.C. Valve	22.9	29.9	0							
S.C. Bypass	0	0	0							
4th So. Valve	0	0	1144							

Tank Level Log

Recorded By Jake on call from 7-25-18 to 7-31-18

Date	7-25	7-25	7-25	7-26	7-26	7-26	7-27	7-28	7-28	7-28
Time	7:00 am	2:00 pm	9:20 pm	6:30 am	3:00 pm	9:40 pm	6:30 am	7:00 am	1:00 pm	10:00 pm
Bartholomew	9.12	9.02	9.10	9.07	8.98	9.19	9.12	8.98	9.10	9.08
Rotary	19.58	20.32	20.55	17.98	17.24	18.18	17.35	20.16	20.25	19.07
HC east HC west	11.60	13.85	14.11	12.11	13.88	13.31	9.81	14.86	18.78	13.35
Upper S.C.	16.01	17.28	18.58	14.63	15.14	17.05	12.68	14.62	16.31	18.80
Lower S.C.	9.39	17.28	19.56	13.45	17.58	19.40	10.15	19.32	17.71	10.60
Jurd spring	12.04	10.26	8.59	9.31	10.12	12.20	11.98	9.68	10.24	12.29
Burt Springs	On	On	On	On	On	On	On	On	On	On
10th	On	On	On	On	On	On	On	On	On	On
9th	On	On	Off	On	On	On	On	On	Off	Off
2nd	On	On	Off	On	On	On (off scribbled)	On	On	On	On
4th	On	On	On	On	On	On	On	On	On	On
Jurd pump	On	On	Off	On	On	On	Off	On	On	On
Evergreen well	Off	Off	Off	Off	Off	Off	Off	Off	Off	Off
P.B. #1	Off	Off	Off	Off	Off	Off	Off	Off	Off	Off
P.B.#2	Off	Off	Off	Off	Off	Off	Off	Off	Off	Off
Canyon Rd. well	On	On	On	On	On (scribbled)	On	On	On	On	Off
H.C. Valve	0	20	20	0	0	0	0	6	44	20
S.C. Bypass	0	0	0	0	0	0	0	0	0	0
4th So. Valve	975	1210	650	966	0	1107	834	1097	1168	0

11.65 11.20 10.60 9.26 10.25

Tank Level Log

Recorded By Jake on call from 7-25 to 7-31-18

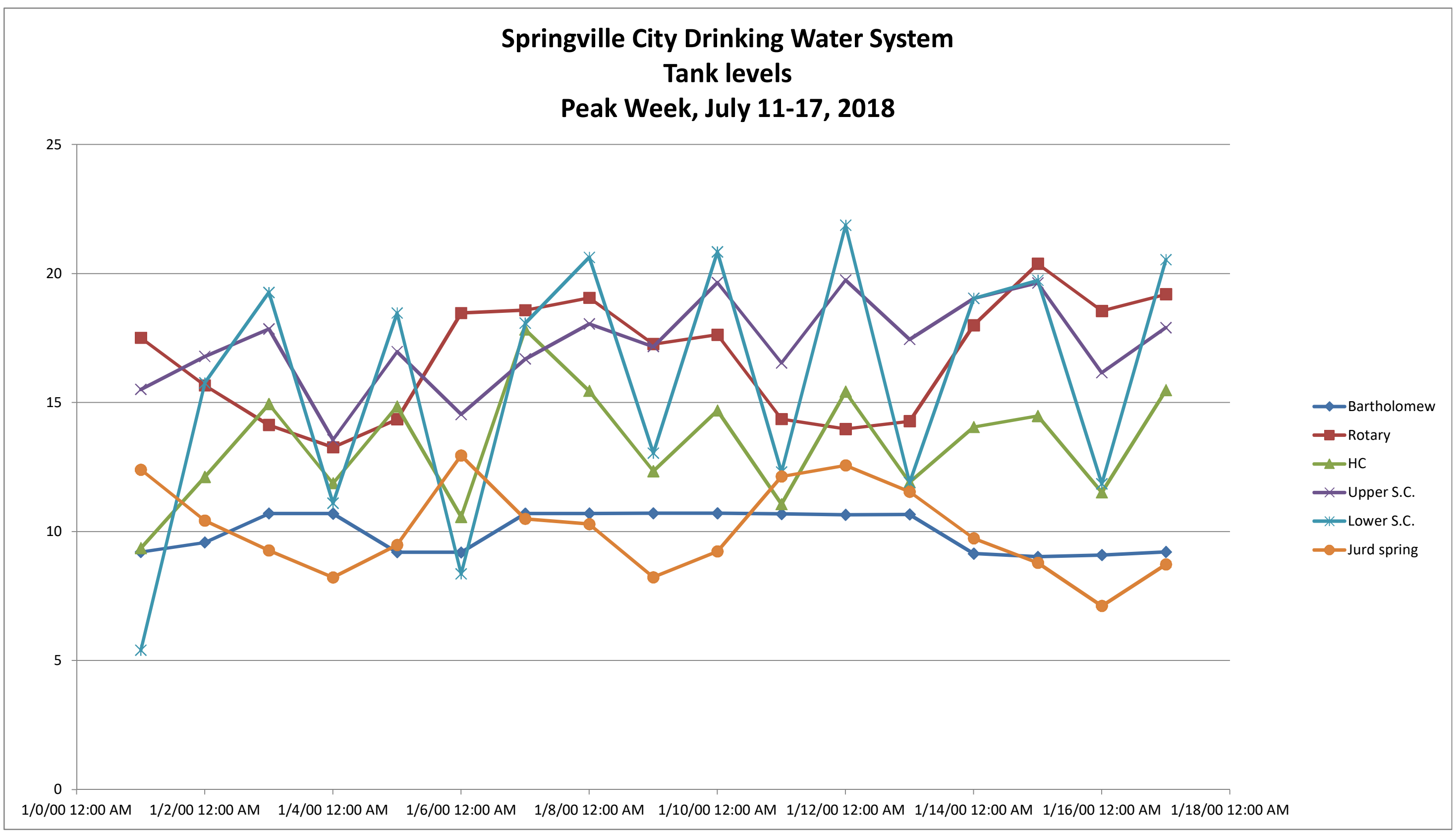
Date	7-29	7-29	7-29	7-29	7-30	7-30	7-30	7-31	7-31	
Time	2:00 am/pm	2:30 am/pm	9:15 am/pm	10:15 am/pm	8:20 am/pm	5:30 am/pm	10:10 am/pm	7:40 am/pm	3:45 am/pm	am/pm
Bartholomew	9.19	9.10	8.97	8.93	9.12	9.19	9.06	9.01	9.11	
Rotary	19.40	19.85	18.91	18.61	16.79	18.85	20.13	18.42	20.82	
HC east HC west	12.73	14.28	11.42	14.21	12.33	14.93	[illegible]	11.08	15.16	
Upper S.C.	17.64	19.67	16.93	19.65	17.89	19.74	19.50	16.92	19.44	
Lower S.C.	16.27	19.24	13.12	15.41	9.18	21.11	18.37	11.90	21.04	
Jurd spring	12.94	9.76	11.20	7.62	8.36	10.06	11.08	12.65	10.77	
Burt Springs	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off
10th	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off
9th	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off
2nd	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off
4th	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off
Jurd pump	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off
Evergreen well	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off
P.B. #1	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off
P.B.#2	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off
Canyon Rd. well	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off	On\off
H.C. Valve	23	22	22	25	0	0	0	0	0	
S.C. Bypass	0	0	0	0	0	0	0	0	0	
4th So. Valve	970	0	1084	100	1060	0	1027	1063	0	

