ORDINANCE 11-03-2013

AN ORDINANCE ADOPTING A PRESSURIZED IRRIGATION MASTER PLAN.

WHEREAS, Santaquin City (the *"City"*) is a political subdivision of the State of Utah, authorized and organized under applicable provisions of Utah law; and

WHEREAS, Santaquin has experienced tremendous growth in the past and anticipates more growth in the future; and

WHEREAS, Santaquin operates and maintains a pressurized irrigation system since 2007 and anticipates needing to expand that system as future growth occurs in the City; and

WHEREAS, the City recently commissioned JUB Engineers, LLC to prepare a Pressurized Irrigation Master Plan and Capital Facilities Plan to establish long term plans for pressure irrigation system infrastructure in the City.

NOW, THEREFORE, BE IT ORDAINED BY THE CITY COUNCIL OF Santaquin CITY, STATE OF UTAH, AS FOLLOWS:

SECTION I. Adoption of Pressurized Irrigation Capital Facilities Plan and Master Plan

The attached Pressurized Irrigation Capital Facilities Plan and Master Plan, prepared November 2013 by JUB Engineers, LLC, is hereby adopted as the official Irrigation Plan of Santaquin City.

SECTION II. Codification, Inclusion in the Code, and Scrivener's Errors

It is the intent of the City Council that the provisions of this ordinance be made part of the City Code as adopted, that sections of this ordinance may be re-numbered or re-lettered, that the word ordinance may be changed to section, chapter, or other such appropriate phrase in order to accomplish such intent regardless of whether such inclusion in a code is accomplished, sections of the ordinance may be re-numbered or re-lettered. Typographical errors which do not affect the intent of this ordinance may be authorized by the City without need of public hearing by its filling a corrected or re-codified copy of the same with the City Recorder.

SECTION III. Severability

If any section, phrase, sentence, or portion of this ordinance is for any reason held invalid or unconstitutional by any court of competent jurisdiction, such portion shall be deemed a separate, distinct, and independent provision, and such holding shall not affect the validity of the remaining portions thereof.

SECTION IV. Effective Date

The City Recorder shall deposit a copy of this ordinance in the official records of the City on November 7, 2013, and before 5:00 p.m. on that day, shall place a copy of this ordinance in three places within the City. This ordinance shall become effective at 5:00 p.m. on November 7, 2013.

PASSED AND APPROVED this 6th day of November, 2013.

By: ______________________
Mayor James E. DeGraffenried

ATTEST:
By ______________________
Susan Farnsworth, City Recorder

SANTAQUIN CITY
Incorporated
January 4,
1932
STATE OF UTAH

Voting	
Council Member Keith Broadhead	yes
Council Member Matt Carr	yes
Council Member Kirk Hunsaker	yes
Council Member James Linford	yes
Council Member Rick Steele	yes

STATE OF UTAH)
) ss.
COUNTY OF UTAH)

I, SUSAN B. FARNSWORTH, City Recorder of Santaquin City, Utah, do hereby certify and declare that the above and foregoing is a true, full, and correct copy of an ordinance passed by the City Council of Santaquin City, Utah, on the 6th day of November, 2013, entitled

"An Ordinance Approving the Irrigation Impact Fee Facility Plan and Impact Fee Analysis."

IN WITNESS WHEREOF, I have hereunto set my hand and affixed the Corporate Seal of Santaquin City Utah this 6th day of November, 2013.

SANTAQUIN CITY
Incorporated
January 4,
1932
STATE OF UTAH

(SEAL)

SUSAN B. FARNSWORTH
Santaquin City Recorder

AFFIDAVIT OF POSTING

STATE OF UTAH)
) ss.
COUNTY OF UTAH)

I, SUSAN B. FARNSWORTH, City Recorder of Santaquin City, Utah, do hereby certify and declare that I posted in three (3) public places the ordinance which is attached hereto on the 6th day of November, 2013.

The three places are as follows:

1. Zions Bank
2. Post Office
3. City Office

I further certify that copies of the ordinance so posted were true and correct copies of said ordinance.

SBFarnsworth
SUSAN B. FARNSWORTH
Santaquin City Recorder

The foregoing instrument was acknowledged before me this 7 day of Nov, 2013, by SUSAN B. FARNSWORTH.

My Commission Expires:

Ann Edington Adams
Notary Public

Residing at: Utah County

ANN EDINGTON ADAMS
NOTARY PUBLIC • STATE of UTAH
COMMISSION NO. 601965
COMM. EXP. 12/01/2014

SANTAQUIN CITY

PRESSURE IRRIGATION SYSTEM
MASTER PLAN and
CAPITAL FACILITIES PLAN

November 2013

Prepared by:

J-U-B ENGINEERS, INC.
240 West Center Street, Suite 200
Orem, Utah 84057
(801) 226-0393
www.jub.com

J-U-B
J-U-B ENGINEERS, Inc.
ENGINEERS • SURVEYORS • PLANNERS

Santaquin

SANTAQUIN CITY

PRESSURE IRRIGATION SYSTEM MASTER PLAN and CAPITAL FACILITIES PLAN

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Adopted by Santaquin City Council
on ____________________

J-U-B ENGINEERS, Inc.
ENGINEERS • SURVEYORS • PLANNERS

EXECUTIVE SUMMARY

The Santaquin City Pressure Irrigation Master Plan and Capital Facilities Plan plans for future infrastructure improvements to the Santaquin pressure irrigation system. It also provides the foundation for collection of pressure irrigation impact fees. J-U-B Engineers created a computer model of the pressure irrigation system in order to identify what improvements would be needed when Santaquin is built out.

We established a level of service with guidance from standards of the State of Utah for outdoor watering when provided by a culinary water system as well as evaluation of other criteria as described in the plan. The existing pressure irrigation system meets the level of service.

Santaquin City will need one additional well, one additional water tank, two storage reservoirs and several booster pumps and pressure reducing valves. Some of these facilities will likely be installed by land developers. Many water lines installed by land developers will need to be larger than the minimum 6" diameter lines. Santaquin City will need to fund the additional line size. Improvements needed to satisfy the demands of future growth are eligible for payment with impact fees. However the timing of many of these improvements will be driven by specific developments, and the City will likely have to bond for some of them and be reimbursed from future impact fee collections.

Growth will likely trigger the construction of the most expensive infrastructure in the next decade. If other infrastructure is constructed prior to being needed to support growth, impact fees can be collected after construction to reimburse the costs as development consumes the available reserve capacity.

We make the following recommendations:

1. Collect impact fees to fund infrastructure to support future growth.
2. Make improvements to the pressure irrigation system so that it is not consuming source and storage capacity in the culinary water system, particularly on the east side of the city in the short term and then in the Summit Ridge area.
3. Construct the improvements identified within the plan that are necessary to accommodate growth.
4. Make operational changes to the system to allow for better overall water management, reduced pumping costs and more efficient and flexible operation of the pressure irrigation system.
5. Update the Master Plan/Capital Facilities Plan at least every 5 years, or when significant changes to planned land use, development or water use occur.
6. Evaluate long-term water right needs and acquisition policy.
7. Periodically review and update user rates.

PRESSURE IRRIGATION MASTER PLAN AND CAPITAL FACILITIES PLAN

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I. INTRODUCTION

A. Purpose

This document is an integrated master plan and capital facilities plan for Santaquin City's pressure irrigation system. It identifies the City's current pressure irrigation system as well as current and future infrastructure needs and provides direction as growth occurs. The recommendations herein are based on conclusions reached using growth projections and computer modeling of the City's pressure system.

B. Background

Previous water master plans prepared for Santaquin City, dating as far back as 1981 (see "Santaquin City Water and Sewer System Study", by Engineering Associates, Inc., dated October 1981) recommended that Santaquin City install a pressure irrigation system to reduce demand on the City's culinary water system for outdoor watering needs.

In the fall of 2004 J-U-B Engineers began working with Santaquin City to study the feasibility of a pressure irrigation system throughout the City. Construction of the citywide system started in 2006 and was completed to its current configuration in 2009.

At the time that the pressure irrigation system was constructed the available funding was not sufficient to construct some of the necessary infrastructure needed. Due to the lack of available funds, the City's culinary water resources were utilized to provide pressure irrigation service in several areas of the City. There are currently four pressure zones that receive pressure irrigation service with "borrowed" culinary water system resources. This situation is now causing heavy strain on the culinary water system. This plan identifies improvements necessary to remove the current pressure irrigation demands from the culinary system.

C. Scope

This master plan includes a discussion of system modeling efforts and summary results and capital facilities planning for the City's pressure irrigation system from 2013 to buildout. It also includes an implementation plan for recommended capital improvement projects.

This plan provides direction for future growth, and the integrated capital facilities plan provides a plan for construction of pressure irrigation system improvements to serve the residents of Santaquin City. The capital improvement projects portion of the plan includes planning level cost estimates as well as an estimated schedule for construction of the recommended improvements

D. Objectives

The objectives of this Pressure Irrigation Master Plan & Capital Facilities Plan are listed below:

1. Model the existing pressure irrigation system
2. Establish levels of service

3. Identify improvements needed to meet existing system deficiencies
4. Model the future water system required to service projected build-out conditions based on the City's current General Plan
5. Identify improvements needed to meet future demands to build-out
6. Prioritize improvement projects
7. Estimate the cost of improvements
8. Identify potential sources of funding for needed improvements
9. Make recommendations for implementation of system improvements

II. APPROACH

A. Existing Conditions

1. Existing Water System

The existing Santaquin Pressure Irrigation System has 2,363 ERUs. Figure A-1 "Existing System" in Appendix A shows the City's existing pressure irrigation system. The system currently has several pressure zones, which are shown in Figure A-2 "Existing Pressure Zones" in Appendix A.

2. Existing Land Use and Pressure Irrigation Connections

Santaquin City's pressure irrigation meters have been located by city staff using mapping grade GPS units. Rather than using existing land use, estimated densities and estimated water use rates to approximate current demand, we used actual water use data and locations. This method bypasses the existing land use component traditionally used for modeling purposes.

Figure A-3 "Existing Pressure Irrigation Connections" in Appendix A shows the Santaquin City boundary, the study area boundary, and existing pressure irrigation connection locations.

3. Existing Population

From 2000 to 2010 Santaquin City experienced tremendous growth. The City's population nearly doubled during that time, from 4,834 in 2000 to 9,128 in 2010, according to US Census data. This type of significant growth can strain the City's infrastructure like the pressure irrigation system. To estimate the 2012 population we started with the actual 2010 census figure and estimated growth rates of 6.56% in 2010, and 8.28% in 2011 through 2012, which are the Santaquin growth rates published by Mountainland Association of Governments, the metropolitan planning organization that covers Utah County. This results in an estimated Santaquin population at the end of 2012 of 10,999.

According to the 2010 US Census, the average household size in Santaquin was 3.93 persons per household. For evaluation purposes we rounded to 3.9 persons per household.

B. Future Conditions

This report identifies two different horizon years for planning purposes. A 10 year horizon was used to determine which capital projects will be needed within that time frame (for impact fee purposes). A buildout horizon was also used to determine capital projects needed between 10 years and buildout.

This report identifies at what number of equivalent residential units (ERUs) each future capital project will be needed. Based upon growth projections it also predicts the approximate year that each project will be needed.

In order for the City to provide new users with the levels of service indicated herein, the pressure irrigation system will need to be expanded and upgraded.

1. Future Land Use

   The study area boundary does not coincide with the current Santaquin City boundary. Currently there are approximately 6,700 acres of land within the City limits. The study area boundary defined by Santaquin City includes the current and anticipated future pressure irrigation service areas. The study area boundary includes 8,444 acres of land. Of these 8,444 acres, 1,200 acres is land that will not contribute to future pressure irrigation demand (street right of way, rail road, etc.).

   Figure A-4 "Future Land Use" in Appendix A shows the current Santaquin City boundary, the study area boundary, and the anticipated future land uses provided by the Santaquin City Planning Department.

2. Future Population

   Santaquin City bases future growth projections on the 2010 US Census and annual growth rates projected by the State of Utah's Governor's Office of Planning and Budget, which are consistent with past actual growth rates in Santaquin City. Table 1 shows anticipated growth projections for the City from 2010 to 2060 (which is considered the buildout population year).

Table 1. Santaquin City Growth Projections

Year	Population	Estimated Annual Growth Rate	Year	Population	Estimated Annual Growth Rate
2010	9,128	6.56%			
2011	9,381	8.28%	2036	33,089	3.05%
2012	10,158	8.28%	2037	34,098	3.05%
2013	10,999	8.28%	2038	35,138	3.05%
2014	11,910	8.28%	2039	36,209	3.05%
2015	12,896	8.28%	2040	37,314	3.05%
2016	13,963	8.28%	2041	38,027	1.91%
2017	15,120	8.28%	2042	38,753	1.91%
2018	16,371	8.28%	2043	39,493	1.91%
2019	17,727	8.28%	2044	40,247	1.91%
2020	19,195	8.28%	2045	41,016	1.91%
2021	19,907	3.71%	2046	41,799	1.91%
2022	20,645	3.71%	2047	42,598	1.91%
2023	21,411	3.71%	2048	43,411	1.91%
2024	22,206	3.71%	2049	44,241	1.91%
2025	23,030	3.71%	2050	45,086	1.91%
2026	23,884	3.71%	2051	45,811	1.61%
2027	24,770	3.71%	2052	46,549	1.61%
2028	25,689	3.71%	2053	47,298	1.61%
2029	26,642	3.71%	2054	48,060	1.61%
2030	27,631	3.71%	2055	48,834	1.61%
2031	28,473	3.05%	2056	49,620	1.61%
2032	29,342	3.05%	2057	50,419	1.61%
2033	30,237	3.05%	2058	51,231	1.61%
2034	31,159	3.05%	2059	52,055	1.61%
2035	32,109	3.05%	2060	52,893	1.61%

The Santaquin City Planning Department estimated that the majority of the growth over the next 10 years would be primarily in the three areas listed below and that the growth would be distributed among the three areas as indicated:

a. North of 400 North (45%)
b. Summit Ridge (40%)
c. East Bench (15%)

C. Level of Service

Santaquin City established levels of service standards that reflect existing conditions. The level of service is in terms of source, storage, and pressure.

D. Model

J-U-B Engineers Inc. (J-U-B) developed a computer model for the system using InfoWater®, a graphically-based water modeling software that runs within ArcGIS®. The model uses essential hydraulic data input to simulate the effect that input data has on the system under a specified scenario (i.e. peak day, peak hour, average day, etc.). The data used for the model include the graphical layout and connectivity of the system, pipe lengths, pipe diameter, pipe roughness (a Hazen-Williams roughness coefficient of either 130 or 140 was used for all pipes in the model), demand at each node, and elevation of each node. Given the required data, the model determines the flow through each pipe and the pressure at each node that will result when the system meets a given demand at each node. The layout and connectivity of the system is shown in Figure A-1 in Appendix A. The model was not calibrated using flow tests. However, some operational data from the City was used to verify input used in the model.

Existing peak day demands were estimated by evaluating the pressure irrigation meter records for 2012. The highest monthly flow for each individual connection was divided by the number of days in the month, and assumed to be used over a period of approximately 12 hours per day to determine the peak day flow rate.

Future peak day demands were estimated by adding existing peak day demands to demands resulting from future growth. Peak day demands from future growth were estimated to be .25 acres per ERU times 5,702.40 gallons per day per irrigated acre.

Table 2 summarizes the land use, acreage, density, ERUs and the corresponding demand.

Table 2. Area, Connections and Demand Data used in the Model

Land Use Zone	Land Use Description	Total Area (Acres)	Existing ERUs	Estimated Percent of Irrigated Land at Buildout	Number of ERUs per Acre of Future Development	Number of ERUs at Buildout	Total Future Peak Day Demand (Ac-ft)
A1	Agricultural - Production	1,227	0	10%	0.40	491	2.15
A2	Agricultural - Farmsteads	1,218	6	10%	0.40	487	2.13
A3	Agricultural - Business	5	1	15%	0.60	3	0.01
C	Commercial	514	40	15%	0.60	308	1.35
ID	Industrial	673	1	15%	0.60	404	1.77
MU-C	Mixed Use - Commercial	96	42	25%	1.00	96	0.42
MU-R	Mixed Use - Residential	122	77	40%	1.60	195	0.85
OS-P	Open Space - Park	802	19	60%	2.40	1,925	8.42
P	Public	484	17	80%	3.20	1,549	6.78
PO	Professional Office	158	19	20%	0.80	126	0.55
R1	Residential - Medium	1,211	1,359	60%	2.40	2,908	12.72
R1A	Residential - Low	936	7	65%	2.60	2,434	10.65
R2	Residential - High	865	746	50%	2.00	1,730	7.57
RM	Residential - Multifamily	196	29	30%	1.20	235	1.03
Total:		**8,507**	**2,363**			**12,891**	**56.40**

Note: The number of ERUs per acre is calculated base on irrigation of 0.25 acres of land per ERU.

Peak hour or peak instantaneous demand for both existing and future conditions were calculated by applying a factor of 2 to the peak day demand.

We evaluated both existing conditions and future conditions using the model to identify instances in which the existing system falls short of the established level of service (existing deficiencies) and what improvements would be needed in order for the future system to provide the established level of service (future needs). These evaluations include various demand scenarios to account for all the conditions represented in the level of service criteria.

E. Capital Improvements

Capital improvements needed to correct existing deficiencies and to meet future needs are identified from the modeling and evaluation results. This plan identifies these as individual capital improvement projects and associated cost estimates are provided (see Section VI "Capital Improvements").

III. LEVEL OF SERVICE

This plan identifies a specific level of service provided for the system. The necessary system improvements listed in this plan will allow the City to provide new users with the same level of service that currently exists.

While there are source, storage and demand criteria in the Utah State Code for outdoor watering provided by a culinary water system, there are none that apply to standalone pressure irrigation systems. In the case of water source we have used the criteria as it applies in a culinary water system; in others cases we have adopted criteria specifically suited for a dedicated pressure irrigation system.

A. System Improvements vs. Project Improvements

Pressure irrigation improvements are categorized according to their function as either system improvements or project improvements.

Project improvements are facilities that are either:

1. Minimum improvements which all developers are required (by City Code) to provide, (i.e. in the case of pressure irrigation lines this is a 6" minimum pipe size); or
2. Those improvements in excess of that listed above that are needed solely to accommodate new users within the development.

System improvements are those improvements in excess of the minimum improvements needed by the development which is a larger segment of the community than a single development. System improvements include the following:

1. Existing improvements that have no reserve capacity
2. Existing improvements that have reserve capacity to accommodate future growth
3. Future improvements needed to accommodate growth.

For the purposes of this document, the definition of system improvements will be limited to the 2^{nd} and 3^{rd} definitions above, since the definition is irrelevant for those improvements having no reserve capacity.

In the case of the pressure irrigation system it is not unusual for 6" pipes to be needed to meet the pressure needs of a development. We therefore are not considering any pipes 6" or smaller to be system improvements.

B. Level of Service Categories and Magnitude

The level of service criterion for the pressure irrigation system is defined as follows:

1. Source

The level of service related to source is both of the following:

a. Peak Day Volume: Provide a source capable of supplying 5702.4 gallons (which is equivalent to 3.96 gallons per minute for 24 hours) per irrigated acre on the peak day of use.
b. Irrigation Season Volume: provide a minimum of 1.87 acre-feet per irrigated acre per irrigation season

For the purposes of evaluating the ability of source infrastructure to satisfy the level of service with regard to peak day volume, we have established the following criteria:

a. For Summit Creek Irrigation Company shares: 1/180th of the annual yield of 1.8 acre feet per share (or less if limited by the maximum physical capacity of Santaquin Pressure Irrigation system facilities that take delivery of the water from the irrigation company). While the natural surface flow will not provide this water on a peak day (in mid-summer or late-summer), Santaquin takes delivery of water from the Summit Creek Irrigation Company through their wells during this part of the irrigation season, so the water delivered on peak day is not tied to peak day surface water flow rates.
b. For wells: pumping at full physical capacity for 21 out of 24 hours per day, or in other words pumping at 87.5% capacity.

These criteria are somewhat patterned after the criteria for outdoor watering in a culinary water system as found in the Utah Administrative Code Section 309-510-7, Source Sizing, for Map Zone 4.

2. Storage

Storage in the pressure irrigation system is intended to be sufficient to make up the difference between fluctuating water supply and water demand. This occurs on an hourly basis during the course of a 24 hour period in which demand exceeds supply during the evening, night and morning hours, and supply exceeds demand during the daytime hours. It also occurs on a seasonal basis, when demand exceeds supply during the heat of the summer. There are also longer periods of time when supply exceeds demand – this occurs on a season basis (such as in the spring) and on a daily basis, such as during periods of rain, or during longer wet weather cycles. Storage during these times allows for the water supplied to be saved for use when demand exceeds supply. Storage must serve all areas receiving pressure irrigation to accommodate these fluctuations. The most desirable means of providing this storage is by doing it in a location that also creates the pressure needed for the system. It is possible, however, for storage to be provided at a lower elevation with pumps creating the pressure needed for a particular area. Due to the ongoing pumping costs, this is only done in unusual circumstances in which construction of a storage facility to also provide needed pressure is either impractical or doesn't make sense financially for the city.

