WESTERN RESOURCE
ADVOCATES

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March 13, 2013

The Local Waters Alternative To the Lake Powell Pipeline

I. Introduction

The Local Waters Alternative is a solution for meeting the future water demands of Washington County, Utah, without the development of the Lake Powell Pipeline. This pipeline, as proposed by the Utah Board of Water Resources, would deliver 69,000 acre-feet per year (AFY) to Washington County, and 4,000 AFY to Kane County.[1] In contrast, the Local Waters Alternative proposes greater water efficiency throughout Washington County, and demonstrates how, under the increased conservation scenario, local supplies can exceed demands by 20% in 2060 without the Lake Powell Pipeline. Local supplies include water reuse and agricultural water transfers. The Local Waters Alternative could cost about two-thirds less than the proposed Lake Powell Pipeline.

There is a clear need for this Local Waters Alternative. Basin-wide, demand for water from the Colorado River already outstrips annual supplies,[2] so any new withdrawals should be carefully scrutinized. However, the data used to establish Washington County's future water demands and supplies - and justify the Lake Powell Pipeline - contains numerous errors and assumptions that undermine its credibility. Specifically, current rates of water use are estimates applied across the county, as opposed to being derived from recently measured data, and the reported current water supplies and future estimates are inconsistent within and across the Draft Study Reports. In

[1] Originally the proposal also included 13,000 AFY to be delivered to Central Iron County, but the county has since withdrawn its request for water from this project, due to the proposal's high costs.
[2] U.S. Department of the Interior, Bureau of Reclamation. 2012. *Colorado River Basin water supply and demand study*. pg. SR-7. Retrieved from: http://www.usbr.gov/lc/region/programs/crbstudy/finalreport/index.html

addition, the water supply alternatives presented in the Draft Study Reports do not sufficiently explore the range of options to meet future water demands. Thus, this alternative, named the "Local Waters Alternative" is submitted as a viable No Action Alternative to the Lake Powell Pipeline.

The Local Waters Alternative projects future water demand in Washington County based on the most recent population projections from the State of Utah and is based on more ambitious yet realistic levels of conservation. It also recasts volumes of water that could be available to meet those demands from reuse and agricultural water transfers, and demonstrates that these options are more cost-effective than the Lake Powell Pipeline. The focus is exclusively on Washington County, since this County claims the largest need for this pipeline[3], and it has been established that Kane County already has sufficient water supplies to meet its demands through 2060 without the pipeline.[4]

The following sections present a revised future water demand based on the latest population projections (Section II), the Alternative to the Lake Powell Pipeline which features more conservation and greater emphasis on local supplies (Section III), and an economic analysis of this Alternative as compared with the Pipeline (Section IV). These analyses show that the Local Waters Alternative is a viable option for Washington County to meet its water demand with only local water supplies through 2060. The Local Waters Alternative should be included in the forthcoming Environmental Impact Statement (EIS) to be issued by FERC.

II. WATER DEMAND & SUPPLY

This section establishes a revised water demand projection for Washington County due to the recently revised population projections from the Utah's Governor's Office of Planning and Budget (GOPB), released in December 2012. This demand projection relies on the same per capita rates of water use (current and future) as those presented in the Draft Study Report 19 Water Needs Assessment.[5] Current and future supplies are also re-established based on information provided in Draft Study Report 19.

A. Updated Population and Water Demand Projections

Population projections are fundamental to future water demand projections. Draft Study Report 19, released in 2011, relied on population projections developed by the GOPB in 2008. In December of 2012, the GOPB released new projections, based in part on the US Census 2010

[3] MWH. 2011. Lake Powell Pipeline Study: Water Needs Assessment. Draft Study 19. Prepared for Utah Division of Water Resources. Pg. ES-5.
[4] MWH. 2011. Lake Powell Pipeline Study: Water Needs Assessment. Draft Study 19. Prepared for Utah Division of Water Resources. Pg. ES-24.
[5] MWH. 2011. Lake Powell Pipeline Study: Water Needs Assessment. Draft Study 19. Prepared for Utah Division of Water Resources.

survey. Importantly, the *actual* population in 2010, which was the baseline data year in Draft Study Report 19, was 17% lower than the 2008 projections estimated. Additionally, the GOPB lowered the projected growth rates over the 2010 – 2060 period, resulting in a 2060 population projection of about 582,000 people in Washington County, as compared with about 860,000 in the 2008 projection. This is a significant shift; one that is incorporated into the Local Waters Alternative and which should be incorporated into the FERC EIS analysis.

Accurate baseline water use data is also essential for developing future water demand projections. However, the reported water use rates in Washington County are only estimates, and not based on reliable or recent data. Draft Study Report 19 estimates that the per capita rate of use in Washington County in 2010 was 291.6 gallons per capita per day (GPCD). This estimate was derived from a complex process, which included using culinary (i.e. potable) water data from six cites in 2009, developing ratios from Division of Water Resources (DWRe) data in 2005, and making multiple, additional assumptions.[6] While this may have been a reasonable approach to create a rough estimate, it indicates that there is very little certainty in the accuracy of this number. This estimate is not a reasonable substitute for actual, measured annual water use data, when claiming a need for additional water supplies. <u>Thus, it is essential that actual, measured water use data be analyzed in the Environmental Impact Statement, before FERC license approval</u>.

Table 1 shows the original and revised population and water demand projections. The revised water demands rely on the same rates of per capita water use as provided in Draft Study Report 19. These rates of water use were determined by the project applicants based on the original State conservation goal, which was a 25% reduction in per capita water use by 2050. However, an important policy shift took place in January 2013; Utah's Governor Gary Herbert moved this target up to 2025. This change is <u>not</u> reflected in the figures below or in any subsequent analyses, because Washington County's conservation goals beyond 2025 are unknown. The effect of this policy would be to accelerate the County's conservation goals, resulting in a much closer alignment with the Alternative's conservation goals through 2025.

