PRESSURIZED IRRIGATION SYSTEM MASTER PLAN

(HAL Project No.: 348.09.200)

May 2012

HANSEN ALLEN & LUCE inc
ENGINEERS

SPANISH FORK CITY

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May 2012

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Spanish Fork City

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Keir Scoubes

City Staff

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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: The development density when it reaches a maximum allowed by planned development.

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.

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.

Headloss: 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.

Irrigated Acreage (Acres): The area of land, in acres, that is irrigated.

Irrigation Water: Water used solely for outdoor watering. Not for human consumption.

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, this is the area within the boundaries of the entity or entities, which 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 water until it is needed by the customers of a water system. This is 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.

Water Conservation: Planned management of water to prevent waste.

ABBREVIATIONS

ac-ft	acre-feet
cfs	cubic feet per second (ft^3/s)
DDW	The State of Utah Division of Drinking Water
E	East
ERC	Equivalent Residential Connection
GIS	Geographic Information System
gpd	Gallons per Day
gpd/conn	Gallons per Day per Connection
gpm	Gallons per Minute
HAL	Hansen, Allen & Luce, Inc.
N	North
MG	Million Gallons
PI	Pressurized Irrigation
PRV	Pressure Reducing Valve
psi	Pounds per Square Inch
S	South
SCADA	Supervisory Control And Data Acquisition
W	West

CHAPTER I

INTRODUCTION

PURPOSE

The purpose of this master plan is to provide specific direction to Spanish Fork City for decisions that will be made over the next 5 to 10 years to help the City provide adequate irrigation water to customers at the most reasonable cost. The recommendations herein are based on conclusions that were reached by analyzing existing demand data, growth projections for the City, and a computer model of the City's pressurized irrigation distribution network.

SCOPE

This master plan includes a study of the City's pressurized irrigation system and customer water usage with the following sections: connections and irrigated acres, source requirements, storage requirements, and distribution system requirements. Based on study findings, an implementation plan with recommended improvements has been prepared. The implementation plan includes conceptual-level cost estimates for the recommended improvements.

The conclusions and recommendations included in this report are limited by the accuracy of development projections and other assumptions. It is expected that the City will review and update this master plan as needed.

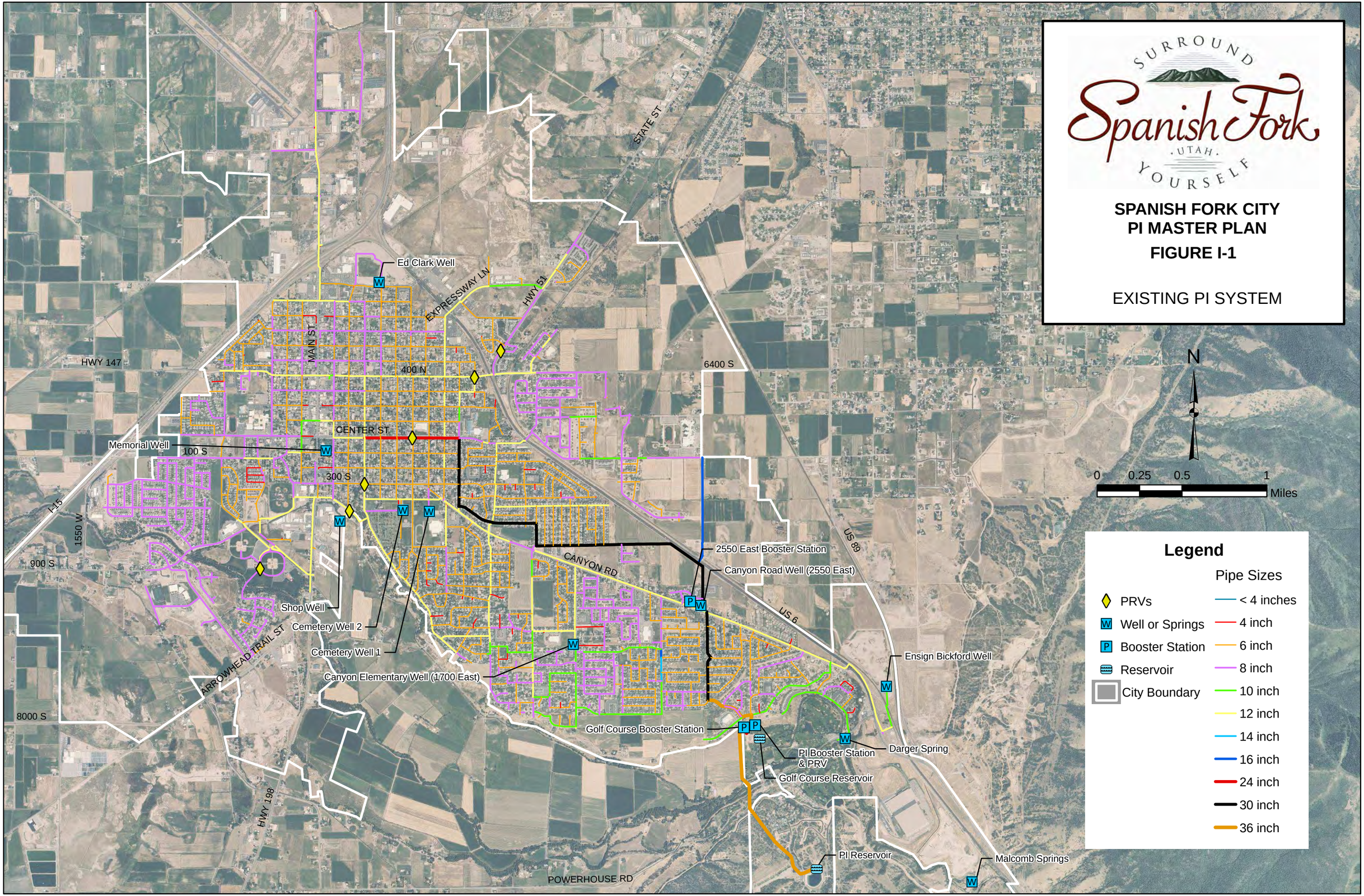
BACKGROUND

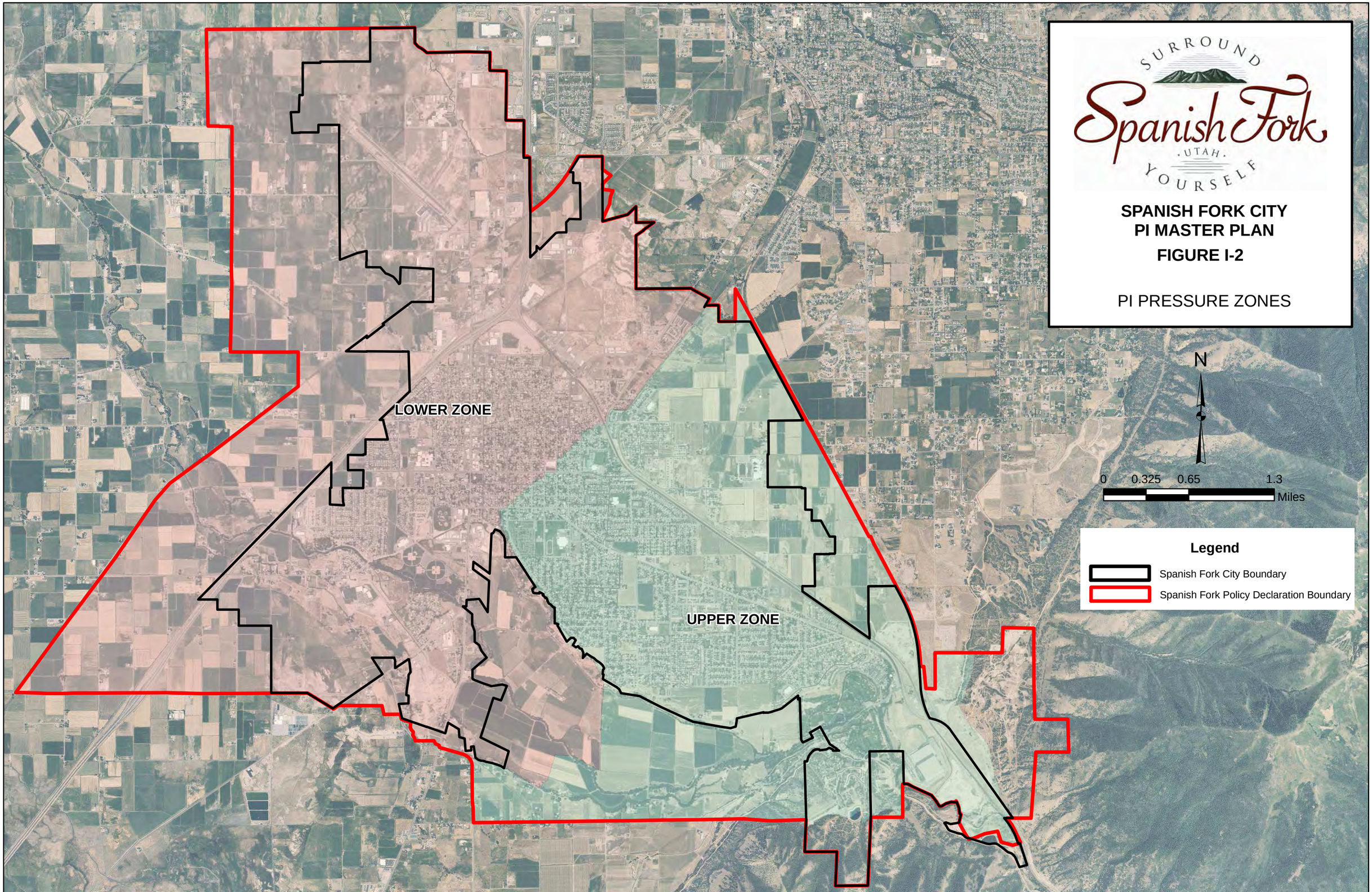
Spanish Fork City is located in central Utah in the south central portion of Utah County. The City is bordered by Utah Lake to the northwest and the Wasatch Mountains to the southeast. The City varies in elevation above mean sea level from about 4500 feet in the northwest to 5200 feet in the southeast foothills and covers an area of about 15.4 square miles. Spanish Fork City is growing rapidly with a population of 34,691 as of the 2010 Census. Between 2000 and 2010 the population of Spanish Fork increased just over 71%. During that period, Spanish Fork City was tied with South Jordan City as the second fastest growing cities in Utah.

Spanish Fork City provides irrigation water to residents of the City via a pressurized irrigation distribution network as shown in Figure I-1. The pressurized irrigation (PI) service reduces demand on the public drinking water system, and greatly reduces the peak summer demands when irrigation usage is highest. The PI system is comprised of two pressure zones as seen in Figure I-2. The upper zone is supplied by nine sources, four of which provide water solely to the upper zone while the remaining five supply both upper and lower zones. In addition to the five shared sources, the lower zone also has two wells as exclusive sources. The elevation head of the upper zone ranges between 4,770 and 4,640 feet above mean sea level, and the lower zone ranges between 4,640 and 4,500 feet above mean sea level. The total length of pipes within the Spanish Fork PI system sums to approximately 120 miles with pipe sizes ranging from 2 to 36 inches in diameter.

PRESSURIZED IRRIGATION SYSTEM MASTER PLANNING APPROACH

Distribution networks are made up of a variety of components including pumps, storage facilities, valves, and pipes. The Spanish Fork PI system must be capable of responding to daily and seasonal variations in demand while suppressing wide variations in pressure. In order


SURROUND
Spanish Fork
UTAH
YOURSELF
SPANISH FORK CITY
PI MASTER PLAN
FIGURE I-1
EXISTING PI SYSTEM
N
0 0.25 0.5 1
Miles
Legend
PRVs
Well or Springs
Booster Station
Reservoir
City Boundary
Pipe Sizes
< 4 inches
4 inch
6 inch
8 inch
10 inch
12 inch
14 inch
16 inch
24 inch
30 inch
36 inch
Ed Clark Well
Memorial Well
Shop Well
Cemetery Well 2
Cemetery Well 1
Canyon Elementary Well (1700 East)
2550 East Booster Station
Canyon Road Well (2550 East)
Golf Course Booster Station
PI Booster Station & PRV
Golf Course Reservoir
Ensign Bickford Well
Darger Spring
PI Reservoir
Malcomb Springs
HWY 147
MAIN ST
EXPRESSWAY LN
HWY 51
STATE ST
400 N
CENTER ST
100 S
300 S
6400 S
I-15
1550 W
900 S
8000 S
CANYON RD
US 89
US 6
ARROWHEAD TRAIL ST
HWY 198
POWERHOUSE RD


SURROUND
Spanish Fork
UTAH
YOURSELF
SPANISH FORK CITY
PI MASTER PLAN
FIGURE I-2
PI PRESSURE ZONES
LOWER ZONE
UPPER ZONE
N
0
0.325
0.65
1.3
Miles
Legend
Spanish Fork City Boundary
Spanish Fork Policy Declaration Boundary

to meet these goals, each of the distribution system components must be designed and operated properly. Furthermore, careful planning is required in order to ensure that the distribution system is capable of meeting the City's needs over the next several decades.

Both present and future needs were evaluated in this master plan. System demands were evaluated by considering historical PI system demands for 2008-2010. Future water needs were estimated by identifying locations where development is expected and adding the incremental increase in water demand associated with the development to the current demand. The build-out water demand was estimated by applying this process throughout City.

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

KEY SYSTEM DESIGN CRITERIA AND PERFORMANCE FINDINGS

Summaries of the key PI system design criteria and performance findings for the Spanish Fork City PI system are included in Table I-1. The design criteria were used in evaluating system performance and in recommending future PI system improvements. Table I-2 presents the design flows analyzed in the pressurized irrigation water model.

TABLE I-1
KEY SYSTEM DESIGN CRITERIA

	CRITERIA	2010 EXISTING CRITERIA	ESTIMATED BUILD-OUT CRITERIA
CONNECTIONS	Billing Records	8,141	18,013
ERCs	Calculated	9,845	21,783
IRRIGATED ACREAGE			
Per ERC	Aerial Imagery & Meter Data	0.15 ac	0.15 ac
Total		1,477 ac	3,261 ac
SOURCE			
Peak Day Demand	Based on measured flow	8,861 gpm	19,605 gpm
Average Yearly Demand	Based on measured flow	5,907 ac-ft	13,070 ac-ft
STORAGE			
Equalization	1/4 Peak Day Volume	10 ac-ft	22 ac-ft
Emergency	1/3 Peak Day Volume	13 ac-ft	29 ac-ft
Operational		20 ac-ft	40 ac-ft
Total		43 ac-ft	91 ac-ft
DISTRIBUTION			
Peak Instantaneous	Based on measured flow	14,768 gpm	32,675 gpm
Max Operating Pressure	City Preference	125 psi	125 psi
Min. Operating Pressure	City Preference	50 psi	50 psi

TABLE I-2
DESIGN FLOW SUMMARY

DEMAND	DEMAND PER ERC	DEMAND PER IRR. ACRE	TOTAL EXISTING DEMAND	TOTAL BUILD-OUT DEMAND	FLOW RATIO
Average Day[1]	0.75 gpm	5.0 gpm	7,384 gpm	16,338 gpm	1.00
Peak Day	0.90 gpm	6.0 gpm	8,861 gpm	19,605 gpm	1.20
Peak Instantaneous	1.50 gpm	10.0 gpm	14,768 gpm	32,675 gpm	2.00

1. Based on annual demand assuming a 6 month growing season

CHAPTER II

CONNECTIONS AND IRRIGATED ACRES

EXISTING SYSTEM

According to billing records obtained for 2008 through 2010, the Spanish Fork PI system includes a total of 8,141 connections. An Equivalent Residential Connection (ERC) is a measure used in comparing demand from residential connections to demand from non-residential connections. By definition, each residential connection represents 1 ERC. The number of ERCs associated with non-residential connections is determined by reviewing the non-residential demand and determining the corresponding number of residential connections that would be required to produce an equivalent demand. A review of billing data for residential lots indicated that the average residential demand within the pressurized irrigation system was 0.75 gpm per connection. Therefore, 1 ERC contributes 0.75 gpm of demand. By dividing the average 2010 demand of 7,384 gpm by the average per ERC demand, the total number of ERCs was determined to be 9,845. Aerial imagery of Spanish Fork was then reviewed in order to determine the irrigated acreage contributed by the average residential lot. Based on this review, a value of 0.15 acres per residential lot was determined to represent the average irrigated acreage. The total irrigated acreage for the city was then found by multiplying 0.15 by the total number of ERCs. Table II-1 provides a per zone summary of the existing ERCs and irrigated acres in Spanish Fork.