The level of service criteria for storage is the larger of the two requirements of 1) hourly fluctuations in which demand exceeds supply and 2) seasonal or daily fluctuations in which supply exceeds demand.

a. Storage for hourly fluctuations in which demand exceeds supply

Demand continually changes as growth occurs, supply of surface water (irrigation company water) is weather dependent, and supply of underground water (well water) is relatively constant except when projects are undertaken that increase it. Therefore, the storage requirement needed to accommodate hourly differences between supply and demand is not a fixed value, or even a value that is directly proportional to ERUs or irrigated acres, but involves a more complex calculation.

The minimum level of service for pressure irrigation storage to accommodate hourly fluctuations is the result of the calculation described below.

1) Identify hourly demand on the system:
    a) Calculate peak day demand as the volume of water required to provide an average of 3.96 gpm per irrigated acre for 24 hours.
    b) Distribute peak day demand across the 24 hours of a day using the diurnal curve established for the Santaquin City Pressure Irrigation System.
2) Identify hourly supply rate of delivery of water to the system as the sum of the following:
    a) For surface water (i.e. shares in an irrigation company), count the maximum reliable delivery rate of water on the peak day of a dry year, distributed across the 24 hours of a day as it would be delivered.
    b) For underground water (i.e. wells), count 87.5% of the maximum pumping capacity of the well, evenly distributed throughout the day.
    c) For other sources of water that have a constant delivery rate, count the rate of delivery.
3) Sum, on an hourly basis, the volume of water demand that exceeds the volume of water supply. This is the deficit between peak day demand and supply.
4) Increase the above figure by a safety factor to account for the inherent uncertainties related to the input variables of the calculation and variation of system operation. We use a factor of 25%. The result is the minimum level of service for pressure irrigation storage.

A sample of this calculation is shown in Appendix C.

b. Storage for seasonal or daily fluctuations in which supply exceeds demand.

Storage to account for seasonal and daily fluctuations between supply and demand provides for efficient use of water and efficient operation of the pressure irrigation system. The minimum level of service for this criterion is storage of 1.6 times the peak day demand (peak day demand is also the peak day volume required for source) on the system.

This level of service is empirical in nature. It is based upon getting as much storage as is practical on a parcel of land where Santaquin City plans future storage. In other words, after establishing the elevation at which storage is needed, and identifying a parcel of land at that elevation that could be used for storage, we estimated how much storage could reasonably fit on the site. The resulting total available storage capacity is 1.6 times the buildout peak day demand.

3. Pressure

The level of service related to pressure is 30 psi at peak instantaneous demand (peak hour) of 7.92 gpm per irrigated acre. This is about the lower threshold of satisfactory pressure to operate a lawn sprinkling system.

IV. EXISTING PRESSURE IRRIGATION SYSTEM

A. Overview

The Santaquin City pressure irrigation system consists of sources, booster pumps, storage facilities and transmission/distribution lines. Existing supply, existing demand, existing deficiencies and reserve capacity of system improvements for each category of improvements is described later in this report.

1. General System Description

The pressure irrigation system currently has multiple pressure zones. The existing pressure zones are:

a. Zone 9N (lowest pressure zone)
b. Zone 10 (2nd lowest pressure zone)
c. Zone 11E (2nd highest pressure zone on the east side of town)
d. Zone 12E (highest pressure zone on the east side of town)
e. Zone 11W (highest pressure zone in the Summit Ridge area)

Surface water from Summit Creek, located in Santaquin Canyon, is diverted into a Summit Creek Irrigation Company (SCIC) pipeline and gravity flows to the existing pressure irrigation regulating pond (Zone 10 Pond (AKA: Ahlin Pond) near the mouth of Pole Canyon at approximately 1200 South and 100 West). This water is conveyed from Summit Creek part of the way down the canyon through a (SCIC) pipeline into a diversion box near the mouth of Santaquin Canyon, then into a dedicated Santaquin City pipeline that runs through the Utah County debris basin and overflow channel to the Ahlin Pond. There is also an alternate diversion pipeline (located north from that listed previously) that can be used should the need arise (and if Summit Creek Irrigation Company allows it to be used).

Water is also provided to the pressure irrigation system from one or both of two SCIC wells. The first well is located at 400 north and 200 West and the second is located at approximately 150 West and 200 North. From either of these wells water is available to be pumped by an existing Santaquin City booster pump facility located adjacent to the SCIC well at 400 North and 200 West. Water pumped from the booster pump facility is pumped into the pressure irrigation distribution system and is either consumed by users or pumped to the Ahlin pond. The ability of this boosted water making it to the Ahlin Pond is dependent on demand. During times when demand is highest, most if not all of the boosted water is consumed by users and does not reach the pond. When demand is lower, water not consumed by users reaches the Ahlin pond to add to system storage.

In 2012, due to it being a dry water year, Santaquin City found it necessary to add an additional source of water for the pressure irrigation system. The City connected the Center Street well (formerly a culinary water well) to the pressure irrigation system. This source gave the City the ability to provide an additional 560 gpm of pressure irrigation source water for use in the system. Should the need arise, the current piping configuration west of the Center Street pump house can be disconnected from the pressure irrigation system and connected into the culinary system.

2. Summit Ridge

   Within the Summit Ridge well house there is a well and a booster pump. Both pumps have the ability to pump water to the Summit Ridge culinary water tank. This is accomplished by opening or closing the appropriate valves inside the well house and within the fenced in area outside of the well house.

   During fall, winter & spring months (on average 6 months out of the year depending on the type of water year) the booster pump is used to pump culinary spring water, fed through a 16" pipeline along 500 South, to the Summit Ridge culinary tank. This saves considerable energy in the form of lower pumping costs. Using this booster pump allows that water only needs to be boosted approximately 200 feet in elevation rather than pumping 600 feet in elevation using the well. The Summit Ridge culinary tank is fed through a dedicated pipeline between the Summit Ridge well house and the Summit Ridge tank.

   During the summer months (and possibly at other times of large demands, as determined necessary by City staff) the Summit Ridge well pumps to the Summit Ridge tank rather than using the booster pump. Again this is accomplished by opening & closing the appropriate valves within the well house and outside the well house. This well is utilized during the summer months because spring water from Santaquin Canyon is not sufficient to keep up with the high demands on the culinary system.

   The above discussion (preceding 3 paragraphs) is carried over from the Santaquin City Culinary Water Master Plan and Capital Facilities Plan being developed concurrently with this plan. Pressure irrigation in the Summit Ridge area of Santaquin is currently "loaned" culinary water resources (source and storage). The pressure irrigation distribution system within Summit Ridge has its own pipelines that are separate from the culinary water system. However, the supply lines to and from the Summit Ridge culinary tank convey both culinary and pressure irrigation water, (there are not separate lines to & from the tank). There is an existing backflow preventer located approximately as shown in Figure A-1 "Existing System" in Appendix A that prevents possible backflow conditions from the pressure irrigation system to the culinary water system, as required by State law.

3. Operations

   Figure A-2 in Appendix A shows the existing pressure zones. Only one of the existing higher pressure zones provides water to a lower pressure zone through multiple pressure reducing valve stations (PRVs). Zone 10 provides water to Zone 9N as Zone 9N does not have its own storage or source. **None** of the other existing pressure zones shown in Figure A-2 in Appendix A have the ability to supply water to lower zones.

   When all culinary water tanks that can be fed by the culinary spring water are full or near full (i.e. not calling for water to be pumped or diverted to them), the City's spring water overflows into a ditch that directs water to Summit Creek Irrigation network of ditches and pipelines and eventually flows to the Summit Creek Irrigation reservoir # 2 located near the Summit Ridge area of town. This spring overflow water is then no longer able to be used by the culinary system.

One of the recommendations made in this plan is to capture as much of this overflow water as possible (by accounts of City Staff this could be as much as 200,000 gallons per day) and divert it into the pressure irrigation system. This will be accomplished with piping, automated valves and SCADA controls that will be installed in the near future. This recommended system improvement is discussed in additional detail later in this plan.

The City has the ability to obtain surface or subsurface water from SCIC. However, in past years, the actual quantity of water received and timing by which the City receives that water from SCIC has, at times, been somewhat complicated. SCIC can choose (and has chosen in past years) at any time to reduce flow to the City from any or all SCIC sources depending on SCIC needs to serve other users, availability of water, etc. This has made operating the pressure irrigation system for City staff somewhat of a challenge since a large portion of the pressure irrigation system source water comes from SCIC. During the 2012 irrigation season SCIC worked with the City better than in years past in order to better provide them with water, according to City held shares in SCIC.

Since the inception of the pressure irrigation system in 2006 the standard practice for SCIC providing the City with surface water has been to allow for gravity flows from Summit Creek up until about July 4th of each season. For the remainder of each season, the City was then required to pump water using their booster pumps at 400 North 200 West. However, during the 2012 irrigation season, SCIC did allow the City to take some of the gravity flow water from Summit Creek late in the irrigation season as well as to pump from the booster pumps at 400 North 200 West.

Currently the Center Street well pumps water into the City's pressure irrigation system. Should the need arise for more water in the culinary water system, the current piping configuration west of the Center Street pump house can be disconnected from the pressure irrigation system and connected into the culinary system. If this source is needed for culinary purposes, the Drinking Water Source Protection Plan (DWSP) filed with the State of Utah, Division of Drinking Water (DDW) would need to be updated prior to use for the culinary system.

4. Culinary Water Supply to the Pressure Irrigation System

There is a major concern with the City's culinary water system. The concern is that currently there are four pressure zones within the city where the pressure irrigation system is fed by the culinary water system. This is facilitated using backflow preventers. The four pressure zones are: Zone 11E, Zone 12E, a portion of Zone 10 located within the Summit Ridge development and Zone 11W.

Specifically on the east side of the city (Zones 11E & 12E) this configuration causes significant stress on the culinary system during the hot dry summer months when outside watering demands are high. At present, during summer months, the culinary system is just barely able to provide an adequate amount of water to Zones 11E & 12E to keep up with high summer demands. As more development occurs and connections are added within these two zones, the system will be **unable** to keep up with increasing demands that are placed on the culinary system.

It is imperative that the City move as quickly as possible to build the necessary infrastructure to enable removing the pressure irrigation system demands from the culinary system.

Due to the small number of existing service connections in the Summit Ridge area the culinary system (in that area) is not currently stressed as heavily by pressure irrigation demands. However, as additional connections are made in that area, the system will also get to the point where it is unable to provide sufficient water for both the pressure irrigation demands and culinary demands with the culinary system. Improvement projects are identified in this plan that will facilitate removing the pressure irrigation demands from the culinary system within the Summit Ride area.

Once the pressure irrigation system is able to provide its own source and storage in existing pressure zones 11E, 12E, 11W and that part of Zone 10 that is within the Summit Ridge area, the backflow preventers (3) discussed above should be disconnected from both the culinary and pressure irrigation systems. The City could remove and salvage them, or if they were willing to maintain them perpetually they could isolate them with valves and leave them in place as a backup pressure irrigation source.

B. Rights

1. Existing Water Rights

Santaquin City holds a total of 554 water shares in Summit Creek Irrigation Company. The shares are held by two different entities: Santaquin City Corporation and Santaquin Special Service District.

Even though the City's culinary water system supplies water to the pressure irrigation system, culinary water rights are not discussed in this master plan. Culinary water rights are discussed and listed in the culinary water master plan being developed concurrent with this plan.

2. Process of Acquiring Water Rights

According to city ordinances, anything annexed prior to November 1994 was required to dedicate water prior to annexation. Between that time and March 2004, water was required at annexation unless a property owner was non-consenting to the annexation or did not intend to develop. After 2004, water was required after annexation and prior to preliminary plats.

The current Santaquin City Code requires that property annexed into the City must be accompanied by sufficient valid water rights to provide water for existing and future needs of the land being annexed (See Santaquin City Code 8-1-10 "Annexation"). The amount of water right required is 3 acre-feet of diversion rights per acre of land annexed. At the City's discretion, as an alternative to providing valid water rights at annexation, City code allows the City to accept "Cash Equivalent of Water Rights". This is sometimes referred to as "Cash in Lieu of Water Rights".

Additionally the City also actively pursues for purchase other water rights that become available. The City purchases both Summit Creek Irrigation Company shares as well as water rights held in area wells when they become available.

3. Water Rights Already Committed but not yet Delivered to Santaquin

There are a number of properties that have committed dedication of water rights to Santaquin City as a condition of annexation. These properties have already been annexed into the City, however the City has not yet received these water rights. Fulfillment of these commitments should be made prior to development of the land. Figure B-1 "Annexed Land without Committed Water Rights" in Appendix B shows land that has been annexed into the City but no water rights have been surrendered as yet. Figure B-1 also shows land that does not require dedication of water rights at the time of development. In order for the City's annexation policy to be met, the City will need to obtain an appropriate amount of water rights at the time of development of these properties.

C. Sources

1. Existing Sources

Santaquin City currently obtains pressure irrigation water from Summit Creek Irrigation Company, the Center Street well, and the culinary water system. Summit Creek Irrigation Company supplies water to the Ahlin pond during the early and late part of the irrigation season through gravity flows in Summit Creek. The flow from Summit Creek has historically diminished in early July. From that point on, through the hottest part of the summer, Summit Creek Irrigation Company provides water to the pressure irrigation system through wells, one well is located at about 400 North 200 West and the other well is located at about 200 North 150 West. A Santaquin City pressure irrigation booster pump station located at about 400 North 200 West pumps water from either of these wells into the pressure irrigation system, and to the Ahlin Pond, when it is not consumed by system demand. The culinary water system provides pressure irrigation source water and storage to the Summit Ridge area (part of Zone 10 (within the Summit Ridge Development) and all of Zone 11W), Zone 11E and Zone 12E. Water from the Center Street Well and the booster pumps at 400 North 200 West can be delivered to the remaining pressure zones in the system.

Table 3 below shows the capacities of the City's existing pressure irrigation sources.

Table 3. Existing Pressure Irrigation Source Capacities

Source	Maximum Reliable Volume on Peak Day (Ac-ft)	Average Volume per Irrigation Season (Ac-ft)
Center Street Well[1]	2.17	390
Summit Creek Irrigation Company[2]	5.22	1662
Culinary Water System[3]	3.89	416
Total Pressure Irrigation Sources:	**11.28**	**2468**

[1]This is based on pumping 560 gpm for 21 out of 24 hours, or at 87.5% capacity. Average volume per irrigation season is based on running 180 days at peak day capacity.

[2]The maximum reliable volume per day is the lesser of volume based on the number of shares and the volume based on minimal flows during the summer when Santaquin City is only getting water delivered through the irrigation company well, pumped into the pressure irrigation system by the booster pump at 400 N 200 W. While the irrigation company has two wells, the booster pump station cannot pump the flow from both of them, so the irrigation company only runs one at a time to deliver water to the city booster pump station. The well pumping capacity is 1,350 gpm. Santaquin City's SCIC right is based on the proportion of shares held by Santaquin City (554) to the total number of shares (2103) times the reliable discharge of 4 streams of 4 cfs each on a dry year during the middle of the summer (peak day), which is what the irrigation company has known to have historically been able to provide to users at a peak day time - this is 16 cfs, or 8.37 ac-ft for 554 shares. The average volume per irrigation season is 3 acre-feet per share, which is what SCIC has historically considered its annual yield.

[3]The culinary water provides water to the pressure irrigation system in part of Zone 10 (within the Summit Ridge area) and to all of Zones 11E, 12E, 11NE & 11W, so the source volume is that amount used for outdoor watering.
The average volume per irrigation season is calculated based on the ratio of the level of service values for maximum day volume and irrigation season volume; irrigation season volume (1.87 ac-ft/irrigated acre) reduced to an average daily volume over 180 days would be 3385 gallons, which is 59.36% of the maximum day volume of 5702.4 gallons. Therefore irrigation season volume is 106.8 (59.36% of 180) times maximum day volume.

2. <u>Demand on Existing Sources</u>

The total existing peak day source demand on the pressure irrigation system is 10.34 ac-ft.

A portion of the 10.34 ac-ft of pressure irrigation system source demand is currently provided by the culinary water system. Zones 11E, 12E, 11W and part of Zone 10 (within the Summit Ridge area) currently use the culinary water system to provide 3.89 ac-ft of water to the pressure irrigation system on peak day.

Current demands on the culinary system are varied throughout different areas of the city. In two areas of the city (Zones 11E & 12E) the system is nearing its capacity to supply sufficient source water to meet both culinary and pressure irrigation demands.

This is especially true during the hot, dry summer months. As discussed previously, taking the pressure irrigation system off of the culinary system needs to be accomplished in order to preserve culinary water source resources for indoor use.

The existing total pressure irrigation source demand is 10.34 ac-ft/day. Culinary water sources provide 3.89 ac-ft/day of that amount through the culinary system for the areas using culinary water for outdoor use (in Zones 11E, 12E, 11W and part of Zone 10 (within the Summit Ridge area)). The total source available to meet peak day demand is 11.28 ac-ft/day.

Currently the Ahlin Pond water cannot be delivered to Zones 11E & 12E. The culinary springs and Cemetery well currently provide water to the pressure irrigation system in those zones to meet an outdoor watering demand of 1.57 mgd. The total source available (Springs and Cemetery Well) to Zones 11E & 12E is 2.25 mgd for both culinary and pressure irrigation. This means that during the hottest days in the summer the Cemetery Well has to pump more than 21 hours per day in order to meet demands for indoor use and outdoor watering.

The cemetery well and the springs are currently the only sources that can supply Zones 11E & 12E for both pressure irrigation and culinary water.

3. <u>Existing Source Deficiencies</u>

The Springs and Cemetery Well are the only sources of water for Zones 11E & 12E. If the Cemetery Well is out of service the Springs cannot deliver enough water for these two zones under a peak day condition. The pressure irrigation demand on the existing culinary system for these two zones is 0.96 mgd (2.94 ac-ft/day). When this pressure irrigation demand is taken off the culinary system, the peak day (culinary only) demand will be 0.68 mgd.

The Water Reclamation Facility will be operational before the end of 2013. Reclaimed water from the facility will be stored in the Winter Storage Ponds. As part of the Water Reclamation Facility project, booster pumps are being constructed that will deliver 3.09 acre feet of water to the pressure irrigation system on a peak day. This will be operational for the 2014 irrigation season.

We consider removing the pressure irrigation demand from the culinary system a pressure irrigation system issue, meaning that at the point in time when the pressure irrigation system has the ability to provide its own source of water other than from the culinary water system, the water previously "loaned" to the pressure irrigation system will become a source in the culinary water system to meet future culinary water needs. We consider the booster pumps that will deliver water from the Winter Storage Ponds to the pressure irrigation system a sewer system project.

For the purposes of determining source deficiencies, we do not count the 3.89 acre feet of water provided by the culinary water system, because that capacity is considered available capacity to the culinary water system, but we do count the 3.09 acre feet of water that will be provided by the sewer project. Therefore for these purposes we consider there to be 0.14 acre feet of reserve source capacity in the pressure irrigation system during peak day conditions (11.28 acre feet – 3.89 acre feet + 3.09 acre feet = 10.48 acre feet, which is 0.14 acre feet more than the existing source demand of 10.34 acre feet). Therefore there is no existing source deficiency.

D. Storage

1. Existing Storage

A listing of the existing storage facilities with capacity of each is shown in Table 4. The Summit Creek Irrigation Company Reservoir is not listed because the irrigation company operates it in a way that provides no storage for the Santaquin City Pressure Irrigation System. However, infrastructure exists that could enable storage in the Summit Creek Irrigation Company Reservoir to serve the pressure irrigation system.

Table 4. Existing Pressure Irrigation Storage

Existing Storage Reservoirs	Capacity (Ac-ft)
Ahlin Pond	36.00
Provided in the Culinary Water System[1]	1.94
Total Storage Capacity:	**37.94**

1The culinary water system provides water to the pressure irrigation system in Zones 11E, 12E and 11W and in part of Zone 10 (within the Summit Ridge Area); this figure represents the number of ERUs present x 0.25 irrigated acres per ERU x 2848 gallons/irrigated acre.

The culinary water system storage serves part of Zone 10 (within the Summit Ridge area) and all of Zones 11E, 12E & 11W; the Ahlin Pond serves the remaining zones.

2. Demand on Existing Storage

Existing storage demand is the larger of a) storage for hourly fluctuations in which demand exceeds supply, and b) storage for seasonal or daily fluctuations in which supply exceeds demand.

a. The case of storage for hourly fluctuations

Pressure irrigation storage demand is the sum of the demand that exceeds the constant source throughout the peak day, increased by a safety factor.

The peak day demand is determined using the number of ERUs, the area of irrigated land per ERU, and the peak day demand of 3.96 gpm per irrigated acre. It is distributed throughout the 24 hours of a day using a diurnal curve.

The constant source is based on the largest dependable flow in a dry year. For existing conditions this would be the Center Street well pumping at full capacity, and the Summit Creek Irrigation Company pumping their one well and the pressure irrigation system boosting that flow into the system, with no water coming from Summit Creek into the Ahlin Pond.

