Culinary Water Master Plan

January 2019

Prepared for:

IVINS CITY
UTAH

Prepared by:

BOWEN COLLINS & ASSOCIATES



CULINARY WATER MASTER PLAN

January 2019



Prepared for:

IVINS CITY
UTAH

Prepared by:

BOWEN COLLINS & ASSOCIATES

TABLE OF CONTENTS

Page No.

EXECUTIVE SUMMARY ES-1
Introduction ES-1
Service Area ES-1
Projected Growth and Water Use ES-1
Evaluation of Culinary Water Systems ES-3

CHAPTER 1 – INTRODUCTION 1-1
Introduction 1-1
Service Area 1-1
Annexation Considerations 1-2
Scope of Services 1-3
Authorization 1-3
Project Staff 1-3
Ivins City Staff 1-4
Ivins City Council 1-4

CHAPTER 2 – POPULATION AND LAND USE ANALYSIS 2-1
Historical Population 2-1
Existing Land Use 2-2
Future Land Use and Projected Buildout 2-3
Population Projections 2-5

CHAPTER 3 – WATER DEMAND ANALYSIS 3-1
Current Demands 3-1
Peak Day Demand 3-3
Peak Hour (Instantaneous) Demand 3-4
Future Demands 3-6
Implementation of the Secondary Irrigation System 3-9

CHAPTER 4 – WATER SOURCE AND TRANSMISSION ANALYSIS 4-1
Ivins City Water Rights 4-1
Water Supply Agreements 4-2
Existing Sources & Transmission Piping 4-5
Evaluation of Existing Source Capacity 4-8
Water Conservation 4-9
Water Quality Considerations 4-9
Future Sources 4-11
Pumping Station & Transmission Analysis 4-13

CHAPTER 5 – WATER STORAGE ANALYSIS 5-1
Fire Storage 5-2
Existing Storage Analysis 5-4

TABLE OF CONTENTS

Page No.

Future Storage – Buildout 5-6
Future Storage – 10 Year Growth Window 5-8
Recommendations 5-9

CHAPTER 6 – DISTRIBUTION PIPING SYSTEM ANALYSIS 6-1
Introduction 6-1
Model Calibration 6-2
Pressure Analysis 6-3
Hydraulic Model Results 6-5
Recommended Distribution System Improvements 6-8

CHAPTER 7 – KAYENTA WATER USERS SYSTEM EVALUATION 7-1
Summary of Existing KWU System 7-1
Benefit of Merging the Ivins & KWU System 7-2
Estimated Replacement Value of KWU System 7-3
Recommended Approach to Combining the System 7-5
Recommended Steps Prior to Merging Systems 7-6

CHAPTER 8 – CAPITAL FACILITIES PLAN 8-1
Recommended Capital Improvement Budget 8-1
Overall Capital Improvements through Buildout 8-3
10-Year Capital Improvement Plan Summary 8-4

TABLE OF CONTENTS
(continued)

LIST OF TABLES

No. Title **Page No.**

ES-1 Ivins City Water Use Projections....ES-2
ES-2 Recommended 10-Year Capital Facilities Projects....ES-3

2-1 Historical Population of Utah, Washington County, and Ivins City....2-1
2-2 Summary of Existing Development....2-2
2-3 Existing Land Use in Ivins City as of 2017....2-3
2-4 Land Use Data for Future Buildout Calculations....2-4
2-5 Ivins Population Projection Data....2-6

3-1 Current Average Annual Water Usage June 2015 to May 2016....3-2
3-2 Total Daily Usage Result from Ivins City Metering....3-3
3-3 Summary of Monthly Meter Data from 2013 – 2016....3-4
3-4 Estimated Water Demand per ERU....3-4
3-5 July 16, 2017 Hourly Meter Results....3-5
3-6 Summary of Current Culinary Water Demands1....3-5
3-7 Projected Future Ivins City Required Source Capacity....3-7
3-8 Revised Water Demand Projections with Secondary Irrigation System....3-10

4-1 Existing Ivins City Water Rights....4-2
4-2 Ivins City Unapproved Water Right Applications....4-2
4-3 Guaranteed Water Deliveries from Gunlock Well Agreement....4-3
4-4 Summary of Ivins City Water Rights/Water Supply Agreements....4-4
4-5 Annual Deliveries to Ivins City Categorized by Location of Delivery Point, 2010 – 2016....4-6
4-6 Estimated Peak Day Deliveries to Ivins City Categorized by Location of Delivery Point, 2010 – 2016....4-7
4-7 Existing Source Connection Capacities....4-9
4-8 Significant Water Quality Parameters for Each Ivins City Water Source....4-10
4-9 Existing Pumping Station/Transmission Pipelines....4-14
4-10 Build-Out Pumping Station/Transmission Pipelines....4-15

5-1 Description of Existing Ivins City Storage Facilities....5-1
5-2 Excerpt from IFC Table B105.1 Minimum Required Fire Flow for Buildings....5-2
5-3 Summary of Existing Buildings Fire Flow Requirements....5-3
5-4 Ivins City Existing Water Storage Analysis....5-4
5-5 Ivins City Analysis of Excess ERUs in Existing Storage Facilities....5-5
5-6 KWU Existing Water Storage Analysis....5-5
5-7 KWU Analysis of Excess ERUs in Existing Storage Facilities....5-5

5-8 Future Tank Storage Evaluation – Build-Out 5-7
5-9 Future Tank Storage Evaluation – 10 Year Growth Conditions 5-8

6-1 Summary of Distribution Piping System 6-1
6-2 Static Pressure Analysis of Pressure Zones per Existing Conditions 6-4

7-1 KWU Historical Water Usage (acre-feet) 7-1
7-2 Existing KWU Storage Facilities 7-1
7-3 KWU Pressure Zone Summary 7-2
7-4 Estimated Replacement Value of Existing KWU System 7-3

8-1 Estimated Replacement Value of Existing Ivins City System 8-2
8-2 Estimated Replacement Value of Existing Ivins City System 8-3
8-3 Culinary Water System Improvements through Build-Out 8-3
8-4 Recommended 10-Year Capital Facilities Projects 8-4

TABLE OF CONTENTS
(continued)

LIST OF FIGURES

No.	Title	On or Following Page No.
ES-1	Ivins City Culinary Water Service Area	ES-1
ES-2	Annual Demand Projection with Secondary Irrigation System	ES-2
ES-3	Peak Day Demand Projection with Secondary Irrigation System	ES-2
ES-4	Recommended 10-Year Capital Improvements	ES-3
1-1	Ivins City Culinary Water Service Area	1-1
2-1	Graph of Ivins City Historical Population	2-1
2-2	Existing Developed and Undeveloped Areas	2-3
2-3	Ivins City Land Use Plan	2-3
2-4	Ivins City Population Projections through Buildout	2-5
3-1	Ivins City Historical Municipal Water Use 2010 to 2017	3-1
3-2	Projected Future Annual Demand through Buildout	3-8
3-3	Projected Future Peak Day Demand through Buildout	3-8
3-4	Revised Annual Demand Projection with Secondary Irrigation System	3-10
3-5	Revised Peak Day Demand Projection with Secondary Irrigation System	3-10
4-1	Water Sourcing and Transmission Schematic	4-5
4-2	Annual Deliveries to Ivins City Categorized by Location of Delivery Point, 2010 – 2016	4-8
6-1	Existing Culinary Water Pressure Zones	6-3
6-2	Existing Peak Day Demand Pressures	6-5
6-3	Existing Peak Hour Demand Pressures	6-5
6-4	Existing Peak Day Demand with Fire Flow	6-5
6-5	10 Year Peak Day Demand Pressures	6-7
6-6	10 Year Peak Hour Demand Pressures	6-7
6-7	Buildout System Layout/Sizing	6-7
6-8	Buildout Peak Day Demand Pressures	6-7
6-9	Buildout Peak Hour Demand Pressures	6-7
7-1	Kayenta Water Users System	7-1
8-1	Recommended 10 Year Capital Improvements	8-4

EXECUTIVE SUMMARY

INTRODUCTION

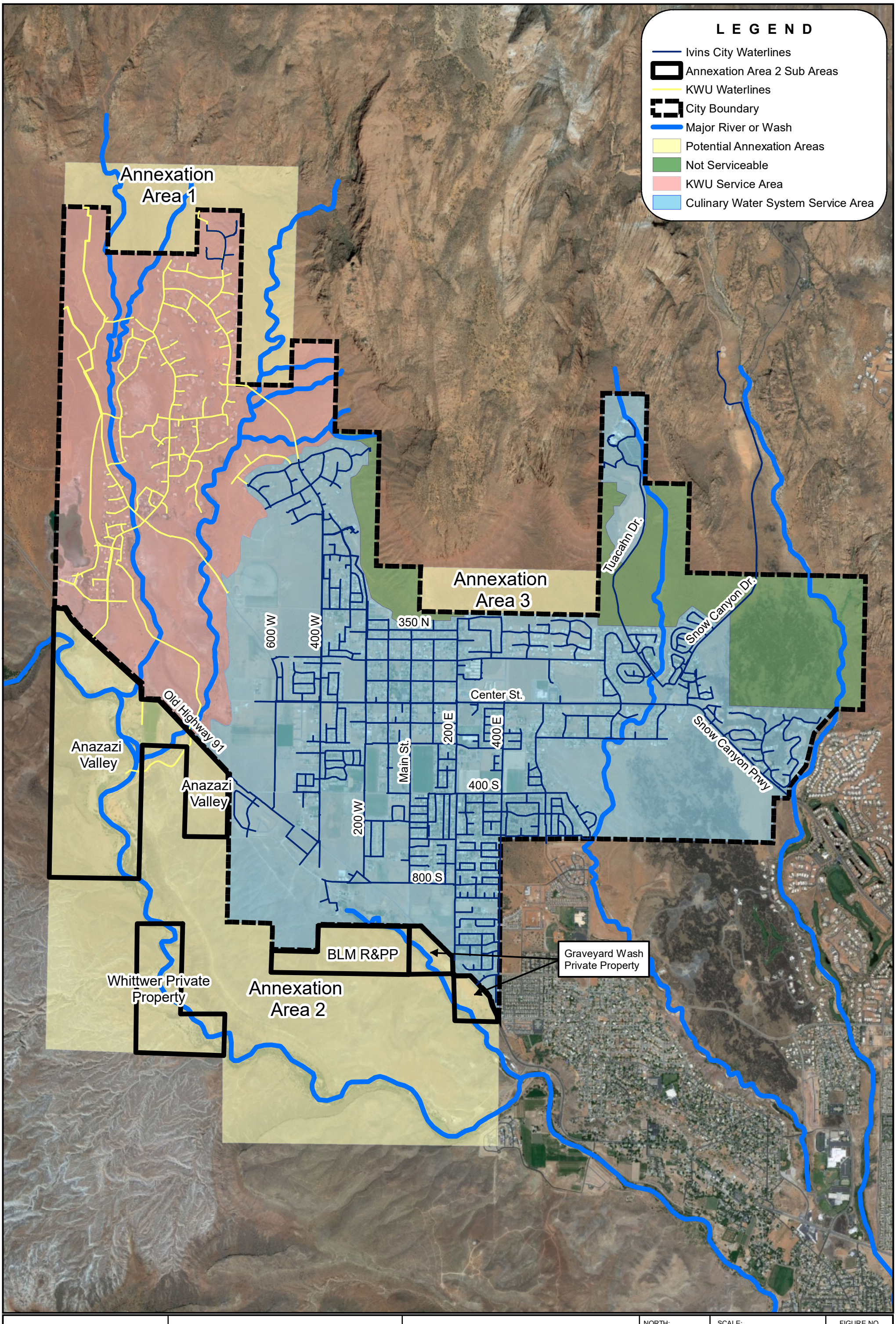
Ivins City (City) contracted the services of Bowen, Collins & Associates, Inc. (BC&A) to complete a Culinary Water System Master Plan. The purpose of this study is to provide the City with an updated plan to maintain a viable and efficient culinary water system capable of meeting future demands of its service area and satisfying customer expectations.

SERVICE AREA

The Ivins City water system service area is shown in Figure ES-1.

PROJECTED GROWTH AND WATER USE

Water system growth projections were developed using the City's current land use plan as well as the 2013 culinary water master plan produced by Ivins City. The results of the growth projections are summarized in Table ES-1, Figure ES-2, and Figure ES-3. These projections take into account the projected demand on the proposed secondary irrigation system in Ivins.



BOWEN COLLINS & ASSOCIATES	IVINS CITY CULINARY WATER MASTER PLAN	IVINS CITY CULINARY WATER SERVICE AREA	NORTH: NORTH	SCALE: 0 1,250 2,500 Feet	FIGURE NO. ES-1

S:\Ivins\235-17-02 Culinary Water Master Plan, IFFP, IFA\4.0 GIS\4.4 Figures\Figure ES-1 - Culinary System Service Area_Update.mxd aanderson 1/31/2019

Table ES-1
Ivins City Water Use Projections

	Ivins City Municipal Water Service Area							Kayenta Water Users System				Total Ivins City (Including KWU)			
		Ivins Culinary Water System			*Ivins Secondary Irrigation System*										
Year	ERUs	Average Annual Demand (acre-feet/yr)	Peak Day Demand (gpm)	Peak Hour Demand (gpm)	Average Annual Demand (acre-feet/yr)	Peak Day Demand (gpm)	Peak Hour Demand (gpm)	ERUs	Average Annual Demand (acre-feet/yr)	Peak Day Demand (gpm)	Peak Hour Demand (gpm)	ERUs	Average Annual Demand (acre-feet/yr)	Peak Day Demand (gpm)	Peak Hour Demand (gpm)
2017	3,629	2,722	3,528	5,469	0	0	0	372	279	362	561	4,001	3,001	3,890	6,030
2020	4,017	2,665	3,455	5,355	347	450	697	490	368	477	739	4,507	3,380	4,381	6,791
2025	4,663	2,897	3,755	5,821	600	778	1,206	687	515	668	1,036	5,350	4,012	5,201	8,062
2030	5,309	2,981	3,864	5,990	1,000	1,296	2,009	884	663	860	1,332	6,193	4,645	6,020	9,332
2035	5,955	3,216	4,168	6,461	1,250	1,620	2,511	1,081	811	1,051	1,629	7,036	5,277	6,840	10,602
2040	6,601	3,450	4,472	6,933	1,500	1,944	3,014	1,278	959	1,243	1,926	7,879	5,909	7,659	11,873
2045	7,247	3,435	4,452	6,901	2,000	2,592	4,018	1,475	1,106	1,434	2,223	8,722	6,541	8,478	13,143
2050	7,893	3,419	4,432	6,870	2,500	3,240	5,023	1,672	1,254	1,626	2,520	9,565	7,174	9,298	14,413
2055	8,539	3,404	4,412	6,639	3,000	3,888	6,028	1,869	1,402	1,817	2,817	10,408	7,806	10,117	15,683
2057	8,797	3,382	4,383	6,795	3,216	4,168	6,462	2,038	1,529	1,981	3,071	10,835	8,126	10,534	16,328

Figure ES-2
Annual Demand Projection with Secondary Irrigation System

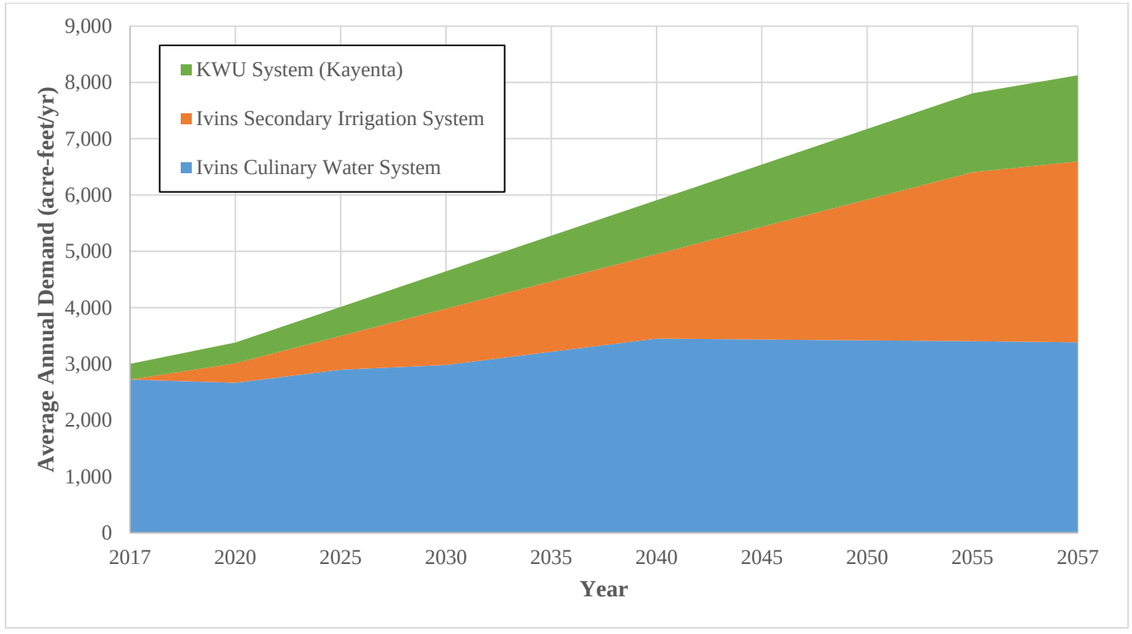
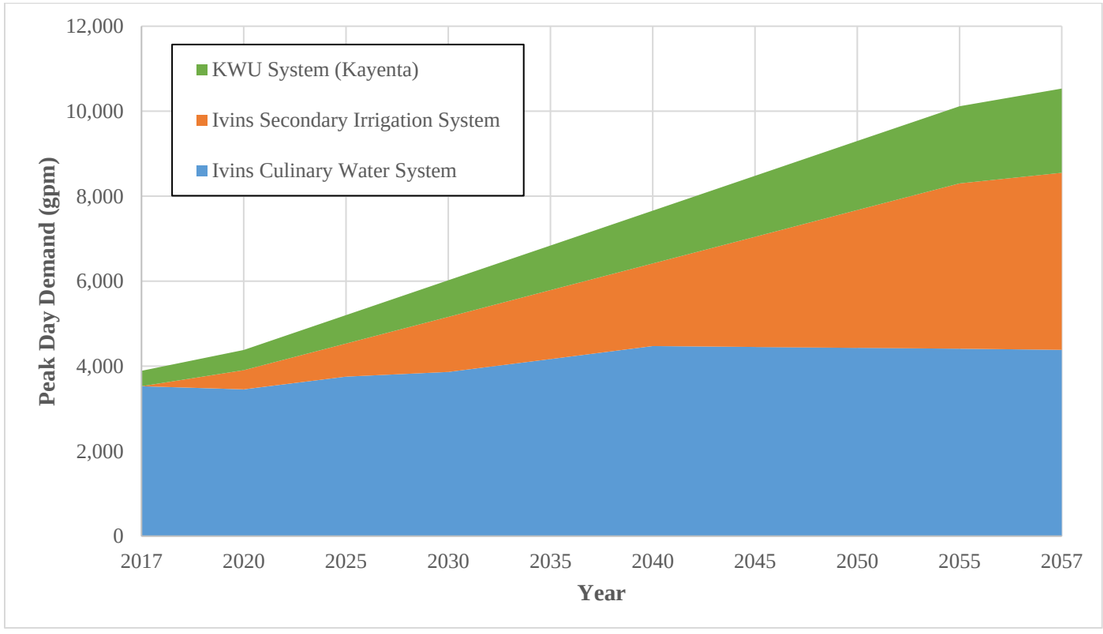


Figure ES-3
Peak Day Demand Projection with Secondary Irrigation System



EVALUATION OF CULINARY WATER SYSTEM

The existing and future Ivins City culinary water systems were evaluated using a hydraulic computer model. Recommendations for future culinary water system improvements were determined based on hydraulic model results, assuming the City implements the secondary irrigation system as recommended in the Secondary Irrigation Master Plan. Figure ES-4 displays the location and projected timing for the recommended improvement projects over the next 10 years. The estimated cost of the recommended projects is shown in Table ES-2.

Table ES-2
Recommended 10-Year Capital Facilities Projects

Project type	Project Identifier	Project Description	Estimated Project Year	Estimated Cost (2017 Dollars)
Distribution System[1]	D-01	Install single booster pump to replace individual booster pumps on homes near the Taviawk Tank	2019	$60,000
Distribution System[2]	D-02	Replace 430 feet of 2-inch pipe with 8-inch pipe	2020	$45,000
			TOTAL	**$105,000**

[1]The City should consider asking the residents benefited by this project to help pay for the improvement
[2]Red Mountain Resort should be advised concerning the potential fire flow deficiency in their location. The City will require the Resort to fund any improvements to fire flow capacity servicing their buildings.

L E G E N D

- Recommended Improvements
- Ivins City Waterlines
- Water Tank

Assure that backup connection from KWU is available, Connection provides necessary supplemental flow to Taviawk subdivision during a fire event

D-01
Install booster pump station to replace the existing individual booster pumps for homes on Shinava Court

D-02
Replace 430 feet of 2-inch pipe with new 8-inch pipe

Tuacahn Dr.
Snow Canyon Dr.
Snow Canyon Prwy
Center St.
350 N
400 W
200 W
600 W
Old Highway 91
Main St.
200 E
400 E
400 S
800 S

BOWEN COLLINS & ASSOCIATES

IVINS CITY
CULINARY WATER MASTER PLAN

RECOMMENDED 10-YEAR CAPITAL IMPROVEMENTS

NORTH:

SCALE: 0 900 1,800 Feet

FIGURE NO.
ES-4

S:\Ivins\235-17-02 Culinary Water Master Plan, IFFP, IFA\4.0 GIS\4.4 Figures\Figure 8-1 - Recommended Distribution System Improvements.mxd aanderson 1/31/2019

CHAPTER 1
INTRODUCTION

INTRODUCTION

Ivins City is one of the quickest growing communities in Washington County. Located just south of Snow Canyon State Park, what was previously a small rural town has rapidly turned into a large residential community. To plan for future water needs in the City, Ivins has retained Bowen Collins & Associates (BC&A) to prepare a master plan update for the City's culinary water system. The purpose of this water master plan report is to evaluate the different components of the City's culinary water system and identify improvements that will resolve existing deficiencies and accommodate the growing needs of the system.

This report, in many ways, is a companion to the City's Secondary Irrigation Master Plan completed by BC&A. Many of the recommendations found in this report have been developed under a certain set of assumptions regarding the implementation of a secondary irrigation system in Ivins.