TABLE II-1
EXISTING ERCS AND IRRIGATED ACRES

PRESSURE ZONE	ERCs	Irrigated Acres
Upper Zone	5,967	895
Lower Zone	3,879	582
TOTAL	**9,845**	**1,477**

SYSTEM PROJECTED AT BUILD-OUT

In order to plan for the future irrigation needs of Spanish Fork City, build-out ERCs and irrigated acres were also determined. The primary assumption employed in determining the build-out ERCs and irrigated acres was that the existing ratio of irrigated acreage to developed acreage would remain constant while development proceeds in Spanish Fork. This ratio was applied over the Policy Declaration Boundary of Spanish Fork City. In addition, it was also assumed that the ratio of irrigated acreage to ERCs would also remain constant at 0.15 irrigated acres per ERC. Table II-2 provides a per zone summary build-out ERCs and irrigated acres.

TABLE II-2
BUILD-OUT ERCS AND IRRIGATED ACRES

PRESSURE ZONE	ERC	Irrigated Acres
Upper Zone	14,110	2,117
Lower Zone	7,673	1,151
TOTAL	**21,783**	**3,268**

CHAPTER III

SOURCES

EXISTING SOURCES

Spanish Fork utilizes multiple water sources to supply water to its PI system. Table III-1 is a summary of the sources used within Spanish Forks PI system.

TABLE III-1
SUMMARY OF EXISTING SOURCES

SOURCE	TYPE[1]	PHYSICAL CAPACITY (gpm)	ZONE
2550 East Well	Dual	1,000	Upper
1700 East Well	Dual	1,700	Upper
Cold Springs	Dual	4,000	Upper
Cemetery Well #2	PI	1,000	Upper
Darger Springs	PI	1,000	Upper
Ed Clark Well	PI	225	Lower
Memorial Well	PI	1,000	Lower
Shop (Fairgrounds) Well	PI	1,300	Lower
Ensign-Bickford Wells	PI	500	Upper
2550 East Booster	PI	250	Upper
Golf Course Pond Booster	PI	4,000	Upper
Total		**15,975**	

1. "PI" indicates the source is used solely in the PI system, "dual" indicates a source that has been approved as a drinking water source but may be also be used in the PI system.

A summary of water rights and shares associated with PI sources is shown in Table III-2.

The City's water rights and water shares far exceed the City's current ability to receive the water through existing sources. It is recommended that the City continue to monitor and perfect water rights and shares. It is recommended that the City also continue to develop sources as more sources are needed.

TABLE III-2
SUMMARY OF PI WATER RIGHTS AND SHARES

SOURCE	VOLUME (ac-ft)	STATUS	POINTS OF DIVERSION
Wells Water Right a26429 [3]	10,467.53	Water Right Proof Due 2014	Cemetery Well #1, Cemetery Well #2, 2550 East Well, 1700 East Well, Memorial Well, Canyon View Park Well, Shop Well
Water Right 51-7805 [3]	355.0	Water Right Proof Due 2014	Cold Springs, Darger Springs
Water Right 51-1750	299.2	Certificated Water Right	Cemetery Well #2
Water Right 51-5523 [3]	345	Certificated Water Right	Cold Springs
Water Right 51-6497 [3]	2,421	Certificated Water Right	Cold Springs
East Bench Canal Company	1,393	City Owned Company Shares	East Bench Canal and Cold Springs
West Field Canal Company	500	City Owned Company Shares	West Field and Cold Springs
Strawberry [1]	2,420	City Owned Company Shares	Spanish Fork River, Canals, and Cold Springs
SUVMWA (CUP) [2]	7,820	Contracted	Currently not available
SUVMWA (Jordan Canal)	113	Contracted	Currently not available

1. Includes Strawberry Project water through East Bench, Westfield and South WDA.
2. South Utah Valley Municipal Water Association (SUVMWA) 1998 and 2003 contract for Central Utah Project (CUP) water allotment. The 2003 contract has been reduced by 1,000 ac-ft in exchange for a grant to help pay for the pressurized irrigation system.
3. Dual sources that may be used in the PI system as well as the drinking water system.

Currently, the Central Utah Project (CUP) water is anticipated to be more expensive than the other potential sources. It is therefore recommended that the other sources of water be developed first. As part of the CUP, a pipeline is planned to convey water south from the existing 96-inch CUP pipeline in Spanish Fork Canyon. The City has conveyance agreements through the South Utah Valley Municipal Water Association (SUVMWA) to convey irrigation shares or Strawberry Project water through this pipeline at a very reasonable cost. This pipeline will cross the City's existing 36-inch main PI transmission line at a pressure higher than the Spanish Oaks Reservoir. It is therefore recommended that the City politically promote the CUP Project so the City can benefit from the pipeline.

It is recommended that the City continue to exact water rights and shares as land in Spanish Fork City is developed. However, the City should avoid accepting water rights that are not for current use in the Policy Declaration Boundary or in current sources. Irrigation companies that have service areas within the Policy Declaration Boundary include the Highline Division, Spanish Fork East Bench Irrigation, Spanish Fork South Irrigation Co., Spanish Fork Southeast Irrigation Co., Spanish Fork West Field Irrigation Co., and Springville Irrigation District. The irrigation companies and their service areas can be seen in Appendix A on the map Ditches & Irrigation Companies.

EXISTING SOURCE REQUIREMENTS

The PI network water sources must be able to meet the expected water demand for two conditions: peak day demand and average yearly demand. Each of these criteria will be addressed in the following paragraphs.

Existing Peak Day Demand

Peak day demand is the water demand on the day of the year with the highest water use and is used to determine the required daily source capacity under existing and build-out conditions. The two primary descriptors in characterizing peak day demand are the diurnal demand curve and average peak day demand. A diurnal demand curve was calculated using SCADA data. The peak day diurnal curve, in non-dimensional form, is shown in Figure III-1 and was obtained by dividing the instantaneous flow values by the daily average flow.

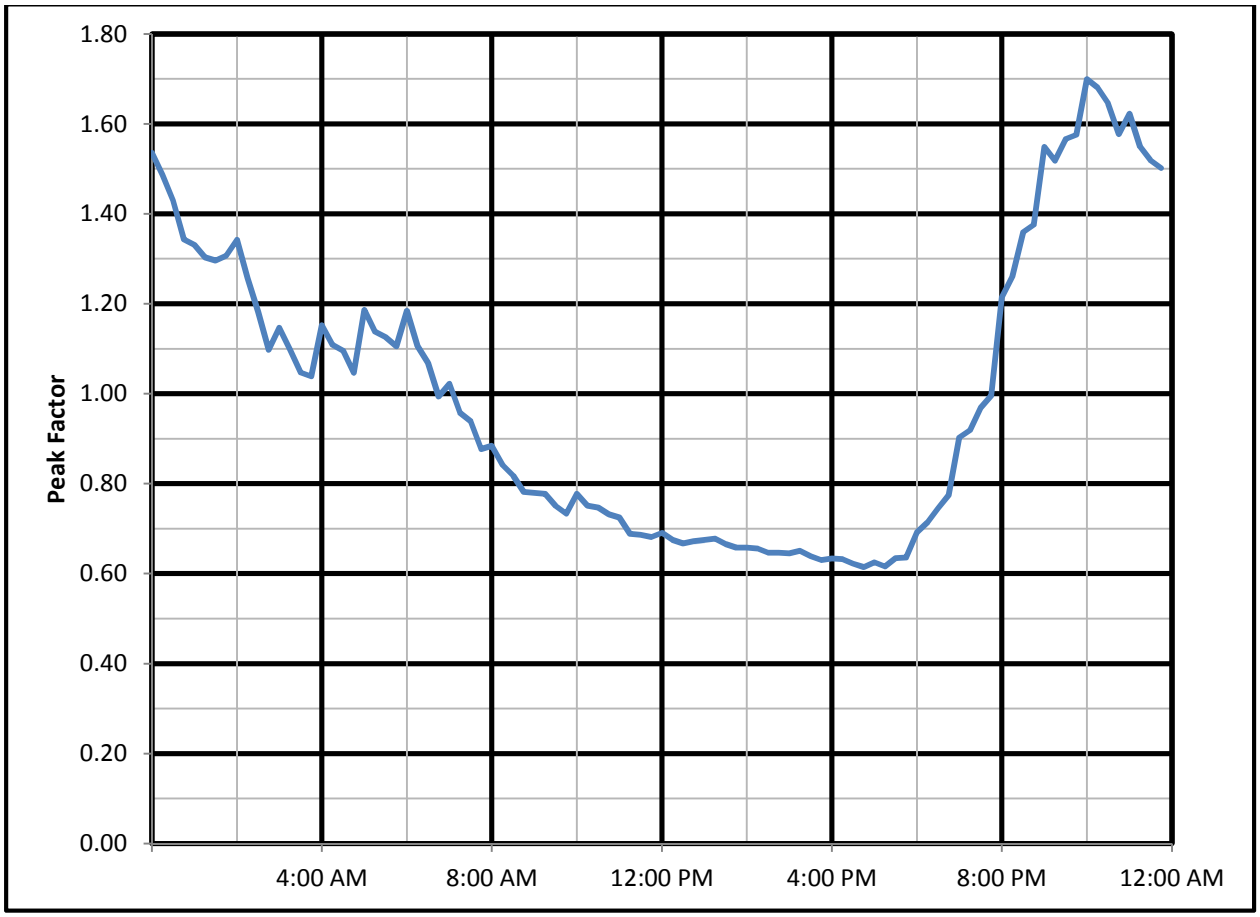


FIGURE III-1: PEAK DAY DIURNAL CURVE

With this demand curve, the primary peak takes place in the evening at about 10:00 PM with trailing subsequent peaks throughout the rest of the night. Minimum demand occurs during the day between 8:00 AM and 7:00 PM. In general, water use is higher throughout the night than at mid-day. This demand pattern results from the use of automatic sprinklers to irrigate at night.

Much of the City irrigates during the night because the State has educated the public to irrigate at night to reduce evaporation. However, it is recommended that certain parts of the City in the wind zone irrigate between 9:30 AM and 9:30 PM due to diurnal winds contributing significantly to evaporation. Sunlight and temperatures during the day do not contribute as much to evaporation as nightly winds in these areas. The wind zone can be seen on Figure III-2.

Billing records and State Standards were considered in order to evaluate the City's existing peak day demand. Billing records provide a monthly record of demands. Between 2008 and 2010 the average demand during the month of July was about 7,384 gpm. Based on prior observations of demand patterns for various Utah cities, it is estimated that the peak day demand for Spanish Fork is about 20% higher than the City's peak monthly average demand. This assumption provides a peak day demand of about **8,861 gpm**. The peak day demand per irrigated acre is determined by dividing the per ERC demand (0.9 gpm/ERC) by the irrigated acreage per ERC (0.15 acres/ERC) giving a value of 6 gpm per irrigated acre. In comparison, state standards stipulate an outdoor water demand of 3.96 gpm per irrigated acre. Although higher than state standards, the calculated demands are well supported by the available data. Moreover, unlike most PI systems, Spanish Fork meters the usage at each connection. In the experience of HAL, the per acre irrigation demand for the Spanish Fork PI system is lower than several other cities located along the Wasatch Front that have unmetered PI systems. It is believed that metering plays a central role in the relatively lower demands.

Existing source requirements and capacities for each pressure zone are summarized in Table III-3. The "ERCs" and "Zone Demand (gpm)" columns are, respectively, the number of ERCs and the source demand in each pressure zone, both as outlined previously. Of the total pressurized irrigation demand, 5,370 gpm, and 3,491 gpm are required individually for the Upper and Lower pressure zones, respectively.

TABLE III-3
EXISTING PEAK DAY SOURCE REQUIREMENTS

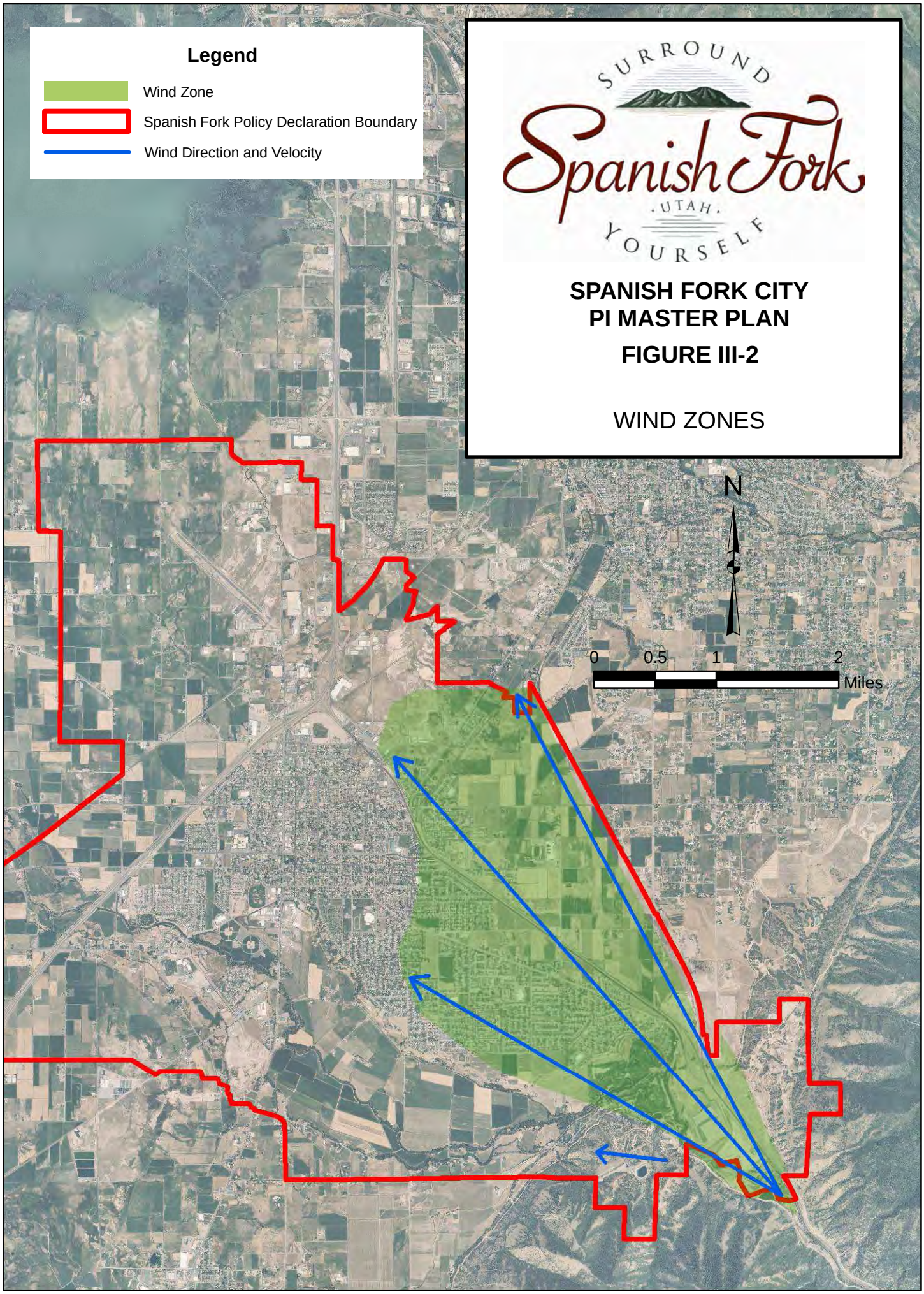
ZONE	ERC[1]	PEAK DAY DEMAND (gpm)	AVERAGE YEARLY DEMAND[2] (ac-ft/year)
UPPER	5,967	5,370	3,580
LOWER	3,879	3491	2,327
TOTAL	**9,845**	**8,861**	**5,907**

1. ERCs were calculated as noted previously.
2. The demands are based on billing data for 2008 through 2010.

Existing Average Yearly Demand

Water utilities must be able to supply the average yearly demand. Average yearly demand is the average volume of water used over the course of one year. For Spanish Fork, the irrigation season is assumed to extend from April 15 to October 15. However, the actual beginning and ending of the season varies based on year-to-year temperature and precipitation variations.

Spanish Fork City's existing yearly demand was evaluated by reviewing historic water use. Figure III-3 illustrates the City's annual water use between 2008 and 2010.