The projected demands below reflect the project applicants' original conservation goals (set forth in Draft Study 19) combined with the most recent population projections. It does not reflect the recent State policy shift in conservation goals. The result is water demand in 2060 that is 75,300 acre-feet per year less than the projected demands in Draft Study Report 19 for the year 2060. Using actual measured data would provide even greater accuracy in projecting future water demands.

[6] MWH. 2011. Study 19. Section 2.3

Table 1. Revised population and water demand projections made in 2012 are significantly lower than estimates from 2008. Total water demands (potable and non-potable) are expressed in acre-feet per year (AFY). Population and water values have been rounded to the nearest hundred.

	Revised Population and Water Demand Projections						
		2010	**2020**	**2030**	**2040**	**2050**	**2060**
Original	2008 GOPB Population Projection	168,100	279,900	415,500	559,700	709,700	860,400
	Draft Study Report 19 GPCD	291.6	275.4	263.4	254.3	247.5	241.6
	Draft Study Report 19 Projected Demand (AFY)	54,900	86,300	122,600	159,400	196,800	232,800
Revised	2012 GOPB Population Projection	138,700	196,800	280,600	371,700	472,600	581,700
	Draft Study Report 19 GPCD	291.6	275.4	263.4	254.3	247.5	241.6
	Revised Projected Demand (AFY)*	45,300	61,900	85,000	108,500	132,800	157,500
Difference between Original and Revised	Projected Water Demands (AFY)	9,600	24,400	37,600	50,900	64,000	75,300

*Calculated by multiplying the gpcd by the population and the number of days in a year (365), and dividing by the number of gallons in an acre-foot (325,851).

B. Current & Future Water Supplies

Current water supplies in Washington County also required estimation due to the data inconsistencies in Draft Study Report 19, which resulted in reported supplies that differ by as much as 15% (about 12,000 AFY). These inconsistencies are documented in Appendix A, and a critique of the supply estimation methodology used can be found in Appendix B. Thus, we request that consistent and well-documented water supply data also be a pre-requisite to properly establish the Purpose and Need in the forthcoming EIS, before any license approval.

At present, Washington County reportedly has 74,560 AFY of potable supplies and 7,450 AFY of secondary (non-potable) supplies, primarily from reservoirs, creeks, wells and reuse. These data were derived directly from Draft Study Report 19, although, as noted above, conflicting information is found in the report. These numbers were chosen because 1) they are reported most frequently in Draft Study Reports 19 and 2) they are reported most frequently in the cited reference documents.[7] The future supplies are identical to those identified in Draft Study Report 19, but do not include the Lake Powell Pipeline.

Table 2. According to the project proponent's assumptions, Washington County's planned future water supplies in Washington County will total over 123,000 acre-feet annually (AFY) by 2060 without the Lake Powell Pipeline. All figures have been rounded to the nearest 10.

	Potable (AFY)	Secondary (AFY)	Potable + Secondary (AFY)
Current Supplies	74,560	7,450	82,010
Future Supplies by 2060:			
Ash Creek	3,830		
Planned Agriculture Transfers		10,080	
Planned Reuse		27,620*	
Future Supply Totals	78,390	45,150	**123,540**

*Considered a maximum.

Figure 1 below illustrates how these future supplies compare with the revised demand projection. The resulting gap between demand and supplies in 2060 is at least 34,000 AFY, which is only half of the claimed need for 69,000 AFY from the Lake Powell Pipeline. It is worth noting that the predicted volume of reuse will decrease as a result of the smaller projected population. This is accounted for the in Local Waters Alternative. The project proponent's predicted gap in 2060 (about 33,500 acre-feet) does not sufficiently support the claim for needing 69,000 acre-feet water from Lake Powell. Beyond 2060, population growth and water demands are uncertain, and beyond water utilities' typical planning horizon of 30 years. Thus, the analysis is confined to the 2060 timeframe.

[7] WCWCD 2010 Water Management and Conservation Plan; WCWCD Capital Financing Program Amended 2006; DWRe 2009 Municipal and Industrial Water Supply and Uses in the Kanab Creek/Virgin River Basin (data from 2005); DWRe 2009 State of Utah Municipal and Industrial Water Supply and Use Studies (data from 2005).

