AGENDA
WORK SESSION
MAYOR AND COMMON COUNCIL
Of the TOWN OF CAMP VERDE
COUNCIL CHAMBERS · 473 S. Main Street, Room #106
WEDNESDAY, JULY 9, 2014 at 5:30 p.m.

Note: Council member(s) may attend Council Sessions either in person or by telephone, video, or internet conferencing.

1. **Call to Order**

2. **Roll Call**

3. **Pledge of Allegiance**

4. **Presentation by Tom O'Halleran and Tony Gioia regarding long-term water planning followed by discussion, consideration, and possible direction to staff relative to bringing back information and recommendations for Council policy considerations.** Staff Resource: Russ Martin

5. **Presentation of the April 2014 "Water Demand and Conservation Assessment for the Town of Camp Verde" study prepared by Western Resource Advocates, followed by discussion, consideration, and possible direction to staff relative to implementation strategies.** Staff Resource: Russ Martin

6. **Adjournment**

Posted by: V Jones Date/Time: 7-3-2014 9:15 a.m

Note: Pursuant to A.R.S. §38-431.03.A.2 and A.3, the Council may vote to go into Executive Session for purposes of consultation for legal advice with the Town Attorney on any matter listed on the Agenda, or discussion of records exempt by law from public inspection associated with an agenda item.

The Town of Camp Verde Council Chambers is accessible to the handicapped. Those with special accessibility or accommodation needs, such as large typeface print, may request these at the Office of the Town Clerk.

WATER DEMAND AND CONSERVATION ASSESSMENT FOR THE TOWN OF CAMP VERDE

April 2014

WESTERN RESOURCE
ADVOCATES

This report was prepared by Linda Stitzer, Western Resource Advocates,
Arizona Senior Water Policy Advisor.

Western Resource Advocates mission is to protect the West's land, air and water.

Major contributors

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Special thanks to

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and
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Jan Grogan, Camp Verde Sanitary District
Dean Harrison, Out of Africa
Stan Leake, U.S. Geological Survey
Terri Nelson, Yavapai County
Jesse Sandoval, Arizona Department of Water Resources
Kim Schonek, The Nature Conservancy
Saeid Tadayon, U.S. Geological Survey
Barbara Wall, Willow Mobile Home Park
Alan Williams, Lake Verde Water Company and Verde Lakes Water Corporation

Note: Footnotes in this document are listed sequentially for that page using Roman numerals. References are listed sequentially for the entire document using Arabic numerals.

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Introduction

This study is an assessment of water use by, and the water conservation potential of, water users within the incorporated limits of the Town of Camp Verde. It is intended as a planning and information resource for the Town that can be used to prepare planning documents and develop water conservation programs, codes and ordinances that minimize impacts to groundwater supplies and the Verde River from current and future uses. Included in the assessment are water demands served by privately operated water systems, as well as "unmetered" wells that include domestic, agricultural and commercial/industrial uses. Not intensively evaluated is surface water delivered by area ditch associations, although the assessment attempts to separate and quantify agricultural irrigation from that associated with households. Based on the reported data and using reasonable demand assumptions for unmetered wells, this assessment also includes conservation, reuse, and water supply strategies that may be considered by the Town in both the near-term and further into the future.

During the Town's 2004 General Plan process, Camp Verdeans identified water quantity/water quality as their #1 concern for the future and considered the Verde River as the Town's #1 asset.

Clearly the Verde River is highly valued by Camp Verde residents, who are concerned about the impact of growth on local water resources. Other communities in the Verde Valley are similarly concerned, as reflected in conservation and water resource planning activity such as General Plan updates, development of a conservation plan by Cottonwood, and Clarkdale's Water Resources Management Program planning effort. There is also increasing awareness of the economic contribution that the River offers from recreational and other non-consumptive uses.

Hydrologic studies provide strong evidence of human impacts to the River. A United States Geological Survey (USGS) study completed in 2013 found that groundwater pumping could decrease baseflow at the Camp Verde gage downstream of Camp Verde by an additional 5,400 to 8,600 acre-feet/year by 2110.[1] Regional demand reduction, increased efficiency and reuse efforts are needed to address this impact.

The Town of Camp Verde, like other communities in Arizona including Sedona, Sierra Vista and Bisbee, does not own and operate a municipal water system. Instead, the community is served by private or investor-owned utilities (IOU), water systems that are regulated by the Arizona Corporation Commission (ACC). In addition, some Camp Verde residents use domestic wells to meet all or part of their demand and may receive Verde River water from ditch associations for irrigation. The lack of a municipal water system, existence of a separate and extensive surface water delivery system, and jurisdictional issues associated with Federal and Tribal land ownership within the Town presents challenges to managing water resources to support growth and a healthy economy in balance with sustaining flows in the Verde River.

Study Area

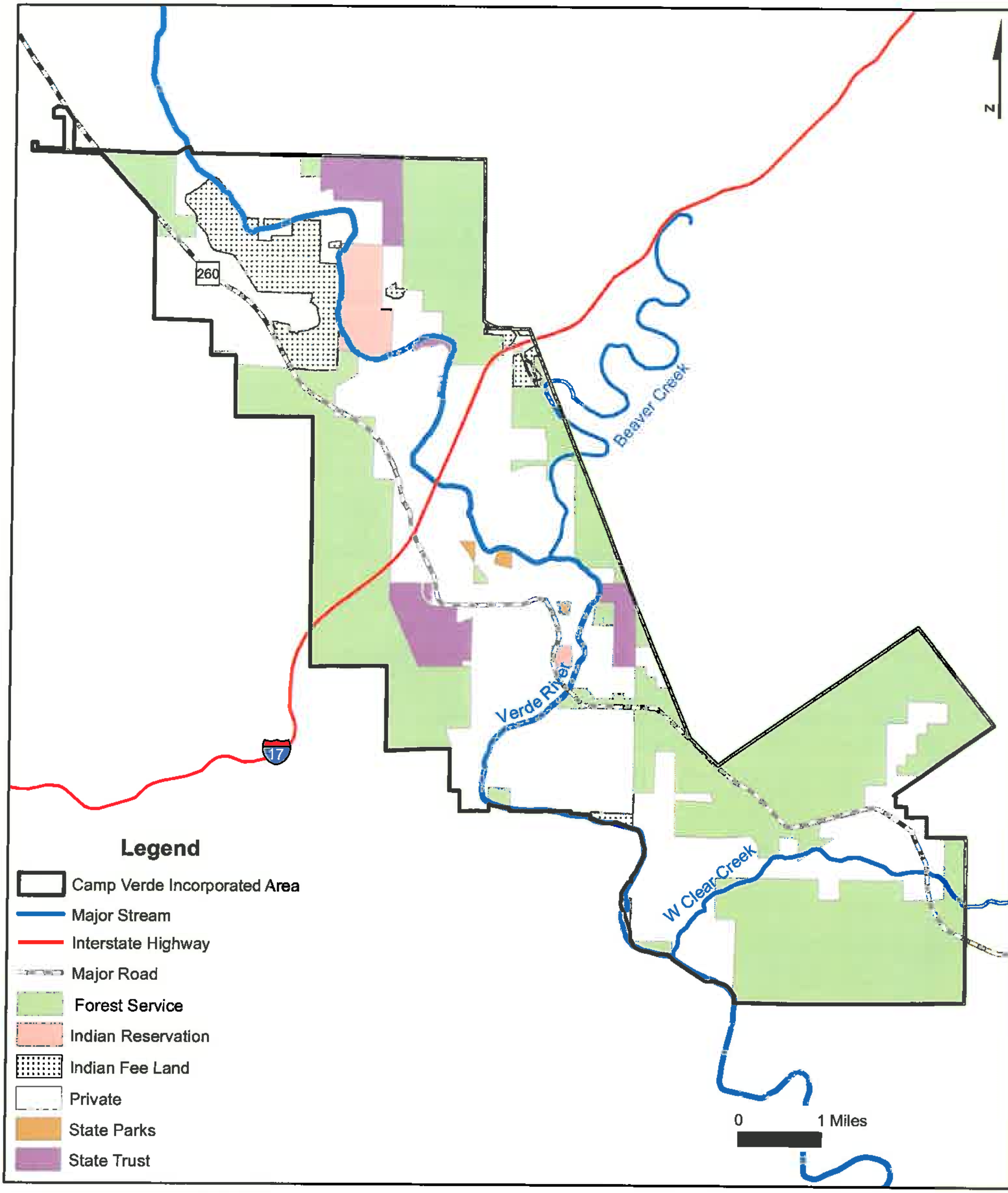
The Assessment study area encompasses the 42.6 square miles of the incorporated limits of the Town of Camp Verde (Figure 1). Located in the Middle Verde subwatershed portion of the Verde River Watershed, Camp Verde is the most downstream community on the River north of the Phoenix metropolitan area. As shown in Figure 1, the Town straddles the Verde River and Arizona State Highway 260, stretching about 7 miles northwest of I-17 and 10 miles to the southeast. There is a variety of land ownership including state trust land, a large amount of Forest Service lands, as well as approximately 1,800 acres of Yavapai-Apache Nation reservation and fee lands; areas that are outside the legal jurisdiction of the Town in terms of water resource management and land use.

Eighteen miles of the Verde River run through the Town and two major perennial tributaries, Wet Beaver Creek and Clear Creek, join the River within the Town limits. This reach of the River also benefits from Oak Creek inflow north of the Town. These watercourses support a rich riparian area and provide recreational opportunities including a popular boat access point at White Bridge/Riverfront Park.

The Nature Conservancy has purchased the 306-acre, historically irrigated Shield Ranch at the southern town boundary, most of which it plans to eventually transfer to the Coconino National Forest, removing it as a future growth area.[2] Across the River from this property is the Arizona State Parks Rockin' River Ranch, a small part of which is within the Town limits. This property is the southern anchor for the 36-mile Verde River Greenway, a public-private effort to preserve the River corridor in the Verde Valley. The State Park land has not yet been developed but will likely provide a variety of recreational uses including river access.

In terms of population, Camp Verde is the second largest incorporated community in the Verde Valley, only slightly smaller than the City of Cottonwood.[i] The 2010 U.S. Census population of Camp Verde was about 10,900, with 10,175 persons residing in 4,088 households and another 698 persons residing in group quarters. The average persons per household was 2.49. The 2010 Census population was less than the previously estimated 2009 population of 11,600 based on historic growth rates. While the growth rate has recently slowed, since 1990, the Town's population has steadily grown with a 14% increase between the 2000 and 2010 Census.

[i] According to the 2010 U.S. Census; Camp Verde 10,873, Clarkdale 4,097, Cottonwood 11,265 and Sedona 10,031. Verde Village Census Designated Place was 11,605.



Data Sources: AZ State Cartographer (2013) and Yavapai Apache Nation (2013)

Figure 1. Land Ownership

The total number of housing units in 2010 was 4,726 with a 13.5% vacancy rate and a corresponding 2.14 persons per housing unit.[3]. Table 1 provides the estimated 2012 population and residents served by water providers and domestic wells based on reported data discussed in the following section. As shown, just 68% of the population is served by water providers, the remainder receive their water from domestic wells.

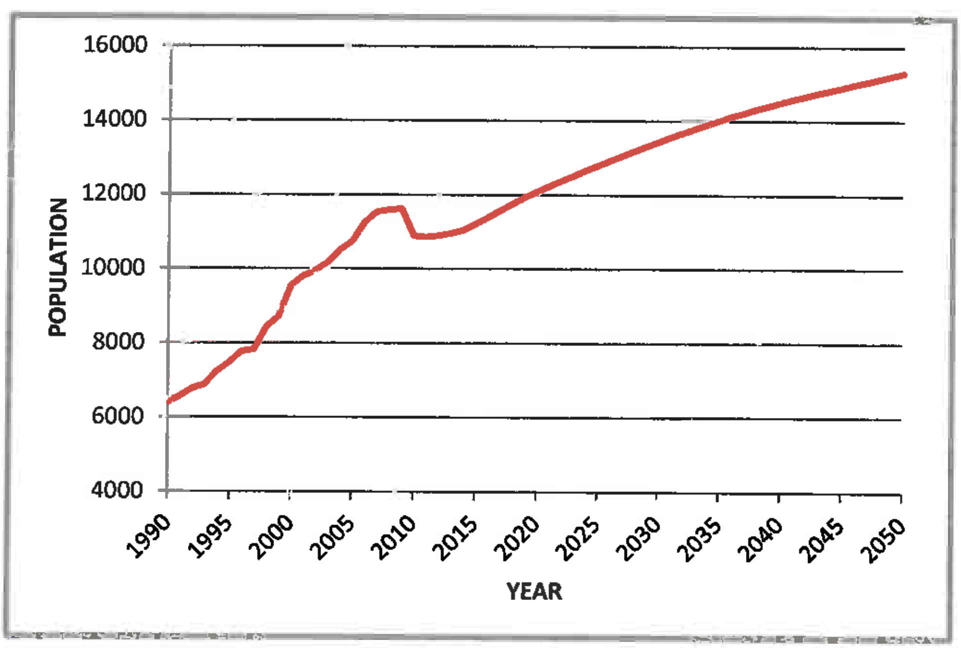
Table 1. Camp Verde 2012 Population.

Area	2012 Population
Camp Verde Population	10,925
Portion of Camp Verde Served by Water Providers	7,448
Portion of Camp Verde not Served by Water Providers	3,477
Within Service Area Boundaries*	1,496
Outside Service Area Boundaries*	1,981

*approximate based on percentage of active, potable use wells in each area

September 2013 population projections from the Arizona Department of Administration project a slower rate of growth than previous projections that predicted a population of 19,100 by 2030. As shown in Figure 2 the new projections forecast 13,400 residents in 2030 and 15,300 by 2050, an increase of 2,500 and 4,400, respectively.[4] Even with slower growth, new residents could account for almost a third of Camp Verde's population and associated housing by 2050.

Figure 2. Camp Verde Population 1990-2050.

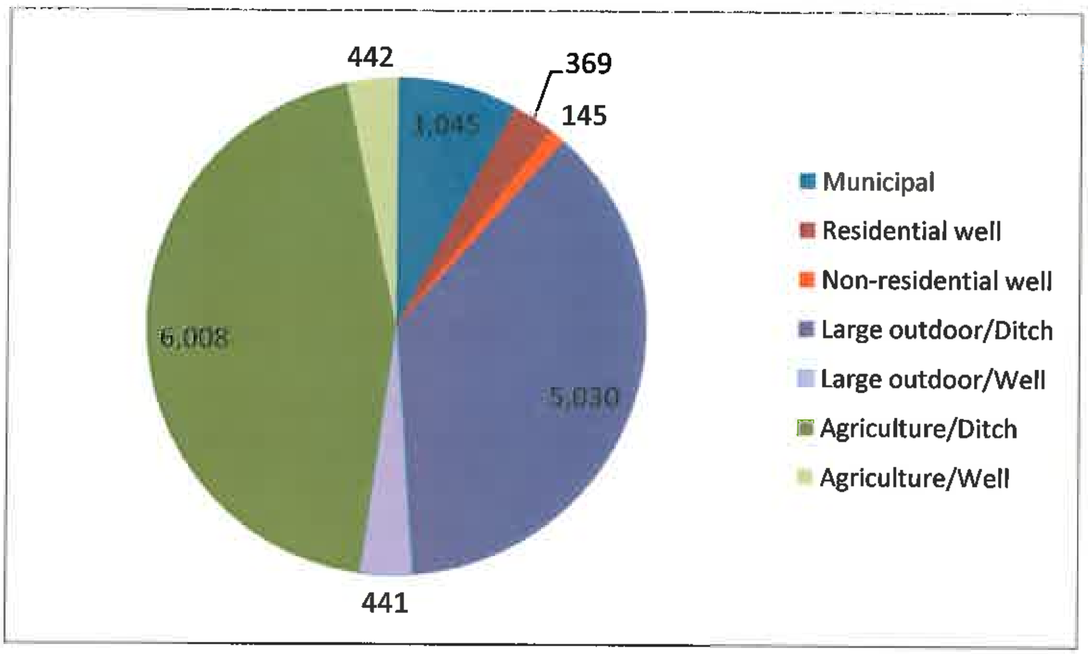


Water Supply and Demand

This section discusses water supply and demand of the major water using sectors in Camp Verde. Included as water use sectors are municipal, unmetered wells (domestic residential and non-residential), large outdoor residential water uses, and agriculture. Water supplies include groundwater, which is the main municipal and domestic water supply, surface water, which supplies most of the water used for agricultural and large outdoor irrigation, and other supplies. Other supplies include Central Arizona Project water, a supply that is not used directly but has been a source of local water supply development projects through a contract exchange, and wastewater, which is not currently reused.

The volume of municipal, well, large outdoor, and agricultural water use is summarized in Figure 3 and discussed in detail in this section. Total demand in 2012/2013 is estimated to be approximately 13,922 acre-feet. Agricultural and large outdoor water demand represents 89% of the total and includes both deliveries by ditch associations and wells. The Assessment focuses primarily on water uses that may be influenced by the Town's planning and management decisions.

Figure 3. Camp Verde Groundwater and Surface Water Demand in 2012/2013 (acre-feet).



Municipal Demand[i]

Thirteen municipal water systems withdrew 1,045 acre-feet of groundwater in 2012 to serve approximately 7,450 residents, 68% of the population of Camp Verde, based on reported connection data. The remaining residents are assumed to use domestic residential wells. Table 2 provides detailed

[i] The term municipal refers to non-irrigation use of water supplied by a privately or publicly owned water company.

statistics for each water provider, while Table 3 shows more summarized data, and Figure 4 shows the location of water provider service areas and the Camp Verde Sanitary District.

Camp Verde Water System (CVWS), Lake Verde Water Company, Verde Lakes Water Corporation, and White Hills Trailer Park are investor-owned utilities regulated by the Arizona Corporation Commission, which issues Certificates of Convenience and Necessity (CC&Ns) granting the right to serve within a specific geographic area and sets rates based primarily on cost recovery while allowing a modest return on investment.

