CITY OF

SARATOGA SPRINGS

DRINKING WATER MASTER PLAN AND CAPITAL FACILITY PLAN

(HAL Project No.: 360.07.300)

July 2017

HANSEN ALLEN & LUCE inc
ENGINEERS

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GLOSSARY OF TECHNICAL TERMS

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

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

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

Demand: Required water flow rate or volume.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Water Conservation: Planned management of water to prevent waste.

ABBREVIATIONS AND UNITS

ac	acre [area]
ac-ft	acre-foot (1 ac-ft = 325,851 gal) [volume]
CIP	Capital Improvement Plan
CFP	Capital Facilities Plan
CUWCD	Central Utah Water Conservancy District
CWP	Central Water Project
DIP	Ductile Iron Pipe
DBP	disinfection byproduct
EPA	U.S. Environmental Protection Agency
EPANET	EPA hydraulic network modeling software
ERC	Equivalent Residential Connection
ft	foot [length]
ft/s	feet per second [velocity]
gal	gallon [volume]
gpd	gallons per day [flow rate]
gpm	gallons per minute [flow rate]
HAL	Hansen, Allen & Luce, Inc.
hp	horsepower [power]
hr	hour [time]
IFA	Impact Fee Analysis
IFC	International Fire Code
IFFP	Impact Fee Facilities Plan
in.	inch [length]
kgal	thousand gallons [volume]
kW	kilowatt [power]
kWh	kilowatt hour [energy]
MG	million gallons [volume]
MGD	million gallons per day [flow rate]
mg/L	milligram per liter [concentration]
µg/L	microgram per liter [concentration]
mi	mile [length]
psi	pounds per square inch [pressure]
s	second [time]
SCADA	Supervisory Control And Data Acquisition
THM	trihalomethane
UV	ultraviolet radiation (disinfection method)
wsfu	water supply fixture unit
yr	year[time]

CHAPTER 1 INTRODUCTION

PURPOSE AND SCOPE

The purpose of this master plan is to provide direction to the City of Saratoga Springs regarding decisions that will be made now and well into the future to provide an adequate drinking water system for its customers at the most reasonable cost. Recommendations are based on demand data, growth projections, standards of the Utah Division of Drinking Water (DDW), city zoning, known planned developments, and standard engineering practices.

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

The results of the study are limited by the accuracy of growth projections, data provided by the City, and other assumptions used in preparing the study. It is expected that the City will review and update this master plan every 5–10 years as new information about development, system performance, or water use becomes available. This master plan replaces the previous one completed by Gilson Engineering, Inc., in 2005.

BACKGROUND

Saratoga Springs is a relatively new community located in northern Utah County, Utah, with an area of 34.6 square miles (Saratoga Springs 2015c). In the decade from 2000–2010, Saratoga Springs was the fastest-growing city in Utah and among the fastest-growing in the country, surging from a population of 1,003 to 17,781 (U.S. Census Bureau 2012, 32). The City has grown rapidly in more recent years, with a current estimated population of 27,221 (GOMB 2017; Saratoga Springs 2014b). See Figure 1-1. At the end of 2016 the City provided water service to about 6,494 connections.

The City's existing drinking water system includes five wells, seven tanks, five pump stations, three pressure zones, and about 113 mi of pipe with diameters of 6 to 20 in. (Saratoga Springs 2015a). Future wholesale use of Central Water Project (CWP) is also planned. Existing and recommended future facilities are shown on the City's Drinking Water Master Plan Map (Appendix A). The City recognizes that its continued growth necessitates proactively planning additional drinking water facilities to maintain the current level of service for indoor water use.

The City also maintains a secondary water system for outdoor use. While drinking water is occasionally used to supply the secondary system under current conditions, both systems are being master planned to operate independently and to have adequate capacity for their own indoor or outdoor purposes. The secondary water system is addressed in a separate master plan.

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

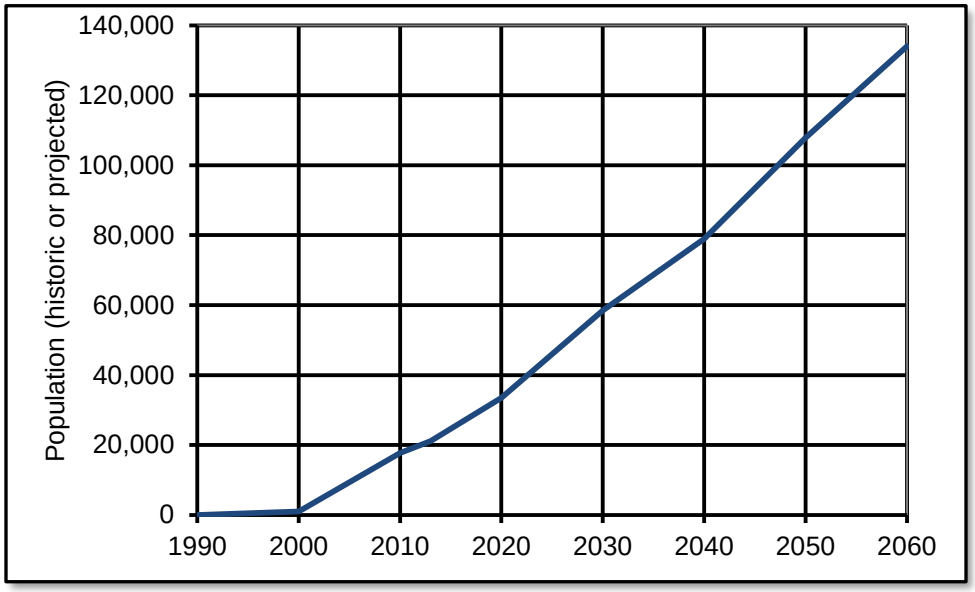

Figure 1-1: Saratoga Springs Historic and Projected Population
(U.S. Census Bureau 2012; GOMB 2017)

MASTER PLANNING METHODOLOGY

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

Identifying present and future water system needs is essential in the management and planning of a water system. For this study, existing water demands were calculated from SCADA data and billed water use. 2060 water demands were predicted using current DDW requirements, current zoning and densities provided by the City, and growth rates prepared by the City.

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

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

DESIGN AND PERFORMANCE CRITERIA

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

Table 1-1: System Design Criteria

	Criteria	Existing Requirements	Estimated Build-out Requirements
Equivalent Residential Connections	Based on data received from the City for the end of 2016	6,494	64,400
Source			
Peak Day Demand	Section R309-510-7/ IFFP	3,608 gpm	35,778 gpm
Average Yearly Demand	Section R309-510-7/ IFFP	2,922 ac-ft	28,980 ac-ft
Storage			
Equalization	Section R309-501-8/ IFFP	2.60 MG	25.75 MG
Emergency	City preference /IFFP	1.05 MG	3.15 MG
Fire Suppression	IFC/ Fire Marshall/IFFP	2.18 MG	5.62 MG
Total		5.83 MG	34.52 MG
Distribution			
Peak Instantaneous	1.5 X Peak Day Demand	5,412 gpm	53,667 gpm
Minimum Peak Day Fire Flow	IFC/ Fire Marshall/IFFP	1,500 gpm @ 20psi	1,500 gpm @ 20psi
Max. Operating Pressure	City Standards	100 psi	100 psi
Min. Pressure: Peak Day	Section R309-510-9/ IFFP	40 psi	40 psi
Peak Instantaneous	Section R309-510-9/ IFFP	30 psi	30 psi

CHAPTER 2 SYSTEM GROWTH

EXISTING CONNECTIONS

Drinking water demands are expressed in terms of equivalent residential connections (ERCs), which for planning purposes are the same as equivalent residential units (ERUs). The use of ERCs is a standard engineering practice to describe the entire system in a common unit of measurement. One ERC is equal to the average demand of an average residential connection. Non-residential demands are converted to ERCs for planning purposes. For example, a commercial building requiring six times as much water as a typical residential connection is assigned an ERC of 6. The entire water demand then can be described with a single ERC count.

HAL analyzed the City's water use data from December 2016 along with discussion with the City and determined that the existing system serves 6,494 ERCs. An extended-period hydraulic model was updated with current water use and pipe information to represent existing conditions. A breakdown of the existing ERCs by pressure zone is shown in Table 2-1.

Table 2-1
Existing ERCs

Zone	ERCs
1	2,162
2N	1,966
2S	2,054
3N	238
3S	74
Total	**6,494**

Raw data used calculating the ERCs are included in Appendix B along with water usage and connection data.

FUTURE CONNECTIONS

At maximum development based on current zoning and densities, also known as build-out, 64,400 ERCs are expected. This is an increase of 57,906 ERCs beyond the existing 6,494 ERCs. The estimate is based on current zoning and densities outlined in Section 19.04 of the City code and on plans for known future developments which HAL has acquired. Saratoga Springs is projected to reach build-out by about 2060. Although actual build-out conditions may be different if zoning and density change significantly, the basic full system layout plan developed by this study will help guide the construction of a responsible system. A breakdown of the build-out ERCs by pressure zone is shown in Table 2-2.

Table 2-2
Build-Out ERCs

Zone	ERCs
1	26,500
2	20,130
3	10,110
4	5,210
5	2,450
Total	**64,400**

The majority of the anticipated growth is associated with large undeveloped parcels that are zoned for high-density planned communities. See Appendix I. From expected locations and densities of new development, HAL prepared an extended-period hydraulic model and engineering calculations to analyze build-out conditions. Build-out demand projections are included in Appendix A.

GROWTH PROJECTIONS

The development of impact fees requires growth projections over the next ten years. In addition to impact fee projects this report will also highlight anticipated projects 10-20 years out in the "Capital Facilities Plan" section of this report. The growth projections for Saratoga Springs were made by evaluating the history of building permit issuance over the last decade as summarized in Table 2-3.

Table 2-3

Residential Building Permit History

Year	Annual Residential Permits	Annual Growth
2000	169	63.1%
2001	483	110.5%
2002	369	40.1%
2003	437	33.9%
2004	383	22.2%
2005	656	31.1%
2006	658	23.8%
2007	489	14.3%
2008	193	4.9%
2009	186	4.5%
2010	232	5.4%
2011	464	10.3%
2012	376	7.8%
2013	438	8.4%
2014	320	5.7%
2015	382	6.4%
2016	812	12.8%

Saratoga experienced rapid growth at the beginning of 2000 followed by a cooling period from 2007 to 2010 with growth rebounding rapidly in the last few years. The City has conservatively projected growth for the near future with stronger growth occurring in the next few years due to the projected development of the LDS Church property. 20 year growth projections for the City are summarized in Table 2-4.

Table 2-4

Growth Projections

Year	Total Projected ERCs	Total Projected wsfu	Annual Growth
2016	6,494	259,760	6.2%
2017	6,897	275,870	12.2%
2018	7,738	309,530	8.3%
2019	8,380	335,220	8.6%
2020	9,101	364,040	10.0%
2021	10,011	400,450	7.0%
2022	10,712	428,480	6.6%
2023	11,419	456,760	6.8%
2024	12,195	487,820	6.8%
2025	13,025	520,990	6.7%
2026	13,897	555,890	6.7%
2027	14,828	593,140	6.7%
2028	15,822	632,880	6.7%
2029	16,882	675,280	6.7%
2030	18,013	720,530	6.6%
2031	19,202	768,080	3.0%
2032	19,778	791,120	3.0%
2033	20,371	814,860	3.0%
2034	20,982	839,300	3.1%
2035	21,633	865,320	3.1%
2036	22,304	892,140	3.1%

CHAPTER 3 WATER SOURCES

Drinking water requirements in this study are based on equivalent residential connections (ERCs). HAL estimated existing and build-out ERCs from the City's current land use and zoning plan.

EXISTING WATER SOURCES

Five wells (Table 3-1 and Drinking Water Master Plan Map, Appendix A) currently supply the City's drinking water. The drinking water wells have a total production capacity of 5,870 gpm or 4,294 ac-ft per year (HAL 2014a). It is assumed that limited additional drinking water quality groundwater is available for future growth. Use of Central Water Project (CWP) water through Central Utah Water Conservancy District (CUWCD) with several wholesale connections is planned to supply the required drinking water source demand.

Table 3-1
Existing Drinking Water Sources

Source	Zone	Peak Day Source Capacity (gpm)	Peak Day Source Capacity (MGD)	Annual Source Capacity[1] (ac-ft)
Well No. 1	1	1,000	1.4	732
Well No. 2	1	1,020	1.5	746
Well No. 3	1	1,750	2.5	1,280
Well No. 4	1	1,000	1.4	732
Well No. 6	1	1,100	1.6	804
Total		**5,870**	**8.4**	**4,294**

1. Annual well capacity assumes about half of the year-round flow at the given flow rate which matches the current drinking water right diversion capacity. Actual volume may be limited by demand or hydrologic constraints.

A summary of the water rights that are owned by Saratoga Springs is included in Appendix C. Existing water right capacity is 4,686 acre feet. It is not anticipated that the City will acquire a significant volume of additional groundwater rights nor is it assumed that a significant volume of additional drinking water quality groundwater is available. It is anticipated that much of the additional source capacity will come from CUWCD.

PUMP STATIONS

Pump stations allow the City to supply water to zones that do not have their own sources. The rated capacity of a pump station is the total flow of the pump station with the largest pump out of service. Saratoga Springs has five pump stations whose service zones, pumps and rated capacity are summarized in Table 3-2.

Table 3-2
Saratoga Springs Pump Stations

Name	From Zone	To Zone	Pumps	Rated Capacity
PS 1 (Grandview)	1	2S	2 x 2,500 gpm	2,500 gpm
PS 2 (Harvest Hills)	1	2N	2 x 1,000 gpm	1,000 gpm
Crossroads Blvd	1	2N	3 x 1,000 gpm	2,000 gpm
Harvest Hills Zone 3	2N	3N	2 x 500 gpm	500 gpm
Fox Hollow	2S	3S	2 x 4,350 gpm	4,350 gpm

EXISTING WATER SOURCE REQUIREMENTS

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

Existing Peak Day Demand

Peak day demand is the water demand on the day of the year with the highest water use. It is used to determine required source capacity under existing and future conditions. Since the secondary system provides water for outdoor use, only indoor demand is allocated to the drinking water system.

Indoor peak day demand may be calculated by either applying the DDW standard of 800 gpd/ERC or computing the demand from actual water use data (Subsection R309-510-7(2)). The level of service selected in the 2017 IFFP is 400 gpd/ERC plus 400 gpd/ERC of redundancy for wells and pump stations which matches the DDW standard. The City currently serves 6,494 ERCs. If calculated by the DDW standard, the peak day drinking water demand is 3,608 gpm (5.2 MGD). As derived from the 2016 water use data, the peak day drinking water demand is 228 gpd/ERC, or 1,028 gpm (1.5 MGD). This study is based on the level of service and DDW standard. Table 3-3 summarizes these data.

Table 3-3
Existing Peak Day Demand

Method	Connections (ERCs)	Peak Day Demand (gpd/ERC)	Peak Day Demand (gpm)
DDW standard/ Level of service with redundancy	6,494	800	3,608
Actual demand		228	1,028

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

Table 3-4
Existing Source Requirements

Zone	ERCs	Pump In (gpm)	Pump Out (gpm)	Demand (gpm)	Total (gpm)	Existing Supply (gpm)
1	2,162	0	2,406	1,201	3,607	5,870[S]
2N	1,966	1,224	132	1,093	1,225	3,000[P]
2S	2,054	1,182	41	1,141	1,182	2,500[P]
3N	238	132	0	132	132	500[P]
3S	74	41	0	41	41	4,350[P]
Total	**6,494**	**2,579**	**2,579**	**3,608**	**N/A**	**N/A**

S= Source Water
P= Pump Station Capacity

Existing Average Yearly Demand

Average yearly demand is the volume of water used during an entire year, and is used to ensure the sources can supply enough volume to meet demand under existing and future conditions. Since the secondary system provides water for outdoor use, only indoor demand is allocated to the drinking water system.

As with peak day demand, average yearly demand may be calculated by either applying the DDW standard of 0.45 ac-ft/ERC (146,000 gal/yr/ERC) or computing the demand from actual water use data (Subsection R309-510-7(2)). The level of service selected in the 2017 IFFP is the same as the DDW standard. If calculated by the DDW standard, Saratoga Springs' average yearly drinking water demand is 2,922 ac-ft. As derived from Saratoga Springs' 2016 water use data, the average yearly drinking water demand is 0.26 ac-ft/ERC, or 1,688 ac-ft. This study uses the DDW standard. Table 3-5 summarizes these data.

Table 3-5
Existing Average Yearly Demand

Method	Connections (ERCs)	Average Yearly Demand (ac-ft/ERC)	Average Yearly Demand (ac-ft)
DDW standard/ Level of service	6,494	0.45	2,922
Actual demand		0.26	1,688

FUTURE WATER SOURCES

Table 3-6 summarizes the City's future planned drinking water sources, which include all existing wells and a future wholesale supply of 10,000 ac-ft/yr. The City has contracted with CUWCD to purchase water beginning July 1st, 2017 at 50 ac-ft. The contracted volume increases by 50 ac-ft July 1st of 2018 and then by 380 ac-ft in volume every July after that until the year 2044 when the City will purchase a total of 10,000 ac-ft per year. According to the level of service selected in the 2017 IFFP, redundancy is assumed within CUWCD system.

Table 3-6
Future Planned Drinking Water Sources

Source	Peak Day Source Capacity (gpm)	Peak Day Source Capacity (MGD)	Annual Capacity[1] (ac-ft)
Well No. 1	1,000	1.4	732
Well No. 2	1,020	1.5	746
Well No. 3	1,750	2.5	1,280
Well No. 4	1,000	1.4	732
Well No. 6	1,100	1.6	804
CUWCD[2]	12,400	8.9	10,000
Total	**18,270**	**17.4**	**14,294**

1. In the absence of other data, annual well capacity assumes half of the year-round flow at the given flow rate. Actual volume may be limited by water rights or hydrologic constraints.
2. City has contracted with CUWCD to purchase water beginning July 1st, 2017 at 50 ac-ft increasing in volume every July until the year 2044 when the City will purchase 10,000 ac-ft per year. Flow rates assume constant delivery over entire year including redundancy.