13.67

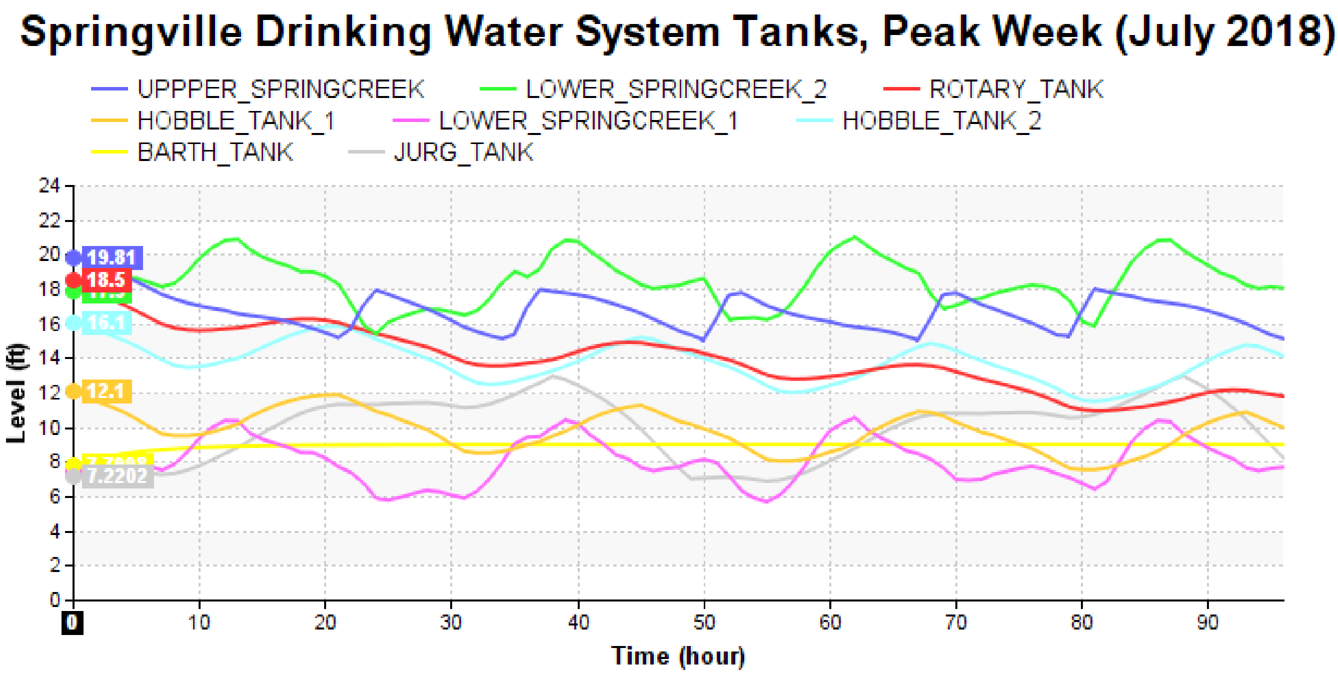
13.55

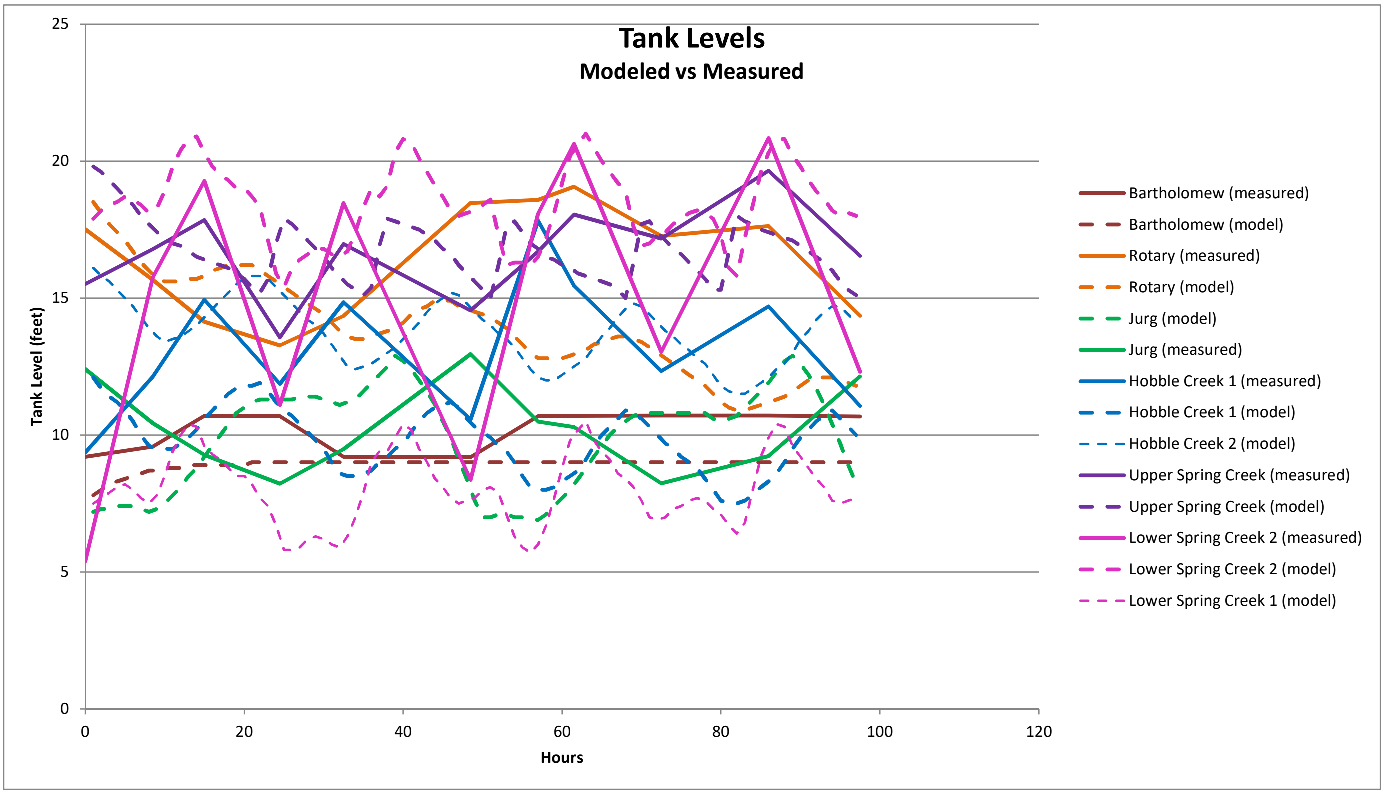
Springville City Drinking Water System
Tank Level Calibration Data
Peak Week, July 11-17, 2018

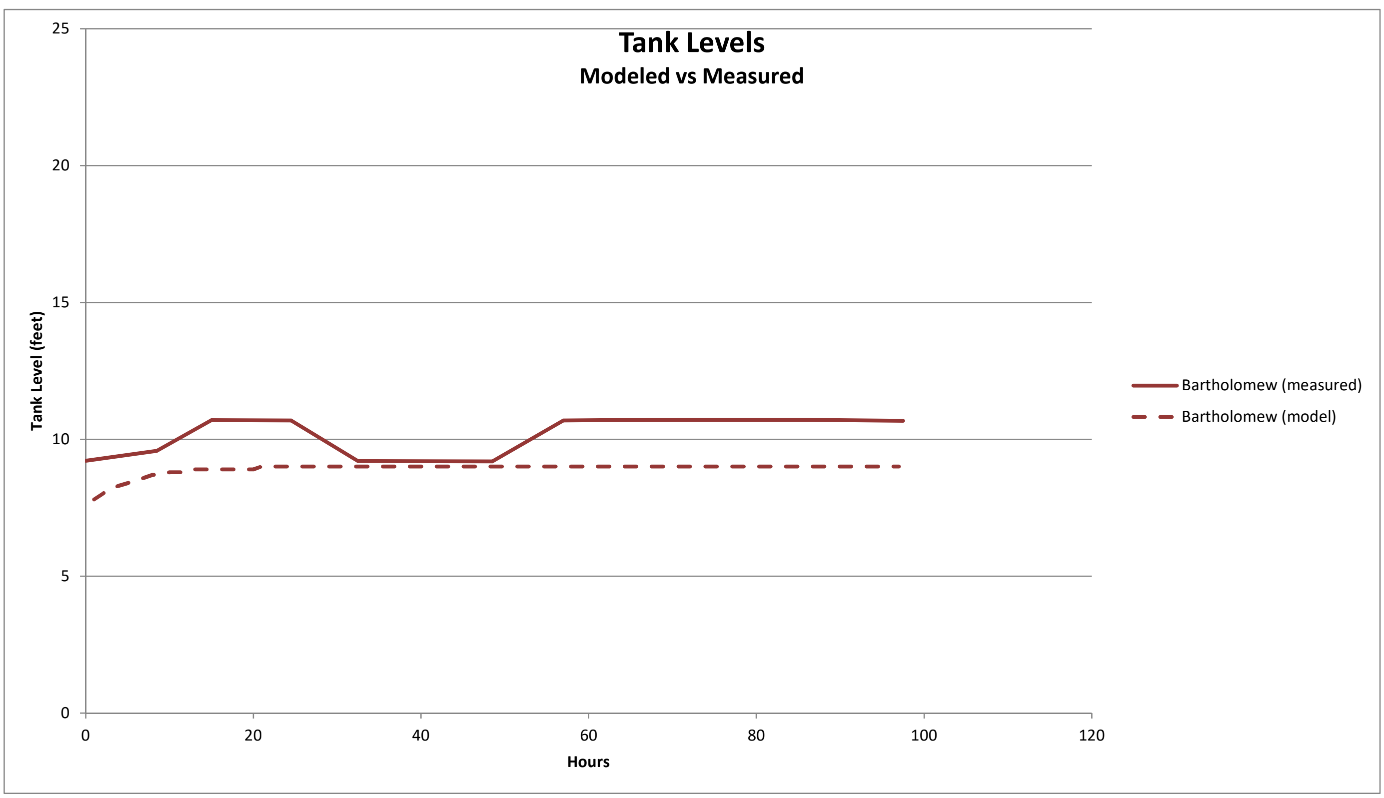
Date	11-Jul	11-Jul	11-Jul	12-Jul	12-Jul	13-Jul	13-Jul	13-Jul	14-Jul	14-Jul	15-Jul	15-Jul	16-Jul	16-Jul	16-Jul	17-Jul	17-Jul
Time	6:30	15:00	21:30	7:00	15:00	7:00	15:30	20:00	7:00	20:30	8:00	17:00	7:00	15:30	20:30	8:30	15:30
Bartholomew	9.21	9.58	10.7	10.69	9.2	9.19	10.69	10.7	10.71	10.71	10.68	10.65	10.66	9.14	9.02	9.09	9.21
Rotary	17.51	15.67	14.13	13.27	14.35	18.47	18.58	19.06	17.27	17.63	14.36	13.98	14.28	18	20.38	18.55	19.2
HC	9.36	12.12	14.94	11.87	14.85	10.57	17.83	15.45	12.34	14.69	11.06	15.42	11.91	14.05	14.48	11.52	15.48
Upper S.C.	15.51	16.79	17.85	13.56	16.97	14.54	16.69	18.05	17.17	19.65	16.54	19.75	17.45	19.04	19.64	16.16	17.9
Lower S.C.	5.4	15.76	19.27	11.1	18.47	8.36	18.08	20.63	13.04	20.84	12.31	21.87	11.9	19.04	19.74	11.85	20.54
Jurd spring	12.4	10.43	9.27	8.22	9.48	12.95	10.49	10.29	8.23	9.23	12.14	12.57	11.54	9.74	8.79	7.12	8.73
Burt spring	On	On	On	On	On	On	Off	Off	On	On	on	on	on	on	on	on	on
10th	On	On	On	On	On	On	On	On	On	On	on	on	on	on	on	on	on
9th	On	On	On	On	On	On	On	Off	On	on	on	off	on	on	off	on	off
2nd	On	On	On	On	On	On	On	Off	On	off	on	off	on	on	on	on	on
4th	On	On	On	On	On	On	On	On	On	on	on	off	on	on	on	on	on
Jurd pump	Off	Off	Off	On	On	On	Off	Off	Of	on	on	off	off	off	off	on	on
Evergreen well	Off	Off	Off	Off	Off	Off	Off	Off	Off	off	off	off	off	off	off	off	off
P.B. #1	Off	Off	Off	Off	Off	Off	Off	Off	Off	off	off	off	off	off	off	off	off
P.B. #2	Off	Off	Off	Off	Off	Off	Off	Off	Off	off	off	off	off	off	off	off	off
Canyon Rd well	On	On	On	On	On	On	On	On	On		on	on	on	off	off	on	off
H.C. valve	0	0	0	0	0	0	0	0	0		0	0	0	0	18	20	20
S.C. Bypass	37	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0
4th So. Valve	850	219	900	1082	0	933	0	1013	1042		1055	1166	958	0	0	1118	0
Pond level														13.24		12.2	12.15