IOUs must annually report total and monthly pumpage and customer delivery data to the ACC, and all Community Water Systems, whether they are private or public, must annually report water use information to the Arizona Department of Water Resources (ADWR) including residential and commercial deliveries, water pumped, and water delivered.[i] The ACC requires that private systems bill customers on the basis of metered deliveries and all but the smallest systems meter water withdrawals. This reported data, not always complete year to year, as well as additional information received from several systems is used in this assessment.

Metered data is key to more accurately estimate per capita water use, separate residential from non-residential water deliveries, track seasonal fluctuations in demand, identify water loss including leaks, and to develop targeted conservation programs.

The largest water provider is the Camp Verde Water System, which pumped almost half the water delivered by water providers in 2012 (Table 2). It operates two separate, non-interconnected systems, the Mongini and the much smaller Verde River Estates. The three Verde Lakes Water Corporation systems pumped a combined total of 222 acre-feet in 2012. Although pumpage data were not available from the Yavapai-Apache Nation, the Nation reported deliveries of 177 acre-feet in 2012, making it the third largest provider in Camp Verde. Other systems serve small subdivisions and mobile home parks.

[i] Community Water Systems are defined under the Clean Drinking Water Act as having 15 year-round service connections or regular service to 25 year round residents.

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Table 2. Recent Camp Verde Community Water System Data.[a]

NAME	YEAR	TOTAL PUMPAGE (AF)[b]	TOTAL DELIVERIES (AF)[b]	SYSTEM LOSS (%)[c]	CONNECTIONS Type	CONNECTIONS No	RESIDENTIAL USE RATES Per Home (AFA)[b,d]	RESIDENTIAL USE RATES Per Capita (gpcd)[b,e]	TOTAL PER CAPITA USE RATE (gpcd)[b,f]	COMMENTS
Buffalo Run MHP	circa 2012	34	NA	NA	Single-family	61	NA		231	Owner estimated that park uses a total 25,000 gpd in the winter and 35,000 gpd in the summer.[g]
	2007	NA	17			5[illegible]	0.29	1[illegible]0	NA	Operator estimated deliveries of 250 gallons per day per household.
Camp Verde Water System - Mongini	2012	504	24[illegible]	14	Single-family	1,264	0.19	68	128	Pumpage and deliveries metered.
			27		Multi-family	19[j]	0.16			
			16[illegible]		Commercial	184	—			
	2011	499	243	15	Single-family	1,200	0.20	71	132	
			29		Multi-family	19[j]	0.18			
			15[illegible]		Commercial	220	—			
	2010	46[illegible]	241	9	Single-family	1,220	0.20	69	121	
			25		Multi-family	19[j]	0.15			
			154		Commercial	199	—			
Camp Verde Water System - Verde Lake Estates	2012	9	8	11	Single-family	46	0.17	62	71	
	2011	8	7	13		47	0.15	53	62	
	201	9	8	11		48	0.17	60	68	
Clear Creek Mobile Home	circa 2012	3	NA	NA	Single-family[h]	22	NA		57	Operator estimated that system pumps an average of 2,500 gallons per day.[g]
	2010	NA	4			50			NA	Operator estimated deliveries assuming 75 gpd per person and 1/3 of units used only on weekends.
	2008									
Lake Verde Water Company	2009	19	18	5	Single-family	68	0.26	110	116	Pumpage and deliveries metered.
	2007	NA	25	NA		NA	NA			Deliveries metered.
	2006	19	29	—		66	0.44	162	120	Pumpage estimated from well electric records; deliveries metered.
Montezuma Heights Water	2012	20	NA		Single-family	42	NA		198	Only well pumpage is metered; includes unknown water use by air park.
	2010	21							206	
Rainbow Acres	2012	16	NA		Commercial[i]	38	—		NA	Only well is metered.
	2011	22				36				
	2010	28				36				
Verde Lakes Water Corp - Clear Creek	2012	79	58	26[k]	Single-family	237	0.20	84	65	Pumpage and deliveries metered; 20 AFA delivered to Still Water
	2006	NA	74	NA		NA	NA			Plateau calculated deliveries based on reported average daily demand.
Verde Lakes Water Corp - Still Water	2012	6[illegible]	51	26[k]	Single-family	255	0.20	83	145	Pumpage and deliveries metered; received 20 AFA from Clear Creek. High calculated system loss and total per capita use rate probably reflect non-use of pumped water with elevated arsenic.
	200[illegible]	0	67	NA		227	0.30	123	NA	Deliveries metered; received water from other system
	2007	46	52			227	0.23	95	86	Pumpage and deliveries metered; probably received water from other system due to elevated arsenic so total per capita use rate likely underestimated.
Verde Lakes Water Corp - Verde Lakes	2012	74	66	11	Single-family	33[illegible]	0.20	81	91	Pumpage and deliveries metered.
	2006	NA	87	NA		NA				Plateau calculated deliveries based on reported average daily demand.
White Hills Trailer Park	circa 2012	47	NA		Single-family	71	NA		275	Operator indicated same amount of use as 2008 annual report.[g]
	2006	47				72			271	Pumpage estimated from well electric records.
Willows Mobile Home Park	2012	21	NA		Single-family	95	NA		92	Only well is metered; total pumpage based on monthly data.[g]
	2011	21								
	2010	21								
Yavapai-Apache Nation	2012	NA	177	NA	Single-family	[illegible]51	NA		293	Includes Middle Verde, Tunlii, Culture, and Castle Crest and Distant Drums water systems; does not include 9 AF for 24 homes and 2 businesses supplied by Camp Verde Water System.[g]
					Commercial	12	—			

Notes:

[a] Data are from ADWR Community Water System reports unless otherwise noted.

[b] AF = acre-feet; AFA = acre-feet/year; gpcd = gallons per capita per day; and NA = data not available or value cannot be calculated based on available data.

[c] System losses were calculated by comparing total pumpage to total deliveries.

[d] Per home use rates were calculated by dividing single-family deliveries by single-family connections. Some connections may be active only during part of the year or inactive (i.e. vacant). As such, actual use by a fully-active household may be somewhat higher. However, Camp Verde Water System connections reportedly only represent active customers.

[e] Residential per capita use rates were calculated assuming 2.15 persons per housing unit based on 2010 US Census data. Persons per housing unit was used rather than persons per household since the former accounts for vacancies. For the Camp Verde Water System, this rate was calculated assuming 2.49 persons per household based on census data and footnote d.

[f] Total per capita use rates were calculated based on total pumpage except for the Yavapai-Apache Nation which is based on total deliveries.

[g] Data from water system owner or operator.

[h] Includes one small retail store based on parcel improvement records.

[i] Includes an assisted care center, schools, club houses, dormitory halls, a recreation center and warehouses based on parcel improvement records.

[j] Includes approximately 164 single-family units based on data provided by owner/operator; units for two facilities were estimated using data from other facilities.

[k] Due to the water transfer between systems this value represents the combined loss of the Clear Creek and Still Water systems.

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Table 3. 2012 Camp Verde Community Water System Data.[a]

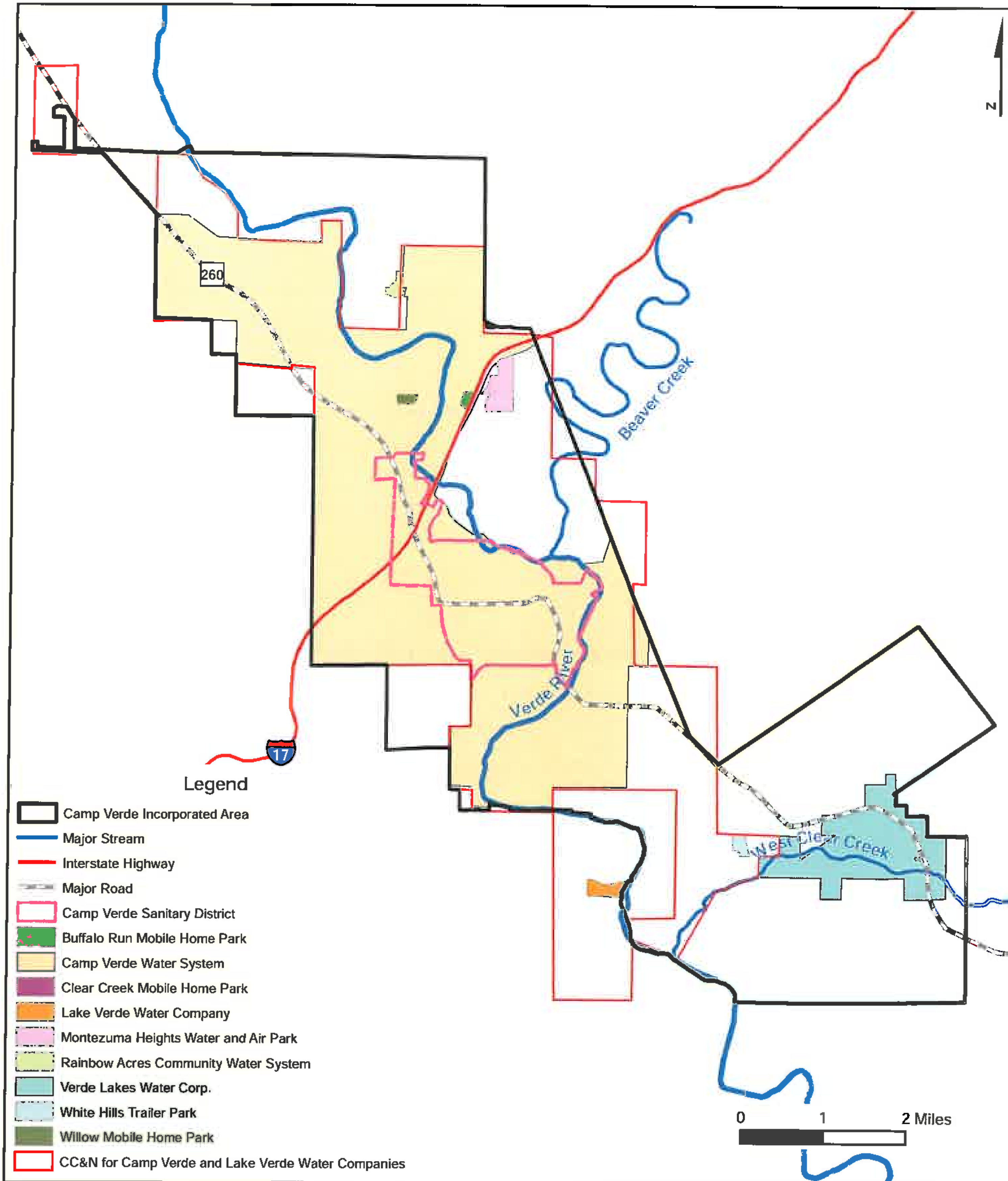
NAME	TOTAL PUMPAGE (AF)	TOTAL DELIVERIES (AF)	SYSTEM LOSS (%)	PER CAPITA USE RATES (gpcd)	
				Residential	Total
Buffalo Run MHP	34	NA			231
Camp Verde Water System - Mongini	504	433	14	68	128
Camp Verde Water System - Verde Lake Estates	9	8	11	63	71
Clear Creek Mobile Home	3	NA			57
Lake Verde Water Company[b]	19	18	5	110	116
Montezuma Heights Water	20	NA			198
Rainbow Acres	16	NA			
Verde Lakes Water Corp - Clear Creek	79	58	26	84	85
Verde Lakes Water Corp - Still Water	69	51		83	145
Verde Lakes Water Corp - Verde Lakes	74	66	11	81	91
White Hills Trailer Park	47	NA			275
Willows Mobile Home Park	21	NA			92
Yavapai-Apache Nation	NA	177	NA		293
Total:	***1,072***[c]				

Notes:

[a] See Table 2A for explanatory notes and comments.

[b] 2009 data.

[c] To calculate total pumpage, assumed Yavapai-Apache Nation total deliveries equaled pumpage.



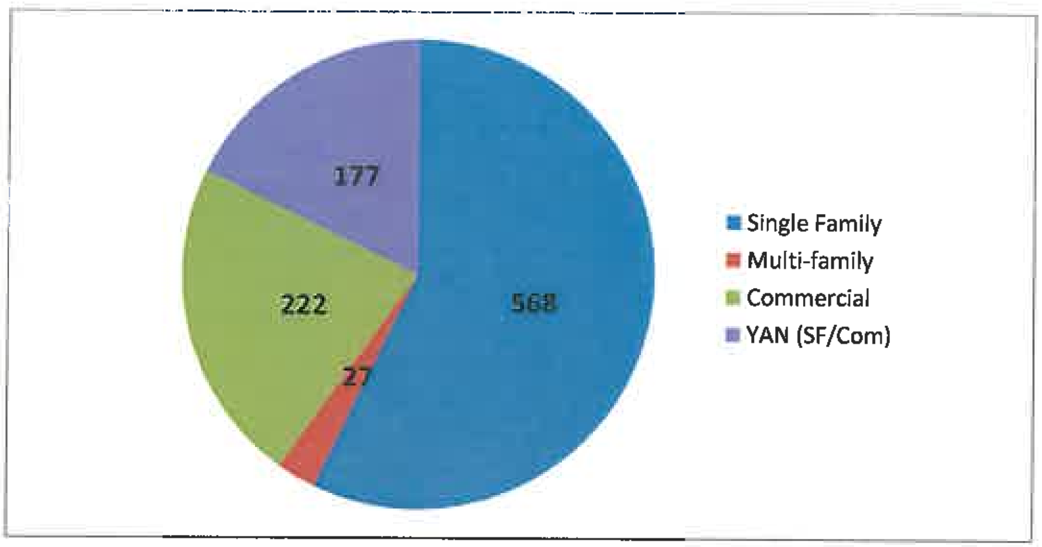
Data Sources: Camp Verde Water System (2013), Verde Lakes Water Corporation (2013), Camp Verde Sanitary District (2013), Yavapai County Assessor (2013), and BOR (2010)

Figure 4. Water and Wastewater Service Areas

As shown in Table 2, most providers serve only single-family residences. CVWS also serves multi-family and commercial accounts while Rainbow Acres serves only commercial users including an assisted care center and dormitory halls. As shown in Figure 5, the largest municipal water use sector is single family residences followed by commercial users. Deliveries by the Yavapai-Apache Nation (YAN) are not separated by type of account, but based on effluent inflow records, suggest about 17% is related to commercial use at the Cliff Castle Casino and Hotel.

Cliff Castle Casino Yavapai-Apache Nation

Figure 5. 2012 Camp Verde Water Provider Customer Use (acre-feet).



Residential per capita use rates are shown for multiple years in Table 2 and summarized for 2012 in Table 3 where data are available. Though there are uncertainties in calculating per capita rates, including the accuracy of population and delivery data, it is a widely used metric to gauge water use efficiency. As shown, these rates vary considerable for some systems from year to year, which may be due in part to the availability of metered data and estimation methods as noted in the comments section of Table 2. Using connection and U.S. Census data to calculate service area population, residential gallon per capita per day (gpcd) rates ranged from 68 to 110 in 2012 with a weighted residential average of the six systems shown on Table 3 of 74 gpcd. These use rates are relatively low, significantly lower than residential rates in Sedona but comparable to those reported in Payson and Clarkdale.

This low residential rate of use may be due to various factors including replacement of old fixtures overtime, more water efficient new homes, desire for less landscape maintenance, economic factors, and water rates. For example, Camp Verde Water System's relatively high water rates (due primarily to a high monthly service charge of $23.75), likely encourages conservation and low use rates. The average monthly water bill of a Camp Verde Water System customer ($40.50) is compared to other northern Arizona communities in Figure 6. By comparison, a Verde Lakes System customer would pay just $18.50 for the same amount of water as the average CVWS customer.[i] In addition, some residents within the CVWS service area receive ditch association water for landscape irrigation, which is not included in the water provider per capita calculation. While Verde Lakes customers use water at a higher rate (81 to 84 gpcd), which might be related to the lower price of water, they also do not receive ditch association water for outdoor use as some CVWS customers do.

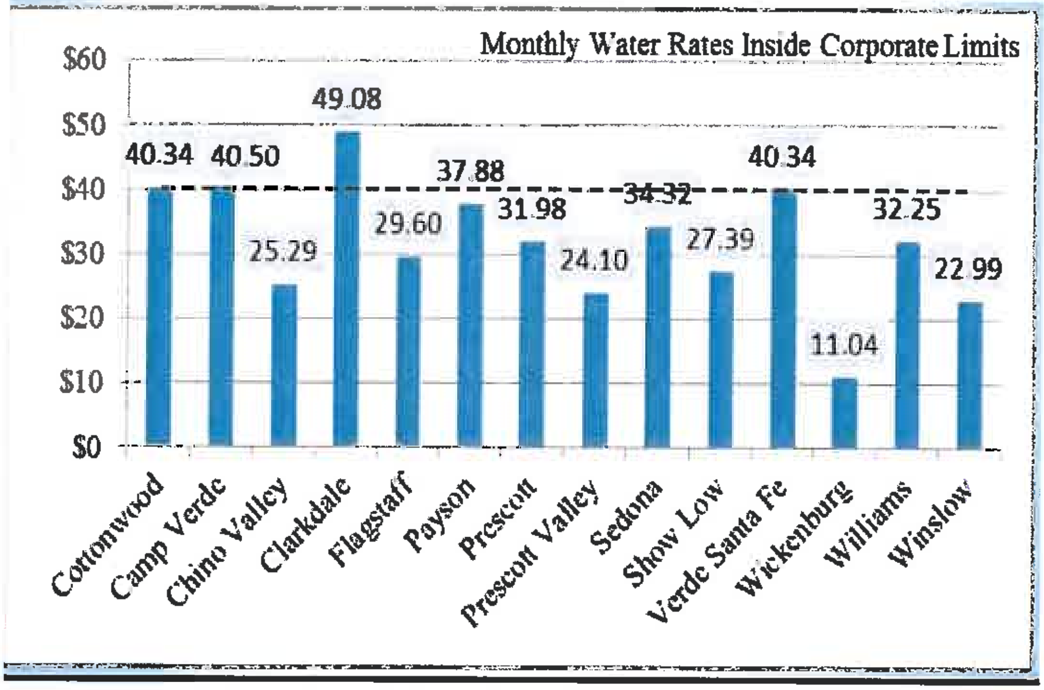
Large residential outdoor water use served by surface water diversions represents some uncertainty in identifying actual use rates. If this water were included in the per capita calculation for CVWS customers the use rate would be significantly higher

Total per capita use rates include both residential and non-residential demand and for the larger systems ranged from 85 to 145 with a weighted average of 138 gpcd for all systems. Some of the small mobile home parks (e.g., Buffalo Run MHP and White Hills Trailer Park) show relatively high total per capita rates, but this seems due primarily to methods of estimating deliveries and not necessarily indicative of actual use rates as noted in the comment column of Table 2. The Yavapai-Apache Nation rate is the highest, in large part due to the casino and hotel in relation to the service area population.