SERVICE AREA

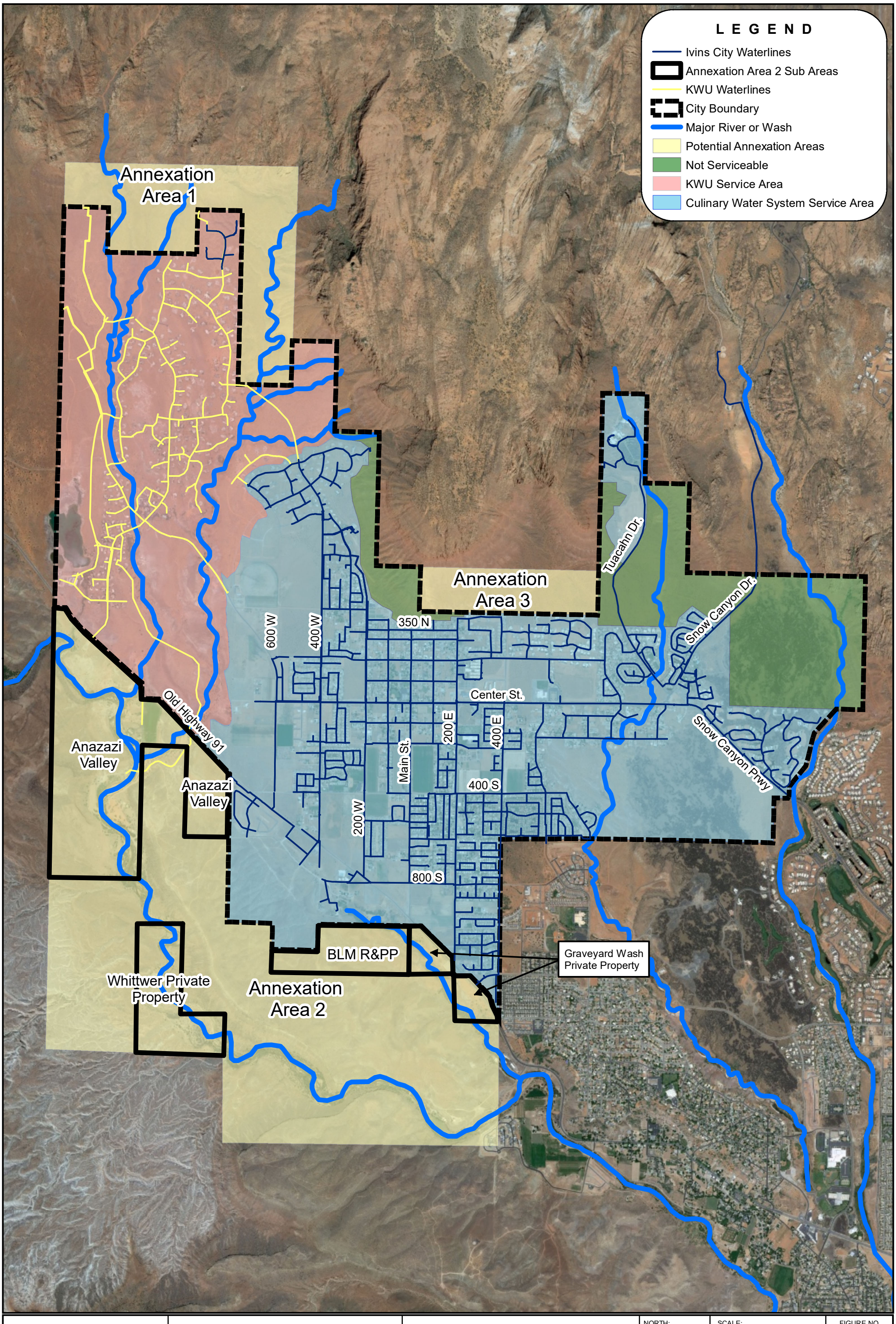
Ivins City is serviced by two water systems, one public system operated by Ivins City and one private system operated by Kayenta Water Users (KWU). The KWU system services the Kayenta area with the exclusion of most of the Taviawk area which is serviced by Ivins City. Figure 1-1 shows a map of the two service areas.

The KWU system has a limited supply of water based on an agreement to use the Ence Wells owned by the Washington County Water Conservancy District (WCWCD). The agreement states the following:

It is recognized that the water transferred, together with the water presently allocated to the Ence well, would allow for a maximum of Six Hundred Twelve (612) culinary connections and that [KWU] reserves (without cost to Ence until connections are actually made) Sixty (60) connections for the use of Ence.

This results in the KWU being able to service a total of 552 connections with its current water supply. The City's planning data shows that the KWU system currently services 363 residences, meaning that the system is at 65% of its total capacity under the current agreement with WCWCD. As discussed in further detail in Chapter 2 of this report, recent changes in the land use plan for Ivins indicate that the Kayenta area could have over 1,500 Equivalent Residential Units (ERUs) at buildout, nearly 3 times the allowable number of connections per the existing water use agreement.

This considered, it may become necessary in the near future for the private KWU water system to be merged with the Ivins City Municipal System to enable additional growth in this area. For this reason, this study includes a valuation of the existing KWU water system to aid City management in moving forward with this potential combination of the two systems.



BOWEN COLLINS & ASSOCIATES	IVINS CITY CULINARY WATER MASTER PLAN	IVINS CITY CULINARY WATER SERVICE AREA	NORTH: NORTH	SCALE: 0 1,250 2,500 Feet	FIGURE NO. 1-1

S:\Ivins\235-17-02 Culinary Water Master Plan, IFFP, IFA\4.0 GIS\4.4 Figures\Figure 1-1 - Culinary System Service Area_Update.mxd aanderson 1/31/2019

ANNEXATION CONSIDERATIONS

Potential annexation zones near Ivins City are shown in Figure 1-1. These areas are described in further detail below.

Area 1: North of Kayenta – This area is within the Red Cliffs Desert Reserve and owned by the U.S. Bureau of Land Management (BLM). The likelihood of an annexation in this area is too low to be considered in the future planning of water systems, therefore this area does not impact this study.

Area 2: Santa Clara River Valley – This is a large area that encompasses much of the Santa Clara River area including the Anazazi Valley and areas identified and protected by the BLM as the Santa Clara River Reserve. The majority of the area is not viable for future annexation and development as the BLM has assigned the area around the Santa Clara River as an avoidance area. However, there are three subareas within that are developable as follows:

- **Anazazi Valley** – The Anazazi Valley has a significant amount of private property that might be developable minus the areas with extremely steep slopes and the flood plain areas of the Santa Clara River. It is expected that at most 320 acres would be developable. The current land use plan does not address a land use for this area, however, for the purpose of this study it is assumed to be low density residential at a density no more than one unit per acre. The servicing of this area could be completed by one of the following options:

    - Service directly from the 3 MG tank owned by City of St. George located on the Shivwits Reservation. Through an agreement with the City of St. George, a connection to the 20-inch Gunlock pipeline could provide sufficient pressure to the upper elevations and a pressure reducing valve (PRV) would need to be provided to service some of the lower elevations.

    - Service by connection to the KWU system, which would require some significant length of new pipelines and require that the KWU system be part of the Ivins City municipal system.

- **Indigo Trails -** There are 70 acres composed of both State of Utah Institutional Trust Lands Administration (SITLA) land and private property adjacent to the Indigo Trails project that could be easily serviced by Ivins. This area has an assumed development potential of 180 ERUs. This development assumption is speculative as it would be subject to zoning and density determinations made by the Planning Commission and City Council.

- **100 Acre R&PP** – There are 100 acres south of the Pendleton properties which are owned by the BLM but available for a Recreation and Public Purpose (R&PP) right-of-way grant. The City is planning to use this land for a large 23 acre park, cemetery, and public works yard. Based on preliminary development plans, it is estimated that this area will represent 90 ERUs of water demand.

- **Graveyard Wash Private Property Areas** – This 60 acre area located to the east of the BLM R&PP land. It is uncertain what type of development will occur in this area,

particularly due to a large portion of the land being in the wash. This area may eventually have some commercial/residential development, but is not anticipated to represent a very significant demand on the system if serviced by Ivins.

- **Whittwer Private Property** – This area may end up being preserved by the Whittwers as it is. The property is too remote to consider developing at this point in time, but should be considered in subsequent master planning efforts.

Area 3: Base of Red Mountain – This area was once considered to be viable for future development when it was administered by SITLA. This land was purchased by State Parks and is no longer considered for future development; therefore this area does not impact this study.

SCOPE OF SERVICES

The general scope of this project involved an analysis of the City's culinary water system and its ability to meet the present and future water needs of its residents. As part of this Master Plan, BC&A completed the following tasks.

Task 1: Collected and reviewed data needed to develop the master plan.

Task 2: Updated population projections and estimated per capita water demands to evaluate existing and future system needs.

Task 3: Evaluated the City's sources and storage facilities for existing and future development conditions.

Task 4: Updated and calibrated the City's hydraulic computer model and identified existing and future system deficiencies.

Task 5: Identified existing deficiencies in the various components of the City's culinary water system.

Task 6: Identified future deficiencies in the various components of the City's culinary water system.

Task 7: Identified improvements to resolve existing and future system deficiencies.

Task 8: Developed a 10-year capital facilities plan identifying recommended improvements to be completed within a 10-year planning window.

Task 9: Documented results in this master plan report.

AUTHORIZATION

Ivins City contracted the services of BC&A to prepare this Culinary Water System Capital Facilities Plan in June of 2017.

PROJECT STAFF

The project work was performed by the BC&A team members listed below. Team members' roles on the project are also listed. The project was completed in BC&A's St. George, Utah office. Questions may be addressed to Todd Olsen, Project Manager at (435) 656-3299.

Keith Larson	Principal-In-Charge
Todd Olsen	Project Manager
Aaron Anderson	Project Engineer
Mike Hilbert	Technical Writing

IVINS CITY STAFF

Ivins City staff worked closely with BC&A personnel in collecting data associated with this master plan. The following City personnel were influential in the completion of this master plan:

Dale Coulam	City Manager
Chuck Gillette	Public Works Director/City Engineer
Tom Jorgensen	Assistant Public Works Director of Administration
Shiloh Pentz	Assistant Public Works Director of Operations
Wally Ritchie	Director of Finance

IVINS CITY COUNCIL

The following elected officials participated in the review and approval of this master plan:

Chris Hart	Mayor
Ron Densley	Councilperson
Dennis Mehr	Councilperson
Cheyne McDonald	Councilperson
Jenny Johnson	Councilperson
Miriah Elliott	Councilperson

CHAPTER 2
POPULATION AND LAND USE ANALYSIS

This chapter reviews historical population, existing land use, future land use and an estimate of buildout population, along with population growth projections to determine the approximate year of buildout. These projections, in conjunction with the water use trends of the existing system, are used to estimate future water system demands and to plan for these demands accordingly.

HISTORICAL POPULATION

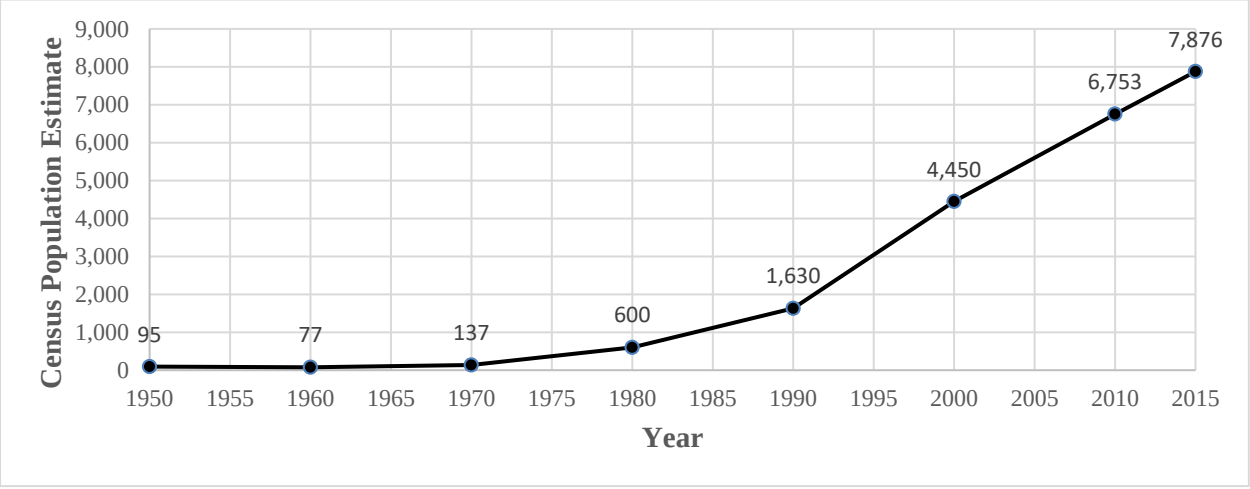
Ivins City has rapidly grown over the past three decades from a sparsely populated rural town to a significant suburban city being the fourth largest city in Washington County. Table 2-1 and Figure 2-1 below show the historical growth of Ivins from 1950 to 2015 based on U.S. Census data.

Table 2-1
Historical Population of Utah, Washington County and Ivins City

	1950	1960	1970	1980	1990	2000	2010	2015[1]
State of Utah	688,862	890,627	1,059,273	1,461,037	1,722,850	2,246,553	2,763,885	2,997,404
% Growth		29.30%	18.90%	37.90%	17.90%	30.40%	23.00%	8.45%
Washington County	9,836	10,271	13,669	26,065	48,560	90,354	138,115	154,602
% Growth		4.40%	33.10%	90.70%	86.30%	86.10%	52.90%	11.94%
Ivins City	95	77	137	600	1,630	4,450	6,753	7,876
% Growth		-18.90%	77.90%	338.00%	171.70%	173.00%	51.80%	16.63%

[1]2015 population estimates taken from "Utah's Long-Term Demographic and Economic Projections Summary" from Kem C. Gardner Policy Institute, University of Utah, July 2017.

Figure 2-1
Graph of Ivins City Historical Population



In previous decades, Ivins had been growing at a rate well above the overall County rate. From 2000 - 2010, the growth rate has slowed to be nearly the same as the County, only to increase once again in the first half of this decade. A review of Ivins City garbage account data, which is a good indicator of the number of homes in Ivins, indicates that the rate at which new homes were being built from 2000 - 2010 exceeded the growth rate of the actual population. This gap may be due to the following:

- First, the quantity of persons per household has significantly decreased from 3.10 to 2.78. This may be indicative of the attractiveness of Ivins as a retirement community as the 65 and older population has increased from 10.2 percent to 19.8 percent.
- There may be a trend in local population demographics towards smaller sized families.
- The attractiveness of Ivins for second homes has increased.

Vacant or vacation homes may use less water indoors than a typical residence, but typically do not use less water for outdoor use. For the purposes of this study, it has been assumed that each housing unit in the City is inhabited (i.e. no reduction in indoor water use for second homes).

Existing Land Use

Land use analysis is the foundation of City and utility planning. Land use and zoning plans help to predict future water use quantities and patterns. The City area was analyzed to determine the number of existing residences, irrigated acres, and the extent of commercial land uses.

Table 2-2 below shows a summary of the existing land use analyzed by area in acres. Of the more than 6,000 acres of the Ivins City Boundary, 2,460 acres or 40.6% is developed. Another 14.7% is considered to be permanent open space.

Table 2-2
Summary of Existing Development

	Total (acres)	%
Developed Area	2,460	40.6%
Undeveloped	2,712	44.7%
Open Space	892	14.7%
Total	**6,064**	

As shown, just under 45% of the City remains to be developed and is currently either naturally vegetated, cultivated, or fallow. A portion of this area may be undevelopable due to slopes, flood plains and other natural geographical features. This does not include the 400 acres of potentially developable land in the Anazazi Valley annexation zone or other potential annexation areas.

Existing land use was further evaluated to determine a more exact number of residences, multi-family units and an estimation of area irrigated by the Ivins Irrigation Company. These results are given in Table 2-3.

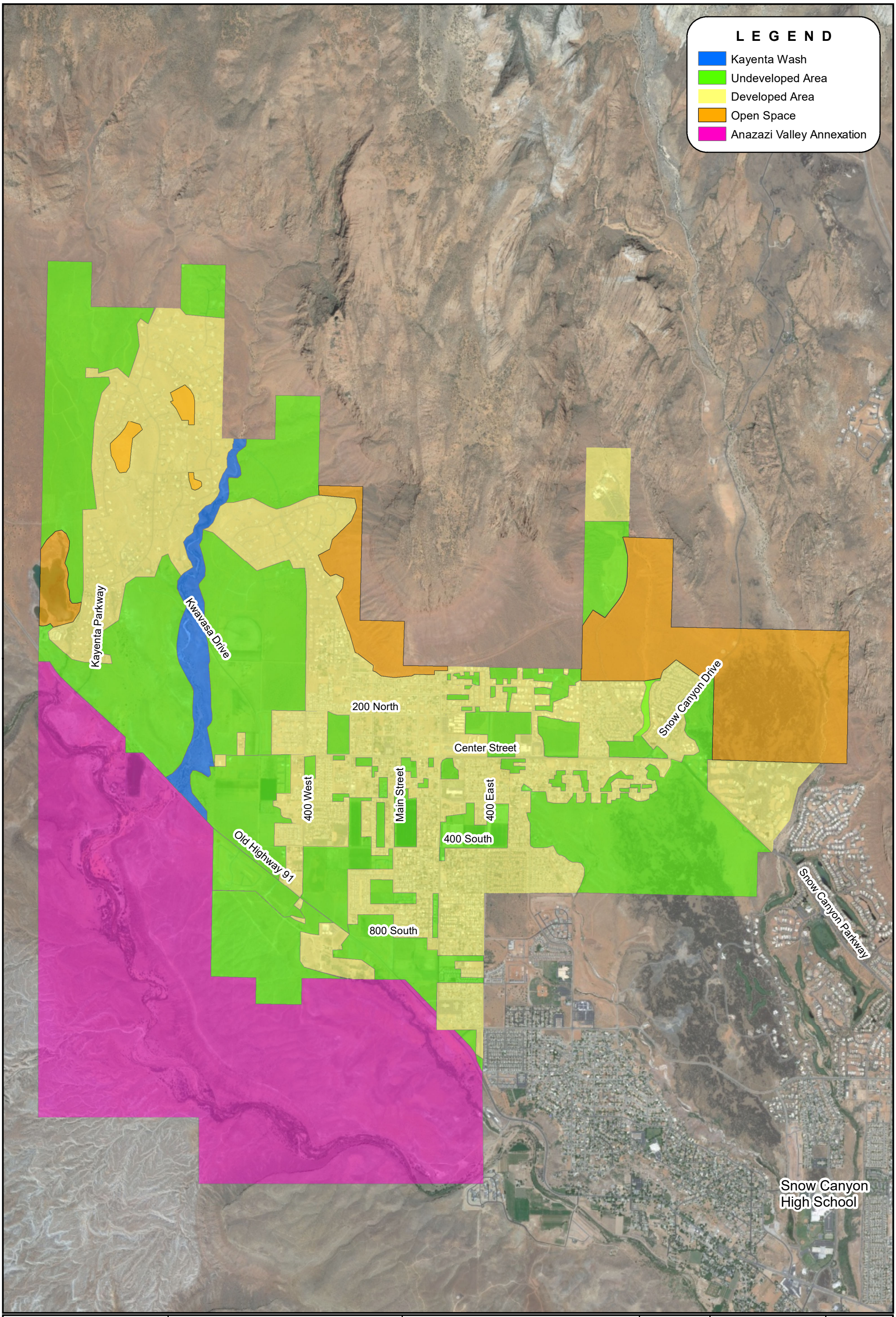
Table 2-3
Existing Land Use in Ivins City as of 2017

	All Ivins City	Ivins Municipal Water System	KWU System (Kayenta)
Single Family Residences	3,506	3,146	360
Multi-Family Units	179	175	4
Estimated Landscaped Acres (Developed Areas)	432 acres	395 acres	37 acres
Irrigated Acres (Cultivated Areas with Irrigation Co.)	270 acres	270 acres	0 acres
Single Family Vacant Lots	507	426	81
Commercial ERUs (indoor use)	316	311	5
Total ERUs	4,001	3,632	369
With build out of existing vacant lots			
Total ERUs	4,508	4,058	450

Figure 2-2 provides a map of areas of the City that are currently developed.

Future Land Use & Projected Buildout

Figure 2-3 shows the current Ivins City land use plan as of August 2017. The build out population for Ivins City is based on a detailed analysis of the current land use plan. The analysis identified areas for infill development as well as the development of undeveloped areas. The results of this analysis are shown in Table 2-4.



BOWEN COLLINS & ASSOCIATES

IVINS CITY
CULINARY WATER
MASTER PLAN

EXISTING DEVELOPED &
UNDEVELOPED AREAS

NORTH:

SCALE: 0 1,250 2,500 Feet

FIGURE NO.
2-2

S:\Ivins\235-17-02 Culinary Water Master Plan, IFFP, IFA\4.0 GIS\4.4 Figures\Figure 2-2- Existing Land Use Development.mxd aanderson 1/31/2019

L E G E N D

Landuse

LDR	*Low Density Residential (Less than or Equal to 2.32 Units/Acre)*
MDR	*Medium Density Residential (2.33 to 4.64 Units/Acre)*
HDR	*High Density Residential (4.65 or Greater Than Units/Acre)*
OS	*Open Space*
WASH	*Dry Wash - Flood Plain*
PARK	*Parks*
RMU TOWN CENTER	*RMU Town Center*
RMU - VILLAGE	*RMU - Village*
COMM COMMUNITY	*Commercial Community*
COMM RESORT	*Commercial - Resort*
COMM NEIGH	*Commercial - Neighborhood*
COMM PROFESSIONAL	*Commercial - Professional and Research*
COMM W LIGHT MFG	*Commercial with Light Manufacturing*
Ivins Roads	

Kayenta Parkway
Kwavasa Drive
200 North
Center Street
400 West
Main Street
400 East
400 South
Old Highway 91
800 South
Snow Canyon Drive
Snow Canyon Parkway

BOWEN COLLINS & ASSOCIATES

IVINS CITY
CULINARY WATER MASTER PLAN

IVINS CITY
LAND USE PLAN

NORTH:
NORTH

SCALE:
0 1,250 2,500
Feet

FIGURE NO.
2-3

S:\Ivins\235-17-02 Culinary Water Master Plan, IFFP, IFA\4.0 GIS\4.4 Figures\Figure 2-3 - Current Land Use Plan.mxd aanderson 1/31/2019

Table 2-4
Land Use Data for Future Buildout Calculations

	Ivins City		Ivins Municipal Water		KWU (Kayenta)	
	Existing	Buildout	Existing	Buildout	Existing	Buildout
Single Family Housing Units	3,503	7,836	3,143	6,537	360	1,299
Multi-Family Housing Units	179	1,000	175	837	4	163
Anazazi Valley SF Residences	3	500	0	0	3	500
Total Housing Units	3,685	9,336	3,318	7,464	367	1,962
Vacant Lots for Single Family Housing	507	0	426	0	81	0
Landscaped Areas (acres)	432	1,050	395	882	37	168
Cultivated Areas (acres)	270	0	270	0	0	0
Transient Units	201	1,471	201	1,441	0	30
Commercial ERUs	316	1,409	311	1,333	5	76
BLM R&PP Land Annex	0	90	0	90	0	0
Total ERUs	**4,001**	**10,835**	**3,629**	**8,797**	**372**	**2,038**

Based on this analysis, the buildout number of residences in Ivins is **9,336** (including an estimated 500 units in the Anazazi Valley annexation area, see Figure 1-1). Assuming that 18% of the residences are second homes or unoccupied in accordance with current information from the County Assessor's Office, 7,656 would be considered permanent resident households. Using a household size of 2.7 (per current census estimates), the estimated **buildout population for Ivins City is approximately 20,700 people**. This represents an increase in the estimated buildout population compared to the 2013 master plan, which is a result of changes to the City's land use plan (low density areas being re-zoned for medium or high density development).

This buildout population estimate will change with any changes to the land use plan. Recently, the trend has been to allow more and more dense development with each modification of the land use plan, so there is a possibility that the estimated buildout population will increase as time moves forward. In prior capital facilities plans, an effort was made to estimate this larger population in anticipation of the land use plan being modified. However, this has been deemed unnecessary as these master plans are updated every four to six years and should simply be adapted as the land use plan changes over time.

Population Projections

Population projections identify the timing of community growth and provide information to determine how soon capital facilities need to be placed into service. This growth projection is based on analysis of previous years of growth and an understanding of the local demographics. Figure 2-4 shows two different population projections for Ivins City:

- **Governor's Office of Planning & Budget (GOPB)**: The Governor's Office of Planning & Budget develops growth projections for cities throughout the State in order to aid in planning and budgeting practices.