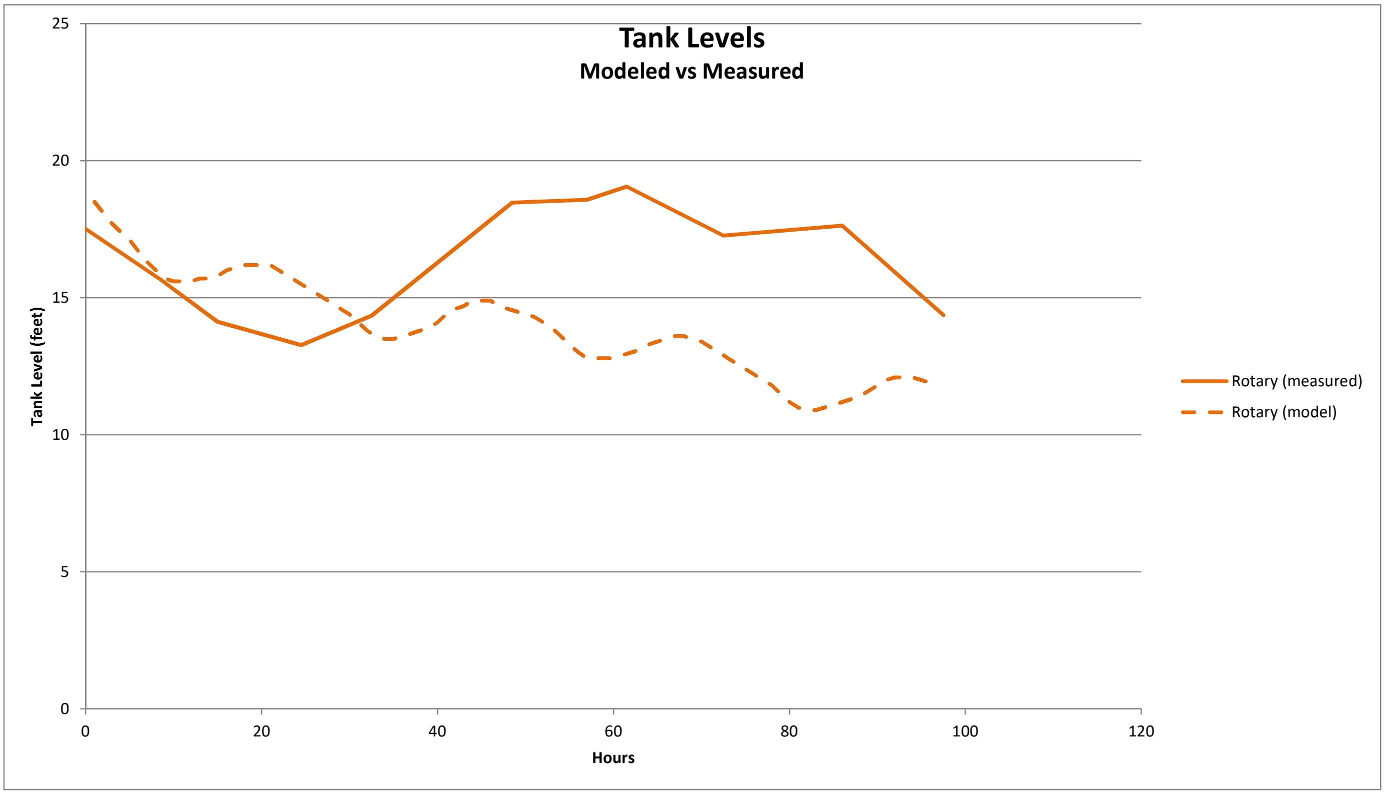


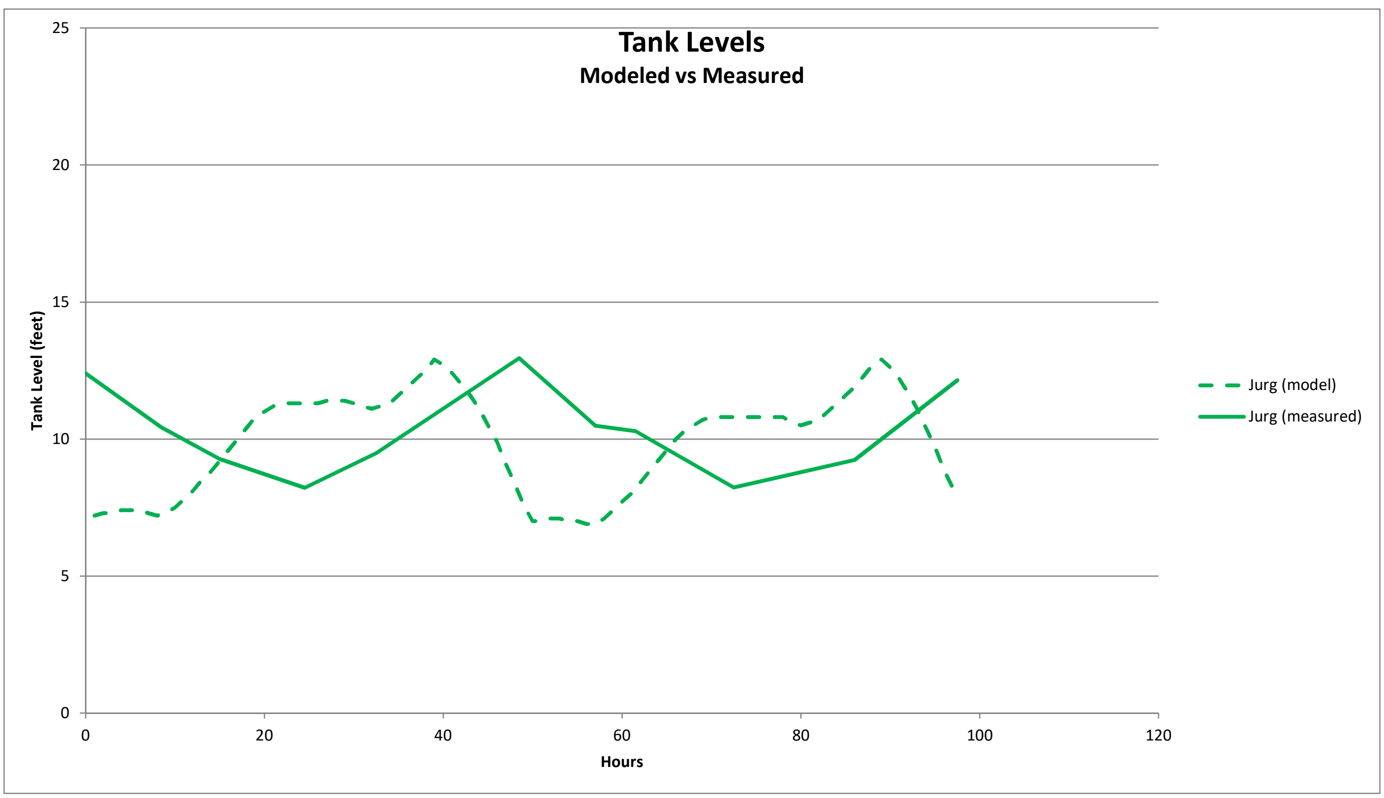
Springville City Existing (2018) Drinking Water System
InfoWater Tank Level Output

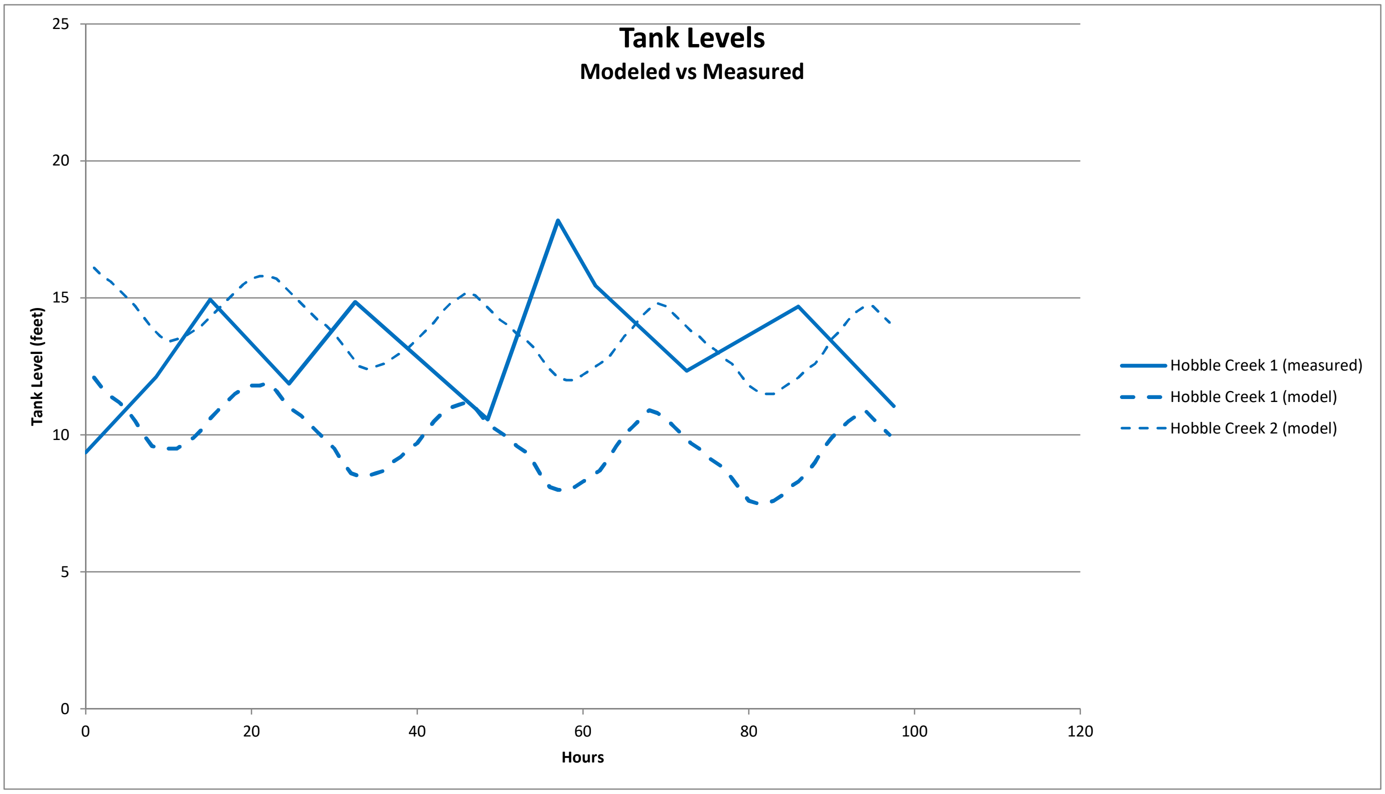


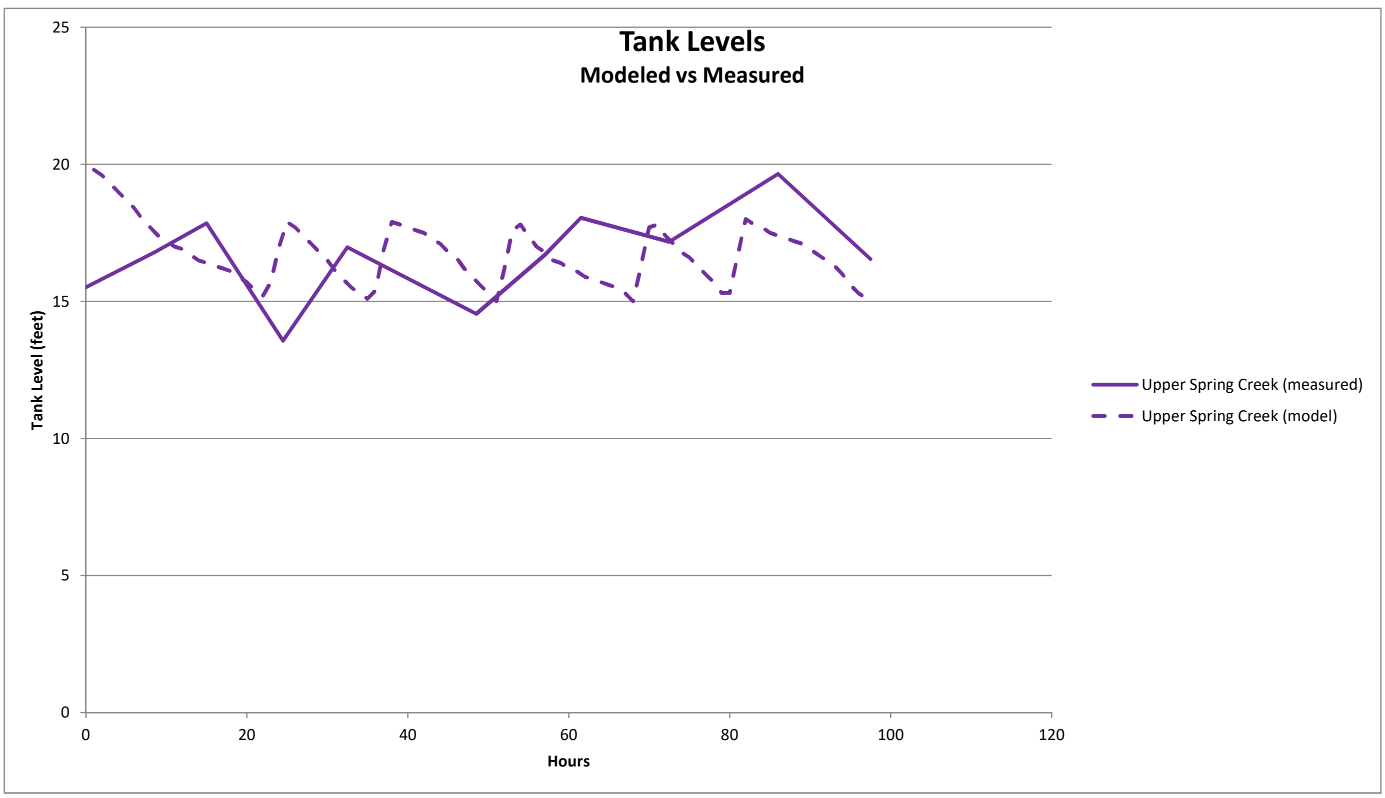

Tank Levels
Modeled vs Measured
Tank Level (feet)
Hours
0
5
10
15
20
25
0
20
40
60
80
100
120
Bartholomew (measured)
Bartholomew (model)
Rotary (measured)
Rotary (model)
Jurg (model)
Jurg (measured)
Hobble Creek 1 (measured)
Hobble Creek 1 (model)
Hobble Creek 2 (model)
Upper Spring Creek (measured)
Upper Spring Creek (model)
Lower Spring Creek 2 (measured)
Lower Spring Creek 2 (model)
Lower Spring Creek 1 (model)