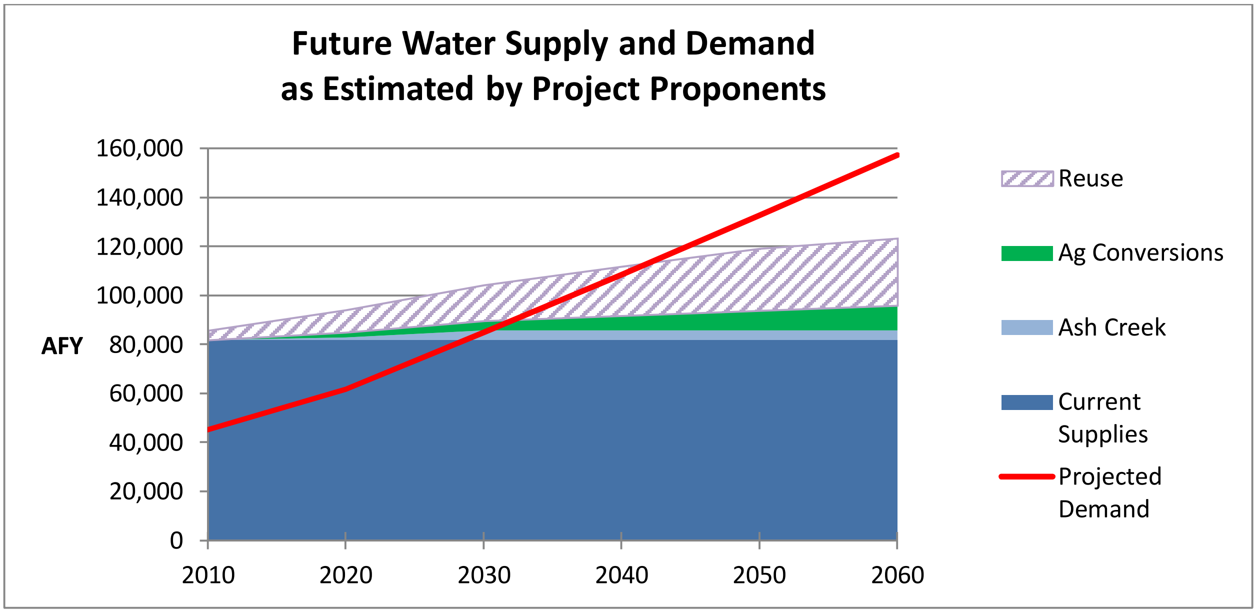

Figure 1. According to the project proponent's assumptions, Washington County could have a 34,000 acre-foot gap between projected water supplies and demands in 2060. Volumes of water are shown in acre feet per year (AFY). The volume of reuse water could be lower than originally predicted, and so it is shown with lines to indicate this variability.

The following section describes the Local Waters Alternative, which emphasizes water conservation as a solution to closing the gap between water supply and demand.

III. Local Waters Alternative

The Local Waters Alternative is divided into three parts. Section IIIA summarizes the Alternative to the Lake Powell Pipeline, which features lower demand for water through conservation and greater volumes of water supplies from local resources. Section IIIB describes in detail a realistic and achievable conservation plan that will significantly reduce future water demands, and Section IIIC describes in detail the volumes of future water supply from reuse and agricultural water transfers. Implementing each of these strategies will close the supply and demand gap in Washington County, and obviate the need for the Lake Powell Pipeline.

A. Local Waters Alternative Summary

The distinguishing feature of the Local Waters Alternative is the emphasis on greater conservation. Future per-capita demand is modeled to decline by 1% per year – that is, every year per capita water use will decline by 1% based on each previous year's level of per capita water use, through 2060. This is a conservation rate that has been achieved by numerous water agencies in the Colorado River Basin, and results in a per capita water use rate in Washington

County in 2060 that is comparable with water use rates in other municipalities *today* in the Colorado River Basin. Importantly, this rate of conservation is achievable and goes a long way toward closing the supply and demand gap, reducing total demands in 2060 by over 42,000 AFY.

Figure 2 depicts this demand scenario along with future water supplies in Washington County under the Local Water Alternative. Each water supply is phased in incrementally over time, resulting in a water supply in 2060 that is between 116,300 – 138,000 AFY, exceeding projected demands. Importantly, these alternative supply options can be developed in different ways at different times, allowing for greater flexibility in meeting future water needs. Thus, under the Local Water Alternative, there is no need for additional water from the Lake Powell Pipeline even by 2060.

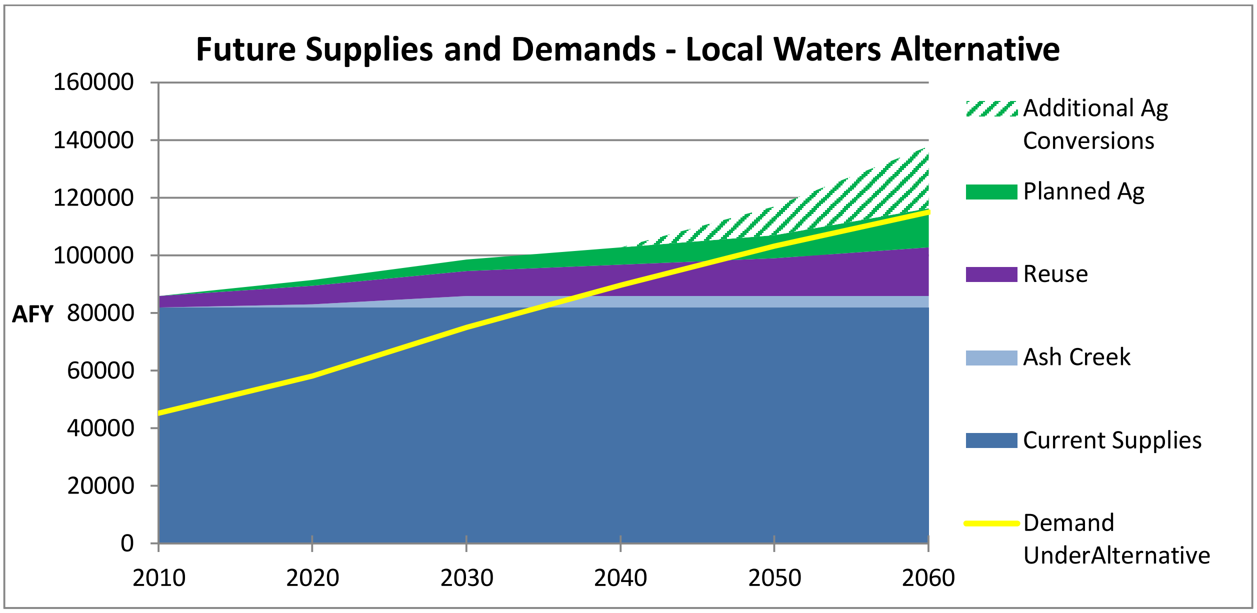

Figure 2. **Under this Local Waters Alternative supplies can meet and exceed water demands through 2060 and beyond.** Water volumes are shown in acre-feet per year (AFY).

