

MEMORANDUM

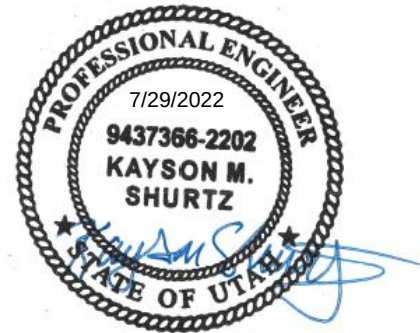
DATE: July 29, 2022

TO: Jared Morgan
GWC Capital
869 N 1500 W
Orem, UT 84057

FROM: Kayson Shurtz, P. E.
Hansen, Allen & Luce, Inc. (HAL)
859 W. South Jordan Pkwy. Ste. 200
South Jordan, UT 84095

SUBJECT: Springville City Annexation
Pressurized Irrigation System Review

PROJECT NO.: 344.224.200



INTRODUCTION

A 320-acre industrial development is proposed located near the intersection of 4000 South (Highway 77) between 800 West and 1300 West (Spanish Fork City addressing). Springville City (the City) requested a feasibility analysis to identify adequate water resources, level of service, and needed infrastructure for this area. The City also requested that the scope of the study be augmented to include approximately 700 additional acres out to Springville City's Annexation Declaration Policy Boundary as shown in Figure 1. The additional developments are north of 4000 South between approximately 700 West and 800 West (160-acre parcel, Spanish Fork City addressing) and north of 4000 South between approximately 1300 West and 2000 West (560-acre parcel, Spanish Fork City addressing). These developments are bordered on the north by Provo Bay of Utah Lake. Additionally, an approximately 477-acre area within City boundaries that was not included in the 2060 Master Plan, as it was expected to be built out past 2060, was included in this analysis because of its proximity to the study area ("West-side buildout"). Any additional areas of the City that are expected to develop after 2060 were not included in this analysis.

As requested, HAL has performed a review of the effects that the proposed developments will have on the City's pressurized irrigation system. This includes a hydraulic modeling analysis of the proposed pressurized irrigation infrastructure for the development. The analysis assumes that the development types within annexation limits but outside of current City limits are light industrial and that irrigated land will be 10% of the total area, and that the West-side buildout area within City boundaries will develop as medium/medium-low density residential with an percent irrigated

of 27-35% as provided to HAL in communication with Springville City and the Springville City Pressurized Irrigation Master Plan and Capital Facilities Plan dated 2020 (Master Plan).

This analysis includes a discussion of the effects of the proposed developments on the existing system, as well as a discussion of the effects of adding this development to the future scenarios of the Master Plan.