- **Custom Growth Projection for Ivins City (Recommended)**: This population projection was developed by looking at recent growth trends in the City and recent changes to the City's land use plan. The growth rate over the past 10 years, like most areas of Southern Utah, has varied significantly from year to year (with growth rates as low as 2% to as high as 8%). On average, the City has seen approximately 140 new homes built per year. Because the fluctuating growth rates tend to normalize over time, it was decided to assume a constant population growth for the City that is not percentage based as a function of the current population. Population was projected out assuming that the City will continue to grow at this average rate of 140 units per year.

As previously stated, it is important to note that changes to the land use plan will influence not only the rate of growth in the City but also the buildout population. If more "low density" areas are replaced with high density housing such as town homes, apartments, etc., the City population growth rate could increase significantly.

Figure 2-4
Ivins City Population Projections through Buildout

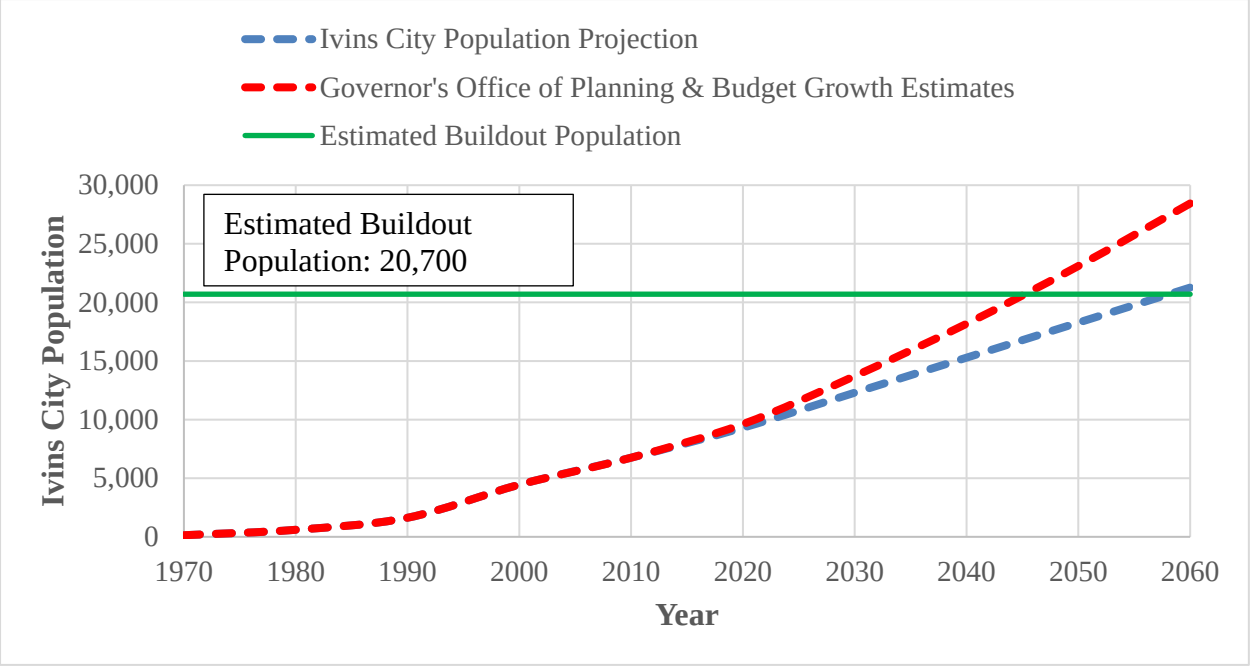


Table 2-5 shown below displays the population projections used for this master plan update. It should be noted that the updated population projection indicates that Ivins City will reach its buildout population of 20,700 by the year 2057.

Table 2-5
Ivins Population Projection Data

Year	Population	Population % Growth	Total Housing Units	Total Residences % Growth	Resident Households*	Household Size
1970	137					
1980	600	338%				
1990	1,630	172%				
2000	4,450	173%	1,690		1,435	3.1
2010	6,753	52%	2,880	70%	2,427	2.78
2015	7,876	17%	3,530	23%	2,895	2.72
↓ Projected Data ↓						
2020	9,366	18%	4,230	20%	3,469	2.7
2030	12,466	32%	5,630	33%	4,617	2.7
2040	15,566	24%	7,030	25%	5,765	2.7
2050	18,665	20%	8,430	20%	6,913	2.7
2060	21,765	16%	9,830	17%	8,061	2.7

[1]Resident households are considered to be 82% of the total housing units accounting for 18% of homes considered to be second homes or otherwise unoccupied per current county assessment records.

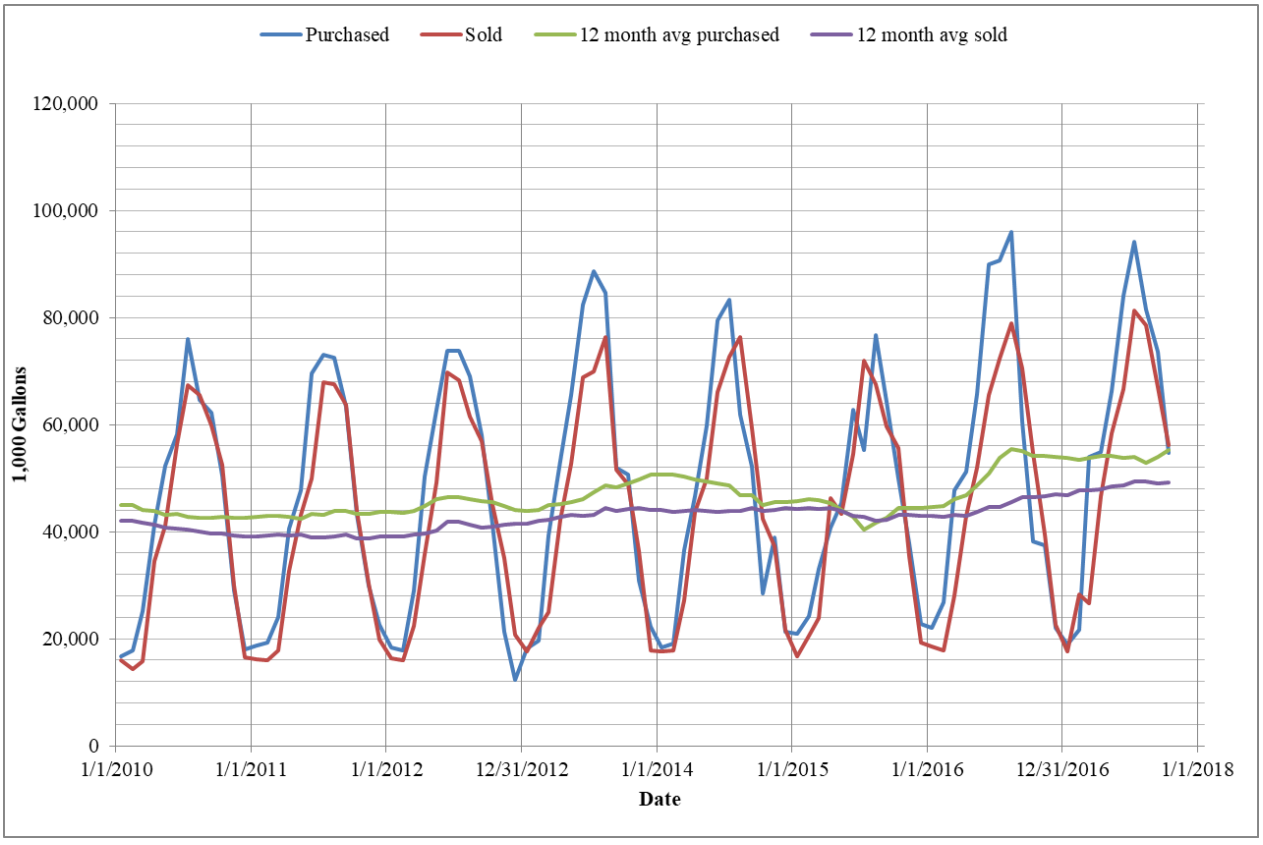
CHAPTER 3
WATER DEMAND ANALYSIS

This chapter evaluates historical and current water use data for the purpose of projecting future water demand for the City. Water demands have been evaluated on an annual, peak day, and peak hour demand basis. This chapter also summarizes the detailed meter evaluation performed by Ivins City as part of the 2013 master plan.

CURRENT DEMANDS

Figure 3-1 below shows the historical water use for Ivins City Municipal Water System from 2010 through the majority of 2017. All water is delivered to Ivins City Municipal Water System customers through one of four master metered delivery points. These points are indicated by the "Purchased" data line. The "Sold" data line represents the summation of the retail meter data. As is typical with most water systems, the Ivins System exhibits a water loss of approximately 8 percent. This water loss is shown more obviously in the 12 month moving averages. In previous years, the City's 12 month averages water loss has been as high as 15 percent; the reduced system loss can be attributed to the City's meter replacement program as well as the leak detection program.

Figure 3-1
Ivins City Historical Monthly Municipal Water Use from 2010 to 2017



The following table shows a summation of all water use from June 2015 to May 2016 in Ivins City including the KWU private water system and the Ivins Irrigation Company (IIC).

Table 3-1
Average Annual Water Usage June 2015 to May 2016

	Gallons/Year	Acre-Feet/Year	MGD	CFS	GPM
Ivins City Purchased	582,710,000	1,789	1.60	2.5	1,109
Ivins City Sold	523,118,000	1,606	1.43	2.2	995
KWU Purchased from WCWCD	45,716,895	140.3	0.13	0.2	87
Total KWU + City Usage	628,426,895	1,929	1.73	2.7	1,196
Ivins Irrigation Company[1]	485,596,000	1,490	1.33	2.1	924
Total Usage	**1,114,022,895**	**3,419**	**3.06**	**4.8**	**2,120**

[1]Estimated deliveries from IIC

The City's 2013 culinary water master plan included a detailed evaluation of water meter data with the purpose of determining the typical water use per Equivalent Residential Unit (ERU) in Ivins. Through discussions with Ivins City personnel, it was decided that the findings from the meter evaluation in the 2013 study were still applicable and valid for use in this updated study. For the detailed meter data evaluation, refer to Chapter 3 of the 2013 master plan.

The results of this meter data evaluation, which analyzed residential, commercial, and irrigation water usage in detail, were that the water usage per ERU in Ivins is **0.65 acre-feet per year** (including system loss through leaks or other sources of water loss). This value is 27% less than the **0.89 acre-feet per year** as required by Utah Administrative Code R309-510-5. When data is available to support lower water use for a community, the State Code does allow the use of reduced water use planning numbers.

The relatively low per ERU water use in Ivins may be due to the following:

- **Ivins City has a lower household size than the typical Utah community, which likely results in lower indoor water use.**
- **A large portion of homes in Ivins, particularly new homes, utilize drought resistant plants and xeriscape landscaping methods, significantly reducing water used for irrigation.**

In planning, it is important to maintain conservative estimates. For this reason, a 15% safety buffer has been applied to the annual water usage value, resulting in an annual demand of **0.75 acre-feet per year per ERU for planning purposes**.

Peak Day Demand

Peak day demand represents the average water demand on the system on the peak usage day of the year. Peak day demand typically occurs during the summer when irrigation demands are highest. To better understand water usage patterns across the City, Ivins placed 88 temporary meters this year throughout the City. These meters collected hourly usage reads from July 16 to August 21. These hourly readings were added together to determine the total daily water usage for these temporarily metered connections. The results of this effort are shown in Table 3-2.

Table 3-2
Total Daily Usage Result from Ivins City Metering

Date	Usage (gal x 10)	Date	Usage (gal x 10
7/16/2017	7,283	8/5/2017	5,719
7/17/2017	6,192	8/6/2017	5,513
7/18/2017	7,190	8/7/2017	5,107
7/19/2017	6,014	8/8/2017	6,044
7/20/2017	7,198	8/9/2017	5,929
7/21/2017	5,357	8/10/2017	6,427
7/22/2017	7,035	8/11/2017	5,163
7/23/2017	5,836	8/12/2017	5,792
7/24/2017	5,483	8/13/2017	5,380
7/25/2017	4,989	8/14/2017	5,546
7/26/2017	4,963	8/15/2017	5,532
7/27/2017	5,700	8/16/2017	5,574
7/28/2017	5,564	8/17/2017	5,869
7/29/2017	6,222	8/18/2017	5,244
7/30/2017	6,198	8/19/2017	6,294
7/31/2017	5,396	8/20/2017	5,838
8/1/2017	6,697	8/21/2017	5,211
8/2/2017	6,003	8/22/2017	5,607
8/3/2017	6,407	8/23/2017	5,725
8/4/2017	6,031	8/24/2017	6,081
		Average	**5,884**

As shown in Table 3-2, the average daily water usage over the testing period was **58,840 gallons**, while the peak daily usage was **72,830 gallons**. Assuming that the average daily usage from July to August represents "peak month" demand, the data suggests that peak day demand is 1.24 times higher than peak month demand (72,830 ÷ 58,840). To identify the ratio of Average Day Demand to Peak Month Demand, City-wide monthly meter billing data from the years 2013 – 2016 was evaluated. Table 3-3 displays a summary of the monthly meter data from these four years.

Table 3-3
Summary of Monthly Meter Data from 2013 – 2016

Year	Average Monthly Demand (gal x 1,000)	Peak Month Demand (gal x 1,000)	Ratio of Peak Monthly Demand to Average Monthly Demand
2013	31,830	54,349	1.71
2014	32,019	52,800	1.65
2015	32,016	53,221	1.66
2016	34,909	58,706	1.68
		Average	**1.68**

The monthly meter data from 2013 – 2016 suggests that, on average, the peak month usage in the City is 1.68 times greater than the average monthly usage over the course of the year. Using these factors, Table 3-4 provides a summary of the system demands on the Ivins culinary water system which will be used for planning.

Table 3-4
Estimated Water Demand per ERU

Demand Category	Quantity
Annual Demand per ERU (acre-feet/year)	0.75
Average Day Demand per ERU (gallons/day)	670
Peak Month Demand per ERU (gallons/day)	1,126
Peak Day Demand per ERU (gallons/day)	1,400[1]

[1]Value rounded up from 1,396 gallons/day

Peak Hour (Instantaneous) Demand

Peak hour demand, also referred to as peak instantaneous demand, is the highest instantaneous demand exerted on the system (not including fire flow demand). This demand typically occurs at a particular time during peak day demand, such as the time in the morning when most sprinkler systems are programmed to turn on. The recently collected hourly meter data from the City can be used to estimate peak hour demand on the system. From this data, July 16 was identified as the highest usage day. Table 3-5 displays the total metered demands for all meters on July 16. As shown in the table, the average hourly meter read over the course of the peak day is 3,050 gallons, while the peak hour read is 5,120 gallons. This equates to a 1.68 peak day to peak hour demand multiplier. However, recent pressure logger data collected by the City used to calibrate the hydraulic computer model indicates that the peak day to peak hour factor may be more on the order of 1.4 – 1.5. Because of the uncertainty associated with a water distribution system, such as pipe friction, minor energy losses through valves, bends, etc., it is good practice to maintain a level of conservatism in planning estimates. At the same time, over-estimating water demands may lead to poorly timed capital improvements which may not actually be necessary. For these reasons, a peak

day to peak hour demand multiplier of **1.55** was chosen for this master plan, which represents a small increase from the assumed value of 1.5 in the 2013 water master plan. Applying this factor to the peak day demand estimate yields a peak hour demand estimate of 2,170 gpd, or 1.51 gpm, per ERU.

Table 3-5
July 16, 2017 Hourly Meter Results

Time	Water Usage (gal x 10)	Time	Water Usage (gal x 10)
12:00 AM	211	12:00 PM	325
01:00 AM	373	01:00 PM	359
02:00 AM	297	02:00 PM	317
03:00 AM	362	03:00 PM	224
04:00 AM	393	04:00 PM	228
05:00 AM	387	05:00 PM	228
06:00 AM	**512**	06:00 PM	162
07:00 AM	441	07:00 PM	209
08:00 AM	455	08:00 PM	169
09:00 AM	442	09:00 PM	172
10:00 AM	331*	10:00 PM	241
11:00 AM	215	11:00 PM	277
		Average	**305**

***Assumed value – data missing for this time step**

Using the results of the demand analysis presented in this chapter in conjunction with the population and land use analysis found in Chapter 2, Table 3-6 provides a summary of current culinary system demands.

Table 3-6
Summary of Current Culinary Water Demands[1]

	Existing ERUs	Average Annual Demand (acre-feet/year)[1]	Peak Day Demand (gpd)	Peak Hour Demand (gpm)
Ivins City Municipal Water System	3,629	2,722	5,080,600	6,598
KWU System	372	279	520,800	676
Total Ivins City (including KWU)	4,001	3,001	5,601,400	7,274

[1]Using planning demand value of 0.75 acre-feet/year/ERU

Future Demands

The future ERUs as calculated in Table 2-4 in Chapter 2 of this report indicate that Ivins City will grow from the current 4,001 ERUs (including KWU) to approximately 10,745 ERUs. Table 3-6 shows the projected future water demands on the system through the estimated buildout year of 2057. Figures 3-2 and 3-3 provide a graphical display of projected annual and peak day demands for Ivins City.

Table 3-6
Projected Future Ivins City Required Source Capacity

	Ivins City Municipal Water System				Kayenta Water Users System				Total Ivins City (Including KWU)			
Year	ERUs	Average Annual Demand (acre-feet/yr)	Peak Day Demand (gpm)	Peak Hour Demand (gpm)	ERUs	Average Annual Demand (acre-feet/yr)	Peak Day Demand (gpm)	Peak Hour Demand (gpm)	ERUs	Average Annual Demand (acre-feet/yr)	Peak Day Demand (gpm)	Peak Hour Demand (gpm)
2017	3,629	2,722	3,528	5,469	372	279	362	561	4,001	3,001	3,890	6,029
2020	4,017	3,012	3,905	6,053	490	368	477	739	4,507	3,380	4,382	6,791
2025	4,663	3,497	4,533	7,026	687	515	668	1,036	5,350	4,012	5,201	8,062
2030	5,309	3,981	5,161	8,000	884	663	860	1,332	6,193	4,645	6,021	9,332
2035	5,955	4,466	5,789	8,973	1,081	811	1,051	1,629	7,036	5,277	6,840	10,603
2040	6,601	4,950	6,417	9,947	1,278	959	1,243	1,926	7,879	5,909	7,660	11,873
2045	7,247	5,435	7,045	10,920	1,475	1,106	1,434	2,223	8,722	6,541	8,480	13,143
2050	7,893	5,919	7,673	11,894	1,672	1,254	1,626	2,520	9,565	7,174	9,299	14,414
2055	8,539	6,404	8,301	12,867	1,869	1,402	1,817	2,817	10,408	7,806	10,119	15,684
2057	8,797	6,598	8,553	13,257	2,038	1,529	1,981	3,071	10,835	8,126	10,534	16,328

Figure 3-2
Projected Future Annual Demand through Buildout

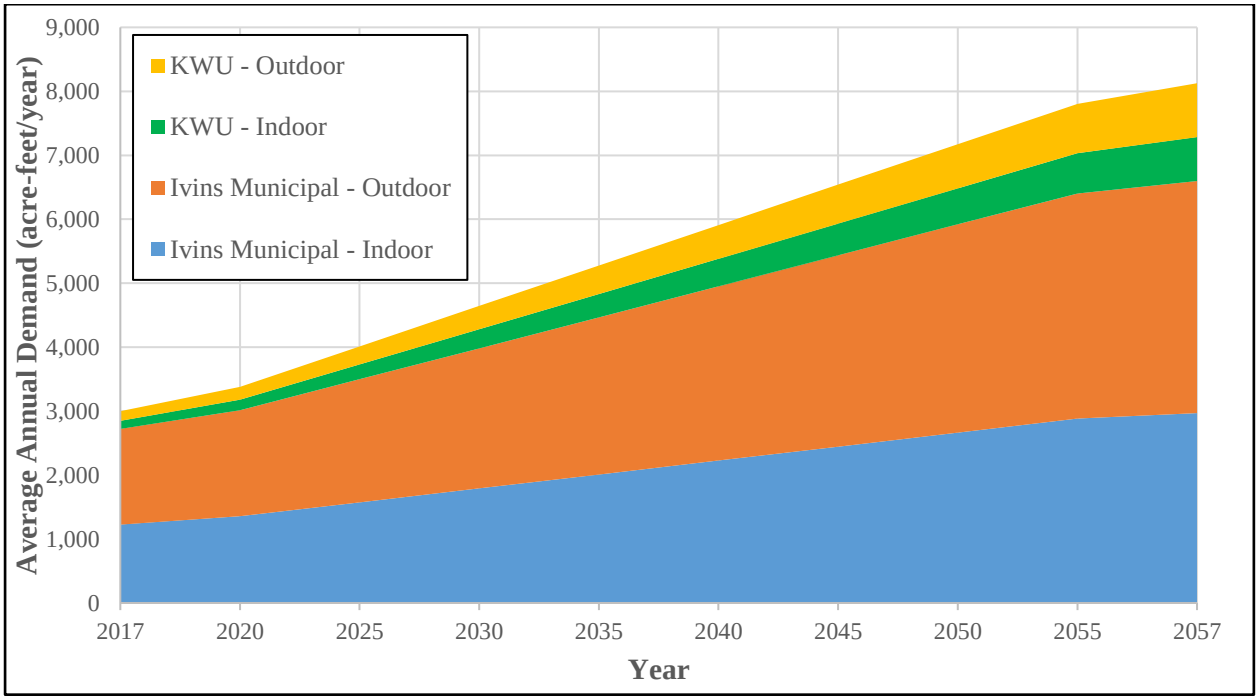
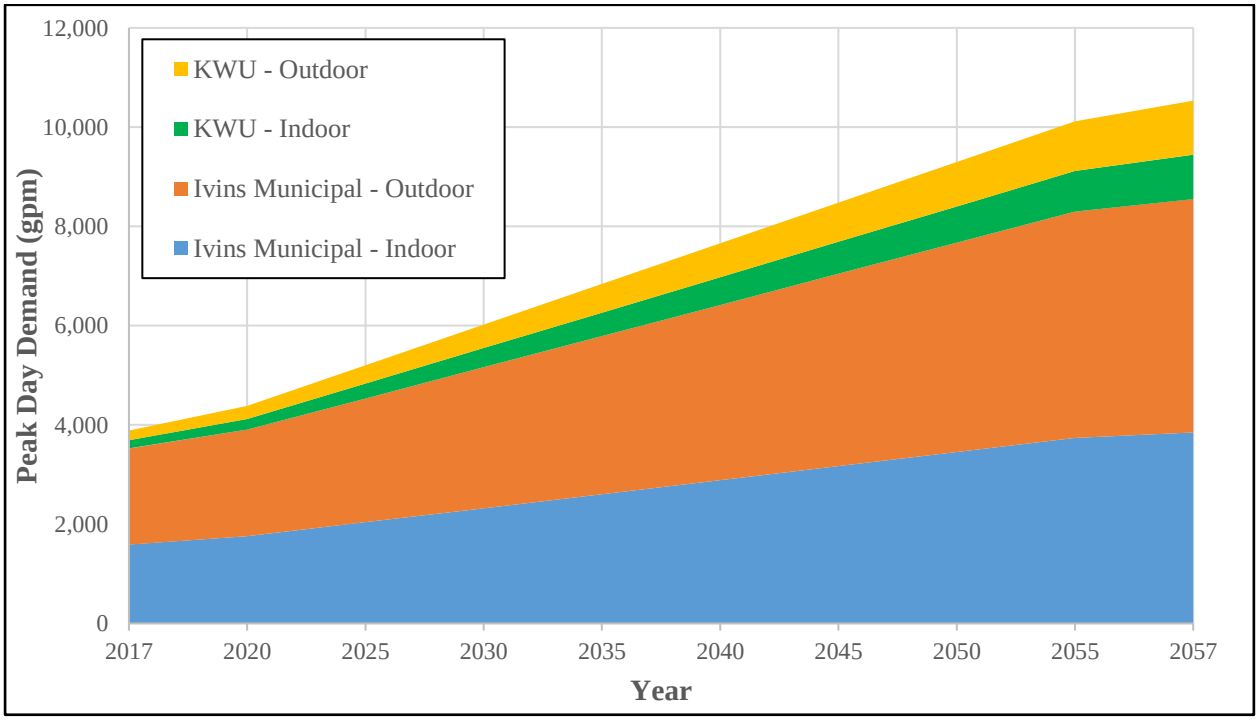


Figure 3-3
Projected Future Peak Day Demand through Buildout



Implementation of the Secondary Irrigation System

Understanding that culinary-quality water sources in Southern Utah are relatively limited, Ivins City began planning the implementation of a secondary pressurized irrigation system that could take advantage of lower quality water sources to meet irrigation needs. In 2002, it became a City requirement that all new development include the installation of secondary irrigation lines for the future system. As identified in Chapter 4 of this report, Ivins City will need to develop additional source capacity to continue meeting future water needs. The majority of the City's water currently comes from 3 sources: The Snow Canyon Wells, The Gunlock Wells, and Quail Creek Reservoir (via the Regional Pipeline). Ivins City has rights to portions of these sources through various agreements with water wholesalers and other municipalities. At this time, water allocated to other users, such as St. George, is not being fully utilized, leaving some unused capacity for Ivins. However, as other cities continue to grow and their demand increases, this water will not be available for Ivins (unless the current agreements are modified).