The safety factor used is 25%.

The existing pressure irrigation storage requirement (to meet hourly fluctuations) is 10.34 acre-feet. The calculation for this figure is shown in Table C-1 in Appendix C.

b. The case of storage for seasonal or daily fluctuations

Existing storage demand is 1.6 times peak day demand (see further discussion of this in Section 3 Level of Service, paragraph B.2.b). Peak day demand is 10.34 acre-feet, so existing storage demand under this criteria is 16.55 acre-feet.

The larger of the two criteria is 16.36 acre-feet, which is the existing storage demand.

3. Existing Storage Deficiencies

With existing storage capacity at 37.94 ac-ft and existing storage demand at 16.36 ac-ft, there are no existing storage deficiencies in the pressure irrigation storage system.

E. Transmission/Distribution System

1. Existing Transmission/Distribution System

Santaquin City has a well-developed existing pressure irrigation distribution system. There are approximately 50 miles of existing pipelines with associated valves, fittings and other related infrastructure.

Figure A-1 in Appendix A shows the extents of the existing transmission/distribution system.

2. Demand on Existing Transmission/Distribution System

The existing transmission/distribution system serves approximately 2,363 ERU's.

Figure C-1 "Existing Pressures at Peak Hour Demand" in Appendix C shows the existing system pressures under peak instantaneous demand conditions of 7.92 gpm per irrigated acre.

3. Existing Transmission/Distribution System Deficiencies

As is evident on Figure C-1, there are no deficiencies in the existing pressure irrigation transmission/distribution system.

V. FUTURE PRESSURE IRRIGATION SYSTEM AT BUILDOUT

A. Overview

Figure E-1 "Buildout System" in Appendix E shows the anticipated pressure irrigation system at buildout.

The pressure irrigation system at buildout will be comprised of the entire existing system infrastructure along with the new improvements identified within this plan. Most, if not all, of the inefficiencies, peculiarities and operational difficulties in the existing system will be overcome and or solved as the improvements identified herein are constructed. These include: removing the pressure irrigation demand from the culinary system and the ability to capture and make use of spring water that currently becomes unavailable for use in the culinary system.

Figure E-2 "Buildout Pressure Zones" in Appendix E shows the pressure zones for the pressure irrigation system at buildout. The following 8 pressure zones or pressure zones with currently isolated areas from existing infrastructure do not currently exist and are planned to become future zones:

1. Zone 7N
2. Zone 8N
3. Zone 9W
4. Zone 10W
5. Zone 12W
6. Zone 11NE
7. Zone 13E
8. Zone 14E
9. Zone 15E

B. Rights

Santaquin City will need additional water rights to meet system demands at buildout. It is anticipated that continuation of the practice of requiring commitment of water shares at the time of annexation, in addition to fulfillment of the commitments already made when land was annexed, will not provide adequate rights to meet buildout demands. We recommend that Santaquin City address long-term water right needs. Santaquin City will need to address the question of adequacy of water rights in the near future.

Santaquin does not require dedication of water rights as a condition of land development, and therefore does not intend to collect impact fees for acquisition of water rights.

C. Sources

1. Future Demand on Sources

Table 5 summarizes the future demand on pressure irrigation sources. This is based on the existing demands plus future modeled demands, which are a function of the future growth rate, development densities, and demand rates.

2. Future Source Needs

   Table 5 summarizes the future needs for pressure irrigation sources. Future source needs are the difference between existing source capacity and future source demand. Table 5 shows future source needs at a point 10 years in the future and at buildout.

3. Solutions to Future Source Needs

   As shown in Table 5 there will be a need for one additional well. It is planned that this new well would serve several purposes. First, the new well would serve as a recovery well for recharged Type 1 water (see discussion in section D "Storage", Part 3 "Solutions to Future Storage Needs" below) in an amount that exceeds the winter storage capacity of the existing winter storage ponds. It would also serve to deliver additional water from future acquired underground water rights.

   The Type 1 water referred to above is Santaquin City's wastewater that will be treated by the City's new Water Reclamation Facility (WRF). This new facility is scheduled to be in operation late in 2013. The Type 1 water from the WRF will be pumped to the City's winter storage ponds (previously sewer lagoon ponds) for storage.

   During the irrigation season (approximately 180 days each year) the stored Type 1 water will be pumped into the City's pressure irrigation system for use. The State of Utah issued Santaquin City an Order of the State Engineer for this reuse of Type 1 water (See State of Utah Order of State Engineer NS0105).

   For the purposes of this master plan, prior to pumping type 1 water into the pressure irrigation system, all of the Type 1 water infrastructure is considered to be related to the City's sewer system, not the pressure irrigation system. From the time the water is treated at the WRF (to produce Type 1 water), to when it is stored at the winter storage ponds, up until the point in time where it is actually pumped into the pressure irrigation system, we consider these wastewater infrastructure needs. The Type 1 water, until pumped into the pressure irrigation system (by pumps at the winter storage pump station) is considered this way because it is a necessity of the City to treat and dispose of (or in Santaquin City's case, to make use of the Type 1 water) the WRF effluent.

   In order to make use of as much Type 1 water during the irrigation season as possible, the booster pumps at the winter storage ponds will need to be upgraded for increased capacities.

   Also as shown in Table 5 the City will need to acquire additional Summit Creek Irrigation Company (SCIC) shares to help satisfy the future demand on sources. In conjunction with acquiring additional shares of SCIC water, several booster pump stations will need to be constructed.

   Water owned by Santaquin City through the South Utah Valley Municipal Water Association (SUVMWA) to be delivered by the Central Utah Water Conservancy District (CUWCD) is anticipated and planned to help meet future water demands in the pressure irrigation system. Two system turn outs are planned for delivery of this water.

This master plan includes an overall strategy for acquiring future sources of water for the pressure irrigation system. This strategy was formulated by identifying the least expensive and seemingly the most accessible water as the water that should be acquired and used first. The "Solutions to Future Sources Needs" section in Table 5 lists sources of water to be acquired according to this least expensive and seemingly most accessible water first strategy.

At buildout, several smaller pressure zones will be provided with pressure irrigation water through the culinary water system. This is planned in order to conserve resources and to limit future infrastructure that will need to be maintained and eventually replaced by the City. These areas are Zones 11NE, 13E, 14E, 15E and 12W. These zones are areas where there are mostly steep slopes and therefore will have limited buildable areas, larger lots, etc. At buildout there will be approximately 800 ERUs served by the culinary water system. This will require only one set of infrastructure (pumps, tanks and distribution system piping) being installed in these zones. A separate meter would be provided for pressure irrigation to monitor use and for billing purposes.

This master plan addresses necessary infrastructure needed to provide additional sources of water for growth, to build out. This plan does not address acquisition of water rights for these new sources. The City will need to need to pursue and acquire the necessary water rights associated with these new sources.

A detailed tabulation of sources is shown in Table D-1 in Appendix D.

Table 5. Summary of Future Water Source Data

Project No.		Peak Day Flow (Ac-ft)	Irrigation Season Flow (Ac-ft)
	Existing Sources		
	Total Existing Source Demand (Ac-ft)	10.34	1104.70
	Total Existing Source Capacity (Ac-ft)	11.28	2468.00
	Future Source Demands		
	Estimated Source Demand in 2023 (Ac-ft)	21.79	2327.99
	Estimated Source Demand at Buildout (Ac-ft)	56.40	6026.54
	Future Source Needs		
	Additional Source Need in 2023 (Ac-ft)	10.51	0.00
	Additional Source Need at Buildout (Ac-ft)	45.12	3558.54
	Solutions to Future Source Needs		
N/A	Booster pumps are being constructed as part of the Water Reclamation Facility (WRF) at the Winter Storage Ponds to deliver water to the Pressure Irrigation System[1]	3.09	556.86
1	Overflow from culinary springs pipeline to PI system[2]	*0.61*	*109.80*
2	Booster pump station to draw from SCIC well at 200 N 150 W and piping to 100 W[3]	5.22	1037.84
3	Booster pump station to draw from SCIC well at 400 S 100 W[3]	5.22	1037.84
N/A	The Culinary Water System will eliminate service to the areas of PI Zones 11E, 12E, 11W and part of Zone 10 (within the Summit Ridge area)[4,5]	-3.89	-415.17
4	Increase booster station capacity at WRF Winter Storage Ponds[6]	8.15	1467.70
5	Recovery Well at WRF Winter Storage Ponds and piping to system. Additional pipeline into distribution system will also be needed at this time, as the existing 10" line from the booster pumps at the Winter Storage Ponds will not be sufficient.[7]	9.20	827.71
6	Booster pump station from Strawberry High Line Canal (or Aqueduct) and piping to system	4.71	936.49
7	North CUP Aqueduct turnout (to Zone 9N) and piping to system[8]	10.04	903.17
8	South CUP Aqueduct turnout (to Zone 10) and piping to system[8]		
N/A	The Culinary Water System will add service to the areas of PI Zones 11NE, 13E, 14E, 15E, and 12W[5]	3.38	361.67
	Total Future Source Capacity (MGD):	56.41	9182.10

[1]This is a facility that will be operational as soon as the Water Reclamation Facility is operational, which is expected to occur in late 2013. It is considered a Sanitary Sewer System project. The peak day flow is based on pumping 800 gallons per minute for 21 hours per day. The irrigation season flow is the peak day flow pumped each of the 180 days of the irrigation season. This number is less than the volume of water available at the Winter Storage Ponds.

[2]This is a temporary measure to make use of this water until the culinary water system can make use of it (after additional CW storage facilities are constructed), therefore it is not included in total future source capacity at buildout.

[3]The irrigation season flow is based on a yield of 3 acre feet per share, which is a number historically used.

[4]The culinary water system will cease to provide this amount of water to the pressure irrigation system in Zones 11E, 12E and 11W.

[5]The average volume per irrigation season is calculated based on the ratio of the level of service values for maximum day volume and irrigation season volume; irrigation season volume (1.87 ac-ft/irrigated acre) reduced to an average daily volume over 180 days would be 3385 gallons, which is 59.36% of the maximum day volume of 5702.4 gallons. Therefore irrigation season volume is 106.8 (59.36% of 180) times maximum day volume.

[6]The increase in booster capacity needed for peak day flow is the flowrate needed to empty the Winter Storage Ponds in 180 days of pumping plus the delivery rate of water to the ponds from the Water Reclamation Facility at buildout during the same 180 days (minus the pumping rate of the previously constructed booster pump). The irrigation season flow is the peak day flow pumped each of the 180 days of the irrigation season.

[7]This depends on recharge basins having been built for recharging Type 1 water from the WRF facility and anticipates pumping 90 days per season (the hottest days during the summer).

[8]The irrigation season flow is the average flow (1/2 of the peak day flow) x 180 days.

D. Storage

1. Future Demand on Storage

Currently, existing culinary water system storage tanks are providing the pressure irrigation system with some storage capacity. The storage provided by the culinary system will change over time as land develops. The storage provided to the pressure irrigation system in the various culinary water pressure zones at various times are shown in Table 6. Note that the culinary water and pressure irrigation pressure zones have the same names and are coincident.

Table 6. Culinary Water System Storage Capacity Provided to Pressure Irrigation System

	Peak Day Storage Capacity Provided by Culinary Water System (AF)		
Pressure Zone	Existing	2023	Buildout
Zone 12E	0.31		
Zone 11E	1.16		
Zone 11W	0.48		
Zone 13E			0.59
Zone 14E			0.29
Zone 15E			0.03
Zone 12W			0.73
Zone 11NE			0.05
Total:	**1.94**	**0.00**	**1.69**

Table 7 summarizes the existing and future demand on pressure irrigation system storage. Note that only culinary water system storage permanently used by the pressure irrigation system, at buildout, is included in the required buildout storage figure later in this document.

Table 7. Pressure Irrigation Storage Demand Tabulation

Year	Population	ERCs	Storage Demand (Ac-ft)
2013	10,999	2,363	16.54
2023	21,411	4,980	34.86
2060	52,893	12,891	90.24

2. Future Storage Needs

Table 8 summarizes the future pressure irrigation storage needs. Future storage needs are the difference between existing storage capacity and future storage demand. Table 8 shows future storage needs at a point 10 years in the future and at buildout.

3. Solutions to Future Storage Needs

As shown in Table 8 there will be a need for additional storage ponds and an open top tank to satisfy future demand on storage.

The Zone 11E reservoir on the Hansen property along with the Zone 11E booster pump station (to be constructed on the Ahlin Pond property) and associated piping will be constructed first. Both components of this project need to be constructed concurrently in order to ensure that both are available for use together.

Construction of the Zone 11W open top tank, the Zone 11W booster pump station and approximately 17,000 linear feet of pipe (20" and 24") would follow the reservoir listed above. All three components of this project need to be constructed concurrently in order to ensure that they are available for use together.

The two projects listed in the preceding two paragraphs will provide the necessary infrastructure to remove the pressure irrigation demands from the culinary water system in zones 11E & 11W.

The project for removing pressure irrigation demands from the culinary system in Zone 12E is discussed in "Solutions to Future Transmission/Distribution System Needs" later in this master plan.

The final storage project will be the Zone 10, 40 acre-foot reservoir to be constructed on the west side (planned to be located within the Summit Ridge area) and associated piping.

A detailed tabulation of storage is shown in Table D-2 in Appendix D. Note that in every year the storage demand needed to accommodate daily and seasonal fluctuations, in which supply exceeds demand, is greater than the storage demand needed to accommodate hourly fluctuations in which demand exceeds supply.

As indicated above, with regards to Type 1 water, and for the purposes of this master plan, the City's Type 1 water is considered part of the City's wastewater system up to the point in time where it is pumped into the City's pressure irrigation system. The WFR treatment, pumping (from the WRF to winter storage) and storage are all considered wastewater system components and are not considered nor addressed in this master plan.

At the point in time when the City's wastewater effluent (Type 1 water) reaches approximately 1 million gallons per day (mgd) the City will need to have in place additional storage for their Type 1 water. At that point the winter storage ponds, which have a combined capacity (using the 2 large ponds) of approximately 178 million gallons, will no longer have the capacity to hold the effluent for the typical 180 day non-irrigation period (winter storage).

The City's future strategy for storing Type 1 water (in excess of 1 mdg) is to utilize Aquifer Recharge and Recovery (ASR). Recharge of Type 1 water would typically occur during the winter months. This would be followed by recovery (pumping during the irrigation season) from the underground aquifer in order to make full use of the City's Type 1 water to which they have right. This recharge and recovery strategy was identified in Santaquin City's 2009 Wastewater Treatment & Collection System Facility Master Plan.

ASR also goes hand in hand with planning efforts over the last several years of the Summit Creek Water Management Project.

The Summit Creek Water Management Project involves 5 organizations within the southern end of Utah County. They include: Summit Creek Irrigation and Canal Company, Santaquin City Corporation, Strawberry Highline Canal Company, Utah County and the Town of Genola. This water management project was undertaken by the above entities in order to better manage water, to try to help alleviate potential flooding concerns, etc. There is a term used to refer to this type of water management. The term is "Conjunctive Management" (See "Conjunctive Management of Surface & Ground Water in Utah, State of Utah, Department of Natural Resources, Division of Water Resources, dated July 2005).

Recharge (and recovery) is also identified as a necessary, long term planning strategy in the 2013 Southern Utah Valley Municipal Water Association's (SUVMWA's) Groundwater Recharge Feasibility Study prepared by Caldwell Richards Sorensen Engineers (CRS).

Future aquifer recharge facilities for underground storage of Type 1 water (for use when WRF effluent reaches 1 mgd) are needed and planned but are not addressed specifically in this master plan. For reasons stated previously, these recharge facilities are considered part of the City's wastewater system and are therefore not addressed nor considered specifically as part of this master planning effort.

As identified in Section C "Source", Part 3 "Solutions to Future Source Needs" above, a future well is planned for use in recovery of the recharged water stored in the underground aquifer. This well is considered part of the pressure irrigation system and is therefore identified as future necessary infrastructure in this master plan. Prior to installation and use of this planned recovery well, Santaquin City plans to recover recharged water using their existing wells.

Table 8. Future Pressure Irrigation System Storage Capacity

Project No.		Storage in Pressure Irrigation Reservoirs (Ac-ft)	Storage in Culinary Water System (Ac-ft)	Total Storage (Ac-ft)
	Existing Storage			
	Total Existing Storage Demand	14.60	1.94 [1]	16.54
	Total Existing Storage Capacity	36.00	1.94 [1]	37.94
	Future Storage Demands			
	Estimated Storage Demand in 2023	34.86	0.00	34.86
	Estimated Storage Demand at Buildout	88.55	1.69 [2]	90.24
	Future Storage Needs			
	Addition Storage Need in 2023	20.26	-1.94	18.32
	Addition Storage Need at Buildout	52.55	-0.25	52.30
	Solutions to Future Storage Needs			
9	Zone 11E Pond (10 ac-ft) on Hansen Property and booster station and associated piping	10.00		10.00
10	Zone 11W Summit Ridge open top tank and booster station with transmission pipelines	3.07	-1.94 [3]	1.13
11	Zone 10 Summit Ridge Pond (40 ac-ft) and transmission lines	40.00		40.00
N/A	Culinary water system provides this pressure irrigation service in Zones 11NE, 13E, 14E, 15E and 12W		1.69 [3]	1.69
	Total Future Storage Capacity	**89.07**	**1.69**	**90.76**

Notes

[1]This is existing PI storage provided by the Culinary Water System to Zones 11E, 12E, 11W and part of Zone 10 (within the Summit Ridge area)

[2]This is estimated PI storage provided by the culinary water system to Zones 11NE, 12W, 13E, 14E & 15E at buildout

[3]This value does not reflect pressure irrigation projects, but rather water provided by the buildout culinary water system to users for ourdoor watering purposes in select zones

E. Transmission/Distribution System

1. Future Demand on Transmission/Distribution System

At buildout the transmission/distribution system is estimated to serve 13,105 ERUs.

2. Future Transmission/Distribution System Needs and Modeling

A modeling engineer uses a computer model to design a water system plan that will serve the needs of the community. The process is not one that lends itself to direct calculations, as is the case with water source and storage planning. Due to the finite nature of pipe sizing and the effect that changes in one pipe size have on a pressure pipe network, the process of resolving future network problems and inadequate pressures requires engineering judgment and skill.

We anticipate that the future pipes in the transmission/distribution system will be built by land developers to serve future development as it occurs. The minimum pipe size is 6" in diameter. We plan pipes to transmit and distribute water to areas of future development, knowing that some of these lines will need to be larger than the minimum pipe size.

In the process of developing the buildout model it becomes necessary to adjust lines sizes to find combinations of pipe sizes that meet future needs while maintaining adequate residual pressures. Through this process the modeling engineer eliminates errors generated by the model (when there are negative pressures), and establishes a network that satisfies residual pressure requirements under the level of service criteria.

The modeling engineer also exercises judgment to plan the system in a way that employs best practices, such as avoiding high velocities and unnecessary pumping, and providing looping and redundancy in the system. There will be some internal looping created by development projects that will reduce pressure losses at buildout. The uncertainty of when and where the project-level looping will occur makes depending upon them unreliable, so we neglect their effect when planning future transmission/distribution lines. Including looping and redundancy as is practical reduces the extent of system disruptions when there are operational situations (such as breaks in a pipe) that require flow to a general area to be provided from more than one direction.

3. Solutions to Future Transmission/Distribution System Needs

Future transmission/distribution system projects are shown in Table 10, Pressure Irrigation Improvements, which is located in Part VI, Capital Improvements of this master plan.

Project number nine shown in Table 10 will provide the necessary infrastructure to remove the pressure irrigation demands from the culinary water system in zone 12E.

Figure E-1 in Appendix E shows the buildout system pipes that satisfy the established level of service for the future conditions.

Figure E-3 "Buildout Pressures at Peak Hour Demand" in Appendix E shows the buildout system pressures under peak instantaneous demand conditions of 7.92 gpm per irrigated acre.

As is evident in Figure E-3, these pipe sizes address the level of service needs with regard to pressure in the buildout condition.

Since we expect that the future pipes will be built by land developers, Santaquin City will need to require that the developers install the size of lines shown in Figure E-1. The developer would be responsible for the cost of installing a 6" line, and Santaquin City will be responsible for paying for the incremental costs difference between the required size and a 6" line. As such, these costs are not identified as discrete projects, but as a series of pipe segments for which the city will incur financial obligation when a developer installs them. Tables G-2, G-3 and G-4 in Appendix G contain tabulations of estimated typical pipe installation and upsizing costs.

In order to estimate the upsizing costs that Santaquin City might incur in the next 10 years, we have evaluated the flow in each of these future pipe segments (ones that don't currently exist) in the year 2023, as well as at buildout. A tabulation of these demands is shown in Table D-3 "Future Transmission/Distribution Pipe Flows Tabulation" in Appendix D. We have calculated the total length and weighted average flow for each pipe size at both the year 2023 and at buildout. A summary of those tabulations are shown in Table 9. Table 9 also shows the percentage of buildout pipe capacity that will be needed in the next 10 years. This is shown for impact fee analysis development purposes.