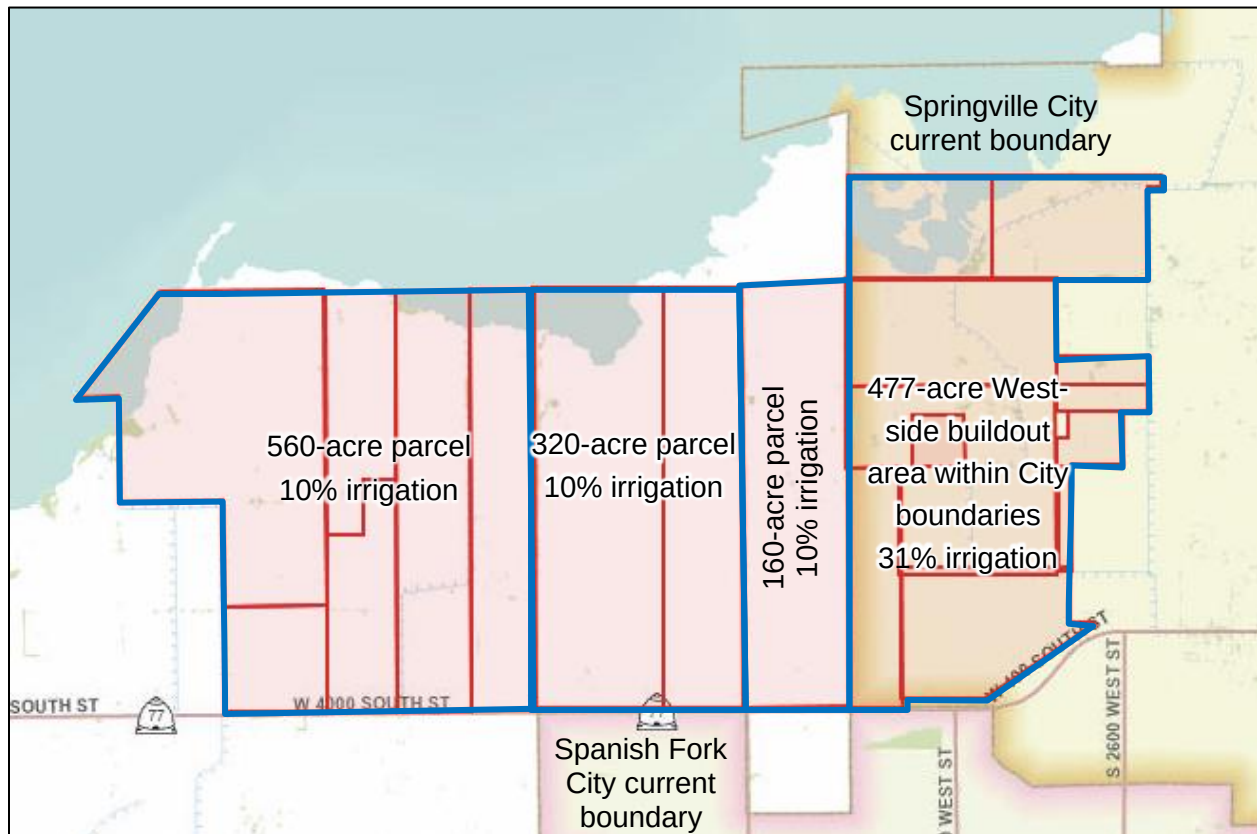


FIGURE 1: ANNEXATION STUDY BOUNDARY AND IRRIGATION FACTOR ASSIGNMENTS

PRESSURIZED IRRIGATION SYSTEM

The proposed developments border the current western boundary of Springville City. The development includes 3.6 million square feet of industrial warehouse on 320 acres; the remaining 720 acres is also assumed to be industrial development of similar density.

Figure 2 shows a schematic of the Master Plan (year 2060) pressurized irrigation pipelines and our assumption of major pressurized irrigation transmission pipelines to the development area. The required size of the transmission main could vary depending on how much source capacity is available in the area. The recommended size is based on the criteria of pressure swing being less than 20 psi. Highway 77 (4000 South) is a major street included in Mountainland Association of Governments (MAG) and Utah County transportation Master Plans, but there are no other major planned roads within the study area which would provide for utility access. MAG plans a new freeway which would cross the westernmost portion of the annexation study area. We

assume a looped pipeline design to provide redundancy (in case an irrigation main goes out of service), to improve water quality, and to reduce pressure swings.