FUTURE WATER SOURCE REQUIREMENTS

As with existing water source requirements, future water source requirements were evaluated on two criteria (Section R309-510-7). First, sufficient water source capacity is needed to meet peak day flow. Second, the water sources must also be capable of supplying the average yearly demand.

Future Peak Day Demand

Following the methodology described for existing conditions and estimating 64,400 ERCs at build-out, the peak day source requirement per DDW standards is projected to be 35,778 gpm (51.5 MGD). Assuming that future water use is similar to that observed 2016, the peak day demand is projected to be 10,197 gpm (14.7 MGD). This study uses the selected level of service from the 2017 IFFP. See Table 3-7.

Table 3-7
Future Peak Day Demand

Method	Connections (ERCs)	Peak Day Demand (gpd/ERC)	Peak Day Demand (gpm)
DDW standard/ Level of service plus redundancy	64,400	800	35,778
Actual demand		228	10,197

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

Table 3-8
Build-Out Source Requirements

Zone	ERCs	Pump In (gpm)	Pump Out (gpm)	Demand (gpm)	Total (gpm)	Existing Supply[1] (gpm)
1	26,500	0	21,056	14,722	35,778	18,270[S]
2	20,130	21,056	9,591	11,183	20,774	5,500[B]
3N	4,250	3,422	1,061	2,361	3,422	500[B]
3S	5,860	6,169	3,194	3,256	6,169	4,350[B]
4N	1,910	1,061	0	1,061	1,061	0
4S	3,300	3,194	1,361	1,834	3,194	0
5S	2,450	1,361	0	1,361	1,361	0
Total	**64,400**	**36,263**	**36,263**	**35,778**	**N/A**	**N/A**

1. Supply includes existing sources, planned CUWCD wholesale connection, and pump station capacity for pressure zones above Zone 1.

S = Source Water
B = Booster Station Capacity

Overall, under build-out conditions there is a projected source capacity deficit of 17,508 gpm based on the capacity of the existing sources and the planned capacity of the CUWCD wholesale connection. It is assumed that the future required source capacity will be in Zone 1. Pump station capacity will be required to deliver source to each upper pressure zone.

Future Average Yearly Demand

Following the methodology described for existing conditions and estimating 64,400 ERCs at build-out, the average yearly source requirement per DDW standards is projected to be 28,980 ac-ft. Assuming that future water use is similar to that observed in 2014, the average yearly demand is projected to be 16,744 ac-ft. This study uses the DDW standard. See Table 3-9.

Table 3-9
Future Average Yearly Demand

Method	Connections (ERCs)	Average Yearly Demand (ac-ft/ERC)	Average Yearly Demand (ac-ft)
DDW standard/ Level of service	64,400	0.45	28,980
Actual demand		0.26	16,744

WATER SOURCE RECOMMENDATIONS

Tables 3-10 and 3-11 compare demands and sources.

Table 3-10
Existing Drinking Water Demand and Source Capacity

Parameter	Peak Day (gpm)	Average Yearly (ac-ft)
Demand	3,608	2,922
Capacity	5,870	4,294
Surplus (+) or Deficit (−)	+2,262	+1,372

Existing drinking water sources are adequate. No immediate drinking water source projects are needed.

Table 3-11
Future Drinking Water Demand and Source Capacity

Parameter	Peak Day (gpm)	Average Yearly (ac-ft)
Demand	35,778	28,980
Capacity	18,270	14,294
Surplus (+) or Deficit (−)	−17,508	−14,686

Planned drinking water sources are inadequate for build-out conditions. It is recommended that the City maintain its current wells and current contract with CUWCD. Additional sources totaling 17,508 gpm and 14,686 ac-ft are recommended. In addition to the additional sources the City will also need additional pumping capacity in order to supply water to the upper pressure zones. Potential locations of future pump stations are shown on the Drinking Water Master Plan Map (Appendix A).

CHAPTER 4 WATER STORAGE

EXISTING WATER STORAGE

The City's existing drinking water system includes seven storage facilities (Table 4-3) with a total capacity of 12.95 MG in Zones 1, 2, and 3 (HAL 2014a, 2-6). The facilities are underground reinforced concrete tanks. Their locations are shown in on the City's Drinking Water Master Plan Map in Appendix A. Each active pressure zone has at least one tank to provide storage. All tanks were constructed in the last 15 years and are in good condition. No storage facilities exist in Zones 4 or 5. Table 4-1 presents a listing of the names and select attributes of the Saratoga Springs water storage tanks.

Table 4-1
Existing Storage Tanks

Name	Type	Diameter (ft)	Volume (MG)	Outlet Level	Emergency Storage Level	Fire Suppression Level	Overflow/ Equalization Level
Tank 1	Concrete	99	0.75	4750.4 (0 feet)	4753.0 (2.6 feet)	4757.2 (6.8 feet)	4763.4 (20.0 feet)
Tank 2	Concrete	82	1.0	4892.0 (0 feet)	4895.8 (3.8 feet)	4900.9 (8.9 feet)	4919.5 (27.5 feet)
Tank 3	Concrete	154	2.0	4905.0 (0 feet)	4906.1 (1.1 feet)	4908.2 (3.2 feet)	4921.0 (16.0 feet)
Tank 4	Concrete	120	1.2	5066.7 (0 feet)	5068.5 (1.8 feet)	5074.1 (7.4 feet)	5082.5 (15.8 feet)
Tank 5	Concrete	152	3.0	4740.4 (0 feet)	4741.5 (1.1 feet)	4745.0 (4.6 feet)	4763.4 (23.0 feet)
Tank 6	Concrete	152	3.0	4898.0 (0 feet)	4899.1 (1.1 feet)	4902.8 (4.8 feet)	4919.5 (21.5 feet)
Tank 7	Concrete	124	2.0	5060.2 (0 feet)	5061.9 (1.7 feet)	5067.2 (7.0 feet)	5082.0 (21.8 feet)

EXISTING WATER STORAGE REQUIREMENTS

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

Equalization Storage

DDW requires 400 gpd/ERC of equalization storage for indoor use (Subsection R309-510-8(2)). With 6,494 ERCs under existing conditions, Saratoga Springs needs 2.60 MG of equalization storage in its drinking water system. Table 4-2 lists the equalization storage requirement by pressure zone.

Table 4-2
Existing Drinking Water Storage Requirements

Zone	ERCs	Equalization (MG)	Fire Suppression (MG)	Emergency (MG)	Total Required Storage (MG)	Existing Storage (MG)
1	2,162	0.86	0.72	0.30	1.89	3.75
2N	1,966	0.79	0.30	0.15	1.24	2.00
2S	2,054	0.82	0.68	0.30	1.80	4.00
3N	238	0.10	0.24	0.15	0.49	1.20
3S	74	0.03	0.24	0.15	0.42	2.00
Total	**6,494**	**2.60**	**2.18**	**1.05**	**5.84**	**12.95**

Fire Suppression Storage

Fire suppression storage is required for water systems that provide water for firefighting (Subsection R309-510-8(3)). The local fire authority determines the need for fire suppression storage. Saratoga Springs' Fire Chief provided fire flow requirements for each zone according to the International Fire Code (IFC), building size, flow rates, and fire duration. Jess Campbell is the Saratoga Springs Fire Chief and the contact information for the Saratoga Springs Fire department is as follows:

Phone: 801-766-6505

Address: 995 West 1200 North
Saratoga Springs, UT 84045

Storage was allocated to each tank according to simulations of fire flow during peak day conditions, considering that fire flow may be supplied by storage in higher zones (HAL 2014a, 2-6). Fire suppression storage was determined with the following assumptions:

- Tank 1—The recommended fire flow for Zone 1 is 4,000 gpm for 4 hr, or 0.96 MG. Tank 1 supplies about 1,000 gpm, or 0.24 MG. The remainder was assigned to Tanks 5 and 3.
- Tank 5—The recommended fire flow for Zone 1 is 4,000 gpm for 4 hr, or 0.96 MG. Tank 5 supplies about 2,000 gpm, or 0.48 MG. The remainder was assigned to Tanks 1 and 3.
- Tank 3—The recommended fire flow for Zone 2 North is 3,000 gpm for 3 hr, or 0.54 MG. Tank 3 supplies 0.30 MG. The remainder was assigned to Tank 4. Tank 3 may also supply fire flow to Zone 1.
- Tank 2—The recommended fire flow for Zone 2 South is 4,000 gpm for 4 hr, or 0.96 MG. Tank 2 supplies about 850 gpm, or 0.20 MG. The remainder was assigned to Tanks 6, 4, and 7.
- Tank 6—The recommended fire flow for Zone 2 South is 4,000 gpm for 4 hr, or 0.96 MG. Tank 6 supplies about 2,000 gpm, or 0.48 MG. The remainder was assigned to Tanks 2, 4, and 7.

- Tank 4—The recommended fire flow for Zone 3 North is 2,000 gpm for 2 hr, or 0.48 MG. Half of the requirement (1,000 gpm or 0.24 MG) was assigned to Tank 4. Tank 4 may also supply fire flow to Zone 2 North or Zone 2 South.
- Tank 7— The recommended fire flow for Zone 3 North is 2,000 gpm for 2 hr, or 0.48 MG. Half of the requirement (1,000 gpm or 0.24 MG) was assigned to Tank 7. Tank 7 may also supply fire flow to Zone 2 North.

Table 4-3 summarizes the fire suppression storage assumed in each storage facility.

Table 4-3
Existing Fire Suppression Storage by Tank

Tank	Zone	Fire Suppression Storage (MG)
1	1	0.24
5	1	0.48
3	2N	0.30
2	2S	0.20
6	2S	0.48
4	3N	0.24
7	3S	0.24
Total		**2.18**

Table 4-2 lists the fire suppression storage by pressure zone.

Emergency Storage

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

Under existing conditions, Saratoga Springs has planned for 0.15 MG of emergency storage in each of its seven tanks, for a total of 1.05 MG (HAL 2014a, 2-6).

Table 4-2 lists the emergency storage by pressure zone.

FUTURE WATER STORAGE REQUIREMENTS

Table 4-4 presents the future drinking water storage requirements by pressure zone. These are then discussed below. A total of 34.5 MG is needed at build-out.

Table 4-4
Future Drinking Water Storage Requirements

Zone	ERCs	Equalization (MG)	Fire Suppression (MG)	Emergency (MG)	Total Required Storage (MG)	Existing Storage (MG)	Storage Deficiency (MG)
1	26,500	10.60	1.24	0.45	11.77	3.75	7.87
2	20,130	8.05	1.50	0.90	9.93	6.00	3.18
3N	4,250	1.70	0.48	0.30	2.24	1.20	1.04
3S	5,860	2.34	0.72	0.45	3.03	2.00	0.73
4N	1,910	0.76	0.24	0.15	1.15	0	1.15
4S	3,300	1.32	0.72	0.45	2.01	0	1.71
5S	2,450	0.98	0.72	0.45	1.67	0	1.37
Total	**64,400**	**25.75**	**5.62**	**3.15**	**34.52**	**12.95**	**21.57**

Equalization Storage

Following the methodology described for existing conditions, and calculating 64,400 ERCs at build-out, the projected indoor equalization storage requirement per DDW standards is 25.75 MG.

Fire Suppression Storage

Firefighting capacity is assumed to remain similar to current conditions, with new capacity in future Zones 4 and 5.

Emergency Storage

It is recommended that the emergency storage for existing zones should be maintained at the existing level and 0.15 MG should be planned for each of the future zones.

WATER STORAGE RECOMMENDATIONS

The City will need about **34.5 MG** of drinking water storage at build-out, of which about 13 MG has already been constructed. An additional 21.5 MG is recommended for build-out. Potential locations for future drinking water storage tanks are shown on the Master Plan Map. The cost for adding new storage facilities varies based on the costs of land, labor, and construction materials. However, $1 per gallon of storage has been found to be a reasonable, conservative estimate. In addition, it is recommended that 20% of the estimated cost should be added for contingency and 15% for engineering. Therefore, the total cost that should be planned for providing adequate build-out storage is $29,119,500.

CHAPTER 5 WATER DISTRIBUTION

HYDRAULIC MODEL

Development

A computer model of the City's drinking water distribution system was developed to analyze the performance of the existing and future distribution system and to prepare solutions for existing facilities not meeting the distribution system requirements. The model was developed with the software EPANET 2.0, published by the U.S. Environmental Protection Agency (EPA 2014; Rossman 2000). EPANET simulates the hydraulic behavior of pipe networks. Sources, pipes, tanks, valves, controls, and other data used to develop the model were obtained from GIS data of the city's drinking water system and other updated information supplied by the City.

HAL developed models for two phases of drinking water system development. The first phase was a model representing the existing system (existing model). This model was used to calibrate the model and identify deficiencies in the existing system. Calibration was performed using fire hydrant tests and by comparing model results to the City's SCADA output. Calibration data is included in Appendix D.

The second phase was a model representing future conditions and the improvements necessary to accommodate growth (future model).

Model Components

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

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

Pipe Network

The pipe network layout originated from GIS data provided by the City (Saratoga Springs 2015a). HAL verified its accuracy by reviewing a model prepared for the previous master plan. Elevation information was obtained from the GIS data provided by the City. Within the Saratoga Springs distribution system, pipes with a diameter of 12 inches or larger are generally concrete-lined ductile iron. Smaller 8-inch and 10-inch pipes are generally PVC. Darcy-Weisbach roughness coefficients for pipes in this model ranged from 0.4 – 0.6 millifeet, which is typical for these pipe materials in EPANET (Rossman 2000, 31).

Water Demands

Water demands were allocated in the model based on billed usage and billing addresses. Demand was determined for each billing address, and the addresses were geocoded in order to link the demands to a physical location. The geocoded demands were then assigned to the closest model node. With the proper spatial distribution, demands were scaled to reach the peak day demand determined in Chapter 3. For the future model, future demands were estimated according to current zoning and densities. Future demands were assigned to new nodes representing the expected location of new development in each pressure zone.

The pattern of water demand over a 24 hr period is called the diurnal curve or daily demand curve. An indoor diurnal curve with a peak factor of 1.5 was selected for this study based on water demand patterns identified by the SCADA system and information developed by other water systems. The diurnal curve was input into the model to simulate changes in the water system throughout the day.

In summary, the spatial distribution of demands followed geocoded water use data; the flow and volume of demands followed DDW standards described in Chapter 3; and the temporal pattern of demand followed a diurnal curve developed from SCADA data.

Water Sources and Storage Tanks

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

ANALYSIS METHODOLOGY

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

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

EXISTING WATER DISTRIBUTION SYSTEM DEMANDS

Saratoga Springs' drinking water distribution system consists of all pipelines, valves, fittings, and other appurtenances used to convey water from sources and storage tanks to water users. The existing water system contains approximately 113 mi of pipe with diameters of 6 in. to 24 in. (Saratoga Springs 2015a). Figure 5-1 presents a summary of pipe length by diameter.

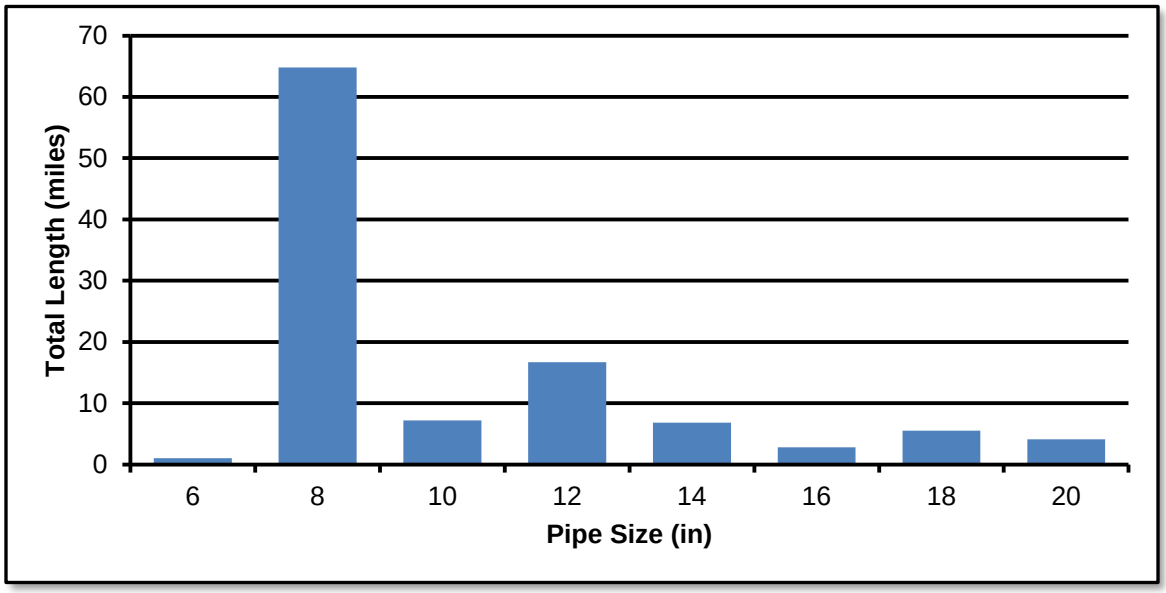

Figure 5-1: Summary of Pipe Length by Diameter

Three pressure zones comprise the existing system, where Zone 1 is the lowest in elevation and Zone 3 is the highest (Drinking Water Master Plan Map, Appendix A). Extended-period hydraulic models were developed for existing and future (build-out) conditions.

Existing Peak Day Conditions

A minimum pressure of 40 psi must be maintained during peak day demand (Subsection R309-105-9(2)). Future peak day demand is assumed to be 800 gpd/ERC for indoor use. For the purposes of this study, the requirement is assumed to include 400 gpd/ERC of demand and 400 gpd/ERC redundancy. With 6,494 ERCs projected, the system's future peak day demand is 3,608 gpm. Hydraulic modeling indicated that the existing system is able to provide this flow while meeting the pressure requirements outlined by R309-105-9.