The percentage of system water losses are also shown on Tables 2 and 3 and are typically determined by calculating the difference between total pumpage and the volume of water delivered to customers. This difference can be due to a number of factors including actual loss due to transmission and distribution main leaks, pressure problems, or underreporting delivery meters. In the Camp Verde area some "losses" may be unusable groundwater with elevated arsenic levels. Understanding the source of water loss improves the accuracy of water use data and reduces the amount of non-revenue water i.e. water that the utility pays to pump, treat and deliver that is not billed. Addressing "real loss" i.e., leaks, results in less water needed to be pumped from the aquifer and leaks can result in expensive infrastructure damage. The total volume of system loss, of those with loss data in 2012, was 120 acre-feet.

[i] Verde Lakes systems charge a base rate of $8.75 to $8.95 with a 3-tier increasing block rate, but the unit prices are low at each tier.

Figure 6. Average Monthly Water Rates Among Selected Northern Arizona Communities (based on 5,000 gallons/month use).



Source: City of Cottonwood Water and Wastewater Rate Study Presentation July 7, 2013.

Interior/Exterior Residential Demand

Understanding the relative amount of water used indoors and outdoors is critical to assess water conservation potential and develop corresponding programs that save the most water. Water use varies seasonally, due primarily to increased residential outdoor water use during the warmer months but also to seasonal residents and tourism that affects non-residential demand.

Residential indoor and outdoor use can be estimated by using monthly water demand data. Assuming that due to the area's cool winter climate, the month of lowest winter use is indicative of year round monthly indoor water use, any use above that is due primarily to outdoor use. Using this method, outdoor demand accounted for approximately 25% of residential demand within the CVWS service area and 42% in the Verde Lakes Water Corporation System in 2012, with a median of 30% overall (Table 4). This provides a general approximation. While it is a widely used method, it tends to overestimate indoor demand since likely some water is used outdoors even in the coldest winter month.

Month to month variability is shown in Figure 7. As expected, although the magnitude of outdoor use varies between the two systems, the seasonal pattern is comparable with outdoor use increasing in April and continuing through the hot summer months with a decline in September as the monsoon rains wind down and increasing again in October as drier, warm weather returns. During the hottest and driest time of year outdoor water use can account for as much as 40 to 65% of total residential demand.

Table 4. Estimated Percentage of Exterior Water Use by Homes Served by Two Camp Verde Community Water Systems.[a]

NAME	YEAR	LOWEST WATER USE MONTH	HIGHEST WATER USE MONTH	PERCENTAGE OF RESIDENTIAL WATER DEMAND FOR EXTERIOR USE[b]
Camp Verde Water System[c]	2012	December	June	25
	2011	February	August	20
	2010	December	June	22
Verde Lakes Water Corporation	2012	December	July	42
	2011	January	June	35
	2010	February	June	42
			Minimum	**20**
			Median	**30**
			Mean	**31**
			Maximum	**42**

NA = Data not available

Notes:

[a] Data from water providers, Community Water System Reports filed with the Arizona Department of Water Resources and annual reports filed with the Arizona Corporation Commission.

[b] Estimated by assuming that water is only used for interior purposes during the lowest water use month. Uses above this base during other months therefore represent exterior use. Percentages were calculated by adding all residential water deliveries above the base and dividing by the total annual residential water delivery.

[c] Ditch companies supply portions of the Camp Verde Water System service area with surface water for irrigation. This may explain. in part. the lower exterior water use estimated for homes served by that system compared to Verde Lakes.

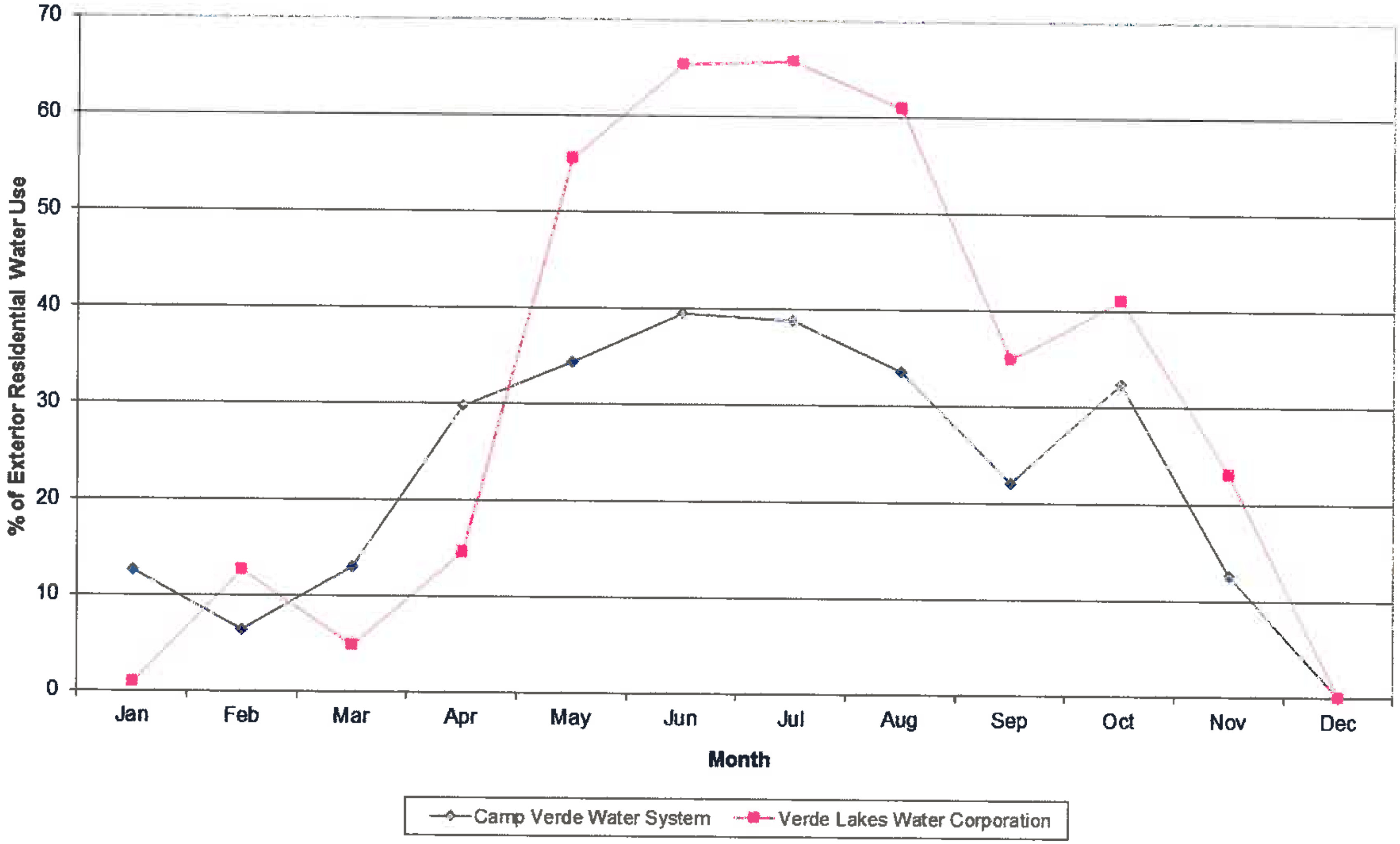
Unmetered Well Demand

Non-water system wells, or unmetered wells consist of domestic wells typically equipped with pumps with a maximum capacity of 35 gpm, and larger wells that serve domestic, commercial, and industrial use. Some wells may serve multiple types of uses or several homes through a well share agreement. There are approximately 1,740 residential wells, 1,608 of which are in use to meet all or part of household demand in Camp Verde, six large non-residential water users, and 87 wells that serve a variety of other non-residential uses both within and outside of water provider service areas. Based on the estimation methods discussed in the following sections, together these account for over 500 acre-feet, a little more than half the water served by water systems.

Residential Wells

Residential uses may include livestock watering and irrigation, in addition to typical household uses. These wells serve approximately a third of the population of Camp Verde and represent an important water demand sector. Because they are exempt from metering and reporting requirements, demand must be estimated using proxies like housing age to estimate interior demand and aerial imagery and comparable metered use to estimate exterior demand.

Figure 7. Estimated Percentage of Residential Exterior Water Use Served by Camp Verde and Verde Lakes Water Companies During 2012.



Western Resource Advocates developed a methodology that has been applied in the Sierra Vista area that serves as a first approximation of domestic well demand.[5] This approach was modified in a subsequent study by Plateau Resources, LLC and used to estimate demand in this assessment.[6] This method assumes that interior use is primarily dependent on housing age and associated plumbing fixture efficiency and that the percentage of "typical" residential exterior use mirrors that within water provider service areas. Other exterior use by domestic residential wells, referred to in this assessment as "Large Outdoor Water Use" is discussed later in this section.

Both unmetered wells outside of service areas and within the boundaries of service areas were evaluated. It is assumed that residential wells outside of water provider service areas use wells for both indoor and outdoor use although some may also receive ditch association water for outdoor irrigation. Within a water provider service area, well owners may use their wells for all or only part of their water needs. To determine how these wells are used, a phone survey of well owners was conducted in November 2013 and the results of the survey were extrapolated to the entire population of well owners within service areas. As shown in Table 5, almost half of well owners use their wells for all their needs while 18% use wells for interior use only and 16% use their wells only for exterior use. Twelve percent of the wells were found to not be in use.

Interior Demand

Recent studies have evaluated changes in indoor water use across the United States and each notes the importance of high-efficiency fixtures in reducing the water demands of newer homes.[7] For this assessment, per capita indoor water use was assumed to be higher in homes constructed before 1997 and lower in newer homes, based on fixture use rates reported by AWWA in 1999 and Aquacraft in 2011.[i] AWWA's data are considered representative of the current indoor water use of pre-1997 homes in Camp Verde, although certainly some older fixtures have been replaced with more efficient ones. The Aquacraft study looked at the indoor water uses of 1,000 homes built after 2001 in 9 cities and are considered representative of the current indoor water use in newer homes. Although these studies were of homes served by water providers, indoor use is assumed to be comparable to that of well owners since most indoor use is non-discretionary (i.e. most people do the same things with water inside their home – wash clothes, flush toilets, take showers). Findings from these studies, which measured individual fixture use, are shown in Table 6. As shown, AWWA also found that retrofitting homes can reduce indoor use by 15-30% depending on fixture/home age, which can reduce interior use to 41 gpcd.

The location of areas served by unmetered residential wells is shown on Figure 8. Outside of water provider service areas, parcels served by unmetered wells, with housing age data, are shown. It was not possible to determine the specific parcel served by an unmetered domestic well within service areas

[i] The use of 1997 to distinguish homes with higher and lower water use fixtures reflects passage of the U.S. Energy Policy Act (EPA) in 1992. This legislation mandated that only water efficient plumbing fixtures (toilets, showerheads, and faucets) could be manufactured from January 1994 onward. Accounting for the use of existing plumbing stocks, it was probably not until 1995 or 1996 that only lower water use fixtures were being installed in new homes and older fixtures in existing homes began to be replaced with more efficient models. In the AWWA (1999) study, data on indoor water use was collected between May 1996 and March 1998 from 1,200 existing homes in 14 towns and cities.

because well location data is only available to the nearest 10-acre section. Without the specific parcel data, housing age cannot be determined. For this reason the location of different aged housing on parcels served by wells outside service areas is shown on Figure 8 while the approximate location of domestic wells within service area boundaries is mapped. As shown, most homes, particularly in the central and northern domestic well areas are older and likely contain more inefficient water fixtures.

Table 5. Results from 2013 Phone Survey of Camp Verde Residential Well Owners Within Water Provider Service Areas.[a]

WELL USE CATEGORY	RESPONDENTS[b,c]	
	Number	Percentage
Well supplies water to one home for both interior and exterior use	28	49%
Well supplies water to one home for interior use only	10	18%
Well supplies water to one home for exterior use only	9	16%
Well not in use[d]	7	12%
Well supplies water to multiple homes for both interior and exterior use[e]	3	5%
Total	***57***	***100%***

Notes:

[a] The survey was conducted during November 2013 by first locating all completed water supply wells in the service areas using current ADWR well registration records and removing the non-residential wells based on well owner name and/or reported well use. The remaining residential well owners were then matched, if possible, to parcel owners in the area using current assessor records. Finally, any matched parcel owners were contacted using phone numbers listed on-line or in well registration documents.

[b] Does not include five well owners who were successfully contacted but either (1) refused to answer the survey; (2) indicated that there was no well on their property; or (3) could not understand the survey questions.

[c] Several well/parcel owners were not successfully contacted, either because no phone number was found on-line, the number found was no longer active, or no one answered the call. Active numbers were tried at least twice on different days if unsuccessful the first time.

[d] Four wells were determined not in use based on review of recent aerial imagery and parcel improvement records.

[e] Includes two shared wells that each serve two homes and a third shared well that serves an undetermined number of homes.

Table 6. Estimated Rate of Interior Water Use by Residential Camp Verde Well Owners.

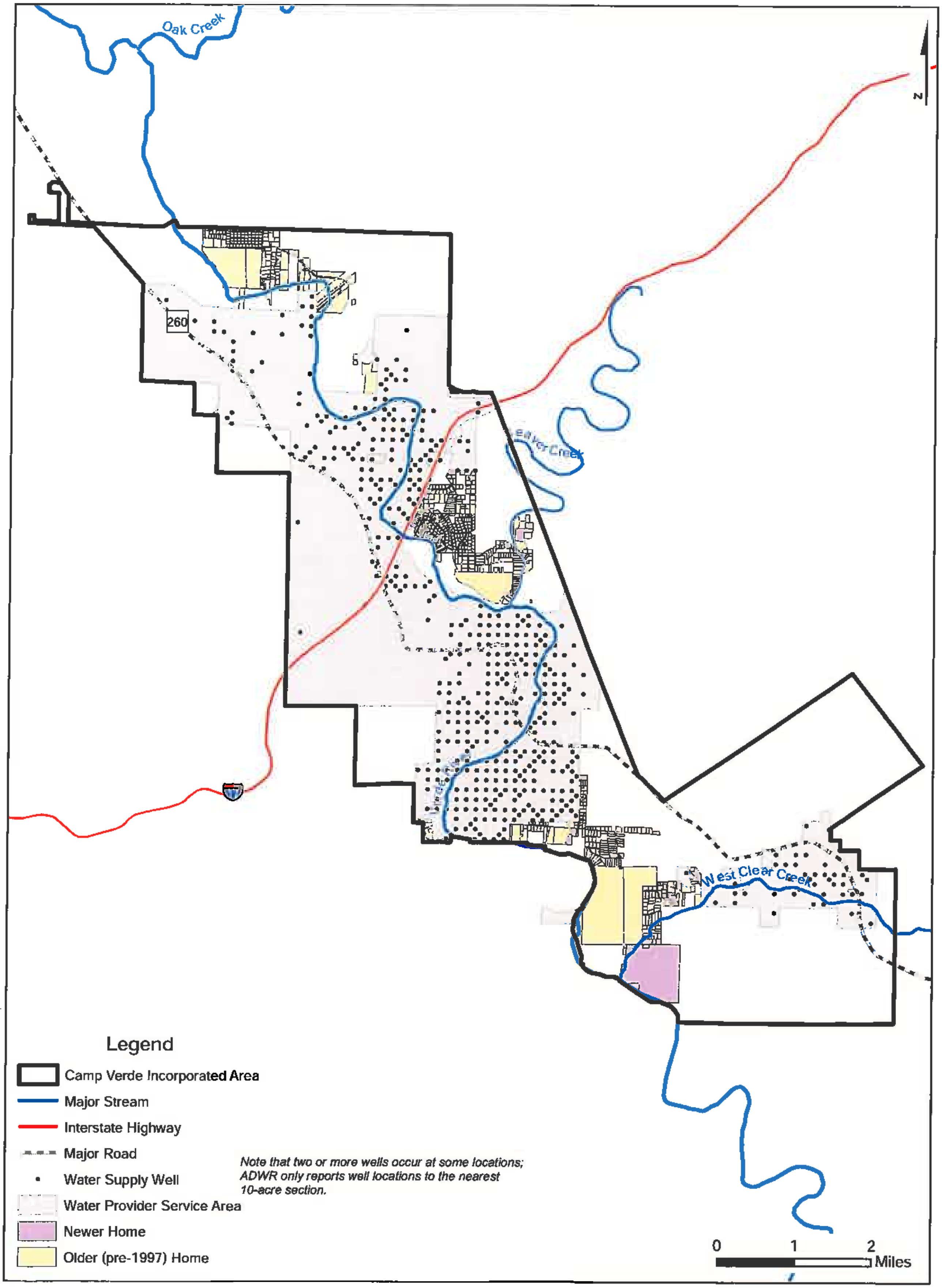
HOME AGE	AVERAGE DAILY INTERIOR WATER USE (gallons per home)[a]									Daily Per Capita Use	Annual Interior Water Use (AFA)[b]
	Toilets	Clothes Washer	Showers	Faucets	Leaks	Other	Bathtubs	Dish Washer	Total		
Before 1997	46.1	37.4	28.8	27.2	23.7	3.9	3.0	2.5	172.5	69.3	0.19
1997 to present	23.4	24.7	25.5	21.5	16.8	2.6	3.0	1.7	119.2	47.9	0.13
Retrofit existing homes with high efficiency fixtures[c]	19.1	21.9	22.4	18.9	10.5	1.5	6.5	1.9	102.6	41.2	0.11

Notes:

[a] Assumes 2.49 persons per household based on 2010 U.S. Census data for the study area. Fixture rates were taken from AWWA (1999) for pre-1997 homes and from Aquacraft (2011a,b) for newer and retrofitted existing homes.

