MUNICIPAL AND INDUSTRIAL WATER SUPPLY AND USES IN THE KANAB CREEK/VIRGIN RIVER BASIN

(Data Collected for Calendar Year 2005)

Prepared by

Utah Department of Natural Resources
Division of Water Resources

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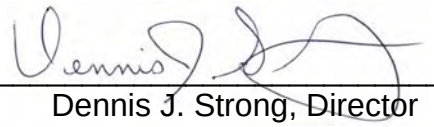

Dennis J. Strong, Director

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EXECUTIVE SUMMARY

The purpose of this report is to document the municipal and industrial (M&I) water system supplies and uses within the Kanab Creek/Virgin River (KCVR) Basin during the calendar year of 2005. These water systems deliver culinary (potable) and/or secondary (non-potable) water and have been separated into four categories, as defined on page 18 of this report. The four categories are public community, public non-community, self-supplied industrial and private domestic water systems. Water supplies, under the current hydrologic and each systematic condition, are evaluated for only potable water service in public community water systems.

The base data for both water supply and uses of public community water systems was provided by each of the water systems. Data for the other categories of water systems was compiled by also using various other agencies and references.

M&I water uses, for the basin, were then totaled and tabulated by county. Portions of the three counties of Iron, Kane and Washington are contained within the KCVR Basin.

Public Community Water Systems

Of the aforementioned categories, public community systems serve about 95 percent of all residents in the State of Utah. Within the KCVR Basin, approximately 90 percent of the population is served by 42 public community water systems. Refer to **Figure 3** on page 6 for a location map of these systems, as well as the general boundaries of the basin.

For planning purposes, accurate and detailed current water use and supply information is invaluable in determining the ability of the basin to meet future water demands. The Division of Water Resources (DWRe) uses the annual reliable potable water supply, as defined on page 9, as a tool to quantify the amount of water that can be delivered by each public community water system to satisfy current and projected peak day demands with present water supply conditions.

In the KCVR basin, it was determined that the current annual reliable potable water supply is 76,271 acre-feet. Springs account for 8 percent, wells 39 percent and surface water 53 percent of this supply. The breakdown of this supply is presented in the following **Table I**.

Table I
KANAB CREEK/VIRGIN RIVER BASIN
Reliable Potable Water Supplies for Public Community Systems
(Acre-Feet/Year)

County	Springs	Wells	Surface	Total
Iron	64.5	68.2	0.0	**132.7**
Kane	685.5	2,894.1	0.0	**3,579.6**
Washington	5,387.5	26,973.2	40,198.0	**72,558.7**
Basin Totals	**6,137.5**	**29,935.5**	**40,198.0**	**76,271.0**

Note: Wells are limited to 50% of their "maximum" capacity for reliable supply when well/pump capacity is the limiting factor. Springs and surface water supplies equal to their respective "maximum" capacities.

M&I water use, within these systems, can be subdivided by two types of water: potable (culinary) and non-potable (secondary). Potable water is delivered by the public community system itself. However, secondary water can be delivered not only by the system, but also by separate irrigation companies, exclusively in some locations.

Table II, on the following page, shows water use data for the potable and non-potable categories of water delivered by the public community systems within the basin. Categorically, the total water uses were approximately 23% residential indoor, 38% residential outdoor, 22% commercial, 15% institutional, and 2% light industrial/stockwatering.

TABLE II
KANAB CREEK/VIRGIN RIVER BASIN
Water Use for Public Community Systems
(Acre-Feet/Year)

	Iron County	Kane County	Washington County	Total
Potable Use				
Residential Indoor	28.6	504.3	10,235.3	**10,768.2**
Residential Outdoor	125.0	846.2	13,871.2	**14,842.4**
Commercial	2.7	273.7	8,743.0	**9,019.4**
Institutional	8.6	716.9	2,208.7	**2,934.2**
Industrial/Stockwater	0.0	18.9	528.2	**547.1**
Total Potable	**164.9**	**2,360.0**	**35,586.4**	**38,111.3**
Secondary Use				
Residential	58.8	405.1	2,252.9	**2,716.8**
Commercial	0.0	0.0	1,353.5	**1,353.5**
Institutional	0.0	91.8	3,699.5	**3,791.3**
Industrial/Stockwater	0.0	0.0	139.7	**139.7**
Total Secondary	**58.8**	**496.9**	**7,445.6**	**8,001.3**
TOTAL WATER USE	**223.7**	**2,856.9**	**43,032.0**	**46,112.6**

In general, and specifically for this report, all per capita water use figures refer to the water use within public community water systems only. Out of a total basin population of 133,780 in 2005, 133,400 people were served by the public community systems. For these systems, residential potable per capita water use calculates to 171 gallons per capita per day (gpcd). Similarly, non-potable residential water use calculated to 19 gpcd. The resultant total per capita water use is 190 gpcd for residential purposes within the public community systems of the basin. With the addition of water use in the commercial, institutional and industrial categories, the per capita water use for public community systems is 255 gpcd for potable and 54 gpcd for non-potable water, for an overall water use of approximately 309 gpcd. Comparatively, in 2005, the statewide average per capita water use was 190 gpcd potable and 70 gpcd non-potable, for a total of 260 gpcd.

Dry summer months, a long growing season and comparatively large lot sizes, in this basin, greatly increase the outside watering requirements compared with the more densely populated basins along the Wasatch Front. Additionally, secondary (non-potable) water comprises a relatively high percentage of the residential and institutional outdoor use. Considering that secondary water is rarely metered, its use tends to far exceed outdoor watering needs. Combined, these factors all contribute to the above average per capita water use, in this basin. The per capita water use values for various combinations of categories and types of water are shown in the following **Table III**.

TABLE III
KANAB CREEK/VIRGIN RIVER BASIN
Average Per Capita Use
(Supplied by Public Community Systems)

CATEGORY	Average Per Capita Use (Ac-Ft/Yr)	Average Per Capita Use (GPCD)
Residential Potable Use	0.192	171
Residential Potable Plus Secondary Use	0.212	190
Total Potable Use	0.286	255
Total Potable Plus Secondary Use	0.346	309

Note: Total potable categories include residential, commercial, institiutional and industrial uses.

Total M&I Water Use

Table IV, on the following page, shows the total potable and non-potable M&I water use for all system types in the KCVR Basin for the year 2005. As can be seen, public community systems deliver the majority of the potable water used within the basin. The table indicates that the total potable M&I water use in 2005 was 38,401 acre-feet. Total non-potable M&I water use in 2005 for the basin was 8,083 acre-feet. Therefore, total M&I water use for all system categories and types of water in 2005, for the KCVR basin, was 46,484 acre-feet.

TABLE IV
KANAB CREEK/VIRGIN RIVER BASIN
Total M&I Water Use for all Categories
(Acre-Feet/Year)

	Iron County	Kane County	Washington County	Total
Potable Use				
Public Community Systems	164.9	2,360.0	35,586.4	**38,111.3**
Public Non-Community Systems	29.7	65.4	13.4	**108.5**
Self-Supplied Industries	0.0	2.0	95.0	**97.0**
Private Domestic	9.7	29.5	44.6	**83.8**
Total Potable Use	**204.3**	**2,456.9**	**35,739.4**	**38,400.6**
Secondary Use				
Secondary Irrigation Companies	58.8	496.9	7,445.6	**8,001.3**
Public Non-Community Systems	0.0	82.0	0.0	**82.0**
Self-Supplied Industries	0.0	0.0	0.0	**0.0**
Total Secondary Use	**58.8**	**578.9**	**7,445.6**	**8,083.3**
TOTAL WATER USE	**263.1**	**3,035.8**	**43,185.0**	**46,483.9**

M&I Water Deliveries and Depletions

On the following page, **Table V** shows both the deliveries and depletions for all the M&I water in the basin. The information contained in the table is very useful for overall water planning purposes. See pages 20 and 21 for detailed definitions of the terms used. In **Appendix B**, there is a table that contains a breakdown of all the deliveries and depletions of each public community water system, as well as all other categories of water systems, within the basin.

TABLE V
KANAB CREEK/VIRGIN RIVER BASIN
M&I Deliveries and Depletions
(Acre-Feet/Year)

COUNTY	Deliveries			Depletions		
	Indoor Use	Outdoor Use	Total	Indoor Use	Outdoor Use	Total
Iron	41.6	221.5	**263.1**	2.9	147.6	**150.5**
Kane	942.6	2,093.2	**3,035.8**	456.0	1,395.5	**1,851.5**
Washington	18,314.3	24,870.7	**43,185.0**	1,858.6	16,580.5	**18,439.1**
Basin Totals	**19,298.5**	**27,185.4**	**46,483.9**	**2,317.5**	**18,123.6**	**20,441.1**

INTRODUCTION

Authority

The Utah Division of Water Resources (DWRe) has the overall responsibility for completing studies, investigations, and plans to assist the responsible development and utilization of the water resources of the state of Utah. The State Water Plan, prepared and distributed in early 1990 by the DWRe, provided the foundation and overall direction to establish and implement the state policy framework of water management. As part of the state water planning process, the DWRe prepares detailed plans for each of the 11 hydrologic basins in the state. The Kanab Creek/Virgin River (KCVR) Basin is one of these 11 basins. A location map of the KCVR Basin is shown in Figure 1 on the next page.

Each basin water plan identifies potential conservation and development projects and describes alternatives to efficiently satisfy the water needs of that basin. As part of this effort, background data reports are completed for each river basin. These include a Water-Related Land Use Report and a Municipal & Industrial Water Supply & Use Report.

Scope

As stated earlier, the subject of this M&I report is a determination of present M&I water supplies and uses within this basin. The data presented in this report may be used in the State Water Plan for the KCVR Basin as well as other DWRe reports and studies. Information considered for this report also includes related investigations recently completed by the DWRe and the Utah Division of Water Rights (DWRi).

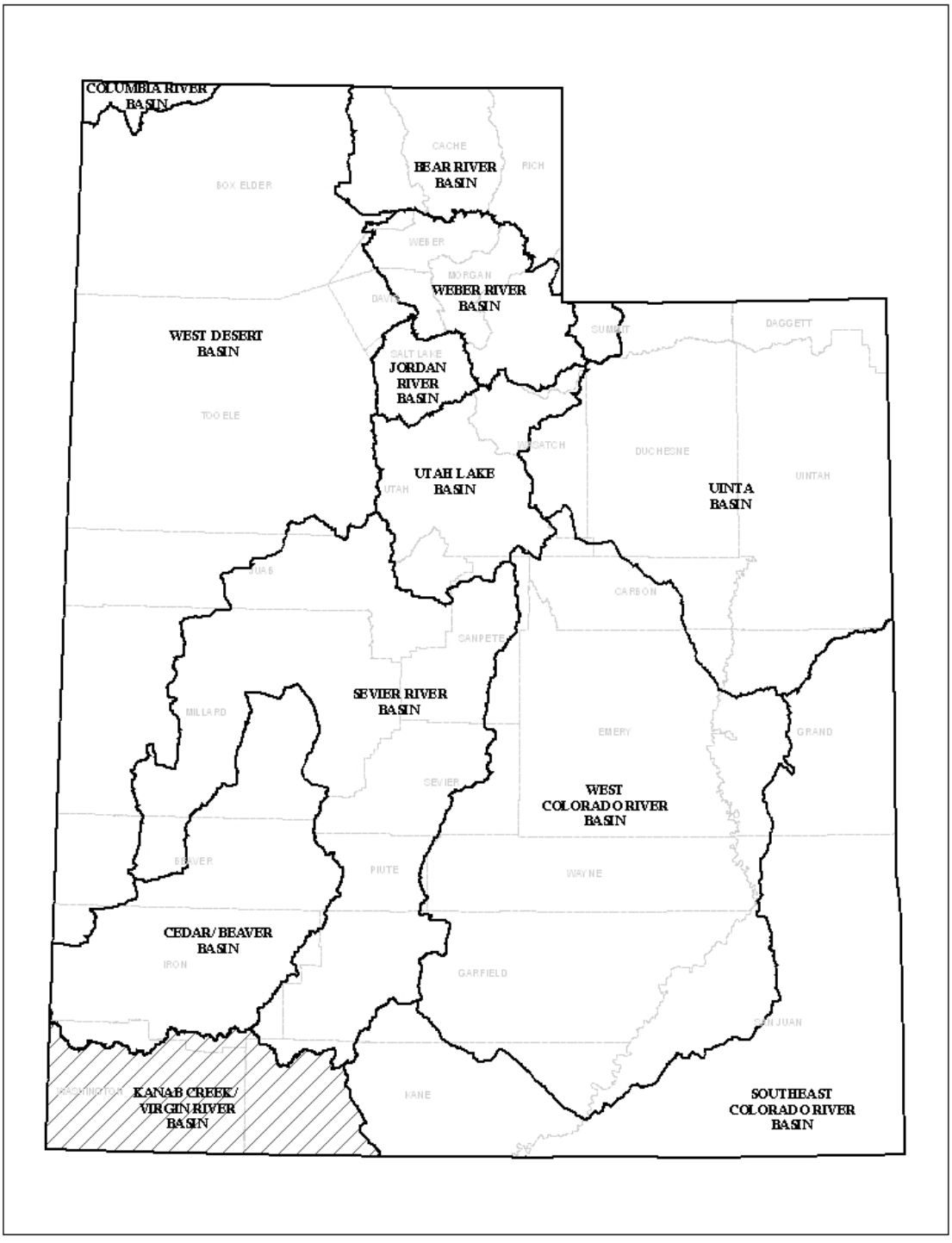

Figure 1. Location of Kanab Creek/Virgin River Basin

Data Collection

This study was initiated in May 2006. The 2005 *Municipal and Industrial Water Use Forms,* distributed by the DWRe, in cooperation with the DWRi and the Utah Division of Drinking Water (DDW), were used as the basis for the study. In all counties, the data collection process is as described in the following section, *Water Supply and Use Methodology*. Water rights discussions presented herein were prepared based on information obtained from the DWRi.