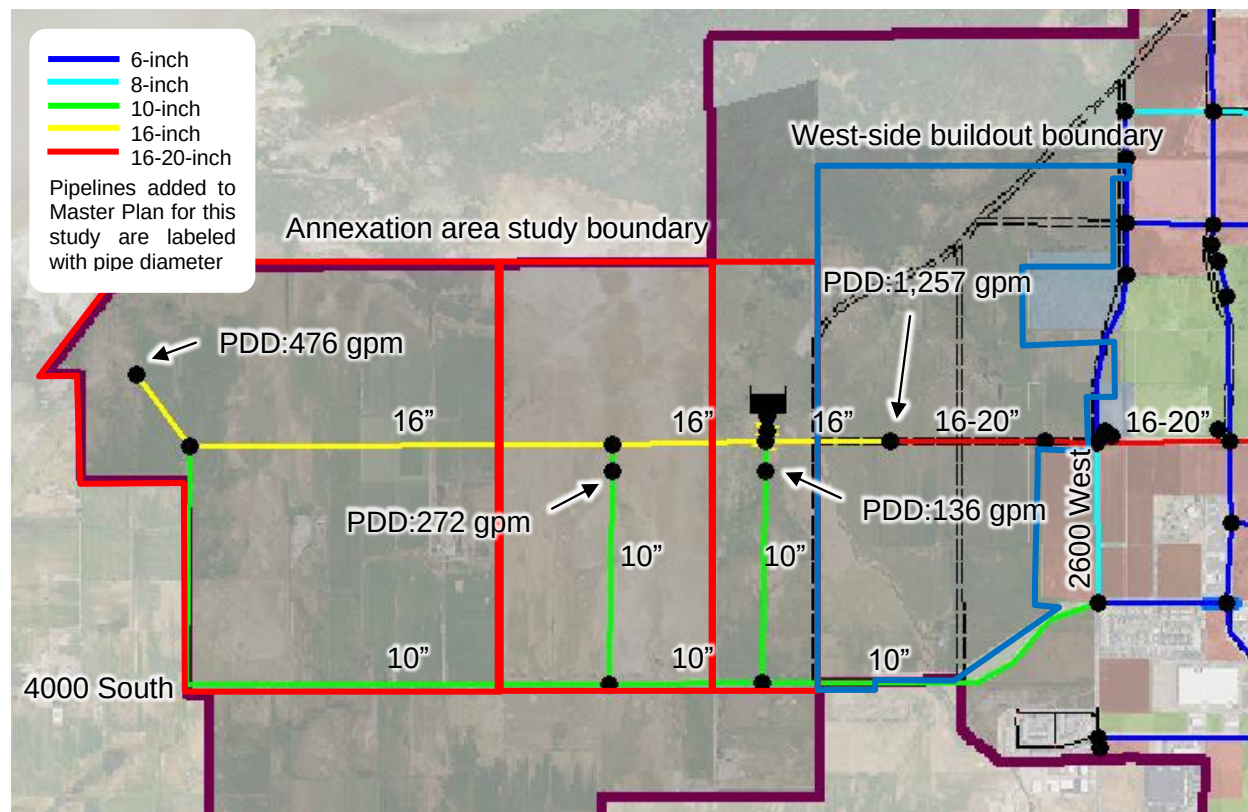


FIGURE 2: IRRIGATION WATER SYSTEM PIPE SIZE AND PEAK DAY DEMAND

Estimated Water Demand

The percentage of irrigated land was assumed to be 10% as specified in the Master Plan for industrial developments. To be conservative, no wetlands were excluded due to assumed developability issues. The 477-acre West-side buildout area is assumed to be medium-low to medium density residential, which have irrigation factors assigned as 27-35%; an average irrigation factor of 31% was used. The total estimated irrigated land was 252 acres (477 (medium res acres) * 0.31 + 1040 (light industrial) * 0.10 = 252 irrigated acres).

Peak day water demand for the development was calculated using the Level of Service from the Master Plan and data currently available for the proposed development. Estimated pressurized irrigation demands are calculated as shown in Table 1.

**TABLE 1: IRRIGATION WATER PEAK DAY DEMAND AND STORAGE VOLUME
FOR WEST-SIDE BUILDOUT/ANNEXATION**

Development	Irrigated Acres	Peak Day Demand¹ (gpm)	Average Yearly Demand¹ (AF/yr)	Storage² (gal)
160 Acre Parcel	16	136	64	98,000
320 Acre Parcel	32	272	128	196,000
560 Acre Parcel	56	476	224	343,000
Total Annexation	104	884	416	637,000
West-side buildout	147.9	1,257	591.2	907,000
Grand Total	252	2,141	1,008	1,550,000

1. Peak Day Level of Service is 8.5 gpm per irrigated acre (Springville City Pressurized Irrigation Master Plan, 2018). The peak instantaneous demand is found by multiplying the peak day demand by a peaking factor of 2. Average Yearly Demand Level of Service is 4 AF per year per irrigated acre (Springville City Pressurized Irrigation Master Plan, 2018).

2. The water storage Level of Service is 6,120 gallons per irrigated acre (Springville City Pressurized Irrigation Master Plan).

Source and Storage

The source and storage required for the study area were evaluated against the available source and storage for the existing and future systems as described in the Master Plan. The City currently has enough storage, water source, and water rights to meet peak daily demand and average yearly demand if the annexation and West-side buildout were immediately constructed, but would face deficits in storage, water rights, and water source earlier than what was estimated in the original Master Plan.

Existing System

A summary of the current source and capacity compared to current and anticipated demands (including the potential annexation development) is included in Table 2 below.

TABLE 2: EXISTING SYSTEM WITH STUDY AREA ADDED

Description	Irrigated Acreage	Peak Day Demand (gpm)	Average Yearly Demand (AF)
Master Plan, 2018 conditions	434	3,689	1,736
West-side build-out within City boundaries	148	1,257	592
Potential Annexation	104	884	416
Total	686	5,830	2,744
Current Water Rights	-	4,417	3,097
Current Potential Excess (+) or Deficit (-) Water Rights	-	-1,413	+353
Current Estimated Physical Capacity	-	8,080	7,100
Current Potential Excess (+) or Deficit (-) Physical Capacity	-	+2,250	+4,356

Springville City currently has sufficient capacity to meet the peak day demand of the potential annexation in addition to the existing peak day demand. Based on the City's peak day demand Level of Service of 8.5 gallons per minute per irrigated acre, the proposed annexation will require 884 gpm source capacity, as shown in Tables 1 and 2. Currently, the City's total reliable source capacity is about 8,080 gpm. Existing demand for constructed development at the time of the 2018 Master Plan was estimated to be 3,689 gpm. With existing demand, the potential annexation, and West-side buildout, the total City peak day demand is estimated to be 5,830 gpm, which is less than the current capacity.