[b] Calculated by multiplying the total average daily interior water use by 365 and converting to acre-feet per year (AFA).

[c] Includes 1.28 gallon per flush toilets, 12 to 15 gallons per load clothes washers, 1.5 gallon per minute (gpm) shower heads and 0.5 gpm sink aerators.



Data Sources: see Figures 2 and 4

Figure 8. Unmetered Residential Well Use Inside and Outside of Water Provider Service Areas

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Typical exterior demand

Exterior use is harder to quantify because it can vary considerably from service area to service area. Because it is not possible to identify typical outdoor water use at residences by remote imagery or even field investigation, we assume that the percentage of "typical" outdoor water use is comparable to that of those served by water providers. This assumes that well users are as mindful of exterior water use as those that pay a water bill since they pay energy, well maintenance, and other costs associated with the volume of ground water pumped. In addition, aerial imagery from May 2013 was reviewed to identify large (non-typical) outdoor residential water use, which is discussed below.

Table 7 shows the estimated range of typical exterior water use of Camp Verde well owners assuming that 20 to 42% of the total residential demand is for outdoor purposes, as it is for water provider customers. It is estimated that older homes use about .05 to .14 acre-feet (16,300 to 45,600 gallons) per household annually and newer homes use .03 to .09 acre-feet (9,800 to 29,300 gallons).

Table 7. Estimated Rate of Total Residential Water Use by Camp Verde Well Owners (excluding large outdoor water use).

HOME AGE	ANNUAL WATER USE PER HOUSEHOLD (AFA)[a]		
	Interior[b]	Exterior[c]	Total
Before 1997	0.19	0.05 to 0.14	0.24 to 0.33
1997 to present	0.13	0.03 to 0.09	0.16 to 0.22

Notes:

[a] Assumes 2.49 people per household based on 2010 U.S. Census data for the study area; AFA = acre-feet per year.

[b] See **Table 5** for further information on interior residential water use rates.

[c] Exterior water use rates were calculated by assuming that 20 to 42% of the total annual residential water demand is for outdoor purposes. See **Table 3** for further information on the percentage of exterior water use by homes in the Camp Verde area.

Total unmetered residential demand

The number of wells and volume of use both outside and inside water provider service areas is shown in Table 8 based on the estimated household water use in Table 7. It is estimated that outside water provider service areas, the typical residential water use by well owners in the 440 older homes ranges from about one-quarter to one-third acre-feet per year (86 to 118 gpcd), while the 200 newer homes use from one-sixth to a little less than one-quarter acre-feet per year (57 to 79 gpcd). Unfortunately, it was not possible to identify housing age on parcels within water provider service areas, so only the combined use estimate is shown on Table 8. Somewhat surprisingly, many wells are in use within water provider service areas. The total volume of typical water use attributable to domestic wells in Camp Verde is estimated to range from 273 to 465 acre-feet a year.

Table 8. Potential Unmetered Residential Well Use in Camp Verde During 2013[a] (excluding large outdoor water use).

CATEGORY	ESTIMATED NUMBER IN STUDY AREA	USE COEFFICIENT		ESTIMATED QUANTITY OF USE (AFA)
		Value[b]	Units	
Outside Water Provider Service Areas				
Older (pre-1997) homes	440[c]	0.24 to 0.33	AFA/ household	106 to 145
Newer homes	200[c]	0.16 to 0.22		32 to 44
Subtotal	***640***			***138 to 189***
Inside Water Provider Service Areas				
Well supplies water to one home for both interior and exterior purposes	539[d]	0.16 to 0.33	AFA/well	86 to 178
Well supplies water to one home but only for interior purposes	198[d]	0.13 to 0.19		26 to 38
Well supplies water to one home but only for exterior purposes	176[d]	0.03 to 0.14		5 to 26
Well not in use	132[d]	0.0		0
Well supplies multiple homes	55[d]	0.32 to 0.66[e]		18 to 36
Subtotal	***1,100***			***135 to 276***
Total	***1,740***			***273 to 465***

Notes:

[a] Assumes all houses are occupied; Census data indicate that the vacancy rate in Camp Verde was 13.5% during 2010 (World Media Group, 2013).

[b] Residential use rates are from **Table 6**. Ranges are used when home ages were not readily available.

[c] Home construction dates are from the Yavapai County (2013) assessor.

[d] Approximately 1,100 potential residential wells were identified in the service areas using ADWR's well's database. To determine whether these wells were actually in use, and if so how, the survey results listed in **Table 4** were considered representative of residential wells in the service areas. Percentages from the survey were multiplied by the total number of potential residential wells.

[e] Three well shares were identified during our survey - two each serve two homes and the other serves an undetermined number of homes. Based on this information, it was assumed for this study that each well share serves approximately two homes. The estimated per household residential use rate was, therefore, multiplied by 2 to represent the total use by each well.

Non-residential Wells

In addition to residential use, there are non-residential well users in Camp Verde as shown in Tables 9 and 10. Large non-residential users include four mines, Camp Verde School District and the Out of Africa Wildlife Park. Large users are defined as those using at least 10 acre-feet of water a year, either reported or assumed based on type of facility. Only three large users provided water use data for a total of almost 100 acre-feet in 2012.

Table 9. Large Non-Residential Camp Verde Water Users Not Served by Water Providers.[a]

CATEGORY	NAME	REPORTED WELL USE DURING 2012 (AFA)[b]
Mines	Arizona Jobsite	NA[d]
	Cemex[c]	11
	Salt River Materials Group (Verde Gypsum)	NA[d]
	Yavapai-Apache Sand and Rock Inc.	NA[d]
School	Camp Verde School District	74
Wildlife Park	Out of Africa	13
	Total:	***98***

Notes:

[a] Other non-residential water uses not served by Camp Verde water providers are listed in **Table 10**.

[b] Metered values reported by the water users during summer 2013; AFA = acre-feet per year.

[c] Formerly Superior Materials, United Metro and Rinker Materials.

[d] Declined to provide data.

Of those reporting, the school district is the largest water user. Use consists of play and sports field irrigation, other landscape irrigation, and food service and domestic use by the elementary, middle, and high school complex. Aerial views of the complex show a blotchy appearance in all fields, indicative of irrigation inefficiency i.e. some areas may be irrigated sufficiently while others are not. School grounds and parks in many places in Arizona are often found to be deficit irrigated overall.

Camp Verde High School

The mines produce aggregate, sand and gravel, asphalt, and concrete and are located in the northern part of Town near the River. Aggregate washing to sort materials according to size accounts for most of the water use. Water is also used to produce products like concrete, to control dust, to wash vehicles, equipment and the inside of mixer drums, to cool equipment and material, and for domestic purposes.[8]

Out of Africa Tiger Splash

Water use at Out of Africa is for animal care and related activities like the tiger splash pool, domestic purposes, concessions and a small amount of landscaping. Future planned expansion of activities at the park may result in additional types of water use.

Other non-residential wells were identified using ADWR well records, Yavapai County parcel files and ADEQ public water system files. This information was compared to Camp Verde Water System non-residential customer records to avoid double counting. Water use was estimated using several studies described in Table 10. The studies provide estimates based on type of use, square footage, and numbers of vehicles and are first level approximations. These uses may account for about 47 acre-feet of water a year and consist of churches, light manufacturing, offices and retail, auto service shops, warehousing, and other users both outside and inside water provider service areas.

The largest single user is the auto sales facility. Based on the cited study, an estimated 7.9 acre-feet of water may be used, presumably for mainly vehicle washing and service. Auto service shops (repair and service stations) are the largest use category, estimated to use 16.9 acre-feet of water annually or about 1.3 acre-feet per facility.

Table 10. Unmetered Non-Residential Camp Verde Well Use in 2012.[a]

TYPE OF USE[b]		USE METRIC			UNIT TOTAL[d,e]	ESTIMATED QUANTITY OF USE (AFA)
Category	Number in Study Area	Value	Units	Source[c]		
Outside Water Provider Service Areas						
Auto Sales	1	3.84	gal/ft²/mo	I	56,208 heated square ft	7.9
Church	4	1.26	gal/ft²/mo	I	36,252 heated square ft	1.7
Clubhouse	1	5.16	gal/ft²/mo	I	1,208 heated square ft	0.2
Light Manufacturing	5	0.87	gal/ft²/mo	I	24,153 heated square ft	0.8
RV Park	1	30	gal/vehicle/day	II	30 vehicles	1.0
Office Building	1	5.39	gal/ft²/mo	I	1,106 heated square ft	0.2
Retail	1	0.11	gal/ft²/day	III	464 square ft	0.1
Service Shop	8	12.47	gal/ft²/mo	I	21,240 heated square ft	9.8
School (private)	1	4.57	gal/ft²/mo	I	1,693 heated square ft	0.3
Warehousing	16	0.76	gal/ft²/mo	I	47,637 heated square ft	1.3
					Subtotal	***23.3***
Inside Water Provider Service Areas						
Church	3	1.26	gal/ft²/mo	I	8,675 heated square ft	0.4
Clubhouse	3	5.16	gal/ft²/mo	I	6,773 heated square ft	1.3
Convenience Store	1	7.92	gal/ft²/mo	I	785 heated square ft	0.2
Heavy Manufacturing	1	1.20	gal/ft²/mo	I	5,771 heated square ft	0.3
Light Manufacturing	1	0.87	gal/ft²/mo	I	4,150 heated square ft	0.1
Medical	4	3.98	gal/ft²/mo	I	1,058 heated square ft	0.2
Municipal	1	15.19	gal/ft²/mo	I	7,110 heated square ft	4.0
Office Building	8	5.39	gal/ft²/mo	I	7,108 heated square ft	1.4
Restaurant	1	25.52	gal/ft²/mo	I	2,300 heated square feet	2.2
Retail	7	0.11	gal/ft²/day	III	13,038 square ft	1.6
RV Park	2	30	gal/vehicle/day	II	100 vehicles	3.4
Service Shop	5	12.47	gal/ft²/mo	I	15,498 heated square ft	7.1
Warehousing	11	0.76	gal/ft²/mo	I	60,421 heated square ft	1.7
					Subtotal	***23.8***
					Total	***47.1***

Notes:

[a] Does not include federal lands. See **Table 8** for large non-residential water uses not served by SVS water providers.

[b] Identified using county assessor parcel files and ADWR well records; verified using ADEQ (2013) public water system files, Internet research, and water provider data on which parcels/uses they currently serve. Not listed in table if found to be out of business.

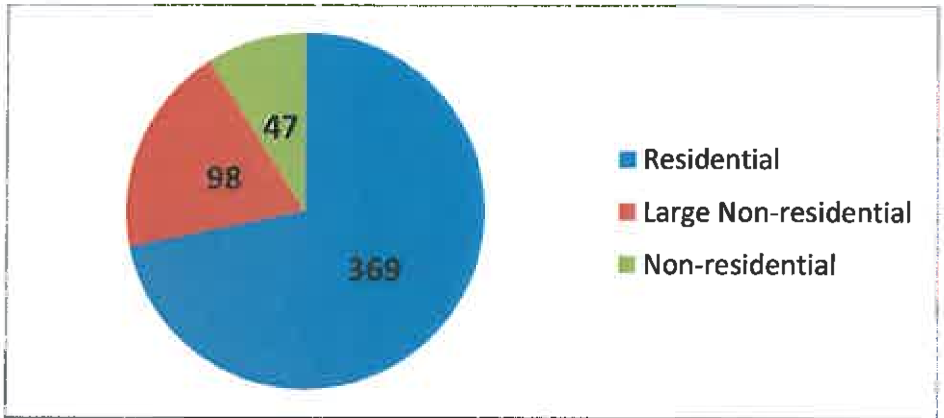
[c] I = Morales and Heaney (2011); II = USFS (2007); and III = AWWA (2000).

[d] Square footage from county assessor and verified by aerial imagery; average number of vehicles reported by operator and verified with Google images.

[e] Heated square footage calculated by applying an adjustment factor in Morales and Heaney (2011) to assessor data.

Total annual unmetered well use is estimated at 514 acre-feet, shown by type of use in Figure 9. Residential is the largest use category by far. The amount of water used by large non-residential wells is more than that shown due to non-reporting by several facilities.

Figure 9. Unmetered Well Use in Camp Verde in 2013 (acre-feet).



Note: Average of use ranges shown

Large Outdoor Water Use

Ditch associations deliver water to members within the town limits for agricultural and landscape irrigation. These include the 17-mile long Verde Ditch and the smaller O.K., Eureka, and Diamond S Ditch associations. Use of surface water is pursuant to a water rights system that has been in place for over a century.[i] Large outdoor water use includes watering of orchards, gardens, pasture, turf, and trees (Table 11). These uses are in addition to typical outdoor water use previously estimated for water company customers using the low water use month method that was applied to derive the domestic well demand estimate.

For this assessment, it is assumed that watering in excess of 0.3 acres but less than two acres is a large outdoor residential water use. An exception is inclusion of turf and landscaped areas larger than two acres that were non-agricultural. USGS acreage estimates, further verified by Plateau Resources, were used to identify and quantify water consumption of these areas. Outside the scope of this study is the difficult quantification of how much of the irrigation losses associated with large outdoor water uses and agriculture return to the river or aquifer.

Large outdoor water uses in Verde Ditch area; November 2013

[i] A court determination, the Verde Ditch Decree (1909), proportionately divided ownership and maintenance responsibilities of the Verde Ditch and stipulates that water in the lower portion of the ditch be one third of the flow of the upper portion to ensure adequate supplies of water for all users.

Table 11. Large Outdoor Water Uses in 2013.[a,b]

TYPE OF USE				USE COEFFICIENTS			CROP CONSUMPTIVE USE (AFA)[e]	IRRIGATION LOSSES (AFA)[f]	TOTAL WATER DEMAND (AFA)[g]
Category	Irrigation Method	Number of Areas Mapped	Total Irrigated Area (acres)	Watering Requirement (ft/yr)[c]	Irrigation Efficiency[c]	Water Demand (ft/yr)[d]			
Within Areas Supplied by Surface Water Diversions[h]									
Apples	Flood	2	2.2	3.6	50%	7.2	8	8	16
Grapes	Drip	2	0.4	2.3	90%	2.6	1	0	1
Pasture[i]	Flood	32	37.5	3.1	50%	6.2	116	116	232
Turf/Landscaping[j,k]	Flood	468	700.1	3.4	50%	6.8	2,380	2,380	4,760
	Sprinkler	1	2.4		80%	4.3	8	2	10
Vegetables	Drip	3	3.6	1.7	90%	1.9	6	1	7
	Flood	1	1.0		50%	3.4	2	2	4
	Subtotals:	***509***	***747.2***				***2,521***	***2,509***	***5,030***
Outside of Areas Supplied by Surface Water Diversions[h]									
Pasture[i]	Flood	4	5.8	3.1	50%	6.2	18	18	36
Turf/Landscaping[j,k]	Flood	87	57.6	3.4	50%	6.8	196	196	392
	Sprinkler	3	3.2		85%	4.3	11	2	13
	Subtotals:	***94***	***66.6***				***225***	***216***	***441***
	Totals:	***603***	***813.8***				***2,746***	***2,725***	***5,471***

ft/yr = feet per year; AFA = acre-feet per year.

Notes:

[a] USGS initially identified acreages using 2010 aerial photography and verified through 2010 and 2013 summer field visits. Plateau further verified by analysis of high resolution aerial photography flown on May 28, 2013. Does not include previously irrigated areas that appeared on the 2013 imagery to be discontinued.

[b] Includes irrigated areas that each cover less than 2.0 acres.

[c] Average watering requirements from USDA (2013) and ADWR (2000); USGS (2013) provided typical irrigation efficiencies.

[d] Calculated by dividing the watering requirement by the irrigation efficiency.

[e] Calculated by multiplying the total irrigated area by its watering requirement.

[f] Based on the total irrigated area, watering requirement and irrigation efficiency; can include evaporation, irrigation return flows and percolation.

[g] Calculated by adding crop consumptive use and irrigation losses.

[h] See **Figure 3b** for map showing which irrigated lands are within and outside of areas supplied by surface water diversions.

[i] Includes about 4 acres of fallow lands possibly cropped later in the year by flood irrigation plus about 2 acres of lands that appeared partly cropped on the May 2013 imagery and were assumed 75% active.

[j] Includes grass adjacent to homes and horse properties plus mixed grass and orchards. Also includes about 29 acres not previously identified by USGS that Plateau assumed were flood irrigated turf. About 129 acres of these lands appeared partly cropped on the May 2013 imagery and were assumed 75% active.

[k] Does <u>not</u> include smaller (typically less than 0.3-acre) lawns that were unidentified by USGS but observed by Plateau around as many as 100 homes on the May 2013 imagery. For purposes of this study, these smaller lawns are considered incidental exterior uses already accounted for in the metered and unmetered residential use rates. Also does not include about 10 acres of fields irrigated by the Camp Verde School District which provided Plateau with their metered well use (see **Table 7**).