General Description of the Basin

The Utah portion of the KCVR Basin includes approximately 3,500 square miles of land in the southwest corner of the state. Utah's portion of the basin extends from the Utah/Arizona state line on the south to the Bull Valley and Harmony Mountains to the north. On the west, the basin extends from the Utah/Nevada state line east to the divide between Johnson Wash and Kaibab Gulch Tributaries. The basin spans most of Washington County as well as part of Iron and Kane counties. The Virgin and Kanab hydrologic sub-areas form the basin.

Elevations within the basin vary from high points of 10,375 feet at Black Mountain in the Cedar Mountains and 10,365 feet at Signal Peak in the Pine Valley Mountains to lows of 2,297 feet and 2,461 feet where the Beaver Dam Wash and Virgin River, respectively, cross the Utah/Arizona state line. Notable features of the basin include Zion National Park, Snow Canyon and Coral Pink Sand Dunes State Parks and a portion of Grand Staircase-Escalante National Monument. **Figure 2**, on page 5, is a detailed map of the basin.

The basin has 42 public community water systems (including Fredonia and Colorado City, Arizona). These systems serve 133,400 people (almost all of the 133,780 total basin population which includes 1,040 in Fredonia, Arizona and the combined population of Hildale, Utah and Colorado City, Arizona due to all of their sources of water being in Utah). Additionally, the basin has 16 public non-community systems. **Figure 3**, on page 6, indicates the location of these systems. These systems serve National Recreation Areas, State Parks, summer home communities, campgrounds, isolated commercial establishments, and roadside rest stops and parks. The basin also has two self-supplied industries.

M&I water use is steadily increasing within the basin as the entire basin is currently experiencing accelerated growth. Tourism, industry and climate drive most of this growth, which is likely to continue well into the future.

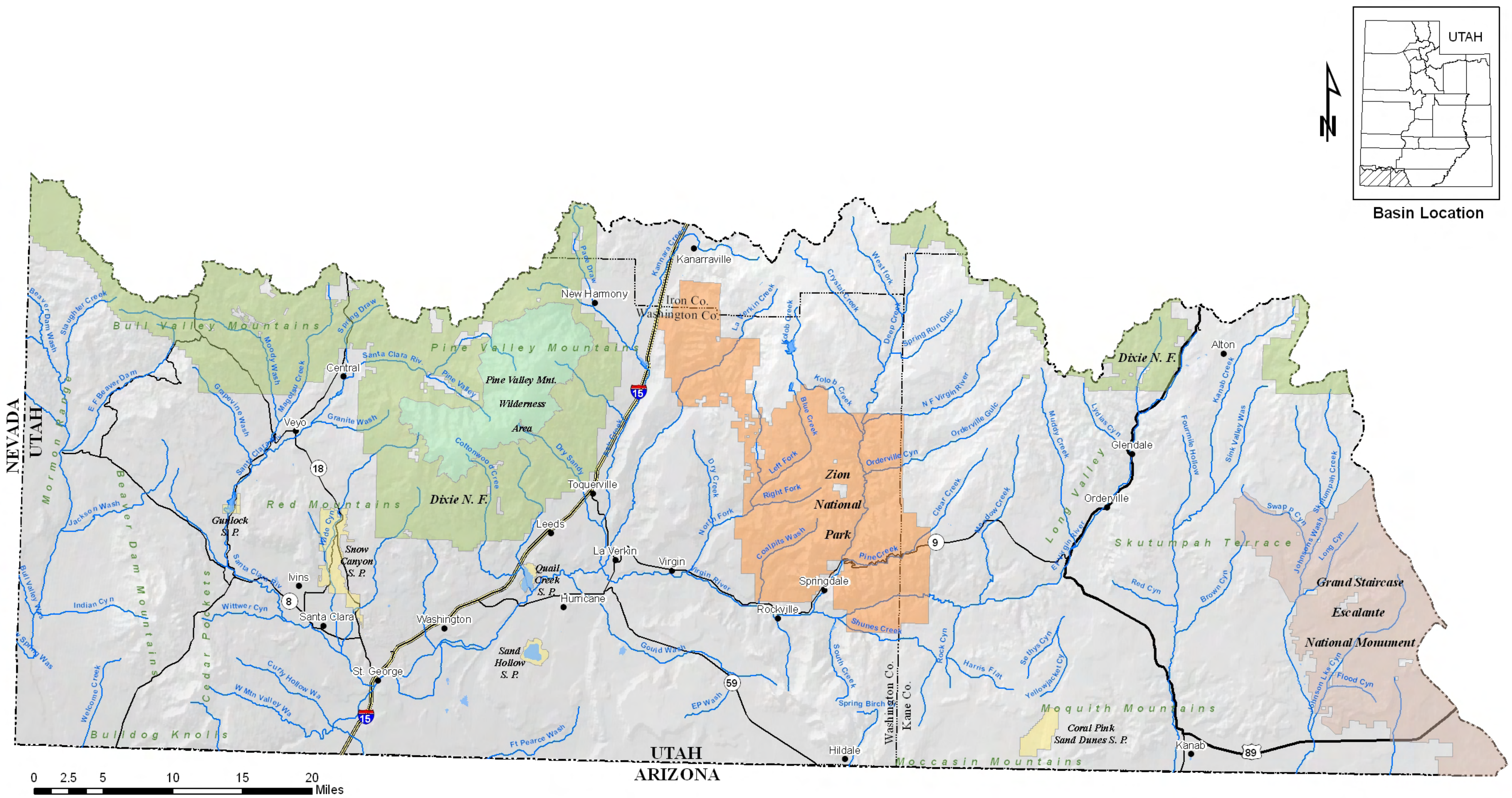

Figure 2. Kanab Creek/Virgin River Basin Drainage Map

PUBLIC COMMUNITY SYSTEMS

Washington County

1 Angell Springs SSD
2 Casa De Oro Water Company
3 Central Culinary Water Company
4 Dammeron Valley Water Works
5 Diamond Ranch Academy
6 Diamond Valley Acres
7 Dixie Deer SSD
8 Eldorado Hills Mutual Company
9 Gunlock SSD
10 Harmony Farms Water Users
11 Harmony Heights
12 Hildale, UT/Colorado City, AZ
13 Homespun Village Water Company
14 Hurricane
15 Ivins
16 Kayenta Water Users Inc.
17 La Verkin
18 Leeds Domestic Water Users
19 Little Plains
20 Mountain Springs Water Company
21 New Harmony Water System
22 Pine Valley Irrigation Company
23 Pine Valley Mt. Farms
24 Rockville Pipeline Company
25 Santa Clara
26 Silver Reef SSD
27 Springdale
28 St. George
29 Toquerville
30 Veyo Culinary Water Association
31 Virgin
32 Washington
33 Washington County WCD-Hurval
34 Winchester Hills Water Company
35 Zion Canyon Water System

Kane County

36 Alton
37 East Kanab Water Company
38 Fredonia, AZ
39 Glendale
40 Kanab
41 Kane County WCD-Johnson Canyon
42 Orderville

Iron County

43 Kanarraville Water System

PUBLIC NON-COMMUNITY SYSTEMS

Washington County

A Home Valley Park Subdivision
B Little Creek Travel Center
C Pine Valley Rec (Juniper)
D Woodland & Kolob Acres
E Zion NP Kolob Visitor Center
F Zion NP Sinawava Temple
G Zion Panorama Subdivision

Kane County

H Best Friends Sanctuary
I Bryce Zion KOA
J Clear Creek Family Ranch (East Zion SSD)
K Coral Pink Sand Dunes
L East Zion SSD
M Flying Ranch (Not Listed)
N Zion Frontier Resort (Mukuntuweep RV Park)
O Zion Mountain Resort
P Zion Ponderosa Resort (East Zion SSD)
Q Zion Ridge Homes (East Zion SSD)

Iron County

R Kanarraville State Hwy RS

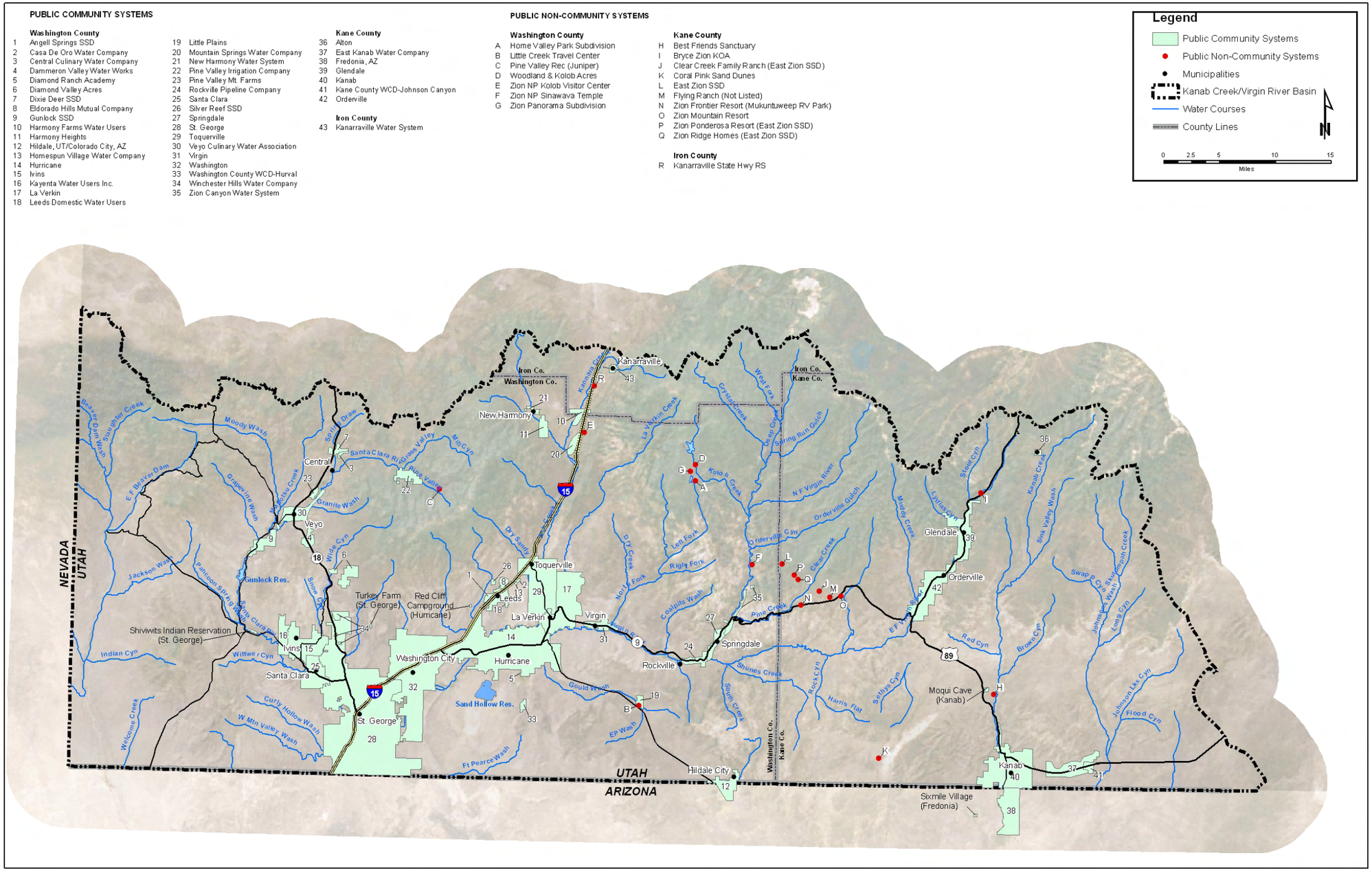

Figure 3. Locations of Public Community and Non-Community Systems

WATER SUPPLY AND USE METHODOLOGY

Background

Over the past 45 years, the DWRe has employed various procedures to obtain municipal and industrial water use (M&I) data. In recent years, these procedures have become more comprehensive. When the DWRe began water planning in the 1960's, available data consisted mainly of supplies and uses for the state as a whole. At that time, Utah's agricultural water uses far exceeded M&I uses. M&I water use was calculated simply by multiplying estimated per capita water use rates by census population data.

By the early 1980's, M&I diversions made up a larger percent of all statewide water uses and the entire water community increased their focus on M&I water supplies and uses. The DWRi launched a program to collect yearly, statewide M&I data from each public community water system. The procedure involved mailing a survey designed to query major public water suppliers about their sources of water supply. Additionally, the United States Geological Survey (USGS) began M&I water use studies. The DWRe relied on both data sources in its planning efforts by the late 1980's.

With the preparation of the State Water Plan Basin reports, and the increasing focus on water conservation, the DWRe saw the need to verify and improve the quality and quantity of the available data. The first method used included assisting the DWRi in the improvement of their M&I data collection program. Secondly, the DWRe began verifying the accuracy of the data through yearly field surveys described in the following four sections.

Data Collection Methodology for Public Community Water Systems

Each year, the DWRe targets several hydrologic basins for M&I water supply and use analysis. The most recent water use information supplied by the DWRi is the basis used to begin the study. Prior to 2003, this information was submitted using a standard form by each water supplier. An example of the water use data form for La Verkin is found in **Appendix A**. Since 2003, the program has been updated, allowing for the water suppliers to electronically submit their data.

The DWRe staff contact the manager or operator of each community water system (as defined by the DDW) to schedule a data collection and analysis meeting. These meetings are necessary because data often is not reported (either on the water use forms or electronically) in the detail required for a complete M&I water use study. During these meetings, staff clarifies and collects additional data as needed. Total water supply and usage of the water systems are calculated based on information gathered during these meetings. When data is not available, it is necessary to estimate a part or all of the system use.

A secondary objective of these meetings is to instruct the operator or manager on how to most accurately and effectively complete the water use data form and/or submit their information electronically. This methodology has been used since 1992.

Water Supply

Potable Water

Two factors define the potable water supply for public community water systems: maximum developed potable water supply available under present conditions and reliable potable water supply. The maximum developed potable water supply available under present conditions is defined as the water resource that is presently being utilized. It is limited by a mechanical constraint (such as pump capacity or pipe size), a hydrologic constraint (such as reliable stream flow or groundwater safe yield) or a legal constraint (such as a water right or legal contract).