Legend
Wind Zone
Spanish Fork Policy Declaration Boundary
Wind Direction and Velocity
SURROUND
Spanish Fork
UTAH
YOURSELF
SPANISH FORK CITY
PI MASTER PLAN
FIGURE III-2
WIND ZONES
N
0
0.5
1
2
Miles

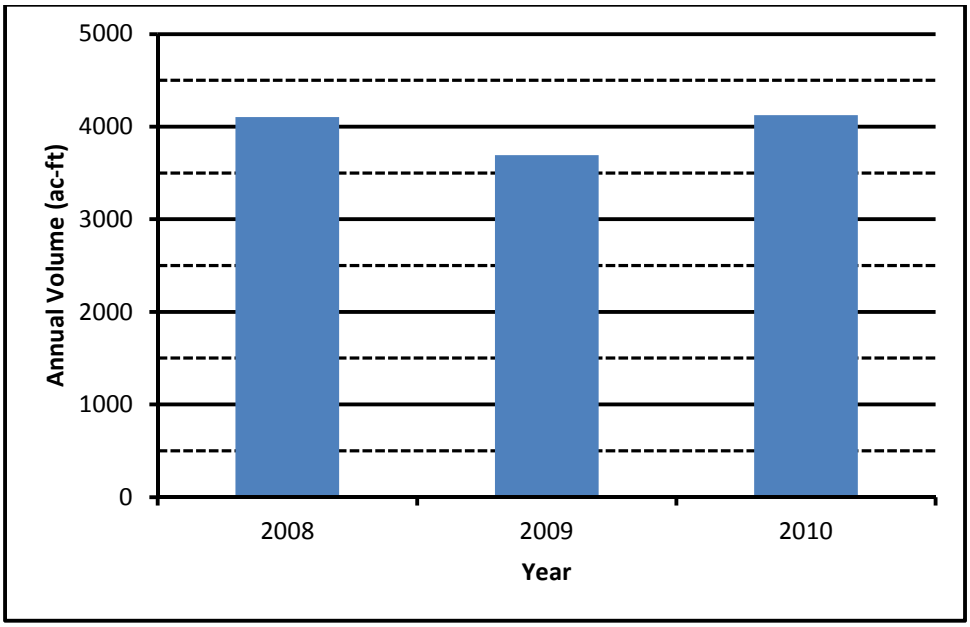


FIGURE III-3: ANNUAL PRESSURIZED IRRIGATION WATER USE

Water use for that period ranged from 3,693 ac-ft to just over 4,122 ac-ft. In comparison, the average day demand per irrigated acre has been previously defined as 5 gpm per irrigated acre (see Table I-2). This average day value is based on July demands obtained from billing data. Assuming this demand will be exercised continuously over a 6 month period gives a volume of 4 ac-ft per irrigated acre, which corresponds to a total volume of 5,907 ac-ft. While higher than the historical observed irrigation demands, this is the annual demand that could be exerted in the case of an early dry spring followed by little rain during the summer months. Furthermore, the duty assigned by the State Engineer to irrigated land in Spanish Fork is 4 ac-ft per acre. Based on these considerations it is recommended that Spanish Fork should secure adequate rights to provide an annual volume of **5,907 ac-ft**. Average yearly demand recommendations are provided in Table III-3

BUILD-OUT SOURCE REQUIREMENTS

As with existing water source requirements, future water source needs were evaluated on the basis of peak day demand and average yearly demand. Build-out demand requirements were calculated in similar manner to the existing demands, but used the build-out ERC projections.

Build-Out Peak Day Demand

Based on the projected build-out ERCs, the projected peak day demand at build-out was calculated to be **19,605 gpm** with the per zone demand as detailed in Table III-4.

Build-Out Average Yearly Demand

Based on the projected build-out ERCs, the projected annual demand at build-out was calculated to be **13,070 ac-ft** with the per zone demand as detailed in Table III-4.

TABLE III-4
BUILD-OUT PEAK DAY SOURCE REQUIREMENTS

ZONE	ERC[1]	PEAK DAY DEMAND (gpm)	AVERAGE YEARLY DEMAND (ac-ft/year)
UPPER	14,110	12,699	8,466
LOWER	7,673	6,906	4,604
TOTAL	**21,783**	**19,605**	**13,070**

1. ERCs were calculated as noted previously.

There are three potential source options that are recommended the City pursue as more source is needed. The first, which has already been mentioned, is to add a connection from a new proposed CUP pipeline that will cross the City's existing 36-inch transmission line. The second recommended potential source is a 4,000 gpm booster station at 2550 East tank and well site. A booster station with Variable Speed Drive (VFD) could deliver irrigation share water and Cold Springs water out of the storage tank. The third recommended potential addition source of water for the future PI system is a VFD pump station that boosts water out of the Golf Course Pond. This would allow the Golf Course Pond to be used as equalization storage and add capacity to pump irrigation share water into the PI system as more becomes available.

The City has access to water rights and shares for sole use in the PI system that total 12,550 ac-ft/year. This nearly meets the build-out average yearly demand of 13,070 ac-ft/year. With the dual source's water rights and shares included, the rights and shares exceed the build-out average yearly demand. However, nearly meeting the future demand with the PI water rights and shares does not provide any redundancy in case of source failures, requirements in the drinking water system, and fluctuation of source flows. Most of the water rights and shares are controlled by the River Commissioner based on flows in the Spanish Fork River. The water rights and shares are the highest amount of water possible in a good water year. In a poor water year the amount of available water can be much less, with no water available for some water rights. Therefore, continued management and exaction of water rights and shares is recommended as future demands and redundancy require.

SOURCE RECOMMENDATIONS

The following is a list of recommendation presented in this chapter.

- It is recommended that redundancy be incorporated into the pressurized irrigation system so that the pressurized irrigation system is able to meet all of the demand objectives with a major source unavailable.

- It is recommended that the City continue to exact water rights and shares as land in Spanish Fork City is developed. However, the City should avoid accepting water rights that are not for current use in the Policy Declaration Boundary or in current sources. Irrigation companies that have service areas within the Policy Declaration Boundary include the Highline Division, Spanish Fork East Bench Irrigation, Spanish Fork South Irrigation Co., Spanish Fork Southeast Irrigation Co., Spanish Fork West Field Irrigation

Co., and Springville Irrigation District. The irrigation companies and their service areas can be seen in Appendix A on the map Ditches & Irrigation Companies. It is recommended that the City exact that amount of water the new development will use to irrigate. This master plan assumes that 4.0 acre-feet is needed per irrigated acre. It was determined that the average irrigated acreage per ERC is 0.15 acres which produces a yearly demand requirement of 0.6 acre-feet per ERC. It is recommended that for nonresidential development the City calculate the amount of water required by multiplying the irrigated acreage by 4.0 acre-feet.

- The City's water rights and water shares far exceed the City's current ability to receive the water through existing sources. It is recommended that the City continue to monitor and perfect water rights and shares. It is recommended that the City also continue to develop sources as more sources are needed.

- Currently, the Central Utah Project (CUP) water is anticipated to be at a much higher cost than the other potential sources. It is therefore recommended that the other sources of water be developed first.

- It is recommended that the City promote the need for a CUP pipeline that is planned to convey water south from the existing 96-inch CUP pipeline so that the City can convey irrigation shares and Strawberry Project water at a high pressure directly to the Spanish Oaks reservoir.

- It is recommended that the City add a 4,000 gpm pump station with Variable Speed Drive (VFD) at the 2550 East Tank and well site to deliver irrigation share water and Cold Springs water out of the storage tank.

- It is recommended that the City add a 4,000 to 6,000 gpm pump station with Variable Speed Drive (VFD) at the Golf Course Pond to deliver additional irrigation share water out of the pond.

CHAPTER IV

STORAGE

EXISTING STORAGE

The City's existing pressurized irrigation system includes two open air storage facilities, both located to the south of the City. The larger of the two, Spanish Oaks Reservoir, is at an elevation of 5180 feet and has a capacity of approximately 77 ac-ft while the smaller, Golf Course Pond, is at an elevation of 4670 feet and has a capacity of approximately 24 ac-ft. The locations of the storage facilities are shown on Figure I-1. Spanish Oaks Reservoir is located sufficiently high to allow gravity flow to either of the two PI pressure zones. The Golf Couse Pond is used to receive canal water which is then pumped to the Spanish Oaks Reservoir.

EXISTING STORAGE REQUIREMENTS

Storage tanks within the PI system are used to provide: 1) equalization storage volume to make up the difference between the peak day flow rate and the peak instantaneous demand; 2) emergency storage; and 3) operational storage to receive irrigation water when available and facilitate efficient pump operation. Existing storage requirements for the Spanish Fork PI system are addressed within the following sections.

Equalization Storage

The need for equalization storage is highest during the irrigation season on days of peak water use. Accordingly, the required equalization storage was evaluated by analyzing the volume of water used under peak day conditions based on the diurnal curve and peak instantaneous demand for Spanish Fork City. Based on the available data, a storage requirement of 25% of the peak day demand volume is recommended. This corresponds to a total volume of **9.8 ac-ft (3.2 MG).** As the Golf Course Pond must be pumped to provide water, Spanish Oaks Reservoir currently supplies all of the equalization storage for the PI system.

Emergency Storage

Emergency storage is intended to provide a safety factor that can be used in the case of unexpectedly high demands, pipeline failures, equipment failures, electrical power outages, water supply contamination, or natural disasters. While the reliability of a PI system is often deemed to be less critical as compared to a drinking water system, the City has ample storage within their PI system. Therefore, it is suggested that Spanish Fork reserve an emergency storage volume equal to 1/3 of the equalization storage volume. As before, the Golf Course Pond cannot be considered to supply emergency storage because of the pumping requirement.

Operational Storage

Spanish Fork City owns irrigation shares that vary in availability according to delivery schedules. Operational storage allows Spanish Fork to receive irrigation water when available, and store the water for later use. The primary function of Golf Course Pond is to receive and temporarily store surface water prior to pumping the water up to Spanish Oaks Reservoir. The buffering capacity provided by Golf Course Pond also allows efficient operation of the Golf Course Pond pumps. In addition to Golf Course Pond, the water in Spanish Oaks Reservoir beyond that necessary for providing equalization and emergency storage also contributes to the City's

operational storage. A summary of existing storage requirements by reservoir is included in Table IV-1.

TABLE IV-1
EXISTING STORAGE REQUIREMENTS

ZONE	EQUALIZATION (ac-ft)[1]	EMERGENCY (ac-ft)[2]	OPERATIONAL (ac-ft)	TOTAL (ac-ft)	EXISTING (ac-ft)
Spanish Oaks Reservoir	10	13	10	33	77
Golf Course Pond	0	0	10	10	24
TOTAL	10	13	20	43	101

1. 25% of the peak day volume.
2. 1/3 of the peak day volume.

BUILD-OUT STORAGE REQUIREMENTS

The storage volumes required at build-out are based on the same equalization, emergency, and operational requirements as calculated for the existing conditions but have been updated to reflect build-out demands. The City's build-out storage requirements are presented in Table IV-2.

TABLE IV-2
BUILD-OUT STORAGE REQUIREMENTS

ZONE	EQUALIZATION (ac-ft)[1]	EMERGENCY (ac-ft)[2]	OPERATIONAL (ac-ft)	TOTAL (ac-ft)	EXISTING (ac-ft)
Spanish Oaks Reservoir	22	29	20	71	77
Golf Course Pond	0	0	20	20	24
TOTAL	22	29	40	91	101

1. 25% of the peak day volume.
2. 1/3 of the peak day volume.

STORAGE RECOMMENDATIONS

Currently Spanish Fork City has approximately 100 ac-ft of storage which should be enough storage for build-out. It is recommended that the storage situation be reviewed regularly to anticipate any storage issues arise as the City develops. It is recommended that the City add a 2,000 to 6,000 gpm pump station with VFD at the Golf Course Pond to not only deliver additional irrigation share water out of the pond but to also allow the use of the Golf Course Pond as equalization storage.

CHAPTER V

DISTRIBUTION SYSTEM

EXISTING DISTRIBUTION SYSTEM

The distribution system consists of all pipelines, valves, fittings, and other appurtenances used to convey water from the water sources and storage tanks to the water users. The existing PI system contains over 120 miles of distribution pipe ranging in size from 2 to 36 inches in diameter. Two pressure zones exist in the system. The existing distribution system is shown in Figure I-1.

EXISTING DISTRIBUTION SYSTEM REQUIREMENTS

The City prefers that the PI distribution system maintain pressures between **50 and 125 psi** at all points in the system under normal operating conditions, including Peak Instantaneous, Peak Day, and Average Day.

Existing Peak Instantaneous Demand

Peak instantaneous demand is the highest demand on the peak day. The pipes in the distribution system must be large enough to convey the peak instantaneous demand while maintaining a pressure at connections between 50 and 125 psi. The peaking factor from the peak day flow to peak instantaneous flow was selected to be 1.7. Data from the SCADA system showed values that were less than 1.5, but 1.7 was selected to add a safety factor. Applying this peaking factor of 1.7 to the peak day demand gives a total existing peak instantaneous demand of **14,768 gpm**.

BUILD-OUT DISTRIBUTION SYSTEM REQUIREMENTS

The existing system requirements apply to the projected build-out system.

Build-Out Peak Instantaneous Demand

Assuming the same peaking factor of 1.7 applies to the build-out peak day demand gives a build-out peak instantaneous demand of **32,675 gpm**.

COMPUTER MODEL

A computer model of the City's PI system was developed to analyze the performance of the existing and future distribution system. The software used for the model was EPANET 2.0. EPANET 2.0 is a computer program that models the hydraulic behavior of piping networks. The pipe, tank, well and valve data used to develop the model were obtained from GIS data of the City's PI system and other updated information supplied by the City.

Computer models were developed for three phases of water system development. The first phase was the development of a model of the existing system (existing model). This model was used to calibrate the model and identify deficiencies in the existing system. A second model was developed which was used to identify those corrections necessary to improve existing system deficiencies (corrected existing model). The third phase was the development of a future model to indicate those improvements that will be necessary for the projected "build-out" condition (future model).

MODEL COMPONENTS

The two basic elements of the computer model are pipes and nodes. A pipe is described by its inside diameter, overall length, minor friction loss factors, and a roughness value associated with friction head losses. A pipe can include elbows, bends, valves, pumps, and other operational elements. Nodes are the end points of a pipe and they 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 put in or taken out of the system. A boundary node is a point where the hydraulic grade is known (a reservoir or PRV).

The computer model of the PI distribution system is not an exact replica of the actual PI system. Pipeline locations used in the model are approximate and every pipeline may not be included in the model, although efforts were made to make the model as complete and accurate as possible. It is not necessary to include all of the distribution system pipes in the model to accurately simulate its performance.

Pipe Network

As indicated previously, the pipe network layout was based upon the City's GIS inventory. The computer model of the PI distribution system is not an exact replica of the actual water system, although efforts were made to make the model as complete and accurate as possible. Pipeline locations used in the model are from the City's GIS inventory. Service laterals were not included in the model and the locations of general valves are not represented in the model. Every other pipeline that was included in the GIS inventory was included.

Demands

Water demands were input into the PI system model by flow in gallons per minute. Water demands were located in the model based on billing data and billing address. The average yearly demand was determined for each billing address, and then the billing addresses were geocoded in order to link the demands to a physical location. Using GIS, the geocoded demands in gallons per minute were then assigned to the closest model demand node. Future demand was assigned to nodes in the future model which best represented the location of the anticipated demand by ERC.

The billed average day demands assigned to the demand nodes were then multiplied by a peaking factor that increased the total demand to the average peak day demand calculated (8,861 gpm).

The pattern of how the demand changes over a 24 hour period is referred to as a diurnal or daily demand curve. The diurnal curve for peak day was developed using the SCADA system and modified to represent a more aggressive peak day with a peak instantaneous 1.7 times the peak day average. The peak day diurnal curve is presented in Figure III-1. The diurnal curves are used by the model to change the demand at each demand node for each time period to simulate how demand changes in the water system throughout the day.

In summary, the billing data was used for accurate demand distribution, production data was used for demand volume, and data from the SCADA system was used to define how the demand varies throughout the day.

Sources and Storage Tanks

The sources of water in the model are the wells and springs. Wells are represented with a reservoir to represent the ground water, a pump with a pump curve, and a pipe representing the pump column to the surface. Reservoir location and volume are represented in the model. The extended period model predicts the levels in the reservoirs as they fill from sources and as they empty to meet demand in the system.

MODEL CALIBRATION

A water system computer model should be calibrated before it may be relied on to accurately simulate the performance of the distribution system. Calibration is a comparison of the computer results, field tests, and actual system performance. Field tests are accomplished by performing flow tests and pressure tests on the system. When the computer model does not match the field tests within an acceptable level of accuracy, the computer model is adjusted to match field conditions.

The extended period model was run for several days with the demand curve repeating every 24 hours in order for the model to be compared to how the actual system performs. Key indicators of the model performing correctly are the reservoirs filling and emptying in consistent and similar patterns without running empty, and pumps turning on and off at similar times.

The model was calibrated successfully with the use of pressure tests and system performance information from the SCADA system. Calibration data is found in Appendix B. It is recommended that City staff continue to conduct tests on an ongoing basis and review SCADA information to refine the model calibration as system conditions change.

ANALYSIS METHODOLOGY

The extended period EPANET 2.0 model was used to analyze the performance of the water system with current and projected future demands. An extended period model is actually a static model run many times, once for each time step. Like a movie is made up of individual pictures put together in a time series, the results of the extended period model can be viewed over time to watch how the system responds to changes in demand. The extended period model was used to analyze the worst case conditions in the system, analyze system controls and operation, analyze performance of the system over time, analyze system recommendations, analyze the water system for system optimization recommendations, and analyze the system for water quality. System recommendations for existing conditions and future conditions at build-out were checked with the extended period model to confirm adequacy.

Two extreme operating conditions were analyzed with the model, high pressure conditions, and peak instantaneous conditions. Each of these conditions is a worst-case situation so the performance of the distribution system may be analyzed for compliance with Spanish Fork City's requirements. Each operating condition is discussed in more detail below.