Based on the City's average annual demand Level of Service of 4.0 acre-feet per year per irrigated acre, the proposed development will require 416 acre-feet (AF) per year, as shown in Tables 1 and 2. Currently, the City's total reliable source capacity is about 7,100 AF/yr. Existing demand for constructed development at the time of the 2018 Master Plan was estimated to be 1,736 AF/yr. With existing demand, the potential annexation, and West-side buildout, the total City average annual demand is estimated to be 2,744 AF/yr, which is less than the current total source volume capacity. Springville City currently has sufficient volume to satisfy the annual demand of its existing users as well as the potential annexation.

Based on the City's storage Level of Service of 6,120 gallons of storage per irrigated acre, the proposed development and West-side buildout will require 1.55 million gallons (MG) (4.76 AF) of equalization storage, as shown in Table 1. The required storage for existing development at the time of the 2018 Master Plan is estimated to be 8.2 AF. Currently, the City's total storage capacity is 32 AF in Bartholomew Pond, although the City would like to maintain a minimum of 14.9 AF in the pond at all times (i.e., 6 feet of drawdown maximum) to improve water quality and reduce vegetation, which limits actual storage to 17.1 AF. With existing storage requirements, the potential annexation, and West-side buildout included, the required storage is estimated to be 13 AF. Springville City currently has sufficient storage capacity to serve its existing customers and

accept the potential annexation.

Additions to Master Plan System

The potential annexation area was not included in the 2018 Master Plan projections for the year 2060. A summary of the anticipated peak day and average annual demands by West-side buildout (assumed in 2060), including the potential annexation development, is included in Table 3 below.

TABLE 3: BUILDOUT SYSTEM (2060) WITH STUDY AREA ADDED

Description	Irrigated Acreage	Peak Day Demand (gpm)	Average Yearly Demand (AF)
Master Plan Projection for 2060	991	8,424	3,964
West-side build-out within City boundaries	148	1,257	592
Potential Annexation	104	884	416
Total	1,243	10,565	4,972
Current Water Rights	-	4,417	3,097
Current Potential Excess (+) or Deficit (-) Water Rights		-6,148	-1,875
2060-Estimated Physical Capacity	-	8,080	7,100
2060 Potential Excess (+) or Deficit (-) Physical Capacity	-	-2,485	+2,128

There is sufficient source volume available for the year 2060 with the potential annexation added. However, there is not sufficient source peak day flow for the year 2060. Another source is required to increase peak day flow, as is discussed in the Master Plan.

By 2060, Springville is predicted to need 18.6 AF of equalization water storage. With the potential annexation and West-side buildout, an additional 4.76 AF of equalization storage above the Master Plan are needed for a total of 23.4 AF storage. This leaves Springville City with a deficit of 6.3 AF of storage and increases the original 2060 deficit of 1.5 AF the City faced. The Master Plan discusses increasing daily pond level fluctuations to 7 feet, leaving a minimum of 12.9 AF in the pond at all times, which increases storage to 19.3 AF, but the City would still exceed storage capacity in 2035 and face a shortfall of 1.2 AF of storage by 2038.

Master Plan Capital Facility Projects

The Master Plan does not indicate a need for additional storage or source in the next 20 years. However, the Master Plan identifies that water rights with a volume of at least 243 AF are needed by 2038 and the potential annexation increases this need and potentially accelerates the schedule depending on how quickly development occurs. The potential annexation and West-side buildout also require new water source and storage before 2038 which is different than the Master Plan.

Specifically, if the West-side buildout and annexation were built in 2022, the City would be obligated to address water rights immediately, a new source by 2031, and new storage by 2035. It must be noted that the timing of development for these areas is highly uncertain at this point and therefore the timing of when certain things will need to be addressed is subject to change based on how quickly development progresses. The deficits that will be faced by the City in the PI system are summarized in Table 4. The most pressing deficit is in water rights. The storage deficits are calculated with the assumption that Springville will increase storage pond fluctuations to 7 feet. Water rights, peak day demand, average annual volume, and storage are each addressed below.