The lesser amount of water supply, due to these three constraints, is considered to be the maximum developed potable water supply available under present conditions used in this analysis.

The determination of well pump capacities, average annual spring flow estimates, treatment plant capacities, and water right information aid in the calculation of this value. It should be noted that, due to the complexity of water rights, contracts, exchanges, etc., a detailed search of water right limitations associated with each entity is not within the scope of this study.

The reliable potable water supply is defined as the capacity to meet peak day demands, expressed as an annual volume. It is valuable in determining future water supply capacities of the particular community water system sources (wells, springs, etc.). **The reliable potable water supply is calculated by adding together the maximum developed water supply capacity of surface sources, one-half of the maximum yield of wells or their pump capacities (unless otherwise indicated by the system manager), and a percentage of the average annual flow of spring sources.** The percentage of the spring source flows range between 50% and 100%. The determination of the percentage is based on information provided by the water supplier.

On page 11, **Figure 4** graphically presents the relationship between the maximum developed potable water supply and the reliable potable water supply of a system. By quantifying the maximum developed and the reliable potable water supply of a system, the total population that a system may potentially support can be determined. The current total yearly water use is the volume under the lower curve (*Present Water Use Pattern*). The future total yearly water use is the volume under the upper curve (*Future Water Use Pattern*). The latter volume is equivalent to the reliable developed potable water supply.

The maximum developed potable water supply under present conditions is the volume under the upper line (*Maximum Water Supply*) in **Figure 4**. This amount is a

theoretical annual volume based upon a maximum daily flow rate (limited by the water right or system capacity). Consequently, the peak day demand point on the future water use curve (*Future Peak Day Demand*) cannot exceed this upper limit. Due to the fluctuating nature of some sources (particularly springs), and the fact that most culinary water system storage tanks are designed to store only about one day of water demand, not all of the total maximum developed potable water supply is available to meet future water needs.

It is important to note that the reliable potable water supply is a theoretical annual volume based upon the current daily peak demand flow rate of any one system, under its current demand conditions. Additional supply may be made available by lowering and/or increasing the size of existing well pumps, pumping existing wells for longer durations, increasing storage capacity and/or distribution pipe sizes. However, being based only on current conditions, these systematic changes may cause operational problems during times of peak demand. Therefore, the DWRe uses the reliable potable water supply only as a reference tool to quantify the annual amount of water that can be delivered by each community water system.

For planning purposes, the reliable potable water supply is essential for estimating what population base each system can theoretically support with current demand patterns. It is also a guideline to help predict the approximate timing of future system improvements in order to meet any increase in demand.

Secondary Water

Deliveries of non-potable (secondary) water are an important component of the water use within the boundaries of public community water systems. However, quantifying the available supply of this water is difficult. In Utah, many of the secondary water systems are part of a larger agricultural irrigation system. Hence, the theoretical supply includes both agricultural and M&I water. Currently, separating M&I secondary from agricultural water is mostly estimated, due to the lack of and/or absence of metering, particularly at the level of individual property connections.

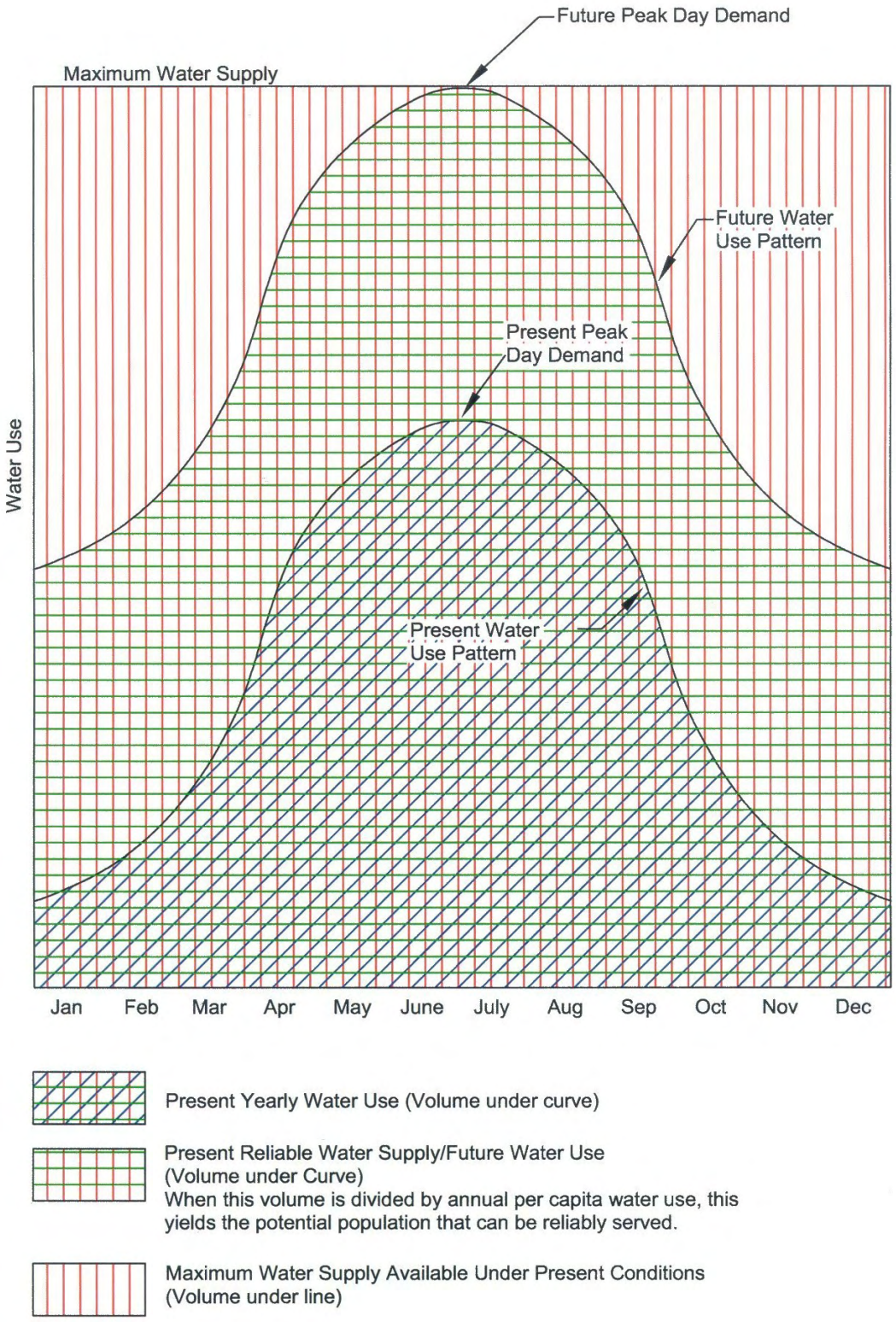

Figure 4. Water Supply and Use Hydrograph

With secondary water use becoming more prevalent for outdoor landscaping, estimating the available supply of this water is becoming increasingly more important. **For planning purposes, the DWRe assumes that the supply for M&I secondary irrigation is simply equal to the current use.**

Water Use

Present water use, as defined herein, is the developed water supply that is actually delivered by the distribution system from surface or subsurface sources. Water use is divided into four categories: residential, commercial, institutional and industrial.

Residential

The staff collects data about the number of residential connections and the amount of water used by those connections from a water system representative. Water use in this category is divided into three subcategories: culinary-outdoor, culinary-indoor, and secondary-outdoor. While most systems will meter the total culinary residential water use, indoor and outdoor use are rarely metered separately. Secondary water use is rarely metered. Therefore, the DWRe usually estimates these subcategory totals.

Typically, culinary indoor use will be estimated first. One method to estimate the indoor use is to review residential meter reading totals for the system from the winter months, if available. Since outdoor watering typically does not occur during the winter months, it can be assumed that the water used in winter months is for indoor use only. The winter water use is then used to determine the total yearly indoor use.

When the above method does not yield a reasonable value for indoor use, the per capita indoor water use for a system can be estimated by using an equation that was developed in a detailed residential study, “Identifying Residential Water Use”,

completed by the DWRe in 2001. The mathematical equation that was developed is as follows:

$$GPCD_{Indoor} = 90.3 / P_{PH} + 42.3$$

where:

$GPCD_{Indoor}$ = gallons per capita day (per capita indoor water use)

P_{PH} = persons per household (US Census Bureau)

The total yearly indoor water use is then calculated for the system by multiplying the result of the above equation by the current population. Outdoor culinary water use can then be estimated by subtracting the total yearly indoor water use from the given total residential culinary water use.

Because very few entities meter secondary outdoor water use, the DWRe staff estimates the outdoor secondary water use by using the average lot size, percent irrigated, percent of residences that are supplied by separate secondary (pressurized and ditch) irrigation systems, water right-duty rates (volume of water required for turf growth) in the area, and other related information for each system. In determining residential secondary use, care is taken to not include irrigation water use for small pastures or farm fields that can often be found adjacent to residences, particularly in rural communities.

Commercial

For most systems, the system operator can separate metered commercial water use data from the total water use. In cases where this data is not available, or is extremely difficult to obtain, the DWRe staff attempts to estimate commercial water use by inventorying commercial businesses in the area and using published commercial water use estimates. The DDW and the Utah State Water Lab, among others, publish these estimates. In some rural communities where there are a relatively small number of commercial connections, the businesses are visited individually by the DWRe staff and asked about their water use.

Some commercial facilities use secondary water to irrigate outside landscapes. This is especially typical for commercial golf courses. Again, it is typical that secondary water is not metered. The DWRe staff estimates this use by multiplying the size of the irrigated area by a water right-duty rate or the evapotranspiration (ET) rate with assumed application efficiency percentage. The ET used is indicative of the amount of water, in inches, necessary for turf growth.

Institutional

Institutional water use is water used for city, county, state and federal government facilities, parks, municipal golf courses, schools, hospitals, churches, military facilities, as well as fire hydrant testing and other municipal losses in the water system. Because this water use is often not metered, the process to acquire this data is difficult. The system operator is asked to provide information about city facilities such as the number and size (irrigated acreage) of parks, schools, churches, and municipal golf courses. Water right-duty rates and/or the ET, with appropriate efficiencies, are used to calculate the amount of water that is needed to irrigate these areas. Estimates of leakage and water use for testing of system facilities are also included in this category.

Industrial

Industrial water use is defined as water used in the production of a product. Therefore, such commercial establishments as dairies, mink farms, and greenhouses, as well as stockwatering, are included in this category, provided a community water system serves them. Industrial water use within community water systems is calculated with the same process used to calculate commercial water use data discussed earlier.

Data Collection Methodology for Public Non-Community Water Systems

The DWRe staff attempts to contact each non-community system and/or make a personal visit to these systems. Non-community systems rarely meter their water use, so the DWRe staff estimate the annual water use. Questions are asked to determine the types of facilities on the system, population served, water source information, irrigation of outside areas, etc. This data, along with information found in water-related publications, is used to determine water use. The maximum and reliable water supplies for these systems are relatively small, often not available and are therefore not included in this study. However, for planning purposes, the DWRe assumes that the water supply for these systems is equal to their water use.

Data Collection Methodology for Self-Supplied Industrial Water Systems

Although self-supplied industries are included in the Non-Community Water Systems category as defined by the DDW, the DWRe has divided them into a separate category due to their importance. The category is equivalent to the DDW's Non-Community, Non-Transient category.

Water use is acquired for self-supplied industries by using data from the DWRi's Industrial Water Use Form and/or electronically submitted data. The DWRi collects annual water use data from most of the major self-supplied industrial water users in the state. This data is confidential. Therefore, the data presented in this M&I study is

only presented as county totals. As with other non-community systems, the maximum and reliable water supplies are often not available and are not in the scope of this study. For planning purposes, the DWRe assumes that the water supply for these systems is equal to their water use.

Data Collection Methodology for Private Domestic Water Systems

Private domestic systems are residences that are not connected to any public community or non-community water system. They are usually supplied by individual wells. To determine the water use data for this category, the population of those served by private domestic systems is estimated. This population is estimated by subtracting the population served by community water systems from the county population data acquired from the Governor's Office of Planning and Budget (GOPB). The remainder is assumed to be the population that is served by private domestic systems. The per capita water use rate for this category is assumed to be the same as the rate for the public community system residential category for that county. To determine the total water use by private domestic systems, the estimated population is then multiplied by this rate. Again, the maximum and reliable water supplies for private wells, being relatively small, are not in the scope of this study. Similarly, for planning purposes, the DWRe assumes that the water supply for these systems is equal to their water use.

DEFINITIONS OF WATER TERMS

Water is supplied by a variety of systems for many types of users. The general term supply is defined as the amount of water available. Municipalities own most of the individual water supply systems. However, in some cases the owner/operator is a private company, state or federal agency. Thus, a "public" water supply may be either publicly or privately owned and supply treated and/or untreated water.

Water Supply Terms

Maximum Developed Potable Water Supply - The annual volume of potable (culinary) water which is the lesser of the hydrologic capacity of the water source, the physical capacity of the water system, or the amount allowed by the collective water rights. (See pages 8-10 for a more detailed explanation)

Reliable Potable Water Supply - The annual volume within the maximum developed water supply that is available to meet peak demands. This is generally calculated as 100% of the maximum supply from surface water sources, 50% of the maximum yield of wells, and between 50% and 100% of the average annual spring flows. When this number is divided by the average per capita usage, the resulting number represents the theoretical maximum population that the water source can serve. (See pages 8-10 for a more detailed explanation)

Municipal and Industrial Water Supply - Includes all water (potable and non-potable) supplied for residential, commercial, institutional, light industry, and self-supplied industries. This supply is delivered by public community systems, public non-community (transient and non-transient) systems, self-supplied industrial systems, unregulated Indian water systems and private wells.

Types of Water

Potable Water – Includes water meeting all applicable Federal, State, and Local drinking water requirements for residential, commercial, institutional and industrial uses. It is also referred to as culinary water supply.