High Pressure Conditions

Low flow or static conditions are usually the worst case for high pressures in a PI distribution system. A condition similar to static condition that can also cause high pressures in the City's PI system occurs when demand is low and pumps are on to fill storage tanks. During times of low demand, the pumps increase the pressure in the system high enough to reverse the flow

coming from the tanks. The highest pressures are reached when pumps are on, tanks are almost full, and demand is low. Both of these high pressure conditions were simulated with the model. The City would prefer that maximum pressures be kept below 125 psi.

Peak Instantaneous Demand Conditions

Peak Instantaneous demand conditions can sometimes be the worst-case scenario for low pressures throughout a PI distribution system. The PI system reaches peak instantaneous demand conditions during the hottest days of the summer when both indoor and outdoor water use is the highest. The high demand creates high velocities in the distributions pipes which reduces pressure. Usually, minimum pressures of 30 psi at peak instantaneous demand are too low for customer satisfaction; hence, the City prefers a minimum pressure of 50 psi under this condition.

CONTINUED USE OF THE COMPUTER PROGRAM

It is recommended that the City continue updating the model as the PI system changes. Below is a list of ways in which the model could help the City with PI system management. The computer model can assist City staff in determining:

- Effect of new development on the system
- Efficient system operation
- Effect on the system if individual system facilities are added or taken out of service
- Selection of pipe diameters and location of proposed PI mains

The computer model should be maintained for future use. Necessary data required for continued use of the program are:

- The location, length, diameter, pipe material, and ground elevation at each end of each new pipeline constructed
- Changes in PI supply location and characteristics
- Location and demand for new connections

RESULTS

Generally speaking, the computer model showed that the distribution system performs quite well in both existing and future scenarios.

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 C. 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 future pipelines, PRVs are given below under Distribution System Recommendations.

DISTRIBUTION SYSTEM RECOMMENDATIONS

All of the distribution system recommendations are pipeline projects to provide capacity for projected future growth. No existing issues were identified in the existing model. Projects to

support City expansion are listed in Table V-1 in no particular order. Conceptual level costs for the proposed projects are presented in Chapter VI. The proposed projects can be seen on Figure V-1.

TABLE V-1
PROPOSED FUTURE GROWTH PROJECTS

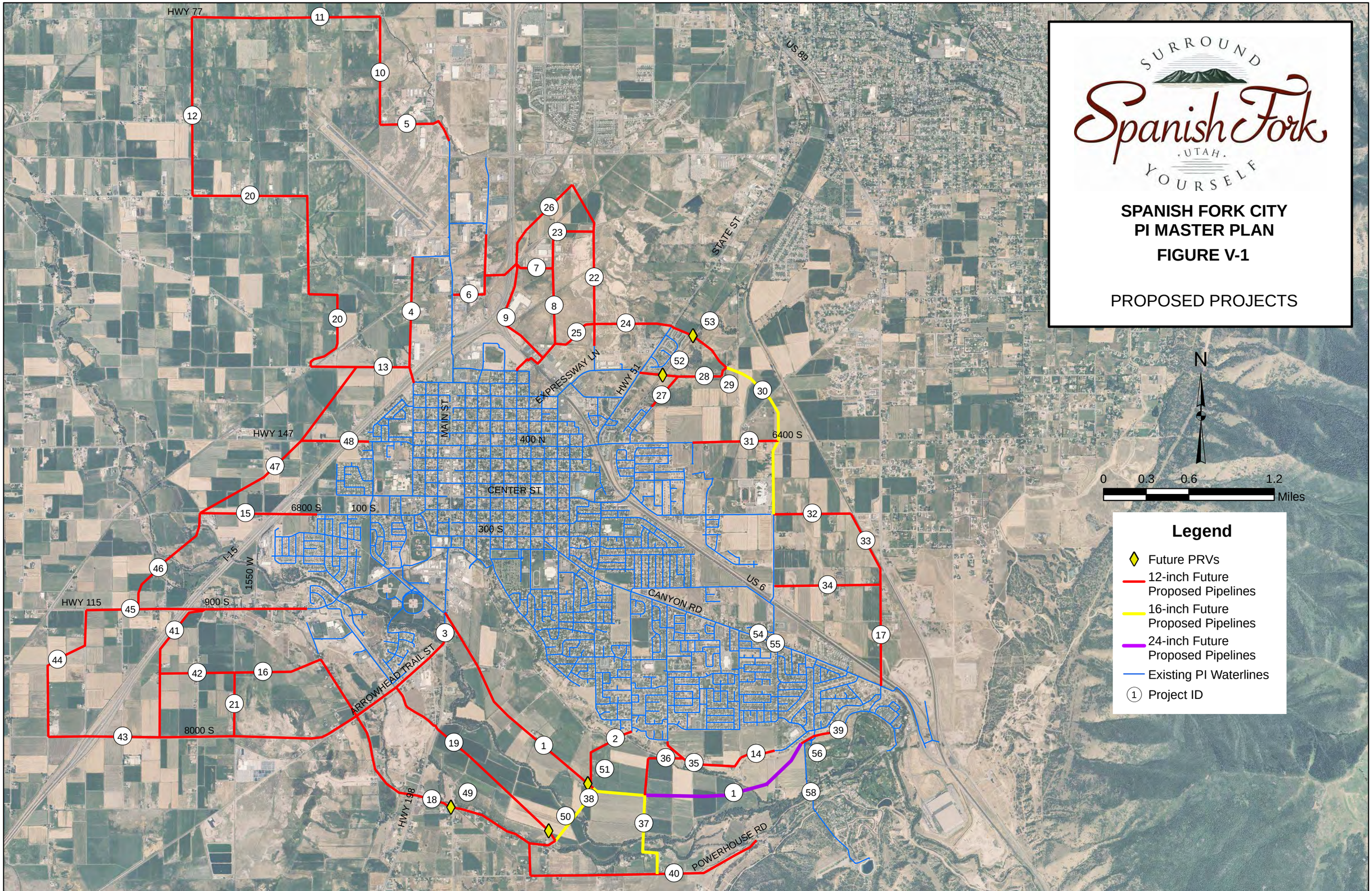
MAP ID	LOCATION	DESCRIPTION
1	From 2770 E and River Bottoms Road to Volunteer Drive and Main Street	Install 8,670 feet of 12-in pipe, 1,960 feet of 16-in pipe, and 6,580 feet of 24-in pipe from 2770 E and River Bottoms Road to Volunteer Drive and Main Street
2	From 2300 S and 1100 E to 1400 E and 1870 S	Install 2,980 feet of 12-in pipe from 2300 S and 1100 E to 1400 E and 1870 S
3	Arrowhead Trail Street between 1900 S and 1030 S on Main Street	Install 6,100 feet of 12-in pipe in Arrowhead Trail Street between 1900 S and 1030 S on Main Street
4	300 W between 900 N and 1900 N	Install 4,700 feet of 12-in pipe in 300 W between 900 N and 1900 N
5	3000 N between Main Street and 600 W	Install 3,040 feet of 12-in pipe in 3000 N between Main Street and 600 W
6	1600 N from Main Street to 200 E and 200 E from 1600 N to 2100 N	Install 1,170 feet of 12-in pipe in 1600 N from Main Street to 200 E and install 2,220 feet of 12-in pipe in 200 E from 1600 N to 2100 N
7	1800 N between 200 E and Chappel Drive	Install 2,770 feet of 12-in pipe in 1800 N between 200 E and Chappel Drive
8	Chappel Drive from 1800 N to 1200 N and to 1000 N and 500 E	Install 4,890 feet of 12-in pipe in Chappel Drive from 1800 N to 1200 N and to 1000 N and 500 E
9	Kirby Lane from Chappel Drive to 450 E and then to 1800 N	Install 4,190 feet of 12-in pipe in Kirby Lane from Chappel Drive to 450 E and then to 1800 N
10	600 W between 3100 N and State Road 77	Install 4,000 feet of 12-in pipe in 600 W between 3000 N and State Road 77
11	Highway 77 between 550 W and 2050 W	Install 6,990 feet of 12-in pipe in Highway 77 between 550 W and 2050 W
12	2050 W between 3800 N and 2400 N	Install 6,620 feet of 12-in pipe in 1150 W between 3050 N and 2400
13	1000 N between 300 W and 1120 W	Install 3,670 feet of 12-in pipe in 1000 N between 300 W and 1120 W
14	Canyon Crest Road between 2300 E and 2600 E	Install 1,310 feet of 12-in pipe in Canyon Crest Road between 2300 E and 2600 E
15	100 S between 1050 W and 1850 W	Install 4,350 feet of 12-in pipe in 100 S between 1060 W and 1850 W
16	1300 S between Mill Road and 1200 W	Install 3,300 feet of 12-in pipe in 1300 S between Mill Road and 1200 W

TABLE V-1
PROPOSED FUTURE GROWTH PROJECTS
(CONTINUED)

MAP ID	LOCATION	DESCRIPTION
17	3400 E from 1500 S to 750 S	Install 3,750 feet of 12-in pipe in 3400 E between 1500 S to 750 S
18	Mill Road between 1300 S and State Road 164, Woodland Hills Drive between State Road 164 and State Road 198, and South Field Road between State Road 198 and 3000 S	Install 2,480 feet of 12-in pipe in Mill Road between 1300 S and State Road 164 and install 4,030 feet of 12-in pipe in Woodland Hills Drive between State Road 194 and State Road 198 and install 5,820 feet of 12-in pipe in South Field Road between State Roads 198 and 3000 S
19	From 2750 S and 820 E to Arrowhead Trail Street and Del Monte Road	Install 8,310 feet of 12-in pipe from 2750 S and 820 E to Arrowhead Trail Street and Del Monte Road
20	2400 N between 2050 W and 1100 W, 1100 W and 900 W between 2400 N and 1000 N	Install 4,330 feet of 12-in pipe in 2400 N between 2050 W and 1100 W, install 7,890 feet of 12-in pipe in 1100 W and 900 W between 1600 N and 1000 N
21	1700 W between State Road 164 and 1400 S	Install 2,360 feet of 12-in pipe in 1700 W between State Road 164 and 1400 S
22	1100 E from 1200 N to 950 E and 2500 N	Install 6,190 feet of 12-in pipe in 1100 E from 1200 N to 950 E and 2500 N
23	2100 N from 1100 E to Chappel Drive and Chappel Drive from 2100 N to 1800 N	Install 1,450 feet of 12-in pipe in 2100 N between 1100 E and Chappel Drive and 1,310 feet of 12-in pipe in Chappel Drive from 2100 N to 1800 N
24	1300 N between Chappel Drive to 1100 E	Install 2,880 feet of 12-in pipe in 1300 N between Chappel Drive to 1100 E
25	1200 N from Chappel Drive to 1100 E and 1300 N	Install 1,790 feet of 12-in pipe in 1200 N from Chappel Drive to 1100 E and 1300 N
26	Future Road connecting 1950 N on Williams Lane to 950 E and 2500 N	Install 3,750 feet of 12-in pipe in future road connecting 1950 N on Williams Lane to 950 E and 2500 N
27	1420 E Extension to Expressway Lane	Install 1,480 feet of 12-in pipe in future extension of 1420 E to Expressway Lane
28	Expressway Lane between State Road 51 and 2250 E	Install 3,060 feet of 12-in pipe in Expressway Lane between State Road 51 and 2250 E
29	2250 E between Legacy Farms Parkway and Expressway Lane	Install 390 feet of 12-in pipe in 2250 E from Legacy Farms Parkway to Expressway Lane
30	Legacy Farms Parkway from 400 N to State Road 51 and in 2550 E from 400 N to 100 S	Install 2,610 feet of 12-in pipe and 6,440 feet of 16-in pipe in Legacy Farms Parkway between 400 N and State Road 51 and install 2,780 feet of 12-in pipe in 2550 E from 400 N to 100 S
31	400 N between Stahell Lane and Legacy Farms Parkway	Install 3,190 feet of 12-in pipe in 400 N between Stahell Lane and Legacy Farms Parkway
32	150 S between 2550 E and Railroad	Install 2,880 feet of 12-in pipe in 150 S between 2550 E and Railroad
33	3400 E along Railroad between 750 S and 150 S	Install 2,910 feet of 12-in pipe in 3400 E and along the Railroad between 750 S and 150 S
34	750 S between 3400 E and 2560 E	Install 3,940 feet of 12-in pipe in 750 S between 3400 E and 2560 E

TABLE V-1
PROPOSED FUTURE GROWTH PROJECTS
(CONTINUED)

MAP ID	LOCATION	DESCRIPTION
35	2300 S (relatively) between 2300 E and 1700 E	Install 3,270 feet of 12-in pipe in 2300 S between 2300 E and 1700 E
36	From 1550 E and 2050 S to 1830 E and 2080 S	Install 1,300 feet of 12-in pipe from 1550 E and 2050 S to 1830 E and 2080 S
37	1100 E and 1200 E between 3000 S and 2080 S	Install 1,380 feet of 12-in pipe and 3,430 feet of 16-in pipe in 1100 E and 1200 E between 3000 S and 2080 E
38	From 620 E and South Field Road to 2300 S and 1100 E	Install 1,020 feet of 12-in pipe and 2,480 feet of 16-in pipe from 620 E and South Field Road to 2300 S and 1100 E
39	Rivers Bottom Road Between Canyon Glen Loop and 2770 E	Install 1,570 feet of 12-in pipe in Rivers Bottom Road between Canyon Glen Loop and 2770 E
40	3000 S between 2400 E and 620 E	Install 8,760 feet of 12-in pipe in 3000 S between 2400 E and 620 E
41	1800 W along I-15 between 3000 S and 900 S	Install 5,620 feet of 12-in pipe in 1800 W and along I-15 between 3000 S and 900 S
42	1300 S between 1200 W and 1800 W	Install 2,770 feet of 12-in pipe in 1300 S between 1200 W and 1800 W
43	3000 S between 1000 W and 2200 W	Install 10,420 feet of 12-in pipe in 3000 S between 1000 W and 2200 W
44	From 2200 W and 3000 S to 1950 W and 900 S	Install 5,520 feet of 12-in pipe in From 2200 W and 3000 S to 1950 W and 900 S
45	900 S between 2000 W and 1150 W	Install 16,420 feet of 12-in pipe in 900 S between 2000 W and 1150 W
46	From 900 S and 2500 W to 100 S and 2000 W	Install 4,510 feet of 12-in pipe in From 900 S and 2500 W to 100 S and 2000 W
47	From 100 S and 1850 W to 1000 N and 700 W	Install 8,080 feet of 12-in pipe from 100 S and 1850 W to 1000 N and 700 W
48	400 N between 1230 W and 650 W	Install 2,520 feet of 12-in pipe in 400 N between 1230 W and 650 W
49	Woodland Hills Road and South Field Road	Install 10" PRV at Woodland Hills Road and South Field Road (See project 18)
50	2650 S and 750 E	Install 10” PRV at 750 E and 2650 S (See project 19)
51	1050 E and 2250 S	Install 10" PRV at 1050 E and 2250 S (See project 1)
52	Expressway Lane and 1600 E	Install 10" PRV at Expressway Lane and 1600 E (See project 28)
53	Legacy Farms Parkway and State Road 51	Install 10” PRV at Legacy Farms Parkway and State Road 51 (See project 30)
54	Canyon Road Transmission Pipeline	Transfer the existing drinking water system transmission pipeline to the pressurized irrigation system


SURROUND
Spanish Fork
UTAH
YOURSELF
SPANISH FORK CITY
PI MASTER PLAN
FIGURE V-1
PROPOSED PROJECTS
N
0 0.3 0.6 1.2
Miles
Legend
Future PRVs
12-inch Future Proposed Pipelines
16-inch Future Proposed Pipelines
24-inch Future Proposed Pipelines
Existing PI Waterlines
Project ID
HWY 77
HWY 147
HWY 115
I-15
1550 W
900 S
8000 S
6800 S
100 S
300 S
400 N
CENTER ST
MAIN ST
EXPRESSWAY LN
HWY 51
STATE ST
US 89
6400 S
US 6
CANYON RD
ARROWHEAD TRAIL ST
HWY 198
POWERHOUSE RD

CHAPTER VI

CAPITAL IMPROVEMENTS PLAN

Throughout the master planning process, the three main components of the City's pressurized irrigation system (source, storage, and distribution) were analyzed to determine the system's ability to meet existing demands and also the anticipated future demands at build-out. Each of the system deficiencies identified in the master planning process and described previously in this report were presented in an alternatives workshop with City staff. Possible solutions were discussed for each of the identified system deficiencies as well as possible solutions for maintenance and other system needs not identified in the system analysis. 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

Project costs for PI system improvements are presented in Table VI-1 in no particular order with the location of each project shown in Figure V-1. Each recommendation includes a conceptual cost estimate for construction.