Plainly stated, Ivins needs to begin developing additional source capacity. The best option for the City at this point is to move forward with the implementation of the secondary irrigation system. The reasoning behind this recommendation is discussed in Chapters 4 and 7 of this report. To this point in this chapter, water demand projections have assumed that all system demand in Ivins for existing and future conditions comes and will continue to come solely from the culinary water system. Table 3-7, Figure 3-4, and Figure 3-5 provide a revised culinary water system demand projection assuming the following:

- **The City will implement the irrigation system according to the phases outlined in Chapter 8 of the Secondary Irrigation Master Plan.**
- **All new development in Ivins will be connected to and use the secondary irrigation system.**

Note that the values shown in Table 3-7 assume that the secondary irrigation system is extended to the entirety of the secondary irrigation service area (see Secondary Irrigation Master Plan). As the secondary irrigation system develops, it may or may not make sense for the City to extend the system to existing users that do not have existing irrigation lines in place (because of the cost to replace asphalt, conflicts with other existing utilities, etc.). As the system develops and as it becomes more clear how the WCWCD will continue to meet the water needs of the west side of Washington County, Ivins will be able to evaluate to what extent the irrigation system will ultimately need to be extended.

Table 3-7: Revised Water Demand Projections with Secondary Irrigation System

	Ivins City Municipal Water Service Area							Kayenta Water Users System				Total Ivins City (Including KWU)			
		Ivins Culinary Water System			*Ivins Secondary Irrigation System*										
Year	ERUs	Average Annual Demand (acre-feet/yr)	Peak Day Demand (gpm)	Peak Hour Demand (gpm)	Average Annual Demand (acre-feet/yr)	Peak Day Demand (gpm)	Peak Hour Demand (gpm)	ERUs	Average Annual Demand (acre-feet/yr)	Peak Day Demand (gpm)	Peak Hour Demand (gpm)	ERUs	Average Annual Demand (acre-feet/yr)	Peak Day Demand (gpm)	Peak Hour Demand (gpm)
2017	3,629	2,722	3,528	5,469	0	0	0	372	279	362	561	4,001	3,001	3,890	6,030
2020	4,017	2,665	3,455	5,355	347	450	697	490	368	477	739	4,507	3,380	4,381	6,791
2025	4,663	2,897	3,755	5,821	600	778	1,206	687	515	668	1,036	5,350	4,012	5,201	8,062
2030	5,309	2,981	3,864	5,990	1,000	1,296	2,009	884	663	860	1,332	6,193	4,645	6,020	9,332
2035	5,955	3,216	4,168	6,461	1,250	1,620	2,511	1,081	811	1,051	1,629	7,036	5,277	6,840	10,602
2040	6,601	3,450	4,472	6,933	1,500	1,944	3,014	1,278	959	1,243	1,926	7,879	5,909	7,659	11,873
2045	7,247	3,435	4,452	6,901	2,000	2,592	4,018	1,475	1,106	1,434	2,223	8,722	6,541	8,478	13,143
2050	7,893	3,419	4,432	6,870	2,500	3,240	5,023	1,672	1,254	1,626	2,520	9,565	7,174	9,298	14,413
2055	8,539	3,404	4,412	6,639	3,000	3,888	6,028	1,869	1,402	1,817	2,817	10,408	7,806	10,117	15,683
2057	8,797	3,382	4,383	6,795	3,216	4,168	6,462	2,038	1,529	1,981	3,071	10,835	8,126	10,534	16,328

Figure 3-4
Revised Annual Demand Projection with Secondary Irrigation System

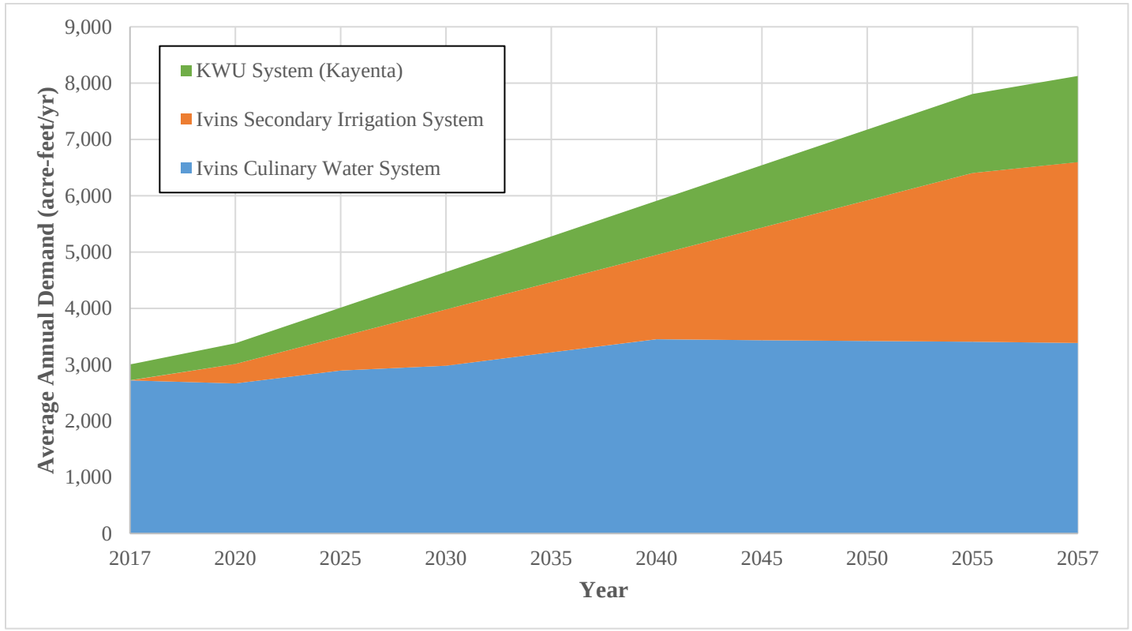
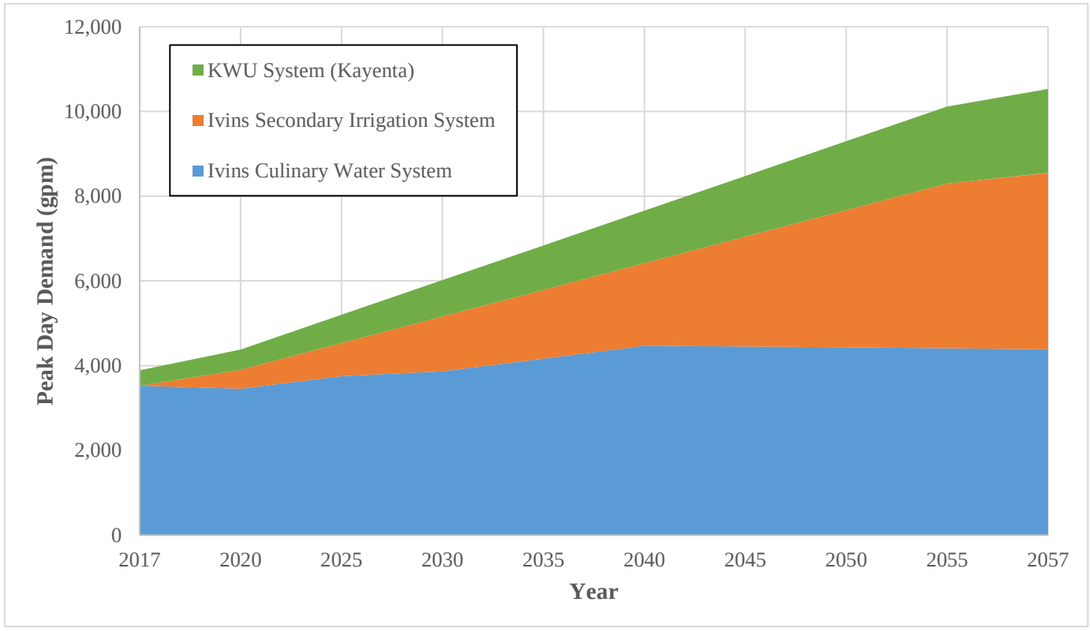


Figure 3-5
Revised Peak Day Demand Projection with Secondary Irrigation System



CHAPTER 4
WATER SOURCE & TRANSMISSION ANALYSIS

Water sources and transmission capacity are the backbone of a water system. Assuring that the system has adequate source and transmission capacity is critical for successful and reliable operation. This chapter provides a review of the City's current water rights, existing water sources, water quality considerations, and future considerations in terms of water sourcing to the water system.

IVINS CITY WATER RIGHTS

Ivins water rights are based on shares in irrigation companies and actual appropriated water rights that have been transferred into the Snow Canyon Wells which are jointly owned by the City of St. George, City of Santa Clara, and Ivins City.

Table 4-1 provides a summary of the water rights owned by Ivins City on the basis of shares and appropriated water rights. As shown, Ivins currently has a total of 740 acre-feet of water rights. The 393 acre-feet of water in the Snow Canyon Wells is directly accessible to the City as well as the 103.7 acre-feet of water in the irrigation company which is used to irrigate the cemetery, Ivins City Park, UNITY Park and the Red Mountain Elementary Fields. Ivins City should plan to consolidate its shares in irrigation companies into a single point of diversion. Ideally, all shares should be allocated to the 30" Gunlock Irrigation Pipeline from Gunlock Reservoir which will serve as the primary water source for the initial phases of the secondary irrigation system (see Secondary Irrigation Master Plan for more information).

Table 4-1
Existing Ivins City Water Rights

Source	Water Right No. or Number of Shares	Water Right			Use
		Flow	Total	Depletion Limit	
		cfs	ac-ft	ac-ft	
St. George Clara Irrigation Company	47.5 shares x 4.08 ac-ft/share (81-203)	NR	193.8	96.9**	Irrigation
Ivins Irrigation Company	103.69 shares x 1 ac-ft/share	NR	103.69	51.8**	Irrigation
Santa Clara Irrigation Company	11 shares x 4.51 ac-ft/share	NR	49.6	24.8**	Irrigation
Snow Canyon Wells	• 81-1427(a35599)	NR	138.72	82.84	Municipal
	• 81-1322(a32324)	0.42	138	82.4	
	• 81-86 (a32501)	0.1	72.4*	72.4*	
	• 81-2207, 81-2328, 81-2411, 81-2457 (a35599)	NR	43.45	26.01	
	Snow Canyon Wells Total	--	392.57	263.65	
TOTAL			**739.66**	**437.15**	

*Calculated from cubic-feet per second
**Calculated as 50% of total water right volume
NR: No Restriction

Ivins City has submitted applications for water rights which are yet to be approved by the State and are listed as follows in Table 4-2. It is uncertain whether these water right applications will ever be approved.

Table 4-2
Ivins City Unapproved Water Right Applications

Source	Water Right No.	Diversion (cfs)
West Ivins Wells	81-1786	2
West Ivins Wells	81-1702	2
Beaver Dam Wash	81-3656	9

Water Supply Agreements

Ivins City has secured additional source capacity through agreements with other water providers. The **Gunlock well agreement** signed in 1969 with the City of St. George guarantees the delivery of water from the Gunlock Well Field which consists of eleven wells located near Gunlock Reservoir. These wells deliver water in a 20-inch pipeline to a 3 MG tank located on the Shivwits Paiute Indian Reservation and then another 18-inch and 20-inch pipeline delivers this water through Ivins City to the City of St. George. Ivins taps into this pipeline at 200 West and 400 West.

The agreement with the City of St. George guarantees the deliveries of the quantities shown in Table 4-3.

Table 4-3
Guaranteed Water Deliveries from Gunlock Well Agreement

Year	Acre-feet/Year
2008	538
2013	577
2018*	614

*Water deliveries stay at 614 acre-feet/year beyond the year 2018

Historically, the City of St. George has allowed Ivins City to take more water than specified by the agreement (at times when it is not needed by St. George). Ivins City has used as much as 809 acre-feet/year in the past, but quantities above Ivins City's agreed limit may become unavailable as demands increase in St. George. For this reason, only the usage stated in the agreement has been accounted for in this study.

The **Snow Canyon Compact,** originally signed in 1978, is a joint project with the City of St. George and the City of Santa Clara to construct five wells in the West Canyon of Snow Canyon connecting to two storage tanks, each 3 MG in size. The compact was reworked and resigned in 2006. By agreement, Ivins City owns 12 percent of the storage capacity and production capacity which is estimated at 324 gpm. As indicated in Table 4-1, Ivins City owns 393 acre-feet of the annual well production water rights. The agreement allows for Ivins City to withdraw additional water beyond its ownership and compensate the other members of the compact accordingly. However, since this water will eventually be used by each respective owner, the City should not plan on any additional water beyond the 393 acre-feet being available in the long term (assuming there are no additional wells drilled in Snow Canyon).

The **Ence Well Water Supply Agreement** signed in 2001 with the WCWCD enables the delivery of water from the Ence Wells located in the Anazazi Valley at a flow capacity estimated at 600 gpm, provided that the District first meet its obligations to "Priority Users" which are defined as Terry Marten in connection with KWU, the Ence Properties (future development), and successors of the Shela Wilson property. The total water right for the Ence Wells is 880 acre-feet, and of this capacity, approximately 400 acre-feet is allocated to KWU and another 100 acre-feet is used by local irrigators annually. Assuming the District meets these priority users, Ivins can plan to have access to approximately 380 acre-feet per year from this source. Water from the Ence Wells meets drinking water standards and could be used in either the culinary or secondary irrigation system.

In 2000, Ivins City agreed to purchase a 1,000 acre-foot block of annual water supply from the **Quail Creek Project** from WCWCD with a right to purchase another 1,000 acre-foot block of water. This water is treated at the Quail Creek Water Treatment Plant and the delivery of this water was enabled through the **Regional Pipeline Project**. Since the Snow Canyon wells exceed the maximum allowable arsenic standards which were lowered by the EPA in 2001, water from Quail Creek is blended with Snow Canyon Well water to meet the minimum standard. The 2002 Regional Pipeline Agreement with the WCWCD, City of St. George, and Santa Clara enabled the construction of a pipeline which has a capacity to supply 7,000 gpm to the Snow Canyon Area.

Ivins City purchased 8 percent of the portion of the line that is 60-inch in diameter and 24.5 percent of the capacity of the 24-inch/30-inch pipeline for a flow capacity of approximately 1,700 gpm providing potentially **2,000 acre-feet of water annually**.

As the region became more interconnected with the regional pipelines operated by the WCWCD, the need for the **Regional Water Supply Agreement** (RWSA) was determined to be the best way to handle everyone's growing water supply needs in the Dixie area. The RWSA is signed by the majority of regional cities and towns which includes Ivins, St George, Santa Clara, Washington, Hurricane, La Verkin, Toquerville, Virgin, Leeds, and Apple Valley. The agreement puts the responsibility of all future sources of water to be supplied to each community on WCWCD. While the agreement specifies that the District will develop and provide water to Ivins, it does not identify specifically to what point the District will deliver the water. The District is planning to begin a west side water supply study that will look at the future water needs for the western area of Washington County. However, until that study is complete, it has been assumed that no additional water beyond what Ivins City currently holds claim to in the Regional Water Supply Agreement will be available in the future (i.e. the Regional Pipeline is nearly at capacity and additional water conveyance improvements will be needed to deliver more water from Quail Creek Reservoir to Ivins). Adding additional pipeline capacity from Quail Creek Reservoir to the west side of the County would most likely involve multiple municipalities; for Ivins to undergo such a project on its own would be cost prohibitive. This considered, it makes sense for Ivins to utilize water sources that are nearby. Since all culinary-quality sources are at or near capacity, a secondary irrigation system will help take advantage of some of the lower quality water sources available in the area, such as reuse water for the St. George Water Reclamation Facility. Ultimately, in order for Ivins City to have sufficient water through buildout, proactive steps toward acquiring additional sources will need to be taken.

Table 4-4 provides an overall summary of the City's current water rights and water supply agreements.

Table 4-4
Summary of Ivins City Water Rights/Water Supply Agreements

Description	Flow Capacity (gpm)	Annual Production (acre-feet/year)
Irrigation Water Shares	As needed	347
Snow Canyon Compact Water Rights	350	393
Gunlock Wells Agreement	As needed	614
Ence Wells Water Supply Agreement	600	380[1]
Quail Creek Project	1,700	2,000
	Total Potable Water:	**3,387**
	Total Water:	**3,734**

[1]The Ence Well has a total water right of 880 acre-feet with a 600 gpm capacity. Of this 880, approximately 400 acre-feet is allocated to KWU and Ence, and another 100 acre-feet is used by irrigation users. This considered, it is estimated that 380 acre-feet is potentially available for the Ivins culinary water system.

Existing Sources & Transmission Piping

The City has four main connections that provide water into the system plus one additional emergency connection that is rarely used under current conditions. Each of these connections have a master meter that is used to determine how much water has been delivered into the system. Figure 4-1 shows a schematic of the source and transmission piping network that delivers water to Ivins City.

Snow Canyon Drive Tap – This is a 6-inch tap feeding into a 6-inch master meter tapped from the 24-inch pipeline from the Snow Canyon Tanks providing blended water from the Snow Canyon Wells and the treated water from Quail Creek WTP. The tap feeds into a 10-inch waterline in the 3312 Snow Canyon Pressure Zone which then provides connectivity to the 3290 North Zone as the 10-inch waterline passes along 200 North to the west. The Tuacahn Pumping Station is connected to this 10-inch line and there is connectivity to the south part of the 3312 Zone via an 8-inch pipeline on Painted Hills Drive. This connection has historically provided 100 to 540 acre-feet per year with a peak day flow estimated to range from 200 to 660 gpm.

Snow Canyon Parkway Tap – This is a 10-inch tap feeding into an 8-inch master meter tapped from the 24-inch pipeline from the Snow Canyon Tanks providing blended water from the Snow Canyon Wells and the treated water from Quail Creek WTP. The tap feeds into a 10-inch waterline that runs west on Center Street to provide connectivity to the 3290 North and South Zone. The 10-inch waterline also runs east and connects to the PRV that feeds into the 3175 Reserve PRV Zone. A connection near the upstream side of the PRV provides water into the Red Mountain Spa looping back into pipelines that are connected to the Snow Canyon Drive Tap. This metering point was moved three to four years ago after it was discovered that the tap was connected to the pumping side of the regional pipeline rather than the tank outlet. The original location was closer to the Reserve PRV, but is now closed and locked. This connection has historically provided 560 to 800 acre-feet per year with a peak day flow estimated to range from 660 to 1,050 gpm.

200 West Tap – This is a 10-inch tap feeding into an 8-inch master meter tapped from the 20-inch Gunlock pipeline owned and operated by the City of St. George providing water from five wells near Gunlock Reservoir. The tap feeds into a 10-inch dedicated transmission pipeline delivering water directly into the two 2 MG tanks at the Cliff Rose tank site in the Taviawk subdivision. St. George has had problems with the Gunlock Wells arsenic levels, with currently only Well 2 and Well 11 having low enough arsenic levels to meet EPA standards. The Gunlock Well Field has typically been capable of producing 4,000 gpm, but now only provides about 1,450 gpm. As a result, the City of St. George has installed an isolation valve (between the 200 West tap and the 400 West tap) that has enabled this tap to be supplied with treated water from the Quail Creek WTP. This connection has historically provided 190 to 460 acre-feet per year to Ivins with a peak day flow estimated to range from 460 to 1,000 gpm.

400 West Tap – This is a 10-inch tap feeding into a 6-inch master meter tapped from the 20-inch Gunlock pipeline owned and operated by the City of St. George providing water from five wells near Gunlock Reservoir. The tap feeds into a 10-inch dedicated transmission pipeline delivering water directly into the two 2 MG tanks at the Cliff Rose tank site in the Taviawk subdivision. A 1,300 gpm pump is available to boost pressures and increase flow to the tank if needed. This pump is typically used when there is a high demand on the Gunlock 20-inch pipeline from St. George.

GUNLOCK WELLS OWNED AND OPERATED BY ST. GEORGE

3 MG GUNLOCK TANK OWNED AND OPERATED BY ST. GEORGE

20" Gunlock Pipeline

KAYENTA WATER USERS ASSOCIATION (PRIVATE WATER SYSTEM)

IVINS CITY TAVIAWK TANK 0.5 MG

SNOW CANYON WELLS JOINTLY OWNED BY ST. GEORGE, SANTA CLARA, AND IVINS OPERATED BY ST. GEORGE

TWO 3 MG SNOW CANYON TANKS JOINTLY OWNED BY ST. GEORGE, SANTA CLARA, AND IVINS OPERATED BT ST. GEORGE

3350 Tuacahn Zone

IVINS CITY TUACAHN TANK 0.5 MG

3460 Taviawk Zone

IVINS CITY 3290 2MG TANK

IVINS CITY 3290 2MG TANK

Ivins Reservoir

TAVIAWK BOOSTER PUMP STATION

TUACAHN BOOSTER PUMP STATION

TO KWU

3390 Taviawk PRV Zone

400 W BOOSTER PUMP STATION

3290 Zone North

3312 Snow Canyon Zone

24" Snow Canyon Pipeline

24" Regional Pipeline

IVINS CITY TAPS FROM SNOW CANYON WELLS

EMERGENCY TAP FOR IVINS TO ENCE WELL LINE

20" Gunlock Pipeline

ENCE WELLS OPERATED BY WCWCD PRIMARY SOURCE FOR KAYENTA EMERGENCY SOURCE FOR IVINS

Quail Creek Water Treatment Plant Operated by WCWCD

WTP

Ivins Reservoir

IVINS CITY TAPS FROM GUNLOCK WELLS

Ivins Reservoir

TO ST. GEORGE

TO SANTA CLARA

18" Gunlock Pipeline

Ivins Reservoir

TO ST. GEORGE

L E G E N D

- Well Sources
- Storage Tanks
- PS — Booster Pumps
- WTP — WCWCD WTP
- KWU Boundary
- City Boundary
- Transmission Line Operated by St. George or WCWCD
- Transmission Line Operated by Ivins City

NORTH:

SCALE: 0 1,000 2,000 Feet

WATER SOURCING AND TRANSMISSION SCHEMATIC

IVINS CITY

CULINARY WATER MASTER PLAN

BOWEN COLLINS & ASSOCIATES

FIGURE NO. 4-1

S:\Ivins\235-17-02 Culinary Water Master Plan, IFFP, IFA\4.0 GIS\4.4 Figures\Figure 4-1 - Source Supply Schematic.mxd aanderson 1/31/2019

Since construction of the Regional Pipeline, the pump has seldom been used. The Taviawk Pumping Station connects to this 10-inch transmission line and boosts water to the higher 0.5 MG Taviawk Tank. Near the 400 W tap is a PRV station that would allow for water to bypass the tanks and pass directly into the distribution system. The PRV is set so that this would only occur during major peaking in the system. This tap continues to be serviced with the Gunlock wells despite the reduced production capacities as previously described. This connection has historically provided 205 to 370 acre-feet per year with a peak day flow estimated to range from 385 and 620 gpm.