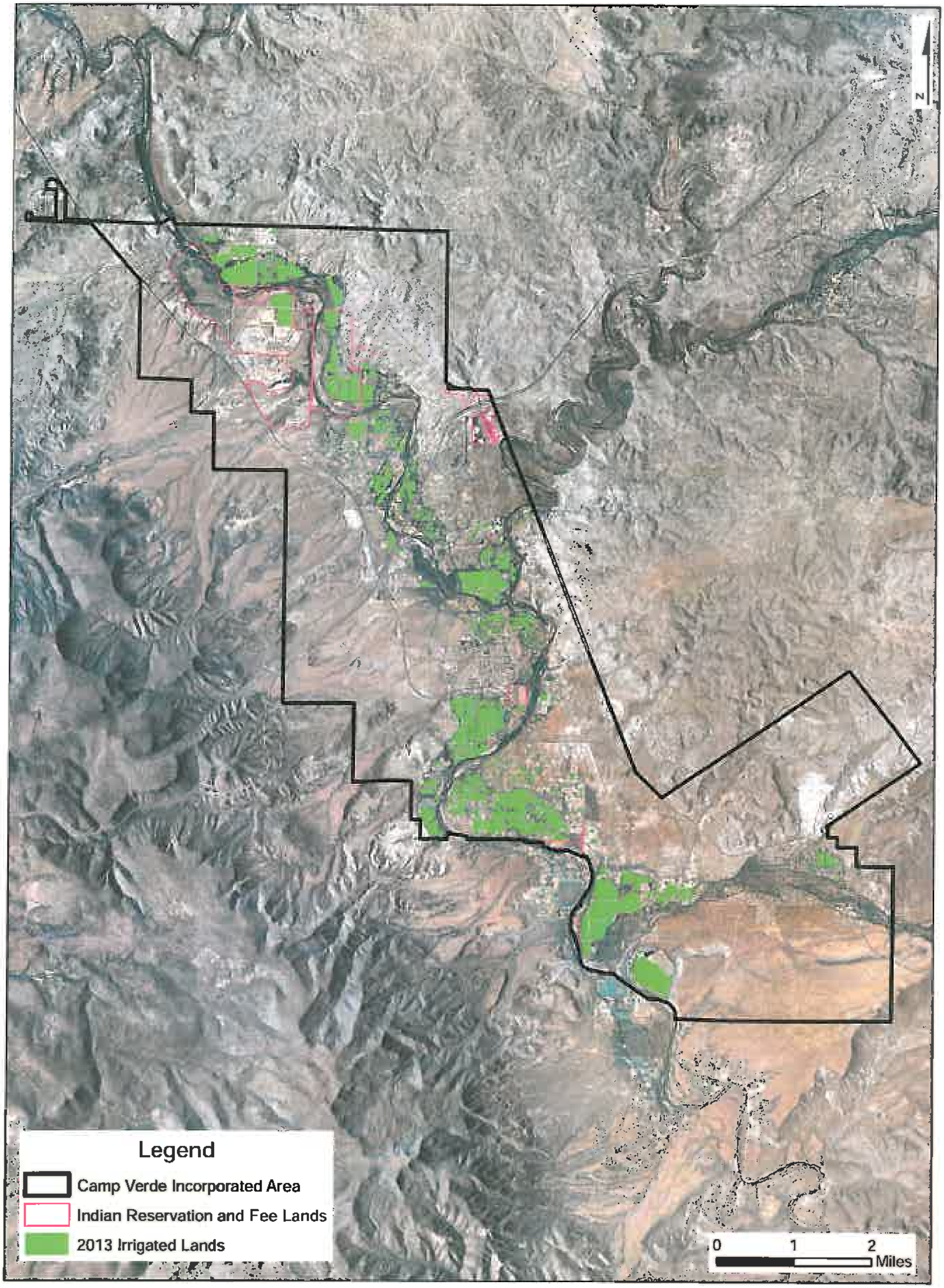
The Central Yavapai Highlands Water Resources Management Study, as well as others, have assumed 100% return, but this is highly unlikely and a needed subject for future study. To generate a rough estimate of demand (i.e. the amount applied to the land), losses associated with irrigating crops and landscapes were calculated based on the total irrigated area, watering requirement and irrigation efficiency. Irrigation losses can include evaporation, irrigation return flows (surface runoff) and percolation to the water table.

Fort Verde State Park - parade grounds and landscape irrigated with well water

The location of all irrigated lands in 2013 is shown on Figure 10. Figure 11 includes ditch association boundaries and separates irrigated lands into agricultural (> 2 acres in size) and large outdoor use. As shown, concentrations of large outdoor use are found in ditch association lands in the southern part of Verde/Verde West, within Jordan Meadows, in the northern part of Diamond S and the eastern part of Pioneer. There are almost 814 acres of large outdoor irrigated lands, most of which are located within areas supplied by ditch associations. This study did not attempt to identify the source of water but it could be assumed that most of the water used within ditch association areas is delivered by a ditch association and areas outside by well water.

Total annual large outdoor water demand was estimated at 5,471 acre-feet with 5,030 acre-feet of demand within areas served by ditch associations and 441 acre-feet outside these areas.[i] Ninety-four percent of this irrigation is for turf and landscaping purposes with an associated loss of 2,580 acre-feet assuming the irrigation efficiencies in Table 11. The number of irrigated acres outside ditch association areas is evenly distributed between agricultural and large outdoor water uses, each with about 65 acres.

[i] See notes to Table 11 for further information about outdoor water use estimates



Data Sources: USGS (2013) and Plateau review of May 2013 aerial photography

Figure 10. 2013 Irrigated Lands

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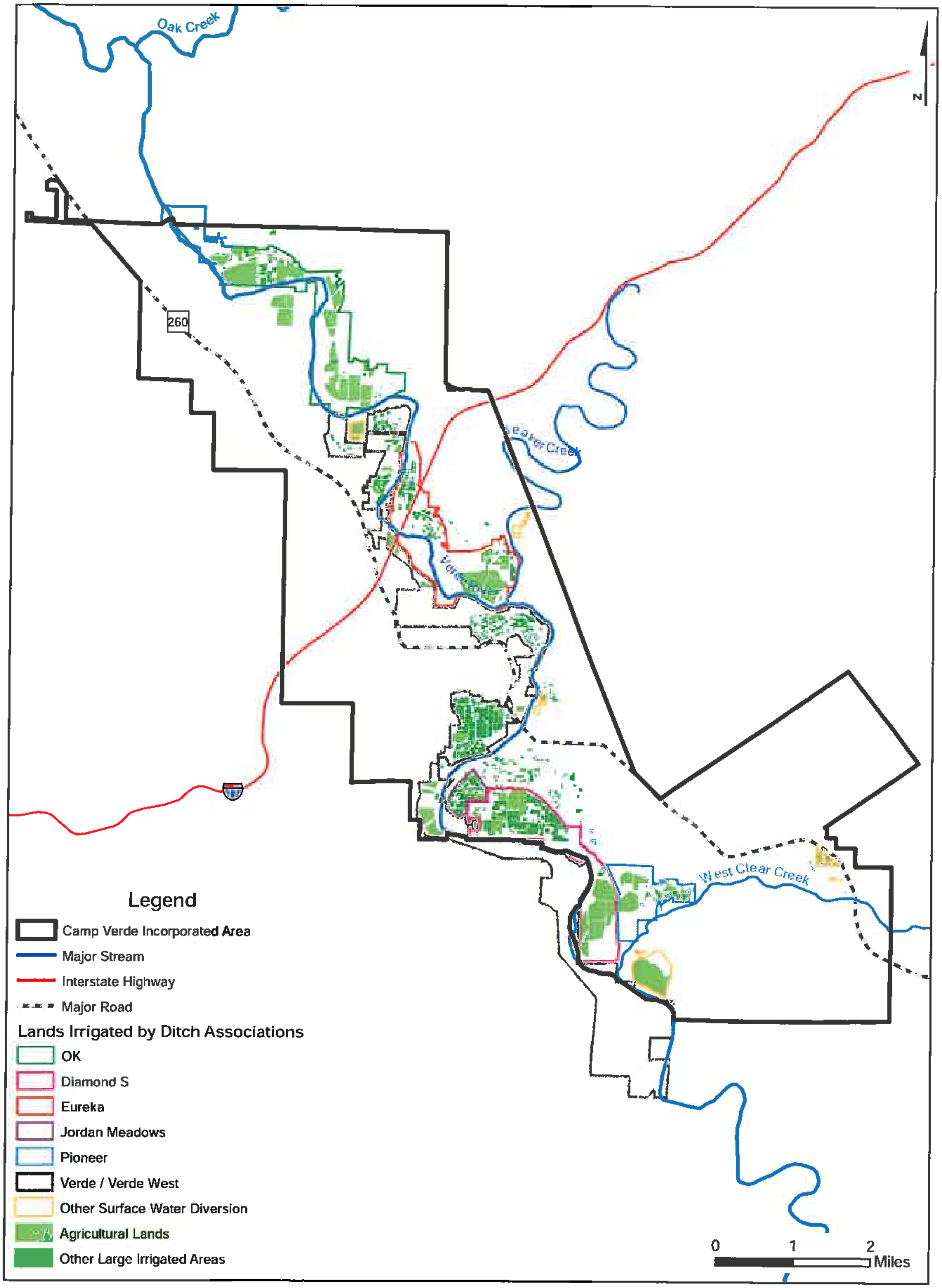

Data Sources: ADWR (2000), USGS (2013) and Plateau review of May 2013 aerial photography

Figure 11. Lands Irrigated by Surface Water Diversions and Well Pumpage in 2013

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Agricultural Demand

Agricultural water use is outside the jurisdiction of the Town and is not a primary focus of this study. However, it is the largest water use in Camp Verde and its demand has been estimated for comparison with other water demands. For the purposes of this study, agriculture is defined as irrigation of plants for animal or human consumption on 2 or more acres of land. As with the approach used to estimate demand for large outdoor water uses, we used 2010 and 2013 USGS acreage estimates, further verified by Plateau Resources and, as shown in Table 12, include an irrigation efficiency coefficient to generate an estimate of the amount of water necessary to apply to the land above the consumptive use of the crop, i.e. the "irrigation losses". A recent appraisal study by the Bureau of Reclamation estimated about 9,300 acre-feet per year of consumptive use, calculated by multiplying the number of acres by the plant watering requirement and did not include irrigation efficiency or irrigation losses, assuming that all water applied and not consumed by the crop returns to the aquifer or river.[i]

As shown, the approach results in 6,008 acre-feet of agricultural water demand within areas served by ditch companies and 442 acre-feet of flood irrigated alfalfa and pasture in areas outside of known ditch company boundaries, which is assumed to be well water.

Agricultural Irrigation, November 2013 – Eureka Ditch

[i] Central Yavapai Highlands Water Resource Management Study, Tan appraisal level study funded through a cost share agreement between the Bureau of Reclamation, Arizona Department of Water Resources and Yavapai County Water Advisory Committee

Table 12. Agricultural Water Use in 2013.[a,b]

TYPE OF USE				USE COEFFICIENTS			CROP CONSUMPTIVE USE (AFA)[e]	IRRIGATION LOSSES (AFA)[f]	TOTAL WATER DEMAND (AFA)[g]
Category	Irrigation Method	Number of Areas Mapped	Total Irrigated Area (acres)	Watering Requirement (ft/yr)[c]	Irrigation Efficiency[c]	Water Demand (ft/yr)[d]			
Within Areas Supplied by Surface Water Diversions[h]									
Alfalfa	Flood	29	226.8	3.6	50%	7.2	816	816	1,632
	Sprinkler	12	38.1		80%	4.5	137	34	171
Corn	Flood	14	254.0	1.9	50%	3.8	483	483	966
Grapes	Drip	1	3.0	2.3	90%	2.6	7	1	8
Pasture[i]	Flood	69	469.5	3.1	50%	6.2	1,455	1,455	2,910
	Sprinkler	2	16.2		80%	3.9	50	13	63
Pecans	Flood	4	48.6	2.5	50%	5.0	122	122	244
Vegetables	Flood	1	4.4	1.7	50%	3.4	7	7	14
	Subtotals:	***132***	***1,060.6***				***3,078***	***2,931***	***6,008***
Outside of Areas Supplied by Surface Water Diversions[h]									
Alfalfa	Flood	5	59.7	3.6	50%	7.2	215	215	430
Pasture[i]	Flood	1	2.0	3.1	50%	6.2	6	6	12
	Subtotals:	***6***	***61.7***				***221***	***221***	***442***
	Totals:	***138***	***1,122.3***				***3,299***	***3,152***	***6,450***

ft/yr = feet per year; AFA = acre-feet per year.

Notes:

[a] USGS initially identified acreages using 2010 aerial photography and verified through 2010 and 2013 summer field visits. Plateau further verified by analysis of high resolution aerial photography flown on May 28, 2013. Does not include previously irrigated areas that appeared to Plateau as discontinued on the 2013 imagery.

[b] Includes irrigated areas that each cover at least 2.0 acres and appear to be used for commercial purposes. Some areas less than 2.0 acres are included here if likely part of the same farming operation.

[c] Average watering requirements from USDA (2013) and ADWR (2000); USGS (2013) provided typical irrigation efficiencies.

[d] Calculated by dividing the watering requirement by the irrigation efficiency.

[e] Calculated by multiplying the total irrigated area by its watering requirement.

[f] Based on the total irrigated area, watering requirement and irrigation efficiency; can include evaporation, irrigation return flows and percolation.

[g] Calculated by adding crop consumptive use and irrigation losses.

[h] See **Figure 3b** or map showing which irrigated lands are within and outside of areas supplied by surface water diversions.

[i] Includes about 16 acres of fallow lands possibly cropped later in the year by flood irrigation plus about 126 acres of lands that appeared partly cropped on the May 2013 imagery and were assumed 75% active.

Other Water Supplies

Central Arizona Project Water

Camp Verde Water System, as well as several other water systems in the watershed, received a Central Arizona Project (CAP) water allocation with the expectation that subcontractors located outside of the CAP service area (Maricopa, Pima and Pinal counties) would exchange their CAP entitlements for a local surface water supply held by a downstream senior right holder located within the CAP service area. However, environmental issues associated with this exchange led some subcontractors, including Camp Verde Water System, to transfer their allocations to the City of Scottsdale in exchange for monies deposited into a trust fund to be used for alternative water supply development. CVWS's subcontract of 1,443 acre-feet/year yielded gross proceeds of $1,443,000. These funds are used, "for the purpose of defraying the expenses associated with designing, constructing, acquiring and/or developing an alternative water supply....." ADWR provides oversight on expenditures from this account.[9] CVWS has used the fund to replace wells that pumped water from the floodplain alluvium of the Verde River and associated delivery and storage infrastructure.[10] Remaining funds total approximately $50,000. In addition, the Yavapai-Apache Tribe holds a CAP allocation of 1,200 acre-feet/year.

Wastewater

Expansion of the Camp Verde Wastewater Treatment Plant (WWTP), completed in 2010, increased treatment capacity to 650,000 gallons per day (gpd) and included upgrading the treatment level to a secondary standard and effluent discharge to evaporation ponds. The Town took possession of the WWTP and delivery system in 2013 from the Camp Verde Sanitary District, which will allow it to manage the resource to meet management objectives. Upgrades to the plant are still underway to bring it to a tertiary treatment level that would expand reuse opportunities including turf irrigation (e.g., at a future park) and aquifer recharge. The Town currently has 1,200 sewer customers and treats about 280,000 gpd or about 314 acre-feet per year at the plant.[11] Eight Tribal sewer systems on tribal lands in Camp Verde treat another 200 acre-feet of effluent annually.[12] Wastewater is the only water supply that increases as population grows, and is increasingly utilized throughout Arizona to meet non-potable uses. Development of this resource and extension of sewer hookups can help offset some of the impact of future demand.

Camp Verde Wastewater Treatment Plant

Surface Water

In addition to the surface water claims by the Ditch Associations, which are currently in use for irrigation, the Town and the Nation have claims to surface water as summarized below (Table 13). YAN claims include reservation and fee lands, are a mix of state-based and federal reserved right claims, and some are located outside of Camp Verde. With the exception of court decrees and settlements within the Verde watershed, surface water rights have not been adjudicated, a process that is slowly proceeding through the Gila River Adjudication process.

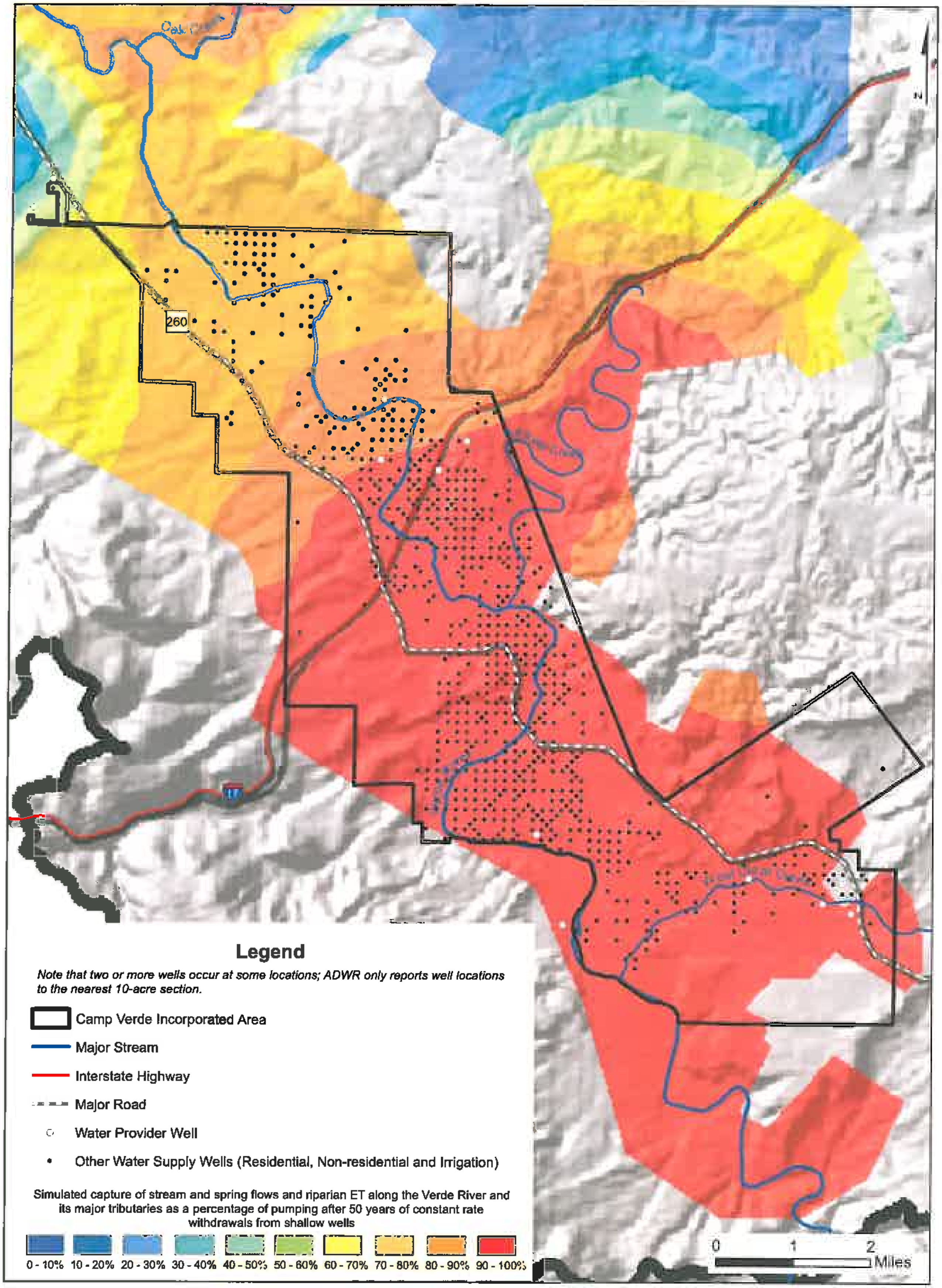
Table 13. Surface Water Claims by Camp Verde and the Yavapai-Apache Nation.