Table 9. Future Transmission/Distribution Pipe Flows Summary

	Pipe Size						
	8"	10"	12"	14"	16"	20"	24"
Total Length at Buildout (ft)	29,685	36,892	9,693	686	2,505	1,877	307
Buildout Weighted Average Flow (GPM)	410	894	1,425	1,235	1,436	5,218	7,182
2023 Weighted Average Flow (GPM)	108	216	617	27	106	2,414	0
Percent of Buildout Pipe Capacity Needed in Next 10 Years:	26%	24%	43%	2%	7%	46%	0%

For the purposes of estimating when pipes will be installed, we expect the construction timing to parallel the growth projections, since they will be constructed by future development.

VI. CAPITAL IMPROVEMENTS

A. List of Projects and Priorities

Table 10 shows capital improvement projects necessary to provide for future growth. It also indicates an approximate time frame for when those projects will be needed. For source and storage projects the point at which projects are needed is shown in terms of ERUs and years. We determined the ERU numbers from the model, then applied anticipated growth rates to identify the estimated year when each project will likely be needed. Those projects that are likely very far in the future are shown at the buildout date. Payment to land developers for upsizing from 6" pipes to larger pipes needed as system improvements will gradually occur as land develops from now until buildout.

The likely funding sources are based on project type (to resolve existing deficiency or meet future need) and anticipated year of need. More detailed information about each project and costs associated with each project are found in Appendix G.

Table 10. Pressure Irrigation Improvements

Project Number	Project Name	Estimated Cost	Point at Which Project is Needed (ERUs)	Point at Which Project is Needed (Year)	Funding Source	Comments
	Projects to Satisfy Needs of Future Growth					
	Source Projects					
1	Overflow from culinary springs pipeline to PI system	$112,500	2,592	2014	Impact Fees	
2	Booster pump station to draw from SCIC well at 200 N 150 W and piping to 100 W	$485,313	2,840	2015	Impact Fees	
3	Booster pump station to draw from SCIC well at 400 S 100 W	$455,313	3,713	2018	Impact Fees	
4	Increase booster station capacity at WRF Winter Storage Ponds	$350,000	4,423	2020	Impact Fees	
5	Recovery Well at WRF Winter Storage Ponds and piping to system	$1,773,115	5,386	2025	Impact Fees	
6	Booster pump station from Strawberry High Line Canal (or Aqueduct) and piping to system	$526,734	6,055	2028	Impact Fees	
7	North CUP Aqueduct turnout (to Zone 9N) and piping to system	$526,734	9,523	2043	Impact Fees	
8	South CUP Aqueduct turnout (to Zone 10) and piping to system	$694,234	9,523	2043	Impact Fees	
	Storage Projects					
9	Zone 11E Pond (10 ac-ft) on Hansen Property and booster station and associated piping	$1,546,525	3,713	2018	Impact Fees	
10	Zone 11W Summit Ridge open top tank and booster station with transmission pipelines	$5,416,959	3,713	2018	Impact Fees	
11	Zone 10 Summit Ridge Pond (40 ac-ft) and transmission lines	$1,623,663	6,055	2028	Impact Fees	
	Transmission/Distribution System Projects					
12	Booster Pump Station from zone 11E to zone 12E (Variable Frequency Drive (VFD))	$706,250	3,713	2018	Impact Fees	
13	**Additional PRVs**	$900,000	We estimate that these costs will be spread over the next 35 years as land develops, so (10/35) of the cost will be required in the next 10 years.		Impact Fees	The estimated annual cost is $900,000/35, or $25,714
	1 - PRV from zone 11W to zone 10W	$75,000				
	3 - PRVs from zone 10W to zone 9W	$225,000				
	3 - PRVs from zone 10 to zone 9N	$225,000				
	4 - PRVs from zone 9N to zone 8N	$300,000				
	1 -PRV from zone 11E to zone 10	$75,000				
14	**Incremental Cost Upsizing Beyond 6" Pipes**	$1,640,203	We estimate that these costs will be spread over the next 35 years as land develops, so (10/35) of the cost will be required in the next 10 years.		Impact Fees	The estimated annual cost is $1,640,203/35, or $46,863
	Incremental cost from 6" to 8" pipes	$207,792				
	Incremental cost from 6" to 10" pipes	$664,064				
	Incremental cost from 6" to 12" pipes	$319,862				
	Incremental cost from 6" to 14" pipes	$32,245				
	Incremental cost from 6" to 16" pipes	$170,356				
	Incremental cost from 6" to 20" pipes	$198,973				
	Incremental cost from 6" to 24" pipes	$46,911				
	Total:	$17,657,541				

Figure F-1 "System Improvements" in Appendix F shows the projects that need to be constructed to meet future needs.

B. <u>Funding Sources</u>

Section 302 (2) of the Impact Fee Act requires the City to "generally consider all revenue sources, including impact fees and anticipated dedication of system improvements, to finance the impacts on system improvements." By doing so, the City ensures fair and equitable treatment among users and concludes whether impact fees are the most appropriate method to fund the growth.

There are a number of revenue sources available for managing Santaquin's pressure irrigation system. They are listed below.

1. User Charges

   The City collects user fees for water services. User fees pay for water that the City purchases from various sources, as well as the value of water created by the City's own water sources. User fees are the primary source of funding for debt payments, maintenance and operation expenses of the City's water system.

2. Grants, Low Interest Loans and donations

   Santaquin City has had grants and low interest loans for water-related projects in the past. It is possible that it may get additional grants for future projects. Additionally some infrastructure is donated, though this typically is at the project improvement level rather than at the system improvement level.

3. Special Assessment Areas

   This method of financing growth is acceptable and allocates the cost of the new development to the new development. However, special assessment areas can be expensive to establish and complicated to administer, especially if a large development is being considered. Moreover, the special assessments may not accurately reflect the true cost of the facilities.

4. Bonds

   The City may elect to issue bonds to maintain a steady flow of funds to pay for needed facilities. The City has issued bonds in the past, and may determine that bonds are a suitable mechanism for funding future water system facilities. The City may use the revenues from impact fees to pay debt service on bonds for eligible projects, or user fees for other projects. In addition, the City may use impact fees to pay for costs of issuance on future bonding. Bonds may be issued in addition to collecting impact fees.

5. Impact Fees

   This source is a common and equitable method of funding new system improvements because it imposes the cost of new growth upon that new growth. The detailed analysis required to impose impact fees accurately allocates the true impact of a system or facility to those creating the impact. Those creating the most impact, therefore, pay more. The speculative nature of these revenues, and their elasticity, however, make cash flows from impact fees unpredictable.

   The City may, on a case by case basis, work directly with a developer to adjust the standard impact fee to respond to unusual circumstances and ensure that impact fees are imposed fairly. The City may also, on a case by case basis, adjust the amount of the fee based upon studies and data submitted by a developer.

6. Developer Installed and Financed (Reimbursable by Impact Fees)

   This is a source that the City has recently used to help fund infrastructure needs within specific development areas of the city. This type of arrangement is typically accomplished with a development agreement between the City and the developer.

All of the above forms of financing the expenses associated with a water system have a place and are needed. For instance, user rates are needed for ongoing operation and maintenance costs; grants, low interest loans and some bonds are necessary for major infrastructure improvements; special assessment bonds can work well where there is a deficiency in a particular area or as a tool to build infrastructure to spur development; impact fees are the equitable, appropriate and needed means of funding system improvements to accommodate future growth.

VII. CONCLUSION & RECOMMENDATIONS

A. Conclusion

This master plan effort was undertaken to evaluate Santaquin City's existing pressure irrigation system, to identify existing deficiencies, to identify reserve capacities and to identify future system needs related to demands due to growth. Recommendations follow.

B. Recommendations

1. Establish Impact Fees to Fund Projects to Meet Future Needs

This report, in conjunction with the IFFP and IFA, will provide the basis for collection of impact fees necessary to construct the improvements required to support future growth.

We recommend that Santaquin City adopt impact fees in an amount that will fund the projects required to meet future needs without subsidizing the effect of growth using current users.

We recommend that Santaquin City implement a practice of following this plan in constructing the projects anticipated to satisfy the demands of future growth. As growth occurs and other factors affect conditions relative to the assumptions made in this plan the City will need to consider adjusting priorities as needed in order to accommodate changing conditions.

2. Pressure Irrigation System to Provide its own Sources and Storage

As discussed throughout this plan, it is imperative that the City work diligently to build new project improvements for the pressure irrigation system that will allow for removing pressure irrigation demands on the culinary system. This is an urgent need; we recommend that Santaquin City pursue it with diligence.

3. Construct Projects to Provide Additional Source and Storage

There are multiple projects that are necessary to accommodate growth within the next ten years. We recommend that the City fund and construct these projects in order to be able to accommodate future growth. Impact fees could then be used to reimburse costs as the projects are entirely related to growth. The projects are as follows:

- Project No. 1: Overflow from culinary springs pipeline to PI system
- Project No. 2: Booster pump station to draw from SCIC well located at 200 N 150 W and piping to 150 W
- Project No. 3: Booster pump station at SCIC well located at 400 S 100W
- Project No. 4: Increase booster pump capacity at WRF Winter Storage Ponds and piping to system
- Project No. 9: Zone 11 E Pond (10 ac-ft) on Hansen property and booster station and associated piping
- Project No. 10: Zone 11 W Summit Ridge open top tank and booster station with transmission pipelines
- Project No. 12: Booster pump station from Zone 11E to Zone 12E

These projects will provide for more efficient and flexible operation of the pressure irrigation system and provide the necessary storage and pumping capabilities. The projects will also allow for more operational flexibility for providing water from any source to any zone within the system. As these facilities are constructed the IFFP should be updated. As they are constructed these projects will transfer from future projects to system facilities with reserve capacity to serve future growth. At that point impact fees should be adjusted to pay for the reserve capacity.

By constructing project 1 (see Table 10) the City will be able to capture the culinary spring water that is currently diverted down the SCIC ditch and to SCIC reservoir #2, making it no longer available for use in the culinary system. According to staff accounts this could divert as much as 200,000 gallons per day into the Ahlin Pond. This water is currently lost because there is not sufficient storage in the culinary system to capture all the flow coming from the springs. This diversion may be abandoned or not used once additional culinary water storage facilities are constructed allowing for all of the spring water to be stored and then used in the culinary system.

By constructing projects 9, 10 & 12 (see Table 10) the City will be able to remove pressure irrigation demands from the culinary water system. This is something that we encourage the City to pursue with diligence.

By constructing projects 2 & 3 (see Table 10) the system will be able to obtain additional SCIC water as the City continues to acquire additional shares in the irrigation company.

Project 4 (see Table 10) will be necessary once the Type 1 water from the WRF exceeds 1 mgd.

The projects listed above are only those projects that are projected as needed within the next 10 years. There are other future projects listed in this plan that will need to be constructed at the appropriate time when growth requires. See Table 10 for a complete list of all projects required to buildout in order to accommodate growth.

4. Operational Recommendations

As soon as new project improvements are constructed and in operation, several system operational parameters should be addressed. Changing these parameters will allow for better overall water management, reduced pumping costs and more efficient and flexible operation of the pressure irrigation system.

Within the future higher pressure zones (Zones 11NE, 12W, 13E, 14E & 15E) the culinary water system will provide distribution, source and storage for all culinary and pressure irrigation needs. Only a single distribution/transmission pipeline system will be required to be installed within these higher areas. However, each connection will be provided with a pressure irrigation meter and a culinary water meter.

5. Updates to Master Plan and Capital Facilities Plan

   We recommend that Santaquin City update this plan as needed but at intervals of not more than every 5 years. An interim update may be needed if planned land uses change significantly.

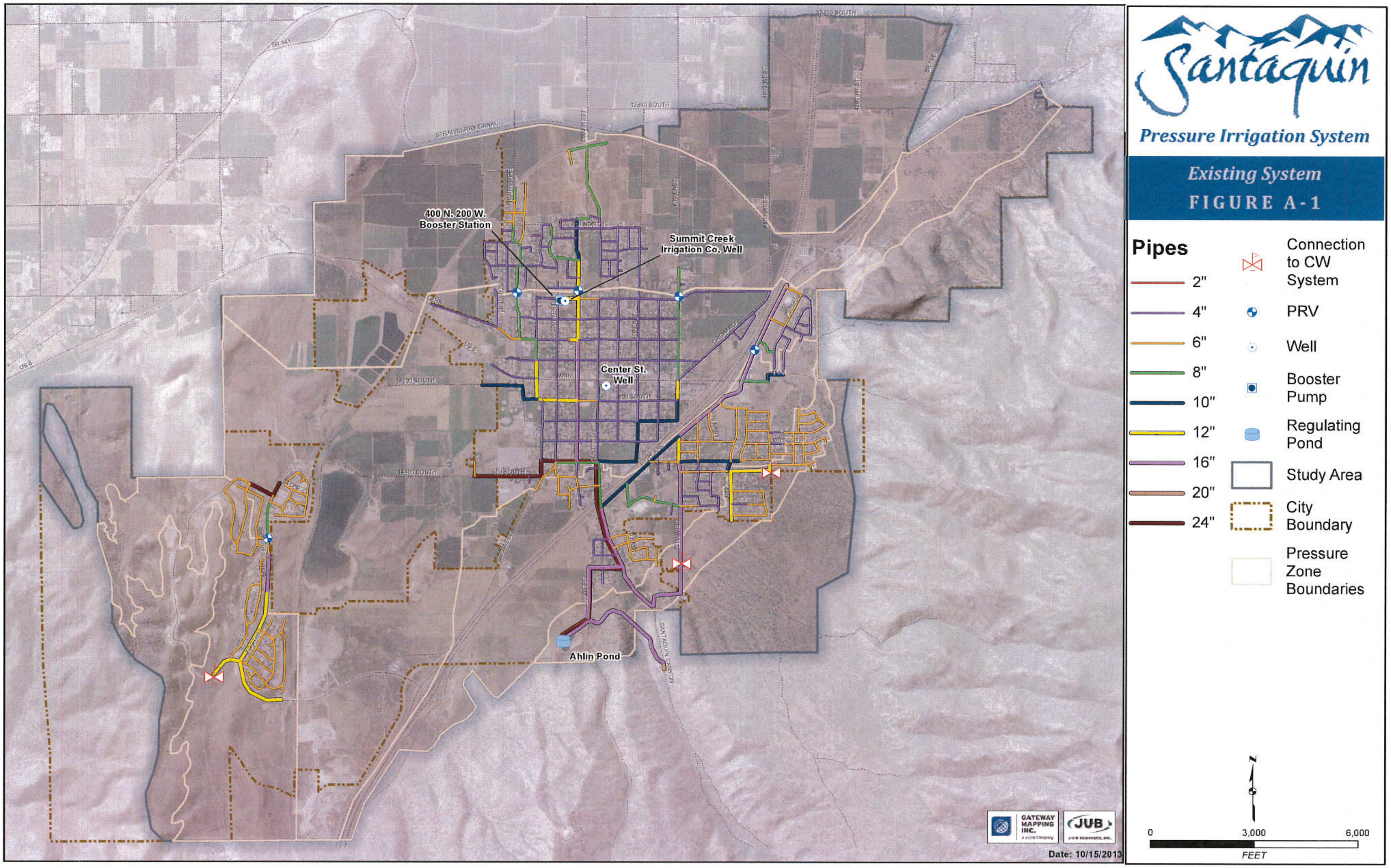
6. Water Rights

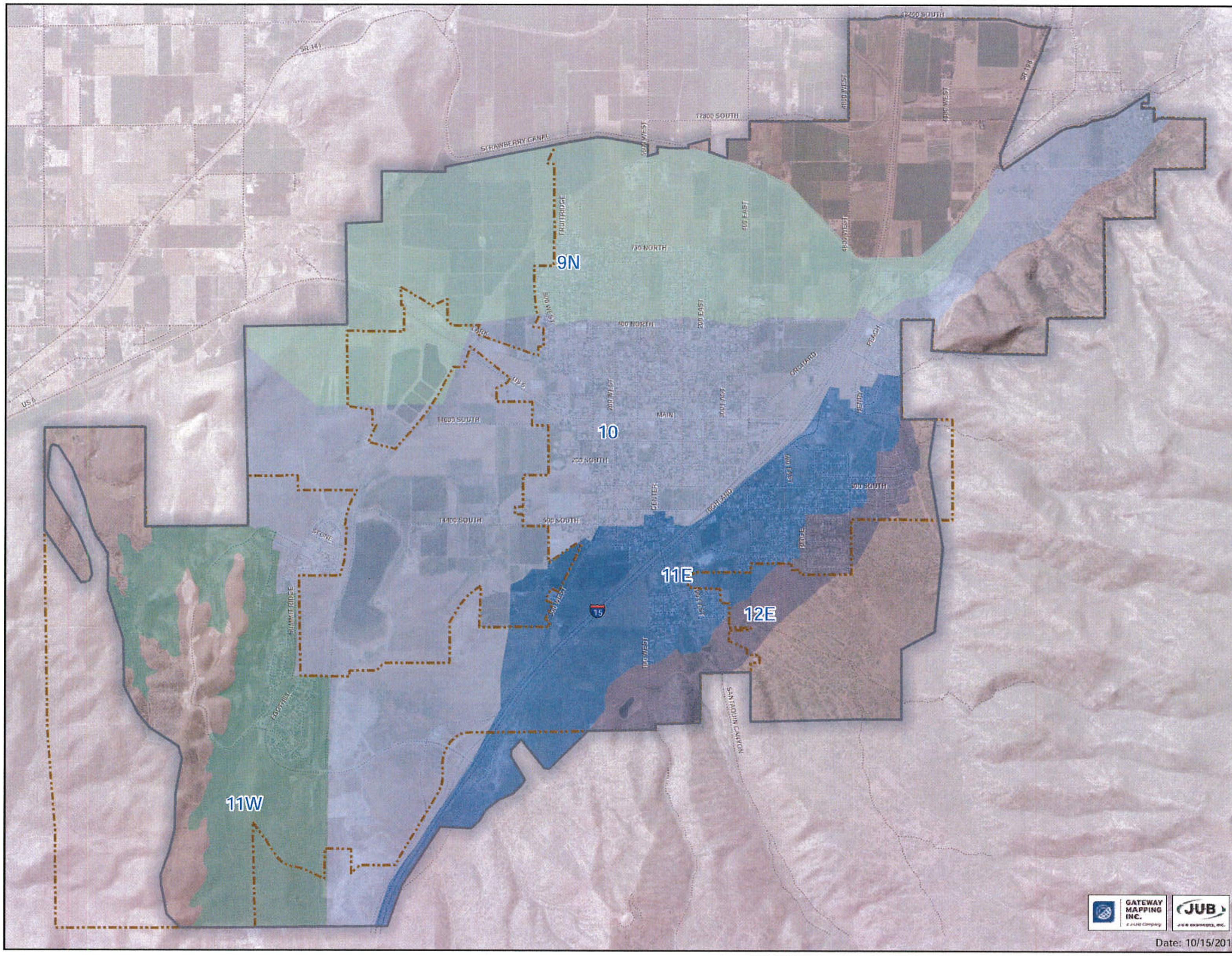
   The evaluation of water rights was outside the scope of this study. However, we recommend that in the near future Santaquin City evaluate long-term water right needs and acquisition policy to make sure that there will be sufficient water rights to enable development of the sources and use of water sufficient to meet the demands outlined in this report.

7. Periodic Review of User Rates

   We recommend that Santaquin City periodically review and update their water user rates. User rates cover operation & maintenance for the system. As costs to maintain and operate the system will likely increase over time, user rates need be updated periodically to make sure that revenue generated can cover costs. More frequent smaller adjustments are more tolerable than infrequent large adjustments.