At the 400 West Tap the 8-inch **Ence Well pipeline** connects into the same 10-inch pipeline that delivers water to the two 2 MG tanks at the Cliff Rose site. This connection is rarely used due to some taste and odor complaints that began occurring when the source was originally connected, but will begin to be utilized more as demands in the City increase. The master meter for this pipeline is located at Highway 91 near the Anazazi Valley access road.

Table 4-5 and 4-6 show a summary of the annual use from each source tap as well as the estimated peak flow through each tap, respectively. Figure 4-2 charts this annual use by source.

Table 4-5
Annual Deliveries to Ivins City Categorized by Location of Delivery Point, 2010 – 2016

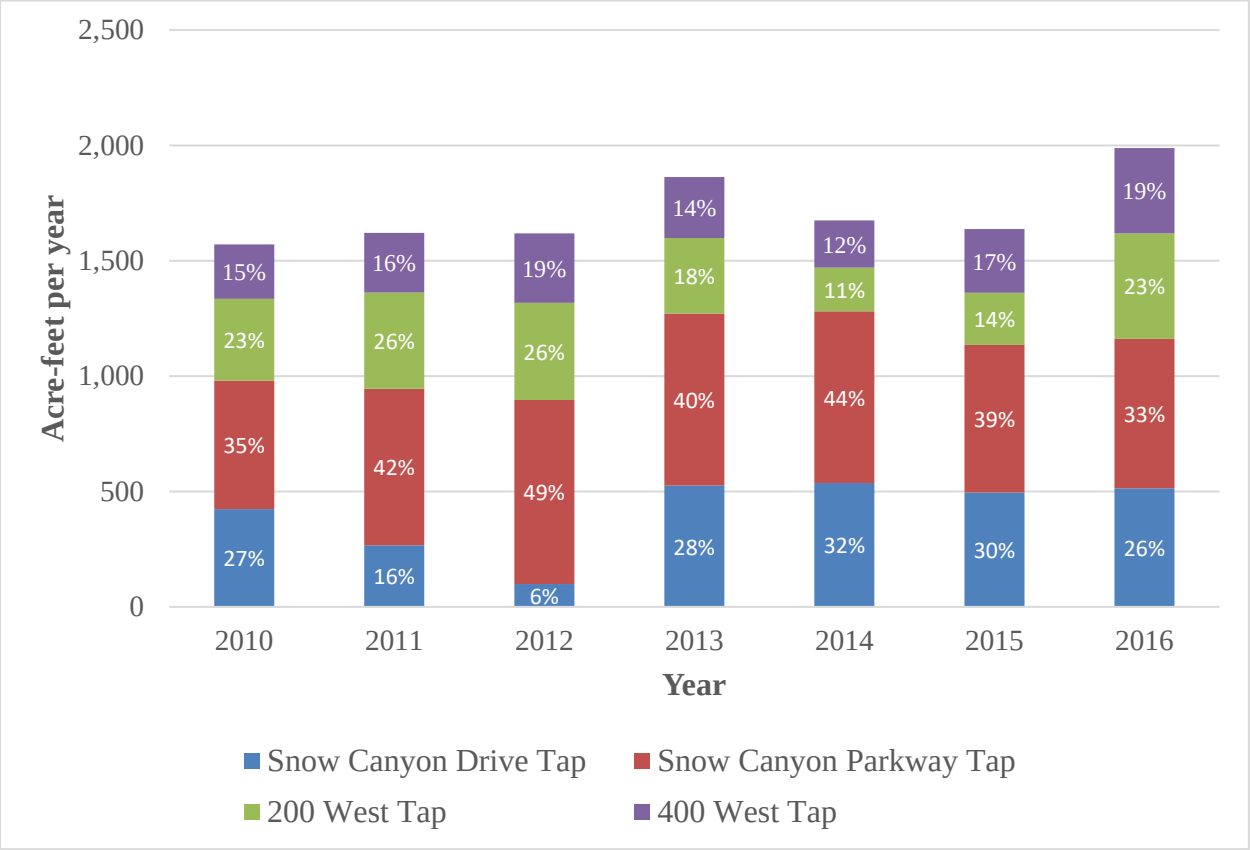
	Annual Use (acre-feet/year)						
	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Snow Canyon Drive Tap	424	267	99	526	536	496	513
Snow Canyon Parkway Tap	557	679	798	746	744	639	648
200 West Tap	355	417	421	327	189	226	458
400 West Tap	236	259	301	265	205	276	370
Ence Wells	0	0	0	0	0	0	0
Total	**1,572**	**1,622**	**1,619**	**1,864**	**1,674**	**1,637**	**1,989**

Table 4-6
Estimated Peak Day Deliveries to Ivins City Categorized by Location of Delivery Point, 2010 – 2016

	Estimated Peak Day Flow (gpm)*						
	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Snow Canyon Drive Tap	457	452	202	659	590	498	512
Snow Canyon Parkway Tap	677	826	853	853	1,054	670	655
200 West Tap	762	775	776	665	462	707	999
400 West Tap	491	417	528	528	381	394	616
Ence Wells	0	0	0	0	0	0	0
Total	**2,387**	**2,470**	**2,359**	**2,705**	**2,487**	**2,269**	**2,782**

*Peak month demand x 1.24 (estimated by comparing summer hourly meter data collected in 2017)

Figure 4-2
Annual Deliveries to Ivins City Categorized by Location of Delivery Point, 2010 - 2016



As shown in Figure 4-2, the City has historically received the majority of its water from the Snow Canyon taps. As currently configured, it appears that it may be difficult for the Snow Canyon taps to produce much more than 1,750 gpm without the addition of a booster pump station. The 200 West and 400 West taps are most likely unable to supply much more than 2,400 gpm as currently configured.

Evaluation of Existing Source Capacity

As outlined in the City's service standards, sources must be capable of meeting the following requirements

1. **Supply capacity meets average annual demands**
2. **Supply capacity meets peak day demand with largest source out of service.**
3. **Supply capacity will refill fire storage portion of tank storage in 24 hours.**

Annual Source Capacity

As shown in Table 4-4, the City currently has access to an estimated **3,387 acre-feet per year** of source supply. Per the source planning numbers shown in Table 3-6, the City's current demand is

2,722 acre-feet per year. At this time, the City has sufficient annual source capacity, but needs to begin developing additional source capacity to meet future needs.

Peak Day Source Capacity

The peak capacities for each source tap, as considered for this analysis, if considered as its own source, are provided in Table 4-7.

Table 4-7
Existing Source Connection Capacities

Source	Capacity
Snow Canyon Drive	500 gpm
Snow Canyon Parkway	1,250 gpm
200 West Tap	1,100 gpm
400 West Tap	1,300 gpm
Ence Well	600 gpm
Total Source Capacity	4,750 gpm
Minus Largest Source	-1,300 gpm
Total Reliable Source	**3,450 gpm**

The total peak capacity of the City's sources is estimated to be 4,750 gpm. However, it is not reasonable to assume that each tap is capable of delivering peak flows at all times. For this reason, the "reliable source capacity" for the City has been calculated by removing the largest single tap for the system. As shown in Table 4-7, this reduction yields a peak day supply capacity of 3,450 gpm. As shown in Table 3-6 from Chapter 3, required peak day demand source capacity for the Ivins system is 3,528 gpm plus an additional 410 gpm for refilling fire storage (410 gpm for 24 hours to fill 585,000 gallons of fire storage, see Chapter 5) for a total of 3,938 gpm. **This suggests that Ivins stands in need of additional peak day source capacity. However, the implementation of the secondary irrigation system will provide an additional source of water which remediates this deficiency (phase 1 and 2 of secondary irrigation system, refer to Secondary Irrigation Master Plan).**

Water Conservation

Ivins City prepares a Water Conservation plan every five years as required by Utah Law. The last plan was prepared and adopted in September 2013. The City is planning to update its Water Conservation Plan in 2018.

The Washington County Water Conservancy District also has a water conservation plan which was updated in December, 2015. The plan is available at the district's website: **www.wcwcd.org**

Water Quality Considerations

The following Table 4-8 shows some of the significant water quality parameters of each of the City's water sources. Total dissolved solids (TDS) is typically a good measure of overall water

quality for aesthetic effects such as taste, odor or color. The EPA requires that TDS be less than 1,000 ppm as a primary maximum contaminant level (MCL) standard and recommends that the levels be kept below 500 ppm as a secondary non-enforceable standard. The Gunlock Wells are shown to have the lowest TDS concentrations. However, based on actual sampling, the Snow Canyon Wells tend to be the best for good taste.

Table 4-8
Significant Water Quality Parameters for Each Ivins City Water Source

	TDS (ppm)	Arsenic (ppb)	Hardness (ppm as CaCO3)	Nitrates (ppm as N)	Sulfates (ppm)
Regional Water (Quail Creek WTP)[a,b]	585	1.0	350	0.1	250
Snow Canyon Wells[a]	480	11.0	85 to 300	0.3	200
Gunlock Wells[a]	299	9.0	280	0.3	23
Ence Wells[b]	480	7	*	*	145

[a]Source: St. George City 2007 Water Quality Report
[b]Source: 2015 WCWCD Consumer Confidence Reports
*No data available

The water from the Quail Creek Water Treatment Plants meets EPA primary standards but has fairly high TDS and sulfate concentrations. There have been some taste and odor problems from the treatment plant in the summer months when algae production in Quail Creek Reservoir can be difficult to control. The Water District has, for the past few years, aggressively controlled the algae problem with copper sulfide lake treatments as well as changing the powdered activated carbon brand to a higher quality brand which seems to have corrected the problems. The District does indicate that eventually ozone treatment of the water may be necessary in the future to best remove the taste and odors. If this treatment process is added, the cost of water could increase by $0.10 to $0.15 per 1,000 gallons.

The MCL for arsenic is 10 ppb. As shown in Table 4-8, the Snow Canyon Wells exceed this standard, but after blending with treated water from the treatment plant, the levels are within EPA minimum requirements. Some Gunlock Wells have been pulled from production by the City of St. George due to arsenic levels that exceed the MCL. St. George is in the process of adding arsenic treatment to the Gunlock Wells, but until these treatment facilities are finished or a feasible option of blending water can be provided, these wells will remain out of production for culinary purposes.

The Ence Wells have been discontinued for water deliveries into the Ivins City Municipal system for now due to taste and odor complaints. However, the wells are the sole source of the KWU private water system that serves Kayenta. As shown in Table 4-4, water from the Ence Wells has been counted as part of Ivins water portfolio and is planned to be utilized to meet future demands (whether it be for the culinary water system of for the secondary irrigation system).

Future Sources

As indicated in the demand analysis section in Table 3-6 of Chapter 3, estimated future Ivins City water demands are:

- **Annual Demand: 6,598 acre-feet per year**
- **Peak Day Demand: 8,553 gallons per minute**

These water demands are planned to be met through a combination of culinary and irrigation water supplies. As indicated in the evaluation of existing sources, the Ivins City system needs to consider the expansion of the culinary (and secondary) system to be able to supply an additional **3,832 acre-feet of annual supply and 5,103 gpm of peak day supply capacity**. Since Ivins is heavily reliant on sources that serve multiple municipalities, it is difficult to determine if shared sources can help meet Ivins City's needs along with other communities. This makes it a challenge for Ivins to plan for future capital facilities projects to accommodate future source needs. The following is a list of potential sources which could be utilized to meet future water demands in Ivins City:

- **St. George Water Reclamation Facility (WRF) Reuse Water** – One of the more likely sources of future source capacity for Ivins City is the St. George WRF Reuse Facility. This facility, which currently has a capacity of 7 MGD (with room to add an additional 3.5 MGD) treats water from St. George's wastewater treatment plant to Type 1 reuse water standards. A 24" pipeline and pump stations can deliver water to a number of locations, including Ivins. During the summer months, the pipeline runs at full capacity meeting golf course and other irrigation needs. In order for Ivins to potentially gain access to reuse water, a storage reservoir would be required that could allow the reuse plant to operate year round (currently, without storage, the facility can only operate when there is demand). The City of St. George has identified two potential reservoir locations, one of which is located in Ivins. Figure 4-2 displays the location of two potential reservoir sites identified by St. George City. "Dry Wash Reservoir" would provide up to 4,500 acre-feet of storage, while "Graveyard Wash Reservoir" would provide around 2,000 acre-feet of storage. Either of these reservoirs could potentially provide Ivins with a significant amount of water to be used in the secondary irrigation system, effectively offsetting demands on the culinary water system. Ideally, Ivins City would be able to purchase reuse water from St. George and exchange this water in one of the proposed reservoirs for water in Gunlock Reservoir, taking advantage of the natural elevation of Gunlock to provide needed pressures for the system. However, since reuse water may be slightly lower quality than the water in Gunlock Reservoir, this exchange may or may not be feasible. For the purpose of this master plan, it has been assumed that the Dry Wash Reservoir will be constructed and that Ivins will need a pump station at the reservoir to deliver water from the reservoir to the elevated storage tanks in the irrigation system.

- **Ivins Irrigation Company Water Shares** – As the agricultural/green field areas of Ivins City develop, irrigation shares in the Ivins Irrigation Company may become available. Ivins City should plan to acquire these irrigation shares as and if they become available. The WCWCD may also have access to additional shares in Ivins Irrigation Company that could be used in the proposed secondary irrigation system. **Ivins City Council should seek legal advice about passing an ordinance that requires developers of agricultural fields to**

sell IIC shares to either Ivins City, WCWCD, or another agricultural user. It should be prohibited to sell the water shares to an individual residential lot with a property size of 2 acres or less.

- **Gunlock Wells/Arsenic Treatment Plant** – The City of St. George is currently in the process of adding arsenic treatment to the Gunlock Wells. The total combined annual yield of the well field is approximately 3,200 acre-feet with a peak production rate of 4,000 gpm. In recent discussions, St. George City has said that this water is fully allocated for use in St. George. This considered, additional water from the Gunlock Wells is likely not a long-term solution for Ivins' future water needs.

- **Gunlock Reservoir Surface Water Treatment Plant** – The WCWCD could consider converting the non-potable water system into a potable system with a surface water treatment plant. Such a project would not increase the overall water supply to the region, but it would increase the potable water supply. This would not likely be an improvement that would take place in the near future, considering the stipulations involved with converting the reservoir from an irrigation supply to a culinary water supply.

- **New Well Development** – Ivins City has a few applications for water rights that are unapproved, and since water rights in the Virgin River drainage are considered to be fully appropriated by the State, it is unlikely that these applications will be approved.

- **Upsizing Pipeline Capacity from Quail Lake Water Treatment Plant (WTP)** – With the Lake Powell Pipeline on the horizon and with the growing water demands on the west side of the County, there may be the need to increase the culinary water conveyance capacity from Quail Creek to Ivins, Santa Clara, and the west side of St. George. Currently, there is no plan for such a project in the WCWCD capital facilities plan, but the District is planning to carry out a study in the near future on water needs for the west side of the County.

- **Beaver Dam Wash Water Development** – The WCWCD 2006 Capital Facilities Plan has indicated that a reservoir in the Beaver Dam Wash and a pipeline into the Santa Clara River system could supply up to an additional 4,000 gpm or 6,500 acre-feet annually. Since then, this project has become less likely due to the cost and relative benefit to the District.

Exactly which sources will be used to serve future Ivins demands is somewhat uncertain at this point, but the most probable source of water is the St. George Reuse Facility. Implementing the secondary irrigation system will be important and will open up new options for meeting the City's growing water demands.

It should be noted that the 2013 master plan included a discussion regarding the potential for a wastewater scalping plant in Ivins. Per the 2016 Ivins Sewer Master Plan completed by BC&A, the implementation of a wastewater scalping plant was not recommended at this point in time, primarily due to its cost. However, as growth continues in Ivins and the surrounding communities and water sources become more limited, or if wastewater scalping technologies become more cost-effective, a scalping plant may become a viable option. A new reservoir, such as Dry Creek

Reservoir, in Ivins would also increase the feasibility of a scalping plant, allowing the facility to run year round and store excess treated water in the reservoir.

Pumping Station & Transmission Analysis

Table 4-9 provides an analysis of the City's pumping and transmission facilities under existing conditions. The City recently upgraded the Taviawk and Tuacahn booster pumps, adding flow capacity to the Taviawk pump and redundancy to the Tuacahn pump. As shown in Table 4-9, the City has a minor deficiency in transmission capacity from the 4 system taps (combined capacity of 3,950 gpm with a demand of 4,054). In the 2013 master plan, the City identified a booster pump project to be installed at the 200 W tap, adding 250 gpm of capacity. This improvement has not yet been constructed, and the City has not observed the need for the facility to this point. The proposed secondary irrigation system, which will serve as a new source to the system, will help offset demands if a major tap were to go offline (note that irrigation system cannot offset flow needed to fill fire flow storage). If the City begins to see water levels in the Cliff Rose Tanks dropping more quickly than expected, the 200 W pump station should be constructed.

Table 4-10 provides the analysis of the pumping and transmission facilities under build-out conditions. The analysis assumes that the secondary irrigation system has been fully implemented throughout the City. The recommended improvements to the system are as follow:

- Add a redundant booster pump at 400 W to improve reliability
- Construct a booster pump at 200 W to increase capacity to 1,500 gpm
- Construct a booster pump at Snow Canyon Parkway to increase capacity to 1,600 gpm

Each of these recommended improvements is anticipated to fall outside of the 10-year planning window, considering that the secondary irrigation system will reduce overall demands on the culinary system. However, the projects may be needed sooner if the City begins to observe issues with flow capacity from the various taps.

Table 4-9
Existing Pumping Station/Transmission Pipelines

Pumping Station/Transmission Pipe Name	# Pumps	Flow Capacity (gpm)	Total Head (ft)	Capacity with one pump out of service (gpm)	Existing PDD (gpm)	Fill Fire Flow Storage in 24 Hours (gpm)	Total Required Capacity (gpm)	Transmission Pipe Diameter (in.)	Flow Velocity at Full Capacity (fps)
Taviawk	3	450	175	125	196	167	363	8	2.9
Tuacahn	2	320	60	200	47	167	214	10	1.3
400 W	1	1,300	20	1,100	3,285	406	4,054*	10	5.3
200 W	0	1,100	0	1,100				10	4.5
Snow Canyon Dr	0	500	0	500				10	2.0
Snow Canyon Pkwy	0	1,250	0	1,250				10	5.1

*Includes required flow through to Taviawk pump station

Table 4-10
Build-Out Pumping Station/Transmission Pipelines

Pumping Station/Transmission Pipe Name	# Pumps	Flow Capacity (gpm)	Total Head (ft)	Capacity with one pump out of service (gpm)	Existing PDD (gpm, calculated)	Fill Fire Flow Storage in 24 Hours (gpm)	Existing Required Capacity (gpm)	Transmission Pipe Diameter (in.)	Flow Velocity (fps)
Taviawk	3	450	175	450	295	167	462	8	1.5
Tuacahn	2	320	60	200	95	167	262	10	1.1
400 W	**2**	**1,300**	20	**1,300**	3,993	406	4,861*	10	5.3
200 W	**2**	**1,500**	0	**1,500**				10	4.5
Snow Canyon Dr**	0	500	0	500				10	2
Snow Canyon Pkwy**	**2**	**1,600**	30	**1,600**				10	5.1

*Includes required flow to Taviawk pumping station
**Modeling results indicate that as demands increase out of the Snow Canyon Tanks into St. George and Santa Clara, and booster pump may be needed at the Snow Canyon Parkway or Snow Canyon Drive Tap to provide needed flow

CHAPTER 5
WATER STORAGE ANALYSIS

Water storage is essential to a municipal water system. Storage allows for equalization of flow as system demand varies throughout the day. Storage also provides water for emergencies such as fires and power outages. The City's service standards for water storage are given as follows:

- Equalization Storage:
  - Indoor: Minimum 400 gallons per ERU
  - Outdoor: 4,964 gallons per irrigated acre
- Fire Suppression Storage: Meet need of individual buildings per International Fire Code (IFC) Appendix B.
- Emergency Storage: Emergency storage is not required by the State Code and "shall be based upon an assessment of risk and the desired degree of system dependability." Ivins City's storage facilities do not include emergency storage.

Table 5-1 shown below provides a description of the City's existing storage facilities.

Table 5-1
Description of Existing Ivins City Storage Facilities

Tank Name	Capacity (gallons)	Elevation (ft)		Height (ft)	Inside Diameter (ft)	Zone Supply via Gravity	Zone Supply via PRV	Type
		Base	Overflow					
Snow Canyon 1*	237,500	3292.0	3312.0	20.0	160.0	3312 Snow Canyon	3275 Reserve	Concrete Buried Cylinder
Snow Canyon 2*	237,500	3292.0	3312.0	20.0	160.0	3312 Snow Canyon	3275 Reserve	Concrete Buried Cylinder
Tuacahn	460,000	3315.0	3352.5	37.5	43.0	3350 Tuacahn	None	Painted Steel Cylinder
Cliff Rose 2MG (North)	1,946,000	3270.0	3292.5	23.0	120.0	3290 Zones	3275 South PRV	Painted Steel Cylinder
Cliff Rose 2MG (South)	1,946,000	3270.0	3290.8	21.5	130.0	3290 Zones	3275 South PRV	Concrete Buried Cylinder
Taviawk	420,000	3440.0	3460.0	23.0	60.0	3460 Taviawk	3390 Taviawk PRV	Painted Steel Cylinder

*Snow Canyon Tanks are owned by the Snow Canyon Compact which is shared by Ivins, St. George and Santa Clara. Ivins is entitled to 7.9% of the 3MG of storage in each tank.

The age of each tank operated by Ivins City is given as follows:

- Cliff Rose (North) 2 MG – Constructed 2002 – Age 15 years
- Cliff Rose (South) 2 MG – Constructed 2016 – Age 1 year
- Tuacahn 0.4 MG – Constructed 1995 – Age 22 years
- Taviawk 0.5 MG – Constructed 1999 – Age 18 years

All of these tanks, except for the new Cliff Rose 2 MG concrete tank, are refurbished and repurposed tanks from the oil and gas industry. The true age of these facilities is unknown.