TABLE 4: PRESSURIZED IRRIGATION DEFICITS THROUGH 2060 IF WEST-SIDE BUILDOUT AND ANNEXATION OCCUR IN 2022

Description	Water Rights		Source		Storage
	Flow (gpm)	Volume (AF)	Flow (gpm)	Volume (AF)	Volume (AF)
2022	2,060	0	0	0	0
2028	3,181	479	0	0	0
2038	4,822	1,251	1,159	0	1.2
2060	6,148	1,875	2,485	0	6.3

Table 6-4 of the Master Plan lists City-owned water rights which could potentially be used in the PI system, which have a total flow of 2,421 gpm and average annual volume of 3,040 AF. These water rights alone are not sufficient for source flow for the years 2025-2060.

The land to be annexed also carries a number of water rights which are listed below in Table 5. The sum of these rights is not enough to meet 2060 needed water rights, but for the annexation and West-side buildout area alone, the sum of these rights is sufficient. In combination with the City-owned water rights, these rights would be sufficient through 2060.

TABLE 5: WATER RIGHTS IN ANNEXATION BOUNDARY

Water Right(s)	Description	Current Owner	Source Flow (gpm)	Source Volume (AF)
51-1073, 51-1445, 51-2308, 51-9029	3 Wells	Brent & Kris Money ³	161.1	132 ¹
51-1708	Dry Creek	Brent & Kris Money ²	4488	540 ¹
51-2907, 51-2908	2 Wells	Hanson Family Limited Partnership ²	23.3	17.3 ¹
51-1405, 51-1510, 51-2189, 51-6866	2 Wells	Lynn Ray (& Sharon) Hales/Hales Family ²	253.5 ²	552.9 ¹
51-3623, 51-8673	1 Well	Sumsion Farms LLC ²	9.9	5.04 ¹
51-2320, 51-1382	2 Wells	Nielsen/SUVMWA	16.6	4.93 ¹
51-1582	1 Well	Swenson Properties ²	6.7	5.6 ¹
55-9630	1 Well	Main Street American Fork LLC	1.3 ²	1.59
51-2188, 51-7934, 51-7983, 51-8021, 51-8169, 51-8280, 51-8281, 51-8320, 51-8377, 51-8425, 51-8908, 51-9008, 51-9009, 51-9012	1 Well	Various	79.9	20.2
51-1276, 51-1584, 51-1043	3 Wells	Crandall Farms ²	1173.6	109.1 ¹
51-5272, 51-2272, 51-4441, 51-1210, 51-2693	3 Wells, Packard Drain	Karl H. Alleman	4388.1	190.9
Total	13 Wells	Various	~10602	~1580³

1. Only the flow is contained within the water right, so the source volume is estimated from the equivalent livestock units (ELUs) and irrigated acreage. There are 0.028 AF per ELU, 0.45 AF per family per year, and 4 AF per irrigated acre (the duty for Utah County) allowed. Source flow was estimated where necessary from the volume pumped equally over an entire year.

2. The water right owners are also land owners.

3. This equates to an average daily flow of 1670 gpm for 214 days. This flow could be higher if only pumped part time.

The City needs a new source by 2031. New sources listed in the Master Plan include piping the Highline Ditch to increase source capacity by 1,300 gpm (if Hobble Creek water rights are not moved to Bartholomew Springs to use in the drinking water system), constructing new pump stations to increase source capacity by 900-3,000 gpm, or reusing City effluent. These options generally need multiple projects to be selected to provide the necessary source flow for 2060 with annexation/West-side buildout (only Swenson pump station has source flow of 3,000 gpm) and the options vary in their desirability.

New source could also be derived from the water rights already associated with this land (Table

5). Water rights could be purchased and moved to other points of diversion, such as Packard Drain or Dry Creek and/or pumped for use in the PI system. The sum of these rights could meet the needed source flow for 2060.

The City is also currently obligated to purchase 4,945 AF (equating to roughly 6,000 gpm) of water from the ULS pipeline, but this water is relatively expensive and there are other considerations discussed in the Master Plan to using this water which may limit its use. This water alone, or in combination with the other City-owned rights discussed above, could meet 2060 average annual demand and source flow requirements.