Existing Peak Instantaneous Conditions

A minimum pressure of 30 psi must be maintained during peak instantaneous demand (Subsection R309-105-9(2)). Peak instantaneous demand was defined based on the diurnal curve for the indoor water demand of Saratoga Springs. The highest peaking factor present on the peak day diurnal curve was 1.5; therefore, the existing peak instantaneous demand was calculated as 3,608 x 1.5 = 5,412 gpm.

Existing Peak Day plus Fire Flow Conditions

A minimum pressure of 20 psi must be maintained while delivering fire flow to a particular location within the system and supplying the peak day demand to the entire system (Subsection R309-105-9(2)). For modeling analysis, a minimum fire flow of 1,500 gpm was selected for all fire hydrants in the system. Higher flows were modeled for select locations as directed by the Saratoga Springs Fire Chief.

Identifying every pipe which is not capable of supplying the required fire flow is beyond the scope of this study. The computer analysis should not replace physical fire flow tests at fire hydrants as the primary method of determining fire flow capacity.

FUTURE WATER DISTRIBUTION SYSTEM DEMANDS

Future Peak Day Conditions

A minimum pressure of 40 psi must be maintained at all connections during peak day demand (Subsection R309-105-9(2)). Future peak day demand is assumed to be 800 gpd/ERC for indoor use. For the purposes of this study, the requirement is assumed to include 400 gpd/ERC of demand and 400 gpd/ERC redundancy. With 64,400 ERCs projected, system's future peak day demand is estimated at 35,778 gpm. Hydraulic modeling indicated that the future system can meet this requirement with the future pipelines shown on the Master Plan Map.

Future Peak Instantaneous Conditions

Peak instantaneous demands were calculated in a similar manner to existing conditions. The peak day to peak instantaneous peaking factor was 1.5 and the total peak instantaneous demand was 53,667 gpm. Hydraulic modeling indicated that the future system can meet this requirement with the future pipelines shown on the Master Plan Map.

Future Peak Day plus Fire Flow Conditions

A minimum pressure of 20 psi must be maintained while delivering fire flow to a particular location within the system and supplying the peak day demand to the entire system (Subsection R309-105-9(2)). For modeling analysis, a fire flow of 1,500 gpm was selected for all fire hydrants in the system. Additional analyses were performed for larger buildings as required by the Fire Marshal. Hydraulic modeling indicated that the future system can meet the future fire flow requirements with the future pipelines shown on the Master Plan Map.

WATER DISTRIBUTION SYSTEM RECOMMENDATIONS

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

Recommendations for distribution improvement projects were based on the modeling, as outlined above, and guidance provided by Saratoga Springs personnel. There are a few recommendations that will move parts of one pressure zone to another. The first existing distribution system recommendation is to lower pressures by moving the area of Lake View Terrace Road below the canal alignment that is just west of the road from pressure Zone 2 to Zone 1. Current pressures can reach 160 psi. Minimum pressures after making the change would be 70 psi. There are two locations that are currently at the very top of Zone 2 that are recommended to be moved over to Zone 3 to provide increased pressure. These locations are shown in Figure 5-2.

The future distribution projects are associated with providing transmission capacity to and from future storage tanks and sources. It is expected that these projects may change somewhat as

compared to current projections depending on the availability of land and other considerations that may affect the final locations of the proposed storage tanks.

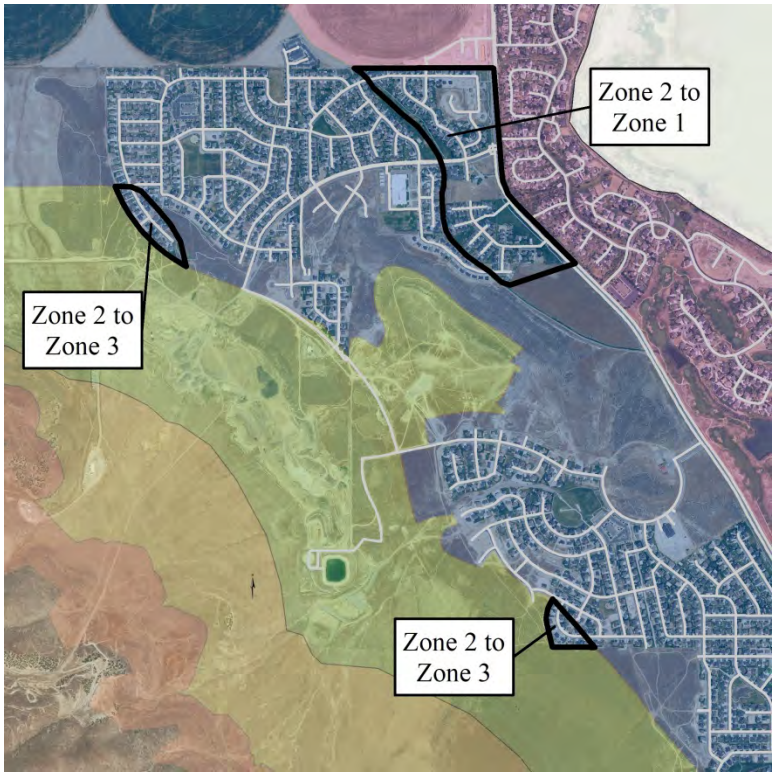

Figure 5-2: Location of Proposed Zone Changes

Future additional transmission pipelines are expected to be installed as the City expands. The locations and lengths of these transmission pipelines depend on the final location of future streets and configuration of developments. Specific pipelines smaller than 10 inches have not been located for this study. It is recommended that each development be reviewed to ensure adequate system capacity. It is also recommended that developments be checked for dead end pipelines of more than 600 feet to safeguard water quality and provide supply redundancy.

Anticipated future pipes larger than 10 inches have been located according to zone demand following proposed road alignments. Total cost for these future distribution system pipelines is estimated to cost about $20,000,000. The assumed locations of these pipelines are illustrated on the Drinking Water Master Plan Map in Appendix A.

CHAPTER 6 CAPITAL FACILITY PLAN

GENERAL

The purpose of this section is to identify the drinking water facilities that are required, for the 20-year planning period, to meet the demands placed on the system by future development. Proposed facility capacities were sized to adequately meet the 20-year growth projections and were compared to current master planned facilities. A detailed design analysis will need to be provided before construction of the facilities to ensure that the location and sizing is appropriate for the actual growth that has taken place since this capital facility plan (CFP) was developed. Specific projects with costs are presented at the end of this chapter.

METHODOLOGY

The future water demands were added incrementally by year to the facility analysis. At the year a facility reaches capacity, a solution was identified that will accommodate growth for the 20-year planning period. A hydraulic model was developed for the purpose of assessing the system operation and capacity with future demands added to the system. The model was used to identify problem areas in the system and to identify the most efficient way to make improvements to transmission pipelines, sources, pumps, and storage facilities.

Currently the Drinking Water System supplements the Secondary Water System as needed during peak demands in portions of the City. In several cases the future drinking water demands required the secondary water system demand be removed from a drinking water system facility triggering a project required for the secondary water system but not the drinking water system. For both the Drinking Water System CFP and the Secondary Water System CFP each system was analyzed with no sharing of capacity for future projections. It was assumed for all calculations that no Secondary Water System facilities are being supplemented by Drinking Water System capacity.

The future system was evaluated in the same manner as the existing system, by modeling (1) Peak Instantaneous Demands and (2) Peak Day Demands plus fire flow conditions.

FUTURE WATER SOURCE

The future system will continue to utilize groundwater sources for drinking water. The City has decided to acquire future drinking water through the Central Water Project (CWP) provided by Central Utah Water Conservancy District (CUWCD), the City should have sufficient drinking water source at their disposal for the Drinking Water System well into the future even if groundwater sources become limited.

Future growth projections indicate that the City will need to provide additional drinking water source. The CFP analysis utilized a source capacity level of service of 10 gpd/wsfu for indoor water use and 10 gpd/wsfu for redundancy. It was assumed that CUWCD will provide for mechanical redundancy in their own system at 10 gpd/wsfu.

The following are source projects selected to meet the source requirements for future growth:

- CWP North & Redwood Road Turnouts – Provide source to the entire City through the CWP project.
- CWP Pony Express Turnout – Provide source to the entire City through the CWP project.
- CWP 2300 West Turnout – Provide source to the entire City through the CWP project.

FUTURE WATER STORAGE

The proposed level of service requires that the water system have 10 gallons per wsfu for equalization storage along with appropriate fire suppression storage requirements. The future 20-year growth projection requires a number of tanks to supply storage to future pressure zones. It is anticipated that fire flow pressure reducing valves (PRVs) will be placed between zones to convey fire flows from upper zones to lower zones during fire events. The following tanks are anticipated to meet future demands:

- Zone 1 North Tank – Zone 1 North Tank with a capacity of 5,000,000 gallons.
- Zone 2 North Tank – Zone 2 North Tank (Church Property) with a capacity of 2,500,000 gallons.
- Zone 2 North Tank – Zone 2 North Tank (Mt. Saratoga) with a capacity of 2,000,000 gallons.
- Zone 3 North Tank – Zone 3 North Tank (Mt. Saratoga) with a capacity of 1,400,000 gallons.
- Zone 3 South Tank – Zone 3 South Tank with a capacity of 700,000 gallons.
- Zone 4 South Tank – Zone 4 South Tank with a capacity of 1,000,000 gallons.
- Zone 4 North Tank – Zone 4 North Tank with a capacity of 1,200,000 gallons.

FUTURE ZONE PUMPING

Future zone pumping requirements were evaluated to determine pump station needs to meet future peak day demands. All zones requiring pump stations were evaluated using the source capacity level of service of 10 gpd/wsfu for indoor water use and 10 gpd/wsfu for redundancy. The growth model required new pump stations to provide water to meet future demands. Zone pumping must provide source capacity to the pump station from the lower zone and provide the needed source to the zone above. The required pump stations to meet future demands are shown below:

- Zone 2 North Pump Station – Increase Pump Station capacity by 500 gpm (SR-73).

- Zone 2 North Pump Station – Pump Station at CUW Connection (2,250 gpm @ 150 HP).

- Zone 3 North Pump Station – Pump Station for Mt. Saratoga in Zone 3 (1,200 gpm @ 125 HP).

- Zone 3 South Pump Station – Pump Station for the new zone 3 south zone (250 gpm @ 25 HP).

- Zone 4 North Pump Station – Pump Station for the new zone 4 north zone (250 gpm @ 25 HP).

- Zone 4 South Pump Station – Pump Station for the new zone 4 south zone (250 gpm @ 25 HP).

FUTURE TRANSMISSION PIPING

Future transmission lines would need to be constructed to allow for future growth in the undeveloped areas of the City. The model was used to determine the most efficient way to keep waterline velocities and pressures within the criteria limits with added future demands. The majority of the waterline projects are required to connect sources to storage tanks and to the existing and future areas of the system. These transmission lines are described below:

- Zone 3 North Transmission Line – 12-inch and 16-inch lines interconnecting the proposed tank and pump station to the existing water lines.

- Zone 2 North Transmission Line – 16-inch transmission from CUW Connection to North Zone 2.

- Zone 2 Transmission Line – 20-inch transmission to North Zone 2 Tank (Church Property).

- Zone 1 Transmission Lines – 24-inch, 20-inch, and 16-inch transmission lines from CUWCD connection to proposed tank and to existing water lines.

- Zone 4 South Transmission Line – 16-inch line interconnecting the proposed tank and pump station to the existing water lines.

- Zone 3 South Transmission Line – 16-inch line connecting the proposed pump station to the existing zone water lines.

- Zone 4 North Transmission Line – 12-inch line interconnecting the proposed tank and pump station to the existing water lines.

FUTURE WATER RIGHTS

It is not anticipated that the City will acquire more water rights specifically for its drinking water system due the general lack of available groundwater rights in the area. Those coming into the system will need to bring their own water rights, purchase from a developer who has water right credits, or purchase water rights from CUWCD.

The existing demand at the proposed level of service of 10 gpd per wsfu is 2,922 acre-feet, while the existing supply is 4,758 acre-feet (see Table 3-10). The excess capacity of 1,836 acre-feet (owned by developers as credit), together with additional water contracted through CUWCD, is sufficient to cover the additional demands imposed by growth over the next ten years. For development beyond ten years it is anticipated that the majority of water rights will come from CUWCD.

MASTER PLANNING

Throughout the master planning process, the three main components of the City's water system (source, storage, and distribution) were analyzed to determine the system's ability to meet existing demands and also the anticipated future demands. This section of the report will specifically detail development over the next 20 years. Each of the system deficiencies identified in the master planning process and described previously in this report were presented in an alternatives workshop with City staff. Possible solutions were discussed for each of the identified system deficiencies as well as possible solutions for maintenance and other system needs not identified in the system analysis. After the workshop, HAL studied the feasibility of the solution alternatives and developed conceptual costs.

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

PRECISION OF COST ESTIMATES

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

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

For example, at the master planning level (or conceptual or feasibility design level), if a project is estimated to cost $1,000,000, then the precision or reliability of the cost estimate would typically be expected to range between approximately $500,000 and $1,500,000. While this may seem very imprecise, the purpose of master planning is to develop general sizing, location, cost, and scheduling information on a number of individual projects that may be designed and constructed over a period of many years. Master planning also typically includes the selection

of common design criteria to help ensure uniformity and compatibility among future individual projects. Details such as the exact capacity of individual projects, the level of redundancy, the location of facilities, the alignment and depth of pipelines, the extent of utility conflicts, the cost of land and easements, the construction methodology, the types of equipment and material to be used, the time of construction, interest and inflation rates, permitting requirements, etc., are typically developed during the more detailed levels of design.

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

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

SYSTEM IMPROVEMENT PROJECTS

As discussed in previous chapters, source, storage and distribution system capacity expansion will be needed to meet the demands of future growth. The City's Drinking Water Master Plan Map (Appendix A) includes recommended projects over the period from existing conditions through 20 years into the future. Cost estimates have been prepared for the recommended projects and are included in Appendix F.

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

1. "Means Heavy Construction Cost Data, 2017"
2. Price quotes from equipment suppliers
3. Recent construction bids for similar work

All costs are presented in 2017 dollars. Recent price and economic trends indicate that future costs are difficult to predict with certainty. Engineering cost estimates provided in this study should be regarded as conceptual level for use as a planning guide. Only during final design can a definitive and more accurate estimate be provided for each project. The recommended projects that are expected to be needed through 2036 are presented in Table 6-1. For a breakdown of cost estimates provided in Table 6-1, refer to Appendix F.

TABLE 6-1
RECOMMENDED 20 YEAR PROJECTS

TYPE & PHASING YEAR	MAP ID	RECOMMENDED PROJECT	COST
Source and Storage – Growth Project **0-10 Years**	1	A 1.4 MG tank will be constructed in Zone 3 North. A pump station will be installed to serve Zone 3 North. The pump station will provide 1,200 gpm and require 125 HP. Install 5,600 feet of 12-inch transmission and Install 1,700 feet of 16-inch transmission line to connect it to Zone 3 North Storage (Project 1)	$3,663,000
Storage – Growth Project **0-10 Years**	2	A 2.0 MG tank will be constructed in Zone 2 North. Install 1,500 feet of 16-inch transmission line to connect to existing system.	$2,945,000
Source – Growth Project **0-10 Years**	3	A CUWCD connection at Pony Express and a Zone 2 pump station with 3,400 feet of 16 inch pipe.	$1,205,000
Source – Growth Project **0-10 Years**	4	A CUWCD connection at 2300 West and 2,000 feet of 16 inch pipe.	$346,000
Source and Storage – Growth Project **2027**	5	A 2.5 MG tank will be constructed to serve the central area of Zone 2. 15,200 feet of 20-inch DIP and 3,400 feet of 16-inch DIP will be installed to provide transmission to the zone.	$6,158,000
Source and Storage – Growth Project **2028**	6	A 1.2 MG tank will be constructed to provide storage for Zone 4N (The Springs). A 250 gpm pump station will be installed to provide water to the zone. 13,000 feet of 12-inch pipe will be installed to connect the pump station to Zone 3 and the tank. A PRV will be installed in anticipation of connecting to the existing Zone 3N further north.	$3,832,000
Storage – Growth Project **2028**	7	A 1 MG tank will be constructed in the Fox Hollow area of Zone 4 South. A 250 gpm pump station and 1,400 feet of 16-in pipe will be constructed to serve Zone 4 South.	$2,088,000
Source and Storage – Growth Project **2028**	8	A 5 MG tank will be constructed in Zone 1 North. Transmission lines will be installed through to connect the tank to Redwood Road. This will require 5,300 feet of 24-inch pipe, 4,100 feet of 20-inch pipe, and 5,900 feet of 16-inch pipe. A connection to the Central Utah Water Conservancy District line will be made at Redwood Road near the Pony Express Parkway.	$9,306,000
Storage – Growth Project **2029**	9	A 0.7 MG tank will be constructed in Zone 3 South, in Israel Canyon. A pump station will be installed to provide water to the tank. 1,700 feet of 16-inch pipe will be installed to connect the pump to the tank.	$1,717,000
Water Rights – Growth Project **2036**	-	Existing excess capacity, as well as the water acquired through the CUWCD contract, will be sufficient to meet the demands of the system through 2036.	-
TOTAL			$31,260,000

1. The Map ID corresponds to the project number on the Capital Facility Plan Improvements map. Refer to Appendix G.

The water rights associated with the CUWCD connections will not owned by the City and will therefore not be an expense that will be included in the capital facilities plan. They are presented in Table 6-1 as an indication that the City will be maintaining the designated level of service.

SUMMARY OF COSTS

Table 6-2 is a summary of project costs through 2060. A total of $55,964,780 is attributed to project cost for this time period. This cost represents a best estimate for total cost to the City to maintain the desired level of service while accommodating future growth through build-out conditions. This table does not include any financing costs associated with funding options.