Unit costs for the construction cost estimates are based on conceptual level engineering. Sources used to estimate construction costs include:

1. “Means Heavy Construction Cost Data, 2011"
2. Price quotes from equipment suppliers
3. Recent construction bids for similar work

All costs are presented in 2011 dollars. 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. A cost estimate calculation for each project is provided in Appendix D. All existing system improvement projects are recommended to be completed in 0 to 5 years.

TABLE VI-1
CAPITAL IMPROVEMENT PROJECTS

ID	DESCRIPTION	COST
1	Install 8,670 feet of 12-in pipe, 1,960 feet of 16-in pipe, and 6,580 feet of 24-in pipe from 2770 E and River Bottoms Road to Volunteer Drive and Main Street	$3,067,000
2	Install 2,980 feet of 12-in pipe from 2300 S and 1100 E to 1400 E and 1870 S	$414,000
3	Install 6,100 feet of 12-in pipe in Arrowhead Trail Street between 1900 S and 1030 S on Main Street	$848,000
4	Install 4,700 feet of 12-in pipe in 300 W between 900 N and 1900 N	$654,000
5	Install 3,040 feet of 12-in pipe in 3000 N between Main Street and 600 W	$423,000
6	Install 1,170 feet of 12-in pipe in 1600 N from Main Street to 200 E and install 2,220 feet of 12-in pipe in 200 E from 1600 N to 2100 N	$471,000
7	Install 2,770 feet of 12-in pipe in 1800 N between 200 E and Chappel Drive	$385,000
8	Install 4,890 feet of 12-in pipe in Chappel Drive from 1800 N to 1200 N and to 1000 N and 500 E	$680,000
9	Install 4,190 feet of 12-in pipe in Kirby Lane from Chappel Drive to 450 E and then to 1800 N	$583,000
10	Install 4,000 feet of 12-in pipe in 600 W between 3000 N and State Road 77	$556,000
11	Install 6,990 feet of 12-in pipe in Highway 77 between 550 W and 2050 W	$972,000
12	Install 6,620 feet of 12-in pipe in 1150 W between 3050 N and 2400	$921,000
13	Install 3,670 feet of 12-in pipe in 1000 N between 300 W and 1120 W	$510,000
14	Install 1,310 feet of 12-in pipe in Canyon Crest Road between 2300 E and 2600 E	$182,000

TABLE VI-1
CAPITAL IMPROVEMENT PROJECTS
(CONTINUED)

ID	DESCRIPTION	COST
15	Install 4,350 feet of 12-in pipe in 100 S between 1060 W and 1850 W	$605,000
16	Install 3,300 feet of 12-in pipe in 1300 S between Mill Road and 1200 W	$459,000
17	Install 3,750 feet of 12-in pipe in 3400 E between 1500 S to 750 S	$521,000
18	Install 2,480 feet of 12-in pipe in Mill Road between 1300 S and State Road 164 and install 4,030 feet of 12-in pipe in Woodland Hills Drive between State Road 194 and State Road 198 and install 5,820 feet of 12-in pipe in South Field Road between State Roads 198 and 3000 S	$1,715,000
19	Install 8,310 feet of 12-in pipe from 2750 S and 820 E to Arrowhead Trail Street and Del Monte Road	$1,156,000
20	Install 4,330 feet of 12-in pipe in 2400 N between 2050 W and 1100 W, install 7,890 feet of 12-in pipe in 1100 W and 900 W between 1600 N and 1000 N	$1,699,000
21	Install 2,360 feet of 12-in pipe in 1700 W between State Road 164 and 1400 S	$328,000
22	Install 6,190 feet of 12-in pipe in 1100 E from 1200 N to 950 E and 2500 N	$861,000
23	Install 1,450 feet of 12-in pipe in 2100 N between 1100 E and Chappel Drive and 1,310 feet of 12-in pipe in Chappel Drive from 2100 N to 1800 N	$384,000
24	Install 2,880 feet of 12-in pipe in 1300 N between Chappel Drive to 1100 E	$400,000
25	Install 1,790 feet of 12-in pipe in 1200 N from Chappel Drive to 1100 E and 1300 N	$249,000
26	Install 3,750 feet of 12-in pipe in future road connecting 1950 N on Williams Lane to 950 E and 2500 N	$521,000
27	Install 1,480 feet of 12-in pipe in future extension of 1420 E to Expressway Lane	$206,000
28	Install 3,060 feet of 12-in pipe in Expressway Lane between State Road 51 and 2250 E	$425,000
29	Install 390 feet of 12-in pipe in 2250 E from Legacy Farms Parkway to Expressway Lane	$54,000
30	Install 2,610 feet of 12-in pipe and 3,660 feet of 16-in pipe in Legacy Farms Parkway between 400 N and State Road 51 and install 2,780 feet of 16-in pipe in 2550 E from 400 N to 100 S	$1,398,000
31	Install 3,190 feet of 12-in pipe in 400 N between Stahell Lane and Legacy Farms Parkway	$444,000
32	Install 2,880 feet of 12-in pipe in 150 S between 2550 E and Railroad	$400,000
33	Install 2,910 feet of 12-in pipe in 3400 E and along the Railroad between 750 S and 150 S	$405,000
34	Install 3,940 feet of 12-in pipe in 750 S between 3400 E and 2560 E	$548,000
35	Install 3,270 feet of 12-in pipe in 2300 S between 2300 E and 1700 E	$455,000
36	Install 1,300 feet of 12-in pipe from 1550 E and 2050 S to 1830 E and 2080 S	$181,000
37	Install 1,380 feet of 12-in pipe and 3,430 feet of 16-in pipe in 1100 E and 1200 E between 3000 S and 2080 E	$743,000
38	Install 1,020 feet of 12-in pipe and 2,480 feet of 16-in pipe from 620 E and South Field Road to 2300 S and 1100 E	$540,000
39	Install 1,570 feet of 12-in pipe in Rivers Bottom Road between Canyon Glen Loop and 2770 E	$218,000
40	Install 8,760 feet of 12-in pipe in 3000 S between 2400 E and 620 E	$1,218,000

TABLE VI-1
CAPITAL IMPROVEMENT PROJECTS
(CONTINUED)

ID	DESCRIPTION	COST
41	Install 5,620 feet of 12-in pipe in 1800 W and along I-15 between 3000 S and 900 S	$781,000
42	Install 2,770 feet of 12-in pipe in 1300 S between 1200 W and 1800 W	$385,000
43	Install 10,420 feet of 12-in pipe in 3000 S between 1000 W and 2200 W	$1,449,000
44	Install 5,520 feet of 12-in pipe in From 2200 W and 3000 S to 1950 W and 900 S	$768,000
45	Install 16,420 feet of 12-in pipe in 900 S between 2000 W and 1150 W	$2,283,000
46	Install 4,510 feet of 12-in pipe in From 900 S and 2500 W to 100 S and 2000 W	$627,000
47	Install 8,080 feet of 12-in pipe from 100 S and 1850 W to 1000 N and 700 W	$1,124,000
48	Install 2,520 feet of 12-in pipe in 400 N between 1230 W and 650 W	$350,000
49	Install 10" PRV at Woodland Hills Road and South Field Road (See project 18)	$31,000
50	Install 10” PRV at 750 E and 2650 S (See project 19)	$31,000
51	Install 10" PRV at 1050 E and 2250 S (See project 1)	$31,000
52	Install 10" PRV at Expressway Lane and 1600 E (See project 28)	$31,000
53	Install 10” PRV at Legacy Farms Parkway and State Road 51 (See project 30)	$31,000
54	Canyon Road Transmission Pipeline	$993,000
55	Install 4,000 gpm VFD pump at 2550 E and Canyon Road	$1,200,000
56	Install 6,000 gpm VFD pump at 2850 E and River Bottoms Road	$1,500,000
57	Update the Model and Master Plan as needed, and update the Impact Fees Annually	$304,183
58	Install connection to the 36-inch reservoir transmission line from the eventual Central Utah Project pipeline	$150,000
	TOTAL	**$38,868,183**

FUNDING OPTIONS

Funding options for the recommended projects, in addition to water use fees, could include the following options: general obligation bonds, revenue bonds, State/Federal grants and loans, and impact fees. In reality, the City may need to consider a combination of these funding options. The following discussion describes each of these options. Currently the City is making payments on a revenue bond through fiscal year 2017. Details of the debt service schedule are found in Appendix D. It is recommended that the City start to fund a pipeline and facility replacement program. The City could start with a small amount of $50,000 to $100,000 a year until the bond is paid off. It would then be recommended to fund the pipeline replacement program with $250,000 to $500,000 a year--the lower end representing one percent of the estimated replacement cost based on actual cost and the higher end representing the estimated replacement cost over 50 years using master plan cost estimates.

General Obligation Bonds

This form of debt enables the City to issue general obligation bonds for capital improvements and replacement. General Obligation (G.O.) Bonds would be used for items not typically financed through the Water Revenue Bonds (for example, the purchase of water source to ensure a sufficient water supply for the City in the future). G.O. bonds are debt instruments backed by the full faith and credit of the City which would be secured by an unconditional pledge

of the City to levy assessments, charges or ad valorem taxes necessary to retire the bonds. G.O. bonds are the lowest-cost form of debt financing available to local governments and can be combined with other revenue sources such as specific fees, or special assessment charges to form a dual security through the City's revenue generating authority. These bonds are supported by the City as a whole, so the amount of debt issued for the PI system is limited to a fixed percentage of the real market value for taxable property within the City.

Revenue Bonds

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

State/Federal Grants and Loans

Historically, both local and county governments have experienced significant infrastructure funding support from state and federal government agencies in the form of block grants, direct grants in aid, interagency loans, and general revenue sharing. Federal expenditure pressures and virtual elimination of federal revenue sharing dollars are clear indicators that local government may be left to its own devices regarding infrastructure finance in general. However, state/federal grants and loans should be further investigated as a possible funding source for needed PI system improvements.

It is also important to assess likely trends regarding federal/state assistance in infrastructure financing. Future trends indicate that grants will be replaced by loans through a public works revolving fund. Local governments can expect to access these revolving funds or public works trust funds by demonstrating both the need for and the ability to repay the borrowed monies, with interest. As with the revenue bonds discussed earlier, the ability of infrastructure programs to wisely manage their own finances will be a key element in evaluating whether many secondary funding sources, such as federal/state loans, will be available to the City.

Impact Fees

Impact fees can be applied to water related facilities under the Utah Impact Fees Act. The Utah Impacts Fees Act is designed to provide a logical and clear framework for establishing new development assessments. It is also designed to establish the basis for the fee calculation which the City must follow in order to comply with the statute. However, the fundamental objective for the fee structure is the imposition on new development of only those costs associated with providing or expanding water infrastructure to meet the capacity needs created by that specific new development. The following information on reimbursement for pipelines over 6-inch and existing remaining capacity is provided to the City to aid in the calculation of impact fees. It is recommended that the impact fee calculation be updated annually.

Reimbursement for Pipelines Over 6-inch

The City requires that a developer install the minimum size of pipe in a new development. If the pipe size is recommended by the model and Master Plan to be a larger diameter to accommodate future growth than it is recommended that the City require the developer to install the larger pipeline. It is recommended that the developer be reimbursed the difference between the larger pipe cost and the cost of minimum sized pipe (6 inch) as shown in Table VI-2. Reimbursement for growth related capacity above 6-inch is listed in Table VI-3 with an ID of A and a total cost representing an estimated reimbursement cost over the next 10 years. The 2550 E Project listed in Table VI-3 with an ID of B is already constructed and

TABLE VI-2
PERCENTAGE OF PIPELINE COST RELATED TO GROWTH

PIPE SIZE	COST PER LINEAL FOOT	% GROWTH RELATED
6 inch	$73/ft	0%
8 inch	$81/ft	10%
10 inch	$91/ft	20%
12 inch	$103/ft	29%
16 inch	$119/ft	39%
18 inch	$136/ft	46%
20 inch	$145/ft	50%
24 inch	$174/ft	58%
30 inch	$236/ft	69%
36 inch	$316/ft	77%

Existing Remaining Capacity

The Utah Impact Fees Act allows for the calculation of Impact Fees based on an estimated cost of existing system capacity that will be recouped by future development. The following is an estimate of remaining capacity in the existing pressurized irrigation source, storage, and distribution.

Source. The remaining capacity of source for the Spanish Fork Irrigation System was calculated based on the level of service Design Criteria presented in Table I-1 and I-2. The level of service for source is 0.90 gpm per ERC with a total existing system source requirement of 8,861 gpm. Table III-1 shows the total of existing sources as 15,975 gpm. Because Cold Springs is not available yet for use as a source in the pressurized irrigation system, this reduces the existing capacity to 11,975 gpm. Subtracting the existing source requirement of 8,861 gpm from the existing capacity leaves a 3,114 gpm capacity or 3,460 ERCs. At the time the Golf Course PI Pond Pump Station facility was constructed, 100% of the capacity was for future growth. The Golf Course PI Pond Pump Station is listed in Table VI-3 as project C.

Storage. The remaining capacity of storage for the Spanish Fork Irrigation System was calculated based on the level of service Design Criteria presented in Table I-1 and IV-1.

Currently the City has 77 ac-feet of storage and an existing requirement of 28 ac-ft in the Spanish Oaks reservoir. This leaves a remaining capacity available for future growth of 63%. The Golf Course Pond has a capacity of 24 ac-ft. At the time the Golf Course PI Pond was constructed, 100% of the capacity was for future growth. The Spanish Oaks reservoir is listed in Table VI-3 with the pressurized irrigation distribution system with an ID of D. The Spanish Oaks reservoir and the citywide pressurized irrigation distribution system have a combined remaining capacity of 55%. The Golf Course Pond is listed in Table VI-3 with an ID of D.

Distribution System. The capacity for the distribution system was calculated based on the level of service Design Criteria presented in Table I-1. Using the existing extended period hydraulic model for the Pressurized Irrigation System, the demand was increased until the existing system reached unacceptable performance during peak instantaneous demand. Unacceptable performance was defined as a minimum normal operating pressure of 50 psi. The highest elevations in each zone reaching 50 psi corresponded to a maximum system-wide pressure reduction during peak instantaneous demand of 20 psi caused by high velocities. The maximum capacity of the existing pressurized irrigation distribution system was determined to be 16,686 ERCs. In 2003, when the system was completed, there were 8,067 existing ERCs. The additional capacity of the distribution system for future growth was 8,619 ERCs, or 52%. The pressurized irrigation distribution system is listed in Table VI-3 with the Spanish Oaks reservoir with an ID of D. The Spanish Oaks reservoir and the citywide pressurized irrigation distribution system have a combined remaining capacity of 55%.

Summary of Impact Fee Related Projects

Table VI-3 shows impact fee eligible projects that Spanish Fork City has completed or anticipates completing in the next ten years. The percent impact fee eligible column is the current remaining capacity available to new development for the existing projects and the anticipated percentage of the proposed projects attributed to new development. Projects already constructed have letter IDs. Master Plan recommended projects have Map ID numbers from Table VI-1.

TABLE VI-3
IMPACT FEE RELATED PROJECTS

ID	DESCRIPTION	% IMPACT FEE ELIGIBLE	TOTAL COST
B	2550 E Trunkline (Nebo School District)	41%	$110,554
C	Golf Course PI Pond Pump Station	100%	$314,882
D	Citywide Pressurized Irrigation System	55%	$17,315,139
E	Golf Course PI Pond	100%	$638,430
6	2000 N 200 E Railroad Casing	29%	$13,043
54	Canyon Road Transmission Line/Crab Creek	100%	$993,000
57	Model, Master Plan & Impact Fee Updates	100%	$304,183
58	CUP Connection	100%	$150,000

SUMMARY OF RECOMMENDATIONS

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

1. It is recommended that the City continue to update the model as the PI system changes and use the model as a tool for determining: the effect of changes to the system, verification of pipe diameters, and location of proposed PI water mains. It is recommended that the City update the Master Plan as needed.

2. It is recommended that redundancy be incorporated into the pressurized irrigation system so that the pressurized irrigation system is able to meet all of the demand objectives with a major source unavailable.

3. It is recommended that the City continue to exact water rights and shares as land in Spanish Fork City is developed. However, the City should avoid accepting water rights that are not for current use in the Policy Declaration Boundary or in current sources. Irrigation companies that have service areas within the Policy Declaration Boundary include the Highline Division, Spanish Fork East Bench Irrigation, Spanish Fork South Irrigation Co., Spanish Fork Southeast Irrigation Co., Spanish Fork West Field Irrigation Co., and Springville Irrigation District. The irrigation companies and their service areas can be seen in Appendix A on the map Ditches & Irrigation Companies. It is recommended that the City exact that amount of water the new development will use to irrigate. This master plan assumes that 4.0 acre-feet is needed per irrigated acre. It was determined that the average irrigated acreage per ERC is 0.15 acres which produces a yearly demand requirement of 0.6 acre-feet per ERC. It is recommended that for nonresidential development the City calculate the amount of water required by multiplying the irrigated acreage by 4.0 acre-feet.

4. The City's water rights and water shares far exceed the City's current ability to receive the water through existing sources. It is recommended that the City continue to monitor and perfect water rights and shares. It is recommended that the City also continue to develop sources as more sources are needed.