The City must also address new storage by 2035. Increasing daily pond fluctuations in Bartholomew Pond by 1 foot does not provide enough storage in 2035. The Master Plan suggests creating a separate pressure zone beyond 2060 served by a new irrigation pond at an elevation of approximately 4730 feet which could potentially be served by a new source, which is also needed by 2031.

If desired the City could consider requiring xeriscaping for areas where it makes sense in the annexation area and possibly the West-side buildout area to reduce demands on the system. If xeriscaping were implemented reductions to source, storage, and potentially transmission could be realized.

Transmission

Springville City maintains a pressurized irrigation network computer model so that the system performance, including transmission capacity, can be evaluated. The potential annexation and West-side buildout area was added to the model so that the effects of the development on the City system could be assessed. Node elevations were identified using Google Earth.

Pressure Zone

The proposed annexation would be served by the water lines from Center Street and 400 South.

Master Plan Capital Facility Projects

The Master Plan projects are shown in Figure 7-1 of the Master Plan. The Master Plan identifies 10 transmission projects. In particular, projects 1-3 which are summarized in Table 6, are important to properly transmit water to the annexation study area.

TABLE 6: MASTER PLAN CAPITAL FACILITY PROJECTS – TRANSMISSION

Master Plan Project	Description	Projected Year When Required
1	20-inch pipeline in 700 South	2028
2	16-inch pipeline in Center Street from 1500 West to West Frontage Road	2028
3	12-inch pipeline in Center Street through 2600 West	2028

Master Plan Projects 1-3 install the main transmission line towards the annexation area in 20-inch, 16-inch, and 12-inch diameter segments. It is assumed that the 12-inch segment would continue as far west as development continues.

Model Results for the Proposed Development

The model predicted that large pressure swings would exist within the West-side buildout and annexation areas with the existing Master Plan. These results were due to a long transmission line from the sole source (Bartholomew Pond). To minimize the need to upsize segments, particularly already existing segments, new sources were added at Dry Creek and Packard Drain. The Master Plan predicts that Dry Creek and Packard Drain could supply up to 2,000 and 900 gpm. Water rights in the area, if purchased and transferred to Dry Creek, could supply about another 2,000 gpm during the irrigation season (Table 5). The model was tested at 2,000 and 4,000 gpm supply. An additional 1,300 gpm for piping the Highline Creek were also added to this source. The minimum pipe diameters to keep pressure swings <20 psi were identified and are shown in Figures 2 and 3. As shown in the figures developing sources on the west side of the system helps to alleviate pressure swings and allows for smaller pipes to be utilized. We recommend that if these areas are annexed into the City that additional sources for the PI system be developed in the area.

Peak instantaneous minimum and maximum pressures within the development for 2,000 gpm and 4,000 gpm Dry Creek supply are shown in Table 7, Figure 4, and Figure 5.

**TABLE 7: DRINKING WATER HYDRAULIC MODELING RESULTS
WITHIN THE PROPOSED DEVELOPMENT**

	2,000 gpm Dry Creek supply		4,000 gpm Dry Creek supply	
Condition	Pressure (psi)		Pressure (psi)	
	Minimum	Maximum	Minimum	Maximum
Peak Day	86.9	92.6	91.4	97.5
Peak Instantaneous	76.2	82.2	76.8	83.2
Diurnal Pressure Variation	17.5-19.0		17.0-19.0	

The proposed pressurized irrigation piping meets the criteria set by Springville City for minimum pressures.