Table 6-2
Summary of Costs

Project Type	Cost
Source	$7,835,280
Storage	$29,119,500
Distribution	$19,010,000
Total	$55,964,780

The total cost for additional source needed for future growth, through build-out, is estimated to be $7,835,280. $3,365,280 of the total source cost comes from the projects in Table 6-1. The remaining $4,470,000 is an estimate of the six pump stations (and the land required) shown in the Drinking Master Plan Map in Appendix A that are not included in the 20 year projects (Table 6-1). The total cost for additional storage needed for future growth, through build-out, is estimated to be $29,119,500 (pg. 4-4). The total cost for additional distribution piping represented in the Drinking Master Plan Map (Appendix A) over the same period is estimated to be $19,010,000 (Appendix F).

FUNDING OPTIONS

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

General Obligation Bonds

This form of debt enables the City to issue general obligation bonds for capital improvements and replacement. General Obligation (G.O.) bonds would be used for items not typically financed through the Water Revenue Bonds (for example, the purchase of water source to ensure a sufficient water supply for the City in the future). G.O. bonds are debt instruments backed by the full faith and credit of the City which would be secured by an unconditional pledge of the City to levy assessments, charges, or ad valorem taxes necessary to retire the bonds. G.O. bonds are the lowest-cost form of debt financing available to local governments and can

be combined with other revenue sources such as specific fees, or special assessment charges to form a dual security through the City's revenue-generating authority. These bonds are supported by the City as a whole, so the amount of debt issued for the water system is limited to a fixed percentage of the real market value for taxable property within the City.

Revenue Bonds

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

State or Federal Grants and Loans

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

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

Impact Fees

The Utah Impact Fees Act, codified in Title 11, Chapter 36a, of the Utah Code, authorizes municipalities to collect impact fees to fund public facilities. An impact fee is "a payment of money imposed upon new development activity . . . to mitigate the impact of the new development on public infrastructure" (Subsection 11-36a-102(8)). Impact fees enable local governments to finance infrastructure improvements without burdening existing development with costs that are exclusively attributable to growth.

Impact fees can be applied to water-related facilities under the Utah Impact Fees Act. The Act is designed to provide a logical and clear framework for establishing new development assessments. It is also designed to establish the basis for the fee calculation which the City must follow in order to comply with the statute. The fundamental objective for the fee structure is the imposition on new development of only those costs associated with providing or expanding

water infrastructure to meet the capacity needs created by that specific new development. Impact fees cannot be applied retroactively.

In April 2014 Saratoga Springs completed an Impact Fee Facilities Plan and Impact Fee Analysis for its drinking water system (HAL 2014a).

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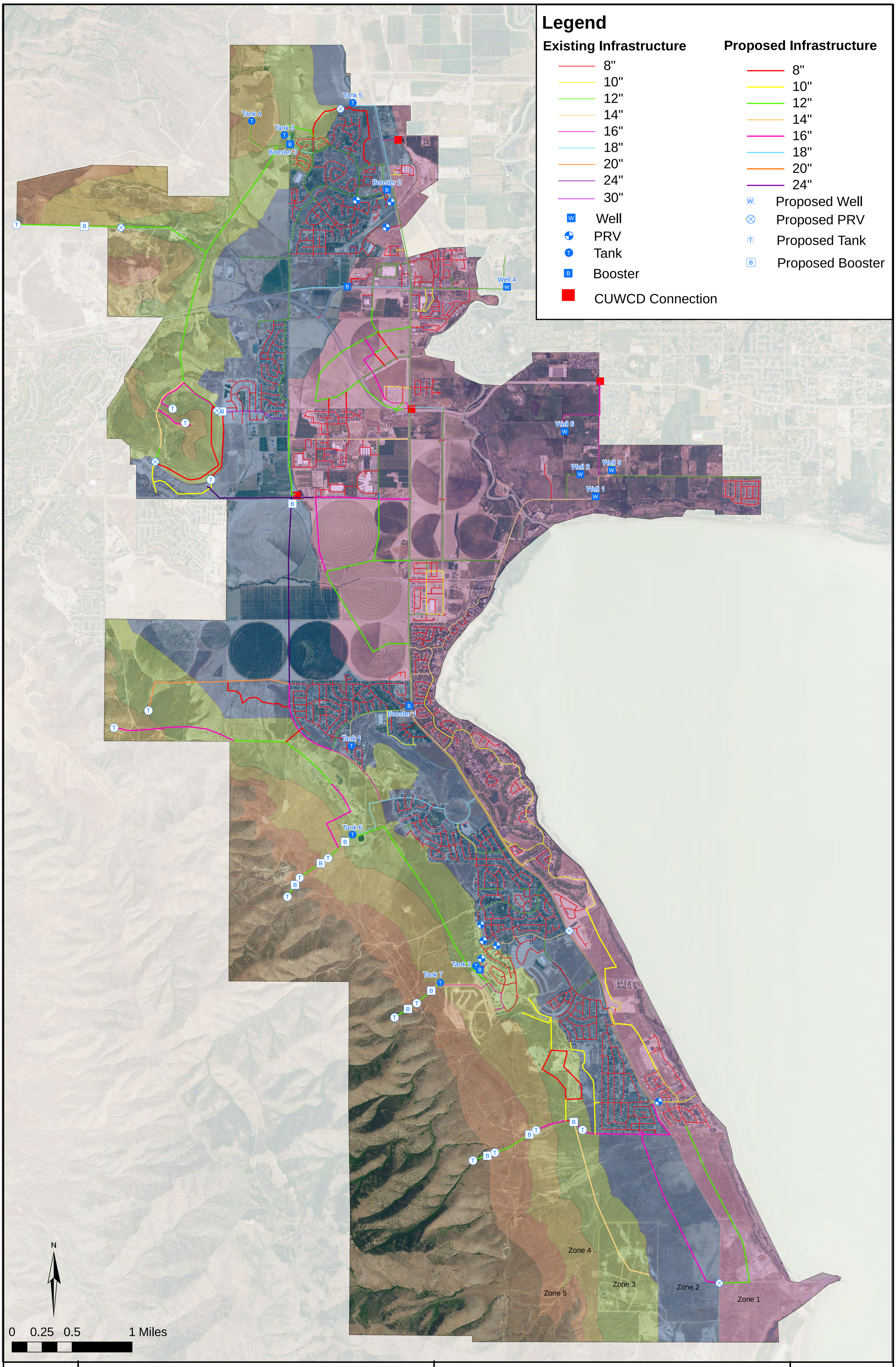
APPENDIX A

Drinking Water Master Plan Map



Date: 7/3/2017
Document Path: H:\Projects\360 - Saratoga Springs City\07.300 Drinking Water Plans Update\GIS\Working\SS_WorkingMap_MasterPlan.mxd

HANSEN ALLEN & LUCE inc ENGINEERS

SARATOGA SPRINGS

FUTURE DRINKING WATER SYSTEM

APPENDIX A

APPENDIX B

Water System Data and Calculations

Saratoga Springs
2017 Water System Master Plans
Build-Out Projections
7/5/2017 KMS

ZONE 1	Drinking Water				Secondary Water			
	Service (ERC)	Peak Day Source (gpd)	Avg. Yearly Source (ac-ft)	Storage (MG)	Service (irr-ac)	Peak Day Source (gpm)	Avg. Yearly Source (ac-ft)	Storage (ac-ft)
Unit Req.	N/A	800	0.45	0.0004	N/A	7.5	3.13	0.028
North Demand	23,750	19,000,000	10,688	9.5	2,385	17,888	7,465	67.5
South Demand	2,750	2,200,000	1,238	1.1	549	4,118	1,718	15.5
Total Demand	26,500	21,200,000	11,925	10.6	2,934	22,005	9,183	83.0
North Capacity		17,380,800	14,734	3.0		5,000	2,033	0.0
South Capacity				0.8		1,100	447	2.1
Total Capacity		17,380,800	14,734	3.8		6,100	2,480	2.1
Needed Capacity		21,200,000	11,925	9.9		20,905	8,736	80.9

ZONE 2	Drinking Water				Secondary Water			
	Service (ERC)	Peak Day Source (gpd)	Avg. Yearly Source (ac-ft)	Storage (MG)	Service (irr-ac)	Peak Day Source (gpm)	Avg. Yearly Source (ac-ft)	Storage (ac-ft)
Unit Req.	N/A	800	0.45	0.0004	N/A	7.5	3.13	0.028
North Demand	9,820	7,856,000	4,419	3.9	1,088	8,160	3,405	30.8
South Demand	10,310	8,248,000	4,640	4.1	1,721	12,908	5,387	48.7
Total Demand	20,130	16,104,000	9,059	8.1	2,809	21,068	8,792	79.4
North Capacity		4,320,000		2.0		2,200	893	9.0
South Capacity		3,600,000		4.0		8,300	3,374	39.5
Total Capacity		7,920,000	0	6.0		10,500	4,267	48.5
Needed Capacity		8,184,000	9,059	2.1		10,568	4,525	30.9

ZONE 3	Drinking Water				Secondary Water			
	Service (ERC)	Peak Day Source (gpd)	Avg. Yearly Source (ac-ft)	Storage (MG)	Service (irr-ac)	Peak Day Source (gpm)	Avg. Yearly Source (ac-ft)	Storage (ac-ft)
Unit Req.	N/A	800	0.45	0.0004	N/A	7.5	3.13	0.028
North Demand	4,250	3,400,000	1,913	1.7	369	2,768	1,155	10.4
South Demand	5,860	4,688,000	2,637	2.3	756	5,670	2,366	21.4
Total Demand	10,110	8,088,000	4,550	4.0	1,125	8,438	3,521	31.8
North Capacity		720,000		1.2				0.0
South Capacity		6,264,000		2.0		4,350		4.0
Total Capacity		6,984,000	0	3.2		4,350	0	4.0
Needed Capacity		1,104,000	4,550	0.8		4,088	3,521	27.8

ZONE 4	Drinking Water				Secondary Water			
	Service (ERC)	Peak Day Source (gpd)	Avg. Yearly Source (ac-ft)	Storage (MG)	Service (irr-ac)	Peak Day Source (gpm)	Avg. Yearly Source (ac-ft)	Storage (ac-ft)
Unit Req.	N/A	800	0.45	0.0004	N/A	7.5	3.13	0.028
North Demand	1,910	1,528,000	860	0.8	87	653	272	2.5
South Demand	3,300	2,640,000	1,485	1.3	427	3,203	1,337	12.1
Total Demand	5,210	4,168,000	2,345	2.1	514	3,855	1,609	14.5
North Capacity		0	0	0.0		0	0	0.0
South Capacity		0	0	0.0		0	0	0.0
Total Capacity		0	0	0.0		0	0	0.0
Needed Capacity		4,168,000	2,345	2.1		3,855	1,609	14.5

ZONE 5	Drinking Water				Secondary Water			
	Service (ERC)	Peak Day Source (gpd)	Avg. Yearly Source (ac-ft)	Storage (MG)	Service (irr-ac)	Peak Day Source (gpm)	Avg. Yearly Source (ac-ft)	Storage (ac-ft)
Unit Req.	N/A	800	0.45	0.0004	N/A	7.5	3.13	0.028
North Demand	0	0	0	0.0	0	0	0	0.0
South Demand	2,450	1,960,000	1,103	1.0	318	2,385	995	9.0
Total Demand	2,450	1,960,000	1,103	1.0	318	2,385	995	9.0
North Capacity		0	0	0.0		0	0	0.0
South Capacity		0	0	0.0		0	0	0.0
Total Capacity		0	0	0.0		0	0	0.0
Needed Capacity		1,960,000	1,103	1.0		2,385	995	9.0

SUMMARY	Drinking Water				Secondary Water			
	Service (ERC)	Peak Day Source (gpd)	Avg. Yearly Source (ac-ft)	Storage (MG)	Service (irr-ac)	Peak Day Source (gpm)	Avg. Yearly Source (ac-ft)	Storage (ac-ft)
Unit Req.	N/A	800	0.45	0.0004	N/A	7.5	3.13	0.028
North Demand	39,730	31,784,000	17,879	15.9	3,929	29,468	12,298	111.1
South Demand	24,670	19,736,000	11,102	9.9	3,771	28,283	11,803	106.7
Total Demand	64,400	51,520,000	28,980	25.8	7,700	57,750	24,101	217.8
North Capacity		22,420,800	14,734	6.2		7,200	2,926	9.0
South Capacity		9,864,000	0	6.8		13,750	3,821	45.6
Total Capacity		32,284,800	14,734	13.0		20,950	6,747	54.6
Needed Capacity		36,616,000	28,980	15.8		41,800	19,387	163.2

APPENDIX C

Water Rights Summary Data

Saratoga Springs City Water Rights

Proof Priority	Change #	Water Right Number	Owner	Total Diversion (Acre-Feet)	Total Depletion (Acre-Feet)	Diversion Owned by Saratoga Springs	Depletion Owned by Saratoga Springs	Amount Owned by Others	Culinary Credits to Others	Secondary Credits to Others	Base Priority	Change Priority	Segregated From	Use	Prior Source	Current Source	If in Non-Use Status, Expiration Date	Current Wells	Proof Due Date	Canal Company	Certificate #	Canal Company Shares	Proof Status	Notes
1	**a35255**	**54-1226**	Saratoga Springs City, North Jordan Irrigation Co.	294.12	132.94	294.12	132.94		228.11		1853	2009	59-3496	Municipal	North Jordan Canal	Wells		C1, C2,C3, C4, C6	12/31/2023	North Jordan Irrigation Co.	2884	171	Proof Submitted to State on 12/22/2015	Credit is to Property Reserve Inc. (PRI) for Culinary Use
2	**a29007**	**54-1134**	Saratoga Springs City, South Jordan Canal Co.	69.16	29.32	69.16	29.32			69.16	1870	2004		Municipal	South Jordan Canal	Wells		S1, S2	10/31/2018	South Jordan Canal Co.	D7681	14	Proof Submitted to State on 12/22/2015	Credit to DCP Capital LLC (Lee Daniels) for secondary use
3	**a26292**	**54-1086**	Saratoga Springs City, Utah and Salt Lake Canal Co.	201.96	85.63	201.96	85.63				1870	2002		Municipal	Utah and Salt Lake Canal	Wells		C1, C4, C6	5/31/2016	Utah and Salt Lake Canal Co.	L0040	44	Proof Submitted to State on 12/22/2015	44 shares provided by Rindelsbach, 66 AF used in Sunrise Meadows, remaining used up in Benches subdivision
4	**a33374**	**54-1227**	Saratoga Springs City, Utah and Salt Lake Canal Co.	82.62	37.34	82.62	37.34				1870	2007		Municipal	Utah and Salt Lake Canal	Wells		S1, S4, S5	8/31/2022	Utah and Salt Lake Canal Co.	L0369(1), L0374(1), L0559(2),L0631(14)	18	Proof Submitted to State on 12/22/2015	The Approved change on this water right stated that 20% of the 82.62 AF right was to remain in the canal campany's ditches for carrier water, leaving 66.096 for the city to use. Saratoga purchased 2 shares (each share worth 3.672 AF) in 2009 from Kerkmans. The City Purchased 6 more shares @ $3,500/AF in 2012, and the last 10 shares from the Kerkman Family Trust in 2013 for $3,500/AF.
5	**a33375**	**54-1085**	Saratoga Springs City, Utah and Salt Lake Canal Co.	270.81	114.82	270.81	114.82				1870	2007		Municipal	Utah and Salt Lake Canal	Wells		S2	8/31/2022	Utah and Salt Lake Canal Co.	L0040 (57), K0915(2)	59	Proof Submitted to State on 12/22/2015	**Rindelsbach 34.39 AF Secondary Credit for Benches.**57 Shares provided by Rindelsbah, 2 shares purchased from Lake View Ranches.Application pending to change POD to include culinary wells.
6	**a35252**	**54-1223**	Saratoga Springs City, Utah and Salt Lake Canal Co.	330.48	149.4	330.48	149.4				1870	2003	59-3499	Municipal	Utah and Salt Lake Canal	Wells		C1, C2,C3, C4, C6	12/31/2023	Utah and Salt Lake Canal Co.	L0328	72	Proof Submitted to State on 12/22/2015	
7	**a35253**	**54-1214**	Saratoga Springs City, Utah and Salt Lake Canal Co.	142.29	64.315	142.29	64.315				1870	2009	59-3499	Municipal	Utah and Salt Lake Canal	Wells		C1, C2,C3, C4, C6	12/31/2023	Utah and Salt Lake Canal Co.	L0308	31	Proof Submitted to State on 12/22/2015	115.2 AF Credit transferred to DR Horton for Legacy Farms (Plats 1A-1F) on 4/19/15 and 20.8 AF Credit transferred to DR Horton for Legacy Farms (Plat 1A-1F) on 9/10/15. DR Horton has used 116.8 AF for plats 1A, 1B, 1C, 1D, 1E, 1F & Clubhouse, and 91.5 AF for plats 2A, 2B and part of 2C (16.39 AF). Proof of Beneficial Use Filed on 12-22-2015
8	**a36310**	**59-5851**	Saratoga Springs City, Utah and Salt Lake Canal Co.	64.26	29.0455	64.26	29.0455				1870	2010		Municipal	Utah and Salt Lake Canal	Wells		C1, C2,C3, C4, C6, S1, S5	Filed Extension 10/31/2015	Utah and Salt Lake Canal Co.	L0364	14	Proof Submitted to State on 12/22/2015	
9	**a22549**	**55-9343**	Saratoga Springs City, East Jordan Irrigation Company	401.72	170.33	401.72	170.33				1877	1998	57-7637	Municipal	East Jordan Canal	Wells		C3, S1	8/31/2023	East Jordan Irrigation Co.	C2692	83	Proof Submitted to State on 12/22/2015	
10	**a26478**	**55-9582**	Saratoga Springs City, East Jordan Irrigation Company	101.64	43.1	101.64	43.1				1877	2002	53-1375	Municipal	East Jordan Canal	Wells		C3, C4, C6, S1, S2	1/31/2017	East Jordan Irrigation Co.	C2620	21	Proof Submitted to State on 12/22/2015	
11	**a29006**	**54-1136**	Saratoga Springs City, East Jordan Irrigation Company	58.08	30.78	58.08	30.78			58.08	1877	2004	57-7637	Municipal	East Jordan Canal	Wells		S1, S2	10/31/2018	East Jordan Irrigation Co.	C3011	12	Proof Submitted to State on 12/22/2015	**Credit to DCP Capital LLC (Lee Daniels) for secondary use**
12	**a32599**	**54-1088**	Saratoga Springs City, East Jordan Irrigation Company	15.488	10.9384	19.36	10.9384				1877	2007	57-7637	Municipal	East Jordan Canal	Wells		S1, S2, S4, S5	8/31/2021	East Jordan Irrigation Co.	C3012	4	Proof Submitted to State on 12/22/2015	The Approved change on this water right stated that 20% of the right was to remain in the canal campany's ditches for carrier water, leaving 15.488 for the city to divert.
13	**a32706**	**54-1204**	Saratoga Springs City, East Jordan Irrigation Company	62.92	26.678	62.92	26.678				1877	2007		Municipal	East Jordan Canal	Wells		S3, S4	6/30/2020	East Jordan Irrigation Co.	C2545 (missing)	13	Proof Submitted to State on 12/22/2015	**Missing Deed-**A Water Right Deed, entry number 18725 recorded with Utah County in 2007, transferred 13 shares of East Jordan Irrigation Company shares, Certificate Number C2545, from Rick Salisbury to the City of Saratoga Springs. Water Right Number 55-1203 were based on these 13 shares and the DWRi renumbered them to Water Right Number 54-1204(a32706) when a change application was filed. Certificate No. C2545 is still in the name of Rick Salisbury on the records of East Jordan Canal Company. It is possible the City didn't update ownership according to the deed. The City has not been able to locate the original certificate to update ownership now.
14	**a32707**	**54-1203**	Saratoga Springs City, East Jordan Irrigation Company	62.92	26.678	62.92	26.678				1877	2007		Municipal	East Jordan Canal	Wells		S3, S4	10/31/2020	East Jordan Irrigation Co.	C6181	13	Proof Submitted to State on 12/22/2015	This water right is based on 13 shares in East Jordan Irrigation Company that were the basis for Water Right Number 55-9504 which was renumbered by the DWRi to Water Right Number 54-1203(a32707). Paul Johnson conveyed the 13 shares, Stock Certificate Number C6173, to the City of Saratoga Springs in 2015, see the Water Share Deed entry number 44982 with Utah County Recording Office. This water right does not appear to be a duplicate to Water Right Number 54-1204. Certificate C6173 was replaced by C6181.
15	**a35254**	**54-1212**	Saratoga Springs City and East Jordan Irrigation Company	579.59	261.945	579.59	261.945		579.59		1877	2009	57-7637	Municipal	East Jordan Canal	Wells		C1, C2,C3, C4, C6	12/31/2023	East Jordan Canal Co.	C3040	119.75	Proof Submitted to State on 12/22/2015	**Credit is to Property Reserve Inc. (PRI) for culinary Use**
16	**a36936**	**51-8050**	Saratoga Springs City	50	28.25	50	28.25				1889	2010	51-5785	Municipal	Benjamin Slough	Wells		C1, C2,C3, C4, C6, S1,S4, S5	10/31/2019					Annual Depletion limited to 28.25 AF. Municipal use.
17	**a27150**	**55-2905**	Saratoga Springs City	16	9.04	16	9.04				1899	2002		Municipal	Underground Water Well	Wells		C1, C2	7/31/2017					
18	**a39183**	**55-3556**	Saratoga Springs City	5.94	2.94	5.94	2.94				1905	2013		Municipal	Underground Water Well	Wells		C1, C2,C3, C4, C6	2/28/2019					0.045 cfs of Water Right Aquired with Public Woks property purchase. Based on flow of 0.045 cfs and 105 ELU's. Based on 105 stock units and irrigation of .75 acres, volume of 5.94 ac-ft.
19	**a26962**	**55-9693**	Saratoga Springs City, Utah Lake Distributing Co.	402.99	170.83	402.99	170.83				1908	2002	59-13	Municipal	Utah Lake Distributing Canal	Wells			8/31/2019	Utah Lake Distributing Co.	4331	78.863	Ready to Submit but held out since the City doesn't have enough volume to proof.	Utah Lake, Utah Lake Dam Diverting Works - Change application for 3 underground wells that are not operating
20	**a26962a**	**55-9726**	Saratoga Springs City, Utah Lake Distributing Co.	246	104.3	246	104.3				1908	2002	55-9693	Municipal	Utah Lake Distributing Canal	Wells		C1, C2, C4, C6	12/31/2017	Utah Lake Distributing Co.	4331	48.1409	Proof Submitted to State on 12/22/2015	Utah Lake, Utah Lake Dam Diverting Works