Claim #	Amount (acre-feet/year)	Use
Camp Verde		
39-56035	20	From irrigation well
39-56037	18.4	From Irrigation well
36-67228	8.4	From Woods Ditch
39-56036	21	From Verde Ditch
Total	67.8	
Yavapai-Apache Nation		
39-50059	4,266	Irrigation
	1,069	Garden Plots
	556	Municipal/domestic
	350	Aquaculture
	321	Commercial/industrial
	30	Mining
	6	Stock
Total	5,530.69	

Groundwater Capture Zones

The Northern Arizona Regional Groundwater Flow Model, completed by the USGS in 2010 included a capture zone map, shown in Figure 12, onto which well location data has been plotted. The capture zones were simulated in the model by evaluating the quantity of stream and spring flows and riparian evapotranspiration that would be reduced along the Verde River and its major tributaries after 50 years of constant-rate pumping from "shallow" wells, those completed in the upper part of the Verde Formation (Layer 1 of the regional model). The potential quantity captured at each well site is presented as a percentage of pumping. According to the USGS, most of the wells in Camp Verde pump water from the upper part of the Verde formation.[13] As shown on Figure 12, most wells are located in areas where, after 50 years of continuous pumping, the well would capture 90-100% of groundwater flow at the well site that would otherwise flow to the Verde and tributaries.

This Figure is intended to illustrate the relative impact of pumping to watercourses and show that most shallow wells in Camp Verde have a close connection to river flow and as such, conservation and efficiency improvements can be of some direct benefit. Worth noting is that the Camp Verde Water System production wells are located outside the floodplain alluvium in the extreme northwest part of the Town in an area with less direct impact on the River.



<u>Data Sources</u>: ADWR (2013), USGS (2010)

Figure 12. Simulated Ground-water Capture Zones at Camp Verde Well Locations

Water Conservation and Management

This section offers an overview of water resource management approaches that could be considered by the Town, which has a number of water resource management authorities. Cities and towns may adopt water conservation codes and ordinances, implement conservation programs, develop wastewater reuse infrastructure, and make land use decisions that influence future water demand. Payson, Sierra Vista, and Flagstaff, as well as other smaller communities in Arizona, provide relevant examples of potential options available to the Town. There may be legal uncertainties regarding the extent of certain management authorities, but those discussed in this section have been implemented in Arizona.

General Water Resource Management Authorities

Municipalities clearly have authority over plumbing codes, certain water conservation requirements, siting and location of land uses, and can prohibit certain types of water use. They may require use of effluent or harvested rainwater for turf and landscape irrigation, and may incentivize actions that support local management objectives and punish activities that conflict with them. For example, municipalities can encourage conservation by providing rebates for fixture replacement and enforce water waste ordinances.

Land use and zoning laws can be used to regulate and incentivize the location of new water uses and the intensity of those uses. For example, municipalities and counties can adopt zoning overlays and plans that require aggressive conservation or limit development in areas where wells may adversely impact stream flow by establishing caps on the issuance of building permits. For example, the Babocomari Area Plan in the Sierra Vista Subwatershed allocates a baseline volume of water to support one residence per four acres. Future requests for increased densities would not increase groundwater withdrawals beyond the baseline assumption. The plan also encourages the use of conservation subdivision options and easements to protect washes and the hydrologic function of the Babocomari River, including a prohibition of new wells in the 100-year floodplain alluvium[14]. Both this plan and the Sierra Vista Subwatershed Overlay District set stricter conservation standards for new development to promote installation of low flow fixtures, rainwater harvesting systems and other conservation features. Platting entities can also offer density incentives that usually result in less outdoor landscape area and associated water demand for new developments.

The Growing Smarter legislation allows counties and cities to plan for development as it relates to available water resources through the Water Resource Element required in community comprehensive plans. This Element must address legally and physically available water supplies, water demand projections from future growth and an analysis of how future water demand will be met.[15] When properly developed, this Element can guide communities in making smart land use decisions based on available water resources and management goals. These strategies are addressed more fully in the following sections.

Water Adequacy

ADWR's Water Adequacy Program requires that developers of subdivisions outside of the State's active management areas obtain a determination of whether there is sufficient water of adequate quality available for 100 years. If the supply is inadequate, lots may still be sold but the condition of the water supply must be disclosed in promotional materials and sales documents. In some instances, developers choose to not submit the information necessary to make the adequacy determination because of the expense involved.

Legislation adopted in 2007 authorizes a county board of supervisors or a city or town to require a demonstration of adequacy before the final plat can be approved. In the case of a city or town, this requires a unanimous vote of its City or Town Council. Yavapai County has not adopted this provision but the Town of Clarkdale did in September 2008. Having this authority allows communities to ensure that there are adequate water supplies for its citizens and helps to reduce speculative development.

Conservation Codes

There are numerous examples of municipal codes that require water conserving action that do not require that the community operate a municipal utility. For example, the City of Sierra Vista, which is served by several investor owned utilities, has adopted an extensive number of water conservation code measures and is the first community in the nation to adopt in code the EPA WaterSense New Home Specification[16]. This requires use of WaterSense labeled fixtures and outdoor water efficiency features as well as requiring that new homes be built by a WaterSense building partner.[i] Sierra Vista also prohibits turf in commercial zones, limits the amount of turf in multi-family residential, limits turf to the rear yard in residential zones and requires car washes to reuse 75% of their water (see Appendix A).

Because of their limited water resources, Payson and Flagstaff have adopted rigorous conservation goals and codes. The Payson Town manager is authorized to declare or rescind water conservation requirements that conform to "resource status levels" that consider the safe amount of water available ("safe production capability") compared to the amount of demand. Flagstaff recently adopted Low Impact Development standards including mandatory active rainwater harvesting systems (excluding single family residential).[17]

The Town of Payson's Code of Ordinances requires subdivision developers to pay a $7,570/residential unit impact fee or supply enough potable water from new sources to offset their projected demand although the "new sources" provision was modified following Payson's agreement with Salt River Project for water from CC Cragin Reservoir. This agreement restricts Payson from drilling new wells or seeking sources of water from outside the community.[18]

Listed below are ordinances and standards employed by 15 Arizona communities surveyed for Western Resource Advocates Arizona Water Meter report as well as others recommended by ADWR in its active

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[i] WaterSense is a partnership program by the EPA that seeks to protect the future of the nation's water supply by offering people a simple way to use less water with water-efficient products, new homes and services. Products that are WaterSense-certified use at least 20% less water than their conventional counterparts.

management area performance-based regulatory program (the Modified Non-Per Capita Conservation Program)[i].

Most Common

- Low water use landscaping requirements
- Water waste and tampering ordinance
- Plumbing Code requirements more restrictive than the 1990 Uniform Plumbing Code and additional requirements for commercial/public e.g. self-closing faucets, waterless urinals
- Limitations on water features and water-intensive landscaping
- Landscape watering restrictions
- Grey water and water harvesting ordinances and guidelines
- New development standards including overlay districts

Others

- Model home requirements for new residential developments
- Non-residential landscape water-use efficiency standards
- Car wash recycling and other non-landscape commercial watering restrictions
- Conservation plans for new non-residential customers
- Hot water recirculation systems in new development
- Low Impact Development (LID) ordinance
- Conservation or effluent use standards for golf courses
- Evaporative cooler prohibition, or requirement for recirculating systems in new development
- Limits on residential landscaping
- Rainwater harvesting for new commercial
- Sub-metering new multi-family developments exceeding four units
- Native plant salvage for landscaping
- Water-body prohibitions (lakes, ponds)
- Mister restrictions
- High-efficiency washers in new multi-family and commercial laundry facilities
- No new outdoor pools
- Residential graywater stub-outs in new development
- Mandatory plumbing retrofit on home resale

Planning and Zoning

Planning and zoning requirements or incentive programs can also be used to promote water efficiency in new or substantially remodeled construction. This can be particularly effective since it is much more efficient and cost-effective to design-in conservation features from the beginning rather than retrofitting.

Many communities have low water use plant requirements, typically from an approved list, for landscaping along streets and in parking areas. Some communities, such as Sierra Vista extend this requirement to residential front yards, commercial and multifamily new development (see Appendix A).

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[i] The Arizona Water Meter Report contains links to specific code language and is available at http://www.westernresourceadvocates.org/water/azmeter/report.pdf

In 2007 Cochise County established a Sierra Vista Sub-Watershed Water Conservation Overlay Zone, an area where pumping may impact flow in the San Pedro River. Within this hydrologic zone more stringent standards for new residential and non-residential construction are required.[19] Building permits for new homes within the zone must include:

- Graywater lines plumbed to at least two fixtures and capped for optional future use
- Hot water on demand systems for sinks and showers
- No single-pass evaporative coolers
- Outdoor sprinkler systems must include rain or humidity sensors to override the irrigation system after rainfall.

A city or county may also provide incentives for builders and developers to voluntarily design and construct water efficient homes. For example, Cochise County developed a voluntary residential green building program that awards credits for construction measures that increase water efficiency. Homes with more credits receive a higher green rating, lower permit fees, and faster approval timeframes. Credits are given for installation of features such as rainwater harvesting systems, drought-tolerant plants and high efficiency irrigation systems.

Similarly, Yavapai County's planning and zoning ordinance has density incentives based on inclusion of a certain number of conservation features that include use of only drought tolerant landscaping and prohibition of turf or grass in all common area landscaping, and installation of lot scale rainwater harvesting and graywater systems.

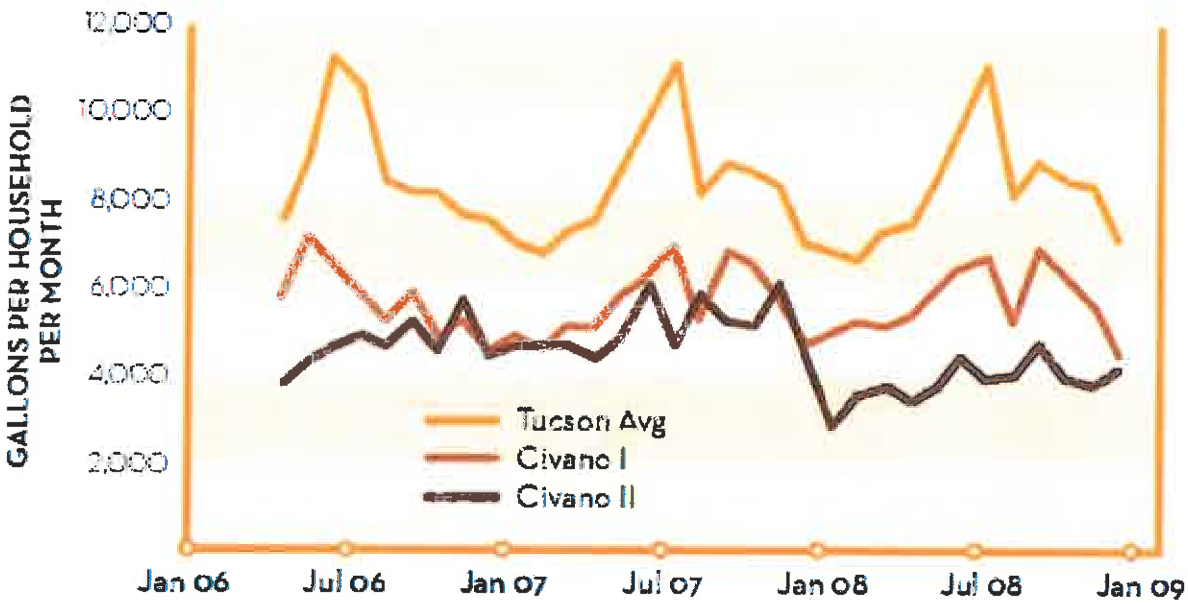
A number of communities, including Camp Verde have development standards for new golf courses that may prohibit them altogether or require that they use reclaimed water and be designed to use water efficiently.

WRA made a number of "water-smart" planning recommendations for new development in a 2009 report.[20] These included:

- recognition that sound land use planning can be a source of water supply,
- integration of land use planning with water supply planning,
- density bonuses, a streamlined approval process or discounted tap fees to homebuilders engaged in water-smart development
- planning from the ground up including installation of recycled water distribution systems, water-wise landscaping and efficient fixtures and appliances
- government and agencies lead by example and partner with others to educate the community on the benefits of water-smart development

The water conservation benefits of Water-Smart development are clearly shown in Figure 13 for Civano, a master-planned community in Tucson that attributes its water savings to strict landscape standards, small lot size, rainwater harvesting, use of recycled water, and community awareness.

Figure 13. Water Use at Civano I, Civano II, and the Tucson Average.



An untried approach in Arizona (though somewhat similar to Payson's previous development Code) that has been implemented in California and New Mexico, is a water demand offset program. The basic principle of an offset program is that a developer must implement, or pay a fee in lieu of implementing, actions that offset the impacts of their proposed project on water resources. This typically requires an offset greater than 1:1 to account for variations in demand and loss of water saving efficiency over time. For example the Soquel Water District in California requires that new development have "zero impact" on the groundwater supply by requiring developers to replace toilets, retrofit high water use landscapes, and make other efficiency improvements in existing housing. Santa Fe, faced with surface water supply variability, drought sensitivity, high summer peak demand, and increasing projected demand focused on toilet replacement. An offset program, like any conservation program, should be structured to achieve a key objective. Program objectives can vary from keeping the municipal demand at a baseline level to one that focuses effluent recharge to areas of maximum hydrologic benefit.

Conservation Programs

Conservation measures may be implemented by both water utilities and towns and ideally should be based on the water use characteristics of the community. Funds for conservation are typically a challenge and thoughtful demand analysis will result in more likelihood of a successful water saving program. Water providers may fund programs through their water rate structure or even a voluntary conservation check box on the water bill. Municipalities without a water utility may fund conservation programs through the annual budget process, sewer revenue or, although limited, grants or assistance programs, for example the EPA Green Infrastructure Technical Assistance Program.[21]

The water service rates of IOUs that serve the town must be approved by the ACC whose overarching objective is to ensure that water customers receive a reliable water supply at a fair and reasonable cost.

Because rates are essentially set at "cost of service" levels, there is little revenue available to initiate water conservation programs. In addition, because the rate making process may be lengthy, expensive, and the outcome uncertain, it may be difficult for private water companies to easily recover lost revenue related to decreasing usage because of conservation programming. For this reason, a utility rate adjustment policy to compensate from revenue lost from a conservation program should be supported at the state level.

One example of a conservation program initiated by a community without a municipal water system is the City of Sierra Vista's Toilet Rebate Program. To date, this program has replaced over 2,560 toilets, saving more than 74 acre-feet (24 million gallons) of water. The city has rebated more than $225,000 over the past 10 years, and has spent an additional $55,000 administering the program. Over a 20-year life of a toilet, the cost of the saved water is less than $200/acre-foot. To reduce costs and improve efficiency, the City recently partnered with The Cochise Water Project (TCWP), a regional non-profit organization, to combine their toilet rebate programs. TCWP is installing only 0.8 gallon per flush toilets, which use half the water of toilets required under the current U.S. Plumbing Code.[i] Toilet and fixture replacement are also appropriate for older commercial buildings, as are waterless or WaterSense urinals at schools and high use public restrooms. Replacing a water using urinal at a high use location with a waterless urinal can result in savings of 40,000 gallons a year at a cost of $250-$500 per fixture.[ii]

A popular, relatively low-cost program for non-residential water users is pre-rinse spray valve replacement. These are spray nozzles used to remove food and grease as the initial step in dishwashing lines. They are inexpensive (about $50), easy to install, and attractive to commercial kitchen managers because of the water *and* energy savings, and improved operation of the low-flow nozzles. A program in Colorado Springs, Colorado resulted in an average savings of 55,000 gallons per year/fixture at a cost of $293/acre-foot.[22]

Many communities support conservation information and education programs, either individually or in coordination with other entities. These programs typically focus on residential water users but could target other use sectors. Partnerships with local cooperative extension offices that offer programs like Project WET, Water Wise, and SmartScape are valuable options. Collaboration with other communities to fund and implement conservation programs is a potential regional option, as most communities lack resources to effectively fund conservation staff and programs themselves.

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[i] Information on water savings and costs of toilet replacement programs is available from Western Resource Advocates with a summary at http://westernresourceadvocates.org/water/caseforconservation.php.

[ii] In conjunction with replacement, it is necessary to train custodial staff on proper cleaning and maintenance.

While the State requires implementation of conservation measures in conjunction with municipal drought declarations and IOUs must adopt curtailment strategies to address emergency supply shortage situations, these measures should not be considered equivalent to a conservation strategy to address long-term water resource needs associated with population growth and increasing water demand.