Secondary Water – Includes water not meeting safe drinking water requirements. It is also referred to as non-potable (non-culinary) water. This water is usually delivered by pressurized or open ditch systems for irrigation of privately and publicly owned landscapes, gardens, parks, cemeteries, golf courses and other open areas. Sometimes called "dual" water systems, they are installed to provide an alternative to irrigating with culinary water for these outdoor areas. Although Irrigation companies most often provide this water, public community systems may deliver this water as well. Self-supplied industries can also use secondary water for industrial processes.

Water System Categories

Public Community Water System - Provides potable and/or non-potable water by either a privately or publicly owned water system serving at least 15 connections used by year round residents or regularly serves at least 25 year round residents. Water from the public community water supplies may be used in both indoor and outdoor applications for residential, commercial, institutional, and industrial purposes.

Public Non-Community Water System - Provides potable and/or non-potable water by either a privately or publicly owned water system of one of two types: transient and non-transient. Transient systems are systems that do not serve 25 of the same non-resident persons per day for more than six months per year. Examples include campgrounds, RV parks, restaurants, convenience stores, etc. Non-transient systems are systems that regularly serve 25 of the same non-resident persons per day for more than six months per year. Examples include churches, schools and industries. This report categorizes industrial non-transient systems as self-supplied industries.
Self-Supplied Industrial System - Provides potable and/or non-potable water for use by individual privately owned industries (usually from their own wells or springs).

Private Domestic System – Provides potable and/or non-potable water from privately owned wells and/or springs for use by individual homes.

Water Use Terms

Water is used in a variety of ways and for many purposes. It is often said that water is "used" when it is diverted, demanded, withdrawn, depleted or consumed. But it is also "used" in place for such things as fish and wildlife habitat, recreation and hydropower production. **Water use in this report is defined as "delivered" water.** A table that shows the basin's M&I water deliveries and depletions is provided in **Appendix B**.

In the previous water supply section, the word "use" can be interchanged with the word "supply" to define the current demand associated with those definitions. Some additional water use terms are as follows:

Commercial Use - Use normally associated with small business operations that may include drinking water, food preparation, personal sanitation, facility cleaning and maintenance and irrigation of facility landscapes. Examples include retail businesses, restaurants and hotels.

Industrial Use - Use associated with the manufacturing or production of products. The volume of water used by industrial businesses can be considerably greater than water used by commercial businesses. Examples include manufacturing plants, oil and gas producers, mining companies, mink farms and dairies.

Institutional Use - Use normally associated with general operation of various public agencies and institutions (i.e. schools, municipal buildings, churches) including drinking water, personal sanitation, facility cleaning and maintenance and irrigation of parks, cemeteries, playgrounds, recreational areas, golf courses, and other facilities. The amount of water used by cities for outside irrigation of public areas typically is not metered.

Residential Use - Use associated with residential cooking, drinking water, washing clothes, miscellaneous cleaning, personal grooming and sanitation, irrigation of lawns, gardens and landscapes, and washing automobiles, driveways and other outside

residential facilities. Examples include single-family homes, apartments, duplexes and condominiums.

Other Water Terms

Consumption - Water evaporated, transpired or irreversibly bound in either a physical, chemical or biological process. Consumed water results in a loss of the original water supplied.

Consumptive Use - Losses of water brought about by human endeavors when used for residential, commercial, institutional, industrial, agricultural, power generation, and recreation. Naturally occurring vegetation, fish and wildlife also consumptively use water.

Deliveries - Water already within a system that is being provided to an individual connection, whether potable or non-potable and/or metered or not. The connection can be for residential, commercial, institutional, and/or industrial uses. **For the purpose of this report, the delivered water amount is equivalent to water use.**

Depletion - Water consumed and made unavailable for return to a given designated area, river system or basin. It is intended to represent the net loss to a system. The terms consumption and depletion are often used interchangeably but are not the same. For example, water exported from a basin is depletion from the basin system but is not consumed in the basin. The exported water is available for use (consumption) in another basin or system. Water diverted to irrigate crops in a given system, but not returned for later use, is depletion. Precipitation that falls on irrigated crops is not considered a part of the supply like surface water and groundwater diversions. For this reason, precipitation falling on and consumed by irrigated crops is not considered as being depletion from the system.

Diversion - Water diverted from supply sources such as streams, lakes, reservoirs or groundwater for a variety of purposes, including cropland irrigation, as well as residential, commercial, institutional and industrial uses.

Withdrawal - Water withdrawn from supply sources such as lakes, streams, reservoirs or groundwater. This term is normally used in association with groundwater withdrawal. The terms *diversion* and *withdrawal* are often used interchangeably.

WATER RIGHTS IN THE KANAB CREEK/VIRGIN RIVER BASIN

Although a detailed analysis of water rights is not part of this report, a water supply and use study would not be complete without at least a discussion on the current water right regulations in the area. The following discussion was obtained from the DWRi. It explains the current general water right regulations in the KCVR Basin with regards to M&I uses.

Kanab and Johnson Creek

Surface and ground waters are considered to be fully appropriated at this time. New diversions and uses must be accomplished by change applications filed on owned or acquired existing rights. Changes between surface and underground sources are reviewed to indicate hydrologic connection, that underlying rights are not enlarged or that there is no potential for interference with existing water rights. However, groundwater applications will be reviewed on an individual basis for isolated locations.

Virgin River

Surface and ground waters are considered to be fully appropriated at this time. New diversions and uses must be accomplished by change applications filed on owned or acquired existing rights. Changes between surface and underground sources are reviewed to indicate hydrologic connection, that underlying rights are not enlarged or that there is no potential for interference with existing water rights. However, exceptions for new groundwater appropriations are described below.

The Canaan Gap drainage, east of the Hurricane Cliffs, is still open to small underground appropriations for domestic filings. These filings are limited to the requirements of one family, ¼ acre of irrigation and up to 10 head of livestock.

The Beaver Dam Wash drainage area is open to small underground water appropriations for domestic filings. These filings are limited to the requirements of one family, ¼ acre of irrigation and up to 10 head of livestock.

IRON COUNTY M&I WATER SUPPLIES AND USES

The Iron County portion of the KCVR Basin claims Kanarraville as its only incorporated community. Within this portion of the basin, Kanarraville is the only public community system and the Kanarraville state highway rest stop is the only public non-community system. There are no self-supplied industries in this area. The locations of the public community and non-community systems are shown in **Figure 3** on page 6.

As shown in the following **Table 1**, the maximum annual potable water supply for public community systems in this portion of Iron County is 201 acre-feet: about 32% from springs and 68% from wells.

TABLE 1
IRON COUNTY
Maximum Potable Water Supplies for Public Community Systems
(Acre-Feet/Year)

WATER SUPPLIER	Springs	Wells	Surface	Total
IRON COUNTY				
Kanarraville	64.5	136.5	0.0	**201.0**
IRON COUNTY	**64.5**	**136.5**	**0.0**	**201.0**

Note: All values represent maximum system source capacities limited by water rights, hydrologic constraints, and/or system constraints.

The reliable potable water supply for public community systems in the Iron County portion of the KCVR Basin is 133 acre-feet. The reliable supply is 66% of the maximum supply. The breakdown of this supply is presented in **Table 2** on the following page.

TABLE 2
IRON COUNTY
Reliable Potable Water Supplies for Public Community Systems
(Acre-Feet/Year)

WATER SUPPLIER	Springs	Wells	Surface	Total*
IRON COUNTY				
Kanarraville	64.5	68.2	0.0	**132.7**
IRON COUNTY	**64.5**	**68.2**	**0.0**	**132.7**

* Wells are limited to 50% of their "maximum" capacity for reliable supply when well/pump capacity is the limiting factor. Springs and surface water supplies are equal to their respective "maximum" capacities.

Table 3, on the following page, shows the breakdown of potable water use for each public community system. This table indicates that for Iron County, the current annual use of 165 acre-feet of water (within the public community systems) is about 124% of the reliable supply and 82% of the maximum available supply.

TABLE 3
IRON COUNTY
Water Use for Public Community Systems

WATER SUPPLIER	POTABLE USAGE (Acre-Feet/Year)						Service Population	Gallons Per Capita Per Day
	Residential Indoor	Residential Outdoor	Commercial Total	Institutional Total	Industrial Total	Total M & I		
IRON COUNTY								
Kanarraville Municipal Water System	28.6	125.0	2.7	8.6	0.0	164.9	360	408.9
IRON COUNTY TOTALS	**28.6**	**125.0**	**2.7**	**8.6**	**0.0**	**164.9**	**360**	**408.9**
A	B	C	D	E	F	G	H	J

A, B, C, D, E, F, H — Input data
G=B+C+D+E+F — Potable M&I Water Use
J=G*(325,851 gallons per acre-foot)/H/(365 days per year) — Average gallons per capita per day water use

Table 4, below, presents the amount of secondary water used for various categories within the boundaries of the Kanarraville public community system. A separate irrigation company, Kanarraville Reservoir & Irrigation Company, delivers secondary water to customers. Total secondary water use is 59 acre-feet.

TABLE 4
IRON COUNTY
Secondary (Non-Potable) Water Use Within Public Community Systems
(Acre-Feet/Year)

WATER SUPPLIER	Residential Use (Ac-Ft/Yr)	Commercial Use (Ac-Ft/Yr)	Institutional Use (Ac-Ft/Yr)	Industrial/ Stockwater Use (Ac-Ft/Yr)	Total Secondary Use (Ac-Ft/Yr)
IRON COUNTY					
Kanarraville Municipal Water System					
Kanarraville Reservoir and Irrigation Co.	58.8	0.0	0.0	0.0	**58.8**
IRON COUNTY TOTALS	**58.8**	**0.0**	**0.0**	**0.0**	**58.8**

Table 5, below, presents various per capita rates for the public community system in the Iron County portion of the KCVR Basin.

TABLE 5
IRON COUNTY
Average Per Capita Water Use
for Public Community Systems

Water Supplier	Service Population	Residential Water Use			CII Water Use*			TOTAL WATER USE		
		Potable	Non-Potable	Sub Total	Potable	Non-Potable	Sub Total	Potable	Non-Potable	TOTAL
Kanarraville Municipal Water System	360	381	146	**527**	28	0	**28**	409	146	**555**
IRON COUNTY TOTALS	**360**	**381**	**146**	**527**	**28**	**0**	**28**	**409**	**146**	**555**

*Commmercial, Institutional, and Industrial

The following **Table 6** indicates water use for public non-community and private domestic systems in this portion of the KCVR Basin. Kanarraville state highway rest stop is the only non-community system in this area. There are no self-supplied industries and only a small number of private domestic wells. All of these uses amount to about 39 acre-feet of potable water.

TABLE 6
IRON COUNTY
Water Use for Public Non-Community Systems,
Self-Supplied Industries and Private Domestic Systems
(Acre-Feet/Year)

IRON COUNTY WATER SUPPLIER	POTABLE USAGE					Total Secondary Water Use (Ac-Ft/Yr)
	Residential Use (Ac-Ft/Yr)	Commercial Use (Ac-Ft/Yr)	Institutional Use (Ac-Ft/Yr)	Industrial/ Stockwater Use (Ac-Ft/Yr)	Total Potable Use (Ac-Ft/Yr)	
Non-Community System						
Kanarraville State Highway RS	0.0	0.0	29.7	0.0	**29.7**	**0.0**
Self-Supplied Industries[1]	0.0	0.0	0.0	0.0	**0.0**	**0.0**
Private Domestic	9.7	0.0	0.0	0.0	**9.7**	**0.0**
IRON COUNTY TOTALS	**9.7**	**0.0**	**29.7**	**0.0**	**39.4**	**0.0**

[1]There are no self-supplied industries in Iron Co.

Collectively, the total potable M&I water use from all systems in this portion of the KCVR Basin is about 204 acre-feet, while secondary use is 59 acre-feet; giving a total M&I water use of 263 acre-feet.

KANE COUNTY M&I WATER SUPPLIES AND USES

The Kane County portion of the KCVR Basin includes the incorporated communities of Alton, Glendale, Orderville and Kanab, as well as Fredonia, Arizona. Fredonia, Arizona is included with this basin because it receives water supplies from Utah. Within this area, there are 7 public community systems, 7 public non-community systems, and one self-supplied industry. The locations of the public community and non-community systems are shown in **Figure 3** on page 6.

As shown in the following **Table 7**, the maximum annual potable water supply for public community systems in Kane County is about 6,808 acre-feet: about 10% from springs and 90% from wells.

TABLE 7
KANE COUNTY
Maximum Potable Water Supplies for Public Community Systems
(Acre-Feet/Year)

WATER SUPPLIER	Springs	Wells	Surface	Total
KANE COUNTY				
Alton Town Water	33.9	0.0	0.0	**33.9**
East Kanab Water Co.	0.0	333.9	0.0	**333.9**
Glendale Town Corp.	104.8	29.8	0.0	**134.6**
Kanab Municipal Water System	104.8	4,363.2	0.0	**4,468.0**
Kane County WCD (Johnson Canyon)	0.0	192.6	0.0	**192.6**
Orderville Town Water System	79.1	768.1	0.0	**847.2**
[1]Fredonia (AZ)	362.9	434.4	0.0	**797.3**
KANE COUNTY TOTALS	**685.5**	**6,122.0**	**0.0**	**6,807.5**

Notes:
1. Fredonia is included due to all of its water sources being located in Kane County, UT
2. All values represent maximum system source capacities limited by water rights, hydrologic constraints, and/or system constraints.

The reliable potable water supply for public community systems in the Kane County portion of the KCVR Basin is 3,580 acre-feet. The reliable supply is 53% of the maximum supply. The breakdown of this supply is presented below in **Table 8**.