FIRE STORAGE

Fire storage requirements are governed by the City adopted 2012 International Fire Code. In Appendix B, Section B105, fire flow requirements for residential one- and two- family dwellings no larger than 3,600 sq. ft. (all floors including basements and garage) is 1,000 gpm. For residential buildings larger than 3,600 sq. ft. fire flows must be in accordance with Table B105.1 which lists fire flows based on building size and construction type. For the typical non-fire resistant residential construction, homes larger than 3,600 sq.ft. must have the following fire flows shown in Table 5-2 (excerpted from the full Table B105.1).

Table 5-2
Excerpt from IFC Table B105.1 Minimum Required Fire Flow for Buildings

Fire Flow Calculation Area for Type V-B Construction (sq. ft.)	Required Fire-Flow (gpm)	Fire Flow Duration (hrs)	Fire Storage Required (gallons)
3,601 – 4,800	1,750	2	210,000
4,800 – 6,200	2,000	2	240,000
6,201- 7,700	2,250	2	270,000
7,701 – 9,400	2,500	2	300,000
9,401 – 11,300	2,750	2	330,000

Most of the older medium and high density single family units are small enough for the 1,000 gpm fire flow requirement. However, all of the tank service areas encompass areas with structures that would require more than the minimum flow. The following table provides a summary of the large fire flow requirements areas of the City.

Table 5-3
Summary of Existing Buildings Fire Flow Requirements

Area/Building	Maximum Fire Area (Sq. Ft)	Building Type	Required Fire Flow (gpm)	Duration (hours)	Required Fire Storage (gallons)	Tank
Taviawk Subdivision	6,000	V-B	2,000	2	240,000	Taviawk
Tuacahn Center for the Arts	39,163 (sprinkled)	II-A or III-A	2,000	2	240,000	Tuacahn
Citadel Subdivision	8,500	V-B	2,500	2	300,000	Snow Canyon
The Reserve Subdivision	11,000	V-B	2,750	2	330,000	Snow Canyon
Snow Canyon Medical Clinic	22,600 (sprinkled)	V-A	2,000	2	240,000	Snow Canyon
Church at Center Street/600 East	19,150 (sprinkled)	V-A	2,000	2	240,000	Snow Canyon
Church at Center/Main	23,000	V-A	2,750	2	330,000	Cliff Rose Two 2 MG
200 East Commercial Area	7,950	V-B	2,500	2	330,000	Cliff Rose Two 2 MG
Stake Center at 250 E 1060 S	28000 (sprinkled)	V-A	2,250	2	270,000	Cliff Rose Two 2 MG
Heritage Church at 200 E 1060 S	17,500	V-A	2,250	2	270,000	Cliff Rose Two 2 MG
Red Mountain Spa	50,000	V-A	2,500	2	300,000	Snow Canyon
Red Mountain Elementary	50,000	V-A	3,000	3	540,000	Cliff Rose Two 2 MG
Vista School	57,000 (sprinkled)	V-B	3,250	3	585,000	Snow Canyon
Fitness Ridge Spa	31,000 (sprinkled)	V-A	2,500	2	300,000	Cliff Rose Two 2 MG
Posovi Subdivision	6,800	V-B	2,250	2	270,000	KWU Upper
Veterans Care Facility	17,000	V-A	2,750	2	330,000	Cliff Rose Two 2 MG
Rocky Vista University Medical School	71,690	II-A	3,000	3	540,000	Cliff Rose Two 2 MG
Rocky Vista University Student Housing	24,560	V-A	2,000	2	240,000	Cliff Rose Two 2 MG

The building with the highest fire storage requirement is Vista School with a fire storage requirement of 585,000 gallons. This impacts the storage in the 3290/3312 Pressure Zones which are served primarily by the two 2 MG Cliff Rose tanks. This pressure zone is also served by storage in the two 3 MG Snow Canyon storage tanks, but Ivins technically only has access to 7.9% of the storage capacity in these tanks (per the Snow Canyon Compact). The Taviawk and Tuacahn fire storage requirement is 240,000 gallons.

EXISTING STORAGE ANALYSIS

The following tables provide an evaluation of existing storage for the Ivins City municipal system and the KWU system. As shown, with the addition of the newly constructed 2 MG Cliff Rose Tank, the City has sufficient storage to meet its established standards.

Table 5-4
Ivins City Existing Water Storage Analysis

Tank Service Area	Tanks	Available Storage (gallons)	Fire Storage (gallons)	Equalization		Excess Storage (gallons)
				Indoor (gallons)	Outdoor (gallons)	
3290/3312 Zones	Cliff Rose 2MG	1,946,000	585,000	1,345,000	1,783,000	**654,000**
3165 PRV Zone	Cliff Rose 2MG	1,946,000				
3140 PRV Zone	Snow Canyon	475,000				
		4,367,000				
3460 Taviawk	Taviawk	486,000	240,000	95,000	128,000	**23,000**
3390 PRV Zone						
3350 Tuacahn	Tuacahn	460,000	240,000	13,000	52,000	**155,000**

Table 5-5
Ivins City Analysis of Excess ERUs in Existing Storage Facilities

Tank Service Area	Tanks	ERUs Serviced	**Excess ERUs**	Vacant Lots	**Remaining ERUs with development of vacant lots**
3290/3312 Zones 3175 PRV Zone 3140 Reserve PRV	Cliff Rose 2MG Cliff Rose 2MG Snow Canyon	3,359	**598**	215	**383**
3460 Taviawk 3390 PRV Zone	Taviawk	236	21	65	**(44)**
3350 Tuacahn	Tuacahn	32	**120**	0	**120**

Table 5-6
KWU Existing Water Storage Analysis

Tank Service Area	**Tanks**	**Available Storage (gallons)**	**Fire Storage (gallons)**	**Equalization**		**Excess Storage (gallons)**
				Indoor (gallons)	**Outdoor (gallons)**	
Kayenta Upper	Indian Hills	250,000	270,000	72,000	89,000	**319,000**
	Posovi	500,000				
		750,000				
Kayenta Mid/Lower	Poson	1,200,000	240,000	78,000	97,000	**785,000**

Table 5-7
KWU Analysis of Excess ERUs in Existing Storage Facilities

Tank Service Area	Tanks	ERUs Serviced	**Excess ERUs**	Vacant Lots	**Remaining ERUs with development of vacant lots**
Kayenta Upper	Indian Hills Posovi	178	**355**	50	**305**
Kayenta Mid/Lower	Poson	194	**875**	33	**842**

With the recent construction of the new 2 MG Cliff Rose tank (replacing the previous 1 MG tank), the City has excess storage in all of its existing tank service areas. However, as shown in Table 5-5, the Taviawk tank does not have sufficient capacity to service all of the vacant lots in the 3460 Taviawk/3390 PRV Zone. The KWU system has ample storage capacity to meet current demands including the buildout of existing vacant lots. As outlined in Chapter 1, the City has been considering the acquisition of the KWU system, combining the system into one Ivins City municipal system. One potential benefit of merging the system would be that the 3460 Taviawk and 3390 PRV Zone could utilize some of the excess storage in the Posovi and Indian Hills for fire flow protection, freeing up equalization capacity in the Taviawk tank for new development. There is currently an emergency connection between the Ivins Municipal System and the KWU system near the intersection of Taviawk Dr. and Shinava Drive. In the case of a fire flow event, this connection could be used to supplement fire flow capacity to these pressure zones, and since fire flow can be counted toward multiple areas, it would not detrimentally effect or reduce the storage capacity available for users in the Upper Kayenta Zone.

FUTURE STORAGE – BUILDOUT

Water storage requirements at build-out have been estimated using the City's current land use plan and the growth projections presented in Chapter 2 of this report. Table 5-8 provides the breakdown of estimated storage needs for the City both with and without the implementation of a secondary irrigation system. It should be noted that when the secondary irrigation system is developed in Ivins, it will require the construction of new storage facilities, or in other words, implementing a secondary irrigation system will not eliminate the need for additional water storage for the City.

Table 5-8
Future Tank Storage Evaluation – Build-Out

Tank Service Area	Tanks	Available Storage (gallons)	Fire Storage (gallons)	Equalization (gallons)		Excess Storage (gallons)	Excess Storage with Irrigation System in Place (gallons)
				Indoor (gallons)	Outdoor (gallons)		
3290/3312 Zones 3175 PRV Zone 3140 Reserve PRV	Cliff Rose 4MG Snow Canyon	4,000,000 475,000 4,475,000	585,000	3,230,000	4,025,900	**-3,365,900**	**660,000**
3460 Taviawk 3390 PRV Zone	Taviawk	486,000	240,000	175,000	230,000	**-159,000**	**71,000**
3350 Tuacahn	Tuacahn	413,000	240,000	62,000	125,000	**-14,000**	**-14,000**
3310 Comanche Cliffs		0	240,000	18,000	50,000	**-308,000**	**-308,000**
KWU System							
Kayenta Upper	Indian Hills Posovi	250,000 500,000 750,000	240,000	198,000	245,000	**67,000**	**67,000**
Kayenta Mid/Lower/Anazazi	Poson	1,200,000	240,000	581,000	585,000	**-206,000**	**-206,000**

As shown in Table 5-8, implementation of the secondary irrigation system would significantly reduce the amount of additional storage needed for the culinary system. However, the secondary irrigation system will need over 4 MG of storage to service the system through buildout.

FUTURE STORAGE – 10 YEAR GROWTH WINDOW

To this point, storage has been evaluated for existing and full build-out conditions, which provides a big-picture view of the City's storage facilities. However, when it comes to developing a Capital Facilities Plan and calculating Impact Fees, it is important to also look at projected system growth within a 10-year growth window. To estimate storage needs within the next 10 years, BC&A met with City personnel to discuss and identify which areas of the City were experiencing the heaviest growth and which areas were anticipated to see growth within the next 10 years. Table 5-9 presents the projected water storage needs for the City through 2027. As shown, the City will need additional storage capacity within the next 10 years (secondary irrigation storage will offset culinary water storage needs).

Table 5-9
Future Tank Storage Evaluation – 10 Year Growth Conditions

Tank Service Area	Tanks	Available Storage (gallons)	Fire Storage (gallons)	Equalization (gallons)		Excess Storage (gallons)
				Indoor (gallons)	Outdoor (gallons)	
3290/3312 Zones 3175 PRV Zone 3140 Reserve PRV	Cliff Rose 4MG Snow Canyon	3,900,000 475,000 4,375,000	585,000	1,815,000	2,602,000	**-627,000**
3460 Taviawk 3390 PRV Zone	Taviawk	486,000	240,000	120,000	172,500	**-46,500**
3350 Tuacahn	Tuacahn	413,000	240,000	34,000	89,000	**50,000**
KWU System						
Kayenta Upper	Indian Hills Posovi	250,000 500,000 750,000	240,000	100,000	125,000	**79,000**
Kayenta Mid/Lower/Anazazi	Poson	1,200,000	240,000	207,000	257,000	**496,000**

RECOMMENDATIONS

As shown in Table 5-8, the implementation of a secondary irrigation system significantly changes the storage needs of the culinary water system. As identified in Chapter 8 of the Secondary Irrigation Master Plan, **it is recommended that the City construct a new 2 MG irrigation tank within the next 1-2 years as part of the proposed secondary irrigation system**. This tank will provide the storage for the City's needs throughout the next 10 years. Beyond the next 10 years, storage needs will be dependent on the extent to which the irrigation system is actually expanded (which is it itself a function of the availability of irrigation water). If the irrigation system is ultimately limited to only a portion of the City, additional culinary storage will be needed, but if the irrigation system is expanded throughout the City, only a small amount of, if any, additional culinary storage may be needed (depending on whether the Comanche Cliffs area is supplied water from Ivins or from the 3 MG Shivwits Tank from St. George).

CHAPTER 6
DISTRIBUTION PIPING SYSTEM ANALYSIS

This chapter discusses the City's existing distribution facilities and analyzes the ability of the existing piping system to handle current water demands and identifies the required facilities to meet future demands. From this analysis, deficiencies will be identified for which capital improvements will be recommended.

INTRODUCTION

The existing Ivins City distribution piping system comprises over 70 miles of piping ranging from 2-inch to 16-inch diameter. Table 6-1 summarizes the City's existing water distribution system.

Table 6-1
Summary of Distribution Piping System

Diameter (in)	Length (ft)	Length (miles)
2	4,428	0.84
4	7,909	1.5
6	101,928	19.3
8	190,280	36.0
10	47,811	9.0
12	14,051	2.7
14	5,684	1.1
16	942	0.2
	373,033	**70.6**

The distribution system has been evaluated using a computer based hydraulic model which analyzes a distribution of demands over a network of pipelines and determines the resultant flows in each individual pipe and resultant pressures at each node of the network. The model will also evaluate the available fire flow at each node based on the City's service standards.

The following models were evaluated as part of this master plan:

- **Scenario E1-PDD: Existing Peak Day Demand (2017)** – Model demands are based on the existing peak day demand.
- **Scenario E2-PHD: Existing Peak Hour Demand (2017)** – Model demands are based on existing peak hour demand.

- **Scenario E-3 – PDD+FF: Existing Peak Day Demand with Fire Flow (2017)** - This model simulation includes peak day demand plus fire flow demand (which varies based on building size, construction type, etc., see Table 5-3 of Chapter 5).

- **Scenario 10YR-1-PDD: Peak Day Demand with 10 Year Growth (2027) –** Model demands are based on projected peak day demand in the year 2027.

- **Scenario 10YR-2-PHD: Peak Hour Demand with 10 Year Growth (2027)** - Model demands are based on projected peak hour demand in the year 2027.

- **Scenario BO1-PDD: Build-Out Peak Day Demand –** Model demands are based on projected peak day demand at full build-out of the City.

- **Scenario BO2-PHD: Build-Out Peak Day Demand –** Model demands are based on projected peak hour demand at build-out.

The InfoWater software package from Innovyze was used to model the City's distribution system. The model includes all distribution and transmission pipelines, but does not include service connection piping. All the evaluated scenarios were "steady state" simulations and assumed that the tanks were 25 percent full.

As discussed in Chapter 4, the City is planning to begin implementing a secondary irrigation system as soon as 2018. As the irrigation system expands throughout the City, the demand on the culinary water system will decrease. The following assumptions have been included in the model scenarios:

- **Existing Conditions Scenario** – All water demand comes from the culinary water system as currently configured.

- **10-Year Growth Scenario** – The 10-year growth scenario assumes that Phase 1 and Phase 2 of the secondary irrigation system are complete (refer to Chapter 8 of the Secondary Irrigation Master Plan), which is anticipated to reduce the culinary system peak day demand by 750 gpm.

- **Build-Out Scenario** - The build-out growth scenario assumes that the secondary irrigation system has been fully implemented throughout the City (i.e. all phases have been completed). Ultimately, conditions at build-out are subject to change and are highly dependent on the availability of water in the future (whether it be culinary quality or secondary irrigation quality).

MODEL CALIBRATION

Model calibration is the process of adjusting hydraulic parameters so that model output results correlate with actual observed conditions in the water system. Model calibration for the Ivins City model was achieved by comparing simulated model pressures against actual field pressure

readings for different location throughout the system. A few assumptions regarding the calibration of the model are listed below:

- **Pipe Roughness** – Pipe roughness in the distribution system was assigned a Hazen-Williams coefficient of 130. While new PVC pipe can have a roughness coefficient as high as 150, pipe scale and general pipe wear typically increase pipe roughness over time.

- **Pipe Size Data** – Pipe diameters and locations in the model were assigned based on the City's current GIS database.

- **Node Elevation** – Junction elevations in the model were assigned using a Digital Elevation Model (DEM) which was developed by Washington County in 2012.

PRESSURE ANALYSIS

The City's current water pressure zones are shown in Figure 6-1. This figure shows the pressure zones for both the Ivins City system and the Kayenta Water Users system. Undevelopable zones are identified with a cross hatch. A detailed hydraulic evaluation of the KWU system is outside of the scope of this study and is shown for informational purposes only.

The municipal system is divided into nine pressure zones as follows:

Connected to the Taviawk Tank are:

- 3460 Taviawk Zone
- 3390 Taviawk PRV Zone

Connected to the two 2 MG Cliff Rose and the Snow Canyon Tanks are:

- 3290 North Zone (North of Center Street)
- 3290 South Zone (South of Center Street)
- 3312 Snow Canyon Zone
- 3164 PRV Zone
- 3140 Reserve PRV Zone

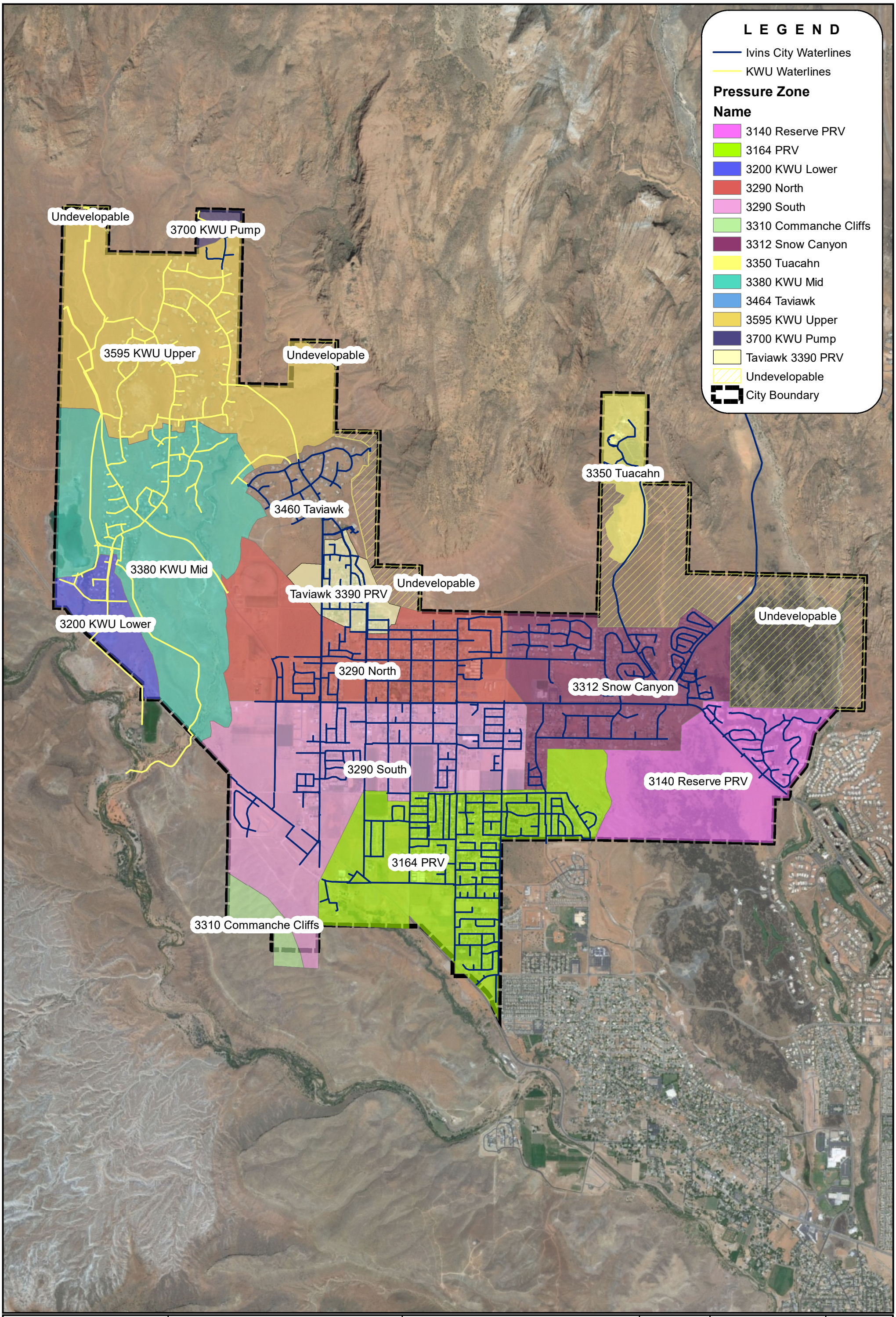
Connected to the Tuacahn Tank is:

- 3350 Tuacahn Zone

Another zone, which is currently undeveloped, is potentially unserviceable by the City's current tanks:

- 3310 Comanche Cliffs Zone

The static pressures of each of the pressure zones is summarized in Table 6-2.



BOWEN COLLINS & ASSOCIATES

IVINS CITY
CULINARY WATER MASTER PLAN

EXISTING CULINARY WATER PRESSURE ZONES

NORTH:

SCALE: 0 1,250 2,500 Feet

FIGURE NO. 6-1

S:\Ivins\235-17-02 Culinary Water Master Plan, IFFP, IFA\4.0 GIS\4.4 Figures\Figure 6-1 - Existing Ivins City Pressure Zones.mxd aanderson 1/31/2019

Table 6-2
Static Pressure Analysis of Pressure Zones per Existing Conditions

Zone	Tank/PRV HGL (feet)			Zone Elevation (feet)		Static Pressure Range (psi)	
	High	Low	25% Full	High	Low	High	Low
3460 Taviawk	3460	3440	3445	3418	3160	130	12
3390 Taviawk PRV	3390	3390	3390	3254	3150	104	59
3350 Tuacahn	3352.5	3315	3324	3230	3150	88	41
3312 Snow Canyon	3312	3292	3297	3160	2988	140	59
3290 North/South	3290.8	3270	3275	3180	2985	133	42
3175 Reserve PRV	3175	3175	3175	3042	2940	102	58
3164 South PRV	3164	3164	3164	3015	2940	97	65

High Static Pressure = Pressure at Lowest Elevation with High Tank HGL
Low Static Pressure = Pressure at Highest Elevation with 25% Full Tank HGL

In review of Table 6-2, the pressure problem in the 3460 Taviawk zone is apparent. In the upper area of the zone there are 4 homes that utilize a booster pump/pressure vessel to obtain the necessary pressure. Model simulations indicate that 2 of these homes (at the higher elevations) do not have adequate fire flow protection (under the 20 psi residual pressure rule in R309-510, these homes only have 850 gpm of available fire flow, while 2,000 gpm is required based on the size of the homes). At 2,000 gpm, model simulations indicate that residual pressure at the hydrant is around 15 psi, but line pressure in the piping between the hydrant and the Taviawk Tank drops below 5 psi. Ultimately, there is some uncertainty regarding the systems capability to provide fire flow protection to these homes and has been identified as a deficiency. Considering that there are no cost-effective means of remediating this deficiency, it recommended that the City conduct a fire flow test on the 2 hydrants located just below the Taviawk tank to identify the actual capacity of each hydrant. As will be discussed in further detail in Chapter 7, combining the KWU system with the Ivins City system would provide additional flow to this area via the PRV located near the intersection of Taviawk Dr. and Shinava Dr.

The 3312 Snow Canyon Zone shows static pressures at 140 psi which is 10 psi above the maximum pressure per the Ivins Service Standard. These pressures occur mostly near the Puerto Drive PRV on the upstream side of the valve. The high pressures may cause additional leakage and potential problems to users if the individual PRVs on the homes are not properly working. If this area were to become an issue (i.e. multiple service line failures, water main leaks or breaks, etc.), the PRV could be relocated to a point further north on Puerto Drive (near the intersection of Puerto Drive and Mesa Vista Dr.) to reduce the pressure in this area. At this time, relocating the PRV would not be cost efficient, therefore **there is no recommendation to remediate this system deficiency at this time**.

As identified in the 2013 Master Plan, **it would be beneficial to combine the 3164 PRV and 3175 Reserve PRV pressure zones**. As development occurs in the currently undeveloped southeast

region of the City, these two pressure zones will naturally move toward each other, and both areas could operate under an HGL of 3175. This would provide a valuable second connection for The Reserve area which currently only has a single connection through the PRV on Snow Canyon Parkway. This single connection has needed to be shut down in the past to work on the PRV or fix a leak, which shuts down all water service to The Reserve.