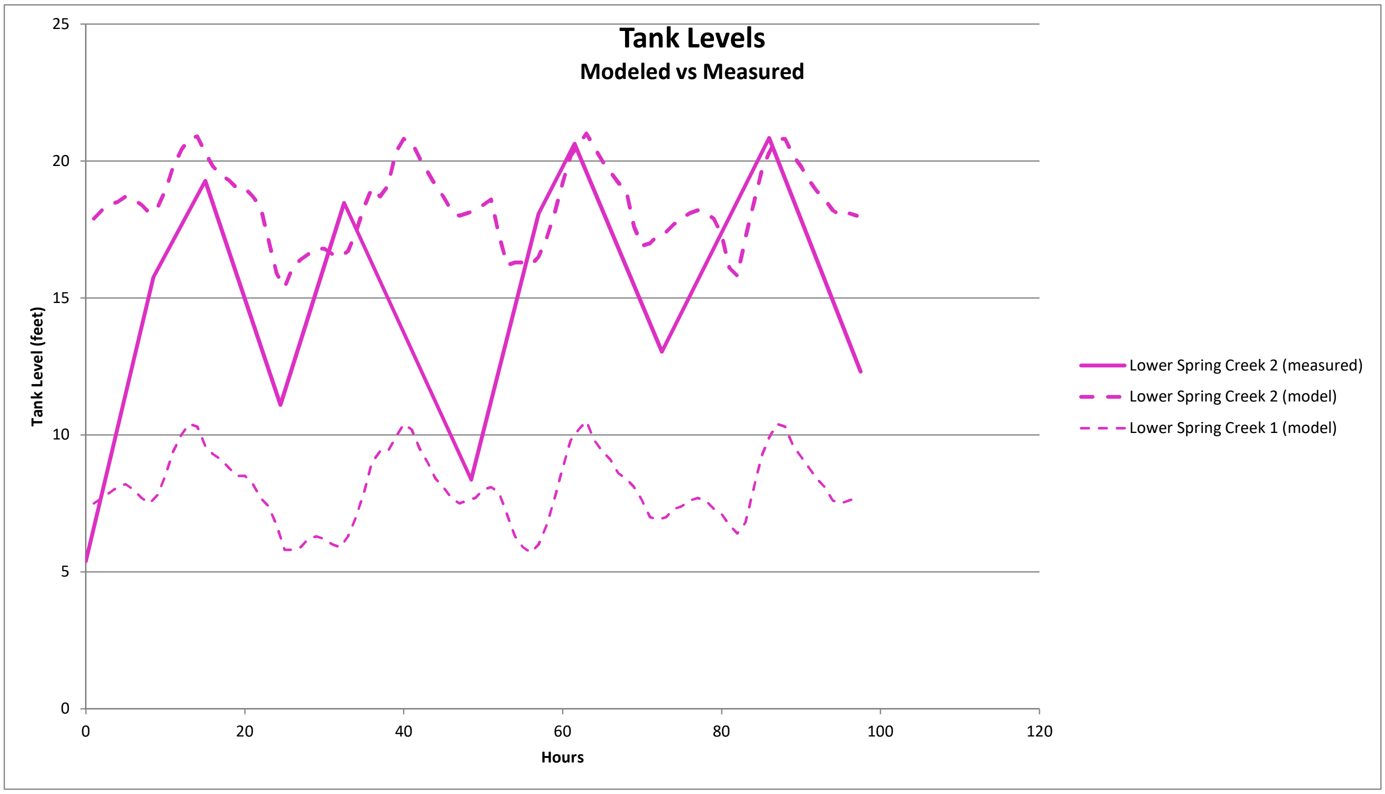

Tank Levels
Modeled vs Measured
Tank Level (feet)
Hours
0
5
10
15
20
25
0
20
40
60
80
100
120
Bartholomew (measured)
Bartholomew (model)


Tank Levels
Modeled vs Measured
Tank Level (feet)
Hours
Rotary (measured)
Rotary (model)
0
5
10
15
20
25
0
20
40
60
80
100
120


Tank Levels
Modeled vs Measured
Tank Level (feet)
Hours
Jurg (model)
Jurg (measured)
0
5
10
15
20
25
0
20
40
60
80
100
120


Tank Levels
Modeled vs Measured
Tank Level (feet)
25
20
15
10
5
0
0
20
40
60
80
100
120
Hours
Hobble Creek 1 (measured)
Hobble Creek 1 (model)
Hobble Creek 2 (model)


Tank Levels
Modeled vs Measured
Tank Level (feet)
25
20
15
10
5
0
0
20
40
60
80
100
120
Hours
Upper Spring Creek (measured)
Upper Spring Creek (model)


Tank Levels
Modeled vs Measured
Tank Level (feet)
Hours
0
5
10
15
20
25
0
20
40
60
80
100
120
Lower Spring Creek 2 (measured)
Lower Spring Creek 2 (model)
Lower Spring Creek 1 (model)

Wat - Pressure Concern Tasks from 4/1/2015 to 12/31/2018

Division: Water Completed: 179 Total: 185

Date Created	Service Order	Task #	Asset/Address	Status	
04/08/2015	SO-6608	14030	2500 CANYON ROAD	Complete	72 PSI on Hose bib
04/21/2015	SO-6936	14369	998 N 500 E	Complete	bad PRV
04/22/2015	SO-6951	14385	636 S 200 E	Complete	75 PSI
04/28/2015	SO-7102	14538	853 S HOUTZ AVE	Complete	62 PSI
04/30/2015	SO-7220	14658	821 E 1125 N	Complete	80
05/04/2015	SO-7415	14854	611 W 650 S	Complete	46 PRV too low
05/26/2015	SO-8111	16576	1772 W 1065 S	Complete	40 bad PRV
05/26/2015	SO-8118	16583	1726 W 970 S	Complete	86
06/03/2015	SO-8436	16913	634 S 1840 E	Complete	54 bad PRV
06/03/2015	SO-8459	16936	1516 E 400 S	Complete	50
06/10/2015	SO-8671	17155	2094 S 400 E	Complete	78
06/18/2015	SO-8942	17440	903 ARTISTIC CIRCLE	Complete	95
06/22/2015	SO-9022	17521	1123 W 1550 S	Complete	65 Hose bib
06/23/2015	SO-9089	17600	292 N 950 W	Complete	40 low PRV setting
06/25/2015	SO-9129	17684	242 N 550 W (HOUSE POWER)	Complete	75
06/25/2015	SO-9139	17659	1267 E 225 N	Complete	55
06/25/2015	SO-9175	17696	691 S 750 W	Complete	110
06/26/2015	SO-9223	17748	760 E 1000 S	Complete	115
07/01/2015	SO-9341	17880	Brookline Condos 425 S. 2500 W.	Complete	90
07/01/2015	SO-9436	17979	1516 E. 400 S.	Complete	65 adjusted PRV
07/02/2015	SO-9480	18022	275 E 2200 S	Complete	100
07/14/2015	SO-9840	18393	837 W. 1325 S.	Complete	68
07/15/2015	SO-9891	18445	380 E 200 N	Complete	105
09/03/2015	SO-11809	22960	614 E 600 N	Complete	100
09/25/2015	SO-12554	24551	1233 S 2450 E	Complete	80
09/29/2015	SO-12702	24702	887 S 800 E	Complete	80 low flow, restrictions in pipe.
10/01/2015	SO-12822	24858	84 N 1230 E	Complete	90
10/01/2015	SO-12823	25620	663 S 2080 E	Complete	80

10/19/2015	SO-13362	27123	1582 W 970 S	Complete	50 bad PRV
10/19/2015	SO-13363	27124	310 W CENTER	Complete	125
10/21/2015	SO-13444	27205	310 W CENTER	Complete	?
11/06/2015	SO-13980	28463	457 S 1680 E	Complete	60 At Hose bib
11/12/2015	SO-14097	28583	45 A STREET	Complete	85
11/12/2015	SO-14098	28584	45 A STREET	Complete	85
12/01/2015	SO-14418	28929	200 E 1300 N	Complete	105
12/10/2015	SO-14654	29174	1277 W 1300 S	Complete	ok now
12/11/2015	SO-14701	29221	1040 E 200 N	Complete	105
12/14/2015	SO-14707	29227	340 W 300 S	Complete	60
12/28/2015	SO-15001	29538	1167 S 2100 E	Complete	? prob. inside house
12/31/2015	SO-15099	29647	834 N 600 E	Complete	52 bad PRV
01/08/2016	SO-15434	31815	167 S 1125 W	Complete	80
01/13/2016	WAT-00015457	31889	203 E 2500 S	Complete	75
01/19/2016	WAT-00015483	31965	1260 W 1650 N	Complete	125
01/20/2016	WAT-00015497	32029	742 W 1330 S	Complete	70
01/20/2016	WAT-00015498	32033	2780 E CANYON ROAD	Complete	75
02/10/2016	WAT-00015595	32459	1535 N MTN SPRINGS PKW	Complete	bad PRV
02/12/2016	WAT-00015605	32509	1696 E 700 S	Complete	70
02/29/2016	WAT -00015686	32844	691 S HOUTZ AVE.	Complete	70
02/29/2016	WAT -00015689	32850	99 E 200 S	Complete	75
03/07/2016	WAT -00015738	33184	522 W 100 S	Complete	[illegible]
03/22/2016	WAT -00015836	34426	635 N 880 E	Complete	62 at Bib
04/11/2016	WAT -00015983	39603	649 S 170 W	Complete	55 at Bib
04/15/2016	WAT -00016024	39806	821 E 1125 N	Complete	? bad PRV
04/19/2016	WAT -00016051	39904	1875 S STATE	Complete	105
04/20/2016	WAT -00016055	39913	1373 E 950 S	Complete	105
04/20/2016	WAT -00016060	39927	1091 S 500 E	Complete	35 bad PRV
04/22/2016	WAT -00016080	40120	267 N 200 E	Complete	115
04/27/2016	WAT -00016116	40411	795 E 400 N	Complete	105
05/06/2016	WAT -00016225	40999	1076 S 2450 E	Complete	80
05/16/2016	WAT -00016284	42302	1771 W 910 S	Complete	?

05/27/2016	WAT -00016371	43123	1717 W 1300 S	Complete	100
05/27/2016	WAT -00016384	43157	306 E 800 S	Complete	70 water leak
06/13/2016	WAT -00016552	43944	2645 CANYON ROAD	Complete	64 bad PRV?
06/16/2016	WAT -00016584	44140	3876 S GRINDSTONE DR LOT # 8	Complete	? tank was off
06/16/2016	WAT -00016597	44181	115 N 1540 E	Complete	65
06/22/2016	WAT -00016642	44443	184 E 2550 S	Complete	105 bad PRV
06/23/2016	WAT -00016648	44491	360 W 300 N	Complete	125
06/27/2016	WAT -00016666	44612	30 B STREET	Complete	80
07/08/2016	WAT -00016790	45197	1091 S 2000 E	Complete	80 PRV bad
07/19/2016	WAT -00016874	46864	1998 E 700 S	Complete	100 PRV bad
07/20/2016	WAT -00016877	46905	591 E 1150 N	Complete	100 PRV bad
07/20/2016	WAT -00016884	46954	1291 E 225 N	Complete	50 ~~town~~ tank elev.
08/02/2016	WAT -00016988	47646	661 N 350 W	Complete	? bad PRV
08/12/2016	WAT -00017078	48382	336 W 550 N	Complete	80 bad PRV
09/27/2016	WAT -00017458	52000	949 S 2300 E	Complete	80 bad PRV
10/13/2016	WAT -00017643	53942	515 E 400 N	Complete	85
10/14/2016	WAT -00017651	53998	1045 N SPRING CREEK PLACE	Complete	90
10/17/2016	WAT -00017660	54038	180 W 200 N	Complete	? plugged water tap
10/19/2016	WAT -00017684	54120	1179 W 100 S	Complete	? bad PRV
10/21/2016	WAT -00017704	54241	2497 W 500 S # 6	Complete	? bad PRV
10/25/2016	WAT -00017724	54358	961 W 125 N	Complete	80
10/27/2016	WAT -00017738	54467	1392 S 1700 W	Complete	80
11/02/2016	WAT -00017806	54756	1650 N 1350 W	Complete	150 water leak & PRV
11/23/2016	WAT -00017932	55492	1912 E 600 S	Complete	?
12/22/2016	WAT -00018054	56371	494 E 400 S	Complete	? bad faucet in kitchen
01/18/2017	WAT -00018140	56855	477 W 50 S	Complete	?
01/25/2017	WAT -00018164	57057	809 S 2000 E	Complete	105 - PRV bad
01/27/2017	WAT -00018176	57143	602 N 400 E	Complete	110 bad PRV
02/01/2017	WAT -00018218	57328	2572 E 925 S	Complete	75
02/02/2017	WAT -00018229	57389	1154 E CLARMONT DR	Complete	? broken sprinkler
02/16/2017	WAT -00018424	58082	101 W 450 N	Complete	105 bad PRV
03/06/2017	WAT -00018582	58705	615 E 700 S	Complete	65