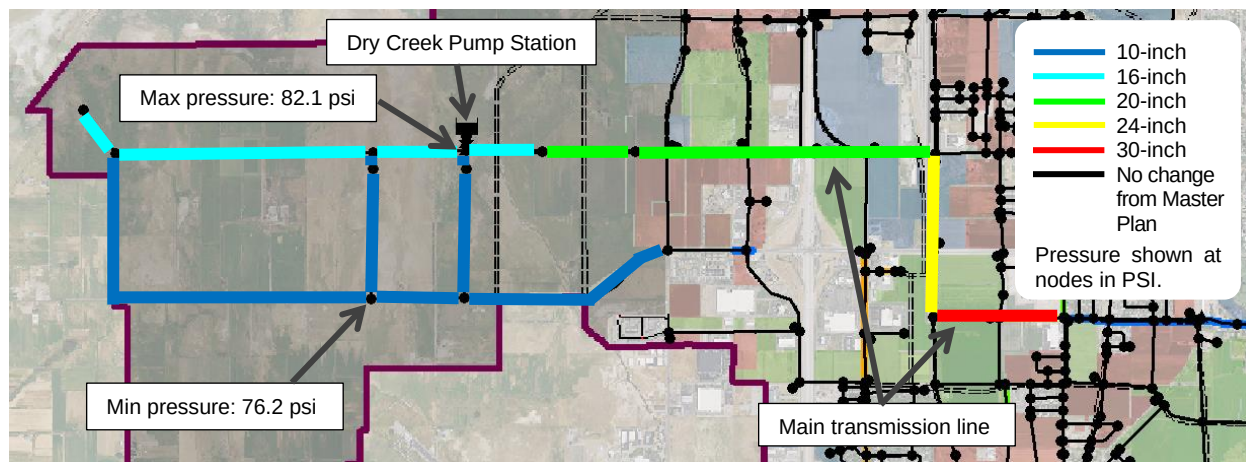


FIGURE 4: PRESSURIZED IRRIGATION SYSTEM PEAK INSTANTANEOUS PRESSURE, 2000 GPM DRY CREEK SUPPLY

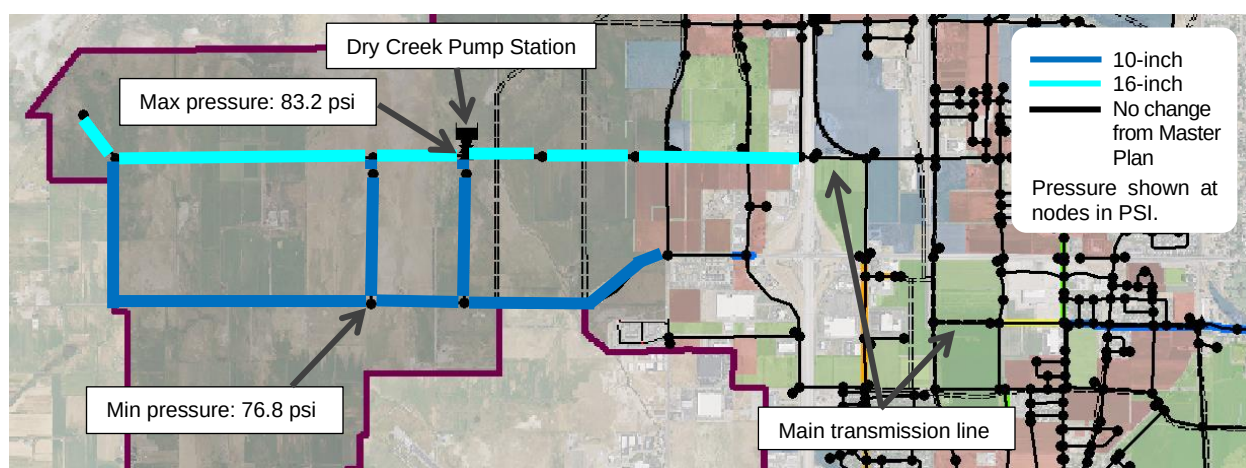


FIGURE 5: PRESSURIZED IRRIGATION SYSTEM PEAK INSTANTANEOUS PRESSURE, 4000 GPM DRY CREEK SUPPLY

EFFECTS OF THE PROPOSED DEVELOPMENT ON THE EXISTING SYSTEM

The pressurized irrigation water model was used to evaluate effects on the existing system from the new development. Existing locations with modeled minimum pressures below 50 psi were evaluated to determine if construction of the new development will reduce pressure at these locations. The model predicts that adding the new development and sources will cause increases of 0-4 psi (4,000 gpm at Dry Creek) or 0-5 psi (2,000 gpm at Dry Creek) at these locations, and resulted in fewer locations falling below Springville's level of service of 50 psi. The lowest pressures observed were from 31-32 psi at peak instantaneous demand and 40-41 psi at peak day demand at a location in south Springville, west of about 2000 South State Street, in an area about elevation 4610 feet. The hydraulic analysis predicts that the proposed development will not adversely impact the existing system.

COST ESTIMATES

The proposed annexation will require more infrastructure than was included in the Master Plan, and upgrades to existing Master Plan facilities. Therefore, the cost estimates presented here in Tables 8 and 9 are in addition to those from the Master Plan, and some costs are replacements for the original Master Plan costs. The transmission cost estimates assume an average of four feet depth to pipe and include valves, fittings, and service lateral connections. These costs are master planning level and it would be anticipated that the true costs could be +/-50% from the numbers presented. It should be noted that these costs do not include the acquisition of water rights. The City should actively review and acquire water rights that would be of benefit to the City as development occurs.