Some of the more popular water conservation programs that have been implemented in Arizona include:[23]

- Public awareness through local or regional messaging
- Special events/programs and community presentations
- Adult education and training programs
- Youth education programs
- Residential water audits
- Toilet rebates
- Indoor water fixture replacement rebate/incentive
- Landscape conversion rebate/incentive
- Xeriscape demonstration garden

Other programs include:

- Landscape consultations/audits
- Non-residential water budget programs
- Smart irrigation
- Hot water recirculating system or instant hot water system rebate
- Rainwater Harvesting

Wastewater and Graywater Reuse

Wastewater reuse is increasingly viewed as an important alternative supply by a number of Arizona communities. For example, Payson and Flagstaff deliver effluent for turf irrigation, and Flagstaff has a "Non-Potable (Reclaim) Water Hauling" program that provides class A+ reclaimed water to permittees. Some communities require effluent for golf course irrigation and dust control. Sierra Vista strategically recharges wastewater at its Environmental Operations Park, without recovery, to create a buffer between municipal groundwater pumping centers and the San Pedro River in order to maintain baseflow in the River.

When planning for reuse, daily and seasonal variations in effluent production, as well as variations in the end use demand, must be considered. Wastewater reuse options also depend on the treatment level as described in Appendix B. A+ treatment allows for school ground and food crop irrigation, among other uses, while Class B treatment is acceptable for golf course, orchard and vineyard irrigation, and livestock watering. Even Class C treated wastewater can be used for irrigating forage crops and watering non-dairy animals.

Arizona's 2010 Blue Ribbon Panel on Water Sustainability noted that the location of treatment plants at the lowest edge of a community made reuse costly, but that incentives could be developed to match reclaimed water with potential uses to encourage reuse, and that decentralized treatment could allow a variety of uses with lower infrastructure costs.[24]

Graywater is defined in statute as "wastewater that has been collected separately from a sewage flow and that originates from a clothes washer or a bathroom tub, shower or sink but that does not include wastewater from a kitchen sink, dishwasher or toilet" [A.R.S. 49-201(18)]. Use of graywater is allowed throughout Arizona and does not require a permit, but use is expected to be consistent with ADEQ best management practices[25].

A study conducted in 2001 by the Water Conservation Alliance of Southern Arizona (Water CASA) covering the greater Tucson area found that 13 percent of single-family residences and manufactured homes did some type of graywater reuse and that the largest source, by far, was clothes washing machines, accounting for 66 percent of all graywater sources. Bathroom tubs and showers accounted for another 15 percent. The study also found that irrigation of shade or ornamental trees was the most common end use at 32 percent, followed by shrub irrigation (19 percent), and grass irrigation (14 percent). The study suggested that factors likely to increase the likelihood of graywater reuse included: older homes; lower value homes; lower income levels; manufactured homes (due to easier access to plumbing); and, septic tanks (due to interest in maintaining septic tank function).

The Blue Ribbon Panel study suggested that the Tucson graywater ordinance represents a model to increase graywater use. The ordinance requires that plans for new single-family houses and duplexes include plumbing for graywater distribution, which prepares the structures for easy graywater use when built.

Rainwater Harvesting and Stormwater Capture

Harvesting rainwater for landscape watering and other purposes allows homeowners to conserve potable water supplies and to reduce their water bills. There are no Arizona regulations for rainwater harvesting on individual residential lots. Because of Arizona's arid climate, the volume of rainwater available for harvesting may be a limiting factor at certain times of year, but well-designed and managed systems can significantly reduce potable demand. While there is considerable information available about the design of active (with storage) and passive rainwater harvesting, water savings and costs of these systems have not been quantified because of the variability in the size, design, and individual use of systems. The Cochise Water Project (TCWP), in conjunction with the University of Arizona Cooperative Extension is studying water savings as part of TCWP rainwater harvesting rebate program. Preliminary results suggest an average water saving of about 5,000 gallons a year at a cost of about $1,300 per acre-foot.[i]

There are many examples of larger-scale rainwater harvesting projects in commercial and institutional settings that may combine other sources of water such as cooling condensate and stormwater. For

[i] A brief overview of rainwater harvesting programs by Western Resource Advocates is available at http://www.westernresourceadvocates.org/media/pdf/CFC-Rainwater%20Harvesting.pdf.

example, a project at the University of Arizona collects rainwater and cooling tower condensate to maintain landscaping and mitigate a flooding problem. A Tucson Water Ordinance requires that new commercial development meet 50% of their irrigation demand with harvested rainwater.

Low impact development, or Green Infrastructure design, can be incorporated in landscape plans to detain and infiltrate stormwater while also passively irrigating plants. Simple curb cuts and "bump outs" (shown in photo) can be incorporated into existing and new streets to slow and divert stormwater to planted areas. These features can also slow traffic and improve pedestrian use and safety.[i] The Water Infrastructure Finance Authority (WIFA) offers low-interest loans to cities and towns for stormwater management and green infrastructure projects, including planning, design and construction. It also offers a lower interest rate for on-site collection and management of rainwater.[26]

Example of a "bump out" in Tucson capturing stormwater and directing it to planted areas

There are also opportunities to develop multi-source, multi-purpose projects that might combine, for example, harvested rainwater, captured stormwater, reclaimed water, remediated water and other types of water. The Kino Environmental Restoration Project (KERP) in Tucson has a primary function as a stormwater control project but was also designed to receive reclaimed water. This project converted a 50-acre stormwater retention basin into 141 acres of riparian and other vegetation surrounded by recreational paths. Collected water is also used to irrigate a nearby playing field. Cochise County is planning a flood-control/stormwater infiltration project ("The Mansker Project") near the San Pedro River to address both flooding problems and to help maintain river flow. This project may include collecting stormwater runoff from an upslope development and conveying it to the facility to augment infiltration.

[i] The Tucson-based Water Management Group offers a number of resources on Green Infrastructure and Low Impact Development; for example see "Green Infrastructure for Southwestern Neighborhoods, 2010 at http://watershedmg.org/sites/default/files/greenstreets/WMG_GISWNH_1.0.pdf.

Water Conservation Strategies

The previous section presented an overview of water conservation and management options, primarily using examples from Arizona. A number of these options are further described in this section as possible strategies for consideration by Camp Verde. Presented are "first-tier" strategies, those that are the easiest to implement in the near term, and additional strategies. The strategies should be considered as a menu of possibilities, some of which align with the 2005 Camp Verde General Plan Implementation Strategies, now being updated.

These strategies are suggested as a starting point for further evaluation and discussion, and are based on the water use data collected for this assessment, the corresponding conservation potential, and with consideration of the authorities and resources of the community.

Because there are relatively few current conservation efforts in the community, it is important to build on existing efforts, lay a groundwork of information and education about local water resources, describe the importance of using water efficiently, and generally establish what is often referred to as a "culture of conservation". This is an important first step for Camp Verde, paired with enacting ordinances and conservation programs that address the most obvious water waste and are the least expensive to implement. Along with addressing current demands, planning that incorporates conservation into new development is a logical approach. Once this groundwork is established, and community support for conservation grows, more intensive efficiency programs and codes can be considered.

Existing Conservation Potential

Residential

Approximately 2,800 homes (59%) in Camp Verde were constructed prior to adoption of the U.S. Energy Policy Act of 1992, including homes inside water provider service areas, as well as approximately 440 older homes using domestic wells.[27] This suggests the potential for substantial indoor water savings.

*Assuming indoor use in pre-1997 homes is 69 gpcd, **100 acre-feet or more a year could be saved if half these older homes were retrofit with high efficiency fixtures.***

Since the Town does not operate a water utility, it unfortunately does not qualify for a Bureau of Reclamation WaterSmart Grant to fund conservation programs, however it does have other options to finance conservation programs. For example, a plumbing fixture retrofit program that targeted older homes to replace the most inefficient toilets and fixtures could be funded from general tax revenue. Alternatively, Sierra Vista uses its sewer enterprise fund to support a toilet rebate program, as water saved from the program is considered a reduction in cost for the wastewater treatment plant. In addition, toilets and other fixtures may be purchased in bulk to reduce costs and some communities have used trained volunteers to perform retrofits.

Typical residential outdoor use served by a water company appears to be fairly modest in most areas, representing 30% of total residential use, or about 21,100 gallons a year for the average household. However, some service areas including Verde Lakes may have higher exterior water use with a pronounced summer peak (refer back to Figure 7). This may be due to more landscaping, summer gardens, evaporative coolers, or other reasons. All residential outdoor use should be further investigated to better identify conservation opportunities. Programs that promote efficient irrigation, landscape conversion, rainwater harvesting, or even evaporative cooler operation and maintenance may be appropriate.[i]

Typical landscaping in the older part of CVWS Service Area

Because typical outdoor use is relatively low in areas not served by ditch companies, rainwater harvesting systems, either passive or with storage, may be able to meet a significant part of outdoor demand.

Potential "first-tier" strategies:

- Provide irrigation efficiency and Xeriscape design and practice information to homeowners
- Create hi-profile Xeriscape and low water use vegetable demonstration gardens that include rainwater harvesting features and drought adapted crops (e.g. at a school or hi-use public site)

[i] About 600 gallons of water can be connected from an inch of rain that falls on a 1,000 square foot catchment area.

- Distribute "give away" devices such as WaterSense showerheads and faucet aerators (with an approach that promotes installation) and provide information on leak detection and repair and pressure reduction.

Additional strategies:

- Develop funding for an interior water fixture replacement program that targets older homes and requires installation of EPA WaterSense fixtures
- Contract with a conservation specialist (e.g. NRCD, Cooperative Extension) to offer water audits and assistance to high outdoor water users.

Clarkdale Xeriscape demonstration garden

Non-residential

Commercial demand is 38% of water use in the Camp Verde Water System service area, and improving efficiency at a handful of high use businesses can result in more "bang for the buck". City facilities can lead by example by installing low flow plumbing fixtures and efficient, low water use landscaping.

Though type of water use varies depending on the business, common to most are toilets and sinks, therefore a low water use fixture replacement program for older business would be appropriate, but would likely need to be sufficiently incentivized. This could be particularly appropriate at older hotels. Some studies have identified retail establishments and health clubs as good water saving candidates. Installation of WaterSense toilets, waterless urinals, WaterSense pre-rinse spray valves in commercial kitchens, and other low use fixtures at the schools, Cliff Castle Casino, Out of Africa and other high use areas would be relatively inexpensive and could save significant amounts of water. Audits of the highest

Installation of WaterSense pre-rinse spray valves in commercial and institutional kitchens is a cost-effective water conservation option. ***With at least 30 restaurants as well as institutional kitchens, savings of 5 acre-feet a year are possible at a cost of less than $2,000.***

non-residential users, including those on their own wells (auto sales, service shops, restaurants and the municipal use/Marshall's Office and Teen Center) could further identify water savings opportunities.

Larger commercial buildings provide an excellent opportunity for rainwater harvesting. Collected rainwater might be used to irrigate landscapes or diverted to a detention/infiltration basin to recharge the aquifer - potential sites should be further investigated. In addition, irrigation audits of school grounds, Butler Park, Community Center Park and other large public use irrigated areas could improve efficiency and save water.

Industrial types of use such as sand and gravel facilities may be difficult to address and current efficiency levels are not known. ADWR has mandatory conservation programs in the active management areas for new large cooling towers and regulates sand and gravel mines that use more than 100 acre-feet a year. These facilities must recycle wash water and implement a dust control and cleanup conservation measure from a list of approved measures. Perhaps the best way to address water efficiency for industrial facilities is through demonstration of conservation practices as a condition of approval of new facilities.

Potential "first-tier" strategies:

- Pre-rinse spray valve replacement program for commercial and institutional kitchens
- Explore incentives for rainwater and stormwater capture
- Investigate a commercial conservation partnership with the YAN
- Improve conservation efficiency of city facilities

Additional strategies:

- Urinal and other plumbing fixture replacement at schools and high use public restrooms
- Turf irrigation audit of school playing fields and other large turfed areas
- Commercial rainwater/stormwater reuse incentive program (e.g. rebate for rainwater harvesting systems)

Agricultural and Large Outdoor Use

With 89% of the water demand in Camp Verde connected to agricultural and large outdoor water use, it is clear that efficient surface water delivery and irrigation that minimizes evaporative and other losses is key. Recently installed automated ditch gates, beginning on the Diamond S ditch and supported by The Nature Conservancy, are an excellent example of voluntary and collaborative efforts that have kept more water in the River, while delivering enough water to users to meet their needs without impact to surface water rights or reduction in irrigated acres. Expanding these improvements as well as increasing irrigation efficiency, conversion to lower water use crops, and shifting to winter crops/seasonal fallowing can all result in reduced diversions and allow more water to remain in the River year-round for recreational and other purposes.

Irrigated pasture

Most of the large outdoor water use is for turf and landscaping with losses that may be as high as 2,580 acre-feet a year. With an assumed 50% irrigation efficiency there is an opportunity to reduce the amount of water applied above the plants' needs.

A homeowner irrigation efficiency education program could include better management and maintenance of laterals and conversion to more efficient irrigation systems and lower water use plants. Where well water is used, a program could include time of day and passive rainwater harvesting information. ***Even a modest 5% improvement in efficiency could save over 100 acre-feet a year.***

Large outdoor water use – Verde Ditch

Potential "first-tier" strategies:

- Support ditch association efficiency improvements and identify an appropriate supporting role for the town;
- Build partnerships with ditch associations, the Natural Resource Conservation District, The Nature Conservancy, and others to design and implement an ongoing homeowner irrigation efficiency program;
- Provide irrigation efficiency information to large outdoor water users on wells.

Additional strategies:

- Pursue funding to support a cooperative ongoing irrigation efficiency program that includes irrigation system improvements/replacement

Public Conservation Information and Education

To establish a culture of conservation, the Town could provide water conservation information on its website and/or through mailings to residents, and distribution at local businesses and water provider offices. It could also partner with Yavapai County Cooperative Extension to promote conservation education and outreach, engage the business community, or explore cooperative regional water conservation opportunities as it has done with the Value the Verde program. Any outreach program should be well designed to advance local conservation goals and contain a local message that resonates with residents. This could involve conservation messaging at regularly occurring public events, (such as Park and Recreation Department's Family Movie nights) with prizes and contests.[i]

Potential "first-tier" strategies:

- Community-wide, locally themed, residential conservation education and information that includes information on tracking water use, behavioral changes, and "engineering" (i.e. fixture replacement) practices. Websites, brochures, recurring events, active and ongoing community engagement can all be considered
- Engage in regional conservation partnerships, including support of applicable Extension programs

Additional strategies:

- Commercial water conservation education and audit program that evaluates on-site water use and provides tailored conservation options

New Development, Planning and Ordinances

Integrating land and water use planning by requiring that water efficiency be a key component in new residential and commercial development plans will stretch water supplies and lessen potential impacts to the Verde River. Town planning that includes evaluation of potential impacts to water supplies by major developments, and requires developments to include design features that minimize use, reduce run-off, and enhance recharge will help reach efficiency goals. Overlay zoning districts that require additional conservation could be considered in sensitive areas.

Local plumbing codes that are more rigorous than the existing federal codes, such as adoption of WaterSense New Home Specifications by Sierra Vista are becoming commonplace. Other efficiency strategies include restricting high water use landscaping, providing incentives for higher density housing that keep high-value community amenities like open space with trails and recreational facilities, and requiring graywater and rainwater harvesting features will help maintain Camp Verde's quality of life by reducing impacts of future water demand.

Camp Verde already has conditions to promote efficient water use by golf courses in its 2012 Planning and Zoning Ordinance, as well as some low water use landscaping and efficient irrigation requirements

[i] An example is TCWP Movies in the Park that provides family entertainment in early-summer preceded by a water conservation message, contest and prizes. The contest has included a high school water conservation video.

for "protective landscaping" (shade and screening of building frontages) that provide a starting place for additional conservation codes.

Water waste ordinances that apply to both residential and non-residential customers are common and would support Town conservation education efforts. Ordinances typically include prohibitions on allowing water to escape from property, washing down driveways and sidewalks, and other water waste. A summary of the Tucson ordinance, which considers water waste "unethical", is found in Appendix C.

Potential "first-tier" strategies:

- Adopt a water waste prohibition ordinance
- Become an EPA WaterSense partner, adopt WaterSense codes for new residential development, and require new development to include additional water conserving features
- Evaluate the impact of new development on local water supplies and the Verde River in planning documents and through code development
- Require efficient fixtures in new commercial development, including WaterSense pre-rinse spray valves and toilets
- Adopt a low water use plant list and adhere to Xeriscape practices in all public areas and in new commercial and residential development

Additional strategies:

- Consider overlay districts in hydrologically sensitive areas that would require additional conservation features
- Consider incentives for highly water efficient development (e.g. faster permitting, density bonuses)
- Turf and swimming pool limits in new residential construction
- Car washes must recycle water
- Prohibit commercial misting systems
- Require that fountains be recirculating
- Mandatory retrofit on resale
- Prohibit artificial lakes
- New golf course prohibition or special use requirements
- Water Demand Offset Program for new development

Reuse and Supply Management Strategies

Reuse and supply related strategies, including adopting water adequacy requirements for new development, wastewater reuse, and acquisition of local water companies extend and protect existing water resources. In addition, agreements between key claimants to the Verde River would provide more certainty about available water resources and potential future use.

Wastewater and Graywater Reuse

The Town's acquisition of the wastewater treatment plant and its ongoing upgrades offer a number of reuse opportunities for Camp Verde that are currently being discussed. Options range from agricultural and turf irrigation to aquifer recharge, and will expand as more of the community is sewered (see Appendix B). An initial option to utilize treated effluent before distribution infrastructure is built, is to offer standpipe effluent to permittees, a program currently offered in Flagstaff.

Expansion of sewer systems into areas served by septic systems is often considered financially unfeasible, although septic to sewer projects are eligible for funding through the WIFA Clean Water Revolving Fund.[28] Sierra Vista is expanding service to neighborhoods where lots are too small to comply with current state septic tank siting requirements and where septic failures have occurred. Funded through grants, the connection cost for homeowners can be spread over 20 years to reduce economic impacts.[29] The table below provides an estimate of potential wastewater yield that could be captured from adding currently septic-served homes to the sewer system. It assumes a mix of existing older and newer homes using data from Tables 6 and 8, and estimates 80% of indoor water use is discharged.[30,31]

Estimated Daily Household Discharge to Sewer	Annual Household Discharge	100 households
124 gpd	45,260 gallons	13.0 acre-feet

All indoor water use does not replenish the aquifer via septic tank recharge. For a leach field to operate properly, the effluent must be in contact with air to prevent formation of a biomat that will inhibit downward percolation. It is estimated that about 80% of interior use is discharged to a septic tank leach field and of this, 60% is lost to evapotranspiration.