APPENDIX A
EXISTING SYSTEM MAPS


Santaquin
Pressure Irrigation System
Existing System
FIGURE A-1
Pipes
2"
4"
6"
8"
10"
12"
16"
20"
24"
Connection to CW System
PRV
Well
Booster Pump
Regulating Pond
Study Area
City Boundary
Pressure Zone Boundaries
0
3,000
6,000
FEET
400 N. 200 W. Booster Station
Summit Creek Irrigation Co. Well
Center St. Well
Ahlin Pond
GATEWAY MAPPING INC.
JUB
Date: 10/15/2013



Santaquin

Pressure Irrigation System

Existing Pressure Zones

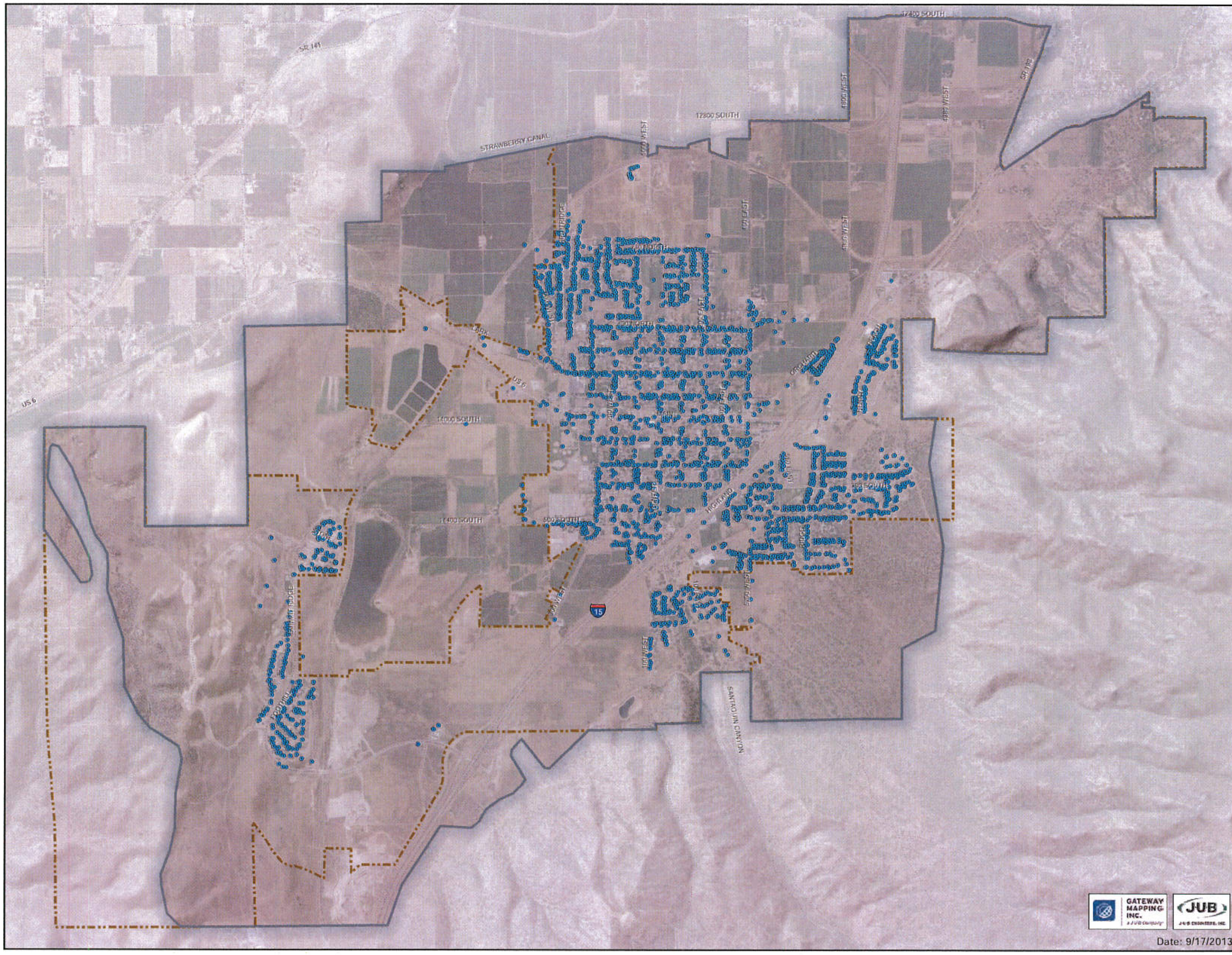
FIGURE A-2

Existing Zones

- Zone 9N
- Zone 10
- Zone 11E
- Zone 11W
- Zone 12E

N

0 — 3,000 — 6,000 FEET



Santaquin

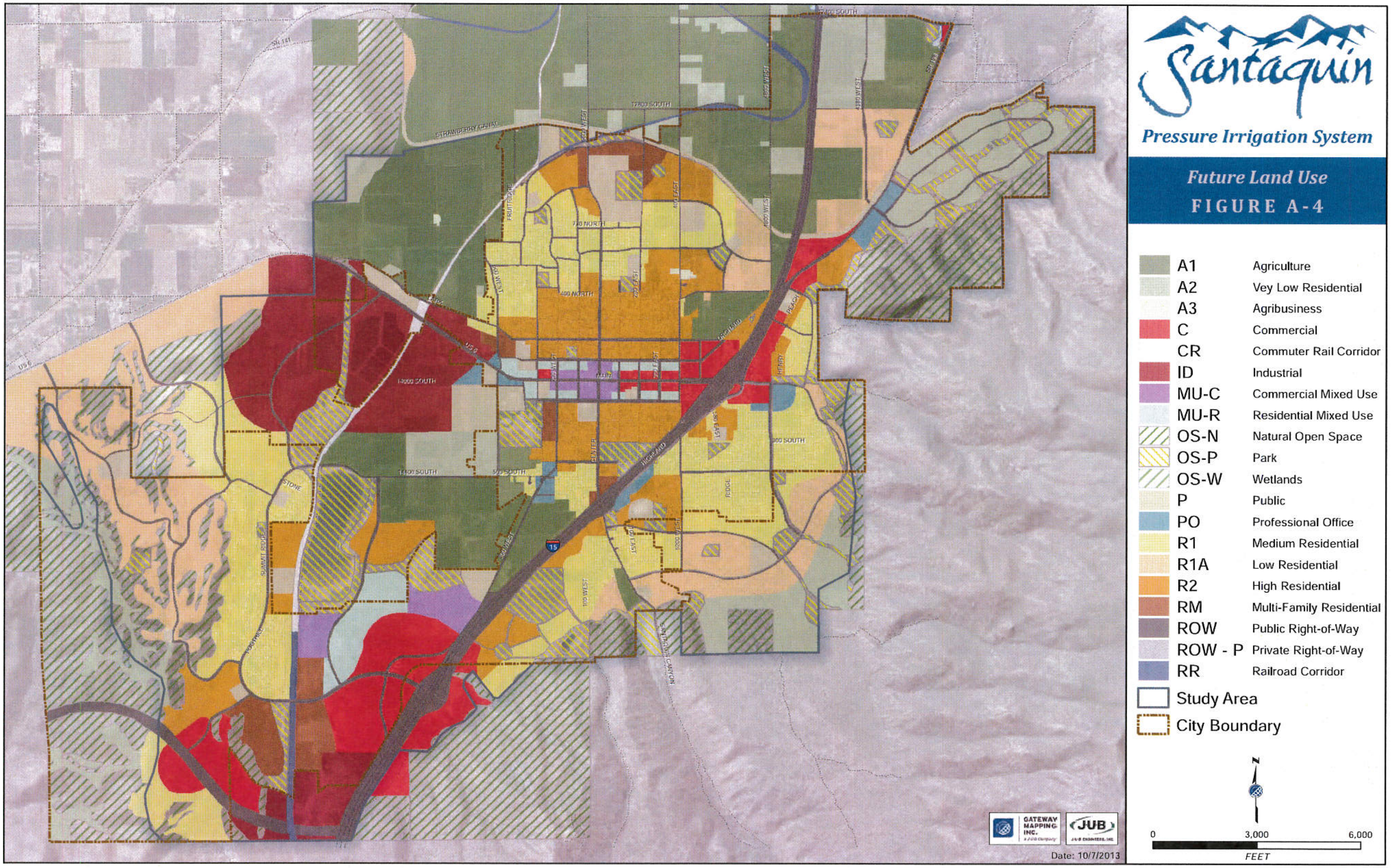
Pressure Irrigation System

Existing Pressure Irrigation Connections

FIGURE A-3

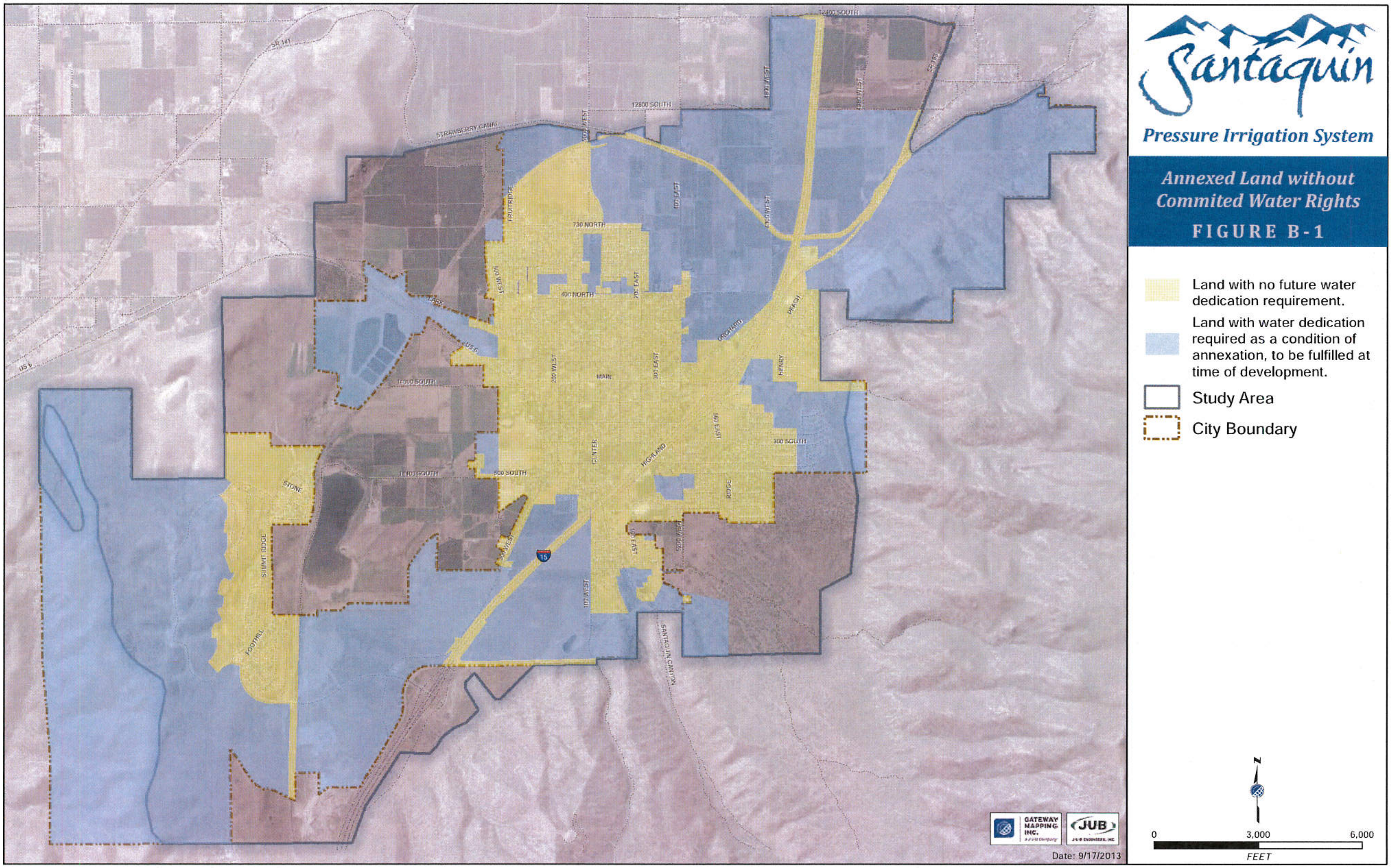
- Existing Connections
- Study Area
- City Boundary

0 3,000 6,000 FEET



Santaquin
Pressure Irrigation System
Future Land Use
FIGURE A-4
A1 Agriculture
A2 Vey Low Residential
A3 Agribusiness
C Commercial
CR Commuter Rail Corridor
ID Industrial
MU-C Commercial Mixed Use
MU-R Residential Mixed Use
OS-N Natural Open Space
OS-P Park
OS-W Wetlands
P Public
PO Professional Office
R1 Medium Residential
R1A Low Residential
R2 High Residential
RM Multi-Family Residential
ROW Public Right-of-Way
ROW - P Private Right-of-Way
RR Railroad Corridor
Study Area
City Boundary
N
0
3,000
6,000
FEET
GATEWAY MAPPING INC.
JUB
Date: 10/7/2013

APPENDIX B
ANNEXED LAND WITHOUT COMMITTED WATER RIGHTS MAP


Santaquin
Pressure Irrigation System
Annexed Land without
Commited Water Rights
FIGURE B-1
Land with no future water dedication requirement.
Land with water dedication required as a condition of annexation, to be fulfilled at time of development.
Study Area
City Boundary
0
3,000
6,000
FEET
GATEWAY MAPPING INC.
JUB
Date: 9/17/2013
12400 SOUTH
12800 SOUTH
STRAWBERRY CANAL
SR 141
US 6
730 NORTH
400 NORTH
FRUITRIDGE
500 WEST
200 WEST
MAIN
200 EAST
300 EAST
400 EAST
CENTER
HIGHLAND
ORCHARD
HENRY
PEACH
300 SOUTH
500 SOUTH
13400 SOUTH
14000 SOUTH
STONE
SUMMIT RIDGE
FOOTHILL
100 WEST
100 EAST
RIDGE
SANTAQUIN CANYON
15

APPENDIX C
EXISTING SYSTEM

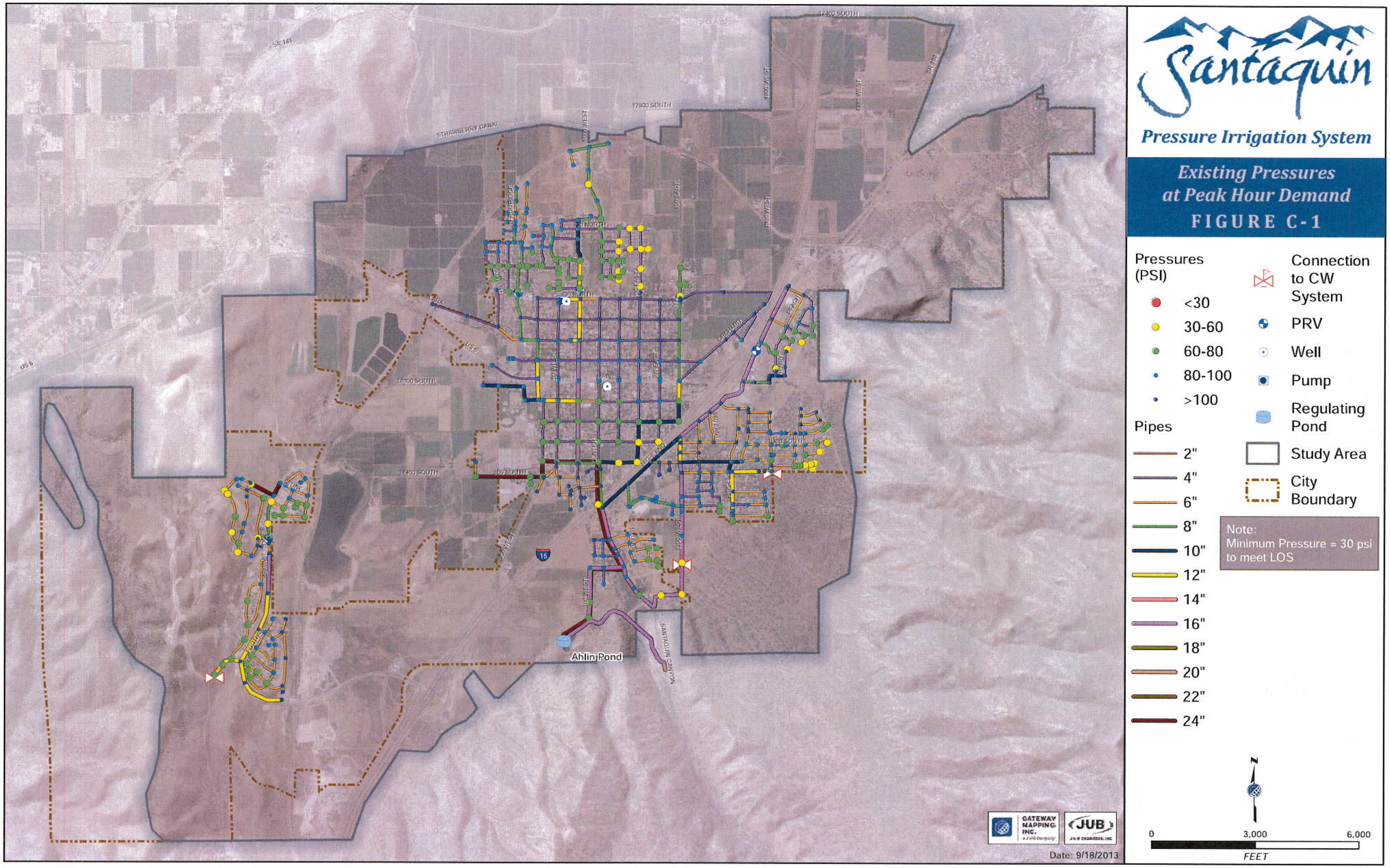

Santaquin
Pressure Irrigation System
Existing Pressures at Peak Hour Demand
FIGURE C-1
Pressures (PSI)
<30
30-60
60-80
80-100
>100
Pipes
2"
4"
6"
8"
10"
12"
14"
16"
18"
20"
22"
24"
Connection to CW System
PRV
Well
Pump
Regulating Pond
Study Area
City Boundary
Note:
Minimum Pressure = 30 psi to meet LOS
0
3,000
6,000
FEET
N
Ahlin Pond
SANTAQUIN CANYON
STRAWBERRY CANAL
12800 SOUTH
12400 SOUTH
1400 SOUTH
500 SOUTH
GATEWAY MAPPING INC.
JUB
Date: 9/18/2013

Table C-1. Existing Storage Demand Calculation
(based on hourly demand fluctuations)

ERUs in Year: 2013	2363
Irrigated area per ERU (acres):	0.25
Maximum day demand per irrigated acre (gpm):	3.96
Maximum Day Demand (ac-ft):	**10.34**

Hour	Diurnal Curve Multiplier[1]	Instantaneous Demand[2] (gpm)	Demand During Hour (ac-ft)	Constant Source (gpm)	Constant Source During Hour (ac-ft)	Required Storage During Hour (ac-ft)
1	0.3	1,421	**0.26**	2550	**0.47**	0.00
2	0.4	1,895	**0.35**	2550	**0.47**	0.00
3	0.5	2,369	**0.44**	2550	**0.47**	0.00
4	0.7	3,317	**0.61**	2550	**0.47**	0.14
5	0.9	4,264	**0.79**	2550	**0.47**	0.32
6	1	4,738	**0.87**	2550	**0.47**	0.40
7	1	4,738	**0.87**	2550	**0.47**	0.40
8	0.8	3,790	**0.70**	2550	**0.47**	0.23
9	0.6	2,843	**0.52**	2550	**0.47**	0.05
10	0.4	1,895	**0.35**	2550	**0.47**	0.00
11	0.05	237	**0.04**	2550	**0.47**	0.00
12	0.05	237	**0.04**	2550	**0.47**	0.00
13	0.05	237	**0.04**	2550	**0.47**	0.00
14	0.05	237	**0.04**	2550	**0.47**	0.00
15	0.05	237	**0.04**	2550	**0.47**	0.00
16	0.05	237	**0.04**	2550	**0.47**	0.00
17	0.05	237	**0.04**	2550	**0.47**	0.00
18	0.6	2,843	**0.52**	2550	**0.47**	0.05
19	0.7	3,317	**0.61**	2550	**0.47**	0.14
20	0.8	3,790	**0.70**	2550	**0.47**	0.23
21	1	4,738	**0.87**	2550	**0.47**	0.40
22	0.8	3,790	**0.70**	2550	**0.47**	0.23
23	0.6	2,843	**0.52**	2550	**0.47**	0.05
24	0.4	1,895	**0.35**	2550	**0.47**	0.00

Total Maximum Day Demand (ac-ft): **10.34** **Storage (ac-ft):** **2.65**

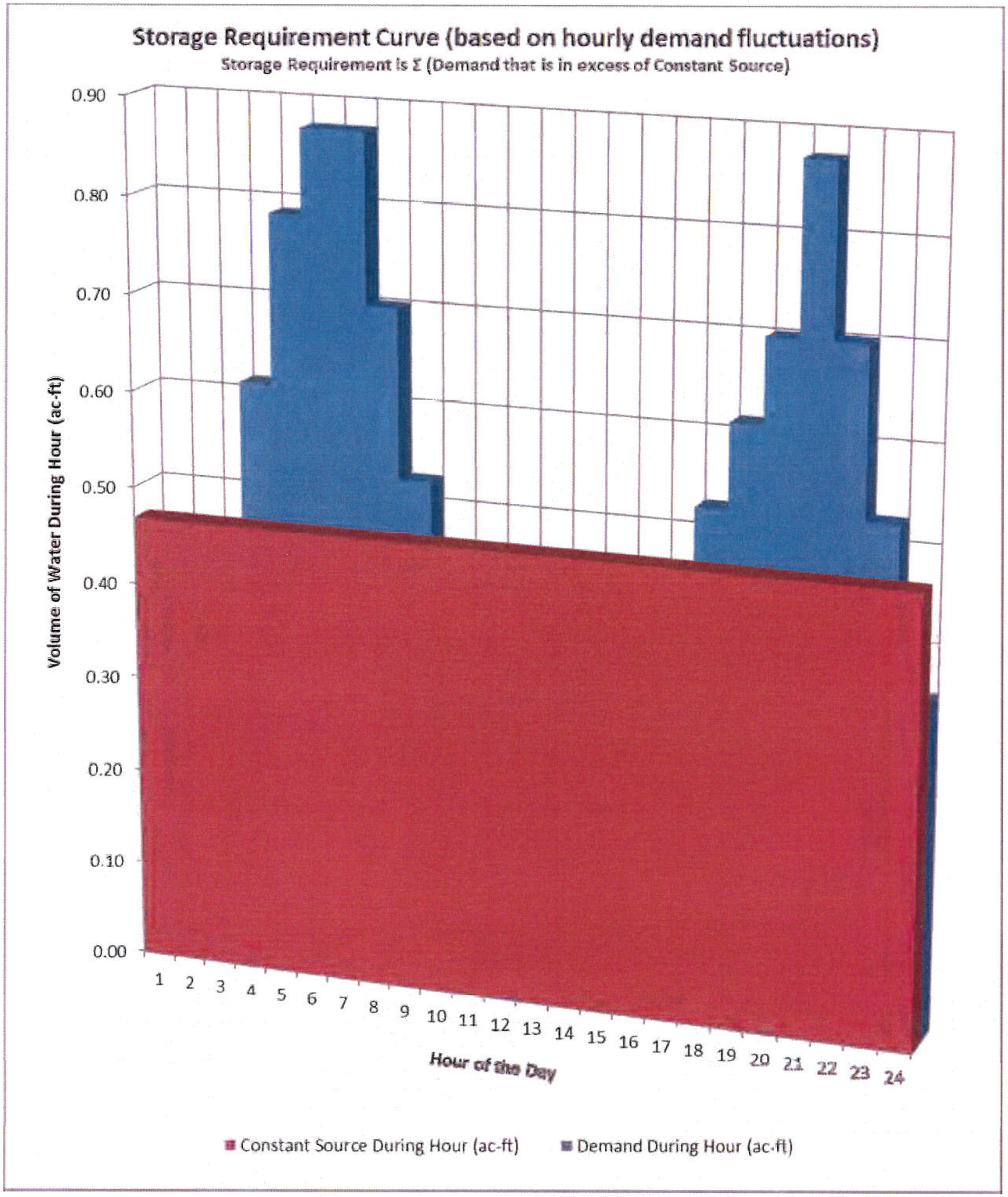
"Safety Factor" - Percentage of Additional Storage: 25%

Total Storage (ac-ft): **3.32**

[1]This dirunal curve shows the distribution of water use during the 24 hours of a day. It was developed by J-U-B Engineers based on actual meter readings at water sources of stand-alone pressure irrigation systems along the Wasatch Front.