TABLE 8
KANE COUNTY
Reliable Potable Water Supplies for Public Community Systems
(Acre-Feet/Year)

WATER SUPPLIER	Springs	Wells	Surface	Total[1]
KANE COUNTY				
Alton Town Water	33.9	0.0	0.0	**33.9**
East Kanab Water Co.[3]	0.0	0.0	0.0	**0.0**
Glendale Town Corp.	104.8	14.9	0.0	**119.7**
Kanab Municipal Water System	104.8	2,181.6	0.0	**2,286.4**
Kane County WCD (Johnson Canyon)	0.0	96.3	0.0	**96.3**
Orderville Town Water System	79.1	384.1	0.0	**463.2**
Fredonia (AZ)[2]	362.9	217.2	0.0	**580.1**
KANE COUNTY TOTALS	**685.5**	**2,894.1**	**0.0**	**3,579.6**

Notes:
1. Wells are limited to 50% of their "maximum" capacity for reliable supply when well/pump capacity is the limiting factor. Springs and surface water supplies are equal to their respective "maximum" capacities.
2. Fredonia is included due to all of its water sources being located in Kane County, UT
3. Due to the poor quality, E. Kanab Water Co. well is not listed as a reliable source.

Table 9, on the following page, presents the breakdown of the potable water use for each public community system. These tables indicate that the current annual potable use of 2,360 acre-feet of water is about 53% of the reliable potable water supply of water in Kane County.

TABLE 9
KANE COUNTY
Water Use for Public Community Systems

WATER SUPPLIER	POTABLE USAGE (Acre-Feet/Year)						Service Population	Gallons Per Capita Per Day
	Residential Indoor	Residential Outdoor	Commercial Total	Institutional Total	Industrial Total	Total M&I		
KANE COUNTY								
Alton Town Water	9.0	1.7	0.0	0.3	0.0	**11.0**	140	70.1
East Kanab Water Co.[1]	6.0	1.9	0.0	2.5	0.0	**10.4**	100	92.8
Glendale Town Corp.	29.7	27.6	9.2	0.9	0.0	**67.4**	350	171.9
Kanab Municipal Water System	305.6	412.7	218.2	573.6	9.0	**1,519.1**	3,540	383.1
Kane County WCD Johnson Canyon[2]	16.0	9.2	0.0	1.0	0.0	**26.2**	180	129.9
Orderville Town Water System	51.1	48.2	33.2	92.7	2.0	**227.2**	600	338.1
Fredonia (AZ)[3]	86.9	344.9	13.1	45.9	7.9	**498.7**	1,040	428.1
KANE COUNTY TOTALS	**504.3**	**846.2**	**273.7**	**716.9**	**18.9**	**2,360.0**	**5,950**	**354.1**
A	B	C	D	E	F	G	H	J

[1] Kane Co. WCD wholesales water to E. Kanab Water Co.

[2] Kane Co. WCD delivers water to the Johnson Canyon area, Johnson Canyon, and 8 Mile Gap

[3] Fredonia is included due to all of its sources being located in Kane County, UT

A, B, C, D, E, F, H	Input data
G=B+C+D+E+F	Potable M&I Water Use
J=G*(325,851 gallons per acre-foot)/H/(365 days per year)	Average gallons per capita per day water use

Table 10 presents the annual amount of secondary water used for various categories within the boundaries of the public community systems. In Kane County, within the public community systems, separate irrigation companies deliver secondary water. Total secondary use is estimated to be about 497 acre-feet.

TABLE 10
KANE COUNTY
Secondary (Non-Potable) Water Use Within Public Community Systems
(Acre-Feet/Year)

WATER SUPPLIER	Residential Use	Commercial Use	Institutional Use	Industrial/ Stockwater Use	Total Secondary Use
KANE COUNTY					
Alton Town Water					
Alton Farmers Association	168.3	0.0	0.8	0.0	**169.1**
East Kanab Water Co.	0.0	0.0	0.0	0.0	**0.0**
Glendale Town Corp.					
Glendale Irrigation Co.	84.0	0.0	5.0	0.0	**89.0**
Kanab Municipal Water System					
Kanab Irrigation Co.	65.8	0.0	0.0	0.0	**65.8**
Kane County WCD (Johnson Canyon)	0.0	0.0	0.0	0.0	**0.0**
Orderville Town Water System					
Orderville Irrigation Co.	87.0	0.0	86.0	0.0	**173.0**
Fredonia (AZ)	0.0	0.0	0.0	0.0	**0.0**
KANE COUNTY TOTALS	**405.1**	**0.0**	**91.8**	**0.0**	**496.9**

Various per capita rates for public community systems in the Kane County portion of the KCVR Basin are given in the following **Table 11**.

TABLE 11
KANE COUNTY
Average Per Capita Water Use
for Public Community Systems

Water Supplier	Service Population	Residential Water Use			CII Water Use*			TOTAL WATER USE		
		Potable	Non-Potable	Sub Total	Potable	Non-Potable	Sub Total	Potable	Non-Potable	TOTAL
Alton Town Water	140	68	1,073	**1,141**	2	5	**7**	70	1,078	**1,148**
East Kanab Water Co.	100	71	0	**71**	22	0	**22**	93	0	**93**
Glendale Town Corp.	350	146	214	**360**	26	13	**39**	172	227	**399**
Kanab Municipal Water System	3540	181	17	**198**	202	0	**202**	383	17	**400**
Kane County WCD (Johnson Canyon)	180	125	0	**125**	5	0	**5**	130	0	**130**
Orderville Town Water System	600	148	129	**277**	190	128	**318**	338	257	**595**
Fredonia (AZ)	1040	371	0	**371**	57	0	**57**	428	0	**428**
KANE COUNTY TOTALS	**5950**	**202**	**61**	**263**	**151**	**14**	**165**	**353**	**75**	**428**

*Commmercial, Institutional, and Industrial

The following **Table 12** indicates annual water use for public non-community systems, self-supplied industries, and private domestic systems in this portion of the KCVR Basin. Coral Pink Sand Dunes State Park is among the 7 listed non-community systems. All of these uses amount to 97 acre-feet of potable water and 82 acre-feet of secondary water.

TABLE 12
KANE COUNTY
Water Use for Public Non-Community Systems,
Self-Supplied Industries and Private Domestic Systems
(Acre-Feet/Year)

KANE COUNTY WATER SUPPLIER	POTABLE USAGE					Total Secondary Water Use (Ac-Ft/Yr)
	Residential Use (Ac-Ft/Yr)	Commercial Use (Ac-Ft/Yr)	Institutional Use (Ac-Ft/Yr)	Industrial/ Stockwater Use (Ac-Ft/Yr)	Total Potable Use (Ac-Ft/Yr)	
Non-Community Systems						
Best Friends Animal Sanctuary	1.7	18.3	0.0	0.0	**20.0**	**76.0**
Bryce-Zion KOA	0.0	2.0	0.0	0.0	**2.0**	**0.0**
East Zion SSD	2.2	12.1	0.0	0.7	**15.0**	**0.0**
Shingle Creek State Highway Rest Stop	0.0	0.0	5.8	0.0	**5.8**	**0.0**
State Park Systems						
Coral Pink Sand Dunes	1.0	0.0	1.6	0.0	**2.6**	**0.0**
Zion Frontier Resort (Mukuntupweep)	0.3	7.6	0.0	0.0	**7.9**	**0.0**
Zion Mountain Resort	0.0	11.5	0.0	0.6	**12.1**	**6.0**
TOTALS	**5.2**	**51.5**	**7.4**	**1.3**	**65.4**	**82.0**
Self-Supplied Industries[1]	0.0	2.0	0.0	0.0	**2.0**	**0.0**
Private Domestic	29.5	0.0	0.0	0.0	**29.5**	**0.0**
KANE COUNTY TOTALS	**34.7**	**53.5**	**7.4**	**1.3**	**96.9**	**82.0**

[1]Self-supplied industries include Millania Financial, Inc.

Collectively, the total potable M&I water use of all systems in this portion of the KCVR Basin is 2,457 acre-feet, while secondary use is 579 acre-feet; giving a total M&I water use of 3,036 acre-feet.

WASHINGTON COUNTY M&I WATER SUPPLIES AND USES

The Washington County portion of the KCVR Basin includes the incorporated communities of Hildale, Hurricane, Ivins, La Verkin, Leeds, New Harmony, Rockville, Santa Clara, Springdale, St. George, Toquerville, Virgin and Washington, as well as Colorado City, Arizona. Colorado City is included with this basin because it is operated as one combined system with Hildale and receives some water supplies from Utah. Within this area there are 34 public community systems, 8 public non-community systems, and 1 self-supplied industry. Additionally, Washington County Water Conservancy District wholesales water to Hurricane, Ivins, Kayenta, La Verkin, St. George, Toquerville, Virgin and Washington in addition to supplying retail customers in the Hurricane Valley Subdivision. St. George City delivers water to Ivins and Santa Clara, through the Snow Canyon and Gunlock well fields, in addition to the service of its own retail customers. Locations of public community and non-community systems are shown in **Figure 3**.

As shown in **Table 13**, on the following page, the maximum annual potable water supply for public community systems in the KCVR portion of Washington County is 81,669 acre-feet; 7% from springs, 44% from wells, and 49% from surface treatment plants on Quail Creek Reservoir and the Virgin River.

The reliable potable water supply for public community systems in the Washington County portion of the KCVR Basin is 72,559 acre-feet. The reliable supply is 89% of the maximum supply. The breakdown of this supply is indicated in **Table 14** on page 39.

TABLE 13
WASHINGTON COUNTY
Maximum Potable Water Supplies for Public Community Systems
(Acre-Feet/Year)

WATER SUPPLIER	Springs	Wells	Surface	Total
WASHINGTON COUNTY				
Angell Springs SSD	80.7	33.5	0.0	**114.2**
Casa de Oro	0.0	0.0	0.0	**0.0**
Central Culinary Water	6.1	6.1	0.0	**12.2**
Dammeron Valley Water Works	0.0	852.1	0.0	**852.1**
Diamond Ranch Academy	0.0	27.5	0.0	**27.5**
Diamond Valley Acres Water Co.	0.0	217.7	0.0	**217.7**
Dixie Deer SSD	0.0	219.3	0.0	**219.3**
Gunlock SSD	42.5	63.7	0.0	**106.2**
Harmony Farms Water Users	0.0	142.4	0.0	**142.4**
Harmony Heights	0.0	84.2	0.0	**84.2**
Hildale/Colorado City	42.4	2,724.0	0.0	**2,766.4**
Homespun Village Water Company	0.0	22.4	0.0	**22.4**
Hurricane City Water System	1,613.8	3,708.0	0.0	**5,321.8**
Ivins City	48.4	320.1	0.0	**368.5**
Kayenta Water Users Assoc.	0.0	0.0	0.0	**0.0**
La Verkin City	661.3	0.0	0.0	**661.3**
Leeds Domestic Water Users Assoc.	79.6	677.5	0.0	**757.1**
Little Plains	0.0	265.0	0.0	**265.0**
Mountain Springs Water Co.	0.0	248.0	0.0	**248.0**
New Harmony Town Water	27.9	1,448.0	0.0	**1,475.9**
Pine Valley Irrigation Co.	90.5	47.0	0.0	**137.5**
Pine Valley Mt. Farms Water Co.	0.0	185.2	0.0	**185.2**
Rockville Pipeline Co.	31.0	82.4	0.0	**113.4**
Santa Clara Municipal Water System	96.8	2,547.8	0.0	**2,644.6**
Silver Reef SSD	18.9	0.0	0.0	**18.9**
Springdale Culinary Water	204.8	258.0	498.0	**960.8**
St. George, City of	1,200.0	13,664.1	0.0	**14,864.1**
Toquerville Water Dept.	362.9	0.0	0.0	**362.9**
Veyo Culinary Water Assoc.	239.5	81.5	0.0	**321.0**
Virgin Water Dept.	0.0	0.0	0.0	**0.0**
Washington County WCD	0.0	3,750.0	39,700.0	**43,450.0**
WCWCD - Hurricane Valley retail	0.0	60.0	0.0	**60.0**
Washington Municipal Water System	0.0	3,808.0	0.0	**3,808.0**
Winchester Hills Water Co.	0.0	473.6	0.0	**473.6**
Zion National Park	540.4	66.0	0.0	**606.4**
WASHINGTON COUNTY TOTALS	**5,387.5**	**36,083.1**	**40,198.0**	**81,668.6**

Note: All values represent maximum system source capacities limited by water rights, hydrologic constraints, and/or system constraints.