B. Alternative Demand –1% Conservation Per Year

The Local Waters Alternative features a steady 1% reduction in per capita future demand, based on each previous year's per capita water use. This conservation strategy would result in a total water demand of about 115,000 AFY in 2060, lower than projected future supplies identified under this Alternative. The Local Waters Alternative features reductions across all sectors and identifies numerous pathways to achieve the 1% goal overtime, which is markedly different from the Draft Study Report 22 Alternatives report[8] which considers only the near elimination of outdoor residential water use as the sole conservation strategy.[9] The following sections

[8] Utah Board of Water Resources. 2011. Draft Study Report 22, Alternatives Development.
[9] *Ibid*, pgs. 3-8

demonstrate in detail that a 1% annual decrease in demand is both achievable and an economically viable option for Washington County.

The 1% Conservation Rate

Washington County water providers can reduce per capita water use by 1% per year, starting in 2010 and extending out to 2060, with reductions based on each previous year's use. Over the 50 year timeframe, this represents a nearly 40% reduction in per capita use from 2010 levels. This is a common rate of conservation improvement, based on the achievements of many cities in the west. Moreover, it results in a per capita water use rate in 2060 that has already been achieved or surpassed by many western cities *today*.

A recent survey of 100 cities and water agencies in the Colorado River Basin found that "the majority of people receiving water from the Colorado River basin live in areas where <u>per capita deliveries dropped an average of at least one percent per year</u> from 1990 to 2008" (emphasis added).[10] Some of water agencies that achieved per capita declines of 1% or more per year are located in Salt Lake City, Provo, West Jordan, Orem, Springville and Pleasant Grove.[11] Twenty-eight of 100 water agencies surveyed reduced *total* water deliveries despite seeing increases in population over the same period of time.[12] And although St. George was not among the regions to reduce per capita water use by 1% per year (between 1990 and 2008), in 2008 St. George anticipated that their per capita water use would decline by 1.5 – 2% per year in the years going forward as a result of their conservation program efforts. [13]

Outside the Colorado River Basin, the State of Texas has adopted this same conservation goal. The State convened a Task Force in 2004, which ultimately recommended a 1% per capita water-use reduction goal, driving their system-wide water use down to 140 gallons per capita per day.[14,15] Already, dozens of utilities in Texas have met this goal, and as a result of their success they have set new, lower goals.

A 1% rate of conservation in Washington County would result in a total demand of 115,000 AFY in 2060, with a system-wide water use rate of 176 gallons per capita per day (gpcd). In contrast, the conservation plan proposed in Draft Study Report 19 would result in a total demand of 158,000 AFY and a system-wide water use rate of 242 gpcd in 2060. The conservation

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[10] Cohen, M. J. 2011. Municipal Deliveries of Colorado River Basin Water. Pacific Institute. pg. iii
[11] *Ibid.* pg. 31
[12] *Ibid.* pg. iii
[13] City of St. George. 2008. Water Conservation Plan Update.
[14] S.B. 1094, 78th Leg., Reg. Sess. (Tex. 2003).
[15] Water Conservation Implementation Task Force, Texas Water Development Board Special Report. Report to the 79th Legislature, at 5-6 (2004). Available at: http://www.conservewatergeorgia.net/resources/TX_Conservation_Task_Force_Recs.pdf

proposal in Draft Study Report 19 represents an average annual conservation rate of 0.37% per year, using the same methodology described earlier. While this target meets or exceeds the State's water reduction goals, it is considerably less ambitious than other cities' goals (see Figure 4 and Figure 5).

The water conservation rate proposed by the project applicants, just like the Local Waters Alternative, includes *passive* conservation. Passive conservation is the conservation naturally achieved due to the replacement of older water-using devices, with newer, more efficient ones. This effortless level of water conservation is estimated to be 0.30% per capita per year, according to the State of Colorado's Statewide Water Supply Initiative study.[16] This same rate is applicable to the State of Utah because it is dependent primarily on national plumbing standards and appliances or fixtures that are sold nation-wide, rather than particular local policies or individual water use patterns. Notably, passive conservation may be even greater than is assumed here because of California's water-efficiency legislation and large market-share which has the power to influence national appliance manufacturing standards. Thus, Washington County's *active* conservation efforts will only amount to a 0.07% reduction per capita per year, which is not a significant savings beyond what would be achieved without any plan at all.

Moreover, the County's proposed conservation target is significantly lower than it has been in the past. The proposed plan would result in a total reduction of 17% in per capita use from 2010 to 2060. However, the County has *already* achieved a 13% reduction in per capita use in just <u>nine</u> years (2000-2009). In addition, based on the suite of conservation programs that the county plans to undertake in the coming years[17], it is very likely that the County will exceed its own, modest projections. While the first conservation savings are often the easiest to achieve, it is clear that the County can achieve much more over the course of the next 50 years given the experience of other utilities within the arid West.

[16] Colorado Water Conservation Board. 2010. Statewide Water Supply Initiative. Denver, CO.
[17] MWH. 2011. Lake Powell Pipeline Study: Water Needs Assessment. Draft Study 19. Prepared for Utah Division of Water Resources. Pg 5-13