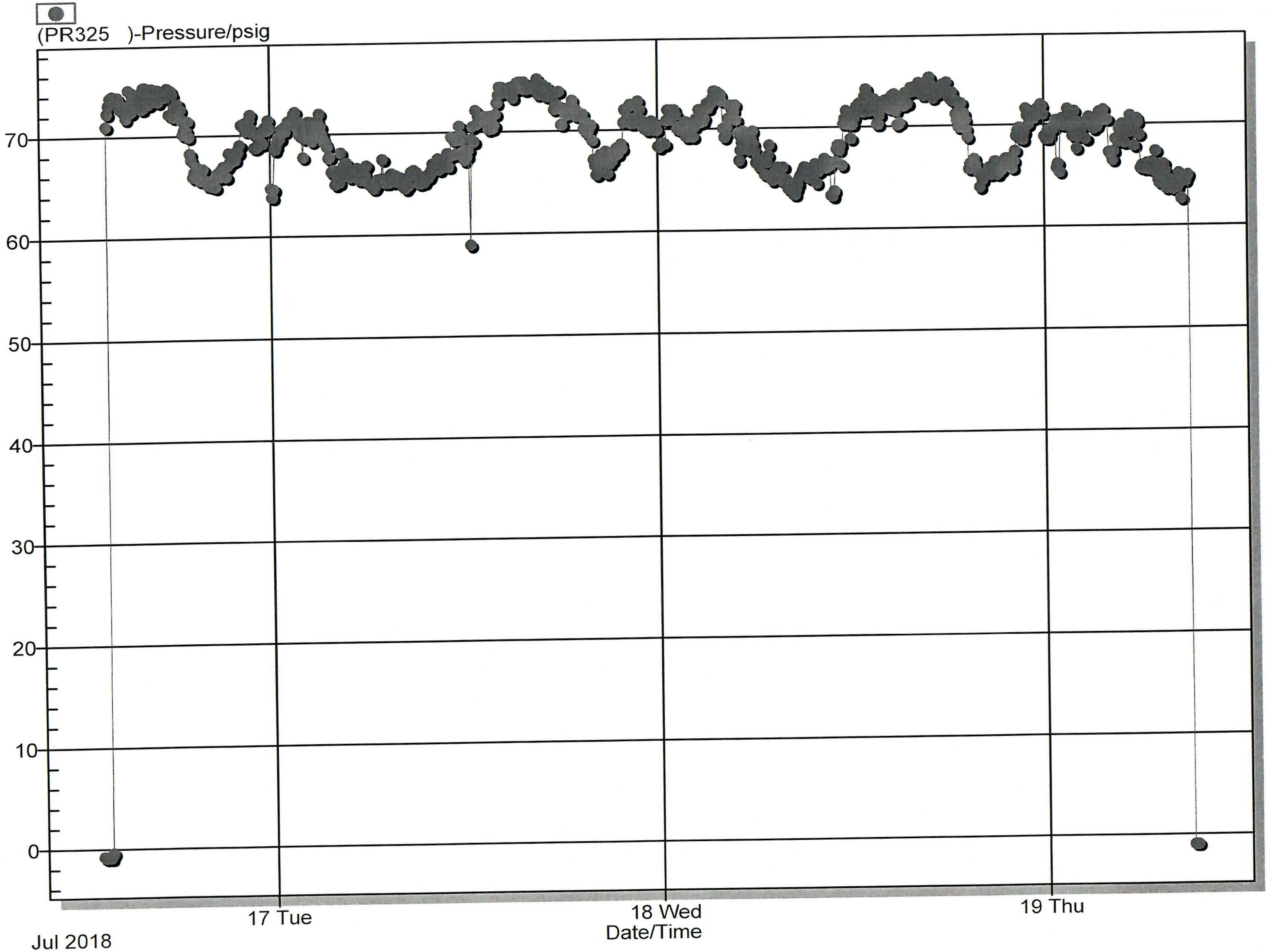
03/21/2017	WAT -00018679	59237	582 E 900 S	Complete	55 bad PRV?
03/28/2017	WAT -00018781	59575	1779 W 910 S	Complete	50 adjust PRV
03/29/2017	WAT -00018790	59606	1188 W 200 S	Complete	85 bad PRV
03/29/2017	WAT -00018799	59641	445 E 200 N	Complete	pressure check
04/10/2017	WAT -00018920	60126	860 E 1150 S	Complete	?
05/08/2017	WAT -00019167	62593	843 E 300 S	Complete	Stop & waste was off
05/10/2017	WAT -00019186	62757	2594 E 700 S	Complete	50
05/12/2017	WAT -00019211	62886	10 KOLOB CIRCLE	Complete	Stop & waste on 1/2 way
05/19/2017	WAT -00019266	63271	616 E CUTLER AVE	Complete	105 bad PRV
05/19/2017	WAT -00019267	63274	843 W 1450 S	Complete	50 bad PRV
05/19/2017	WAT -00019273	63285	467 N 970 E	Complete	55
05/23/2017	WAT -00019290	63456	676 S 800 E	Complete	60 bad PRV
06/05/2017	WAT -00019451	64085	1834 SPRING OAKS DRIVE	Complete	? ok
06/08/2017	WAT -00019530	64444	244 W CENTER	Complete	ok PRV was replaced
06/15/2017	WAT -00019575	64760	544 E 800 S	Complete	75 PRV bad
06/16/2017	WAT -00019608	64870	837 N 970 E	Complete	45, adjusted to 55
06/20/2017	WAT -00019653	65107	469 E 850 N	Complete	?
06/27/2017	WAT -00019708	65425	511 E AARON AVE	Complete	? new line installed
07/13/2017	WAT -00019897	66500	190 N 1440 E	Complete	booster pump bad
07/13/2017	WAT -00019898	66502	1834 SPRING OAKS DRIVE	Complete	ok
08/15/2017	WAT -00020228	69271	1878 SPRING OAKS DRIVE	Complete	bad water softener
08/18/2017	WAT -00020264	70520	185 E 2650 S	Complete	bad PRV
08/21/2017	WAT -00020265	70532	1749 E 750 S	Complete	60
08/24/2017	WAT -00020316	70782	30 S 300 W	Complete	100
09/06/2017	WAT -00020418	71315	2513 E 700 S	Complete	soft water unit
09/07/2017	WAT -00020456	72526	45 S 1300 E	Complete	80 water heater
09/11/2017	WAT -00020476	72588	854 N 600 E	Complete	85 Klauck PRV ↓ to 70
09/11/2017	WAT -00020484	72625	262 E 200 S	Complete	leak in sprinkler
09/13/2017	WAT -00020501	73751	854 N 600 E	Complete	65
09/18/2017	WAT -00020525	73991	230 E 200 S	Complete	95
09/20/2017	WAT -00020540	74065	609 S 1840 E	Complete	? const. near by
09/20/2017	WAT -00020541	74079	671 S 1840 E	Complete	? const. near by

09/22/2017	WAT -00020559	74239	235 E 700 S	Complete	85
09/22/2017	WAT -00020570	74259	477 W 50 S	Complete	?
10/03/2017	WAT -00020694	75780	1373 E 400 S	Complete	? soft water unit
10/12/2017	WAT -00020764	77281	248 S 550 W (HOUSE POWER)	Complete	HOA
10/25/2017	WAT -00020842	77916	1025 E 140 N	Complete	80 bad PRV
10/26/2017	WAT -00020863	77977	1814 E 875 S	Complete	55
10/30/2017	WAT -00020913	78126	1649 E CRANDALL DRIVE	Complete	95
11/13/2017	WAT -00021031	79669	2929 E THIRTY OAKS DR	Complete	65 water softener?
11/13/2017	WAT -00021031	79669	2929 E THIRTY OAKS DR	Complete	" "
11/29/2017	WAT -00021129	80337	1103 E 350 S	Complete	PRV
12/05/2017	WAT -00021167	80533	1267 E 225 N	Complete	?
12/08/2017	WAT -00021185	80658	375 E 1150 N	Complete	50
12/11/2017	WAT -00021198	80741	120 S 200 E	Complete	leak in backyard
12/28/2017	WAT -00021260	83233	50 N 1440 E	Complete	?
01/02/2018	WAT -00021266	83251	1853 E 850 S	Complete	ok
01/31/2018	WAT -00021438	85016	182 W 450 N	Complete	115 bad PRV
02/26/2018	WAT -00021565	86289	951 N 600 E	Complete	? bad PRV
02/27/2018	WAT -00021572	86335	488 W 200 S	Complete	? bad PRV
03/08/2018	WAT -00021644	87850	490 E 700 S	Complete	plugged screens
03/13/2018	WAT -00021661	88957	SMITH CLINIC # 1	Complete	bad PRV
03/26/2018	WAT -00021764	89787	184 E 800 S	Complete	bad water softener
03/26/2018	WAT -00021765	89795	230 N 650 W (NET METERING)	Complete	40 bad PRV
04/05/2018	WAT -00021874	91456	101 N 1300 E	Complete	95
04/11/2018	WAT -00021921	91772	1055 S 2500 E	Complete	55
04/23/2018	WAT -00022017	93471	636 E KOLOB CIRCLE	Complete	85
04/25/2018	WAT -00022032	93677	155 S 1100 W	Complete	bad PRV
04/30/2018	WAT -00022055	93840	2507 S 150 E	Complete	20 bad PRV
04/30/2018	WAT -00022072	93991	524 E 900 S	Complete	bad PRV
05/02/2018	WAT -00022098	94215	1432 S 1400 W	Complete	bad PRV
05/07/2018	WAT -00022113	94407	88 C STREET	Complete	prob. solved
05/08/2018	WAT -00022126	94475	379 BROOKSIDE DR	Complete	bad faucet
05/11/2018	WAT -00022149	95705	1018 W 1500 S	Complete	ok

05/16/2018	WAT -00022177	96935	332 E 700 N	Complete	68 adjusted PRV
05/21/2018	WAT -00022195	97114	402 E 800 N	Complete	bad PRV
05/22/2018	WAT -00022225	97272	1553 E 300 S	Complete	bad PRV
05/23/2018	WAT -00022237	97357	1384 W 1400 S	Complete	72
05/24/2018	WAT -00022245	97414	638 BROOKSIDE DR	Complete	62 bad PRV
05/29/2018	WAT -00022295	97626	1875 S STATE	Complete	ok
05/29/2018	WAT -00022297	97629	243 S 400 E	Complete	90 hard water deposits
05/30/2018	WAT -00022313	97704	676 S 800 E	Complete	60 bad PRV
06/01/2018	WAT -00022366	97951	1236 E 50 N	Complete	80
06/12/2018	WAT -00022461	98403	307 W 700 S	Complete	bad PRV
06/19/2018	WAT -00022518	98760	2255 E CANYON RD	Complete	ok
06/19/2018	WAT -00022519	98762	261 W 300 S	Complete	PRV set low
06/21/2018	WAT -00022549	99005	457 N 100 E	Complete	?
06/27/2018	WAT -00022587	100302	1198 N SPRING CREEK PL - BLDG B	Complete	bad PRV
06/28/2018	WAT -00022591	100366	2228 S 175 E	Complete	sprinkler prob.
07/11/2018	WAT -00022707	102129	141 W 900 N	Complete	bad PRV
07/11/2018	WAT -00022708	102140	766 S 475 E	Complete	40 adjust PRV
07/11/2018	WAT -00022709	102141	772 S 475 E	Complete	35 adjust PRV
07/11/2018	WAT -00022711	103168	216 N 200 E (8 PLEX)	Complete	bad PRV
07/20/2018	WAT -00022786	103897	434 N 550 E	Complete	ok
07/23/2018	WAT -00022800	103987	205 W 900 N	Complete	ok
08/23/2018	WAT -00023055	106022	477 W 50 S	Complete	?
08/27/2018	WAT -00023082	106156	30 S 300 W	Ready for Review	100
08/31/2018	WAT -00023131	107473	1191 S 950 W	Ready for Review	95 bad PRV
08/31/2018	WAT -00023132	107474	222 E 2525 S	Ready for Review	bad PRV
09/06/2018	WAT -00023154	107764	1007 W 1000 S	Ready for Review	90
09/14/2018	WAT -00023214	108128	785 S 100 E (4 PLEX)	Pending	
09/14/2018	WAT -00023214	108128	785 S 100 E (4 PLEX)	Pending	
09/18/2018	WAT -00023237	108237	450 E 900 N	Complete	?