[2]The dirunal curve is scaled by this factor so it represents hourly demand: 4737.96

Existing Storage Demand Graph
(based on hourly demand fluctuations)



APPENDIX D
FUTURE SYSTEM TABLES

Table D-1. Future Source Requirements

	Santaquin Growth Projections				Source Requirement and Supply						
Year	Population	Average Annual Growth Rate	Additional Persons/Yr	ERUs	Source Required per Season (Ac-ft/Season)	Source Req'd on Peak Day (AF/Day)	WRF Type 1 Water Generated (Ac-ft/day)	WRF Type 1 Water Stored Oct 15 to Apr 15 (Ac-ft)	WRF Type 1 Water Sent to Recharge Basins or Land Application During Year (Ac-ft)	SCIC Shares	SCIC Water (Ac-ft/Season)
A	B	C	D	E	F	G	H	I	J	K	L
					E x AA x AC	E x AB x AC (converted to AF/Day)	600,000 gal/day increased annually by C (converted	Smaller of H or 1M gal/day, over 180 days (converted	(H x 360) - (R x 180)	554 increased annually by C, scaled to equal 1350 in 2060	K x AD
2013	10,999	8.28%	841	2,363	1,105	**10.34**				554	1662
2014	11,910	8.28%	911	2,592	1,212	**11.34**	1.84	331.46	106.07	591	1774
2015	12,896	8.28%	986	2,840	1,328	**12.42**	1.99	358.91	160.96	631	1893
2016	13,963	8.28%	1,068	3,108	1,453	**13.60**	2.16	388.63	220.39	673	2020
2017	15,120	8.28%	1,156	3,399	1,589	**14.87**	2.34	420.80	284.75	719	2156
2018	16,371	8.28%	1,252	3,713	1,736	**16.25**	2.53	455.65	354.43	767	2301
2019	17,727	8.28%	1,356	4,054	1,895	**17.74**	2.74	493.37	429.89	819	2456
2020	19,195	8.28%	1,468	4,423	2,068	**19.35**	2.97	534.22		874	2621
2021	19,907	3.71%	712	4,602	2,151	**20.13**	3.08	552.44	1.61	893	2679
2022	20,645	3.71%	739	4,787	2,238	**20.95**	3.19	552.44	22.16	913	2739
2023	21,411	3.71%	766	4,980	2,328	**21.79**	3.31	552.44	43.48	933	2800
2024	22,206	3.71%	794	5,179	2,421	**22.66**	3.43	552.44	65.59	954	2862
2025	23,030	3.71%	824	5,386	2,518	**23.57**	3.56	552.44	88.52	975	2925
2026	23,884	3.71%	854	5,601	2,618	**24.51**	3.69	552.44	112.30	997	2990
2027	24,770	3.71%	886	5,824	2,723	**25.48**	3.83	552.44	136.96	1,019	3057
2028	25,689	3.71%	919	6,055	2,831	**26.49**	3.97	552.44	162.53	1,042	3125
2029	26,642	3.71%	953	6,294	2,943	**27.54**	4.12	552.44	189.06	1,065	3194
2030	27,631	3.71%	988	6,543	3,059	**28.63**	4.27	552.44	216.57	1,088	3265
2031	28,473	3.05%	843	6,754	3,158	**29.55**	4.40	552.44	240.02	1,105	3316
2032	29,342	3.05%	868	6,973	3,260	**30.51**	4.54	552.44	264.19	1,123	3368
2033	30,237	3.05%	895	7,197	3,365	**31.49**	4.68	552.44	289.10	1,140	3421
2034	31,159	3.05%	922	7,429	3,473	**32.50**	4.82	552.44	314.77	1,158	3475
2035	32,109	3.05%	950	7,668	3,585	**33.55**	4.96	552.44	341.22	1,177	3530
2036	33,089	3.05%	979	7,914	3,700	**34.63**	5.12	552.44	368.47	1,195	3585
2037	34,098	3.05%	1,009	8,168	3,818	**35.74**	5.27	552.44	396.56	1,214	3641
2038	35,138	3.05%	1,040	8,429	3,941	**36.88**	5.43	552.44	425.51	1,233	3698
2039	36,209	3.05%	1,072	8,698	4,066	**38.06**	5.60	552.44	455.33	1,252	3757
2040	37,314	3.05%	1,104	8,976	4,196	**39.27**	5.77	552.44	486.07	1,272	3816
2041	38,027	1.91%	713	9,155	4,280	**40.06**	5.88	552.44	505.91	1,278	3833
2042	38,753	1.91%	726	9,337	4,365	**40.85**	5.99	552.44	526.12	1,283	3850
2043	39,493	1.91%	740	9,523	4,452	**41.67**	6.11	552.44	546.72	1,289	3867
2044	40,247	1.91%	754	9,713	4,541	**42.50**	6.22	552.44	567.72	1,295	3884
2045	41,016	1.91%	769	9,906	4,631	**43.34**	6.34	552.44	589.11	1,300	3901
2046	41,799	1.91%	783	10,103	4,723	**44.20**	6.46	552.44	610.91	1,306	3919
2047	42,598	1.91%	798	10,304	4,817	**45.08**	6.59	552.44	633.13	1,312	3936
2048	43,411	1.91%	814	10,508	4,913	**45.98**	6.71	552.44	655.78	1,318	3954
2049	44,241	1.91%	829	10,717	5,010	**46.89**	6.84	552.44	678.86	1,324	3972
2050	45,086	1.91%	845	10,929	5,109	**47.82**	6.97	552.44	702.37	1,330	3989
2051	45,811	1.61%	726	11,111	5,195	**48.62**	7.08	552.44	722.58	1,332	3995
2052	46,549	1.61%	738	11,297	5,281	**49.43**	7.20	552.44	743.10	1,334	4001
2053	47,298	1.61%	749	11,485	5,369	**50.25**	7.31	552.44	763.96	1,336	4007
2054	48,060	1.61%	762	11,676	5,459	**51.09**	7.43	552.44	785.16	1,338	4014
2055	48,834	1.61%	774	11,871	5,550	**51.94**	7.55	552.44	806.69	1,340	4020
2056	49,620	1.61%	786	12,068	5,642	**52.80**	7.67	552.44	828.57	1,342	4026
2057	50,419	1.61%	799	12,269	5,736	**53.68**	7.80	552.44	850.81	1,344	4032
2058	51,231	1.61%	812	12,473	5,831	**54.57**	7.92	552.44	873.40	1,346	4038
2059	52,055	1.61%	825	12,680	5,928	**55.48**	8.05	552.44	896.36	1,348	4044
2060	52,893	1.61%	838	12,891	6,027	**56.40**	8.18	552.44	919.68	1,350	4050

SEE CONTINUATION OF TABLE ON THE FOLLOWING PAGE

Table D-1. Future Source Requirements (Continued)

Year	Peak Day Water Source Supply: SCIC Water - Yield Based on Shares (Ac-ft/Peak Day)	SCIC Water - Delivered through 400 N 200 W Booster Station (Ac-ft/day)	SCIC Water - Delivered through 200 N 150 W Booster Station at SCIC well (Ac-ft/day)	SCIC Water - Delivered through 400 S 100 W Booster Station at SCIC well (Ac-ft/day)	SCIC Water - Delivered to Ahlin Pond (Ac-ft/day)	Re-use Pump from Winter Storage Pond (Ac-ft/Day)	Recharge & Recovery Well #1 (90% of recharge water over 90 days) (Ac-ft/Day)	Center Street Well (Ac-ft/Day)	Overflow from Springs (Ac-ft/Day)	CW Supplied to PI System (Ac-ft/Day)	Strawberry Highline Canal and CUP Aqueducts (Ac-ft/Day)	Total Source Available (Ac-ft/Day)	Excess Source (Ac-ft/Day)
A	M	N	O	P	Q	R	S	T	U	V	W	X	Y
	K x AE / 180 days	1350 gpm, Converted to ac-ft/day	Smaller of (M - N) and N	Smaller of (M - N - O) and N	Smaller of (M - N - O - P) and 4 cfs (one stream of SCIC water)	Smaller of AG and ((I/180)) + H)	90% x J / 90 days	560 gpm x AF (in Ac-ft/Day)	200,000 gal/day	Data from Culinary Water Master Plan	G - sum of N through V (when it is greater than zero)	G - the sum of N through W	G - X
2013	8.36	5.22				-	-	2.17	-	3.89	-	**11.27**	**0.93**
2014	8.92	5.22				3.09	-	2.17	0.61	4.45	-	**15.54**	**4.20**
2015	9.52	5.22	4.30			3.09	-	2.17	0.61	5.01	-	**20.41**	**7.98**
2016	10.16	5.22	4.94			3.09	-	2.17	0.61	5.58	-	**21.61**	**8.01**
2017	10.85	5.22	5.22			3.09	-	2.17	0.61	6.14	-	**22.45**	**7.58**
2018	11.58	5.22	5.22	1.13		3.09	-	2.17	0.61	6.71	-	**24.15**	**7.91**
2019	12.35	5.22	5.22	1.91		3.09	-	2.17	0.61	-	-	**18.22**	**0.49**
2020	13.19	5.22	5.22	2.74		5.94	-	2.17	0.61	-	-	**21.90**	**2.55**
2021	13.48	5.22	5.22	3.04		6.15	-	2.17	0.61	-	-	**22.40**	**2.27**
2022	13.78	5.22	5.22	3.34		6.26	-	2.17	0.61	-	-	**22.81**	**1.87**
2023	14.08	5.22	5.22	3.64		6.38	-	2.17	0.61	-	-	**23.24**	**1.45**
2024	14.40	5.22	5.22	3.95		6.50	-	2.17	0.61	-	-	**23.67**	**1.01**
2025	14.72	5.22	5.22	4.27		6.63	0.89	2.17	0.61	-	-	**25.01**	**1.44**
2026	15.04	5.22	5.22	4.60		6.76	1.12	2.17	0.61	-	-	**25.70**	**1.20**
2027	15.38	5.22	5.22	4.94		6.90	1.37	2.17	0.61	-	-	**26.42**	**0.94**
2028	15.72	5.22	5.22	5.22	0.06	7.04	1.63	2.17	-	-	-	**26.55**	**0.06**
2029	16.07	5.22	5.22	5.22	0.41	7.19	1.89	2.17	-	-	0.23	**27.54**	
2030	16.42	5.22	5.22	5.22	0.76	7.34	2.17	2.17	-	-	0.53	**28.63**	
2031	16.68	5.22	5.22	5.22	1.02	7.47	2.40	2.17	-	-	0.83	**29.55**	
2032	16.94	5.22	5.22	5.22	1.28	7.61	2.64	2.17	-	-	1.15	**30.51**	
2033	17.21	5.22	5.22	5.22	1.55	7.74	2.89	2.17	-	-	1.48	**31.49**	
2034	17.48	5.22	5.22	5.22	1.82	7.89	3.15	2.17	-	-	1.82	**32.50**	
2035	17.75	5.22	5.22	5.22	2.09	8.03	3.41	2.17	-	-	2.18	**33.55**	
2036	18.03	5.22	5.22	5.22	2.37	8.19	3.68	2.17	-	-	2.56	**34.63**	
2037	18.32	5.22	5.22	5.22	2.65	8.34	3.97	2.17	-	-	2.95	**35.74**	
2038	18.60	5.22	5.22	5.22	2.94	8.50	4.26	2.17	-	-	3.35	**36.88**	
2039	18.90	5.22	5.22	5.22	3.23	8.67	4.55	2.17	-	-	3.78	**38.06**	
2040	19.19	5.22	5.22	5.22	3.53	8.84	4.86	2.17	-	-	4.21	**39.27**	
2041	19.28	5.22	5.22	5.22	3.62	8.95	5.06	2.17	-	-	4.60	**40.06**	
2042	19.36	5.22	5.22	5.22	3.70	9.06	5.26	2.17	-	-	5.00	**40.85**	
2043	19.45	5.22	5.22	5.22	3.79	9.18	5.47	2.17	-	-	5.41	**41.67**	
2044	19.54	5.22	5.22	5.22	3.88	9.29	5.68	2.17	-	-	5.82	**42.50**	
2045	19.63	5.22	5.22	5.22	3.96	9.41	5.89	2.17	-	2.62	3.63	**43.34**	
2046	19.71	5.22	5.22	5.22	4.05	9.53	6.11	2.17	-	2.67	4.02	**44.20**	
2047	19.80	5.22	5.22	5.22	4.14	9.66	6.33	2.17	-	2.72	4.41	**45.08**	
2048	19.89	5.22	5.22	5.22	4.23	9.78	6.56	2.17	-	2.77	4.81	**45.98**	
2049	19.98	5.22	5.22	5.22	4.32	9.91	6.79	2.17	-	2.82	5.22	**46.89**	
2050	20.07	5.22	5.22	5.22	4.41	10.04	7.02	2.17	-	2.88	5.64	**47.82**	
2051	20.10	5.22	5.22	5.22	4.44	10.15	7.23	2.17	-	2.93	6.04	**48.62**	
2052	20.13	5.22	5.22	5.22	4.47	10.27	7.43	2.17	-	2.98	6.46	**49.43**	
2053	20.16	5.22	5.22	5.22	4.50	10.38	7.64	2.17	-	3.03	6.88	**50.25**	
2054	20.19	5.22	5.22	5.22	4.53	10.50	7.85	2.17	-	3.08	7.31	**51.09**	
2055	20.22	5.22	5.22	5.22	4.56	10.62	8.07	2.17	-	3.12	7.74	**51.94**	
2056	20.25	5.22	5.22	5.22	4.59	10.74	8.29	2.17	-	3.18	8.19	**52.80**	
2057	20.28	5.22	5.22	5.22	4.62	10.86	8.51	2.17	-	3.23	8.64	**53.68**	
2058	20.31	5.22	5.22	5.22	4.65	10.99	8.73	2.17	-	3.28	9.09	**54.57**	
2059	20.34	5.22	5.22	5.22	4.68	11.12	8.96	2.17	-	3.33	9.56	**55.48**	
2060	20.37	5.22	5.22	5.22	4.71	11.25	9.20	2.17	-	3.38	10.04	**56.40**	

AA = Average Yearly Outdoor Use = 1.87 acre-feet per irrigated acre per season

AB = Peak Day Demand = 3.96 gpm per irrigated acre

AC = Irrigated Area per ERU = 0.25 acres per ERU

AD = SCIC Yield Per Share = 3 acre-feet per season

AE = SCIC **Rate of Delivery** on **Maximum Day** = 2.72 acre-feet per share per season = 4 streams of 4 cfs each for 24 hours (= maximum day delivery of water) per day for 180 days, divided by 2103 SCIC water shares

AF = Number of hours a day pumps are running at the established level of service = 21 hours/day

AG = Capacity of one pump at the type 1 sewer effluent winter storage booster station running 21 hours/day = 3.09 acre-feet/day

Table D-2. Future Storage Requirements

Santaquin Growth Projections					Storage Requirement					
Year	Population	Average Annual Growth Rate	Additional Persons/Yr	ERUs	Peak Day Storage Req'd (when hourly demand exceeds	Storage Req'd (when seasonal supply exceeds demand -	Total Req'd Storage (Ac-ft)	PI System Storage Provided (Ac-ft)	Culinary Water System Storage Provided (Ac-ft)	Total Storage Provided (Ac-ft)
A	B	C	D	E	F	G	H	I	J	K
					Data generated using Table C-1	Column G in Table E-1 x AA	Larger of F and G	Sum of capacity of storage facilities	Data from Culinary Water Master Plan	I + J
2013	10,999	8.28%	841	2,363	3.32	16.36	**16.36**	36.00	1.94	**37.94**
2014	11,910	8.28%	911	2,592	1.93	17.94	**17.94**	36.00	2.22	**38.22**
2015	12,896	8.28%	986	2,840	0.86	19.66	**19.66**	36.00	2.50	**38.50**
2016	13,963	8.28%	1,068	3,108	1.16	21.51	**21.51**	36.00	2.79	**38.79**
2017	15,120	8.28%	1,156	3,399	1.70	23.52	**23.52**	36.00	2.98	**38.98**
2018	16,371	8.28%	1,252	3,713	1.99	25.70	**25.70**	49.07		**49.07**
2019	17,727	8.28%	1,356	4,054	6.38	28.06	**28.06**	49.07		**49.07**
2020	19,195	8.28%	1,468	4,423	5.71	30.61	**30.61**	49.07		**49.07**
2021	19,907	3.71%	712	4,602	6.18	31.85	**31.85**	49.07		**49.07**
2022	20,645	3.71%	739	4,787	6.73	33.14	**33.14**	49.07		**49.07**
2023	21,411	3.71%	766	4,980	7.31	34.47	**34.47**	49.07		**49.07**
2024	22,206	3.71%	794	5,179	7.91	35.85	**35.85**	49.07		**49.07**
2025	23,030	3.71%	824	5,386	7.99	37.28	**37.28**	49.07		**49.07**
2026	23,884	3.71%	854	5,601	8.49	38.77	**38.77**	49.07		**49.07**
2027	24,770	3.71%	886	5,824	9.02	40.31	**40.31**	49.07		**49.07**
2028	25,689	3.71%	919	6,055	9.97	41.91	**41.91**	89.07		**89.07**
2029	26,642	3.71%	953	6,294	10.40	43.57	**43.57**	89.07		**89.07**
2030	27,631	3.71%	988	6,543	10.81	45.29	**45.29**	89.07		**89.07**
2031	28,473	3.05%	843	6,754	11.16	46.75	**46.75**	89.07		**89.07**
2032	29,342	3.05%	868	6,973	11.52	48.26	**48.26**	89.07		**89.07**
2033	30,237	3.05%	895	7,197	11.90	49.82	**49.82**	89.07		**89.07**
2034	31,159	3.05%	922	7,429	12.28	51.42	**51.42**	89.07		**89.07**
2035	32,109	3.05%	950	7,668	12.67	53.08	**53.08**	89.07		**89.07**
2036	33,089	3.05%	979	7,914	13.08	54.78	**54.78**	89.07		**89.07**
2037	34,098	3.05%	1,009	8,168	13.50	56.53	**56.53**	89.07		**89.07**
2038	35,138	3.05%	1,040	8,429	13.93	58.34	**58.34**	89.07		**89.07**
2039	36,209	3.05%	1,072	8,698	14.38	60.21	**60.21**	89.07		**89.07**
2040	37,314	3.05%	1,104	8,976	14.84	62.13	**62.13**	89.07		**89.07**
2041	38,027	1.91%	713	9,155	15.13	63.37	**63.37**	89.07		**89.07**
2042	38,753	1.91%	726	9,337	15.43	64.63	**64.63**	89.07		**89.07**
2043	39,493	1.91%	740	9,523	15.74	65.92	**65.92**	89.07		**89.07**
2044	40,247	1.91%	754	9,713	16.05	67.23	**67.23**	89.07		**89.07**
2045	41,016	1.91%	769	9,906	16.37	68.57	**68.57**	89.07	1.31	**90.38**
2046	41,799	1.91%	783	10,103	16.70	69.93	**69.93**	89.07	1.34	**90.40**
2047	42,598	1.91%	798	10,304	17.03	71.32	**71.32**	89.07	1.36	**90.43**
2048	43,411	1.91%	814	10,508	17.37	72.73	**72.73**	89.07	1.39	**90.46**
2049	44,241	1.91%	829	10,717	17.71	74.18	**74.18**	89.07	1.41	**90.48**
2050	45,086	1.91%	845	10,929	18.06	75.65	**75.65**	89.07	1.44	**90.51**
2051	45,811	1.61%	726	11,111	18.37	76.91	**76.91**	89.07	1.46	**90.53**
2052	46,549	1.61%	738	11,297	18.67	78.19	**78.19**	89.07	1.49	**90.56**
2053	47,298	1.61%	749	11,485	18.98	79.50	**79.50**	89.07	1.51	**90.58**
2054	48,060	1.61%	762	11,676	19.30	80.82	**80.82**	89.07	1.54	**90.61**
2055	48,834	1.61%	774	11,871	19.62	82.17	**82.17**	89.07	1.56	**90.63**
2056	49,620	1.61%	786	12,068	19.95	83.53	**83.53**	89.07	1.59	**90.65**
2057	50,419	1.61%	799	12,269	20.28	84.92	**84.92**	89.07	1.61	**90.68**
2058	51,231	1.61%	812	12,473	20.62	86.34	**86.34**	89.07	1.64	**90.71**
2059	52,055	1.61%	825	12,680	20.96	87.77	**87.77**	89.07	1.66	**90.73**
2060	52,893	1.61%	838	12,891	21.31	89.23	**89.23**	89.07	1.69	**90.76**