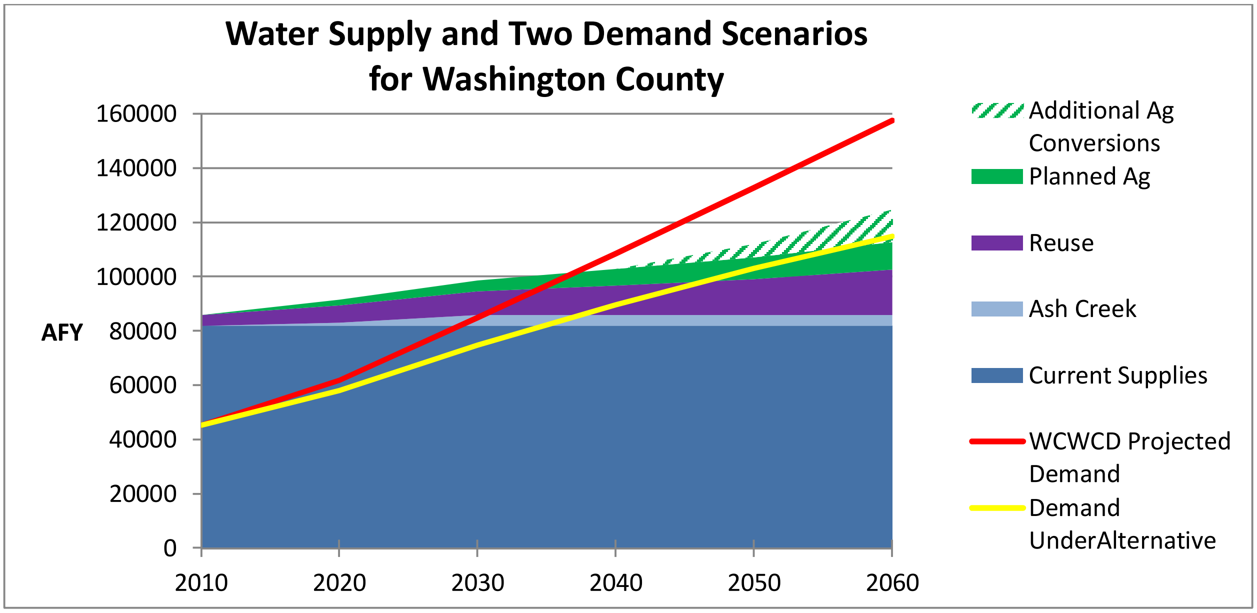

Figure 3. A one percent annual reduction in water use each year will result in a 2060 water demand that is 42,500 AFY lower than the WCWCD's projected demand.

Feasibility of Proposed Rate of per Capita Water Use

Washington County reportedly had a system-wide total water use rate of 292 gallons per capita per day (gpcd) in 2010, which includes both culinary (potable) and secondary (non-potable) water across all sectors. System-wide *potable* use and *residential* only water use are standard units of measurement used by states, water utilities, and water professionals all across the country. Thus, Washington County's reported system-wide use is broken down into these two categories, using water data from the State of Utah. [18] System-wide potable use (culinary water, not secondary water, used by residents, businesses, industry, government, etc.) was 241 gpcd in 2010, and total *residential* water use (potable and non-potable) was 178 gpcd in 2010. These rates of water use are compared with 30 cities throughout the western United States that were surveyed by Western Resource Advocates in separate reports in 2006[19] and 2008.[20] Washington County lands at the high end of the water use spectrum in both cases.

[18] This is derived from the DWRe 2005 Kanab Creek/Virgin River M&I Water Use Report. It assumes the same ratio of water uses by sector and water type as listed in this report, which Study 19 also relied upon. See Appendix B for all details regarding all GPCD computations and comparisons.
[19] Hutchins-Cabibi, T., Miller, B. 2007. Front range water meter: water conservation ratings and recommendations for 13 Colorado communities. Boulder, CO. Western Resource Advocates.
[20] Beckwith, D., Figueroa, J. 2010. Arizona water meter: a comparison of conservation programs in 15 Arizona communities. Boulder, CO. Western Resource Advocates.

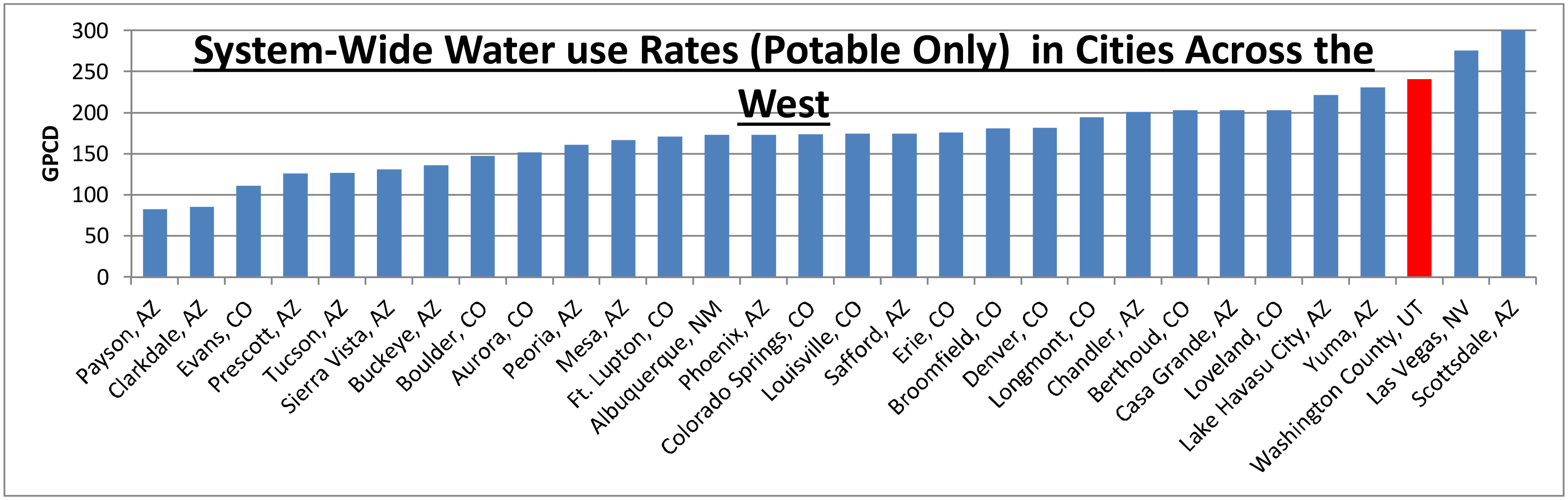

Figure 4. Washington County's average system-wide water use in 2010 is among the highest of 30 communities in the West. These rates of water use are measured in gallons per capita per day (gpcd), and represent potable water used in the residential, commercial, institutional and industrial sectors.