Downloaded Data - Thursday, July 19, 2018

2395 E. 850 So.



Month ___________ Year___________ Week 1 2 3 4 5

PRV	Date	Up stream Pressure	Down stream Pressure	Main line Size & cat # Stock #	Low flow line Size & cat # Stock #	Sight Glass Large valve Small valve
North of hydro Rotary (**North**)		480	150	4/cla 4-90-0 ibcsy 90-01-6686A 4 in. cla	1-2 in. cla 1-2 in phisher	
Rotary (**South)** North of hydro New vault		150	80	4 in. cla		
Rotary flow control PRV		480	150	8/cla 90-01bcsy 90-01-8472b Anti-cavitation		no
Jolly's park In canyon		90	60	4 in/cla	1 in.	
Hobble Creek 3100 e. canyon rd.		105	58	6 in/cla 92-01b 92-01-1301h	2 ½ in cla 92-01 92-01-1841c	L-yes
600 S. 2080 E.	Not used			Straight pipe	Straight pipe	
441 S 2080 E		100	60	12 in/cla 92-01bc 92-01-1556	4 in/cla 92-01b	L-yes S-yes
475 S. 1850 E.	Not used			12 in/cla 92-01b 92-017858	4in/cla 92-01b 92-01-706k	L-yes S-no
1678 e. center Crandall		130	80	12 in/cla 92-01b 92-01-1044d	4in/cla 92-01b 92-01-301k	L-yes S-yes
1111 E 50 N		110	75	8 in/cla 92-01b 92-01-6376g	4in/cla 92-01b 92-01-301k	L-yes S-no
900 S 800 E		105	80	12 in/cla 92-01b 92-01-1044d	4 in/cla 92-01b 92-01-301k	L-yes S-yes
1000 S 600 E		105	80	8 in/cla 92-01b 92-01-637g	2 ½ in/cla92-01b 92-01-1849f	L-yes S-no
880 E 400 N		130	95	8in/cla 8-900121 90-01-5300k	4in/cla 90-01by	L-yes S-no
1125 N 800 E Klauck		100	65	8 in/cla 90-01ab 90-01-157a		L-yes
500 e. 1350 n. Strong's		110	18	12 in/cla 618b 90-01-2110	4 in/cla 90-018b	L-yes S-yes
(***Hooks***) 900 N Main		115	75	8 in/cla 92-01b 92-01-637g	2 ½-cla 92-01b 92-01-1849f	L-yes S-no
400 W 400 N		115	75	12 in/cla 92-01b 92-01-1044b	6 in/cla 92-01b 92-01-369b	L-yes S-yes
740 w. center West side School		115	75	8 in/cla 92-01b 92-01-1044b	3 in/cla 92-01b 92-01-532k	L-yes S-no
IHC 760 w. 400s.		120	75	2-16incla92-01bd 92-01-1833k	4 in/cla 92-01bd 92-01-766d	

790 w. 1600 s. Rodeo Grounds		110	75	8 in/cla 92-01b 92-01-637g	2 ½ incla 92-01b 92-01-1849f	L-yes S-no
Hobble cr tank valve						
4th south valve						
PRV Hobble cr. canyon	Date	UP Stream pressure	Down Stream pressure	Main line	Low flow line	Sight glass
Hatch patch			80	1 in. phisher		
Bill Thomas By driveway			75	1-1 in phisher 1-1 in watts		
Bill Thomas 100 ft. south of driveway			82	1-1 in cla 1-1 in watts	2-4 in roll seal	
Thornhill 2395 s. L.H.F.			70	2-4in. cla	2-1in. cla	
Mackie 2134 L.H.F.				2 in. phisher		
Neilson			80		1-1in. cla 1-1 in. phisher	
Holliday hills		425	80	2-4 in. cla	2-2 in. phishers	
Charlie Compass					2-1 in.	
				2 in. cla		
Hobble creek haven			75	6 in. cla		

44 PRV, S total	14-4 in
9 - 1 in.	4-6 in
4 - 1 ½ in.	7-8 in
4 - 2 in.	6-12 in
1 - 3 in.	2-16 in

Springville Drinking Water System
System Operation Calibration

Location	Comment	Resolution
Canyon Road Well	2014 model shows 3 lines from Hobble Creek tanks ending at Canyon Well. 2 have no PRV, 1 has a PRV. All 3 seem to be connected. GIS shows one line at Canyon Road Well. What is the actual configuration?	Removed abandoned line in model.
Hobble Creek tanks	PRV from Hobble Creek tank to the Hobble Creek zone has a setting of 1500. Was it supposed to be a different type of valve? What is the correct setting?	There is no valve on this tank. There are no controls on the valve in the model, so delete it from the model.
Crandall/Rotary/ Cherrington	Modeled zone boundaries seem to be different than delineated zones	Resolved, see paper notes.
Crandall/Cherrington	Most of Crandall is at 4976-4987. An adjacent area that is shaded as Crandall in GIS is at HGL 5013-5014 (same as Cherrington).	"
Crandall/Rotary	Springville Jr. High, Crandall Drive, 1700-1900 East/200 S-400 S is shown as part of Crandall in GIS, but is part of Rotary in the model.	"
Rotary/Cherrington	Rotary in model is much smaller than delineated in GIS. Part of the area delineated as Rotary has the same HGL as Cherrington.	"
Cherrington	PRVs inside the zone don't appear to be separating zones	"
Spring Creek tank PRV	Closed PRV into Lower Spring Creek tank. Setting is 1500. Should this be an FCV?	Old hydro plant. Lines go through hydro plant (not used any more) or through FCV. Change this to FCV, but it's closed nearly all the time. Leave as closed in model unless needing to be open.
1600 South, Lower Spring Creek to West Field	The PRV at 1600 South has the same pressures on both sides (6 AM in simulation). Setting is 80 psi.	Fixed setting.
1000 S PRV	The zones appear to be connected across the PRV. Water gets past PRV in the 1000 South-1800 South (Mapleton 1600 North), 400 East to 700 East zone.	City acknowledges issue. Not sure where boundaries are. They showed us 2 closed pipes. Add to model and review. Closing the pipes prevent water from flowing around the PRV if Pipe 791 is closed (see next line).
1000 S PRV	Is Pipe 791 closed? IF so, the boundaries between zones is clear. Mobile Home park between 1500 South and 1600 South, between 400 East and 600 East. Is there a connection from the Mobile Home Park to 1500 South? GIS does not show one, and our EPANET model doesn't show one, but the model has one. Delete pipe entirely?	Shawn doesn't know if there's a connection (pipe 791). He agrees there shouldn't be a connection to both 1500 South and 1600 South, as that would cause pressure zones to mix. He thinks the fire hydrants are supplied from 1600 South (so pipe 791 should be deleted or closed). The park is fed through a 4" master meter on Highway 89, near the northwest corner of the park. Add this connection.
Hydro plant	EPANET line missing from Hydro plant to Kelly's/Jurg system	Added to model, per EPANET model.
Jurg Tank	Revise elevations at Rotary Tank and Jurg Tank (model is not correct)	Revised in model.
Rotary Tank	Revise elevations at Rotary Tank and Jurg Tank (model is not correct).	Revised in model.
Upper Springs Tank	Lower Springs to Upper Springs and Rotary Foothill line. What is going on with these? We show 1100-1300 gpm coming from Hobble Creek Canyon through the Rotary line over to the Upper Spring Creek tank. Is that actually happening?	Close line into Upper tank
Evergreen	Evergreen Curve	Added to model.
All pumps	We need VFD settings. Check to see what InfoWater needs and ask Shawn for VFD settings.	Added to model.
Rotary/Upper/Lower Spring Creek	Rotary tank is feeding Upper Spring Creek. EPANET shows two pipes that appear to be acting as overflow from Upper Spring Creek. One connects directly to Lower Spring Creek tank. The other connects to the Rotary line. In EPANET, the line connecting Upper Spring Creek Tank to Rotary line is closed.	Close pipe between Rotary line and Upper Spring Creek tank. Springville verified.
Whitefields Power Plant	Valve at 650 North 400 West is closed. Check to see if this matches model (I don't see any valve in the model at this location)	The closed valve is on the 10" line in 400 West (west of the RR tracks), just south of City Pasture Road. Close this pipe to represent the closed valve. The power plant is supplied from the line to the west of the plant. Move demand to that node.
Valve from Hobble Creek Tank to city	Valve V10002 is a PRV set at 1212. Seems wrong.	1212 would give unrestricted flow. There is no valve here. Delete from model.
Valve from Hobble Creek Tank to city	This valve prevents water from the 900 S, 1000 S, and Canyon Road wells from getting into Hobble Creek tank via Canyon Road. It can get in via River Bottom Road pipe.	Delete
Rotary PRV	Near Hobble Creek tanks, on Rotary line. Setting 58. Is this the right valve?	This is the Hobble Creek 3100 E. Canyon Rd. valve. Setting of 58 psi is correct.
Rotary Flow Control PRV	Where is this? Just upstream of Hobble Creek tanks? Setting is 1200 gpm. Paper shows 150 psi.	This is the bypass around the Hydro plant up the canyon (north of Rotary tank). Change PRV to 150 psi. Leave FCV in model
1000 S Well	What is the route to the Hobble Creek Tank? Is there a connection to the 16" pipe at 800 E 900 S? Looks like the 10" in 800 E is not directly connected to the 16" in 900 South, but is connected to a 10" pipe in 900 South. The 10" pipe in 900 S has a short 10" connecting pipe to the 16" in 900 South.	City confirms it is all interconnected and water can get from 1000 South to River Bottom Road