TABLE 8: NEW CAPITAL FACILITY PROJECTS – TRANSMISSION, SOURCE, AND STORAGE FOR 2,000 GPM SUPPLY

New Project Description	Project Cost	Cost Additional to Master Plan
Extend 16" line in Center Street from freeway to as far west as annexation edge -About 14,000 feet of 16-inch pipe, mix of in/out of street -Replaces Master Plan Project 3 and adds new pipe	\$1,540,000	\$1,120,000
Construct 10" line under 4000 South to west annexation edge, including three parcel laterals -About 20,700 feet of 10-inch pipe mostly in street -New project	\$2,050,000	\$2,050,000
Upgrade 16-inch line to 20-inch under Center Street -About 8,050 feet of 20-inch pipe in street -Replaces Master Plan Project 2	\$1,460,000	\$626,000
Upgrade 20-inch line to 24-inch line under 1500 West -About 3,300 feet of 24-inch pipe in street -Replaces part of Master Plan Project 1	\$739,000	\$718,000
Upgrade 20-inch, 24-inch line to 30-inch line under 700 South -About 2,700 feet of 30-inch pipe in street -Replaces part of Master Plan Project 1 and some existing line	\$792,000	
Dry Creek/Packard Pump Station -2,900 gpm capacity total -New projects	\$2,000,000	\$0 ¹
Irrigation Pond -7 AF capacity -New project	\$2,320,000	\$1,820,000 ¹
Total	\$10,900,000	\$6,340,000

1. The cost of source and storage projects were not included in the Master Plan because they were not expected to be needed in the coming 20 years, but they were expected to be needed by 2060. As such the value for "Cost Additional to Master Plan" was set to \$0 for facilities that likely needed to be built regardless of the annexation. For the irrigation pond, 1.5 AF of additional storage were projected to be necessary by 2060, which accounts for about \$500,000 of the \$2.32M overall cost.

TABLE 9: NEW CAPITAL FACILITY PROJECTS – TRANSMISSION, SOURCE, AND STORAGE FOR 4,000 GPM SUPPLY

New Project Description	Project Cost	Cost Additional to Master Plan
Extend 16" line in Center Street from freeway to as far west as annexation edge -About 14,000 feet of 16-inch pipe, mix of in/out of street -Replaces Master Plan Project 3	\$1,540,000	\$1,120,000
Construct 10" line under 4000 South to west annexation edge, including three parcel laterals -About 20,700 feet of 10-inch pipe mostly in street -New project	\$2,050,000	\$2,050,000
Dry Creek/Packard Pump Station -4,900 gpm capacity total -New projects	\$2,500,000	\$500,000 ¹
Irrigation Pond -7 AF capacity -New project	\$2,320,000	\$1,820,000 ¹
Total	\$8,910,000	\$5,490,000

1. The cost of source and storage projects were not included in the Master Plan because they were not expected to be needed in the coming 20 years, but they were expected to be needed by 2060. As such the value for "Cost Additional to Master Plan" was set to \$0 for facilities that likely needed to be built regardless of the annexation. For the irrigation pond, 1.5 AF of additional storage were projected to be necessary by 2060, which accounts for about \$500,000 of the \$2.32M overall cost.

CONCLUSIONS AND RECOMMENDATIONS

- The City currently has sufficient source capacity to provide peak day demand and average yearly volume, but the City would currently face deficits in water rights. The City would also face deficits of in peak day demand starting in 2031, which would increase further by 2060. The City should continue efforts to pursue new water rights and sources of water to address potential shortfalls in the future.
- The City currently has sufficient storage, but would face a storage deficit in 2035, and a deficit by 2038 of 1.2 AF, even with increasing Bartholomew Pond drawdown by 1 foot. The City should continue efforts to locate and construct new storage.
- The development is expected to cause small increases in pressure existing pressurized irrigation system when new sources are added by 2060, and the system will continue to meet the criteria set by the City with minor exceptions noted.
- The West-side buildout and annexation require upgraded transmission pipeline diameters compared to the Master Plan. The extent of upsizing depends on the magnitude of new sources in the Westfields area. Sources in the Westfields area are crucial to minimizing

pressure swings without upgrading existing or planned future waterlines.

- The City could consider requiring xeriscaping for the industrial and/or residential areas of West-side buildout and annexation properties to decrease the needs for new sources, storage, and upgraded transmission pipelines.