5. Currently, the Central Utah Project (CUP) water is anticipated to be at a much higher cost than the other potential sources. It is therefore recommended that the other sources of water be developed first.

6. It is recommended that the City promote the need for a CUP pipeline that is planned to convey water south from the existing 96-inch CUP pipeline so that the City can convey irrigation shares and Strawberry Project water at a high pressure directly to the Spanish Oaks reservoir.

7. It is recommended that the City add a 4,000 gpm pump station with VFD at the 2550 East Tank and well site to deliver irrigation share water and Cold Springs water out of the storage tank.

8. It is recommended that the City add a 2,000 to 6,000 gpm pump station with VFD at the Golf Course Pond to deliver additional irrigation share water out of the pond and to allow the Golf Course Pond as equalization storage.

9. It is recommended that the City start to fund a pipeline and facility replacement program. The City could start with a small amount of $50,000 to $100,000 a year until the bond is paid off. It would then be recommended to fund the pipeline replacement program with $250,000 to $500,000 a year--the lower end representing one percent of the estimated replacement cost based on actual cost and the higher end representing the estimated replacement cost over 50 years using master plan cost estimates.

10. It is recommended that the impact fee calculation be updated annually.

11. The City requires that a developer install the minimum size of pipe in a new development. If the pipe size is recommended by the model and Master Plan to be a larger diameter to accommodate future growth than it is recommended that the City require the developer to install the larger pipeline. It is recommended that the developer be reimbursed the difference between the larger pipe cost and the cost of minimum sized pipe.

REFERENCES

Horrocks Engineers. (2011). *Spanish Fork City Transportation Master Plan*. Pleasant Grove, UT: Horrocks Engineers.

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Utah Division of Administrative Rules. 2010. *Utah Administrative Code, R309-510*. The Department of Administrative Services.

U.S. Census Bureau. 2010. *Profile of General Population and Housing Characteristics: 2010, Spanish Fork City, Utah*. http://factfinder2.census.gov

APPENDIX A
Calculations and Assumptions

Ditches & Irrigation Companies

1 Inch equals 4,755 Feet

Legend

Roads

- Not Paved
- Paved
- Rivers
- Ditches
- Spanish Fork Boundary

Canal Co Boundaries

- Highline Division
- Lake Shore Irrig. Co
- Mapleton Irrig. District
- Salem Irrig. and Canal Co
- Spanish Fork East Bench Irrig.
- Spanish Fork South Irrig. Co
- Spanish Fork Southeast Irrig. Co
- Spanish Fork West Field Irrig. Co
- Springville Irig. District

1/4/2006

Geographic Information Systems

Spanish Fork City GIS
40 South Main Street
Spanish Fork, UT 84660
(801) 798-5000

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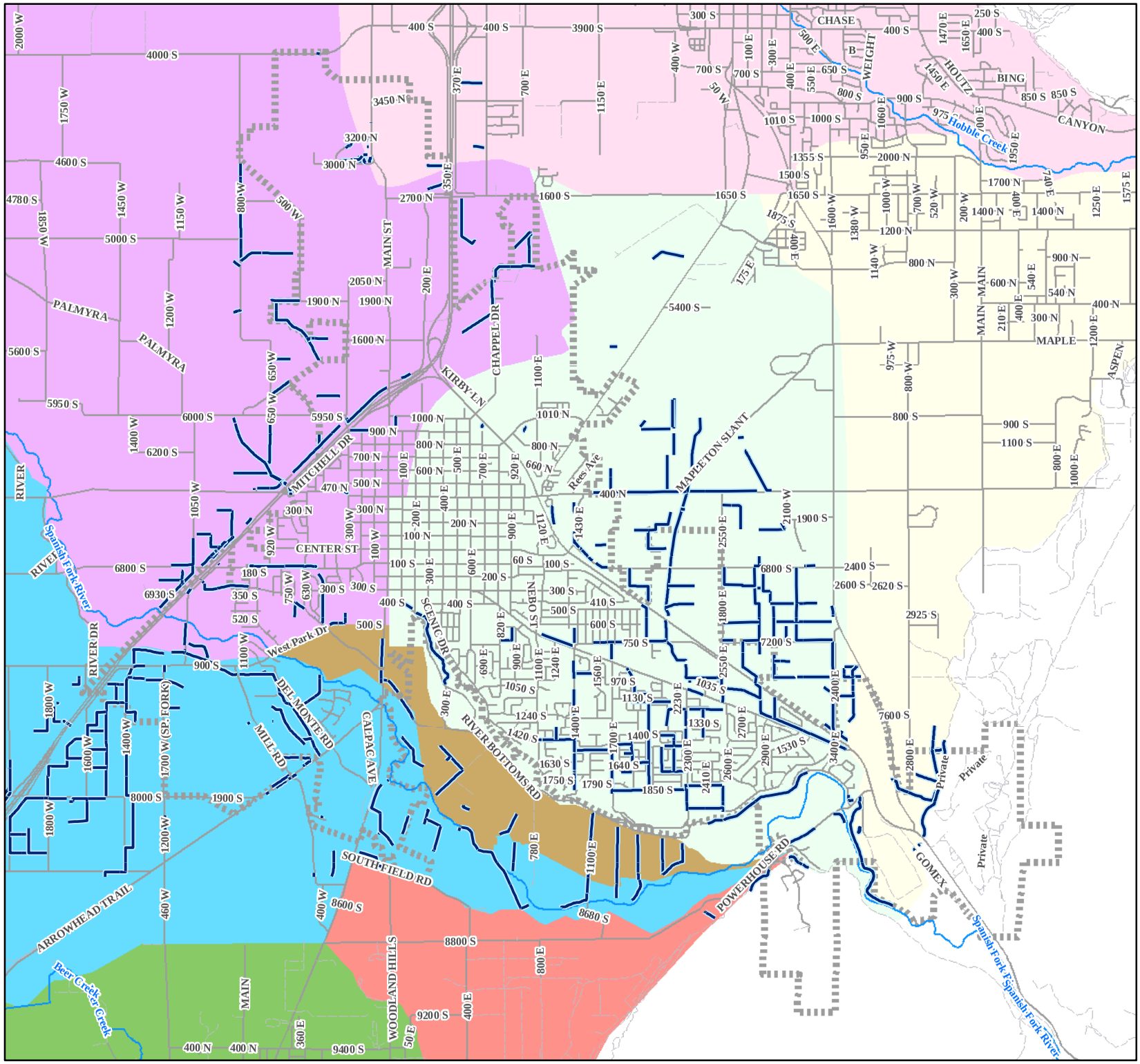
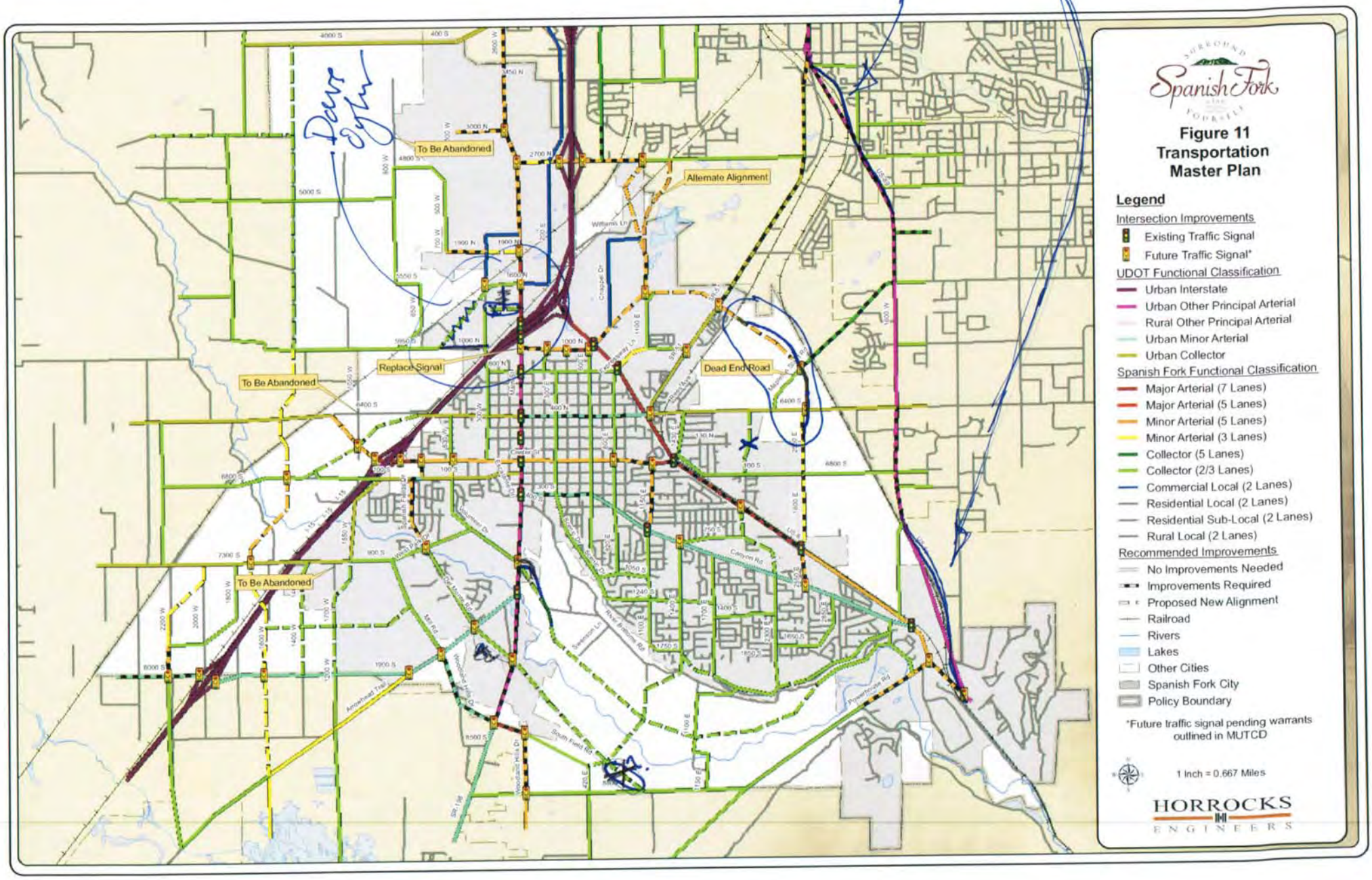
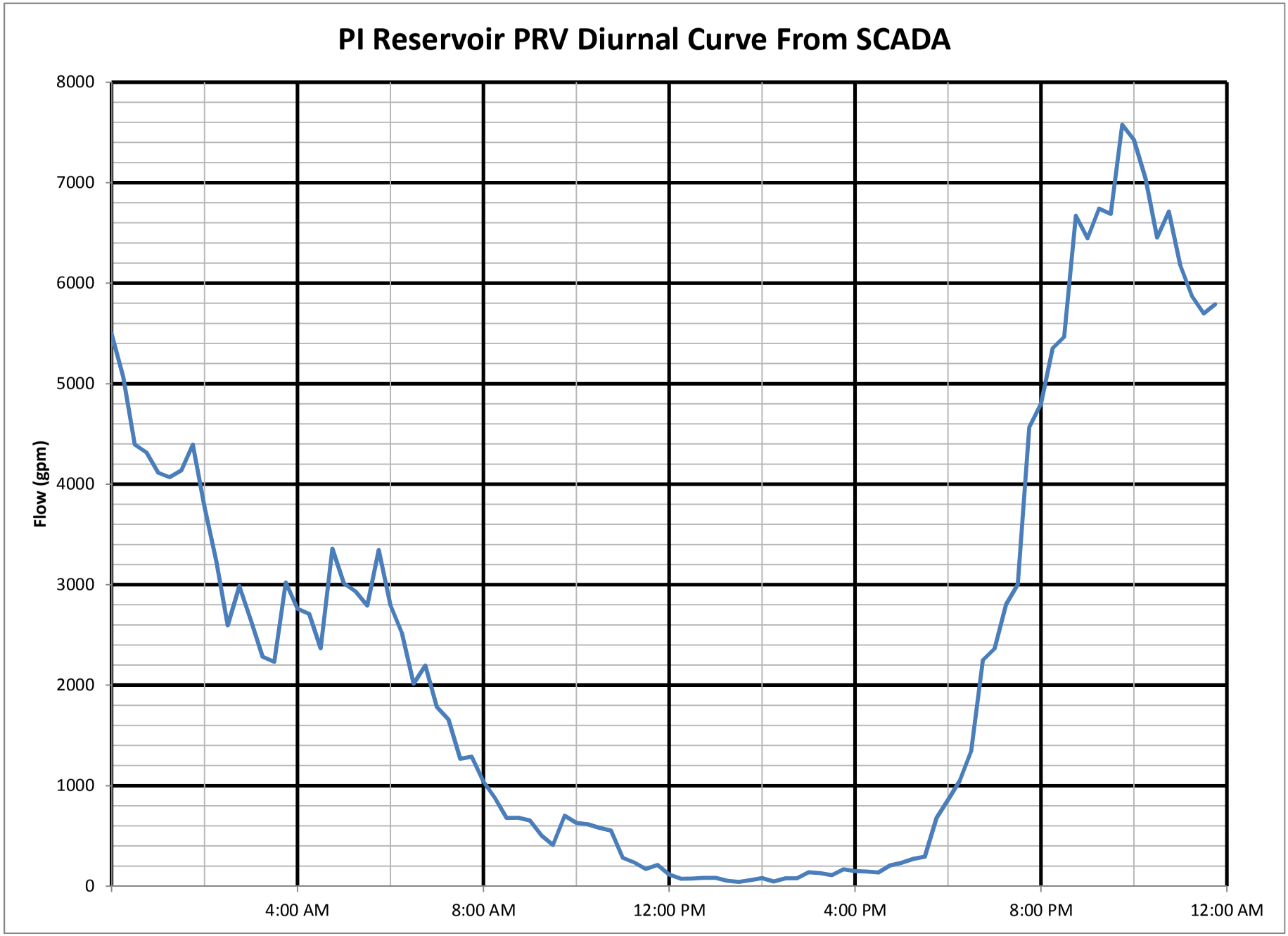