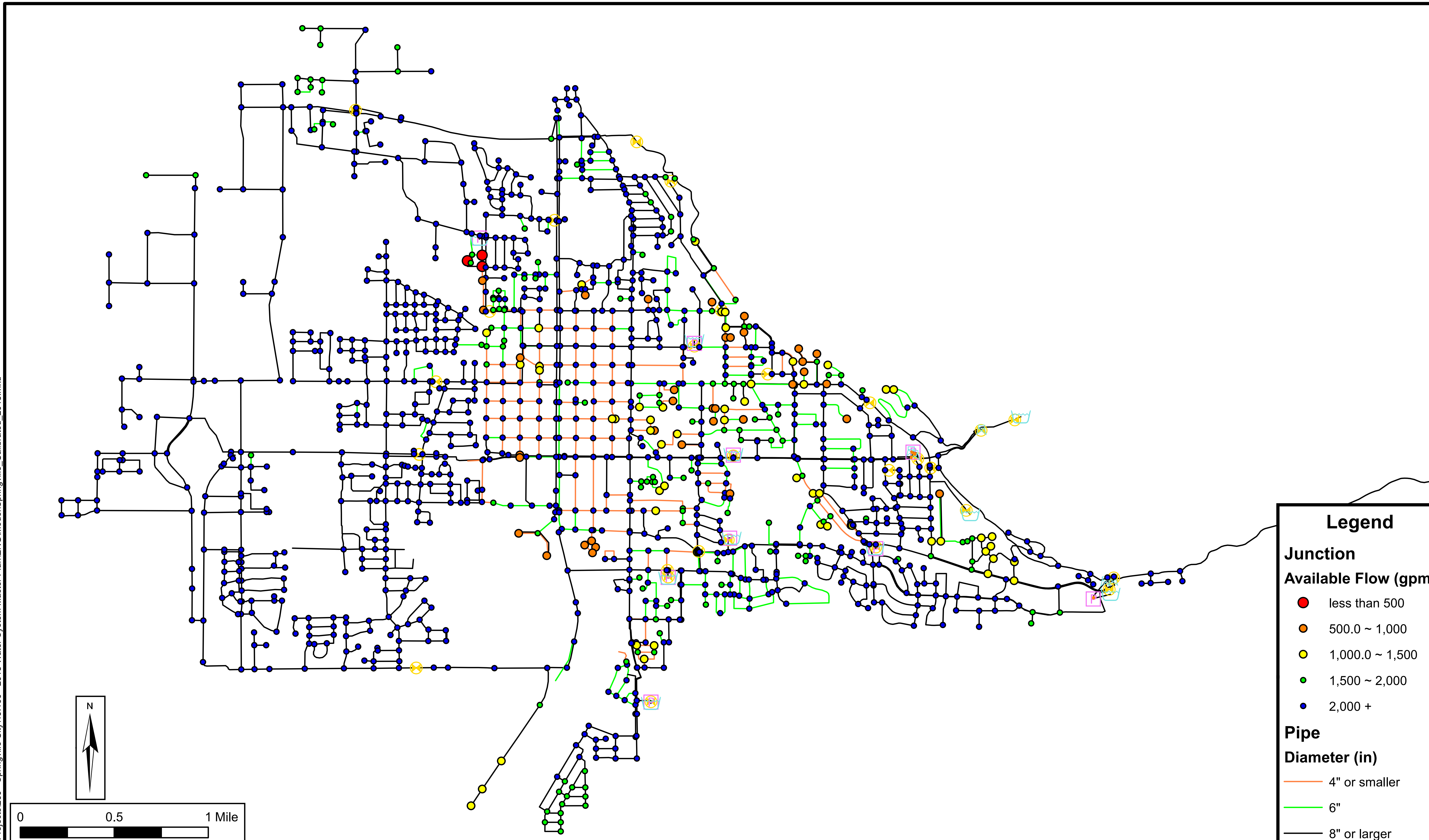
Location	Comment	Resolution
Lower Spring Creek tanks	How are they fed by 900 S/1000S/Canyon Road well? Looks like there's a path, but through 4-8" lines	4th south valve. This is a short interconnection at 1924 East 400 South (see the GIS system for 1924 East), between the Hobble Creek and Spring Creek systems. It is open when the Canyon Road well is running and they want to pump into Spring Creek. The most direct path to the Spring Creek tanks is 1900 East - there's a 12" and 8" that gets to 400 South. Can follow 1470 around as well, plus all the little streets. When the interconnect valve is closed, water pumps into the Hobble Creek tanks via the 12" line in Canyon Road. This is already in the model as P11262. How is it functioning in the model? When is it open in the City typically?
Hobble Creek 3100 E. Canyon Road	Valve coming from Rotary line into system near Hobble Creek tank. Setting is 58 psi. Is this ever opened?	Water comes through there regularly, based on demand. Works year round. That's the only feed for areas off Canyon Road/2500-2400 East going back to 850 South and back to 2300 East (this is just a portion of that zone.) Closed pipe P11282 per conversation with Shawn.
610 S 2080 East	PRVs [Valve V8036] and [Valve V10030] don't exist. They have been removed. Remove them from the model.	Removed in model
400 South near Spring Creek	Several pipes are closed. Be sure they are correct.	
PRV into Klauck (S)	Elev 4683, 95 psi = 4902. Matches second PRV into Klauck.	
PRV into Klauck (NE)	Elev 4750, 65 psi = 4900. Matches other PRV into Klauck.	
Closed pipes		
WP02526	P11026/Deer Creek Way/River Bottom Road - closed, not verified. Is it closed just west of 2650 East?	Right at Deer Creek, by 2541 E. Is closed in the model
	P10806/north of White Fields power plant - verified closed	
	P10908/1500 S 400 E - verified closed	
	807/1355 S 625 E - verified closed	
	6061/2080 E 850 S - verified closed	
	6369, 1857, 1851/700 S, 725 S, 775 S 1900 E - verified closed	
	P11282/2500 E 2400 E (north of Canyon Road) - verified open	
	P27/1100 E Meadow Lark Ln - verified closed (was open in field, but is now closed)	
	961/800 E Hillcrest Drive - verified closed	
	701/100 S 800 E - verified closed	
	703/860 E Center Street - verified closed	
	707/860-900 E Center Street - verified closed	
	1215/1000 E-Canyon Ave Center Street - verified closed	
	1357/Center Street-50 North 1050 East - verified closed	
	1931, 1933/1700 E and 1850 E 400 S - verified as closed	
WP02713	P11434 and P11274 (WP02713) - Lower Spring Creek Tank to 1650 E on 400 S - closed, not verified. When is it open?	Valve that's off is the one closing off the Hobble Creek system coming back from 1470 and feeding up to the east (6" line going back up 4th south). That's all on Hobble Water. Valve on that line has to be off to keep the Cherrington/Hobble zones isolated. Marv helped design the CHerrington pressure zone. Some PRVs were taken out of action, now everything is fed off 2080 East PRV. See comment 64. Looks like P11274 should be open always. Open it. To close the 4th south valve, also close P11434? (see comment 66).
WP02731	6101/1650 E 400 S - closed, not verified	Yes, this is closed and refers to the comment above. All lines on Spring Creek tank should be wide open and feeding Spring Creek zone. 6101 is closed in model.
	P11274 is closed from 1650 E to Spring Creek tank	Seems like per Shawn, it should be open. Open it
4th South valve	If the 4th South valve is closed, seems like P11434 would also need to be closed, or water would still get from Hobble Creek zone to Spring Creek tanks.	Close both the valve and P11434 if needed. The interconnection that we thought was the 4th south valve does NOT EXIST. The northern line comes out of Spring Creek tank. The south line is where the 4th south valve is located (the blue dot on the south pipe). When the 4th south valve opens, it lets water dump into the box in between the two tanks (directly north of the easterly tank). Water can never come back out (west) through this line. Water physically drops unpressurized into the boxes just under the ground, and the tanks are buried.
1650 E 400 S	1650 E/400 S heading south - part of Hobble Creek zone. There shouldn't be any services on Spring Creek until 1300ish East. Might be a hydrant.	This line is part of Hobble Creek zone. Looks correct.
400 S 1300 E	400 S 1300 E - is anything closed? (all open in model)	12" and 6" running diagonally - GIS doesn't show an interconnection. The 12" is Hobble Creek water. The 6" is the service line. It must have to be Hobble Creek also. Interconnect looks like it is OK.
400 S 1470 E	400 S 1470 E - is anything closed? (all open in model)	Spring Creek and Hobble Creek zones can't be interconnected. Verify. The long L connection between the 3rd pipe down and 1470 E should be there. Looks like model is set up correctly.
1540 E Crandall Drive	1915/1540 E Crandall Drive - verified closed at bend	
130 N 1300 E	1283/130 N 1300 E - verified closed	

Location	Comment	Resolution
WP04110, WP04107, WP04113	11232/Center Street 1360-1470 E - City indicates something is closed here, not sure what. See diagram in notes.	Shawn doesn't think anything should be closed, as long as the zones are remaining separate. Looks like they are OK in model.
1360 E Center Street	1360 E Center Street cul-de-sac	Where is it supplied from? Doesn't look like it connects to Hobble Creek zone. See line 77. The line beginning at 900 E 300 North is in the Hobble Creek zone as it continues south to Center Street and then back east to 1300-1500 East.
WP01456, WP01458, WP01455	717, 1361, 1295/1050 East 200 North - three pipes at Tee. not exactly sure which are closed here	Thinks there's a 90 here, not a tee. Thinks the N/S pipeline makes a bend and heads back to the west. The line on 200 North stops and 1100 East pipe feeds 1063 home/1062 home. Pipe 1361 is closed, which is correct. Open pipe 717
WP04679, WP07518	P11222, P11224/275 N 1040 E - closed, but not verified	Not sure. Seems to not be a problem.
WP03613	P11218 /900 E 300 N - closed, not verified	Not sure. Seems to not be a problem. The line beginning at 900 E 300 North is in the Hobble Creek zone as it continues south to Center Street and then back east to 1300-1500 East.
WP07225	P11206/900 E 300 N to 880 E 400 N - closed, not verified	Not sure. Seems to not be a problem.
WP01482/WVA02935	P11308/900 E 400 N - connection between 12" and 10" - Open in model - verify	Yes, this is correct. Used to be PRV.
WP07224	P11200/880 E 400 N - closed, not verified	Not sure. Seems to not be a problem.
WP04533	293/510 E 800 N - Klauck to Spring Creek, closed, not verified	yes
WP03319/WVA01000, WP03324/WVA01033, WP04591/WVA01036, WP03325/WVA01037, WP00024/WVA00024 or WVA01049	105, 131, 145, 153, 157 - Klauck to Spring Creek, closed, not verified	yes, 1150 N/1100 N/1050 N - valves are at 400 East. 1000 N - not sure. Zone break goes through middle of block.
WP03226, WP05616	P11534, P11536/1400 North Mountain Springs Parkway (Nestle), closed, not verified	yes
	5 pipes below/400 S-700 S, Lower Spring to Westfields, closed, not verified	yes
WP03983	P10308/200 S 650 West, closed, not verified	
WP04830	P10784/750 West 400 South, closed, not verified	yes
WP05830	P11956/450 South 750 West, closed, not verified	yes
WP00627	P10514/600 South 750 West, closed, not verified	yes
WP00628	P10528/700 South 750 West, closed, not verified	yes
955 S 2500 E	Shawn says 955 S 2500 E - valve going up the hill is closed (where 2400 E meets 2500 East). Rotary line only feeds the high subdivision.	Closed pipe P11282
2400 E/2500 E	Shawn says 2400-2500 E north of Canyon Road - should only be fed by Rotary	Closed pipe P11282
2080 E 850 S	2080 East 850 South - valve should be closed	Is correct
Parallel pipes	Check all parallel pipes. Many appear to be duplicate pipes for testing larger diameter. Close the extras.	Done
Patterns	Different patterns have different times and aren't going to work together properly. Pattern timesteps are set in the Simulation Time options.	Fixed patterns
Canyon Road Well, Spring Creek Tanks, Hobble Tanks, 4th South Valve		Master Actuator - controls only 4th South Valve. Actuator has to be on to have control of the valve. There is only one valve to be controlled. The interconnection that we thought was the 4th south valve does NOT EXIST. The northern line comes out of Spring Creek tank. The south line is where the 4th south valve is located (the blue dot on the south pipe). When the 4th south valve opens, it lets water dump into the box in between the two tanks (directly north of the easterly tank). Water can never come back out (west) through this line. Water physically drops unpressurized into the boxes just under the ground, and the tanks are buried.
		Shawn agrees that one of the pipes east of the valve would need to be closed. He's not sure which one. If the northerly (18") pipe is closed, it cannot be used to fill the Spring Creek tanks. The 30" can still fill the tanks. I think Shawn said that one of these pipes was closed before he called about the 12" pipe filling Spring Creek, but never draining it. Leave it open for now.
		SCADA3.jpg says Lower Spring Creek Program and Hobble Creek Program should not be run in Auto at the same time. That is only referring to the programs on this page, affecting the operation of the Canyon Road well only. It does NOT affect the normal operation of the Spring Creek and Hobble programs on the SCADA1.jpg page (controlling Bert Springs, 900 S, 1000 S, 200 N, 400 S wells). Shawn notes the 1000 South well is often run in Manual
1000 South Well	1000 South well	10th south usually run manually, though it shows settings in the SCADA program
Tank sets	Tank sets	Each set of tanks typically stays pretty level with each other. When running SCADA, they are only looking at one tank. For Spring Creek, they look at level in the new tank (#2).