Proof Priority	Change #	Water Right Number	Owner	Total Diversion (Acre-Feet)	Total Depletion (Acre-Feet)	Diversion Owned by Saratoga Springs	Depletion Owned by Saratoga Springs	Amount Owned by Others	Culinary Credits to Others	Secondary Credits to Others	Base Priority	Change Priority	Segregated From	Use	Prior Source	Current Source	If in Non-Use Status, Expiration Date	Current Wells	Proof Due Date	Canal Company	Certificate #	Canal Company Shares	Proof Status	Notes
21	**a26962b**	**55-11899**	Saratoga Springs City, Utah Lake Distributing Co.	270.81	114.81	270.81	114.81				1908	2002	55-9693	Municipal	Utah Lake Distributing Canal	Wells		C1, C2, C4, C6	5/31/2017	Utah Lake Distributing Co.	4331	53	Proof Submitted to State on 12/22/2015	Utah Lake, Utah Lake Dam Diverting Works
22	**a27949**	**55-11913**	Saratoga Springs City, Utah Lake Distributing Co.	235.06	99.67	235.06	99.67				1908	2002		Municipal	Utah Lake Distributing Canal	Wells			6/30/2019	Utah Lake Distributing Co.	4331	46	Proof Submitted to State on 12/22/2015	Utah Lake, Utah Lake Dam Diverting Works - Change application for 3 underground wells that are not operating. Aquired from WW Ranches L.C. evidenced by certificate number 3864 for 5 shares, 3851 for 1 share, 3860 for 4 shares, 3859 for 1 share, 3829 for 22 shares, 3827 for 1 share, 3796 for 2 shares, 181 for 7 shares, 3177 for 3 shares. All documents filed with Utah State Engineer must be signed by the ULD and report of water use sent to ULD engineer annually.
23	**a28248**	**55-11924**	Saratoga Springs City, Utah Lake Distributing Co	255.5	108.33	255.5	108.33				1908	2003	59-13	Municipal	Utah Lake Distributing Canal	Wells		S1, S2	4/30/2018	Utah Lake Distributing Co.	4331	50	Proof Submitted to State on 12/22/2015	Utah Lake, Utah Lake Dam Diverting Works - Change application for 3 underground wells that are not operating. Aquired from Rindelsbach Farm L.C. 114 AF used in Stillwater (DAI), 140.5 used in Villages at Hawks (BTS), possible 1 AF credit Remaining to Rindelsbach. 50 shares were originally evidenced by certifiacte # 3898. All documents filed with Utah State Engineer must be signed by the ULD and report of water use sent to ULD engineer annually.
24	**a29140**	**54-1141**	Saratoga Springs City, Utah Lake Distributing Co	444.57	188.50	444.57	188.50			240.57	1908	2004		Municipal	Utah Lake Distributing Canal	Wells		S1, S2, S3, S4	10/31/2018	Utah Lake Distributing Co.	4331	87	Proof Submitted to State on 12/22/2015	Utah Lake, Utah Lake Dam Diverting Works. **Credit to DCP Capital LLC (Lee Daniels) for secondary use.** Shares were aquired from WW Ranches evidenced by certifacte # 3966 for 22 shares and 3957 for 65 shares. All documents filed with Utah State Engineer must be signed by the ULD and report of water use sent to ULD engineer annually.
25	**a31751**	**54-1195**	Saratoga Springs City, Utah Lake Distributing Co.	224.84	101.63	224.84	101.63				1908	2006	55-11962	Municipal	Utah Lake Distributing Canal	Wells		C4, S1, S4	12/31/2021	Utah Lake Distributing Co.	4331	44	Proof Submitted to State on 12/22/2015	Utah Lake, Utah Lake Dam Diverting Works. 44 shares purchased from WW Ranches associated with WR# 55-11962 (a28534), certificate # 4076 (44 of 50 shares). All documents filed with Utah State Engineer must be signed by the ULD and report of water use sent to ULD engineer annually.
26	**a28772**	**55-3117**	Saratoga Springs City	31	27.58	31	27.58				1910	2007		Municipal	Underground Water Well	Wells		S1, S2	9/30/2018					
27	**a28219**	**55-695, 55-860, 55-2433, 55-2820, 55-2821, 55-3303, 55-3304, 55-3541**	Saratoga Springs City	203.384	119.881	203.384	119.881		184.457		1910, 1957, 1954, 1890, 1890, 1890, 1895, 1895	2008		Municipal	Underground Water Well	Wells		C1, C2, C4, C6	2/28/2017					**133.457 Credit is culinary to LMMWC/Wardley McLachlan Development.** Either party can authorize use of this credit. On October 1, 2012 Lynn Wardley transferred **51 af credit to Capital Community Bank** for use in SSD. Used 1.4 AF for 16A Culinary and 3.9 for 16A secondary.
28	**a36937**	**55-1849, 55-2398, 55-4016**	Saratoga Springs City	150.12	85.31	150.12	85.31				1910, 1910, 1900	2010		Municipal	Underground Water Well	Wells		C1, C2,C3, C4, C6, S1, S3, S4, S5	5/31/2020					Although the Div of Water Rights shows 279.04, this WR was reduced by State Engineer during the change application to only cover 150.12 AF and that is all the City purchased. City paid $3,000/AF in July 2009. The remaining amount still owned by Hal J. Scott Trust, 128.92 AF (55-2398) is suspect for non-use due to not being approved with change application, DWR indicates they intend to terminate these remaining rights through the **Orem Adjudication** process. Application pending to change POD to include culinary wells.
29	**a28929**	**54-39, 54-68, 54-100, 54-102, 54-126, 54-127, 54-1097, 54-1098, 55-2242, 55-3828, 55-11969**	Saratoga Springs City	107.849	82.855	107.849	82.855				1952, 1976, 1932, 1934, 1930, 1930, 1961, 1965, 1899, 1909, 1917	2004		Municipal	Underground Water Well	Wells	6/30/2020	C2, C3, S1	11/30/2018					**Credit is for Corporation of the Presiding Bishop (CPB) of which is 34.916 AF are secondary.** For overall water right 52.493 AF are culinary and 55.356 are secondary. Consolidation of WR's 54 - (39,68,100,102,126,127,1097,1098) and 55 - (2242,3316,3828)

Proof Priority	Change #	Water Right Number	Owner	Total Diversion (Acre-Feet)	Total Depletion (Acre-Feet)	Diversion Owned by Saratoga Springs	Depletion Owned by Saratoga Springs	Amount Owned by Others	Culinary Credits to Others	Secondary Credits to Others	Base Priority	Change Priority	Segregated From	Use	Prior Source	Current Source	If in Non-Use Status, Expiration Date	Current Wells	Proof Due Date	Canal Company	Certificate #	Canal Company Shares	Proof Status	Notes
30	**a29654**	**54-863, 54-864, 54-865,54-866, 54-867, 54-868, 54-869, 54-870, 54-871, 54-872, 54-873, 54-874, 54-875, 54-876, 54-877, 54-878, 54-879, 54-880, 54-881, 54-882, 54-916, 54-917, 54-918, 54-975, 54-976, 54-977, 54-978**	Saratoga Springs City	187.91	99.589	187.91	99.589				1955	2004	54-622	Municipal	Underground Water Well	Wells		C3, S1, S5	4/30/2020					Consolidation of 54-863 thru 54-882, 54-916 thru 54-917, 54-975 thru 54-978
31	**a31062**	**54-887, 54-888, 54-889, 54-890, 54-891, 54-892, 54-893, 54-894, 54-895, 54-896, 54-897, 54-903, 54-905, 54-906, 54-907, 54-908, 54-909, 54-910, 54-912-54-915**	Saratoga Springs City	161.8556	82.6917	161.8556	82.6917			76.678	1955	2006	54-622	Municipal	Underground Water Well	Wells		S1, S5	12/31/2020					**Credit is Owned by Casey Development.** Credit was transferred from Summit to Casey in 2014. Consolidation of 54-887 thru 54-897, 54-903, 54-905 thru 54-915. Application to change POD to include culinary wells was denied in December 2014.
32	**a31944**	**54-904**	Saratoga Springs City	1.078	0.5882	1.078	0.5882			1.078	1955	2006	54-622	Municipal	Underground Water Well	Wells		S1, S5	3/31/2021					**Secondary Credit is to Bud Poduska**. He has conveyed these rights to the City with the expectation that his property would be developed as part of Harbor Bay. Current development is stalled and Bud is using the right to provide water to his property with the approval of the City. Prior to Conveyance to City & associated change application, division segregated 5.9595 AF to WR# 54-1209. This WR is now for only 1.078 AF. Change Application a31944 shows municipal use by the City.
33	**a33123**	**54-622**	Saratoga Springs City	282.83	159.8	282.83	159.8			282.83	1955	2007	55-750 (represents 75% of 55-750)	Municipal	Underground Water Well	Wells		S5	7/31/2022					**Water Right Number 54-622 has been conveyed to the City. The following City note is for Change Application a13551 Credit is for Waldo Company**. Water rights have already been transfered into City's Secondary Wells with credit agreement with the City. This agreement provides that Waldo has the right to use the water to develop its own land or to sell it to others for development in the City. The City has an option to purchase the water credits. The credits can be purchased/Used at any time within 15 years (beginning 7/30/08) and Waldo can elect to have the City purchase the water rights credits at the end of 15 years for $3,500 per acre foot. If City does not purchase, credit is extended for an additional 5 years. Change Application Number a33123 approves this right in the City's name for municipal use.
34	**a36309**	**54-623**	Saratoga Springs City	239.25	135.18	239.25	135.18				1955	2010	55-750	Municipal	Underground Water Well	Wells	8/31/2018	C1, C2,C3, C4, C6, S5	Filed Extention 10/31/2015					Nielsen conveyed 100 AF to city in 2007 for $3,500. The City paid Jeff Nielson $2,750 per acre foot for 100 acre feet in 2010, although he conveyed all 139.25 acre feet to the city. The remaining 39.25 AF was purchased in 2011 for $2,900/AF.
35	**a37898**	**54-1278**	Saratoga Springs City	42.187	22.433	42.187	22.433				1955	2012	54-622	Municipal	Underground Water Well	Wells	4/30/2019	S1, S5	10/31/2017					Secondary Water Owned by Waldo Company. A ROC was filed in March of 2015 transferring the water from Waldo Company to the City. Change Application a37898 and Water Right Number 54-1278 show the City as the sole owner of 42.187 ac-ft for municipal use .
36	**a27300**	**55-9727**	Saratoga Springs City	30.882	17.448	30.822	17.448				1957	2002		Municipal	Underground Water Well	Wells		C1, C4, C6	5/31/2017					
37	**a25570**	**55-963**	Saratoga Springs City	3.25	2.89	3.25	2.89				1959	2001		Municipal	Underground Water Well	Wells		C1, C2, C3, S1	3/31/2017					
38	**a36127**	**53-1686**	Saratoga Springs City	450	237.656	450	237.656				1961	2009	51-1277	Municipal	Underground Water Well	Wells		C1, C2,C3, C4, C6, S1, S3, S4, S5	3/31/2024					**City has Purchased all 450 AF as of May 2011**. If the City buys before March 31, 2011 the price is $3000/af, from May 31, 2011 to May 30, 2012 the price is $3250/af, and from May 31, 2012 to May 30, 2013 the price is $3,500.00. Application pending to change POD to include culinary wells.
SUBTOTAL				**6,781.36**	**3,215.46**	**6,785.18**	**3,215.46**	**0.00**	**992.16**	**728.40**														
Saratoga Springs Water Rights Needing Action (Not Ready to Proof)																								
39	**a24096**	**55-9490**	Saratoga Springs City, East Jordan Irrigation Company	48.4	18.227	48.4	18.227				1877	2000	57-7637	Irrigation, Domestic	East Jordan Canal	Underground Water Well		C3, S1	5/31/2024	East Jordan Irrigation Co.	C2652	10		Change use to municipal
40	**a20736a**	**54-1209**	Saratoga Springs City	5.9595						5.9595	1955	2011	54-622; then 54-904 (with application A26748b)	Irrigation	Underground Water Well	Wells			5/31/2021					**Secondary Credit is to Councilman Bud Poduska.** He has conveyed these rights to the City with the expectation that his property would be developed as part of Harbor Bay. Current development is stalled and Bud is using the right to provide water to his property with the approval of the City. Prior to Conveyance to City & associated change application, division segregated 5.9595 AF to WR# 54-1209. **Revision of change application from WR 12-904 may mean this WR is no longer approved for diversion from city wells.**
41		**55-7892**	Saratoga Springs City								1900	none		Stock Watering	Underground Water Well	Wells								0.011 cfs, Validity of Water Right is in question as it was never properly established. A volume of 4.2 ac-ft is calculated from 150 stock units on the Water Right.
42	**a19096**	**55-8873**	Saratoga Springs City, High Country Fruit Farms, South Jordan Canal Co.	420	225.75	420	225.75				1870	1995	59-3500	Municipal (West Utah Lake)	Utah Lake and Jordan River (South Jordan Canal Co.)	Wells		???	10/31/2019	South Jordan Canal Co.	D7818	106.5		High Country Farms and Janice Philps Anderson listed on Water Right. WR was conveyed to City in 1999 for SSD development. City has certificate D 7818 for 107 shares. A ROC needs to be filed with the state to change ownership to the City.