TABLE 14
WASHINGTON COUNTY
Reliable Potable Water Supplies for Public Community Systems
(Acre-Feet/Year)

WATER SUPPLIER	Springs	Wells	Surface	Total (1)
WASHINGTON COUNTY				
Angell Springs SSD	80.7	16.8	0.0	**97.5**
Casa de Oro (2)	0.0	5.8	0.0	**5.8**
Central Culinary Water (3)	6.1	3.1	0.0	**9.2**
Dammeron Valley Water Works (2)	0.0	426.1	0.0	**426.1**
Diamond Ranch Academy	0.0	13.7	0.0	**13.7**
Diamond Valley Acres Water Co.	0.0	163.0	0.0	**163.0**
Dixie Deer SSD	0.0	109.6	0.0	**109.6**
Gunlock SSD	42.5	31.9	0.0	**74.4**
Harmony Farms Water Users	0.0	71.2	0.0	**71.2**
Harmony Heights	0.0	42.1	0.0	**42.1**
Hildale/Colorado City	42.4	1,362.0	0.0	**1,404.4**
Homespun Village Water Company	0.0	11.2	0.0	**11.2**
Hurricane City Water System (3)	1,613.8	1,854.0	0.0	**3,467.8**
Ivins City (3)	48.4	177.4	0.0	**225.8**
Kayenta Water Users Assoc. (3)	0.0	0.0	0.0	**0.0**
La Verkin City (3)	661.3	0.0	0.0	**661.3**
Leeds Domestic Water Users Assoc.	79.6	338.8	0.0	**418.4**
Little Plains	0.0	132.5	0.0	**132.5**
Mountain Springs Water Co.	0.0	124.0	0.0	**124.0**
New Harmony Town Water	27.9	724.0	0.0	**751.9**
Pine Valley Irrigation Co.	90.5	23.5	0.0	**114.0**
Pine Valley Mt. Farms Water Co. (2)	0.0	114.6	0.0	**114.6**
Rockville Pipeline Co.	31.0	41.2	0.0	**72.2**
Santa Clara Municipal Water System (4)	96.8	1,273.9	0.0	**1,370.7**
Silver Reef SSD (5)	18.9	0.0	0.0	**18.9**
Springdale Culinary Water	204.8	129.0	498.0	**831.8**
St. George, City of (6),(3)	1,200.0	13,442.5	0.0	**14,642.5**
Toquerville Water Dept (3).	362.9	0.0	0.0	**362.9**
Veyo Culinary Water Assoc.	239.5	40.8	0.0	**280.3**
Virgin Water Dept. (3)	0.0	0.0	0.0	**0.0**
Washington County WCD (7)	0.0	3,750.0	39,700.0	**43,450.0**
WCWCD - Hurricane Valley retail	0.0	60.0	0.0	**60.0**
Washington Municipal Water System (3)	0.0	2,190.5	0.0	**2,190.5**
Winchester Hills Water Co. (2)	0.0	267.0	0.0	**267.0**
Zion National Park	540.4	33.0	0.0	**573.4**
WASHINGTON COUNTY TOTALS	**5,387.5**	**26,973.2**	**40,198.0**	**72,558.7**

(1) Wells are limited to 50% of their "maximum" capacity for reliable supply when well/pump capacity is the limiting factor. Springs and surface water supplies are equal to their respective "maximum" capacities.
(2) Reliable water supply is considered to be calculated water use.
(3) Has contract with WCWCD for additional water supply
(4) Reliable well supply is calculated based on Santa Clara's 24.7% ownership of wells in Snow Canyon Compact yield. However, Santa Clara can purchase more than their 24.7% share when needed.
(5) Water supplied by Leeds Domestic Water Users Association.
(6) Reliable well supply is calculated based on St. George's 63.3% ownership of wells in Snow Canyon Compact yield. However, St. George has more well water rights available for additional supply, if needed.
(7) **Surface supplies**: Quail Creek and Sand Hollow reservoirs collectively yield 29,500 ac-ft/year. Kolob Reservoir yields 2,000 ac-ft/year. Meadow Hollow Reservoir yields 200 ac-ft/year. The Sand Hollow recovery wells (surface water influenced, hence the classification) yield 8,000 ac-ft/year.
All stated reservoir/surface supplies are considered to be at the 75% reliability level.
Well supplies: Cottom wells yield 2,000 ac-ft/yr, Sullivan wells yield 750 ac-ft/year and the Keyenta wells yield 1,000 ac-ft/year.

Several public community systems in the Washington County portion of the basin have water supply contracts with either another public community system or the Washington County Water Conservancy District. They receive part or all of their water supply through these contracts. **Table 15** indicates which systems currently have supply contracts, the system or water conservancy district that supplies the water, and the contract or delivered amounts for the year 2005.

TABLE 15
WASHINGTON COUNTY
Wholesale Water for Public Community Systems
(Acre-Feet/Year)

Supplier Public Community System	**2005 Amounts** (See Note 1)
Pine Valley Mountain Farms	
Veyo	8.4 *
St. George, City of	
Ivins	1,433.4 *
Santa Clara	1,469.4 *
Washington County Water Conservancy District	
Hurricane	2,000.0
Hurricane Valley retail	58.1 *
Ivins	2,000.0
Kayenta Water Users	491.3 *
La Verkin	1,000.0
St. George City	10,000.0
Toquerville	500.0
Virgin	1,000.0
Washington Municipal Water System	2,000.0
WASHINGTON COUNTY TOTALS	**21,960.6**

Notes: 1) All amounts shown are contracted amounts, unless indicated by (*).
Numbers indicated by (*) are actual delivered quantities in the year 2005.

Table 16, on the following page, presents the breakdown of the potable water use for each public community system. The current annual potable use of 35,586 acre-feet of water is almost 50% of the reliable potable water supply of Washington County.

TABLE 16
WASHINGTON COUNTY
Water Use for Public Community Systems

WATER SUPPLIER	POTABLE USAGE (Acre-Feet/Year)						Service Population	Gallons Per Capita Per Day
	Residential Indoor	Residential Outdoor	Commercial Total	Institutional Total	Industrial Total	Total M&I		
WASHINGTON COUNTY								
Angell Springs SSD	21.8	1.6	0.0	0.0	0.8	**24.2**	270	80.0
Casa de Oro	4.9	0.9	0.0	0.0	0.0	**5.8**	70	74.0
Central Culinary Water	8.1	0.0	0.0	0.0	5.6	**13.7**	100	122.3
Dammeron Valley Water Works	69.2	158.3	0.0	5.0	0.0	**232.5**	840	247.1
Diamond Ranch Academy	7.3	48.0	9.3	0.0	0.2	**64.8**	90	642.8
Diamond Valley Acres Water Co.	79.0	172.2	0.0	23.6	0.0	**274.8**	980	250.3
Dixie Deer SSD	31.1	47.0	2.8	0.3	0.0	**81.2**	390	185.9
Gunlock SSD	7.3	0.0	0.0	0.8	0.0	**8.1**	130	55.6
Harmony Farms Water Users	26.6	28.2	1.5	0.7	12.9	**69.9**	330	189.1
Harmony Heights	10.6	6.0	0.0	0.0	1.0	**17.6**	120	130.9
Hildale/Colorado City*	478.4	482.1	152.6	62.9	15.1	**1,191.1**	5,760	184.6
Homespun Village Water Company	2.4	0.3	0.0	0.0	0.1	**2.8**	40	62.5
Hurricane City Water System	1,048.5	1,000.0	420.1	223.6	0.0	**2,692.2**	11,180	215.0
Ivins City	553.3	569.3	69.9	65.6	3.4	**1,261.5**	6,860	164.2
Kayenta Water Users Assoc.	38.7	31.5	2.3	5.0	0.0	**77.5**	480	144.1
La Verkin City	342.6	118.3	69.8	55.0	4.4	**590.1**	4,370	120.6
Leeds Domestic Water Users Assoc.	56.5	62.8	2.4	27.6	0.0	**149.3**	700	190.4
Little Plains	29.3	56.3	0.0	0.5	1.0	**87.1**	360	216.0
Mountain Springs Water Co.	24.4	17.2	0.8	0.0	0.0	**42.4**	290	130.5
New Harmony Town Water	22.6	39.9	0.0	6.0	0.0	**68.5**	280	218.4
Pine Valley Irrigation Co.	17.1	10.0	1.7	0.2	0.0	**29.0**	100	258.9
Pine Valley Mt. Farms Water Co.	13.7	83.3	0.0	0.0	0.0	**97.0**	170	509.4
Rockville Pipeline Co.	20.2	36.5	0.0	0.0	0.0	**56.7**	250	202.5
Santa Clara Municipal Water System	483.9	786.1	47.8	151.4	2.1	**1,471.3**	6,000	218.9
Silver Reef SSD	7.3	17.0	0.4	1.0	0.0	**25.7**	90	254.9
Springdale Culinary Water	35.9	1.6	93.2	57.0	0.0	**187.7**	590	284.0
St. George, City of	5,242.3	7,819.7	7,062.3	1,246.3	400.0	**21,770.6**	67,000	290.1
Toquerville Water Dept.	92.7	110.0	6.1	1.0	0.0	**209.8**	1,150	162.9
Veyo Culinary Water Assoc.	55.4	159.8	36.8	80.0	49.1	**381.1**	680	500.3
Virgin Water Dept.	41.9	62.3	6.0	1.0	0.0	**111.2**	520	190.9
Washington County WCD								
WCWCD - Hurricane Valley retail	26.7	12.7	8.7	5.0	5.0	**58.1**	340	152.6
Washington Municipal Water System	1,242.0	1,687.2	748.5	81.0	27.5	**3,786.2**	15,400	219.5
Winchester Hills Water Co.	83.9	225.3	0.0	0.8	0.0	**310.0**	1,040	266.1
Zion National Park	9.7	19.8	0.0	107.4	0.0	**136.9**	120	1,018.5
WASHINGTON COUNTY TOTALS	**10,235.3**	**13,871.2**	**8,743.0**	**2,208.7**	**528.2**	**35,586.4**	**127,090**	**250.0**
A	B	C	D	E	F	G	H	J

*Hilldale, UT and Colorado City, AZ have common infrastructure, with sources in both Utah and Arizona. Due to the inability to separate use by state, all use is combined and listed here.

A, B, C, D, E, F, H — Input data

G=B+C+D+E+F — Potable M&I Water Use

J=G*(325,851 gallons per acre-foot)/H/(365 days per year) — Average gallons per capita per day water use

Table 17 indicates the amount of secondary water used for various categories within the boundaries of the public community systems. In the Washington County portion of the KCVR Basin, various irrigation companies deliver secondary water to most of the systems. Total secondary use is 7,446 acre-feet.

TABLE 17
WASHINGTON COUNTY
Secondary (Non-Potable) Water Use Within Public Community Systems
(Acre-Feet/Year)

WATER SUPPLIER	Residential Use (Ac-Ft/Yr)	Commercial Use (Ac-Ft/Yr)	Institutional Use (Ac-Ft/Yr)	Industrial/ Stockwater Use (Ac-Ft/Yr)	Total Secondary Use (Ac-Ft/Yr)
WASHINGTON COUNTY					
Angell Springs SSD	0.0	0.0	0.0	0.0	**0.0**
Casa de Oro	0.0	0.0	0.0	0.0	**0.0**
Central Culinary Water					
Central Canal & Irrigation Co.	29.0	0.0	0.0	0.0	**29.0**
Dammeron Valley Water Works	0.0	0.0	0.0	0.0	**0.0**
Diamond Ranch Academy	0.0	0.0	0.0	0.0	**0.0**
Diamond Valley Acres Water Co.	0.0	0.0	0.0	0.0	**0.0**
Dixie Deer SSD	0.0	0.0	0.0	0.0	**0.0**
Gunlock SSD					
Gunlock Irrigation Co.	33.0	0.0	0.0	1.8	**34.8**
Harmony Farms Water Users	0.0	0.0	0.0	0.0	**0.0**
Harmony Heights					
Harmony Heights Secondary Water Assc.	6.0	0.0	0.0	0.0	**6.0**
Hildale/Colorado City	74.3	0.0	0.0	0.0	**74.3**
Homespun Village Water Company	0.0	0.0	0.0	0.0	**0.0**
Hurricane City Water System	445.5	0.0	494.5	137.9	**1,077.9**
Ivins City					
Ivins Irrigation	80.7	0.0	0.0	0.0	**80.7**
Kayenta Water Users Assoc.	0.0	0.0	0.0	0.0	**0.0**
La Verkin City					
La Verkin Bench Canal Co.	260.0	0.0	0.0	0.0	**260.0**
Leeds Domestic Water Users Assoc.					
Leeds Water Company	80.0	0.0	0.0	0.0	**80.0**
Little Plains	0.0	0.0	0.0	0.0	**0.0**
Mountain Springs Water Co.	0.0	0.0	0.0	0.0	**0.0**
New Harmony Town Water	15.0	0.0	0.0	0.0	**15.0**
Pine Valley Irrigation Co.	50.0	0.0	0.0	0.0	**50.0**
Pine Valley Mt. Farms Water Co.	0.0	0.0	0.0	0.0	**0.0**
Rockville Pipeline Co.					
Rockville Ditch Co.	60.0	0.0	2.0	0.0	**62.0**
Santa Clara Municipal Water System	10.0	0.0	0.0	0.0	**10.0**
Silver Reef SSD	0.0	0.0	0.0	0.0	**0.0**
Springdale Culinary Water	82.4	0.0	20.0	0.0	**102.4**
St. George, City of	0.0	1,000.0	1,521.8	0.0	**2,521.8**
Various Irrigation Companies	704.0	0.0	1,221.2	0.0	**1,925.2**
Toquerville Water Dept.					
Toquerville Secondary System	160.0	0.0	3.0	0.0	**163.0**
Veyo Culinary Water Assoc.					
Veyo Irrigation Company	23.0	0.0	0.0	0.0	**23.0**
Virgin Water Dept.					
Virgin Canal Company	40.0	0.0	2.0	0.0	**42.0**
Washington County WCD					
WCWCD - Hurricane Valley retail	0.0	0.0	0.0	0.0	**0.0**
Washington Municipal Water System	100.0	353.5	425.0	0.0	**878.5**
Winchester Hills Water Co.	0.0	0.0	0.0	0.0	**0.0**
Zion National Park	0.0	0.0	10.0	0.0	**10.0**
WASHINGTON COUNTY TOTALS	**2,252.9**	**1,353.5**	**3,699.5**	**139.7**	**7,445.6**

Various per capita rates for the public community systems in the Washington County portion of the KCVR Basin are given in the following **Table 18**. As may be noted, these per capita use rates are generally higher than other areas of Utah. Certainly climate has its effects, particularly for outdoor watering requirements. However, it should be noted that most cities of the basin, St. George in particular, have a large transient population living in second homes. These people are not included in census population numbers. In addition, even though their properties may be vacant, generally during the hotter months, they still must be maintained and irrigated. These two factors alone will contribute to overall higher per capita water use rates.