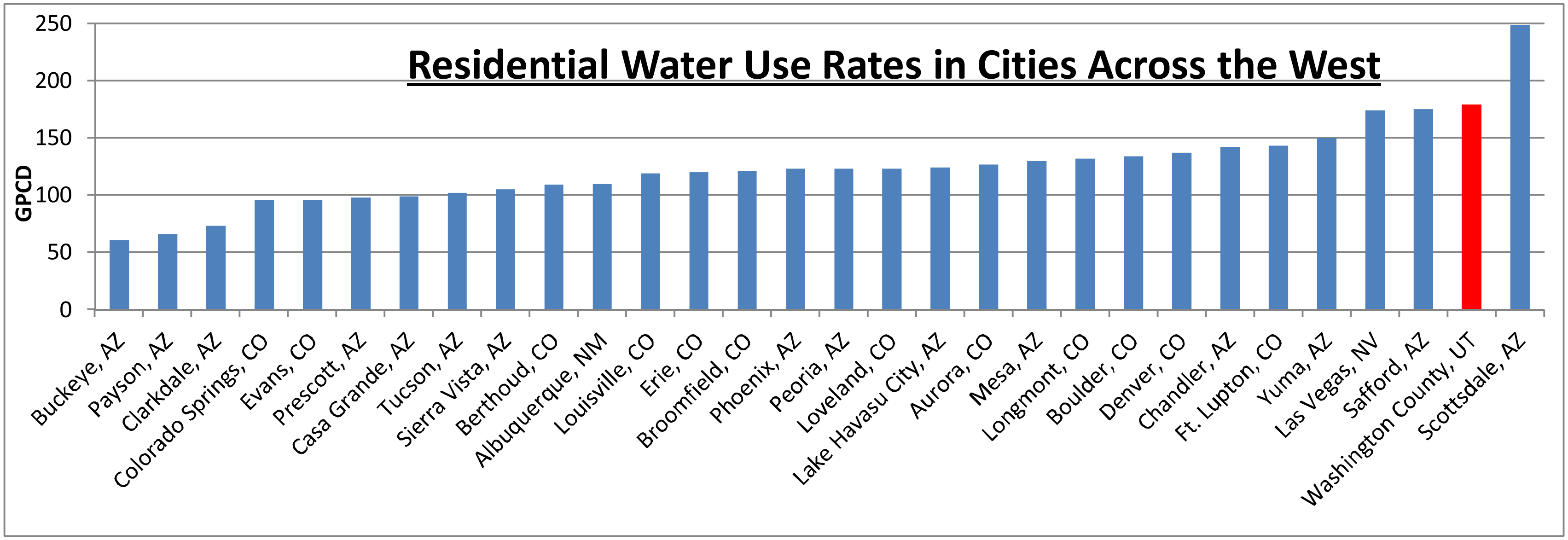

Figure 5. Washington County's average residential water use is second highest when compared to residents in 29 other communities in the West. These rates of water use are measured in gallons per capita per day (gpcd), and include both potable and non-potable water.

The Local Waters Alternative would have Washington County achieve a system-wide total water use rate of 176 gpcd by 2060. This implies a system-wide *potable* water use rate of 118 gpcd, and a residential water use rate of 90 gpcd, based on Table 3. This would place Washington County's system-wide potable use near the low-end of current water use rates in the west, just below Prescott in Figure 4, and this residential water use rate would place the County be just below Colorado Springs in Figure 5. Washington County would achieve these levels of water use over the course of 50 years, whereas these cities have achieved this a few years ago. If instead Washington County adhered to their own proposed conservation rate, in 50 years they would have water use rates higher than 70% of the cities portrayed in Figure 4 and Figure 5.[21]

Table 3. An example of how system-wide 176 GPCD water use rates could be distributed across all sectors. This hypothetical allocation is based on the distribution of water as reported in the DWRe 2005 Kanab Creek/Virgin River M&I Water Use Report, but total residential water use is fixed at 90 gpcd and culinary and secondary demands have been balanced to reflect the proposed supply portfolio (roughly 70% culinary, 30% secondary).

1% Conservation Scenario – 176 gpcd in 2060			
	Culinary	Secondary	Total
Res Indoor	35	0	35
Res outdoor	25	30	55
Commercial	35	15	50
Institutional	20	13	33
Industry/stock water	3	0	3
Subtotals	118	58	**176**

Despite the preponderance of data suggesting that Washington County does in fact have high water use, the Washington County Water Conservancy District (WCWCD) has claimed that such comparisons are not appropriate for two main reasons, which are addressed here:

- Washington County claims gpcd comparisons are unfair because 27% of their water users are seasonal residents, and thus not accounted for in the permanent population.
  - After adjusting for the seasonal population, the County's water use rates are still relatively high, compared to other cities. With this adjustment, Washington County's 2010 system-wide potable use would be 205 gpcd (between Loveland and Lake Havasu City in Figure 4) and the total residential use would be 138 gpcd (between Denver and Chandler in Figure 5). It should be noted that none of these cities make similar adjustments, even though some of them also have seasonal populations (e.g. university students, second homes, etc.). Additionally, because these data are several years old

[21] Assumes the ratio between users and potable and non-potable water remains the same, as was assumed in Draft Study Report 19.