Chamber of Polutline

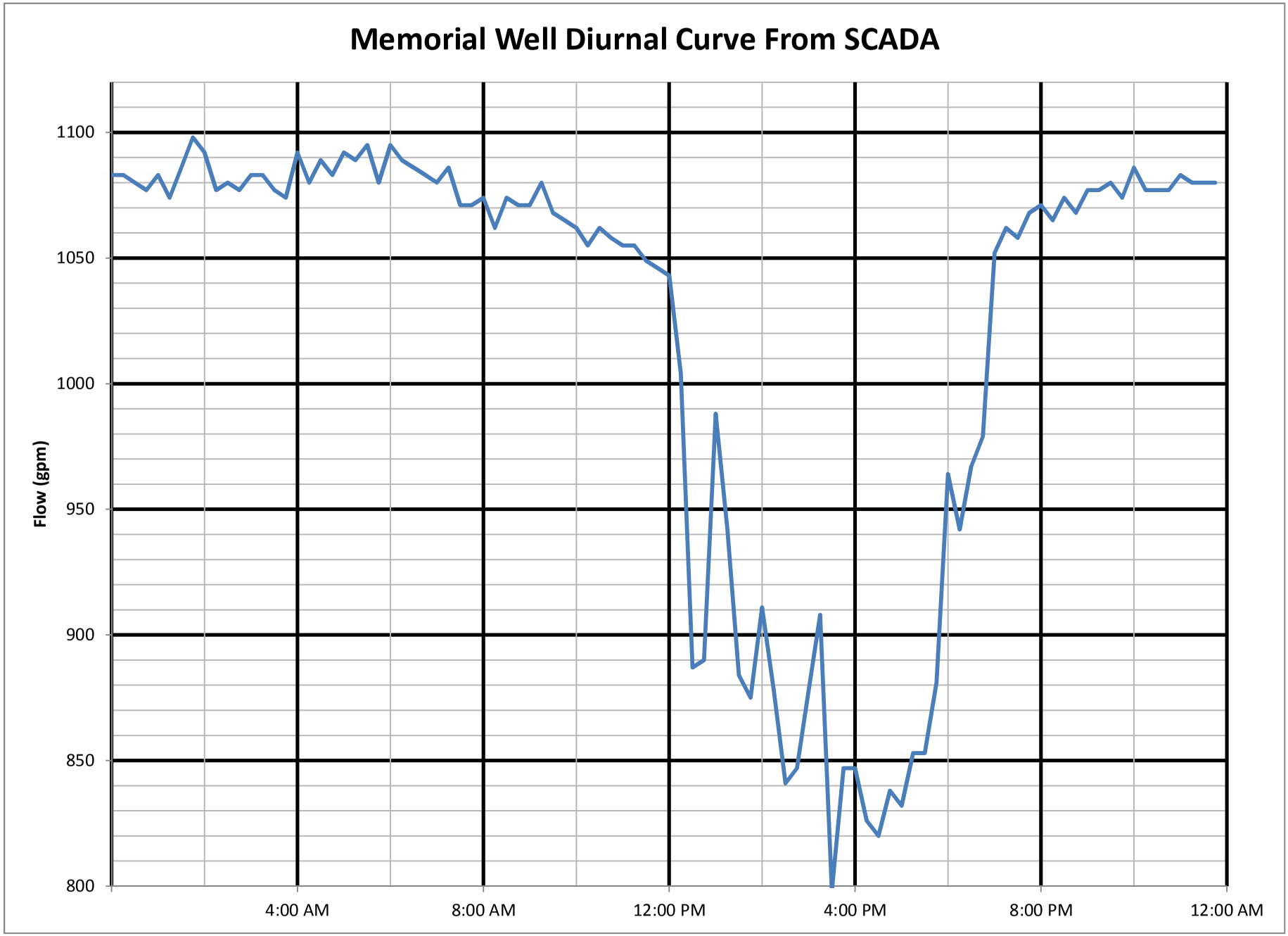
Dave Oyler

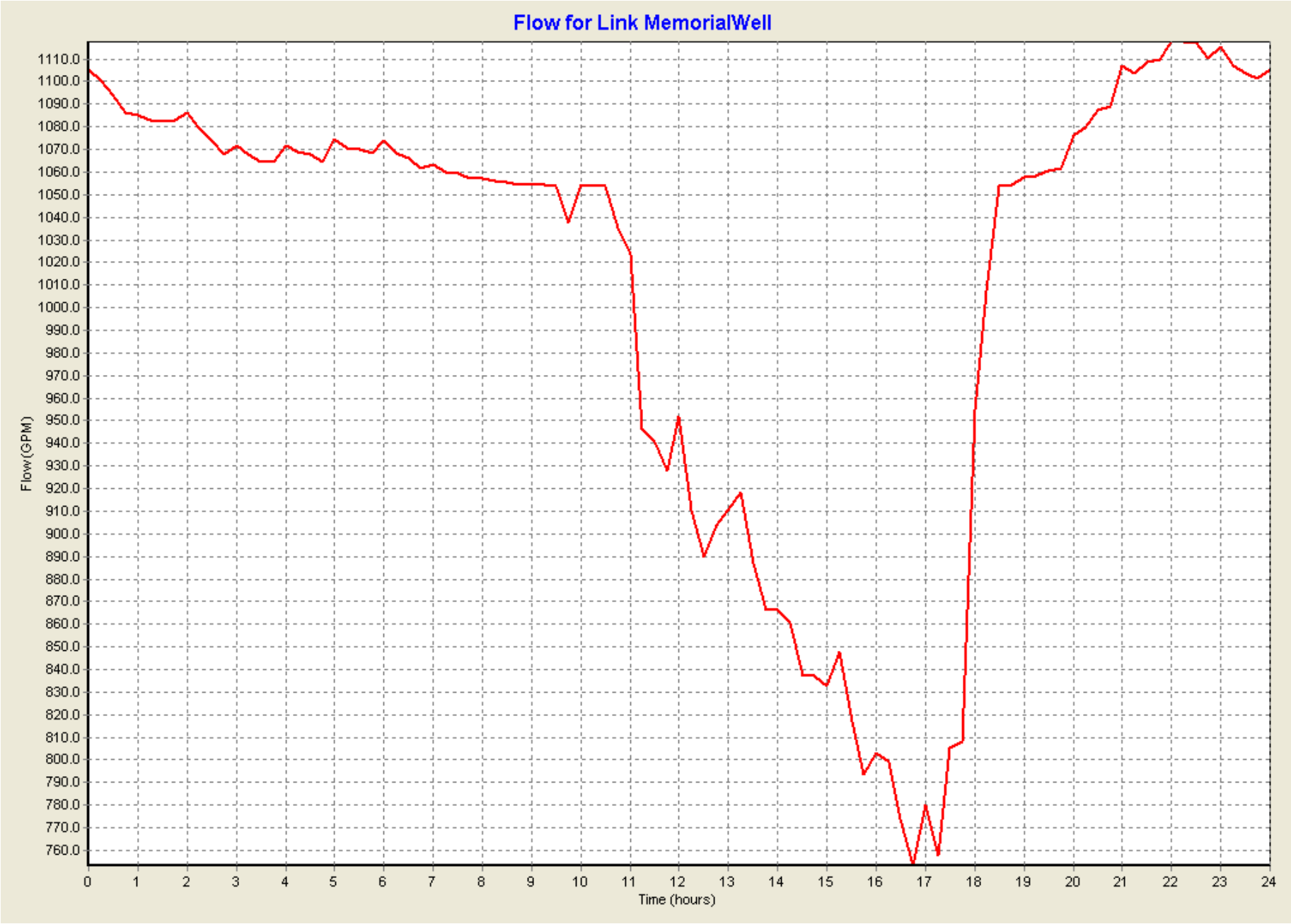


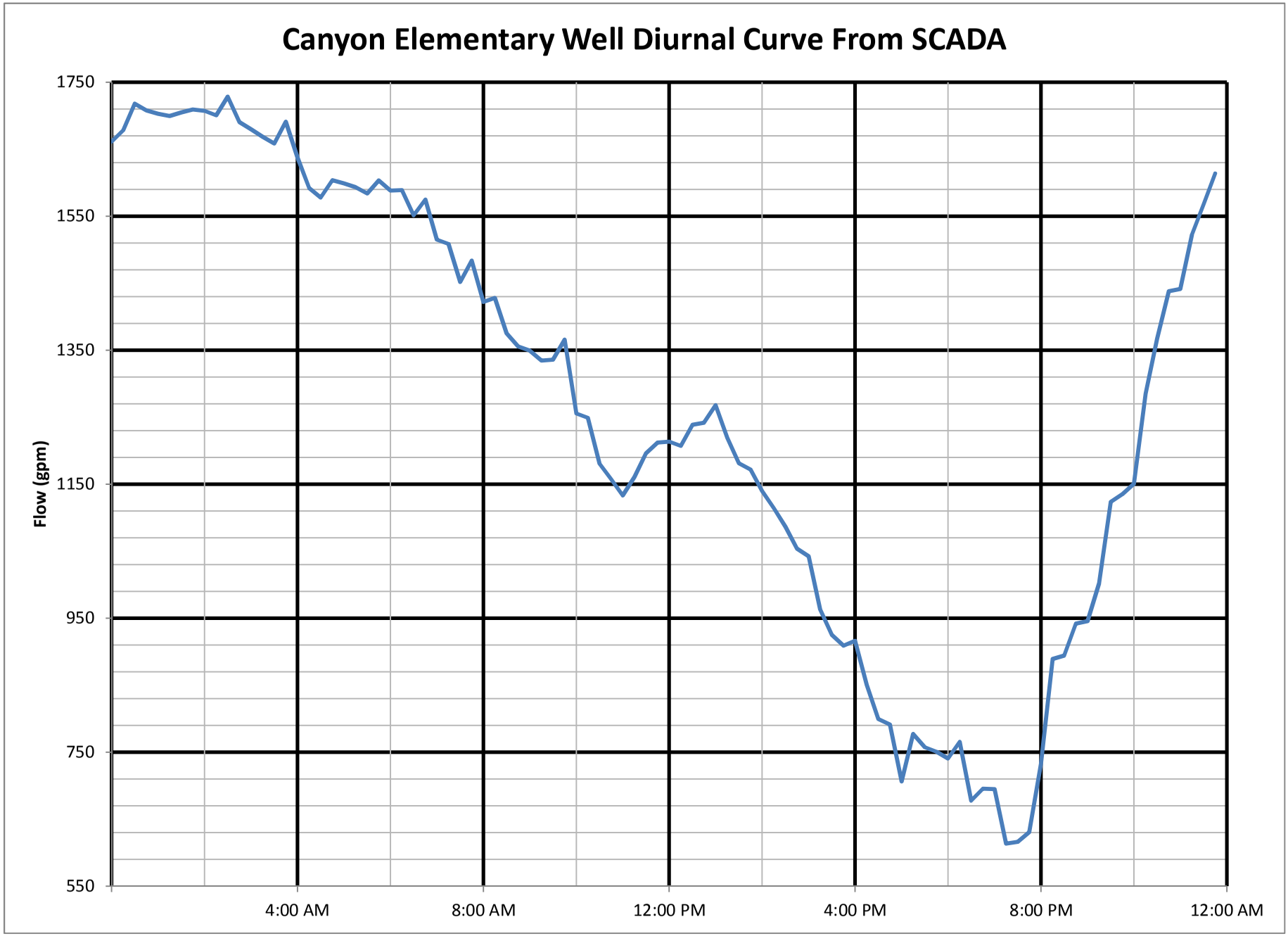
APPENDIX B
Calibration Data

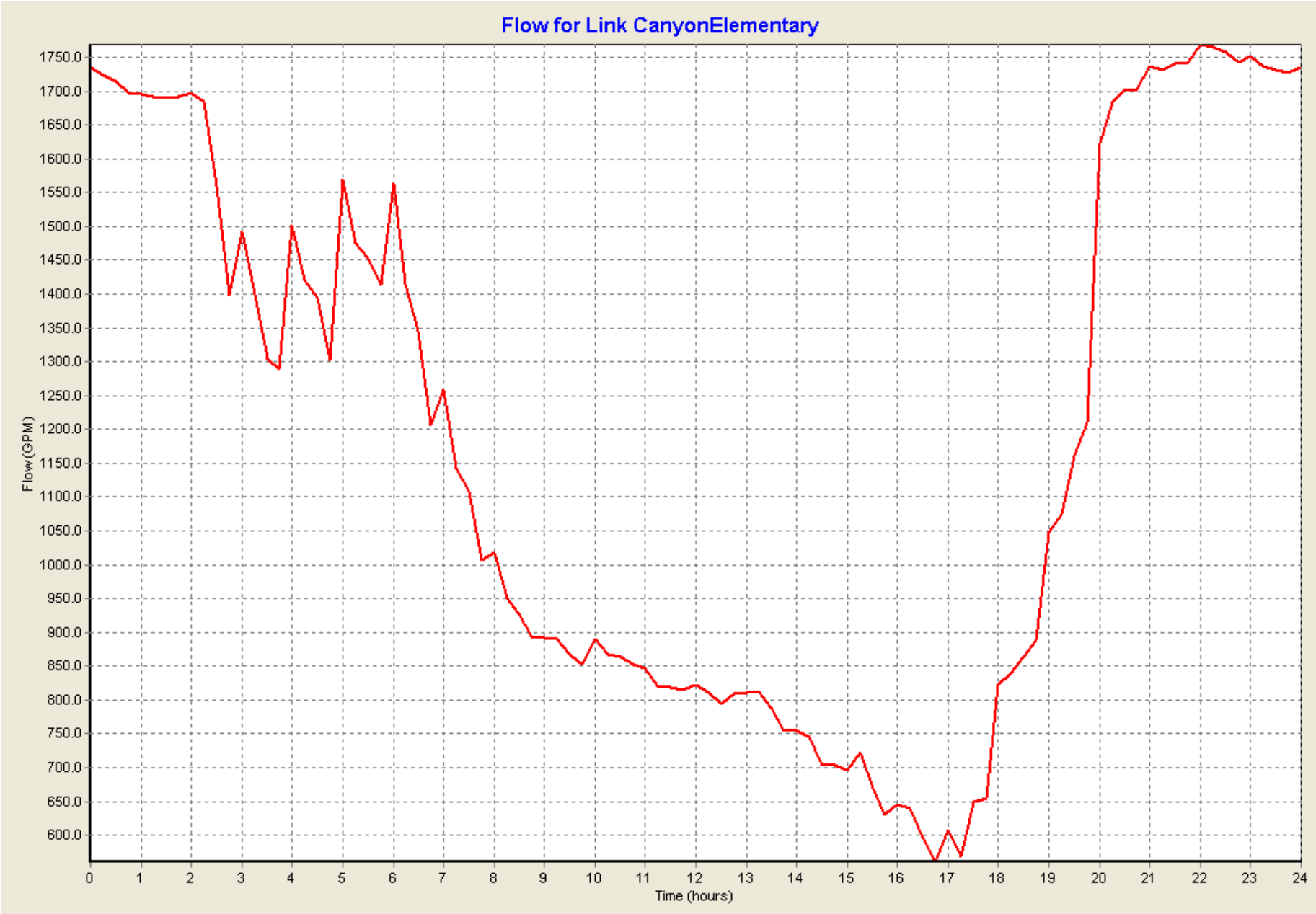

PI Reservoir PRV Diurnal Curve From SCADA
Flow (gpm)
8000
7000
6000
5000
4000
3000
2000
1000
0
4:00 AM
8:00 AM
12:00 PM
4:00 PM
8:00 PM
12:00 AM

Flow for Link PI_PRV
Flow (GPM)
7000.0
6800.0
6600.0
6400.0
6200.0
6000.0
5800.0
5600.0
5400.0
5200.0
5000.0
4800.0
4600.0
4400.0
4200.0
4000.0
3800.0
3600.0
3400.0
3200.0
3000.0
2800.0
2600.0
2400.0
2200.0
2000.0
1800.0
1600.0
1400.0
1200.0
1000.0
800.0
600.0
400.0
200.0
0.0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Time (hours)


Memorial Well Diurnal Curve From SCADA
Flow (gpm)
1100
1050
1000
950
900
850
800
4:00 AM
8:00 AM
12:00 PM
4:00 PM
8:00 PM
12:00 AM


Flow for Link MemorialWell
Flow (GPM)
1110.0
1100.0
1090.0
1080.0
1070.0
1060.0
1050.0
1040.0
1030.0
1020.0
1010.0
1000.0
990.0
980.0
970.0
960.0
950.0
940.0
930.0
920.0
910.0
900.0
890.0
880.0
870.0
860.0
850.0
840.0
830.0
820.0
810.0
800.0
790.0
780.0
770.0
760.0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Time (hours)


Canyon Elementary Well Diurnal Curve From SCADA
Flow (gpm)
1750
1550
1350
1150
950
750
550
4:00 AM
8:00 AM
12:00 PM
4:00 PM
8:00 PM
12:00 AM


Flow for Link CanyonElementary
Flow (GPM)
1750.0
1700.0
1650.0
1600.0
1550.0
1500.0
1450.0
1400.0
1350.0
1300.0
1250.0
1200.0
1150.0
1100.0
1050.0
1000.0
950.0
900.0
850.0
800.0
750.0
700.0
650.0
600.0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Time (hours)

APPENDIX C
Computer Model Output

SEE DISK

APPENDIX D
Cost Estimates

ID	Project Description	Work	Size	UNIT	UNIT TYPE	UNIT COST	COST	Contingency (20%) and Engineering (15%)	TOTAL COST	PROJECT COST
1	Install 8,670 feet of 12-in pipe, 1,960 feet of 16-in pipe, and 6,580 feet of 24-in pipe from 2770 E and River Bottoms Road to Volunteer Drive and Main Street	New Pipe	12	8,670	foot	$103	$893,010	$312,554	**$1,206,000**	**$3,067,000**
		New Pipe	16	1,960	foot	$119	$233,240	$81,634	**$315,000**	
		New Pipe	24	6,580	foot	$174	$1,144,920	$400,722	**$1,546,000**	
2	Install 2,980 feet of 12-in pipe from 2300 S and 1100 E to 1400 E and 1870 S	New Pipe	12	2,980	foot	$103	$306,940	$107,429	**$414,000**	**$414,000**
3	Install 6,100 feet of 12-in pipe in Arrowhead Trail Street between 1900 S and 1030 S on Main Street	New Pipe	12	6,100	foot	$103	$628,300	$219,905	**$848,000**	**$848,000**
4	Install 4,700 feet of 12-in pipe in 300 W between 900 N and 1900 N	New Pipe	12	4,700	foot	$103	$484,100	$169,435	**$654,000**	**$654,000**
5	Install 3,040 feet of 12-in pipe in 3000 N between Main Street and 600 W	New Pipe	12	3040	foot	$103	$313,120	$109,592	**$423,000**	**$423,000**
6	Install 1,170 feet of 12-in pipe in 1600 N from Main Street to 200 E and install 2,220 feet of 12-in pipe in 200 E from 1600 N to 2100 N	New Pipe	12	3390	foot	$103	$349,170	$122,210	**$471,000**	**$471,000**
7	Install 2,770 feet of 12-in pipe in 1800 N between 200 E and Chappel Drive	New Pipe	12	2,770	foot	$103	$285,310	$99,859	**$385,000**	**$385,000**
8	Install 4,890 feet of 12-in pipe in Chappel Drive from 1800 N to 1200 N and to 1000 N and 500 E	New Pipe	12	4,890	foot	$103	$503,670	$176,285	**$680,000**	**$680,000**
9	Install 4,190 feet of 12-in pipe in Kirby Lane from Chappel Drive to 450 E and then to 1800 N	New Pipe	12	4190	foot	$103	$431,570	$151,050	**$583,000**	**$583,000**
10	Install 4,000 feet of 12-in pipe in 600 W between 3000 N and State Road 77	New Pipe	12	4000	foot	$103	$412,000	$144,200	**$556,000**	**$556,000**
11	Install 6,990 feet of 12-in pipe in Highway 77 between 550 W and 2050 W	New Pipe	12	6,990	foot	$103	$719,970	$251,990	**$972,000**	**$972,000**
12	Install 6,620 feet of 12-in pipe in 1150 W between 3050 N and 2400 W	New Pipe	12	6,620	foot	$103	$681,860	$238,651	**$921,000**	**$921,000**
13	Install 3,670 feet of 12-in pipe in 1000 N between 300 W and 1120 W	New Pipe	12	3,670	foot	$103	$378,010	$132,304	**$510,000**	**$510,000**
14	Install 1,310 feet of 12-in pipe in Canyon Crest Road between 2300 E and 2600 E	New Pipe	12	1,310	foot	$103	$134,930	$47,226	**$182,000**	**$182,000**
15	Install 4,350 feet of 12-in pipe in 100 S between 1060 W and 1850 W	New Pipe	12	4,350	foot	$103	$448,050	$156,818	**$605,000**	**$605,000**
16	Install 3,300 feet of 12-in pipe in 1300 S between Mill Road and 1200 W	New Pipe	12	3,300	foot	$103	$339,900	$118,965	**$459,000**	**$459,000**
17	Install 3,750 feet of 12-in pipe in 3400 E between 1500 S to 750 S	New Pipe	12	3,750	foot	$103	$386,250	$135,188	**$521,000**	**$521,000**
18	Install 2,480 feet of 12-in pipe in Mill Road between 1300 S and State Road 164 and install 4,030 feet of 12-in pipe in Woodland Hills Drive between State Road 194 and State Road 198 and install 5,820 feet of 12-in pipe in South Field Road between State Roads 198 and 3000 S	New Pipe	12	12,332	foot	$103	$1,270,196	$444,569	**$1,715,000**	**$1,715,000**
19	Install 8,310 feet of 12-in pipe from 2750 S and 820 E to Arrowhead Trail Street and Del Monte Road	New Pipe	12	8,310	foot	$103	$855,930	$299,576	**$1,156,000**	**$1,156,000**