TABLE 18
WASHINGTON COUNTY
Average Per Capita Water Use
for Public Community Systems

Water Supplier	Service Population	Residential Water Use			CII Water Use*			TOTAL WATER USE		
		Potable	Non-Potable	Sub Total	Potable	Non-Potable	Sub Total	Potable	Non-Potable	TOTAL
Angell Springs SSD	270	77	0	**77**	3	0	**3**	80	0	**80**
Casa de Oro	70	74	0	**74**	0	0	**0**	74	0	**74**
Central Culinary Water	100	72	259	**331**	50	0	**50**	122	259	**381**
Dammeron Valley Water Works	840	242	0	**242**	5	0	**5**	247	0	**247**
Diamond Ranch Academy	90	549	0	**549**	94	0	**94**	643	0	**643**
Diamond Valley Acres Water Co.	980	229	0	**229**	21	0	**21**	250	0	**250**
Dixie Deer SSD	390	179	0	**179**	7	0	**7**	186	0	**186**
Gunlock SSD	130	50	227	**277**	5	12	**18**	56	239	**295**
Harmony Farms Water Users	330	148	0	**148**	41	0	**41**	189	0	**189**
Harmony Heights	120	123	45	**168**	7	0	**7**	131	45	**176**
Hildale/Colorado City	5,760	149	12	**160**	36	0	**36**	185	12	**196**
Homespun Village Water Company	40	60	0	**60**	2	0	**2**	62	0	**62**
Hurricane City Water System	11,180	164	36	**199**	51	50	**102**	215	86	**301**
Ivins City	6,860	146	11	**157**	18	0	**18**	164	11	**175**
Kayenta Water Users Assoc.	480	131	0	**131**	14	0	**14**	144	0	**144**
La Verkin City	4,370	94	53	**147**	26	0	**26**	121	53	**174**
Leeds Domestic Water Users Assoc.	700	152	102	**254**	38	0	**38**	190	102	**292**
Little Plains	360	212	0	**212**	4	0	**4**	216	0	**216**
Mountain Springs Water Co.	290	128	0	**128**	2	0	**2**	131	0	**131**
New Harmony Town Water	280	199	48	**247**	19	0	**19**	218	48	**266**
Pine Valley Irrigation Co.	100	242	446	**688**	17	0	**17**	259	446	**705**
Pine Valley Mt. Farms Water Co.	170	509	0	**509**	0	0	**0**	509	0	**509**
Rockville Pipeline Co.	250	202	214	**417**	0	7	**7**	202	221	**424**
Santa Clara Municipal Water System	6,000	189	1	**190**	30	0	**30**	219	1	**220**
Silver Reef SSD	90	241	0	**241**	14	0	**14**	255	0	**255**
Springdale Culinary Water	590	57	125	**181**	227	30	**258**	284	155	**439**
St. George, City of	67,000	174	9	**183**	116	16	**132**	290	26	**316**
Toquerville Water Dept.	1,150	157	124	**282**	6	2	**8**	163	127	**289**
Veyo Culinary Water Assoc.	680	283	30	**313**	218	0	**218**	500	30	**531**
Virgin Water Dept.	520	179	69	**248**	12	3	**15**	191	72	**263**
Washington County WCD										
WCWCD - Hurricane Valley retail	340	103	0	**103**	49	0	**49**	153	0	**153**
Washington Municipal Water System	15,400	170	6	**176**	50	45	**95**	219	51	**270**
Winchester Hills Water Co.	1,040	265	0	**265**	1	0	**1**	266	0	**266**
Zion National Park	120	219	0	**219**	799	74	**873**	1,018	74	**1,093**
WASHINGTON COUNTY TOTALS	**127,090**	**169**	**16**	**185**	**81**	**36**	**117**	**250**	**52**	**302**

*Commmercial, Institutional, and Industrial

Table 19, below, shows the water use for public non-community systems, self-supplied industries, and private domestic systems in this portion of the KCVR Basin. Zion National Park is among the 8 listed non-community systems. Some residences use private wells. All of these uses amount to 153 acre-feet of potable water

TABLE 19
WASHINGTON COUNTY
Water Use for Public Non-Community Systems,
Self-Supplied Industries and Private Domestic Systems
(Acre-Feet/Year)

WATER SUPLIER	POTABLE USAGE					Total Secondary Water Use (Ac-Ft/Yr)
	Residential Use (Ac-Ft/Yr)	Commercial Use (Ac-Ft/Yr)	Institutional Use (Ac-Ft/Yr)	Industrial/ Stockwater Use (Ac-Ft/Yr)	Total Potable Use (Ac-Ft/Yr)	
WASHINGTON COUNTY						
Non-Community Systems						
Home Valley Park Subdivision	0.3	0.0	0.0	0.0	**0.3**	**0.0**
Little Creek Travel Center	0.0	2.0	0.0	0.0	**2.0**	**0.0**
National Forest Systems						
Juniper Park Campground	0.0	0.0	0.1	0.0	**0.1**	**0.0**
National Park Systems						
Zion National Park - Kolob Canyon	0.0	0.0	0.7	0.0	**0.7**	**0.0**
Zion National Park - Sinawava Temple	0.0	0.0	3.7	0.0	**3.7**	**0.0**
Pine Valley Ranchos[1]	4.5	0.0	0.0	0.0	**4.5**	**0.0**
Woodland & Kolob Acres	1.4	0.0	0.0	0.0	**1.4**	**0.0**
Zion Panorama Subdivision	0.7	0.0	0.0	0.0	**0.7**	**0.0**
TOTALS	**6.9**	**2.0**	**4.5**	**0.0**	**13.4**	**0.0**
Self Supplied Industries[2]	0.0	0.0	0.0	95.0	**95.0**	**0.0**
Private Domestic	44.6	0.0	0.0	0.0	**44.6**	**0.0**
WASHINGTON COUNTY TOTALS	**51.5**	**2.0**	**4.5**	**95.0**	**153.0**	**0.0**

[1]Incorporated into Pine Valley Irrigation System in 2003.
[2]Self-supplied industries include Staker & Parson Co (Western Rock)

Collectively, the total potable M&I water use for all systems in Washington County is about 35,739 acre-feet. Non-potable use is 7,446 acre-feet. This amounts to a total M&I water use of 43,185 acre-feet for the county.

APPENDIX A

LA VERKIN WATER USE DATA FORM

Information jointly requested by:
Utah Division of Water Resources, 538-7264
Utah Division of Drinking Water, 536-4200; and
Utah Division of Water Rights, 538-7392.

UTAH WATER USE DATA FORM
DATA FOR 2002

Return completed form to:
Utah Division of Water Rights
PO Box 146300
Salt Lake City, UT 84114-6300

System Name: LaVerkin City
Address: 111 South Main
LaVerkin, UT 84745

Population Served: 3,400 DEQ#: 27009
County: Washington
E-Mail Address: _____

Contact Person: Doug Gubler
Form filled out by: June Jeffery, Deputy Recorder

Phone Number: (435) 635-2581
Phone Number: _____

I. STORAGE INVENTORY: Total treated storage capacity: 2.5 million in gallons. Number of Tanks: 2

II. SOURCE INVENTORY:

1 Source Name: Ash Creek Spring Area Type: Spring Location: Sec 11, T41S, R13W, SLB&M WR Number: 81-687 81-1602
Method of Measurement: [X] Master Meter, [ ] Estimate, [ ] Other _____
Units of Measurement: x 1,000
Are there any spills/overflow? [ ] Yes, [ ] No If yes, estimate annual quantity _____. Where is source measured? [ ] Before overflow, [ ] After overflow
When do spills/overflow occur? _____ Are spills/overflow included in the quantities reported? [ ] Yes [ ] No

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
8,872	11,189	12,772	22,259	13,270	21,739	21,740	16,021	19,997	17,121	13,693	10,960	189,633

2 Source Name: Toquerville Springs Type: Spring Location: Sec 11, T41S, R13W, SLB&M WR Number: 81-2287
Method of Measurement: [ ] Master Meter, [ ] Estimate, [ ] Other _____
Units of Measurement: _____
Are there any spills/overflow? [ ] Yes, [ ] No If yes, estimate annual quantity _____. Where is source measured? [ ] Before overflow, [ ] After overflow
When do spills/overflow occur? _____ Are spills/overflow included in the quantities reported? [ ] Yes [ ] No

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL

3 Source Name: Upper Ash Creek Springs Type: Spring Location: Sec 11, T41S, R13W, SLB&M WR Number: 81-1073 81-1602
Method of Measurement: [ ] Master Meter, [ ] Estimate, [ ] Other _____
Units of Measurement: _____
Are there any spills/overflow? [ ] Yes, [ ] No If yes, estimate annual quantity _____. Where is source measured? [ ] Before overflow, [ ] After overflow
When do spills/overflow occur? _____ Are spills/overflow included in the quantities reported? [ ] Yes [ ] No

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL

RECEIVED
FEB 19 2003
WATER RIGHTS
SALT LAKE

** If you are using other sources which are not shown above, please enter the appropriate data in the space provided below. **

4 Source Name: Type: Location: WR Number:
Method of Measurement: [ ] Master Meter, [ ] Estimate, [ ] Other _____
Units of Measurement: _____

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL

5 Source Name: Type: Location: WR Number:
Method of Measurement: [ ] Master Meter, [ ] Estimate, [ ] Other _____
Units of Measurement: _____

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL

6 Source Name: Type: Location: WR Number:
Method of Measurement: [ ] Master Meter, [ ] Estimate, [ ] Other _____
Units of Measurement: _____

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL

SOURCE COMMENTS: Water supply conditions were: [ ] Above normal, [ ] Below normal

_____

_____

III. WATER USE BREAKDOWN: (Please use sum of the readings from individual meters, not master meter readings at source. If quantities are not known, please estimate. See instructions for definition of uses shown in bold).

Units of Measurement: 1,000 gallons

Residential: Annual quantity of water delivered for residential purposes 147,317. Total number of residential connections 1,026.
Meter readings at individual connections [ ]; or Estimated [ ]
Number of connections serving multiple units (apartments) from a single connection 50. Units per connection (avg) 2.

Commercial: Annual quantity of water delivered for commercial purposes 28,669. Total number of commercial connections 88.
Meter readings at individual connections [ ]; or Estimated [ ]

Industrial: Annual quantity of water delivered for industrial purposes 1,286. Total number of industrial connections 10.
Meter readings at individual connections [ ]; or Estimated [ ]

Institutional: Annual quantity of water delivered for institutional purposes 12,361. Total number of institutional connections 12.
Meter readings at individual connections [ ]; or Estimated [ ]

Stockwatering: Annual quantity of water delivered for stockwatering purposes _____. Total number of stockwatering connections _____.
Meter readings at individual connections [ ]; or Estimated [ ]

Wholesale: Annual quantity of water delivered for wholesale purposes _____. Please attach a listing of those supplied.
Meter readings at individual connections [ ]; or Estimated [ ]

Other Uses: Annual quantity of water delivered for other purposes _____. Total number of other connections _____.
Meter readings at individual connections [ ]; or Estimated [ ]
Describe other uses _____.

Unmetered: Annual estimate of water delivered by unmetered connections _____. Total number of unmetered connections _____.
Unmetered connections used for _____.

Total annual quantity of water delivered for all purposes 189,633. **Total number of all connections** 1,136.
Of this total, how many connections are active? 1,069.

IV. IRRIGATION SYSTEM (Separate lawn and garden irrigation system, **whether controlled by the drinking water supplier or not**)

Is any of your area served by a separate ditch or pipe fed irrigation water system? [X] Yes, [ ] No If yes, please provide the following information:
What percent of your customers are served by a separate irrigation system? 50 %
Of these customers, what percent are served by ditch? 0 %
What percent are served by pressurized-pipe? 100 %
Do you operate and maintain the separate lawn and garden irrigation water system? [ ] Yes, [ ] No
If the separate irrigation system is operated by other entities, please give name of companies, contact person & phone number:
Dan Howard, President LaVerkin Bench Canal Company 435-635-4848

APPENDIX B

2005 KCVR BASIN
DELIVERIES AND DEPLETIONS

2005 KANAB CREEK/VIRGIN RIVER BASIN M&I DELIVERIES AND DEPLETIONS TABLE

(Acre-Feet/Year)