(from 2006 and 2008), many of these cities have reduced their water use rates below what is reported in both figures.

- Washington County suggests its hot, dry climate makes GPCD comparisons unfair.
  - Several cities have similar, or even drier and hotter, climates and still use less water, as documented in Appendix C. Moreover, hotter and drier temperatures have little impact on indoor use, which accounts for a significant percentage of total annual use.

For these reasons and others explained in Appendix C, special adjustments are not made for Washington County's rate of water use in subsequent calculations and comparisons. The following section explains in detail the feasibility of attaining 90 gpcd in the residential sector.

90 GPCD in the Residential Sector

Setting a target of 90 gpcd for residential water use (indoor and outdoor) by 2060 is a realistic goal that will require a sustained, long-term effort, yet will not require onerous lifestyle changes or landscape modifications beyond those already implemented in many communities across the Mountain West, including many in Washington County. Published literature and technical studies indicate that a 35 gpcd indoor residential goal, and a 55 gpcd outdoor residential goal, can be achieved within the next 50 years *with current technologies and practices*. If water conservation technologies further improve by 2060, these residential gpcd targets will be conservative.

Indoor Residential Water Use Target: 35 gpcd

Because people typically do the same things inside a home, (cook, clean, wash clothes, shower, etc.), the variation of indoor residential per capita water use across the U.S. is low. Indoor water use is commonly determined through end-use studies, where data loggers are used to record flows through a household water meter in short time increments (10 seconds or less). These data can then be processed in a way that identifies which fixture or appliance in the home was using the water. By logging multiple homes over an extended period of time, a water provider can estimate the amount of water used by residential customers for various purposes.

One recent end use study conducted by Aquacraft found that new homes built with fixtures and appliances using the best available water efficiency technology (similar to those built to EPA WaterSense New Home specifications) *currently* achieve an indoor GPCD of 36.[22] Existing homes can also reduce their current water use to 35 gpcd through existing retrofit technology.

In 2011, the Albuquerque Bernalillo County Water Utility Authority (Albuquerque) conducted a retrofit study of single-family high water users to estimate the conservation potential of high

[22] Aquacraft. 2011. *Analysis of Water Use in New Single-Family Homes*. July 20. Accessed October 2, 2012. http://www.aquacraft.com/node/64.

efficiency retrofits and appliances. Albuquerque found that its single-family residential high water users achieved a water use rate of 31 gpcd after implementing a retrofit program.[23]

In addition, the State of Colorado's Statewide Water Supply Initiative (SWSI) established a 35 gpcd goal for indoor residential water use under their medium conservation strategy. SWSI's conservation study describes the methodology to achieve this level of savings, and provides extensive documentation that supports this demand reduction strategy.[24] Thus, numerous studies show that a 35 gpcd target for indoor water use is achievable with *current* technologies and practices. Taking into account that these technologies and practices are expected to improve in the next 50 years, a 35 gpcd target for indoor single-family residential water use is not only achievable, but a conservative goal for Washington County in 2060.

Outdoor Residential Water Use Target: 55 gpcd

Single-family homes in Washington County can reasonably achieve outdoor water use of 55 gpcd and have a lush, vibrant landscape. Provided here is a design for an outdoor landscaped area of average size for a single family residential home in Washington County - 6,500 sq. ft. – with an average household population of 2.8 people.[25] Notably, as the population grows in Washington County it is likely that lot sizes will decrease, making this outdoor water target even easier to achieve.

The landscape plan has 600 sq. ft. of turf (i.e. grass), plants from the Washington County Plant List, and includes permeable hardscape design such as stone walkways and communal areas that allow rain water to filter slowly into the ground (see Table 4 and Figure 6). The Washington County Plant List provides many beautiful native and climate-appropriate trees, shrubs, and perennial flowers that can provide a beautiful landscape ideally suited to the region's ecology. Native and climate-appropriate plants are self-sustaining, and support beneficial insects, pollinators, and native birds that are critical to the region's unique desert ecosystems. Generally, the evolutionary adaptations of these plants also makes them better able to withstand extreme weather events, and results in fewer chemicals needed to fend off pests and disease.

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[23] Aquacraft. 2011. Albuquerque Single-Family Water Use Efficiency and Retrofit Study. December 1. Accessed October 2, 2012. http://www.aquacraft.com/sites/default/files/pub/Aquacraft-(2011)-Albuquerque-Single-Family-Water-Use-Efficiency-and-Retrofit-Study.pdf.

[24] Colorado Department of Natural Resources, Colorado Water Conservation board. 2011. "Appendix L – SWSI 2010 Municipal and industrial Water conservation Strategies." In *Colorado's Water Supply Future, Statewide Water Supply Initiative 2010.* Denver, CO. January. Accessed October 2, 2012. http://cwcb.state.co.us/watermanagement/watersupplyplanning/Documents/SWSI2010/Appendix%20L_SWSI%202010%20Municipal%20and%20Industrial%20Water%20Conservation%20Strategies.pdf.

[25] US Census Bureau. American Fact Finder. DP04-Selected Housing Characteristics: 2006-2010 American Community Survey 5-Year Estimates, Washington County, Utah. The median cost of a single family residence in Washington County is $240,900. The average landscaped area for single family residences (6,600 sq. ft.) in Washington County was calculated by averaging the non-built area of the lots of houses for sale in Washington County (September 6, 2010, http://www.utahhomes.com/Property/PropertySearch.aspx) within the price range of $240,000 - $250,000.