Proof Priority	Change #	Water Right Number	Owner	Total Diversion (Acre-Feet)	Total Depletion (Acre-Feet)	Diversion Owned by Saratoga Springs	Depletion Owned by Saratoga Springs	Amount Owned by Others	Culinary Credits to Others	Secondary Credits to Others	Base Priority	Change Priority	Segregated From	Use	Prior Source	Current Source	If in Non-Use Status, Expiration Date	Current Wells	Proof Due Date	Canal Company	Certificate #	Canal Company Shares	Proof Status	Notes
43	**a24193**	**55-9488**	Saratoga Springs City, Welby Jacob Water Users Co., East Jordan Irrigation Co.	630	267.1098	630	267.1098		246		1877	2000		Domestic	East Jordan Canal and Welby Jacob Canal	Wells		C1, C2, C4	6/30/2024	East Jordan Irrigation Co./Welby Jacob Water Users Co.	2524 2518	384 Welby Jacob		**246 ac-ft secondary owned by Paul Johnson**. 12 Shares of East Jordan Irrigation Company @ 4.84 AF/share = 58.08 AF, the rest is Welby Jacob water rights.
44	**a22239**	**55-1961**	Saratoga Springs City, Shawn Johnson, Lake Mountain Mutual water Co., Scott S. McLachlan, Scott Cooper and Julie Ann McLachlan, TalonsCove Golf Course	393.92	209.4	381.3	202.691	12.62			1895	1998		Irrigation	Underground Water Well	Wells		C1, C4, C6	2/29/2024					**12.62 AF of culinary owned by Scott McLachlan.**The City received a deed from the company that owned the Golf Course for the 12.62 AF but they did not have a deed from McLachlan so they could not transfer ownership to the City. This has never been resolved so McLahlan still is shown as the owner of those WR. Doug provided city copy of LMMWC deed for 12 AF to Saratoga Springs Golf, L.L.C. so City should be able to get 12 AF transfered into its ownership.
45	**a26829**	**55-9680, 55-542**	Saratoga Springs City, Loch Lomond LLC, Scott McLachlan	67.36	38.546	67.36	38.546				1899	2002	55-2905	Municipal	Underground Water Well	Wells		C1, C2	7/31/2017					**State records show the City owning 15.0 ac-ft of the water right with the remaining owned by Scott McLachlan and**Loch Lomand LLC. Loch Lomand LLC has indicated that they conveyed their portion to McLachlan; however he has not filed reports of conveyance so the title remains in Loch Lomand LLC. The change application and Memorandum state the all of the water should be conveyed to the City. Change application shared with WR 55-9680. Even though WR 55-9860 and WR 55-542 have a total ac-ft diversion higher than the change application, the state has indicated that the total of the two have a diversion of 67.36 ac-ft.
46	**a28626**	**55-11959**	Saratoga Springs City, Utah Lake Distributing Co.	57.232	32.34	57.232	32.34				1908	2004		Irrigation	Utah Lake Distributing Canal	Wells		S3	6/30/2018	Utah Lake Distributing Co.	4331(9), 628(5)	14		Utah Lake, Utah Lake Dam Diverting Works. Aquired from Paul Johnson and Scott Royall. 14 shares were originally evidenced by certificate number 3837 for 8 shares, 3839 for 1 share and 548 for 5 shares. All documents filed with Utah State Engineer must be signed by the ULD and report of water use sent to ULD engineer annually.
47	**a25275**	**55-9572**	Saratoga Springs City, Mountain View Ranches LLC, Utah Lake Distributing Co.	638.75	245.40	638.64	245.358	0.11			1908	2001	59-13	Irrigation, Domestic	Utah Lake Distributing Canal	Wells		C1, C2, C4, C6	Filed Extention 9/30/2015	Utah Lake Distributing Co.	4331(125) replaced the following 3941-109 shares 3810-39 shares 3731-38 shares	125		Utah Lake, Utah Lake Dam Diverting Works. **11 of secondary owned by William White**, Bountiful UT, 125 Shares of Stock total.Paul Johnson deeded 56.21 AF and 137.97 in 2002 and 199.29 and 112.42 AF to City in 2004. Lynn Wardley deeded 12 AF to Saratoga Springs Golf, L.L.C. but this never showed up on DWR, Wardley beleives Clty should provide 12 AF credit to Horne.
48	**In Progress**	**59-5923**	Saratoga Springs City	781.83	353.277	781.83	353.277							Irrigation	Utah Lake Distributing Canal	Utah Lake, Jordan River				Utah Lake Distributing Co.	286 - 21 shares 628 - 97 shares 649 - 25 shares 654 - 10 Shares	153		New Change Application for Harbor Marina Pump Station. Water Right number was created with 148 shares but later we found Certificate No. 628(102 shares) had 5 shares already assigned to 55-11959
49	**a25990e**	**54-1178**	Saratoga Springs City, Eagle Mountain City, Shupe Builders, etc.	156.38	66.304	80.38	34.081	76			1908	2001		Municipal/ Irrigation	Utah Lake and Jordan River (Draper Irrigation Company)			S1	Filed Extention 3/2016					**Purchased from Zions Bank for $2,900/AF in 2013**
50			Welby Jacob Canal Co. Saratoga Springs City	107	48.364	107	48.364				~1870			Irrigation	Welby Jacob Canal	Welby Jacob Canal				Welby Jacob Water Users Company	3395	107		**Purchased from Stephen and Bette Gibson for $3,721.7765/AF in December 2016. City needs to get a new certificate issued in its name, have a water right number assigned to those shares in its name, and then file a change application to add a point of diversion at the Marina Pump Station and change the use to municipal.**
51		**54-1215**	Saratoga Springs City, Waldo Company, Utah and Salt Lake Canal Co.	371.79							1870	none		Irrigation	Utah and Salt Lake Canal	Canal				Utah and Salt Lake Canal Co.		81		City ownership is shared with Waldo Company (c/o Jim Davis). The City data base shows the city owning 185.895 ac-ft, but no information can be found on ownership and share certificates. Share certificates and ownerships needs to be determined and a change application needs filed. UPDATE: This appears to be a duplicate created by the state. The state shows a diversion amount of 371.79 Ac-ft with a diversion of 168.0507 Ac-ft.
52		**54-1231**	Saratoga Springs City, Central Utah Water Conservancy District, Utah and Salt Lake Canal Co.	408.51	184.6483						1870	none		Irrigation	Utah and Salt Lake Canal	Canal				Utah and Salt Lake Canal Co.		89		City ownership shared with Central Utah Water Conservancy District and Utah and Salt Lake Canal Company. Irrigation of 81.702 acres. The City data base shows the city owning 408.51 ac-ft, but no information can be found on ownership and share certificates. Share certificates and ownerships needs to be determend and a change application needs filed. UPDATE: This appears to be a duplicate created by the state. The state shows a diversion amount of 408.51 Ac-ft with a depletion of 184.6483 Ac-ft.
53		**54-1220**	Saratoga Springs City, WW Ranches LC, Utah Lake Distributing Co.	158.41							1908	none		Irrigation	Utah Lake Distributing Canal	Utah Lake, Jordan River				Utah Lake Distributing Co.				**This water right appears to be a duplicate created by the state. The state has shared ownership with WW Ranches LC. State shows a diversion amount of 158.41 with a depletion of 71.58 Ac-ft**
SUBTOTAL				**3306.8315**	**1504.7138**	**3212.142**	**1465.739544**	**88.73**	**246**	**5.9595**														
TOTAL				**10,088.195**	**4,720.178**	**9,997.318**	**4,681.203**	**88.730**	**1,238.157**	**734.356**														**Maximum culinary well system capacity is 7,135 AF (Based on 8,800 gpm for 7 wells). The 4 pending change applications to move water to culinary POD totals 632.8632 AF. 465.26 AF owned by others in culinary wells. Existing + credits + pending = 7,026.25 AF. Remaining amount of 108.7486 AF can be moved to culinary wells**
Possible Water Rights for Conveyance to the City																								
	a18982	**55-8950**	Utah Lake Distributing Co., Utah Valley Turf Farm, Welby Jacob Water Users Co.	394.4	167.36			394.4			1908	1995		West Utah Lake Municipal	Utah Lake and Jordan River	Wells, Utah Lake and Jordan River		C1	11/30/2022	ULD Shares held by Welby Jacob Canal Co.		493		**Culinary Water Owned by Doug Horne**. WR information sheet lists LMMWC as owner but they claim the WR is actually owned by Doug Horne. Culinary Water Right. Listed in settelment agreement and was used to capacity possible in LMMWC system purchased by City.**Change application approving diversion from City wells has been extended by speciaol order of State Engineer**. Jim Riley to work with Horne on getting water transferred to Saratoga. Doug Horne deeded 12 AF to Saratoga Springs Golf, L.L.C. Groundwater and surface sources
	a28420	**55-11977**	Loch Lomond	7	3.955			7			1899				Wells				Lapsed					**7 AF of culinary still owned by McLachlan**. Loch Lomand LLC has indicated that they conveyed their portion of the WR to McLachlan; however he has not filed reports of conveyance so the title remains in Loch Lomand LLC.**Change aplication has lapsed.**
		54-899	Peter L. Belliston Family Trust	7.0375	?			7.0375			1955			Irrigation	Wells									Segregated from 54-622
		54-900	Nigel J.A. Bristow Marital and Family Trust	7.0375	?			7.0375			1955			Irrigation	Wells									Segregated from 54-622
	a25990	**54-1080**	Eagle Mountain City, John D. Jacob, Gerald H. Kinghorn, Gary & Jane Lancaster, Terry E. & Tammy Messersmith	96.6700	40.9870			96.67			1912			Shared municipal	Utah Lake and Jordan River			S1						Change Application lists municipal use for Saratoga Springs and Eagle Mountain
	a25990b	**54-1107**	West Desert Airpark LLC	8.4900	3.5998			8.49			1912			Shared municipal	Utah Lake and Jordan River			S1						Change Application lists municipal use for Saratoga Springs and Eagle Mountain
	a25990eg	**54-1272**	Eagle Mountain City	112.1100				112.11			1912			Shared municipal	Utah Lake and Jordan River			S1						Change Application lists municipal use for Saratoga Springs and Eagle Mountain
		54-436	Keith W. Jex								1981			Irrigation, Domestic		Wells								irrigate .2 acres and 1 EDU's Domestic

Proof Priority	Change #	Water Right Number	Owner	Total Diversion (Acre-Feet)	Total Depletion (Acre-Feet)	Diversion Owned by Saratoga Springs	Depletion Owned by Saratoga Springs	Amount Owned by Others	Culinary Credits to Others	Secondary Credits to Others	Base Priority	Change Priority	Segregated From	Use	Prior Source	Current Source	If in Non-Use Status, Expiration Date	Current Wells	Proof Due Date	Canal Company	Certificate #	Canal Company Shares	Proof Status	Notes
		54-439	Richard V. & Estella M. Russell								1981			Irrigation, Stock, Domestic		Wells								
	a15926	**54-443**	Phil Faulk								1981			Irrigation		Wells								
		54-611	Elaine Huntsman								1992			Irrigation, Stock, Domestic										
		54-637	Brent Clark, Gary Free, James L. McQueen, Doron and Rachel Sherman, Sherman Investments L.P.	4.25				4.25			1995			Irrigation, Stock, Domestic										Appears to have permanently lapsed
		54-642	Aylett Children's Trust	1.5900				1.59			1995			Irrigation, Stock, Domestic		Wells								
		54-652	Keith W. Jex	3.472				3.472			1996			Stock		Wells								Jex sold to Alpine Homes Inc., see ent 141129:2004
		54-700	IHC Health Services											Irrigation, Stock, Domestic										
	a37538	**54-898**	James B. and Rosalie M. Wheeler	7.0375	3.0980			7.0375			1959			Irrigation, Stock, Domestic		Underground well, Utah Lake								Water quality from wells not suitable for irrigation/ no home built
	a20734	**54-902**	Judith C. Jensen	7.0375				7.0375			1959			Irrigation, Stock, Domestic		Wells								Extention 5/31/2005
		54-998	IHC Health Services																					
		55-7181	Lake Mountain Mutual Water Co.											Irrigation										Appears to have permanently lapsed
		55-603	Western States Ventures, LLC	0.6780				0.678			1990			Irrigation		Wells								
	a33363	**57-10375**	Central Utah Water Conservancy District, East Jordan Canal Company	2005	906.25			2005			1877			municipal	Utah Lake and Jordan River	Wells				East Jordan Irrigation Company				municipal use listed for Saratoga Springs
	a29325	**55-1166**	Ambro & Sons	9.96	5.353			9.96			1964			Irrigation		Wells								
		55-6595	Alfred Lieber	9.8597				9.8597						Irrigation and Marina		Wells								
		55-490	S. Rex and Ardell D. Zimmerman	26.0500				26.05						Irrigation, Domestic, Stock		Wells								
		55-3437	Salt Lake City Municipal											Irrigation, Domestic		Wells								
		55-2810	Blanche E. Evans											Irrigation		Wells								
		55-2809	Blanche E. Evans											Irrigation		Wells								
		55-139	Salt Lake City Municipal											Irrigation										
	a40255	**55-1559**	Jay W Garlick, Saratoga Springs City	1.52				1.52								Wells		C1, C2, C3, C4, C6	6/1/2024					Withdrawn, owner is now American Fork City
SUBTOTAL				2709.1997	911.599	0.000	0.000	2053.0677	0	0														
TOTAL				**12,797.395**	**5,850.776**	**9,997.318**	**4,681.203**	**2,797.930**	**1,238.157**	**734.356**														**Maximum culinary well system capacity is 7,135 AF (Based on 8,800 gpm for 7 wells). The 4 pending change applications to move water to culinary POD totals 632.8632 AF. 465.26 AF owned by others in culinary wells. Existing + credits + pending = 7,026.25 AF. Remaining amount of 108.7486 AF can be moved to culinary wells.**

APPENDIX D

Calibration Data

Fire Flow Calibration Data

TEST LOCATION	RESIDUAL PRESSURE (PSI)	FIELD FLOW (GPM)	MODEL FLOW (GPM)	DIFFERENCE IN FLOW
Fire Station North Hydrant	60	1,249	1,360	8.89%
Fire Station South Hydrant	50	1,238	1,690	36.51%
Tanner Lane	120	1,494	2,800	87.42%
Smith's	95	1,444	1,408	-2.49%

StateFire
DC Specialties LLC
240 WEST 3680 SOUTH
SALT LAKE CITY, UTAH 84115
PHONE: 801-288-2100 - FAX: 801-269-1606

Water Flow Test Summary Sheet

Project: Smith's Marketplace Store No. 207 Date: 03-09-2016

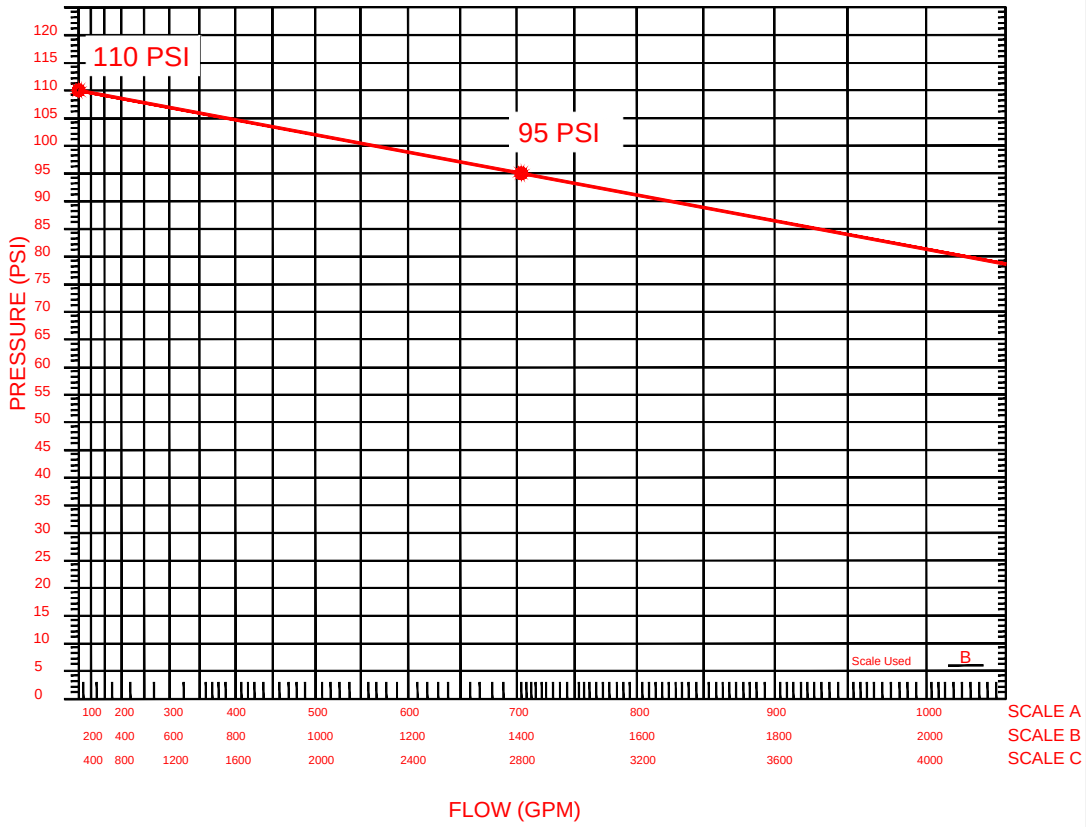
Conducted By: Ben Niffenegger / Kish Marler - Witnessed by Saratoga Springs Fire Deparmtent Time: 1:40 P.M.

Test Locatoion: Redwood Road and Market Street Saratoga Springs, UT

Flow Hydrant Location: Same

Outlet Coefficent: .90 Outlet Dia: 2½ in. Pitot Tube: 74 psi. No. Outlets: 1

Static: 110 psi Residual: 95 psi @ Flow: 1,444 gpm: Flow @ 20 psi 3,800



Notes:

1. Flow test was calculated using the following formula:

$$Q = (29.83)(C_d)(D)^2(Z)^{1/2}$$

Where:

Q = Flow in gallons per minute (GPM).

C_d= Coefficient of discharge.

D = Internal orfice or nozzel diameter in inches.