WATER SUPPLIER	Potable Residential Indoor Use	Potable Residential Outdoor Use	Potable Commercial Use	Potable Institutional Use	Potable Industrial/ Stockwater Use	Total Potable Use	Total Secondary Water Use	Total Indoor Use	Total Outdoor Use	Residential Indoor Return Flow	Commercial Indoor Return Flow	Institutional Indoor Return Flow	Industrial/ Stockwater Indoor Return Flow	Total Indoor Return Flow to Treatment Facility	Pond Evaporation	Treatment Facility Outflow (Indoor Return Flow)	Outdoor Return Flow	Total Return Flow	Total Deliveries	Total Depletions
Iron County																				
Kanarraville	28.6	125.0	2.7	8.6	0.0	164.9	58.8	32.5	191.2	28.0	2.1	1.7	0.0	31.8	0.0	***30.2***	63.7	94.0	223.7	129.7
TOTAL COMMUNITY SYSTEMS	**28.6**	**125.0**	**2.7**	**8.6**	**0.0**	**164.9**	**58.8**	**32.5**	**191.2**	**28.0**	**2.1**	**1.7**	**0.0**	**31.8**	**0.0**	**30.2**	**63.7**	**94.0**	**223.7**	**129.7**
Non-community systems	0.0	0.0	0.0	29.7	0.0	29.7	0.0	5.9	23.8	0.0	0.0	5.8	0.0	5.8	0.0	***5.5***	7.9	13.5	29.7	16.2
Self-Supplied Industries	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	***0.0***	0.0	0.0	0.0	0.0
Private Domestic	3.2	6.5	0.0	0.0	0.0	9.7	0.0	3.2	6.5	3.1	0.0	0.0	0.0	3.1	0.0	***3.0***	2.2	5.1	9.7	4.6
COUNTY TOTALS	**31.8**	**131.5**	**2.7**	**38.3**	**0.0**	**204.3**	**58.8**	**41.6**	**221.5**	**31.2**	**2.1**	**7.5**	**0.0**	**40.8**	**0.0**	**38.7**	**73.8**	**112.6**	**263.1**	**150.5**
Kane County																				
Alton	9.0	1.7	0.0	0.3	0.0	11.0	169.1	9.1	171.0	8.8	0.0	0.1	0.0	8.9	0.0	***8.4***	57.0	65.4	180.1	114.7
East Kanab Water Co.	6.0	1.9	0.0	2.5	0.0	10.4	0.0	6.5	3.9	5.9	0.0	0.5	0.0	6.4	0.0	***6.1***	1.3	7.4	10.4	3.0
Glendale	29.7	27.6	9.2	0.9	0.0	67.4	89.0	37.2	119.2	29.1	7.2	0.2	0.0	36.5	11.0	***23.7***	39.7	63.4	156.4	93.0
Kanab	305.6	412.7	218.2	573.6	9.0	1,519.1	65.8	603.9	981.0	299.5	171.1	112.4	0.0	583.0	260.0	**311.3**	327.0	638.3	1,584.9	946.6
Johnson Canyon Area (KCWCD)	16.0	9.2	0.0	1.0	0.0	26.2	0.0	16.2	10.0	15.7	0.0	0.2	0.0	15.9	0.0	***15.1***	3.3	18.4	26.2	7.8
Orderville	51.1	48.2	33.2	92.7	2.0	227.2	173.0	98.2	302.0	50.1	26.0	18.2	0.0	94.3	22.3	**70.1**	100.7	170.8	400.2	229.4
Fredonia (AZ)	86.9	344.9	13.1	45.9	7.9	498.7	0.0	114.5	384.2	85.2	10.3	9.0	0.0	104.4	117.0	**0.0**	128.1	128.1	498.7	370.6
TOTAL COMMUNITY SYSTEMS	**504.3**	**846.2**	**273.7**	**716.9**	**18.9**	**2,360.0**	**496.9**	**885.5**	**1,971.4**	**494.2**	**214.6**	**140.5**	**0.0**	**849.3**	**410.3**	**434.7**	**657.1**	**1,091.8**	**2,856.9**	**1,765.1**
Non-community systems	1.7	3.5	51.5	7.4	1.3	65.4	82.0	45.7	101.7	1.7	40.4	1.5	0.0	43.5	0.0	***41.3***	33.9	75.2	147.4	72.2
Self-Supplied Industries	0.0	0.0	2.0	0.0	0.0	2.0	0.0	1.6	0.4	0.0	1.6	0.0	0.0	1.6		***1.5***	0.1	1.6	2.0	0.4
Private Domestic	9.8	19.7	0.0	0.0	0.0	29.5	0.0	9.8	19.7	9.6	0.0	0.0	0.0	9.6		***9.1***	6.6	15.7	29.5	13.8
COUNTY TOTALS	**515.8**	**869.4**	**327.2**	**724.3**	**20.2**	**2,456.9**	**578.9**	**942.6**	**2,093.2**	**505.5**	**256.5**	**142.0**	**0.0**	**904.0**	**410.3**	**486.6**	**697.7**	**1,184.3**	**3,035.8**	**1,851.5**
Washington County																				
Angell Springs	21.8	1.6	0.0	0.0	0.8	24.2	0.0	22.6	1.6	21.4	0.0	0.0	0.0	21.4	0.0	***20.3***	0.5	20.8	24.2	3.4
Casa de Oro	4.9	0.9	0.0	0.0	0.0	5.8	0.0	4.9	0.9	4.8	0.0	0.0	0.0	4.8	0.0	***4.6***	0.3	4.9	5.8	0.9
Central	8.1	0.0	0.0	0.0	5.6	13.7	29.0	13.7	29.0	7.9	0.0	0.0	0.0	7.9	0.0	***7.5***	9.7	17.2	42.7	25.5
Dammeron Valley	69.2	158.3	0.0	5.0	0.0	232.5	0.0	70.2	162.3	67.8	0.0	1.0	0.0	68.8	0.0	***65.4***	54.1	119.5	232.5	113.0
Diamond Ranch Academy	7.3	48.0	9.3	0.0	0.2	64.8	0.0	14.9	49.9	7.2	7.3	0.0	0.0	14.4	0.0	***13.7***	16.6	30.3	64.8	34.5
Diamond Valley Acres	79.0	172.2	0.0	23.6	0.0	274.8	0.0	83.7	191.1	77.4	0.0	4.6	0.0	82.0	0.0	***77.9***	63.7	141.6	274.8	133.2
Dixie Deer SSD	31.1	47.0	2.8	0.3	0.0	81.2	0.0	33.4	47.8	30.5	2.2	0.1	0.0	32.7	0.0	***31.1***	15.9	47.0	81.2	34.2
Gunlock SSD	7.3	0.0	0.0	0.8	0.0	8.1	34.8	7.5	35.4	7.2	0.0	0.2	0.0	7.3	0.0	***6.9***	11.8	18.8	42.9	24.1
Harmony Farms Water Users	26.6	28.2	1.5	0.7	12.9	69.9	0.0	40.8	29.1	26.1	1.2	0.1	0.0	27.4	0.0	***26.0***	9.7	35.7	69.9	34.2
Harmony Heights	10.6	6.0	0.0	0.0	1.0	17.6	6.0	11.6	12.0	10.4	0.0	0.0	0.0	10.4	0.0	***9.9***	4.0	13.9	23.6	9.7
Hildale/Colorado City	478.4	482.1	152.6	62.9	15.1	1,191.1	74.3	628.2	637.2	468.8	119.6	12.3	0.0	600.8	217.5	**371.3**	212.4	583.7	1,265.4	681.7
Homespun Village Water Company	2.4	0.3	0.0	0.0	0.1	2.8	0.0	2.5	0.3	2.4	0.0	0.0	0.0	2.4	0.0	***2.2***	0.1	2.3	2.8	0.5
Hurricane	1,048.5	1,000.0	420.1	223.6	0.0	2,692.2	1,077.9	1,429.3	2,340.8	1,027.5	329.4	43.8	0.0	1,400.7	150.3	**1,222.4**	780.3	2,002.7	3,770.1	1,767.4
Ivins	553.3	569.3	69.9	65.6	3.4	1,261.5	80.7	625.7	716.5	542.2	54.8	12.9	0.0	609.9	0.0	595.0	238.8	833.8	1,342.2	508.4
Kayenta Water Users	38.7	31.5	2.3	5.0	0.0	77.5	0.0	41.5	36.0	37.9	1.8	1.0	0.0	40.7	0.0	***38.7***	12.0	50.7	77.5	26.8
La Verkin	342.6	118.3	69.8	55.0	4.4	590.1	260.0	413.8	436.3	335.7	54.7	10.8	0.0	401.3	53.7	**339.6**	145.4	485.0	850.1	365.1
Leeds Domestic Water Users	56.5	62.8	2.4	27.6	0.0	149.3	80.0	63.9	165.4	55.4	1.9	5.4	0.0	62.7	0.0	***59.5***	55.1	114.6	229.3	114.7
Little Plains	29.3	56.3	0.0	0.5	1.0	87.1	0.0	30.4	56.7	28.7	0.0	0.1	0.0	28.8	0.0	***27.4***	18.9	46.3	87.1	40.8
Mountain Springs Water Co.	24.4	17.2	0.8	0.0	0.0	42.4	0.0	25.0	17.4	23.9	0.6	0.0	0.0	24.5	0.0	***23.3***	5.8	29.1	42.4	13.3
New Harmony Water System	22.6	39.9	0.0	6.0	0.0	68.5	15.0	23.8	59.7	22.1	0.0	1.2	0.0	23.3	0.0	***22.2***	19.9	42.1	83.5	41.4
Pine Valley Irrigation Co.	17.1	10.0	1.7	0.2	0.0	29.0	50.0	18.5	60.5	16.8	1.3	0.0	0.0	18.1	0.0	***17.2***	20.2	37.4	79.0	41.6
Pine Valley Mt. Farms	13.7	83.3	0.0	0.0	0.0	97.0	0.0	13.7	83.3	13.4	0.0	0.0	0.0	13.4	0.0	***12.8***	27.8	40.5	97.0	56.5
Rockville	20.2	36.5	0.0	0.0	0.0	56.7	62.0	20.2	98.5	19.8	0.0	0.0	0.0	19.8	8.4	**11.0**	32.8	43.8	118.7	74.9
Santa Clara Municipal Water System	483.9	786.1	47.8	151.4	2.1	1,471.3	10.0	554.5	926.8	474.2	37.5	29.7	0.0	541.4	0.0	530.5	308.9	839.5	1,481.3	641.8
Silver Reef SSD	7.3	17.0	0.4	1.0	0.0	25.7	0.0	7.8	17.9	7.2	0.3	0.2	0.0	7.7	0.0	***7.3***	6.0	13.2	25.7	12.5
Springdale	35.9	1.6	93.2	57.0	0.0	187.7	102.4	121.9	168.2	35.2	73.1	11.2	0.0	119.4	42.9	**74.1**	56.1	130.2	290.1	159.9
St. George City	5,242.3	7,819.7	7,062.3	1,246.3	400.0	21,770.6	4,447.0	11,541.4	14,676.2	5,137.5	5,536.8	244.3	0.0	10,918.6	0.0	10,700.2	4,892.1	15,592.3	26,217.6	10,625.3
Toquerville	92.7	110.0	6.1	1.0	0.0	209.8	163.0	97.8	275.0	90.8	4.8	0.2	0.0	95.8	10.7	**83.2**	91.7	174.8	372.8	198.0
Veyo	55.4	159.8	36.8	80.0	49.1	381.1	23.0	149.9	254.2	54.3	28.9	15.7	0.0	98.8	0.0	***93.9***	84.7	178.6	404.1	225.5
Virgin	41.9	62.3	6.0	1.0	0.0	111.2	42.0	46.9	106.3	41.1	4.7	0.2	0.0	46.0	0.0	***43.7***	35.4	79.1	153.2	74.1
Washington County WCD																				
WCWCD - Hurricane Vallely retail	26.7	12.7	8.7	5.0	5.0	58.1	0.0	39.7	18.4	26.2	6.8	1.0	0.0	34.0	0.0	***32.3***	6.1	38.4	58.1	19.7
Washington Municipal Water System	1,242.0	1,687.2	748.5	81.0	27.5	3,786.2	878.5	1,884.5	2,780.2	1,217.2	586.8	15.9	0.0	1,819.9	0.0	1,783.5	926.7	2,710.2	4,664.7	1,954.5
Winchester Hills Water Co.	83.9	225.3	0.0	0.8	0.0	310.0	0.0	84.1	225.9	82.2	0.0	0.2	0.0	82.4	0.0	***78.3***	75.3	153.6	310.0	156.4
Zion National Park	9.7	19.8	0.0	107.4	0.0	136.9	10.0	31.2	115.7	9.5	0.0	21.1	0.0	30.6	25.3	**4.6**	38.6	43.2	146.9	103.7
TOTAL COMMUNITY SYSTEMS	**10,235.3**	**13,871.2**	**8,743.0**	**2,208.7**	**528.2**	**35,586.4**	**7,445.6**	**18,199.6**	**24,832.4**	**10,030.6**	**6,854.5**	**432.9**	**0.0**	**17,318.0**	**508.8**	**16,437.3**	**8,277.5**	**24,714.8**	**43,032.0**	**18,317.2**
Non-community systems	2.3	4.6	2.0	4.5	0.0	13.4	0.0	4.8	8.6	2.3	1.6	0.9	0.0	4.7	0.0	***4.5***	2.9	7.3	13.4	6.1
Self-Supplied Industries	0.0	0.0	0.0	0.0	95.0	95.0	0.0	95.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	***0.0***	0.0	0.0	95.0	95.0
Private Domestic	14.9	29.7	0.0	0.0	0.0	44.6	0.0	14.9	29.7	14.6	0.0	0.0	0.0	14.6	0.0	***13.9***	9.9	23.8	44.6	20.8
COUNTY TOTALS	**10,252.5**	**13,905.5**	**8,745.0**	**2,213.2**	**623.2**	**35,739.4**	**7,445.6**	**18,314.3**	**24,870.7**	**10,047.5**	**6,856.1**	**433.8**	**0.0**	**17,337.3**	**508.8**	**16,455.7**	**8,290.2**	**24,745.9**	**43,185.0**	**18,439.1**

	Potable Residential Indoor Use	Potable Residential Outdoor Use	Potable Commercial Use	Potable Institutional Use	Potable Industrial/ Stockwater Use	Total Potable Use	Total Secondary Water Use	Total Indoor Use	Total Outdoor Use	Residential Indoor Return Flow	Commercial Indoor Return Flow	Institutional Indoor Return Flow	Industrial/ Stockwater Indoor Return Flow	Total Indoor Return Flow to Treatment Facility	Pond Evaporation	Treatment Facility Outflow (Indoor Return Flow)	Outdoor Return Flow	Total Return Flow	Total Deliveries	Total Depletions
BASIN COMMUNITY SYSTEMS	**10,768.2**	**14,842.4**	**9,019.4**	**2,934.2**	**547.1**	**38,111.3**	**8,001.3**	**19,117.7**	**26,994.9**	**10,552.8**	**7,071.2**	**575.1**	**0.0**	**18,199.1**	**919.1**	**16,902.2**	**8,998.3**	**25,900.6**	**46,112.6**	**20,212.0**
Total Non-community systems	4.0	8.1	53.5	41.6	1.3	**108.5**	**82.0**	**56.4**	**134.1**	3.9	41.9	8.2	0.0	**54.0**	0.0	51.3	44.7	**96.0**	**190.5**	**94.5**
Self-Supplied Industries	0.0	0.0	2.0	0.0	95.0	**97.0**	**0.0**	**96.6**	**0.4**	0.0	1.6	0.0	0.0	**1.6**	0.0	1.5	0.1	**1.6**	**97.0**	**95.4**
Private Domestic	27.9	55.9	0.0	0.0	0.0	**83.8**	**0.0**	**27.9**	**55.9**	27.3	0.0	0.0	0.0	**27.3**	0.0	26.0	18.6	**44.6**	**83.8**	**39.2**
KCVR BASIN TOTALS	**10,800.1**	**14,906.4**	**9,074.9**	**2,975.8**	**643.4**	**38,400.6**	**8,083.3**	**19,298.6**	**27,185.3**	**10,584.1**	**7,114.7**	**583.3**	**0.0**	**18,282.1**	**919.1**	**16,981.0**	**9,061.8**	**26,042.8**	**46,483.9**	**20,441.1**

Color Code:
- Potable Use Data
- Secondary Use Data
- Indoor/Outdoor Use Data
- Return Flow Data
- Delivery Data
- Depletion Data

Treatment Facility Font Key: Regular = Sewage Treatment Plant
Bold = Facultative Ponds/ Lagoons
Bold/Italics = Septic Systems/Tanks