Data from 2000 indicate that about 43% of the Camp Verde housing units were manufactured homes, a structure identified in the WaterCasa graywater study as more likely to use graywater than other housing because of the accessibility of water and drain pipes.[32] In addition, several thousand homes have septic systems, another factor associated with graywater reuse. Evaluating current graywater use practices and promoting additional graywater use, particularly in areas on septic, could result in reducing outdoor water demand.

Installation of graywater stub-outs in new construction, which allow homeowners to easily connect the home's graywater system to landscape irrigation, would reduce the amount of treated groundwater used for watering plants.

Potential "first-tier" strategies:

- Continue to investigate options for wastewater reuse from the WWTP
- Provide information and education on reuse of graywater in selected areas

Additional strategies:

- Evaluate the feasibility of extending sewer service into areas currently on septic systems
- Provide effluent for construction, dust control, and other uses through standpipe service to permittees
- Adopt an ordinance that requires plans for new single family houses and duplexes include graywater stub-outs

Stormwater Capture

Low impact development design can be used to detain and infiltrate stormwater while also passively irrigating plants. Because of the rural nature of the community, opportunities to implement some designs like curb cuts and bump outs (similar to Camp Verde's downtown) may not be widespread, but could be appropriate at certain existing locations and certainly in new development. As previously mentioned, WIFA offers low-interest loans to cities and towns for stormwater management and green infrastructure projects including planning, design, and construction and offers a lower interest rate for on-site collection and management of rainwater.[33] Stormwater capture and infiltration opportunities from building sites, streets, and flood control structures should be investigated.

Main Street, Camp Verde

Low impact development design is an appropriate strategy for managing stormwater and can enhance streetscapes and habitat and reduce potable water use for landscaping. Sierra Vista, Flagstaff and Tucson have implemented a variety of projects at different scales that provide good examples of potential benefits and low interest loans are available from WIFA.[34]

Potential "first-tier" strategies:

- Provide LID training to transportation, planning, and other Town staff
- Investigate opportunities to implement curb cuts or other inexpensive mechanisms to capture and infiltrate stormwater that replaces or reduces irrigation needs

Additional strategies:

- Require Low Impact Development stormwater and rainwater capture features be designed into new development, as well as Town transportation and street redesign projects

Water Adequacy

Camp Verde Water System has already demonstrated water adequacy for its entire service area, becoming a "Designated Water Provider" in 2008. In its designation, the System projected an annual demand of 622.2 acre-feet in 2017, at which time its designation status will be automatically reviewed. The CVWS designation included two subdivisions with a total of 28 lots that were deemed to be inadequate. This designation helps to address water availability uncertainties for new development within Camp Verde but does not address all areas within the Town limits. There are currently 12 subdivisions within the Town limits with a total of 304 lots that have inadequacy determinations.[i]

Because Yavapai County has not adopted a mandatory adequacy provision that would affect all jurisdictions within the county, Camp Verde would need to adopt, by unanimous vote, its own mandatory adequacy provision or ordinance to ensure there are sufficient water supplies for new development for 100 years.[ii] This has been done by two rural Arizona communities, Clarkdale and Patagonia. Adopting this requirement sends a clear message that the community values its water resources and intends to ensure that there are sufficient supplies to support future growth.

Potential "first-tier" strategies:

- Encourage Yavapai County to adopt a mandatory adequacy provision

Additional strategies:

- If Yavapai County does not adopt an adequacy provision, build support for and adopt a Camp Verde water adequacy ordinance

Water Company Acquisition and Support

The Town of Camp Verde has been interested for some time in acquiring the private water companies within its boundaries, although to date this has proven financial unfeasible. Operating a municipal water system would give the town broader and more direct mechanisms to address its water resource goals. Publicly owned systems have more flexibility than an investor owned company to set rates, fund system improvement projects, and make other financial decisions to improve systems operations. As mentioned

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[i] Of these, eight subdivisions of 246 lots were found inadequate due to water quality, while the remaining four subdivisions with 58 total lots were found inadequate because the applicant chose not to submit data.
[ii] There are several exemptions to the requirement, including whether the developer has made "substantial capital investment" or a water supply project is underway and will be completed within 20 years.

earlier in this report, IOUs lack an incentive to implement conservation because the ACC rate process makes it difficult to quickly recover lost revenues associated with reduced demand.

Potential "first-tier" strategies:

- Pursue private water company acquisition
- Coordinate with private water companies on community water conservation and education programs

Additional strategies:

- Encourage water providers to seek rate adjustments that allow recovery of lost revenue related to conservation and provide support in rate hearing
- Explore opportunities to promote implementation of leak detection and repair programs, through the ACC, Rural Water Association of Arizona, WIFA or other opportunity.

Conclusions

This Assessment provides water demand estimates for all Camp Verde water users and potential strategies to meet the needs of residents and support flow in the Verde River. Strategies include conservation programs, codes and ordinances for existing users and new development, and reuse and supply management strategies. The demand estimates, particularly by unmetered wells and surface water users, deserve closer scrutiny, but it is clear that these users represent the vast majority of water use within the town with an estimated 92% of use unmetered and 89% attributable to agricultural and large outdoor irrigation. Consequently, it is critical to consider these demands now and in future planning, which will require innovative and cooperative approaches given the town's lack of direct authority to manage these demands. However, municipalities do have important and meaningful authority in certain areas including plumbing codes, land use and new development design and can incentivize conservation actions by offering rebates. In addition, the town could send a clear message about its commitment to sustaining area water supplies by adopting a mandatory Water Adequacy Provision.

From a water and cost savings perspective, it is important for the Town to strategically target existing uses that have the most water conservation potential including large residential irrigation, older homes and larger non-residential uses. Planning and new development strategies can be very effective in setting water efficiency standards, such as adopting WaterSense codes, land use codes that integrate smart water use features, and implementation of a water conservation education program that builds a culture of conservation in the community.

Water reuse and stormwater and rainwater capture are critical to extend and augment existing water supplies. Since most shallow wells in Camp Verde have a direct connection to the River, maximizing reuse and using captured rainwater and stormwater, in addition to conservation, should translate to direct river benefits by reducing groundwater demand. Expansion of the sewer system and incorporation of Low Impact Development design into existing and new development are potential strategies.

All water users in Camp Verde have a stake in using water in a sustainable manner, both to support the local economy and preserve local water supplies. The Town has an opportunity to advance sound water management by implementing targeted strategies in the near term and in the future.

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Appendices

APPENDIX A: City of Sierra Vista Development Code-Water Conservation

DEVELOPMENT CODE
Amended January 2013
ARTICLE 151.16
WATER CONSERVATION

151.16.001 Purpose
151.16.002 Water Use Regulations
151.16.003 Water Use Regulations – Outdoor Areas

Section 151.16.001
Purpose
The City of Sierra Vista is committed to conserving water, and therefore, the following goals are established:
A. Reduce the rate of depletion of groundwater resources.
B. Reduce overall per capita water use.
C. Ensure compliance with the most current and innovative water-saving conservation fixtures, appliances, and techniques.
D. Reduce the wasting of water.
E. Ensure the efficient delivery of hot water in new residential building development.
F. Ensure that new home development meets or exceeds the Environmental Protection Agency (EPA) WaterSense specifications for residential interior plumbing design and for exterior water-use system design.

Section 151.16.002
Water Use Regulations -- General
A. New Construction – Residential. All interior plumbing in new construction, consisting of one-to-four units, attached or detached, shall meet the following requirements:
1. All toilets shall be WaterSense labeled.
2. All hot water fixtures shall be WaterSense labeled.
3. Hot water pipe insulation. Insulation for hot-water pipe with a minimum thermal resistance (R-value) of R-4 shall be applied to the following:
a. Piping larger than 3/8-inch nominal diameter.
b. Piping located outside the conditioned space.
c. Piping located under a floor slab.
d. Buried piping.
e. Supply and return piping in recirculation systems including branches to each fixture.
4. The installation of a pressure-reducing valve on the house side of the water meter, in an easily accessible location, shall be required for all new single-family residences (preferred location is in the garage or other non-in-ground location). The static service pressure shall be set no higher than 60 pounds per square inch (psi), regardless of input pressure.
5. The following shall apply to all hot water distribution systems:
a. Plan sets shall clearly demonstrate that the water usage limit specified herein is met for all hot-water fixtures except tubs and garden tubs.
b. Nominal 3/8-inch line is required for all faucet and lavatory fixtures.
c. One of the following systems is required:

(1) Whole-house manifold.

(a) The system shall be designed such that less than 0.38 gallons (6 cups) of water are in the piping between the manifold and any hot water fixture.

(2) Demand-Controlled (On-Demand) Hot Water Recirculating systems.

(a) The system shall be designed such that less than 0.13 gallons (2 cups) of water are in the piping between the hot water circulation loop after being primed, and any hot water fixture.

(b) Pump activation switches shall be permanently mounted on walls in all bathrooms and the kitchen. Remote switches may be used in addition to the permanent switches.

(c) A dedicated return line shall be used with a minimal line size of nominal 3/4-inch diameter.

(3) Either system, whole house manifold or trunk/branch/demand-initiated pump systems, must deliver hot water to any fixture within 0.6 gallons (9.6 cups). No other systems are permitted without the prior written approval of the Director.

(4) Alternative systems may be considered and approved by the Director and permitted in lieu of the use of a manifold or demand-controlled (on-demand) system. These systems may include, but are not limited to:

(a) Point-of-use water heaters. Must be located at all bathrooms and at the kitchen. Back-to-back systems sharing one heater shall be considered.

(b) Core Plumbing Systems that minimize pipe volume between the hot water source and any hot water fixture to 0.38 gallons (6 cups) or less.

(c) Systems that utilize a single-trunk recirculation system with a single length of nominal 3/4-inch piping running from the top of the water heater to each fixture in turn and back to the bottom of the water heater. Such systems shall use an on-demand pump meeting the requirements of item 2 above.

(d) New technology that improves upon any of the above, as determined by the Director.

6. Should the homebuilder install a clothes washer, the clothes washer must be Energy Star qualified and be rated as having less than or equal to the lowest current Energy Star Water factor.

7. New single-family construction shall not offer evaporative coolers as the only source of cooling. Maximum rate of unit cannot exceed 3.5 gallons of water per ton-hour of cooling.

8. Water softeners, if installed, must meet NSF/ANSI 44 (including the voluntary efficiency standards in Section 7).

9. Drinking water treatment systems, if installed, shall meet NSF/ANSI (such systems shall yield at least 85 gallons of treated water per 100 gallons processed).

B. New Construction -- Commercial, Industrial, Multi-Family, and Public Development.

1. Waterless urinals shall be installed in all new public, commercial, multi-family residential common use, and industrial buildings where urinals are used. All applicable plumbing codes shall apply.

2. Existing public, commercial, multi-family residential common-use, and industrial building restroom remodels or retrofits shall convert existing urinals to waterless urinals.

3. All new commercial car wash facilities, including automobile dealerships, shall use water recycling systems which recycle a minimum of 75 percent of the water used. This requirement does not apply to small operation auto detailers or similar uses.

4. No automatic toilet flushing fixtures without sensors shall be allowed in new or retrofit construction.

5. Kitchens in which dishwashers are installed must use Energy Star rated dishwashers.

6. All facilities installing clothes washers are required to install Energy Star qualified commercial clothes washers rated equal to or below the lowest current Energy Star Water factor.

7. The use of air-cooling misters is prohibited in commercial and industrial developments.

8. All new multi-family development exceeding four units shall provide independent-unit metering (water meter for each dwelling unit), with the following exceptions:

a. Multi-family complexes providing 80 percent or more low- to moderate-income housing units, as defined by the federal office of Housing and Urban Development, may provide alternative water-saving design methods in lieu of the use of independent-unit metering. The burden of proof is on the applicant to show that an equivalent, or greater, water savings will be achieved.
b. Alternative water-saving methods to include, but not be limited to the following, may be considered by the Director and permitted in lieu of the use of independent-unit metering:
(1) Super insulation.
(2) Short hot-water line run distances (core plumbing systems).
(3) Ratio Utility Billing Systems (R.U.B.S. – as allowed under applicable state law).

C. Existing Buildings. In existing buildings or premises in which plumbing installations are to be replaced, such replacement shall comply with all code requirements for water-saving devices.

Section 151.16.003
Water Use Regulations – Outdoor Areas

A. Water for Parks and Golf Courses.

1. All parks shall use medium- and low-water use plants as per the requirements in Section 151.15.007 or as allowed by the Director. High-water-use turf or other restricted plants shall be allowed only in those areas with heavy usage, such as athletic fields and playgrounds.
2. All golf courses shall use medium- and low-water-use plants as per the requirements in Section 151.15.007 or as allowed by the Director.
3. The water source used for new golf course irrigation shall consist of reclaimed wastewater, harvested rainwater, or an alternative water supply other than groundwater.
4. All new golf course development shall limit turf areas to 5 acres per hole.
5. New ponds, lakes, artificial watercourses, and other types of water hazard areas shall be prohibited except as described in Section 151.16.003 B 1 and 2, except for holding ponds used for treated effluent being used for permitted irrigation purposes.
6. All golf courses shall be approved as conditional uses.

B. Other Areas

1. Ponds, fountains, functional holding ponds, or other reservoirs that are supplied in whole or in part by any water supply shall not exceed 500 square feet of surface area unless approved by the Director.
2. Multiple water features on the same property will be considered together to determine surface area.
3. Flowing water used in fountains, waterfalls, and similar features shall be recirculated.

C. Wasting water is prohibited.

D. Landscaping Requirements. In accordance with the provisions of Article 151.15.

E. Residential Turf Restrictions. In accordance with the provisions of Article 151.15.

1. The use of turf in new single-family residential development shall be limited to rear yard areas only.

APPENDIX B: Reclaimed Water End Use Standards[i]

Reclaimed water quality standards are found at *A.A.C. Title 18, Ch. 11, Art. 3, R18-9-301 through 309.* This article, enacted in 2001, established five classes of reclaimed water based on protection of public health and groundwater quality (A+, A, B+, B, and C). Allowable end uses are listed corresponding with the water quality class designations.

Class A reclaimed water is:

- reserved for open access uses (access to the reclaimed water by the general public is uncontrolled)
- considered essentially pathogen free based on meeting a limit of no detectable fecal coliform organisms
- filtered to meet a 24-hour average turbidity limit of 2 NTU (nephalometric turbidity unit)
- acceptable for irrigation of food crops, residential and school ground landscape irrigation, toilet and urinal flushing, recreational impoundments, snowmaking, and other uses requiring highly treated water
- upgraded to the A+ designation if the water is further treated to remove total nitrogen to below 10 mg/l (that is the drinking water standard for total nitrogen)
- also acceptable for all Class B and C uses.

Class B reclaimed water is:

- allowable for restricted access uses (access to the reclaimed water by the general public is restricted)
- must meet a limit for fecal coliform organisms of 200 colony forming units per 100 ml (substantially equivalent to the ADEQ Surface Water Quality Standard for full-body contact)
- acceptable for irrigation of golf courses, orchards, vineyards, and other restricted access irrigation; landscape impoundments; livestock watering (dairy animals); concrete mixing; and similar designated uses
- upgraded to the B+ designation if the water is further treated to remove total nitrogen to below 10 mg/l (that is the drinking water standard for total nitrogen)
- also acceptable for all Class C uses.

Class C reclaimed water:

- must meet a fecal coliform limit of 1000 colony forming units per 100 ml
- is acceptable for certain restricted uses including irrigation of sod farms and fiber, seed, and forage crops; livestock watering (non-dairy animals); and silviculture.

Under this article, ADEQ may also set reclaimed water quality requirements for industrial reuse on a case-by-case basis.

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[i] Excerpted from the Draft Final Report of the Blue Ribbon Panel on Water Sustainability, November 17, 2010

APPENDIX C: Tucson Water Waste and Tampering Ordinance 6096

Since 1984, it has been illegal in Tucson to allow water to escape from private property onto another person's property or onto public property such as alleys and streets. The Water Waste and Tampering Ordinance reinforces the message that it is unethical as well as unlawful to waste water in Tucson. Updates to the ordinance were made in 1989 and again in 2000.

Tucson Water employs several citation officers or "water cops" who investigate all reported cases of water waste. They also look for evidence of water waste as they patrol Tucson's streets. The "water cop" usually issues a warning for a first-time violation and provides information to the individual about how to correct the problem. If the problem continues, a citation is written. Cited individuals have five days in which to act (pay a fine or contest the charge) or automatically be held liable. Under the law, water wasters can be fined up to $1,000. Depending on the circumstances, this ordinance also allows a property manager or landscape contractor to be cited for water waste in addition to the property owner.

Water-wasting activities that are prohibited include:

- Allowing water to escape from any premises onto public property, such as alleys or streets, or upon any other person's property.
- Allowing water to pond in any street or parking lot to a depth greater than ¼ inch or to permit water to pond over a cumulative surface area greater than 150 square feet on any street or parking lot.
- Washing driveways, sidewalks, parking areas, or other impervious surface areas with an open hose, or a spray nozzle attached to an open hose, or under regular or system pressure, except when required to eliminate conditions that threaten public health, safety or welfare. This restriction does not apply to residential customers.
- Operating a misting system in unoccupied non-residential areas.
- Operating a permanently installed irrigation system with a broken head or emitter, or with a head that is spraying more than 10 percent of the spray onto the street, parking lot, or sidewalk. This prohibition does not apply unless the head or emitter was designed to deliver more than one gallon of water per hour during normal use.
- Failing to repair a controllable leak, including a broken sprinkler head, a leaking valve, or a leaking faucet.

http://cms3.tucsonaz.gov/water/ord-6096