AA = Scale factor: Storage equals peak day demand times this factor (set to force storage provided at buildout to equal required storage = 1.582

Table D-3. Future Transmission/Distribution Pipe Flows Tabulation

Pipe Segment	Dia (in)	Segment Length (ft)	Existing Flow (GPM)	Flow at 2023 (GPM)	Buildout Flow (GMP)	% Needed in Next 10 Years
1269	8	1,216	0	69	393	18%
1277	8	598	0	79	549	14%
1321	8	783	0	97	363	27%
1343	8	1,703	0	41	345	12%
1357	8	1,279	0	0	395	0%
1359	8	1,248	0	0	313	0%
1363	8	661	0	167	377	44%
1385	8	742	0	282	545	52%
1411	8	797	0	90	489	18%
1433	8	1,221	0	281	349	80%
1599	8	1,535	0	224	378	59%
1613	8	1,313	0	462	462	100%
1617	8	1,217	0	0	313	0%
1625	8	779	0	145	456	32%
2143	8	1,070	0	0	529	0%
2161	8	264	0	0	529	0%
2201	8	284	0	102	358	28%
2203	8	1,094	0	346	450	77%
2205	8	1,000	0	102	358	28%
2221	8	1,058	0	56	450	12%
2225	8	153	0	56	450	12%
2261	8	203	0	41	355	12%
2267	8	494	0	107	519	21%
819	8	563	0	380	696	55%
9091D	8	139	0	0	316	0%
9091U	8	399	0	0	421	0%
P11881	8	299	0	0	414	0%
P191	8	106	0	0	316	0%
P407	8	433	0	2	553	0%
P41	8	1,055	0	69	393	18%
P419	8	344	0	6	359	2%
P691	8	141	0	27	420	6%
P695	8	1,662	0	0	403	0%
P707	8	383	0	0	401	0%
P775	8	1,516	0	16	355	4%
P777	8	353	0	56	269	21%
P895	8	1,579	0	103	382	27%
Total of all existing 8 inch pipes						
Total Length:		**29,685**				
Weighted Average Values:				**108**	**410**	**26%**

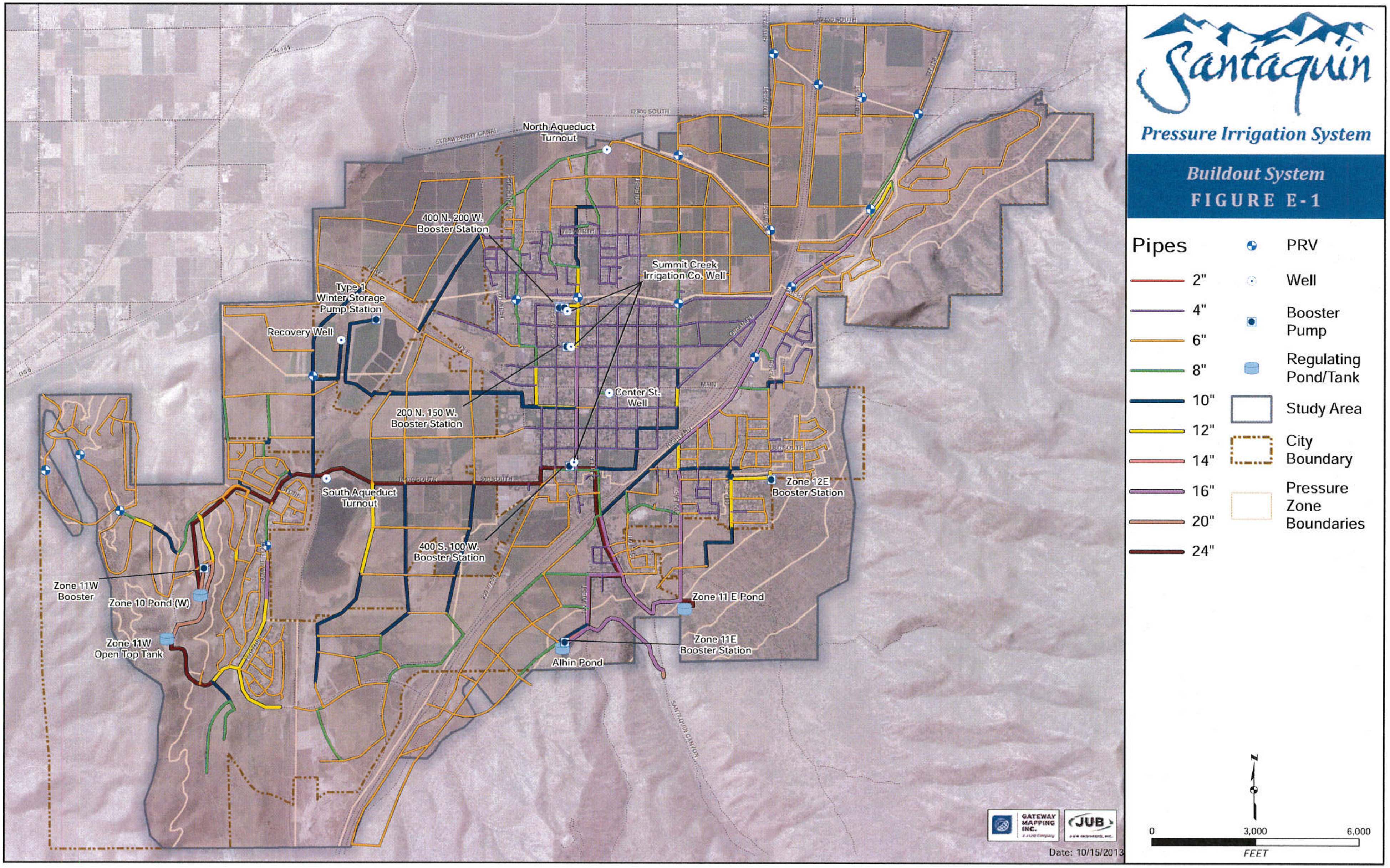
Table D-3. Future Transmission/Distribution Pipe Flows Tabulation (Continued)

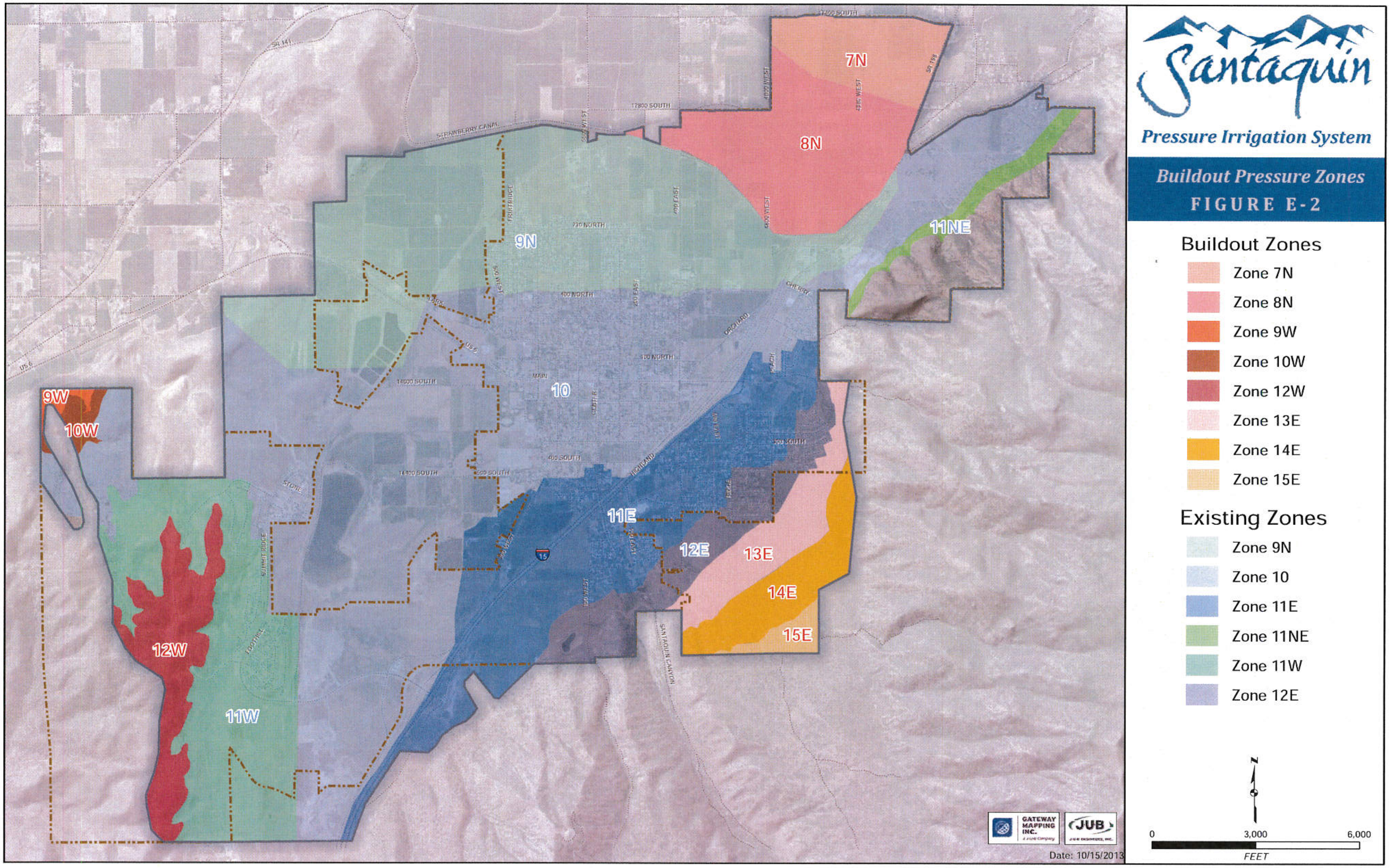
Pipe Segment	Dia (in)	Segment Length (ft)	Existing Flow (GPM)	Flow at 2023 (GPM)	Buildout Flow (GMP)	% Needed in Next 10 Years
1179	10	1,318	0	0	568	0%
1181	10	1,121	0	0	978	0%
1197	10	1,032	0	0	1,040	0%
1227	10	1,294	0	134	1,410	9%
1229	10	1,379	0	136	1,293	11%
1235	10	1,246	0	0	993	0%
1237	10	1,112	0	0	1,244	0%
1271	10	733	0	235	1,107	21%
1273	10	321	0	235	1,107	21%
1287	10	1,321	0	135	1,307	10%
1299	10	155	0	0	772	0%
1315	10	902	0	363	740	49%
1319	10	1,109	0	138	1,294	11%
1413	10	1,124	0	114	1,100	10%
1489	10	413	0	999	1,187	84%
1493	10	773	0	999	1,231	81%
1497	10	686	0	999	1,327	75%
1597	10	982	0	440	801	55%
1845	10	108	0	0	1,040	0%
2163	10	1,125	0	0	525	0%
2199	10	768	0	496	808	61%
849	10	304	0	414	784	53%
861	10	554	0	461	802	57%
9047D	10	72	0	0	1,046	0%
9047U	10	72	0	0	1,040	0%
P229	10	3,531	0	681	681	100%
P399	10	180	0	9	675	1%
P409	10	148	0	0	772	0%
P43	10	1,050	0	163	652	25%
P637	10	183	0	9	877	1%
P761	10	1,440	0	127	1,224	10%
P763	10	1,381	0	235	1,107	21%
P767	10	482	0	290	1,237	23%
P771	10	4,778	0	0	594	0%
P773	10	3,357	0	0	505	0%
P885	10	340	0	822	822	100%
Total of all existing 10 inch pipes						
Total Length:		**36,892**				
Weighted Average Values:				**216**	**894**	**24%**

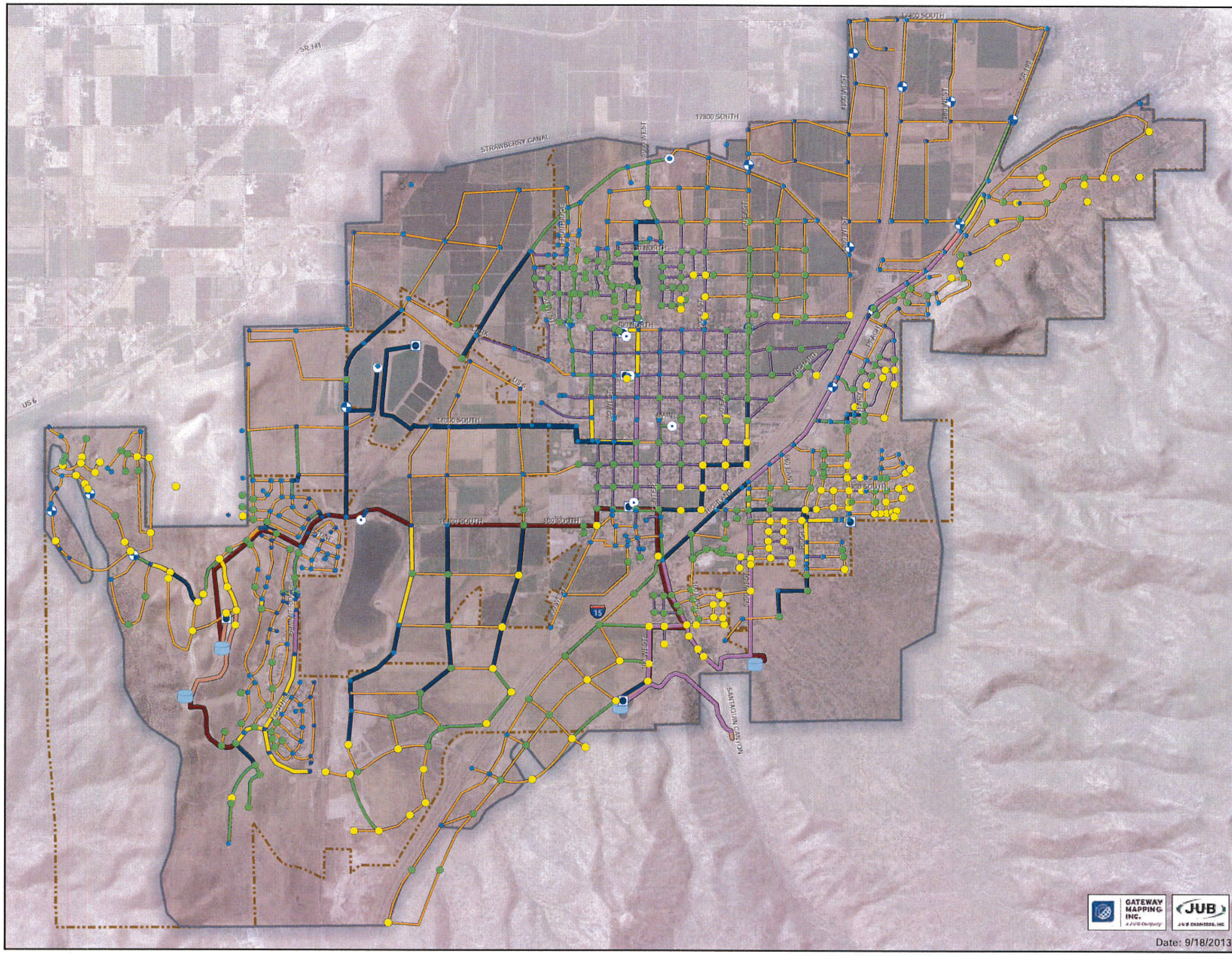
Table D-3. Future Transmission/Distribution Pipe Flows Tabulation (Continued)

Pipe Segment	Dia (in)	Segment Length (ft)	Existing Flow (GPM)	Flow at 2023 (GPM)	Buildout Flow (GMP)	% Needed in Next 10 Years
1207	12	1,840	0	1,400	1,400	100%
1335	12	1,984	0	1,400	1,400	100%
1337	12	1,264	0	219	2,327	9%
1339	12	1,420	0	224	2,158	10%
2147	12	785	0	0	726	0%
2287	12	565	0	0	732	0%
P12399	12	1,154	0	27	821	3%
P345	12	680	0	0	762	0%
Total of all existing 12 inch pipes						
Total Length:		**9,693**				
Weighted Average Values:				**617**	**1,425**	**43%**
P11879	14	686	0	27	1,235	2%
Total of all existing 14 inch pipes						
Total Length:		**686**				
Weighted Average Values:				**27**	**1,235**	**2%**
9069U	16	69	0	169	1,598	11%
B1423	16	572	0	70	1,426	5%
P11747	16	1,106	0	169	1,544	11%
P167	16	46	0	169	1,598	11%
P679	16	713	0	27	1,251	2%
Total of all existing 16 inch pipes						
Total Length:		**2,505**				
Weighted Average Values:				**106**	**1,436**	**7%**
2173	20	936	0	0	5,476	0%
P653	20	79	0	4,814	4,962	97%
P655	20	862	0	4,814	4,962	97%
Total of all existing 20 inch pipes						
Total Length:		**1,877**				
Weighted Average Values:				**2,414**	**5,218**	**46%**
2155	24	133	0	0	5,516	0%
SRDTT1_I	24	112	0	0	8,453	0%
TRCONTR	24	62	0	0	8,453	0%
Total of all existing 24 inch pipes						
Total Length:		**307**				
Weighted Average Values:				**0**	**7,182**	**0%**

APPENDIX E
FUTURE SYSTEM MAPS


Santaquin
Pressure Irrigation System
Buildout System
FIGURE E-1
Pipes
2"
4"
6"
8"
10"
12"
14"
16"
20"
24"
PRV
Well
Booster Pump
Regulating Pond/Tank
Study Area
City Boundary
Pressure Zone Boundaries
0
3,000
6,000
FEET
North Aqueduct Turnout
400 N. 200 W. Booster Station
Summit Creek Irrigation Co. Well
Type 1 Winter Storage Pump Station
Recovery Well
Center St. Well
200 N. 150 W. Booster Station
South Aqueduct Turnout
Zone 12E Booster Station
400 S. 100 W. Booster Station
Zone 11W Booster
Zone 10 Pond (W)
Zone 11 E Pond
Zone 11W Open Top Tank
Zone 11E Booster Station
Alhin Pond
GATEWAY MAPPING INC.
JUB
Date: 10/15/2013


Santaquin
Pressure Irrigation System
Buildout Pressure Zones
FIGURE E-2
Buildout Zones
Zone 7N
Zone 8N
Zone 9W
Zone 10W
Zone 12W
Zone 13E
Zone 14E
Zone 15E
Existing Zones
Zone 9N
Zone 10
Zone 11E
Zone 11NE
Zone 11W
Zone 12E
N
0
3,000
6,000
FEET
7N
8N
9N
10
11NE
11E
12E
13E
14E
15E
9W
10W
12W
11W
SANTAQUIN CANYON
GATEWAY MAPPING INC.
JUB
Date: 10/15/2013