ID	Project Description	Work	Size	UNIT	UNIT TYPE	UNIT COST	COST	Contingency (20%) and Engineering (15%)	TOTAL COST	PROJECT COST
20	Install 4,330 feet of 12-in pipe in 2400 N between 2050 W and 1100 W, install 7,890 feet of 12-in pipe in 1100 W and 900 W between 1600 N and 1000 N	New Pipe	12	12,220	foot	$103	$1,258,660	$440,531	**$1,699,000**	**$1,699,000**
21	Install 2,360 feet of 12-in pipe in 1700 W between State Road 164 and 1400 S	New Pipe	12	2,360	foot	$103	$243,080	$85,078	**$328,000**	**$328,000**
22	Install 6,190 feet of 12-in pipe in 1100 E from 1200 N to 950 E and 2500 N	New Pipe	12	6,190	foot	$103	$637,570	$223,150	**$861,000**	**$861,000**
23	Install 1,450 feet of 12-in pipe in 2100 N between 1100 E and Chappel Drive and 1,310 feet of 12-in pipe in Chappel Drive from 2100 N to 1800 N	New Pipe	12	2,760	foot	$103	$284,280	$99,498	**$384,000**	**$384,000**
24	Install 2,880 feet of 12-in pipe in 1300 N between Chappel Drive to 1100 E	New Pipe	12	2,880	foot	$103	$296,640	$103,824	**$400,000**	**$400,000**
25	Install 1,790 feet of 12-in pipe in 1200 N from Chappel Drive to 1100 E and 1300 N	New Pipe	12	1,790	foot	$103	$184,370	$64,530	**$249,000**	**$249,000**
26	Install 3,750 feet of 12-in pipe in future road connecting 1950 N on Williams Lane to 950 E and 2500 N	New Pipe	12	3,750	foot	$103	$386,250	$135,188	**$521,000**	**$521,000**
27	Install 1,480 feet of 12-in pipe in future extension of 1420 E to Expressway Lane	New Pipe	12	1,480	foot	$103	$152,440	$53,354	**$206,000**	**$206,000**
28	Install 3,060 feet of 12-in pipe in Expressway Lane between State Road 51 and 2250 E	New Pipe	12	3,060	foot	$103	$315,180	$110,313	**$425,000**	**$425,000**
29	Install 390 feet of 12-in pipe in 2250 E from Legacy Farms Parkway to Expressway Lane	New Pipe	12	390	foot	$103	$40,170	$14,060	**$54,000**	**$54,000**
30	Install 2,610 feet of 12-in pipe and 3,660 feet of 16-in pipe in Legacy Farms Parkway between 400 N and State Road 51 and install 2,780 feet of 16-in pipe in 2550 E from 400 N to 100 S	New Pipe	12	2,610	foot	$103	$268,830	$94,091	**$363,000**	**$1,398,000**
		New Pipe	16	6,440	foot	$119	$766,360	$268,226	**$1,035,000**	
31	Install 3,190 feet of 12-in pipe in 400 N between Stahell Lane and Legacy Farms Parkway	New Pipe	12	3,190	foot	$103	$328,570	$115,000	**$444,000**	**$444,000**
32	Install 2,880 feet of 12-in pipe in 150 S between 2550 E and Railroad	New Pipe	12	2,880	foot	$103	$296,640	$103,824	**$400,000**	**$400,000**
33	Install 2,910 feet of 12-in pipe in 3400 E and along the Railroad between 750 S and 150 S	New Pipe	12	2,910	foot	$103	$299,730	$104,906	**$405,000**	**$405,000**
34	Install 3,940 feet of 12-in pipe in 750 S between 3400 E and 2560 E	New Pipe	12	3,940	foot	$103	$405,820	$142,037	**$548,000**	**$548,000**
35	Install 3,270 feet of 12-in pipe in 2300 S between 2300 E and 1700 E	New Pipe	12	3,270	foot	$103	$336,810	$117,884	**$455,000**	**$455,000**
36	Install 1,300 feet of 12-in pipe from 1550 E and 2050 S to 1830 E and 2080 S	New Pipe	12	1,300	foot	$103	$133,900	$46,865	**$181,000**	**$181,000**
37	Install 1,380 feet of 12-in pipe and 3,430 feet of 16-in pipe in 1100 E and 1200 E between 3000 S and 2080 E	New Pipe	12	1,380	foot	$103	$142,140	$49,749	**$192,000**	**$743,000**
		New Pipe	16	3,430	foot	$119	$408,170	$142,860	**$551,000**	

ID	Project Description	Work	Size	UNIT	UNIT TYPE	UNIT COST	COST	Contingency (20%) and Engineering (15%)	TOTAL COST	PROJECT COST
38	Install 1,020 feet of 12-in pipe and 2,480 feet of 16-in pipe from 620 E and South Field Road to 2300 S and 1100 E	New Pipe	12	1,020	foot	$103	$105,060	$36,771	**$142,000**	**$540,000**
		New Pipe	16	2,480	foot	$119	$295,120	$103,292	**$398,000**	
39	Install 1,570 feet of 12-in pipe in Rivers Bottom Road between Canyon Glen Loop and 2770 E	New Pipe	12	1,570	foot	$103	$161,710	$56,599	**$218,000**	**$218,000**
40	Install 8,760 feet of 12-in pipe in 3000 S between 2400 E and 620 E	New Pipe	12	8,760	foot	$103	$902,280	$315,798	**$1,218,000**	**$1,218,000**
41	Install 5,620 feet of 12-in pipe in 1800 W and along I-15 between 3000 S and 900 S	New Pipe	12	5,620	foot	$103	$578,860	$202,601	**$781,000**	**$781,000**
42	Install 2,770 feet of 12-in pipe in 1300 S between 1200 W and 1800 W	New Pipe	12	2,770	foot	$103	$285,310	$99,859	**$385,000**	**$385,000**
43	Install 10,420 feet of 12-in pipe in 3000 S between 1000 W and 2200 W	New Pipe	12	10,420	foot	$103	$1,073,260	$375,641	**$1,449,000**	**$1,449,000**
44	Install 5,520 feet of 12-in pipe in From 2200 W and 3000 S to 1950	New Pipe	12	5,520	foot	$103	$568,560	$198,996	**$768,000**	**$768,000**
45	Install 16,420 feet of 12-in pipe in 900 S between 2000 W and 1150 W	New Pipe	12	16,420	foot	$103	$1,691,260	$591,941	**$2,283,000**	**$2,283,000**
46	Install 4,510 feet of 12-in pipe in From 900 S and 2500 W to 100 S and 2000 W	New Pipe	12	4,510	foot	$103	$464,530	$162,586	**$627,000**	**$627,000**
47	Install 8,080 feet of 12-in pipe from 100 S and 1850 W to 1000 N and 700 W	New Pipe	12	8,080	foot	$103	$832,240	$291,284	**$1,124,000**	**$1,124,000**
48	Install 2,520 feet of 12-in pipe in 400 N between 1230 W and 650 W	New Pipe	12	2,520	foot	$103	$259,560	$90,846	**$350,000**	**$350,000**
49	Install 10" PRV at Woodland Hills Road and South Field Road (See project 18)	PRV Install	8	1	each	$23,000	$23,000	$8,050	**$31,000**	**$31,000**
50	Install 10" PRV at 2800 S and 1000 E (See project 19)	PRV Install	8	1	each	$23,000	$23,000	$8,050	**$31,000**	**$31,000**
51	Install 10" PRV at 1000 E and 2350 S (See project 1)	PRV Install	8	1	each	$23,000	$23,000	$8,050	**$31,000**	**$31,000**
52	Install 10" PRV at Expressway Lane and 1600 E (See project 28)	PRV Install	8	1	each	$23,000	$23,000	$8,050	**$31,000**	**$31,000**
53	Install 10" PRV at Legacy Farms Parkway and State Road 51 (See project 30)	PRV Install	8	1	each	$23,000	$23,000	$8,050	**$31,000**	**$31,000**
54	Canyon Road Transmission Pipeline								**$993,000**	**$993,000**
55	Install 4,000 gpm pump at 2550 E and Canyon Road	Pump Instal	4000	1	each	$888,741	$888,741	$311,059	**$1,200,000**	**$1,200,000**
56	Install 6,000 gpm VFD pump at 2850 E and River Bottoms Road	Pump Instal	6000	1	each	$1,111,106	$1,111,106	$388,887	**$1,500,000**	**$1,500,000**
57	Update the Model and Master Plan as needed and update the impact fees annually								**$304,183**	**$304,183**
58	Install connection to the 36-inch erservoir transmission line from the eventual CUP pipeline								**$150,000**	**$150,000**
									Total	**$38,868,183**

IMPACT FEE RELATED PROJECT COST ESTIMATES

ID	Project Description	NOTES	ACTUAL COST	ESTIMATED FUTURE COST	% Impact Fee Eligible
B	2550 E Trunkline (Nebo School District)		**$110,554**		**39%**
C	Golf Course PI Pond Pump Station		**$314,882**		**50%**
D	Citywide Pressurized Irrigation System		**$17,315,139**		**57%**
E	Golf Course PI Pond		**$638,430**		**58%**
6	2000 N 200 E Railroad Casing	Portion of Project ID 6	**$13,043**		**29%**
54	Canyon Road Transmission Pipeline/Crab Creek		**$993,000**		**100%**
57	Model, Masterplan & Impact Fee Updates			**$304,183**	**100%**
58	CUP Connection			**$150,000**	**100%**

UNIT COSTS FOR PI COST ESTIMATE CALCULATIONS

PVC Pipe In Road Cost/lf		PVC Pipe Out of Road Cost/lf		Check Valve		PRV Valve Station	
Diameter (in)	Cost/lf	Diameter (in)	Cost/lf	Size (in)	Cost	Size (in)	Cost
4	$65	4	$47	4	$875	4	$19,000
6	$73	6	$56	6	$1,175	6	$21,000
8	$81	8	$64	8	$1,550	8	$23,000
10	$91	10	$76	10	$2,725	10	$32,000
12	$103	12	$89	12	$3,900	12	$37,000
14	$103	14	$89	14	$4,013	14	$43,000
16	$119	16	$100	16	$4,125	16	$50,000
18	$136	18	$119	18	$6,475	18	$55,000
20	$145	20	$127	20	$12,288	20	$58,000
24	$174	24	$159	24	$18,100	24	$73,000
30	$236	30	$225	30		30	$84,000
36	$316	36	$312	36		36	$100,000
					Estimation		Estimation

Assumptions

Pipe Costs 2011 RS Ways & Means, 4' cover, 10 laterals/1,000', 0 hydrants/1,000'

Check Valve 2011 RS Ways & Means

PRV Valve Sta. Granger Hunter Drinking Water Master Plan 2005, no inflation compensation due to similar pricing structure

Spanish Fork City

Debt Service Payments

	P I	P I	
	$16,255,000	$16,255,000	
Fiscal	**PI & Water**	**PI & Water**	
Year	Zions	Zions	
Ending	June	Dec./ June	
June 30,	Principal	Interest	Total
	Refunded 8/2010		
2011	130,000	236,922	366,922
2012	100,000	239,963	339,963
2013	1,075,000	1,212,963	2,287,963
2014	1,105,000	1,210,713	2,315,713
2015	1,135,000	1,207,563	2,342,563
2016	1,160,000	1,209,863	2,369,863
2017	1,185,000	1,211,663	2,396,663
2018			
2019			
2020			
2021			
2022			
2023			
2024			
2025			
2026			
2027			
	5,890,000	6,529,647	

Callable after June 1, 2013

SPANISH FORK CITY UTILITY RATES

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REVISED: July 2010

ELECTRIC RESIDENTIAL

BASE CHARGE	-	MONTHLY RATE OF $3.50
ENERGY CHARGE	-	PER kWh $0.08083
POWER COST ADJ.	-	DETERMINED MONTHLY (According to power purchase price from the supplier)

GENERAL ELECTRIC SERVICE

BASE CHARGE	-	MONTHLY RATE OF $6.50
POWER CHARGE	-	DEMAND METERS ONLY, charge additional $6.00 per demand
ENERGY CHARGE	-	FIRST 1000 kWh - $0.11750
	-	NEXT 4000 kWh - $0.07579
	-	ALL OTHER kWh - $0.04747
POWER COST ADJ.	-	DETERMINED MONTHLY (According to power purchase price from the supplier)

LARGE POWER

BASE CHARGE	-	MONTHLY RATE OF $50.00
CAPACITY CHARGE	-	DEMAND $10.00 PER KW / MINIMUM BASED ON: 400 KW floor
POWER COST ADJ.	-	DETERMINED MONTHLY (According to power purchase price from the supplier)
POWER FACTOR	-	THIS CHARGE IS FOR THE ENERGY EFFICIENCY. BUSINESSES THAT DO NOT MAINTAIN A 90% EFFICIENCY ARE CHARGED A PENALTY.
ENERGY CHARGE	-	$0.03150 per kWh usage

COMMERCIAL CULINARY WATER

BASE CHARGE	-	$10.00
WATER CHARGE	-	$ 1.19 PER 1000 GALLONS

RESIDENTIAL CULINARY WATER - ***WITH PI***

BASE CHARGE	-	$10.00
WATER CHARGE	-	$ 1.19 PER 1000 GALLONS

RESIDENTIAL CULINARY WATER - ***WITHOUT PI (within city limits)***

BASE CHARGE	-	$10.00
WATER CHARGE	-	$ 1.19 PER 1000 GALLONS

OUT OF CITY CULINARY WATER

BASE CHARGE	-	$13.60
WATER CHARGE	-	$ 2.46 PER 1000 GALS FOR THE FIRST 16000 GALS, PLUS OUTDOOR USAGE

METERED PRESSURIZED IRRIGATION

BASE CHARGE	-	$ 13.25 - 3/4 INCH OR 1 INCH METER (Most Residential)
	-	$ 25.98 - 1.5 INCH METER
	-	$ 41.69 - 2 INCH METER
		$ 94.80 - 3 INCH METER
		$162.59 - 4 INCH METER
PI USAGE CHARGE	-	$ .92 PER 1000 GALLONS

SEWER

BASE CHARGE	-	$12.00 FOR MAINTENANCE
GALLON CHARGE	-	$ 1.30 PER 1000 GALLONS

Gallon charge is based on winter water use. If no previous winter history customers are given city average of 6,000 gals.

GARBAGE

BASE CHARGE	-	$ 8.75 PER MONTH PER CAN FOR RES. & BUS.
BASE CHARGE	-	$19.50 PER MONTH PER CAN FOR OUT OF CITY

Businesses are limited to 4 cans
Residents can have an unlimited # of cans. However they are required to keep additional cans, a minimum of 6 months.

RECYCLE CAN - Voluntary (every other week)

BASE CHARGE	-	$ 5.50 PER MONTH

YARD LIGHT

CHARGE	-	$13.10 PER MONTH