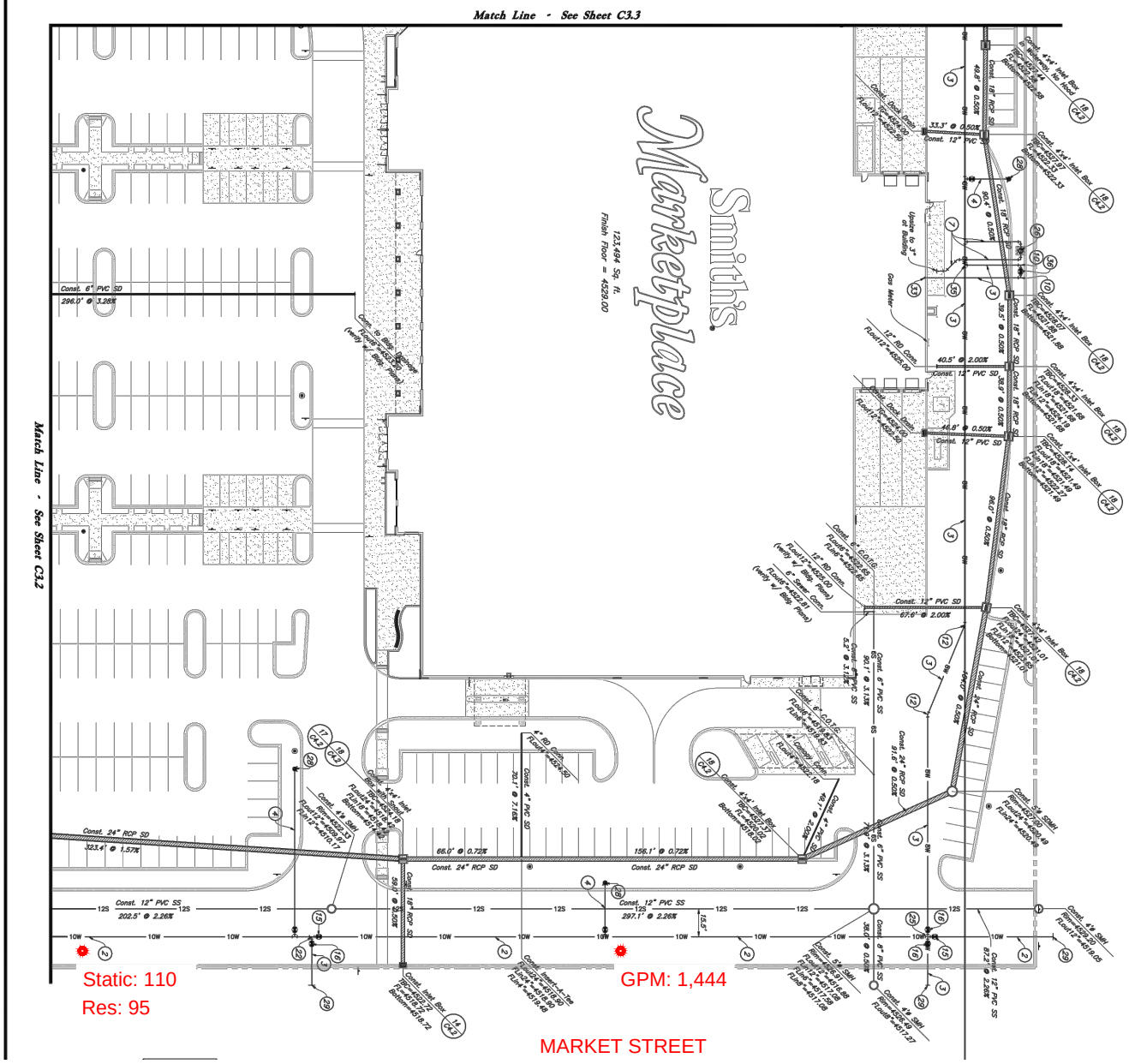
Z = Velocity pressure measured with pitot tube in pounds per square inch (PSI).

2. Flow at 20 PSI was calculated using the following formula.

$$Q_{20} = Q(\text{Delta } P_{20})^{0.54}/(\text{Delta } P_{TEST})^{0.54}$$

StateFire
DC Specialties LLC
240 WEST 3680 SOUTH
SALT LAKE CITY, UTAH 84115
PHONE: 801-288-2100 - FAX: 801-269-1606

PIONEER CROSSING



REDWOOD ROAD

MARKET STREET

Note:
Civil information taken from the Smith's Marketplace Store No. 207 construction documents titled C3.1 Utility Plan, dated 11-16-2015.

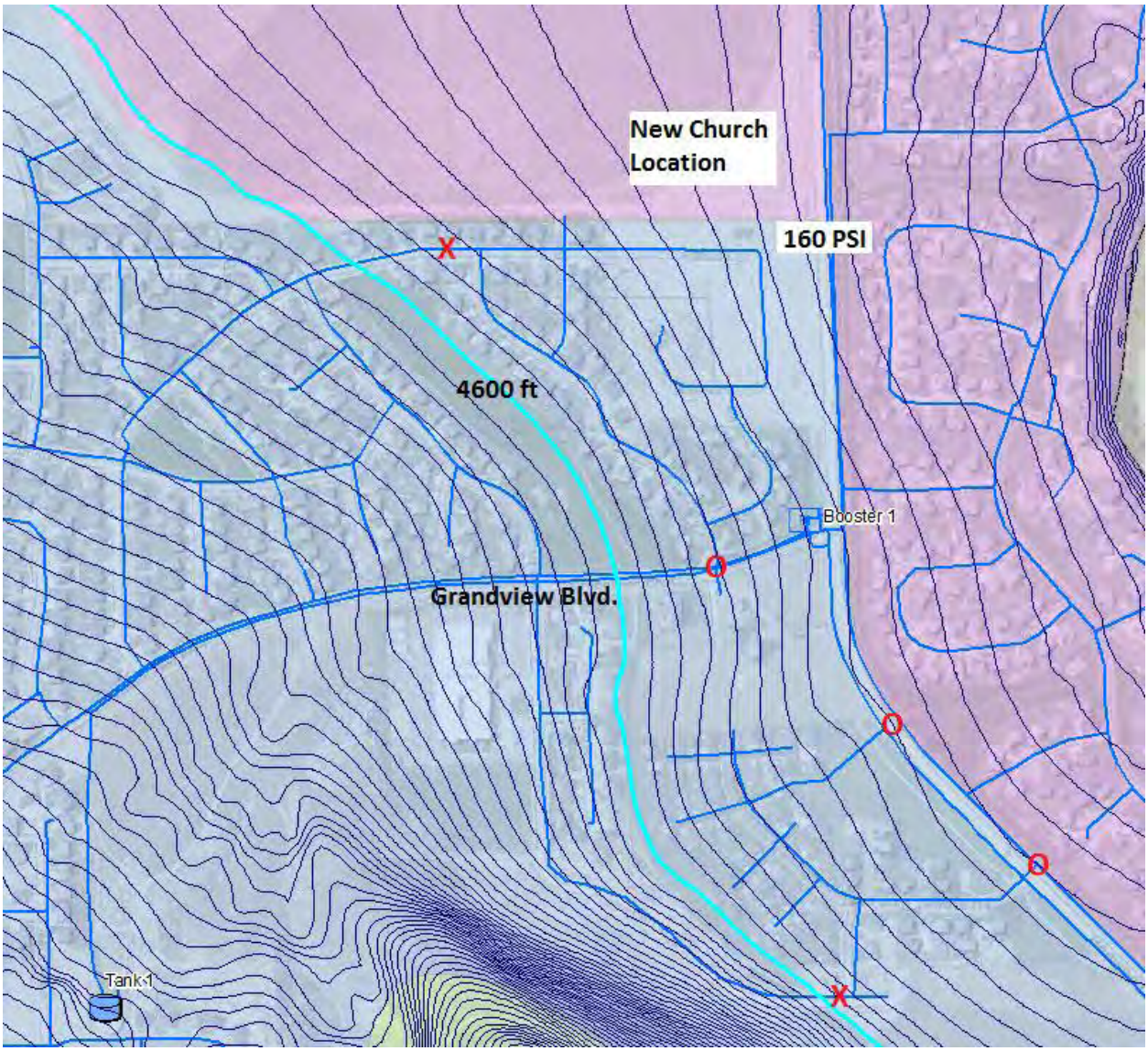
The hydrants on the west end of 1200N were tested on 4/22/2015. The hydrant to the north of the fire station on 1200 were tested and also the hydrant to the south.

Hydrant in front of station:
Static: 80
Residual: 60
Pitot: 60
2.5" Discharge: 1,294gpm
Proj. Hydrant: 2,341gpm

Hydrant south of station:
Static: 80
Residual: 50
Pitot: 55
2.5" Discharge: 1,238gpm
Proj. Hydrant: 1,986gpm

Test Conducted: January 2016
Fire Hydrants Tested were on Hillside Drive
Flow Hydrant# 110641
Gauge Hydrant# 110610

Static: 140
Residual: 120
Pitot : 80
Discharge Flow 2.5”: 1,494 GPM (0.9 Coefficient)
Total Projected Hydrant Flow: 3,931 GPM (based upon hydrant being pulled down to 20psi residual)



APPENDIX E

EPANET 2.0 Hydraulic Models
(compact disc)

APPENDIX F

Cost Estimate Calculations

City of Saratoga Springs Capital Facility Plan
Culinary Water Recommended Improvements
Preliminary Engineers Cost Estimates

Year		Item	Unit	Unit Price	Quantity	Total Price
0-5	***CW 1.***	***Zone 3 North - Pump Station and Tank***				
		16" DIP Transmission Line to Tank	LF	$ 136	1700	$ 231,200
		12 " Transmission Line	LF	$ 111	5600	$ 621,600
		Acquire Property	AC	$ 100,000	3	$ 300,000
		Zone 3 Pump Station (125 HP, 1200 gpm)	LS	$ 500,000	1	$ 500,000
		Zone 3 Tank (1.4 MG)	LS	$ 1,400,000	1	$ 1,400,000
					Engineering & Admin. (10%)	$ 305,280
					Contingency (10%)	$ 305,280
					Total to Zone 3 North - Pump Station and Tank	**$ 3,663,000**
0-5	***CW 2.***	***Zone 2 North - Tank***				
		Acquire Property	AC	$ 100,000	2.5	$ 250,000
		16" DIP Transmission Line to Tank	LF	$ 136	1500	$ 204,000
		Zone 2 Tank (2 MG)	LS	$ 2,000,000	1	$ 2,000,000
					Engineering & Admin. (10%)	$ 245,400
					Contingency (10%)	$ 245,400
					Total to Zone 2 North - Tank	**$ 2,945,000**
2025	***CW 3.***	***CUWCD Pony Express Turnout and Pump Station***				
		16" DIP Transmission Line	LF	$ 136	3400	$ 462,400
		Acquire Property	AC	$ 100,000	0.5	$ 50,000
		Zone 2 Pump Station (150 HP, 2250 gpm)	LS	$ 600,000	1	$ 600,000
					Engineering & Admin. (10%)	$ 46,240
					Contingency (10%)	$ 46,240
					Total to CUWCD Pony Express Turnout and Pump Station	**$ 1,205,000**
2025	***CW 4.***	***CUWCD 2300 West Turnout***				
		16" DIP Transmission Line	LF	$ 136	2000	$ 272,000
		Turnout Connection	LS	$ 20,000	1	$ 20,000
					Engineering & Admin. (10%)	$ 27,200
					Contingency (10%)	$ 27,200
					Total to CUWCD 2300 West Turnout	**$ 346,000**
2027	***CW 5.***	***Zone 2 North - Tank (Church Property)***				
		20" DIP Transmission Line from PS to Tank	LF	$ 160	15200	$ 2,432,000
		Acquire Property	AC	$ 100,000	2	$ 200,000
		Zone 2 North Tank (2.5 MG)	LS	$ 2,500,000	1	$ 2,500,000
					Engineering & Admin. (10%)	$ 513,200
					Contingency (10%)	$ 513,200
					Total to Zone 2 North - Tank (Church Property)	**$ 6,158,000**
2028	***CW 6.***	***Zone 4 North - Pump Station and Tank***				
		12" DIP Transmission Line from PS to Tank	LF	$ 111	13000	$ 1,443,000
		Acquire Property	AC	$ 100,000	2.5	$ 250,000
		Zone 4 Pump Station (25 HP, 250 gpm)	LS	$ 300,000	1	$ 300,000
		Zone 4 North Tank (1.2 MG)	LS	$ 1,200,000	1	$ 1,200,000
					Engineering & Admin. (10%)	$ 319,300
					Contingency (10%)	$ 319,300
					Total to Zone 4 North - Pump Station and Tank	**$ 3,832,000**
2028	***CW 7.***	***Zone 4 South - Pump Station and Tank (Central)***				
		16" DIP Transmission Line from PS to Tank	LF	$ 136	1400	$ 190,400
		Acquire Property	AC	$ 100,000	2.5	$ 250,000
		Zone 4 Pump Station (25 HP, 250 gpm)	LS	$ 300,000	1	$ 300,000
		Zone 4 South Tank (1.0 MG)	LS	$ 1,000,000	1	$ 1,000,000
					Engineering & Admin. (10%)	$ 174,040
					Contingency (10%)	$ 174,040
					Total to Zone 4 South - Pump Station and Tank (Central)	**$ 2,088,000**
2028	***CW 8.***	***Zone 1 North - Tank, CUWCD Connection, and Transmission***				
		24" Transmission Line from CUWCD to Tank	LF	$ 188	5300	$ 996,400
		20" DIP Transmission Line	LF	$ 160	4100	$ 656,000
		16" DIP Transmission Line	LF	$ 136	5900	$ 802,400

City of Saratoga Springs Capital Facility Plan
Culinary Water Recommended Improvements
Preliminary Engineers Cost Estimates

Year		Item	Unit	Unit Price	Quantity	Total Price
		Acquire Property	AC	$ 100,000	3	$ 300,000
		Zone 1 North Tank (5 MG)	LS	$ 5,000,000	1	$ 5,000,000
					Engineering & Admin. (10%)	$ 775,480
					Contingency (10%)	$ 775,480
		Total to Zone 1 North - Tank, CUWCD Connection, and Transmission				**$ 9,306,000**
2029	***CW 9.***	***Zone 3 South - Pump Station and Tank (Northernmost)***				
		16" DIP Transmission Line from PS to Tank	LF	$ 136	1700	$ 231,200
		Acquire Property	AC	$ 100,000	2	$ 200,000
		Zone 3 Pump Station (25 HP, 250 gpm)	LS	$ 300,000	1	$ 300,000
		Zone 3 South Tank (0.7 MG)	LS	$ 700,000	1	$ 700,000
					Engineering & Admin. (10%)	$ 143,120
					Contingency (10%)	$ 143,120
		Total to Zone 3 South - Pump Station and Tank (Northernmost)				**$ 1,717,000**

Subtotal for Short-Term Improvements $ 7,813,000

DRINKING WATER SYSTEM COST

1 Lake Mountain Mutual Purchase

Source	Wells 1,2,4,6 (7,8), 2 Boosters, and pipe	$11,000,000	Wells	$1,000,000
Storage	Tank 1,3,4 and pipelines	$6,626,000	Transmission for wells and boosters	$500,000
Fire	Tank 1,3,4 and pipelines	$2,240,000	Booster station	$500,000
Water Rights	378 acre-feet	$1,134,000	Storage per gallon	$1
TOTAL		**$21,000,000**	Water rights per ac-ft	$3,000
			Total	$21,000,000

2 Lake Mountain Development Purchase (2005 Bond)

Source	Well 3, Booster and pipelines	$914,578	Well 3	$417,014
Storage	Tank 2 and Pipelines	$1,404,557	Tank 2	$519,828
Fire	Tank 2 and Pipelines	$755,047	Booster 1	$180,966
TOTAL		**$3,074,183**	Pipeline B & D	$132,294
			Pipeline C	$907,975
			2005 Bond Interest	$916,106
			Total	$3,074,183

3 Tank 5 and Waterline - 2006 Bond

Storage	Tank 5 and pipeline	$2,645,796	Tank 5 and Pipeline	$3,500,000
Fire	Tank 5 and pipeline	$2,236,090	2006 Bond Interest	$1,381,886
TOTAL		**$4,881,886**	Total	$4,881,886

4 Zone 2 South SID (2009 Bond)

Storage	Tank 6 and pipeline	$1,579,763	Tank 6	$1,588,650
Fire	Tank 6 and pipeline	$547,938	Pipeline	$539,051
TOTAL		**$2,127,701**	Total	**$2,127,701**

5 Water Right Purchases

Water Right	150 acre-feet from L&V Properties	**$450,000**
Water Right	75 acre-feet from L&V Properties	**$225,000**
Water Right	225 acre-feet from L&V Properties	**$675,000**
Water Right	225 acre-feet from Jeff Neilson	**$350,000**
Water Right	225 acre-feet from Jeff Neilson	**$275,000**
Water Right	225 acre-feet from Jeff Neilson	**$113,825**
Water Right		**$233,102**
Water Right		**$79,000**
Water Right		**$147,655**
Water Right		**$241,321**
Water Right		**$75,315**
TOTAL		**$2,865,218**

6 400 North Pipeline

Storage	Pipeline	$186,278	400 North 14" Pipeline	$497,087
Fire	Pipeline	$310,809	Total	$497,087
TOTAL		**$497,087**		

7 Saratoga Road Pipeline

Source	Pipeline	$575,780	Saratoga Road Pipeline	$575,780
TOTAL		**$575,780**		

8 Booster Pump Station 1 Upgrade

Source	Booster Upgrade	$99,995	Booster Pump Station 1 Upgrade	$99,995
TOTAL		**$99,995**		

9 1200 North Pipeline

Storage	Pipeline	$26,659	1200 North 12" Pipeline	$91,681
Fire	Pipeline	$65,022	Total	$91,681
TOTAL		**$91,681**		

10 Fox Hollow Zone 3

Source	Booster	$1,189,127	Tank 7	$1,596,844
Storage	Tank 7 and pipelines	$1,405,223	Fox Hollow Booster	$1,189,127
Fire	Tank 7 and pipelines	$191,621	Total	$2,785,971
TOTAL		**$2,785,971**		