Hydraulic Model Results

Existing System Evaluation

The hydraulic computer model was used to simulate the distribution system under existing conditions. Model results for these scenarios are discussed below with the following model output figure as a reference:

1. Figure 6-2 shows pressures for the 2017 Peak Day Demand Scenario
2. Figure 6-3 show pressures and distribution pipe velocities for the 2017 Peak Hour Demand Scenario
3. Figure 6-4 shows available fire flow in conjunction with 2017 Peak Day Demand

2017 Peak Day Demand

As shown in Figure 6-2, the majority of the system is capable of delivering peak day demands with adequate pressure. However, model simulations indicate the system may have substandard pressures in the following areas:

- **Upper Elevations of Taviawk Development** – Model results indicate that some of the lots near the Taviawk tank do not provide a pressure of 40 psi under peak day demand. While the homes on Shinava Court are shown as being pressure deficient, these homes are on individual booster pumps and therefore have adequate pressure.

- **400 N & 200 E Area** – A small portion of the City along 400 N near 200 E is shown as having substandard peak day demand pressures.

2017 Peak Hour Demand

Like the peak day demand evaluation, the majority of the Ivins system is equipped to deliver peak hour demands with sufficient pressure. As expected, the same areas with peak day pressure deficiencies show peak hour demand deficiencies. While the higher elevation area of Taviawk does show low pressures, they do not drop below the City/State minimum of 30 psi. However, the 400 N/ 200 E area does show peak hour pressures below 30 psi. These low pressures have been confirmed by recent pressure logger data collected by the City.

Peak hour demand model simulations did display a potential issue with the Snow Canyon Parkway Tap. As demands increase from the Snow Canyon Tanks into St. George, increased headloss in the pipeline may affect the amount of water that Ivins can draw from the tap (i.e. low pressure differential between the 24" transmission line and the Ivins distribution system). As demands

L E G E N D

Existing Peak Day Demand
PRESSURE

- Less than 30 psi
- 31 - 40 psi
- 41 - 50 psi
- 51 - 60 psi
- 61 - 80 psi
- 81 - 100 psi
- 101 - 130 psi
- Greater than 130 psi
- Ivins City Waterlines
- PRV
- Water Tank

Home on Shinava Court OK. Home are on booster pumps which increase pressure above City minimums

Peak day pressures on the upper end of Shinava Dr. are below 40 psi (32 - 38 psi)

Peak Day Pressures along 400 N are below 40 psi (32 - 39 psi)

350 N
400 W
200 W
600 W
Old Highway 91
Main St.
200 E
400 E
400 S
800 S
Center St.
Tuacahn Dr.
Snow Canyon Dr.
Snow Canyon Prwy

Note: model results shown are with all storage tanks at 1/4 full

BOWEN COLLINS & ASSOCIATES

IVINS CITY
CULINARY WATER MASTER PLAN

EXISTING PEAK DAY DEMAND PRESSURES

NORTH:

SCALE: 0 900 1,800 Feet

FIGURE NO. 6-2

S:\Ivins\235-17-02 Culinary Water Master Plan, IFFP, IFA\4.0 GIS\4.4 Figures\Figure 6-2 - Existing PDD Pressures.mxd aanderson 1/31/2019

L E G E N D

PRESSURE

- Less than 30 psi
- 31 - 40 psi
- 41 - 50 psi
- 51 - 60 psi
- 61 - 80 psi
- 81 - 100 psi
- 101 - 130 psi
- Greater than 130 psi

VELOCITY

- Less than 2 fps
- 2 - 4 fps
- 4 - 6 fps
- 6 - 8 fps
- Greater than 8 fps

Homes on Shinava Court OK. Homes are on booster pumps which increase pressure above City minimums

Peak Day Pressures along 400 N are below 30 psi (22 - 26 psi)

350 N
400 W
200 W
600 W
Old Highway 91
Main St.
200 E
400 E
400 S
800 S
Center St.
Tuacahn Dr.
Snow Canyon Dr.
Snow Canyon Prwy

Note: model results shown are with all storage tanks at 1/4 full

BOWEN COLLINS & ASSOCIATES

IVINS CITY
CULINARY WATER MASTER PLAN

EXISTING PEAK HOUR DEMAND PRESSURES

NORTH:

SCALE: 0 900 1,800 Feet

FIGURE NO. 6-3

S:\Ivins\235-17-02 Culinary Water Master Plan, IFFP, IFA\4.0 GIS\4.4 Figures\Figure 6-3 - Existing PHD Pressures.mxd aanderson 1/31/2019

L E G E N D

Available Fire Flow

- Less than 500 gpm
- 500 - 999 gpm
- 1,000 - 1,499 gpm
- 1,500 - 1,749 gpm
- 1,750 - 1,999 gpm
- 2,000 - 2,499 gpm
- 2,500 - 2,999 gpm
- 3,000 - 3,499 gpm
- 3,500 - 3,999 gpm
- 4,000 gpm or greater
- Ivins City Waterlines
- Fire Flow Deficiencies
- Water Tank

Fire Flow Substandard
(2,000 gpm Fire Flow Required)

Fire Flow Substandard in Majority of Taviawk Subdivision (2,000 gpm Required Fire Flow)

OK - Hydrant Protects Small Pool House

Fire Flow Substandard

Fire Flow Substandard for Small Portion of Red Mountain Spa

Fire Flow Substandard (2,750 gpm Required Flow)

Fire Flow Slightly Substandard at Fitness Ridge Spa (2,350 gpm Available, 2,500 gpm required)

Tuacahn Dr.

Snow Canyon Dr.

Snow Canyon Pkwy

Old Highway 91

350 N

400 W

200 W

600 W

Center St.

Main St.

200 E

400 E

400 S

800 S

Note: fire flow results shown are with all storage tanks at 1/4 full

BOWEN COLLINS & ASSOCIATES

IVINS CITY
CULINARY WATER MASTER PLAN

EXISTING PEAK DAY DEMAND WITH FIRE FLOW

NORTH:

SCALE: 0 900 1,800 Feet

FIGURE NO. 6-4

S:\Ivins\235-17-02 Culinary Water Master Plan, IFFP, IFA\4.0 GIS\4.4 Figures\Figure 6-4 - Existing PDD with Fire Flow.mxd aanderson 1/31/2019

continue to increase into St. George as well as Santa Clara, Ivins may need to install a booster pump station at this tap in order to move more water into the system.

2017 Peak Day Demand with Fire Flow

As shown in Figure 6-3, there are areas of the City that do not have adequate fire flow capacity:

- **Shinava Court** – As discussed previously, the homes located in Shinava Ct. are located too close to the Taviawk tank (in elevation) to provide the needed fire flow and residual system pressure. The system cannot provide the required fire flow of 2,000 gpm with a residual pressure of 20 psi. Providing the require 2,000 gpm flow would require a larger pressure drop in the system (down to approximately 15 psi). In the case of a fire event, the system will likely be able to provide the necessary flow to these homes at the cost of temporary decreased service to the neighboring homes. While this does not meet the State standards for system performance, correcting this issue would require either the tank to be relocated to a higher elevation or the construction of a high capacity booster pump station, neither of which are cost effective solutions. **It is recommended that the City conduct a fire flow test on the two hydrants near Shinava Court to verify the actual fire flow capacity available for these homes.**

- **Taviawk Subdivision** – The Taviawk subdivision, which is comprised of large homes, has a required fire flow of 2,000 gpm. As indicated in Figure 6-4, this area does not currently meet this fire flow requirement. As will be discussed in further detail in Chapter 7, using the emergency connection between KWU and the Ivins system near Taviawk/Shinava Drive provides the additional flow needed to meet the fire flow requirement, which is a potential benefit for merging the Ivins City system with the KWU system.

- **Center St. & 600 W** – The portion of the system on Center St. west of 600 W (which is currently mostly undeveloped) does not have adequate fire flow capacity (caused by the 6-inch pipe to the area). As identified in the 2013 master plan, this deficiency will need to be corrected as development occurs in the region at the developer's expense. The City should remain aware of this area to assure that this is corrected with development.

- **Fitness Ridge Spa** – Available fire flow at Fitness Ridge Spa is slightly below standard (2,350 gpm available with 2,500 gpm required). Based on the fact that this deficiency is not severe, there is no recommendation for remediation at this time.

- **Red Mountain Spa** – Model simulations indicate a possible fire flow deficiency to one of the units in the Red Mountain Spa area (northeast side). The fire flow capacity is limited by small diameter pipes (2-inch and 6-inch). The 2-inch pipes servicing the fire hydrants should be upsized to 8-inch.

- **The Reserve (Split Rock)** – A number of homes at the higher elevations in The Reserve do not have adequate fire flow capacity. In order to remediate this deficiency, the existing 8-inch line which acts as the primary backbone of The Reserve would need to be replaced with a 12-inch line. This project has not been deemed cost efficient at this time, but the

City should keep the project in mind for the future in case the area has road improvements/replacement that would facilitate the project**.**

10 Year Growth System Evaluation

The hydraulic computer model was used to simulate the distribution system under existing conditions. Note that the system demand associated with the secondary pressurized irrigation system has been removed from the 10 year model simulation (resulting in a lower system demand than existing conditions). Future demand distribution in the 10 year growth model was assigned through discussions with Ivin City management to identify areas of the City that are quickly developing or that are anticipated to develop in the near future. The following figures provide the results of the hydraulic model simulations:

1. Figure 6-5 shows pressures for the 2027 Peak Day Demand Scenario
2. Figure 6-6 show pressures and distribution pipe velocities for the 2027 Peak Hour Demand Scenario

2027 Peak Day Demand

As shown in Figure 6-5, the results for the peak day demand scenario at 10 year growth are very similar to the results of the existing conditions model. This is because the implementation of the secondary irrigation system will essentially cause the culinary water demands to remain close to the same throughout the next 10 years.

2027 Peak Hour Demand

Similar to the 2027 peak day demand simulation, predicted peak hour pressures are very similar to the results for the existing system.

Build-Out System Evaluation

The hydraulic computer model was used to simulate the distribution system under full build-out conditions. Note that the demands associated with the proposed secondary irrigation system have been removed from the hydraulic model. The following figure provide the results of the hydraulic model simulations:

1. Figure 6-7 provides the proposed layout and pipe sizes of the build-out water system
2. Figure 6-8 shows pressures for the Peak Day Demand Scenario at build-out
3. Figure 6-9 show pressures and distribution pipe velocities for the Peak Hour Demand Scenario at build-out.

L E G E N D

PRESSURE

- Less than 30 psi
- 31 - 40 psi
- 41 - 50 psi
- 51 - 60 psi
- 61 - 80 psi
- 81 - 100 psi
- 101 - 130 psi
- Greater than 130 psi
- Ivins City Waterlines
- PRV
- Water Tank

Home on Shinava Court OK. Home are on booster pumps which increase pressure above City minimums

Peak day pressures on the upper end of Shinava Dr. are below 40 psi (32 - 38 psi)

Peak Day Pressures along 400 N are below 40 psi (32-38 psi)

350 N
400 W
200 W
600 W
Old Highway 91
Main St.
200 E
400 E
400 S
800 S
Center St.
Tuacahn Dr.
Snow Canyon Dr.
Snow Canyon Prwy

Note: model results shown are with all storage tanks at 1/4 full

BOWEN COLLINS & ASSOCIATES

IVINS CITY
CULINARY WATER MASTER PLAN

10 YEAR PEAK DAY DEMAND PRESSURES

NORTH:

SCALE: 0 900 1,800 Feet

FIGURE NO. 6-5

S:\Ivins\235-17-02 Culinary Water Master Plan, IFFP, IFA\4.0 GIS\4.4 Figures\Figure 6-5 - 10YR PDD Pressures.mxd aanderson 1/31/2019

Homes on Shinava Court OK. Homes are on booster pumps which increase pressure above City minimums

High pipe velocities out of Snow Canyon Tanks under peak hour demand

Peak Day Pressures along 400 N are below 30 psi (25-29 psi)

350 N
400 W
200 W
600 W
Old Highway 91
400 S
800 S
Main St.
200 E
400 E
Center St.
Tuacahn Dr.
Snow Canyon Dr.
Snow Canyon Prwy

L E G E N D

PRESSURE

- Less than 30 psi
- 31 - 40 psi
- 41 - 50 psi
- 51 - 60 psi
- 61 - 80 psi
- 81 - 100 psi
- 101 - 130 psi
- Greater than 130 psi

VELOCITY

- Less than 2 fps
- 2 - 4 fps
- 4 - 6 fps
- 6 - 8 fps
- Greater than 8 fps
- Ivins City Waterlines
- PRVS
- Water Tank

Note: model results shown are with all storage tanks at 1/4 full

BOWEN COLLINS & ASSOCIATES

IVINS CITY
CULINARY WATER MASTER PLAN

10 YEAR PEAK HOUR DEMAND PRESSURES

NORTH:

SCALE: 0 900 1,800 Feet

FIGURE NO. 6-6

S:\Ivins\235-17-02 Culinary Water Master Plan, IFFP, IFA\4.0 GIS\4.4 Figures\Figure 6-6 - 10YR PHD Pressures.mxd aanderson 1/31/2019

L E G E N D

Pipe Diameter

- 2
- 4
- 6
- 8
- 10
- 12
- 14
- 16
- 20
- 24
- Ivins City Waterlines
- PRV
- Water Tank

Tuacahn Dr.

Snow Canyon Dr.

350 N

400 W

200 W

Center St.

Snow Canyon Prwy

600 W

Old Highway 91

Main St.

200 E

400 E

400 S

800 S

Note: model results shown are with all storage tanks at 1/4 full

BOWEN COLLINS & ASSOCIATES

IVINS CITY
CULINARY WATER MASTER PLAN

BUILD-OUT SYSTEM LAYOUT/SIZING

NORTH:

NORTH

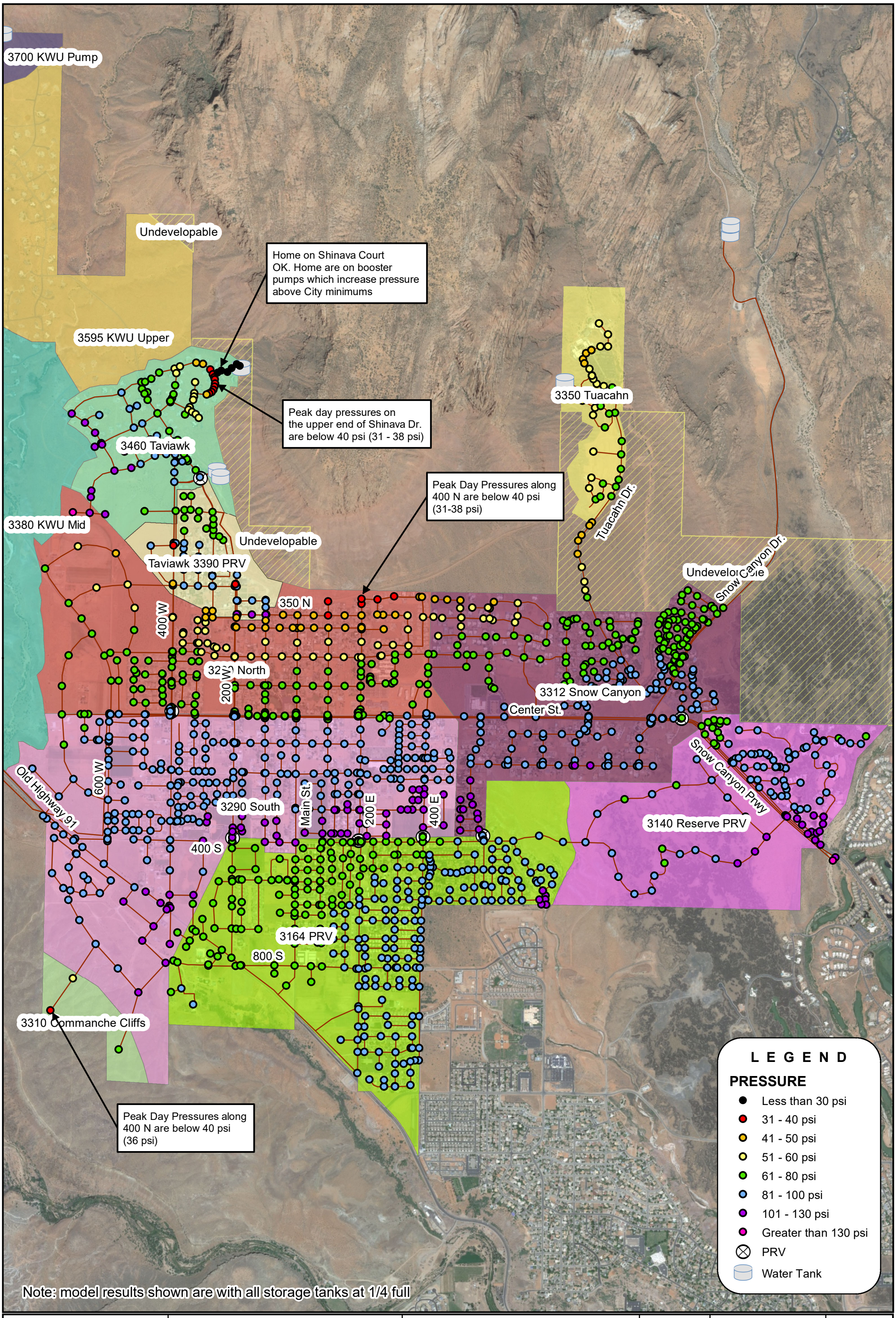
SCALE:

0 900 1,800 Feet

FIGURE NO.

6-7

S:\Ivins\235-17-02 Culinary Water Master Plan, IFFP, IFA\4.0 GIS\4.4 Figures\Figure 6-7 - BO System Layout.mxd aanderson 1/31/2019



BOWEN COLLINS & ASSOCIATES

IVINS CITY
CULINARY WATER MASTER PLAN

BUILD-OUT PEAK DAY DEMAND PRESSURES

NORTH:

SCALE: 0 900 1,800 Feet

FIGURE NO. 6-8

S:\Ivins\235-17-02 Culinary Water Master Plan, IFFP, IFA\4.0 GIS\4.4 Figures\Figure 6-8 - BO PDD Pressures.mxd aanderson 1/31/2019

3700 KWU Pump

Undevelopable

Homes on Shinava Court
OK. Homes are on booster pumps which increase pressure above City minimums

3595 KWU Upper

3460 Taviawk

3380 KWU Mid

Undevelopable

Taviawk 3390 PRV

Peak Hour Pressures along 400 N are below 30 psi (24 - 29 psi)

3350 Tuacahn

Tuacahn Dr.

Snow Canyon Dr.

Undevelopable

350 N

400 W

3290 North

200 W

3312 Snow Canyon

Center St.

Snow Canyon Prwy

600 W

Old Highway 91

3290 South

Main St.

200 E

400 E

3140 Reserve PRV

400 S

3164 PRV

800 S

3310 Commanche Cliffs

Peak Hour Pressure below 30 psi (28 psi)

Note: model results shown are with all storage tanks at 1/4 full

L E G E N D

PRESSURE

- Less than 30 psi
- 31 - 40 psi
- 41 - 50 psi
- 51 - 60 psi
- 61 - 80 psi
- 81 - 100 psi
- 101 - 130 psi
- Greater than 130 psi

VELOCITY

- Less than 2 fps
- 2 - 4 fps
- 4 - 6 fps
- 6 - 8 fps
- Greater than 8 fps
- PRVS
- Water Tank

BOWEN COLLINS & ASSOCIATES

IVINS CITY
CULINARY WATER MASTER PLAN

BUILDOUT PEAK HOUR DEMAND PRESSURES

NORTH:

SCALE: 0 900 1,800 Feet

FIGURE NO. 6-9

S:\Ivins\235-17-02 Culinary Water Master Plan, IFFP, IFA\4.0 GIS\4.4 Figures\Figure 6-9 - BO PHD Pressures.mxd aanderson 1/31/2019

Build-Out System Layout

As shown in Figure 6-7, the majority of future culinary waterlines servicing new development will need to be the standard minimum size of 8-inch diameter, with some 12-inch lines going in around new development near Highway 91.

Build-Out Peak Day Demand

Much like the results of the 10-year growth model, the culinary water system at build-out, assuming full implementation of the secondary water system over time, is simulated to have very similar system pressures to existing conditions. As outlined in Chapter 3, the secondary irrigation system will cause the culinary water system to only see about a 25% increase in demand at build-out.

The build-out scenario identifies a potential future pressure deficiency for the Comanche Cliffs area. If serviced by the 3290 pressure zone, pressures are predicted to be below standards by about 5 psi as this area begins to develop. Developers could explore the potential of connecting to St. George's 20-inch Gunlock line for improved pressures. If the area is serviced by the Ivins system, a maximum pad elevation may need to be established to assure that the new development meets the City's service standards.

Build-Out Peak Hour Demand

As previously mentioned, model results for the peak hour demand scenario at build-out vary only slightly from existing conditions.

Recommended Distribution System Improvements

Based on the hydraulic analysis of the City's culinary water system, the following is a list of recommended improvement projects aimed at remediating existing or future deficiencies. All new distribution lines in the City are to be paid for by the developer, including any line greater than 8-inch that are needed to meet pressure and flow requirements as shown in Figure 6-7.

D-01 – Upper Taviawk Booster Pump – Homes just below the Taviawk Tank are equipped with individual booster pumps to meet pressure requirements. Since the State no longer allows the use of individual booster pumps, it is recommended that a communal booster pump be installed to service these homes.

D-02 – Red Mountain Resort Fire Line Upsize – The Red Mountain Resort currently has a short section of 2-inch pipe which services a fire hydrant. To improve fire protection in the area, the existing 2-inch lines should be replaced with 8-inch lines. This should be a recommendation to the resort and should not be funded by the City.

D-03 – Backup Connection from Kayenta into Taviawk – In order to provide the necessary fire flow coverage for the Taviawk subdivision, the City should assure that the emergency connection

between the KWU and Ivins City system (near intersection of Taviawk Dr. and Shinava Dr.) is available and operational.

CHAPTER 7
KAYENTA WATER USERS SYSTEM EVALUATION

Kayenta, the large residential development on the west side of Ivins City, currently owns and operates a private water system known as Kayenta Water Users (KWU). Water for the system is supplied by the Ence Wells, and the system currently serves approximately 360 housing units and a small number of non-residential connections. As growth has occurred over recent years, the potential of combining the KWU system with Ivins Culinary Water System has been discussed. The purpose of this chapter is to provide a valuation of the existing KWU system and provide Ivins City with recommendations pertaining to merging the two water systems.

SUMMARY OF EXISTING KWU SYSTEM

The KWU water system is composed of one well source (Ence Well, owned by WCWCD), 3 storage tanks, transmission piping, and distribution piping. A map of the KWU system is shown in Figure 7-1. Table 7-1 provides the 2015 and 2016 water usage for KWU as recorded by the Utah Division of Water Rights.

Table 7-1
KWU Historical Water Usage (acre-feet)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Monthly Average Usage	Total Annual Usage
2015	6.7	7.2	9.4	12.1	12.1	18.7	18.1	18.3	16.6	12.6	6.8	6.7	12.1	**145.3**
2016	5.6	6	9.9	9.5	11.5	17.5	15.4	18.1	12.6	12.4	8.8	6.1	11.1	**133.4**

The 3 KWU storage facilities are summarized in Table 7-2.