Location	Comment	Resolution
		For Hobble Creek tank, they look at the west tank.
Bartholomew Tank	What restricts the water coming out of it? Are there PRVs on the penstock line?	PRVs above the hydro plant reduce the pressure from 480 to 80 psi, and then it goes unpressurized into a turn out style box. After the hydro plant, the water is unpressurized, whether the bypass is used or not.
		The hydro plant uses the water, and then it can go to Hobble Creek or Rotary tank
		They try to keep pace in the hydro plant with the water going into Rotary
	How does water get into Bartholomew Tank? What size pipes? How many pipes? All gravity fed? Where are the springs (elevation/distance)? What are the pipe(s) going into the tank	There are two separate spring collection areas. The upper one is in the middle fork, on the highest point to the west. Water is collected from this point and goes into the Upper Bartholomew Hydro plant and then into the tank. Additionally, there are 5 spring collection areas north of the tank. The pipe starts out smaller and increases in size as it passes through each spring collection area, to reach 30" as it goes into the tank. Shawn is not sure what size the tailrace pipe is. Marv should have plans that show it.
Hobble Creek Tanks	Pipe connections	The two tanks are connected to each other. Each tank is connected to one valve house. The two valve houses are connected to each other (unknown pipe size). Shawn thinks water can go freely between the two tanks, between the two valve houses, and back and forth between each tank and its valve house.
Hobble Creek Tanks		Burt Springs drops in freely (unpressurized) to the top of the west tank. Water from the Rotary line drops in unpressurized to the easterly tank.
		Water is either pumping from 900 South and Canyon Road and backing into the Hobble Creek tanks, or it is dumping into the top of the tanks from Burt Springs and Rotary line. (Presumably water can then also feed the system)
Lower Spring Creek Tank	Can Lower Spring Creek pump fill Rotary Tank and Upper Spring Creek tank at the same time?	No. There is a valve on the Rotary line and a valve at the bottom of Lower Spring Creek tank. The valve on the tank is operated manually, and is usually closed. If they needed water from Lower Spring to go into Upper Spring tank, they go up to the Upper tank and open the inlet valve. The valve on the Rotary line would be closed so that water is not also pumping to Rotary Tank or Hobble Tank. So water can go from Lower SPring tank to Upper SPring tank, or from Lower Spring tank to Rotary and/or Hobble.
	How does the system control where Lower Spring Creek pumps to?	Manually
	What are the characteristics of the Lower Spring Creek pump? Flow, head, etc.	1000 gpm sounds reasonable. They just turn it off when the tank is high enough.
		There is an interconnect between Lower Spring Creek and Upper Spring creek zones now. Marv suggested it in 2012-2014. It allows higher pressure water from the Lower Spring Creek zone to go into Upper Spring Creek zone if they are not getting enough water in Upper Spring creek tank.
		They stopped operating the Lower Spring Creek pumpback pumps because they would fill up the Rotary tank. Then the hydro facility would cause Bartholomew tank to dump a lot of water down the canyon, which would then be wasted
Lower Spring Creek Pump Station	Capacity	Optimization report says capacity of Spring Creek Pump Station is 3,300 gpm

APPENDIX C

Fire Flow Available (Existing System)



Date: 4/15/2019
Document Path: H:\Projects\260 - Springville City\49.100 - 2018 Water System Master Plan\ENG\Model\Springville_Calibrated_2018.mxd

HANSEN ALLEN & LUCE inc ENGINEERS

SPRINGVILLE CITY

DRINKING WATER SYSTEM
EXISTING (2018) FIRE FLOW AVAILABLE

FIGURE
C-1

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

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

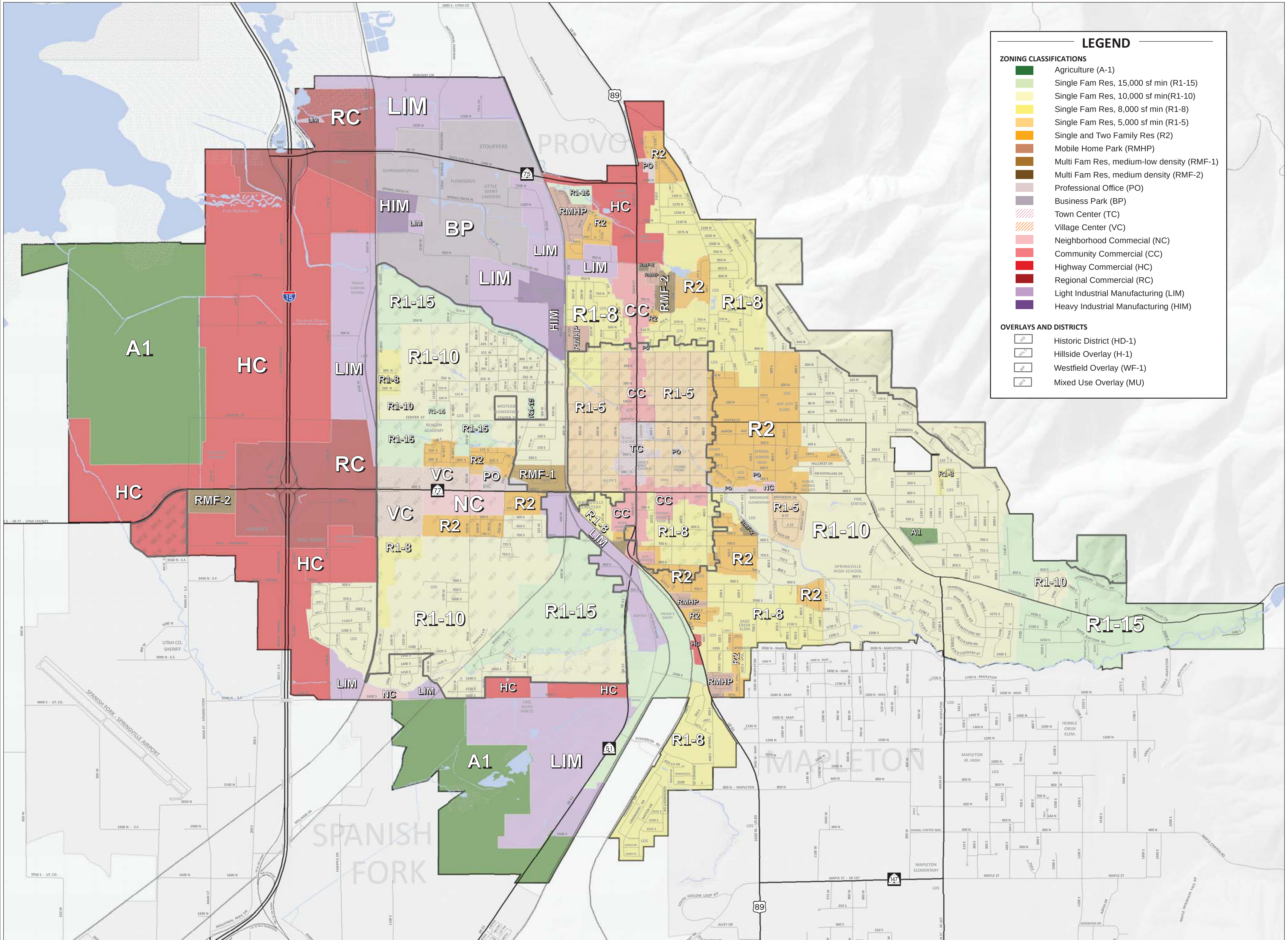
SLC	88.5
Ogden	85.8
Logan	87
Price	85
Provo	87.2

APPENDIX E

InfoWater Hydraulic Models
(Compact disc)

APPENDIX F

City Zoning and General Plan Maps



While every effort has been made to ensure the accuracy of this information, Springville City makes no warranty, expressed or implied, as to its accuracy and expressly disclaims liability for the accuracy thereof.

T:\GIS\Maps\MLP\Springville_Zoning_V4.mxd
03.25.2011

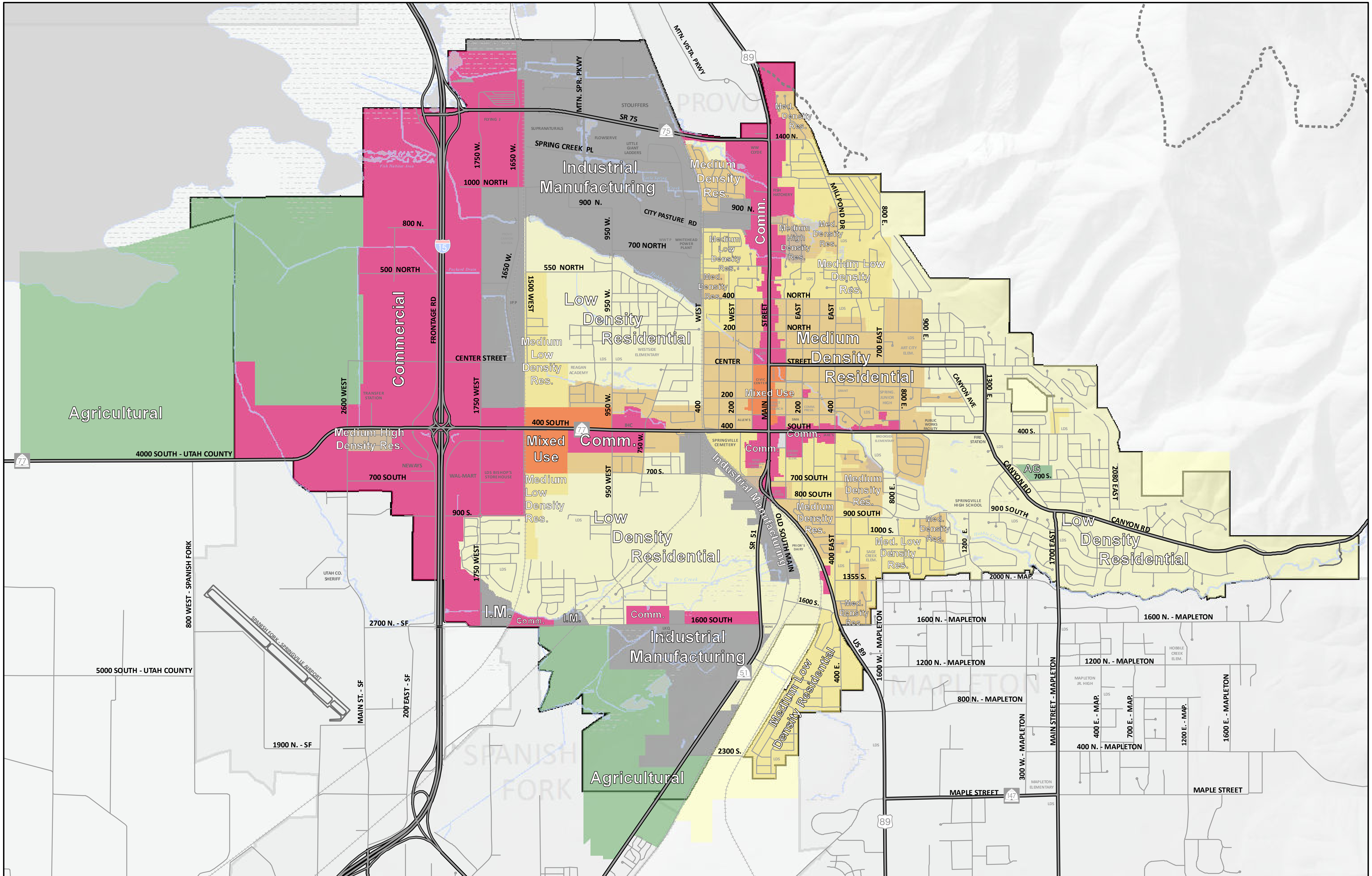
Appointed as the Official Zoning Map, pursuant to Ordinance No.____, this___ day of _______________.

Wilford W. Clyde, Mayor
Venla Gubler, City Recorder
J. Fred Aegerter, Community Development Director

Feet: 0, 750, 1,500, 3,000, 4,500, 6,000
Miles: 0, 0.125, 0.25, 0.5, 0.75, 1

Official Zoning Map
Map Created March 26th, 2011
Springville Building & Zoning Department
110 South Main Street, Springville, UT 84663
(801) 489-2700

Springville City GIS
110 South Main
Springville, UT 84663



While every effort has been made to ensure the accuracy of this information, Springville City makes no warranty, expressed or implied, as to its accuracy and expressly disclaims liability for the accuracy thereof.

T:\GIS\Maps\MLP\Springville_GeneralPlan.mxd
05.26.2010

Springville City General Plan Map

Springville Building & Zoning Department
110 South Main Street, Springville, UT 84663
(801) 489-2700

Springville City GIS
110 South Main
Springville, UT 84663

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

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

25005
(Water System Number)

Springville City
(Water System Name)

1/11/2019
(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]* see model files ☑ 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