11 Talus Ridge Pipeline Upsizes

Source	Pipeline Upsizes	$65,294	Plat A	$259,214
Storage	Pipeline Upsizes	$422,634	Plat B	$125,777
Fire	Pipeline Upsizes	$106,690	Plat D	$55,310
TOTAL		**$594,618**	Plat F	$45,578
			Plat G	$108,739
			Total	$594,618

12 Legacy Farms

Source	Pipeline Upsizes	$117,335	Legacy Farms Pipe Upsize	$389,673
Storage	Pipeline Upsizes	$117,335	Legacy Farms Pipe Upsize VP2	$197,000
Fire	Pipeline Upsizes	$352,004	Total	$586,673
TOTAL		**$586,673**		

13 Harvest Point Commercial Pipeline Upsize for Fireflow

Fire	Pipeline Upsize	$16,023	Pipeline Upsize	$16,023
TOTAL		**$16,023**	Total	$16,023

14 Fox Hollow N6 Pipeline Looping

Fire	Pipeline Looping	$44,721	Pipeline Looping	$89,441
Source	Pipeline Looping	$44,720	Total	$89,441
TOTAL		**$89,441**		

15 Master Planning, CFP, IFFP, IFFA

Planning	2 Updates	$140,000	Master Planning, CFP, IFFP, IFFA	$70,000
TOTAL		**$140,000**		

16 Zone 2 North Source

Source	Booster Station and Pipeline	$729,324	Booster Station	$383,465
Fireflow	18" U-73 Pipeline	$339,980	18" U-73 Pipeline	$685,839
TOTAL		**$1,069,304**	Total	$1,069,304

17 Redwood Rd Transmission Line

Source	Redwood Rd Transmission Line	$311,181	Redwood Rd Transmission Line	$627,743
Fireflow	Redwood Rd Transmission Line	$316,562	Total	$627,743
TOTAL		**$627,743**		

18 Transmission Lines to Connect CWP Turnouts

Source	Transmission Lines	$253,989	Transmission Lines	$253,989
TOTAL		**$253,989**	Total	$253,989

19 IFFP Project - Zone 2 North Tank

Storage	Zone 2 North Tank with Transmission	$2,847,000	Zone 2 North Tank with Transmission	$2,945,000
Fireflow	Transmission Fireflow	$98,000		
TOTAL		**$2,945,000**		

20 IFFP Project - Zone 3 North - Pump Station and Tank

Storage	Redwood Rd Transmission Line	$1,970,200	Redwood Rd Transmission Line	$2,551,320
Fireflow	Storage Plus Tranmission for Fireflow	$581,120	Zone 3 Pump Station (Mt. Saratoga)	$1,111,680
Source	Zone 3 Pump Station (Mt. Saratoga)	$1,111,680	Total	$3,663,000
TOTAL		**$3,663,000**		

21 IFFP Project - Pony Express Turnout and Pump Station

Source	CUWCD Turnout and Transmission	$1,035,000	Pump Station and Property	$780,000
Fireflow	Transmission Fireflow	$170,000	Transmission Line	$425,000
TOTAL		**$1,205,000**	Total	$1,205,000

21 IFFP Project - 2300 West Turnout

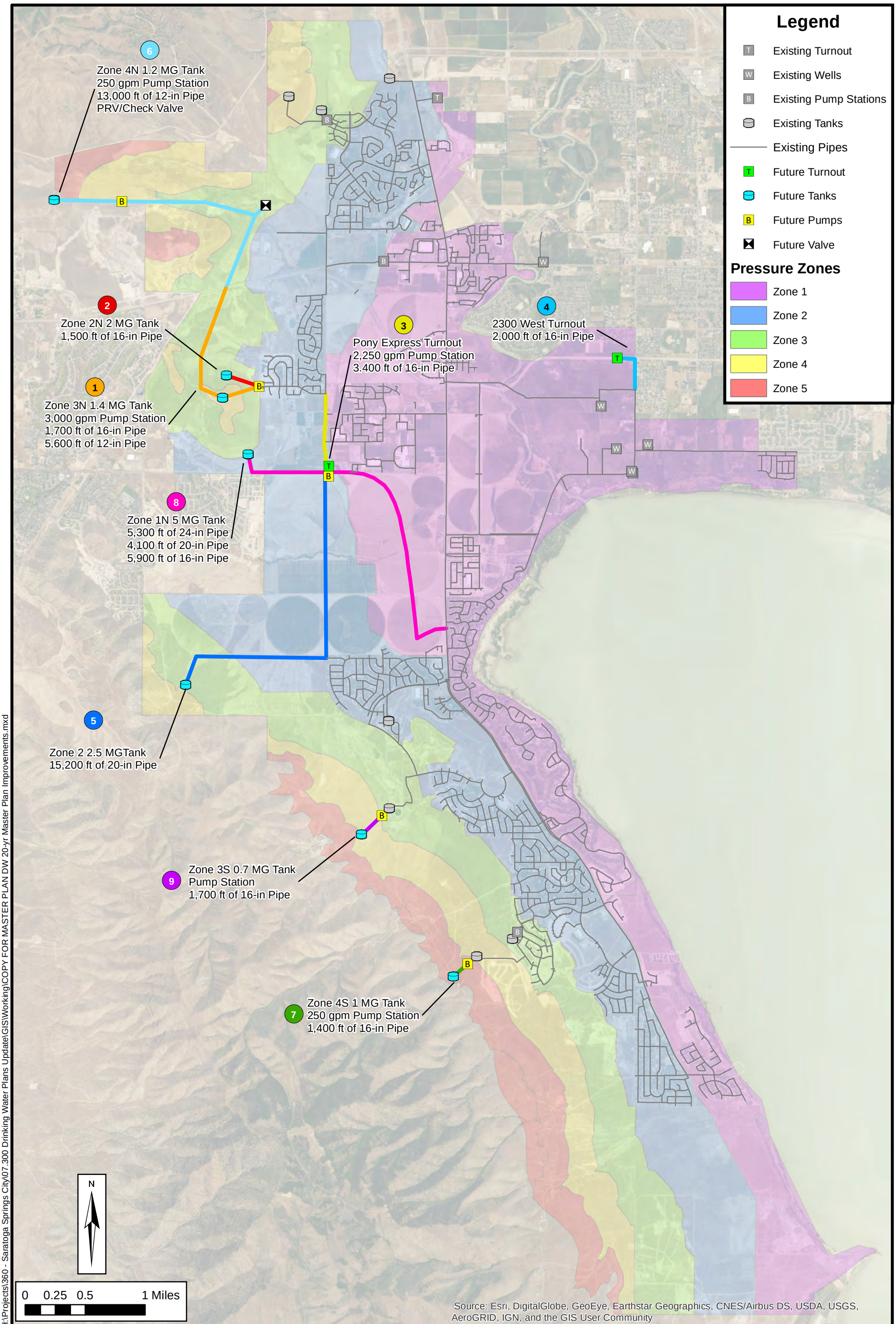
Source	CUWCD Turnout and Transmission	$346,000	CUWCD Source and Transmission	$346,000
TOTAL		**$346,000**	Total	$346,000

22 IFFP Project - Water Rights

Water Rights	658 acre-feet @ $3,200/AF	$2,105,600	Water Rights	$2,105,600
TOTAL		**$2,105,600**	Total	$2,105,600

APPENDIX G

Capital Facility Plan
Improvements Map



Date: 7/3/2017
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HANSEN ALLEN & LUCE INC ENGINEERS

SARATOGA SPRINGS DRINKING WATER SYSTEM

CAPITAL FACILITY PLAN IMPROVEMENTS

APPENDIX G

APPENDIX H

Checklist for Hydraulic Model Design Elements Report

APPENDIX

CHECKLIST FOR HYDRAULIC MODEL DESIGN ELEMENTS REPORT

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

Drinking Water Master Plan
(Project Name or Description)

25138
(Water System Number)

Saratoga Springs City
(Water System Name)

7/19/2017
(Date)

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

1. At least 80% of the total pipe lengths in the distribution system affected by the proposed project are included in the model. *[R309-511-5(1)]* ☑ SA
2. 100% of the flow in the distribution system affected by the proposed project is included in the model. If customer usage in the system is metered, water demand allocations in the model account for at least 80% of the flow delivered by the distribution system affected by the proposed project. *[R309-511-5(2)]* ☑ SA
3. All 8-inch diameter and larger pipes are included in the model. Pipes smaller than 8-inch diameter are also included if they connect pressure zones, storage facilities, major demand areas, pumps, and control valves, or if they are known or expected to be significant conveyers of water such as fire suppression demand. *[R309-511-5(3)]* ☑ SA
4. All pipes serving areas at higher elevations, dead ends, remote areas of a distribution system, and areas with known under-sized pipelines are included in the model. *[R309-511-5(4)]* ☑ SA
5. All storage facilities and accompanying controls or settings applied to govern the open/closed status of the facility for standard operations are included in the model. *[R309-511-5(5)]* ☑ SA

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

☑ _____

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

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

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

[R309-511-7(4)] ☑ _____

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

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

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

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

14. The Report states the total number of equivalent residential connections (ERC) including both existing connections as well as anticipated new connections associated with the project. In accordance with Rule stipulation, the number of ERC's includes high as well as low volume water users. In accordance with Rule stipulation, the determination of the equivalent residential connections is based on flow requirements using the anticipated demand as outlined in *R309-510, Minimum Sizing Requirements*, or is based on alternative sources of information that are deemed acceptable by the Director. *[R309-511-7(3)]* ☑ SA

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

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

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

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

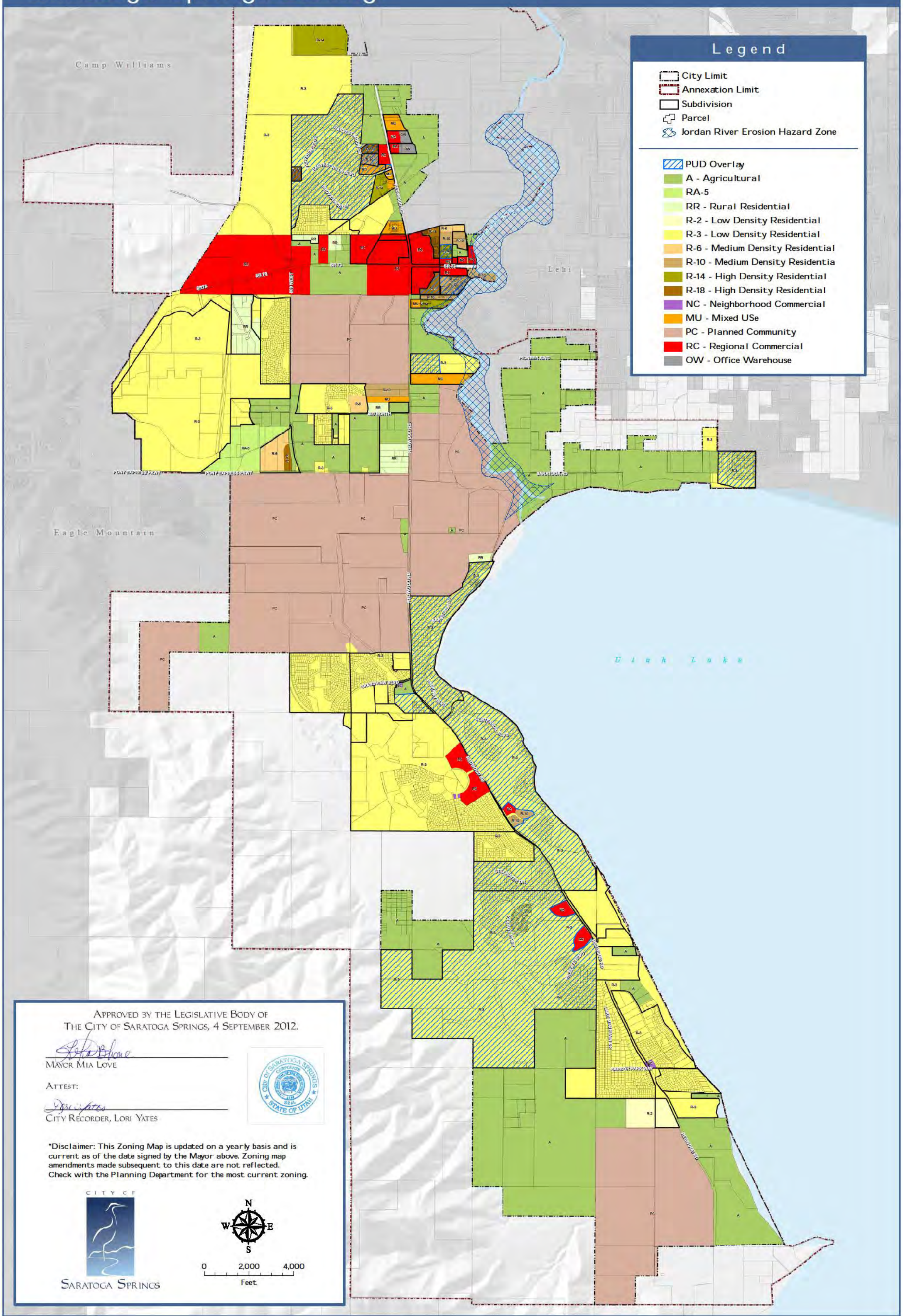
19. The hydraulic model predicts that new construction will not decrease the pressures within the existing water system to such that the minimum pressures as specified in *R309-105-9, Minimum Water Pressure* are not met. *[R309-511-6(1)(d)]* ☑ _____

20. The velocities in the model are not excessive and are within industry standards. ☑ _____

APPENDIX I

City Zoning Plan and
Future Growth Projection Maps

Saratoga Springs Zoning



Approved by the Legislative Body of
The City of Saratoga Springs, 4 September 2012.

Mayor Mia Love

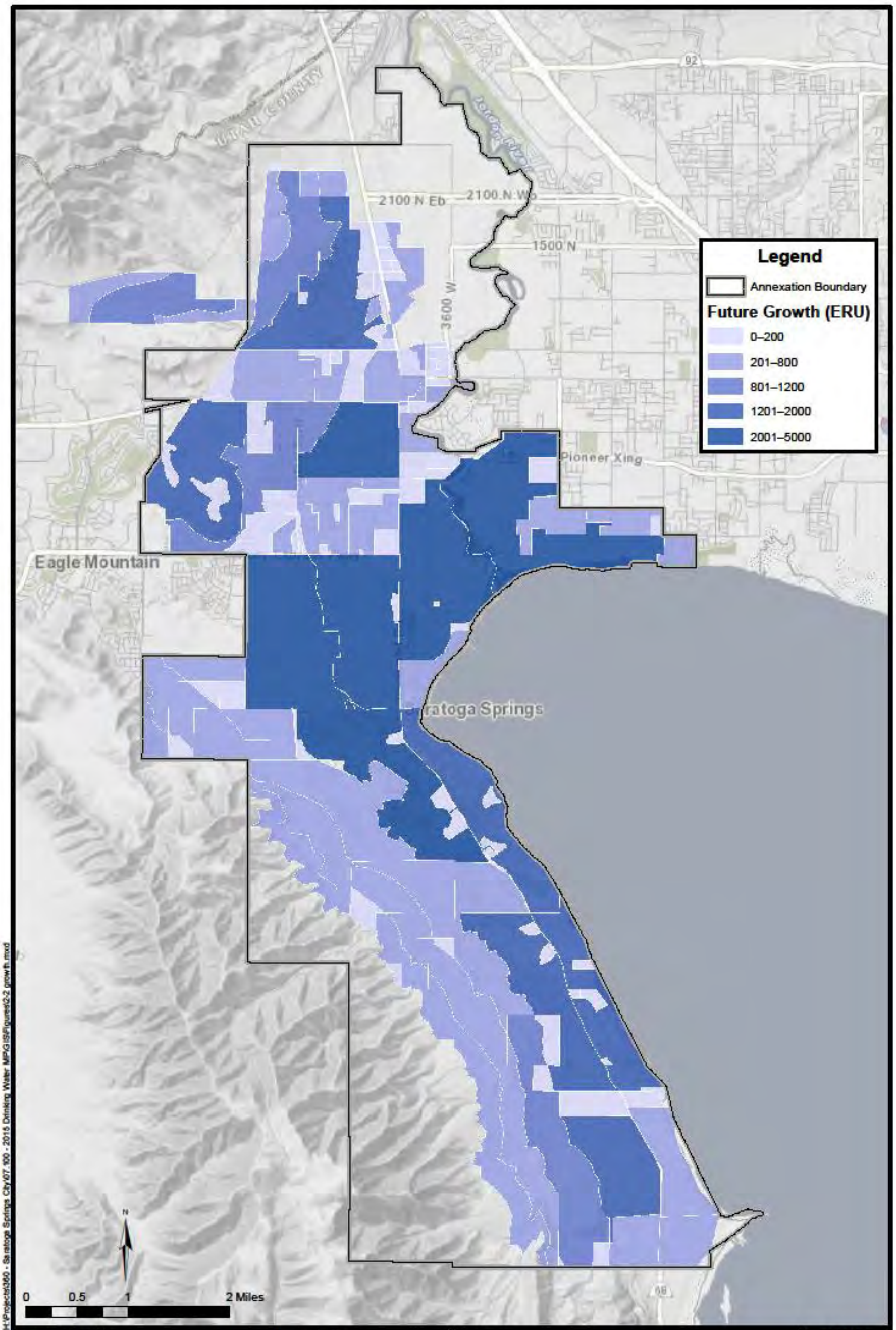
Attest:

City Recorder, Lori Yates

*Disclaimer: This Zoning Map is updated on a yearly basis and is current as of the date signed by the Mayor above. Zoning map amendments made subsequent to this date are not reflected. Check with the Planning Department for the most current zoning.

City of Saratoga Springs

19 September 2012



HANSEN ALLEN & LUCE INC

SARATOGA SPRINGS DRINKING WATER MASTER PLAN

FUTURE GROWTH PROJECTION

FIGURE 2-2

Date: 3/16/2016
Document Path: H:\Projects\360 - Saratoga Springs City\07.100 - 2015 Drinking Water MP\GIS\Figures\2-2 growth.mxd