Table 7-2
Existing KWU Storage Facilities

Tank Name	Tank Type	Pressure Zone	Tank Volume (MG)
Indian Hills	Above Ground Steel	KWU Upper	0.25
Posovi	Buried Concrete	KWU Upper	0.5
Poson	Buried Concrete	KWU Mid/Lower	1.2
		Total	**1.95**

The KWU system has 4 pressure zones, summarized in Table 7-3. The KWU Upper and KWU Mid zones are set by water levels in the storage tanks, while the KWU Lower zone is regulated through a PRV and the KWU Pump zone is the highest elevation zone that requires a booster pump to meet pressure requirements.

Indian Hills Tank
0.25 MG

Posovi Tank
0.5 MG

Poson Tank
1.2 MG

P

Ivins
Reservoir

Taviawk Dr.

Kayenta Pkwy

Kwavasa Dr.

Old Highway 91

Center St.

Ence Well

W

L E G E N D

Kayenta Tanks

W Wells

Name

- 3700 KWU Pump
- 3595 KWU Upper
- 3380 KWU Mid
- 3200 KWU Lower

Diameter

- NA
- 4-inch
- 6-inch
- 8-inch
- 10-inch
- 12-inch

P Booster Pump

BOWEN COLLINS & ASSOCIATES

IVINS CITY
CULINARY WATER
MASTER PLAN

KAYENTA WATER
USERS SYSTEM

NORTH:
NORTH

SCALE:
0 600 1,200
Feet

FIGURE NO.
7-1

S:\Ivins\235-17-02 Culinary Water Master Plan, IFFP, IFA\4.0 GIS\4.4 Figures\Figure 7-1 - Existing KWU System_update.mxd aanderson 1/31/2019

Table 7-3
KWU Pressure Zone Summary

Pressure Zone	Tank	HGL
KWU Upper	Indian Hills, Posovi	3595
KWU Mid	Poson	3380
KWU Lower	Regulated with PRV	3200
KWU Pump	Boosted Pressure from KWU Upper	3700

The water transmission/distribution system contains piping ranging from 4-inch to 12-inch in diameter. Figure 7-1 displays the size and location of the KWU pipe network. Note that some information from the KWU GIS is incomplete or missing pipe diameter information.

BENEFIT OF MERGING THE IVINS & KWU SYSTEM

When Kayenta first began to develop in the 1980's, western Washington County looked very different than it does today. Ivins was a small, rural farming town with less than 1,000 residents. At that point in time, it's probable that Ivins was not equipped to take on this new somewhat isolated development known as Kayenta over a mile away from its furthest western point. For this reason, Kayenta developed its own private water system in order to move forward with its development plan. Over the past 30 years, the west side of the County has experienced significant growth, as shown in the two aerial images shown on page 7-4 comparing the landscape in 1993 versus today.

Combining the Ivins City and KWU water systems is mutually beneficial. Merging the system will give the "Ivins City system" access to additional storage and will provide a significant improvement to fire flow coverage for some of the higher elevation homes in the City. KWU will gain access to the City's experienced operations and maintenance staff, simplifying the day to day operation of the system. Kayenta will at that point be included in the City's water planning efforts.

While this plan will ultimately provide an improvement to Ivins City as a whole, it is important to note the following:

- Kayenta Water Users currently holds enough source capacity for 552 connections. Kayenta currently has over 350 connections, and current land use plans indicate the Kayenta could have as many as 1,948 ERUs at buildout. Upon combining the system, Ivins City will become responsible to acquire and provide water to Kayenta through buildout.

- The condition of the Kayenta Water Users system is unknown. Prior to taking over the system, Ivins City should assure that the system meets all City standards, such as minimum pressures, fire flow capacity, isolation valves, etc. Any deficiencies in the system should be corrected by KWU at their cost prior to turning the system over to Ivins City.

- Connecting the two systems will abruptly increase the size of the system. Ivins City should evaluate its current O&M and clerical/billings workload and evaluate whether additional staff will be needed to support the larger system.

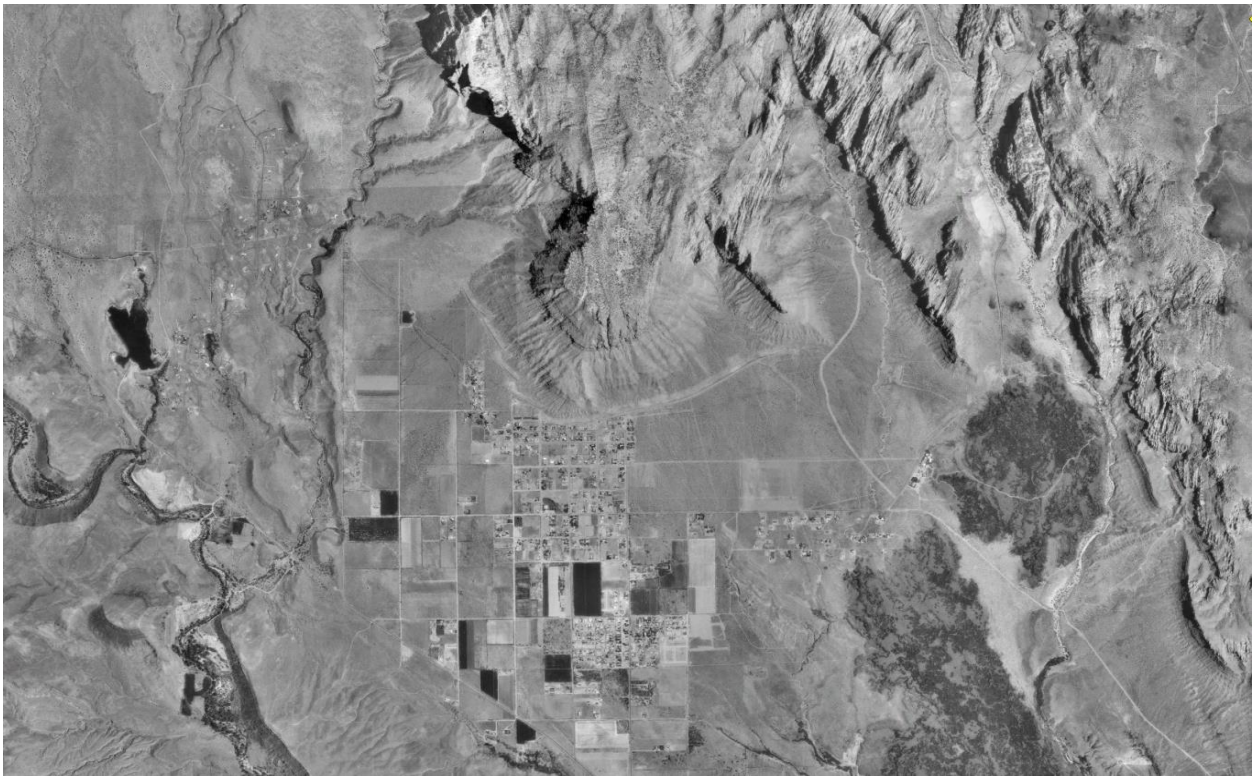
ESTIMATED REPLACEMENT VALUE OF KWU SYSTEM

The estimated replacement value of the existing KWU water system is shown in Table 7-4. This does not represent what the system is currently worth, but is an estimate of what it would cost to replace the system in today's dollars.

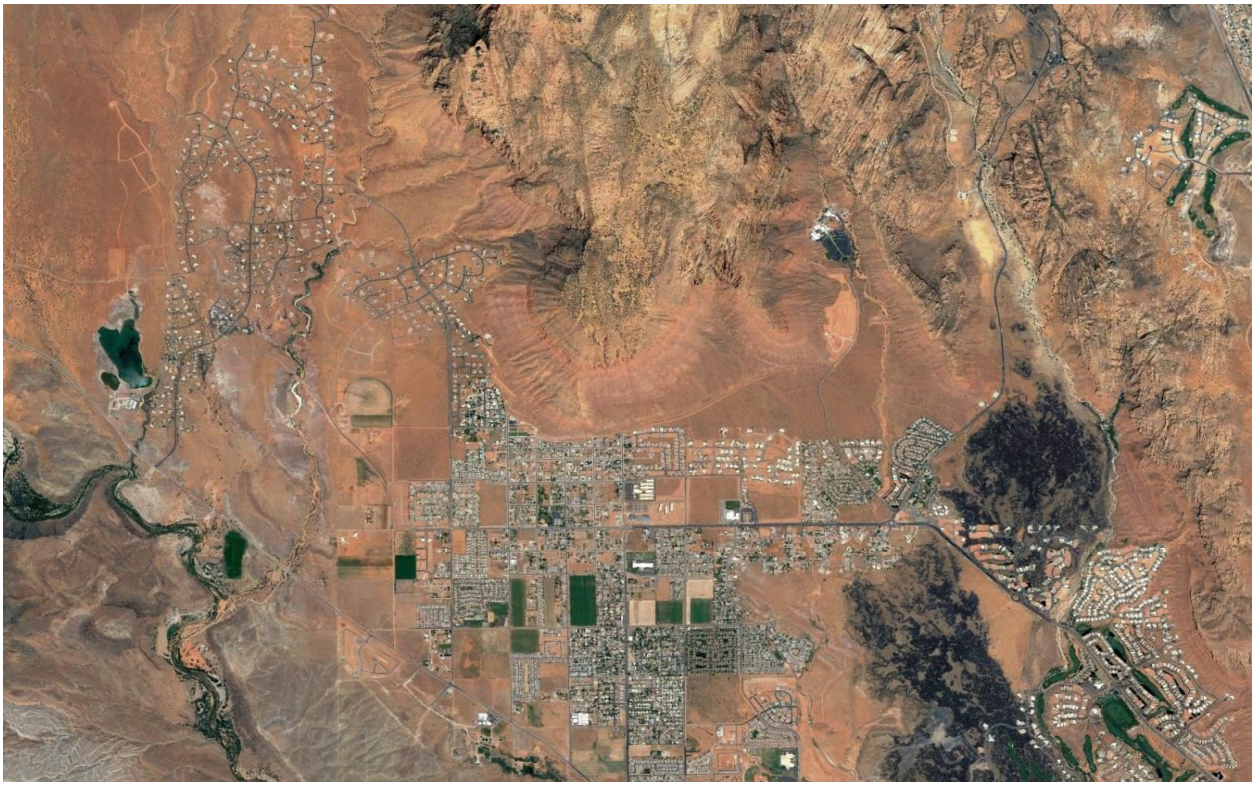
Table 7-4
Estimated Replacement Value of Existing KWU System

System Component	Quantity	Unit Replacement Price	Estimated Replacement Value
Transmission/Distribution Pipes	Length (ft)	$/ft	
4-inch	470	$90	$42,300
6-inch	42,790	$100	$4,279,000
8-inch	63,345	$125	$7,918,125
10-inch	8,858	$130	$1,151,540
12-inch	3,735	$140	$522,900
		Subtotal	**$13,913,865**
Storage Faclities	Volume (gal)	$/gal	
Indian Hills	250,000	$1.30	$325,000
Posovi	500,000	$1.20	$600,000
Poson	1,200,000	$1.00	$1,200,000
		Subtotal	**$2,125,000**
Booster Pump	Capacity (gpm)	$/gpm	
KWU - P1	160	$400.00	$64,000
		Subtotal	**$64,000**
		Grand Total	**$16,102,865**

As shown, the system has an estimated replacement value of around $16 million dollars. The actual value of the system would take into account the actual construction cost of each component along with a method of depreciation, which is beyond the scope of this evaluation. Ultimately, the recommended approach to combining the systems is only partially related to the estimated value of the existing KWU system.



Ivins - 1993



Ivins - 2017

RECOMMENDED APPROACH TO COMBINING THE SYSTEMS

The KWU system is comprised of a combination of "system level" and "project level" improvements. Project level improvements are those improvements which are constructed for a specific project funded by a developer, such as a new subdivision or commercial building. Developers are responsible for the construction and cost of a project level improvement with no obligation from the City for funding. System level improvements, on the other hand, are improvements which benefit the system as a whole or that benefit a large portion of the service area. Examples of system level improvements are storage tanks, booster pumps, and large transmission lines. System level improvements are funded by the City through the combination of impact fees and user rates.

If the KWU were comprised solely of "project level" improvements, there would logically be no need for Ivins to purchase any portion of the system (all funded by developers). However, the KWU system does have 3 storage tanks, a booster pump station, and a transmission line which would fall under the category of "system level" improvements and represent an investment made by Kayenta into the community as a whole (all distribution lines are "project level" improvements).

This considered, BC&A would recommend that Ivins City do the following:

- Merge the two systems and waive all water impact fees until Kayenta reaches the 552 connections that are specified in the agreement between KWU and WCWCD. By taking this approach, the City will give Kayenta credit for the source and transmission facilities they have acquired and developed to this point in time. When Kayenta exceeds 552 connections, Ivins City will then be responsible for acquiring and providing the necessary improvements to meet demands of new develop, at which point users in Kayenta will be required to pay a standard water impact fee.

- The storage analysis in Chapter 5 concluded that the KWU storage tanks have a total capacity to service 1,600 ERUs. When Kayenta reaches 552, they will be utilizing 34.5% of the tanks' capacity. With the plan to begin charging Kayenta an impact fee upon reaching 552 connections, the City should compensate Kayenta for its excess storage capacity (since the impact fee includes the cost of storage facilities and would effectively result in double charging Kayenta for the storage component of the impact fee). This considered, it is recommended that the City purchase the excess capacity in the tanks beyond 552 units (1,048 ERUs) at a depreciated value (i.e. pay 65.5% of the depreciated value of the tanks). The method of depreciation and salvage value assumed in the transaction will need to be discussed and negotiated between the City and Kayenta. Upon purchasing the tanks, the City will then own the facility and collect impact fees for reimbursement.

RECOMMENDED STEPS PRIOR TO MERGING SYSTEMS

Prior to combining the KWU water system with the Ivins City system, it is recommended that the City take the necessary steps to assure that the system meets Ivins City standards. This includes, but is not limited to:

- Fire flow testing
- Pressure logging at various points in the system
- Inspection of storage tanks and booster pump facilities
- Inspection of valves and other appurtenances

It is recommended that the cost to carry out any system inspections or testing be paid for by Kayenta. In order to merge the systems, Kayenta will need to demonstrate to the City that the system meets the City standards and will not present an unreasonable O&M burden on the City. It is also recommended that the City negotiate a "warranty" period ranging from 1-3 years that holds Kayenta responsible for any necessary repairs or replacement that are needed within the specified time period. The City does not want to take over a system that immediately stands in need of repair and rehabilitation.

CHAPTER 8
CAPITAL FACILITIES PLAN

The previous chapters of this report have provided an analysis and discussion of the City's sources, storage facilities, transmission, and distribution facilities. Using these master planning efforts, this chapter provides a Capital Facilities Plan for the culinary water system, outlining the future improvements needed to continue meeting the City's standards for water service.

Ivins is at a crossroads; culinary water sources are becoming more limited, and the City is at somewhat of a geographical disadvantage in terms of water supply. The majority of culinary water in the County is located to the east, while Ivins sits on the far west side of the region, requiring long, expensive water transmission facilities. Understanding this challenge, Ivins City began, starting in 2002, to require new development to install pressurized irrigation lines with the intent of bringing a pressurized secondary irrigation system online. This secondary irrigation system would allow the City to utilize lower quality water sources that do not meet requirements for drinking water. More and more communities across the State are beginning to look at secondary irrigation systems for this basic reason: ***Why treat water to culinary standards if it's used for irrigation?*** This is particularly true in Southern Utah where water sources are limited.

As identified in Chapter 4 of this report, Ivins City is approaching its current culinary source capacity, making this the ideal time to implement the secondary irrigation system (see Secondary Irrigation Master Plan for details). As this system is brought into service, demands will immediately be reduced on the culinary water system, freeing up culinary water capacity for future users. Ultimately, secondary irrigation service will be extended to the majority of the City, taking approximately ½ of the water demand off of the culinary water system.

This considered, the culinary water Capital Facilities Plan has only a select few projects aimed at remediating existing deficiencies; the majority of water system funding over the next 10 years will go into the secondary irrigation system. As overall system demand increases with development in the future, demand on the culinary water system should actually stay steady as the secondary irrigation system is expanded throughout the City.

RECOMMENDED CAPITAL IMPROVEMENT BUDGET

Before establishing a 10-year capital facilities plan, it is important to determine how much funding should be set aside each year for capital improvements. One of the best ways to identify a recommended level of funding is to consider the estimated service life of the system. As with all utilities, each component of a water system has a finite service life. If adequate funds are not set aside for regular system renewal, the water system has the potential to fall into a state of disrepair and be incapable of providing the level of service that Ivins customers have come to expect. To determine the target level of yearly spending on the system, the replacement value of the current system was evaluated. The results of the analysis are shown in Table 8-1. The total cost to replace all pipes, tanks, booster pumps, and the City's proportion of sources is estimated to be approximately $55 million based on current construction costs.

L E G E N D

- Recommended Improvements
- Ivins City Waterlines
- Water Tank

Assure that backup connection from KWU is available, Connection provides necessary supplemental flow to Taviawk subdivision during a fire event

D-01
Install booster pump station to replace the existing individual booster pumps for homes on Shinava Court

D-02
Replace 430 feet of 2-inch pipe with new 8-inch pipe

Tuacahn Dr.
Snow Canyon Dr.
Snow Canyon Prwy
Center St.
350 N
400 W
200 W
600 W
Old Highway 91
Main St.
200 E
400 E
400 S
800 S

BOWEN COLLINS & ASSOCIATES

IVINS CITY
CULINARY WATER MASTER PLAN

RECOMMENDED 10-YEAR CAPITAL IMPROVEMENTS

NORTH:

SCALE: 0 900 1,800 Feet

FIGURE NO. 8-1

S:\Ivins\235-17-02 Culinary Water Master Plan, IFFP, IFA\4.0 GIS\4.4 Figures\Figure 8-1 - Recommended Distribution System Improvements.mxd aanderson 1/31/2019

Individual components of the water system have a different expected service life. When installed correctly, waterlines can last upward of 60 years, while other system components, such as wells and pumps, will have a shorter life span. Taking this into account, Table 8-2 presents the ideal level of annual funding which should be invested into each component of the system. In essence, these values represent how much annual funding should either be invested in the system or set aside to be invested at a later date.

Table 8-1
Estimated Replacement Value of Existing Ivins City System

System Component	Quantity	Unit Replacement Price	Estimated Replacement Value
Transmission/Distribution Pipes	Length (ft)	$/lf	
2-inch*	4,428	$125	$553,500
4-inch*	7,909	$125	$988,625
6-inch*	101,928	$125	$12,741,000
8-inch	190,280	$125	$23,785,000
10-inch	47,811	$130	$6,215,430
12-inch	14,051	$140	$1,967,140
14-inch	5,684	$160	$909,440
16-inch	942	$180	$169,560
24-inch	12,200	$200	$2,440,000
		Subtotal	**$47,330,000**
Storage Facilities	Volume (MG)	$/gallon	
Cliff Rose #1	2	$0.90	$1,800,000
Cliff Rose #2	2	$0.90	$1,800,000
Taviawk	0.42	$1.30	$546,000
Tuacahn	0.46	$1.30	$598,000
Snow Canyon #1**	3	$0.80	$288,000
Snow Canyon #2**	3	$0.80	$288,000
		Subtotal	**$5,320,000**
Booster Pump Stations	Capacity (gpm)	$/gpm	
Taviawk	240	$400	$96,000
Tuacahn	270	$400	$108,000
400 W	1,300	$400	$520,000
		Subtotal	**$724,000**
Wells	Capacity (gpm)	$/gpm	
Ence Well	600	$2,500	$1,500,000
Snow Canyon Wells**	2,700	$2,500	$810,000
		Subtotal	**$2,310,000**
		Grand Total	**$55,684,000**

*Since 2-inch, 4-inch, and 6-inch pipes would be replaced with 8-inch pipes, the replacement value for these pipes is shown with the unit cost for 8-inch pipe.
**Ivins owns 12% of the water production and storage facilities in the Snow Canyon Compact

Table 8-2
Estimated Replacement Value of Existing Ivins City System

System Component	Estimated Service Life	Estimated Replacement Cost	Recommended Annual Budget
Transmission/Distribution Waterlines	60 Years	$47,330,000	$789,000
Storage Facilities	50 Years	$5,320,000	$106,400
Booster Pumps	40 Years	$724,000	$18,100
Wells	40 Years	$2,310,000	$57,750
TOTAL		**$55,684,000**	**$971,250**

As shown in Table 8-2, the ideal level of annual system funding into the water system is $971,000, which is about 1.75% of the total estimated system replacement value. This system investment could be used to rehabilitate and replace deteriorating infrastructure, fund capital projects, or be saved for larger future expenses. Due to the effects of inflation, this value is expected to increase in the future. This value will be incorporated into the City's rate study.

OVERALL CAPITAL IMPROVEMENTS THROUGH BUILDOUT

Table 8-3 provides an overall summary of recommended culinary water projects through the estimated build-out year. The two distribution system projects are aimed at correcting an existing deficiency and are therefore not eligible for impact fee reimbursement. The three pumping projects are impact fee eligible projects driven by growth, but will not be included in the Impact Fee Facilities Plan due to the fact that they fall outside of the 10 year planning window.

Table 8-3
Culinary Water System Improvements through Build-Out

Project Type	Project ID	Project Description	Estimated Project Timing	Estimated Project Cost (2017 dollars)
Distribution System	D-01	Install single booster pump to replace individual booster pumps on homes near the Taviawk Tank	2019	$60,000
Distribution System	D-02	Replace 430 feet of 2-inch pipe with 8-inch pipe	2020	$45,000
Pumping	P-01	Install redundant booster pump at 400 W	2027+	$40,000
Pumping	P-02	Construct new booster pump at 200 W to increase capacity to 1,500 gpm	2027+	$100,000
Pumping	P-03	Construct booster pump at Snow Canyon Parkway to increase capacity to 1,600 gpm	2027+	$200,000
			TOTAL	**$445,000**

10-YEAR CAPITAL IMPROVEMENT PLAN SUMMARY

The recommended 10-year capital improvements for the City's culinary water system are summarized in Table 8-4 and shown in Figure 8-1. Included in the table is a summary of each project along with the estimated construction cost and year. As mentioned previously, the majority of water system projects over the next 10 years will focus on the secondary irrigation system (refer to the Secondary Irrigation Master Plan). Not included in the table are the costs associated with routine system rehabilitation and replacement of system components which will also need to be accounted for in future budgets and rate studies.

Table 8-4
Recommended 10-Year Capital Facilities Projects

Project Type	Project Identifier	Project Description	Estimated Project Year	Estimated Cost (2017 Dollars)
Distribution System[1]	D-01	Install single booster pump to replace individual booster pumps on homes near the Taviawk Tank	2019	$60,000
Distribution System[2]	D-02	Replace 430 feet of 2-inch pipe with 8-inch pipe	2020	$45,000
			TOTAL	**$105,000**

[1]The City should consider asking the residents benefited by this project to help pay for the improvement
[2]Red Mountain Resort should be advised concerning the potential fire flow deficiency in their location. The City will require the Resort to fund any improvements to fire flow capacity servicing their buildings.

Draper, Utah Office:
154 East 14000 South
Draper, Utah 84020
Phone: (801) 495-2224
Fax: (801) 495-2225

Eagle, Idaho Office:
776 East Riverside Drive
Suite 250
Eagle, Idaho 83616
Phone: (208) 939-9561
Fax: (208) 939-9571

St. George, Utah Office:
20 North Main
Suite 107
St. George, Utah 84770
Phone: (435) 656-3299
Fax: (435) 656-2190

WWW.BOWENCOLLINS.COM