Santaquin

Pressure Irrigation System

Buildout Pressures at Peak Hour Demand

FIGURE E-3

Pressure (PSI)
- <30
- 30-60
- 60-80
- 80-100
- >100

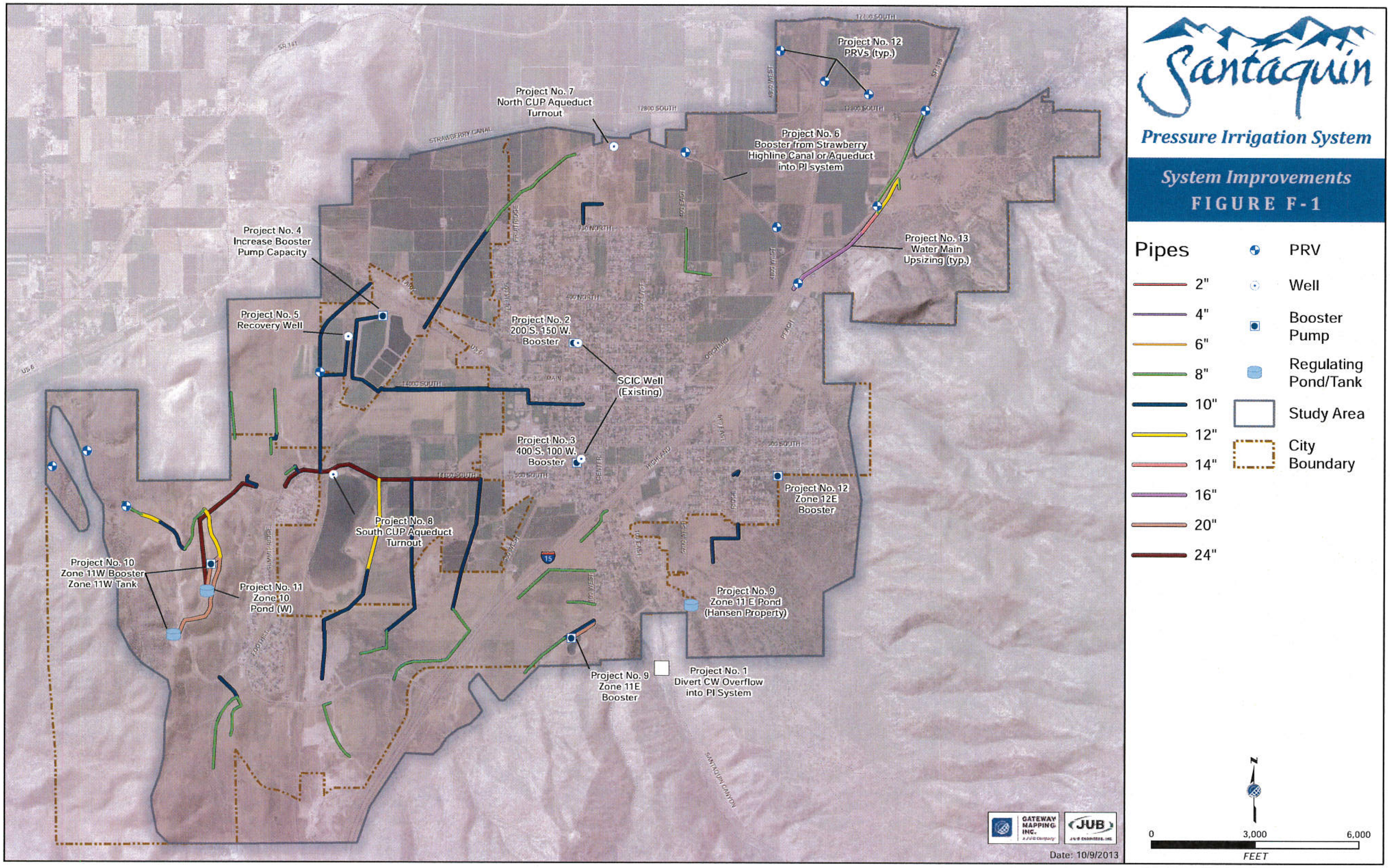
- PRV
- Well
- Pump
- Regulating Pond/Tanks
- Study Area
- City Boundary

Pipes
- 2"
- 4"
- 6"
- 8"
- 10"
- 12"
- 14"
- 16"
- 18"
- 20"
- 22"
- 24"

Note:
Minimum Pressure = 30 psi to meet LOS

0 3,000 6,000
FEET

APPENDIX F
SYSTEM PROJECT IMPROVEMENTS MAP


Santaquin
Pressure Irrigation System
System Improvements
FIGURE F-1
Pipes
2"
4"
6"
8"
10"
12"
14"
16"
20"
24"
PRV
Well
Booster Pump
Regulating Pond/Tank
Study Area
City Boundary
0
3,000
6,000
FEET
Project No. 12 PRVs (typ.)
Project No. 7 North CUP Aqueduct Turnout
Project No. 6 Booster from Strawberry Highline Canal or Aqueduct into PI system
Project No. 13 Water Main Upsizing (typ.)
Project No. 4 Increase Booster Pump Capacity
Project No. 5 Recovery Well
Project No. 2 200 S. 150 W. Booster
SCIC Well (Existing)
Project No. 3 400 S. 100 W. Booster
Project No. 12 Zone 12E Booster
Project No. 8 South CUP Aqueduct Turnout
Project No. 10 Zone 11W Booster Zone 11W Tank
Project No. 11 Zone 10 Pond (W)
Project No. 9 Zone 11 E Pond (Hansen Property)
Project No. 9 Zone 11E Booster
Project No. 1 Divert CW Overflow into PI System
GATEWAY MAPPING INC.
JUB
Date: 10/9/2013

APPENDIX G
OPINION OF CONCEPTUAL PROJECT COSTS

Table G-1. Pressure Irrigation Projects – Opinion of Conceptual Project Costs

Project Number	Project Name				
Source Projects					
1	**Overflow from culinary springs pipeline to PI system**				
	Item Description	Quantity	Unit	Unit Price	Amount
	Valve Vault	1	each	$25,000	$25,000
	Piping, Fittings, Valves, Meters, Etc.	1	each	$35,000	$35,000
	Telemetry/Control/Monitoring	1	each	$30,000	$30,000
	Other Fees: Engineering, Legal, Administrative, Finance 25%				$22,500
				Total	$112,500
2	**Booster pump station to draw from SCIC well at 200 N 150 W and piping to 100 W**				
	Item Description	Quantity	Unit	Unit Price	Amount
	Earthwork (Cut)	500	C.Y.	$10	$5,000
	Earthwork (Fill)	125	C.Y.	$10	$1,250
	Piping, Fittings, Valves, Meters, Etc.	1	each	$65,000	$65,000
	12 Inch Main Line	450	LF	$80	$36,000
	Booster Pumps	2	each	$45,000	$90,000
	Underground Vault	1	each	$46,000	$46,000
	Electrical	1	each	$110,000	$110,000
	Telemetry/Control/Monitoring	1	each	$35,000	$35,000
	Other Fees: Engineering, Legal, Administrative, Finance 25%				$97,063
				Total	$485,313
3	**Booster pump station to draw from SCIC well at 400 S 100 W**				
	Item Description	Quantity	Unit	Unit Price	Amount
	Earthwork (Cut)	500	C.Y.	$10	$5,000
	Earthwork (Fill)	125	C.Y.	$10	$1,250
	Piping, Fittings, Valves, Meters, Etc.	1	each	$65,000	$65,000
	12 Inch Main Line	150	LF	$80	$12,000
	Booster Pumps	2	each	$45,000	$90,000
	Underground Vault	1	each	$46,000	$46,000
	Electrical	1.00	each	$110,000	$110,000
	Telemetry/Control/Monitoring	1	each	$35,000	$35,000
	Other Fees: Engineering, Legal, Administrative, Finance 25%				$91,063
				Total	$455,313
4	**Increase booster station capacity at WRF Winter Storage Ponds**				
	Item Description	Quantity	Unit	Unit Price	Amount
	Piping, Fittings, Valves, Meters, Etc.	1	each	$25,000	$25,000
	Booster Pumps	2	each	$55,000	$110,000
	Electrical	1	each	$95,000	$95,000
	Telemetry/Control/Monitoring	1	each	$50,000	$50,000
	Other Fees: Engineering, Legal, Administrative, Finance 25%				$70,000
				Total	$350,000

Table G-1. Pressure Irrigation Projects – Opinion of Conceptual Project Costs (Continued)

Project Number	Project Name				
5	**Recovery Well at WRF Winter Storage Ponds and piping to system**				
	Item Description	Quantity	Unit	Unit Price	Amount
	Drill New Well	1	each	$450,000	$450,000
	Pump and Motor	1	each	$175,000	$175,000
	10 Inch Main Line	4500	LF	$65	$292,500
	Building	1	each	$125,000	$125,000
	Piping, Fittings, Valves, Meters, Etc.	1.00	each	$125,000	$125,000
	Electrical	1	each	$150,000	$150,000
	Telemetry/Control/Monitoring	1	each	$55,000	$55,000
	Land Acquisition	0.5	Acres	$30,000	$15,000
	Easement Acquisition	4.132231	Acres	$7,500	$30,992
	Other Fees: Engineering, Legal, Administrative, Finance 25%				$354,623
				Total	$1,773,115
6	**Booster pump station from Strawberry High Line Canal (or Aqueduct) and piping to system**				
	Item Description	Quantity	Unit	Unit Price	Amount
	Earthwork (Cut)	500	C.Y.	$10	$5,000
	Earthwork (Fill)	125	C.Y.	$12	$1,500
	Underground Vault	1	each	$100,000	$100,000
	Piping, Fittings, Valves, Meters, Etc.	1	each	$125,000	$125,000
	10 Inch Main Line	1000	LF	$65	$65,000
	Electrical	1	each	$75,000	$75,000
	Telemetry/Control/Monitoring	1	each	$40,000	$40,000
	Land Acquisition	0.1	Acres	$30,000	$3,000
	Easement Acquisition	0.9	Acres	$7,500	$6,887
	Other Fees: Engineering, Legal, Administrative, Finance 25%				$105,347
				Total	$526,734
7	**CUP Aqueduct turnout (to Zone 9N) and piping to system**				
	Item Description	Quantity	Unit	Unit Price	Amount
	Earthwork (Cut)	500	C.Y.	$10	$5,000
	Earthwork (Fill)	125	C.Y.	$12	$1,500
	Underground Vault	1	each	$100,000	$100,000
	Piping, Fittings, Valves, Meters, Etc.	1	each	$125,000	$125,000
	10 Inch Main Line	1000	LF	$65	$65,000
	Electrical	1	each	$75,000	$75,000
	Telemetry/Control/Monitoring	1	each	$40,000	$40,000
	Land Acquisition	0.1	Acres	$30,000	$3,000
	Easement Acquisition	0.92	Acres	$7,500	$6,887
	Other Fees: Engineering, Legal, Administrative, Finance 25%				$105,347
				Total	$526,734

Table G-1. Pressure Irrigation Projects – Opinion of Conceptual Project Costs (Continued)

Project Number	Project Name				
8	**CUP Aqueduct turnout (to Zone 10) and piping to system**				
	Item Description	Quantity	Unit	Unit Price	Amount
	Earthwork (Cut)	500	C.Y.	$10	$5,000
	Earthwork (Fill)	125	C.Y.	$12	$1,500
	Underground Vault	1	each	$100,000	$100,000
	Piping, Fittings, Valves, Meters, Etc.	1	each	$125,000	$125,000
	24 Inch Main Line	1000	LF	$199	$199,000
	Electrical	1	each	$75,000	$75,000
	Telemetry/Control/Monitoring	1	each	$40,000	$40,000
	Land Acquisition	0	Acres	$30,000	$3,000
	Easement Acquisition	1	Acres	$7,500	$6,887
	Other Fees: Engineering, Legal, Administrative, Finance 25%				$138,847
				Total	$694,234
Storage Projects					
9	**Zone 11E Pond (10 ac-ft) and booster station and associated piping**				
	Item Description	Quantity	Unit	Unit Price	Amount
	Earthwork (Cut)	8066.667	C.Y.	$10	$80,667
	Earthwork (Fill)	8,067	C.Y.	$10	$80,667
	Pond Liner (Clay)	4000	C.Y.	$30	$120,000
	Pond Structures	1	LS	$125,000	$125,000
	Piping, Fittings, Valves, Meters, Etc.	1	each	$75,000	$75,000
	Valve Vault	1	each	$40,000	$40,000
	24 Inch Main Line	1000	LF	$199	$199,000
	Booster Pumps	2	each	$45,000	$90,000
	Building	1	each	$100,000	$100,000
	Electrical	1	each	$150,000	$150,000
	Telemetry/Control/Monitoring	1	each	$65,000	$65,000
	Land Acquisition	4	Acres	$30,000	$105,000
	Easement Acquisition	0.92	Acres	$7,500	$6,887
	Other Fees: Engineering, Legal, Administrative, Finance 25%				$309,305
				Total	$1,546,525

Table G-1. Pressure Irrigation Projects – Opinion of Conceptual Project Costs (Continued)

Project Number	Project Name				
10	**Zone 11W Summit Ridge open top tank and booster station with transmission pipelines**				
	Item Description	Quantity	Unit	Unit Price	Amount
	Earthwork (Cut)	6235.007	C.Y.	$10	$62,350
	Earthwork (Fill)	3117.503	C.Y.	$10	$31,175
	1 Million Gallon Tank	1	each	$511,407	$511,407
	Piping, Fittings, Valves, Meters, Etc.	1	each	$65,000	$65,000
	Valve Vault	1	each	$40,000	$40,000
	24 Inch Main Line (From 500 S 600 W to Booster Sta)	10600	LF	$199	$2,109,400
	20 Inch Main Line (From Booster Station to Tank)	3400	LF	$164	$557,600
	24 Inch Main Line (From Tank to Distribution System)	3000	LF	$199	$597,000
	Building	1	each	$100,000	$100,000
	Electrical	1	each	$150,000	$150,000
	Telemetry/Control/Monitoring	1	each	$65,000	$65,000
	Land Acquisition	1	Acres	$30,000	$30,000
	Easement Acquisition	1.95	Acres	$7,500	$14,635
	Other Fees: Engineering, Legal, Administrative, Finance 25%				$1,083,392
				Total	$5,416,959
11	**Zone 10 Summit Ridge Pond (40 ac-ft) and transmission lines**				
	Item Description	Quantity	Unit	Unit Price	Amount
	Earthwork (Cut)	24200	C.Y.	$10	$242,000
	Earthwork (Fill)	24200	C.Y.	$10	$242,000
	Pond Liner (Clay)	8000	C.Y.	$30	$240,000
	Piping, Fittings, Valves, Meters, Etc.	1	each	$65,000	$65,000
	Valve Vault	1	each	$40,000	$40,000
	24 Inch Main Line	500	LF	$199	$99,500
	Electrical	1	each	$35,000	$35,000
	Telemetry/Control/Monitoring	1	each	$35,000	$35,000
	Land Acquisition	10	Acres	$30,000	$300,000
	Easement Acquisition	0.1	Acres	$7,500	$430
	Other Fees: Engineering, Legal, Administrative, Finance 25%				$324,733
				Total	$1,623,663

Table G-1. Pressure Irrigation Projects – Opinion of Conceptual Project Costs (Continued)

Project Number	Project Name				
	Transmission/Distribution Projects				
12	**Booster Pump Station from zone 11E to zone 12E (Variable Frequency Drive (VFD))**				
	Item Description	Quantity	Unit	Unit Price	Amount
	10 Inch Main Line	1000	LF	$65	$65,000
	Piping, Fittings, Valves, Meters, Etc.	1	each	$65,000	$65,000
	Booster Pumps	2	each	$55,000	$110,000
	Building	1	each	$100,000	$100,000
	Electrical	1	each	$125,000	$125,000
	Land Acquisition	0.5	Acres	$50,000	$25,000
	Telemetry/Control/Monitoring	1.00	each	$75,000	$75,000
	Other Fees: Engineering, Legal, Administrative, Finance 25%				$141,250
				Total	$706,250
13	**Various PRV Stations**				
	Item Description	Quantity	Unit	Unit Price	Amount
	PRV Valve	1	each	$25,000	$25,000
	Valve Vault	1.00	each	$15,000	$15,000
	Piping, Fittings, Valves, Meters, Etc.	1.00	each	$20,000	$20,000
	Other Fees: Engineering, Legal, Administrative, Finance 25%				$15,000
				Total (Each)	$75,000
				Total PRV Stations:	12
				Total for all PRV Stations:	$900,000
14	**Incremental Pipe Costs**				
	Item Description	Quantity	Unit	Unit Price	Amount
	Incremental Costs from 6" to 8" Pipe	29684.56	LF	$7	$207,792
	Incremental Costs from 6" to 10" Pipe	36892.42	LF	$18	$664,064
	Incremental Costs from 6" to 12" Pipe	9692.78	LF	$33	$319,862
	Incremental Costs from 6" to 14" Pipe	686.07	LF	$47	$32,245
	Incremental Costs from 6" to 16" Pipe	2505.24	LF	$68	$170,356
	Incremental Costs from 6" to 20" Pipe	1877.1	LF	$106	$198,973
	Incremental Costs from 6" to 24" Pipe	306.61	LF	$153	$46,911
	Other Fees: Engineering, Legal, Administrative, Finance 25%				
				Total	$1,640,203
				Total Estimated Project Costs:	**$16,757,541**
	Costs estimated in this spreadsheet come from the best information available from recent pipe, tank and well project costs from JUB data reviewed.				

Table G-2. Pressure Irrigation Unit Prices Used for Estimated Pipe Installation and Oversizing Reimbursement

Item	Unit	Unit Price
4" PVC secondary main	L.F.	$12.57
6" PVC secondary main	L.F.	$12.77
8" PVC secondary main	L.F.	$15.09
10" PVC secondary main	L.F.	$21.87
12" PVC secondary main	L.F.	$27.53
14" PVC secondary main	L.F.	$34.00
16" PVC secondary main	L.F.	$43.25
18" PVC secondary main	L.F.	$53.00
20" PVC secondary main	L.F.	$63.00
24" PVC secondary main	L.F.	$74.89
6" Gate valve	EA.	$1,000.00
8" Gate valve	EA.	$1,500.00
10" Gate valve	EA.	$2,500.00
12" Butterfly valve	EA.	$3,000.00
14" Butterfly valve	EA.	$4,000.00
16" Butterfly valve	EA.	$5,000.00
18" Butterfly valve	EA.	$6,500.00
20" Butterfly valve	EA.	$8,000.00
24" Butterfly valve	EA.	$12,000.00
6" Bend/Fitting	EA.	$400.00
8" Bend/Fitting	EA.	$500.00
10" Bend/Fitting	EA.	$650.00
12" Bend/Fitting	EA.	$800.00
14" Bend/Fitting	EA.	$1,000.00
16" Bend/Fitting	EA.	$1,200.00
18" Bend/Fitting	EA.	$1,600.00
20" Bend/Fitting	EA.	$2,000.00
24" Bend/Fitting	EA.	$2,500.00
6" Cross	EA.	$1,000.00
8" Cross	EA.	$1,200.00
10" Cross	EA.	$1,500.00
12" Cross	EA.	$1,800.00
14" Cross	EA.	$2,200.00
16" Cross	EA.	$2,700.00
18" Cross	EA.	$3,100.00
20" Cross	EA.	$3,500.00
24" Cross	EA.	$4,500.00
Secondary main bedding material	L.F.	$2.00
Secondary main backfill material	L.F.	$15.86

Table G-3. Sample of Detailed Pressure Irrigation Pipe Costs Used for Estimated Pipe Installation and Oversizing Reimbursement

Item	Unit	Quantity	Unit Price	Cost
12" PVC secondary main	L.F.	10,000	$27.53	$275,310
10" Gate valve	EA.	50	$2,500.00	$125,000
12" Butterfly valve	EA.	20	$3,000.00	$60,000
12" Bend/Fitting	EA.	60	$800.00	$48,000
12" Cross	EA.	25	$1,800.00	$45,000
Secondary main bedding material	L.F.	10,000	$2.00	$20,020
Secondary main backfill material	L.F.	10,000	$15.86	$158,640
Incidentals	%	30%	$219,590.95	$65,877
	SUBTOTAL (per 10,000 ft of length):			**$797,847**
	SUBTOTAL (per 100 ft of length):			**$8,000**
	SUBTOTAL (per ft of length, rounded):			**$80**

Table G-4. Pressure Irrigation Pipe Costs Used for Estimated Pipe Installation and Oversizing Reimbursement

Item	Unit	Unit Price
6-inch Main Line PI	L.F.	$47.00
8-inch Main Line PI	L.F.	$54.00
10-inch Main Line PI	L.F.	$65.00
12-inch Main Line PI	L.F.	$80.00
14-inch Main Line PI	L.F.	$94.00
16-inch Main Line PI	L.F.	$115.00
18-inch Main Line PI	L.F.	$138.00
20-inch Main Line PI	L.F.	$164.00
24-inch Main Line PI	L.F.	$199.00
Oversizing 6 to 8 inch Pipe PI	L.F.	$7.00
Oversizing 6 to 10 inch Pipe PI	L.F.	$18.00
Oversizing 6 to 12 inch Pipe PI	L.F.	$33.00
Oversizing 6 to 14 inch Pipe PI	L.F.	$47.00
Oversizing 6 to 16 inch Pipe PI	L.F.	$68.00
Oversizing 6 to 18 inch Pipe PI	L.F.	$91.00
Oversizing 6 to 20 inch Pipe PI	L.F.	$106.00
Oversizing 6 to 24 inch Pipe PI	L.F.	$153.00