Drip irrigation is featured in this design. It results in the use of 4,625 gallons of water per month, and these watering requirements relate to post-establishment of the landscape (i.e. water needed during installation of the landscape is not included in the GPCD calculations). Drip irrigation (and its maintenance) for the turf area is assumed to be an economically viable alternative to a fixed automatic spray or rotor irrigation system that would be installed by a licensed landscape contractor.[26] The EPA's GreenScapes cost calculator was used to estimate the water requirements and compare the cost of irrigating this landscape with a sub-surface drip irrigation system with a rain shut-off valve, and with a traditional sprinkler system. Using this calculator, an average a drip irrigation system uses 60% less water per year and is cost competitive when compared with a traditional sprinkler system.

Thus, 90 gpcd - 35 indoor, 55 outdoor - for new and existing homes is an entirely feasible option that does not necessitate the virtual elimination of residential outdoor watering, as proposed in Draft Study Report 22: Alternatives Development.[27]

Table 4. Outdoor water use at a rate of 54 gallons per person per day is achievable under landscape Scenario 1. This is even lower than the proposed level under the Local Waters Alternative.

Plant Type / Landscape Feature	Area[a] (sq.ft.)	Water Use[b]	Irrigation Type	Required Water (gal/month)
Turfgrass	600	Low	Drip-Press Comp	2,746 [c]
Shrubs & Perennial Flowers	814	No-Low	Drip-Press Comp	1,225 [c]
Trees	2,179	No-Low; Low	Drip Irrigation	654[d]
Mulch	3,386	NA	NA	0
Permeable Hardscape	1,700	NA	NA	0
			Total Water Required	4,625

[a]The total area is 6,500. However, the summation of all listed areas is larger due to the overlapping tree canopies.
[b]Plants and water use categories from Washington County Plant List (Updated March 31, 2010).
[c]Monthly landscape water requirement is based on the peak watering month for St. George, UT, assuming an average monthly reference ET of 11.09 inches/month, and an average monthly rainfall for the peak watering month of 0.18 inches/month. All calculations made with the EPA Water Budget Tool (V 1.01) for the WaterSense Single Family New Home Specification.
[d]Drip irrigation calculations are based on irrigating 5-6 inches/sq. ft./season the whole mature plant area of the desert trees (diameter of crown diameter squared x 0.7854) minus the area extending 3 feet from the base of the trees, using a 90% efficient drip system.

[26] A fixed automatic spray or rotor irrigation system, installed by a licensed landscape contractor, is required in all new developments in St. George under the St. George Landscape Standards Ordinance. ST. GEORGE, UTAH, CODE §§ 10-25-3(C)-(D).
[27] Utah Board of Water Resources. 2011. Draft Study Report 22: Alternative Development. pg 3-6.

PLANT LIST

KEY	BOTANICAL NAME	COMMON NAME	QTY
A	Penstemon palmeri	Palmer's Pestemon	9
B	Juniperus x pfitzeriana 'Sea Green'	Sea Green Juniper	3
C	Dalea pulchra	Indigo Bush	30
D	Vauquelina californica	Arizona Rosewood	3
E	Coreopsis sp.	Coreopsis	60
F	Robinia ambiqua idahoensis	Idaho Locust	1
G	Muhlenbergia rigens	Deer Grass	32
H	Chrysothamnus nauseosus	Rabbitbrush	5
I	Oenothera sp.	Evening Primrose	36
J	Hesperolae parviflora	Red Yucca	14
K	Perovskia atriplicifolia	Russian Sage	13
L	Acacia smallii	Sweet acacia	2

PLANT LIST

KEY	BOTANICAL NAME	COMMON NAME	QTY
M	Wisteria sinensis 'Texas'	Texas Wisteria	2
N	Chitalpa tashkentensis 'Pink Dawn'	Chitalpa	1
O	Juniperus media "Holbert"	Holbert Juniper	8
P	Leocophyllum frutescens	Texas Ranger	20
Q	Prospis glandulosa	Honey Mesquite	2
R	Atriplex canescens	Fourwing Saltbush	13
S	Juniperus scopulorum 'Skyrocket'	Skyrocket Juniper	4
T	Cercidium 'Desert Museum'	Desert Museum Palo Verde	1
U	Lepidium fremontii	Fremont's Primrose	24
V	Pinus eldarica	Afghan pine	2
W	Coraderia selloana 'Dwarf'	Dwarf Pampa Grass	15

Figure 6. Landscape design for an average home in Washington County, based on a water use rate of 54 gallons per person per day. This design features native, low-water use plants and a small area of turf.

86 GPCD in the Commercial, Institutional and Industrial Sector

The commercial, institutional and industrial (CII) sector comprises the remainder of water demands in the county. Very little data is available regarding efficient levels of water use in this sector, for a number of reasons. First, every municipality has a different mix of businesses, industries and institutions, each of which exhibits different water use patterns. Secondly, many private businesses do not like to publicize data about their operations voluntarily, and so data is generally unavailable. However, one can infer from the data provided in Figure 4 and Figure 5 that this is a reasonable target because Washington County's *future* system-wide use would be at the low-end of how cities are using water "today". A more detailed study of water use patterns in the CII sector in Washington County would help to inform this 86 gpcd projection, and would also help the county as they plan for a strong economic future.

Implementation Pathways

This section outlines a few key conservation measures that will strengthen current initiatives already underway, with the intent of achieving a system-wide water use rate of 176 gpcd. All major cities in Washington County have made significant reductions in their system-wide and residential water use over the past decade. Although the County may have captured some "low-hanging fruit" (i.e., the easiest and cheapest conservation measures), numerous conservation strategies have yet to be utilized, all of which will create continued reductions in water use.

WCWCD contracted with Maddaus Water Management to review conservation program options, costs and benefits. [28] Based on this analysis, WCWCD adopted the mid-level program, which is a list of 25 indoor and outdoor conservation measures, known as Program B. Given this list it seems likely that the County will <u>exceed</u> their modest conservation target (i.e. use even less water). However, in addition to this list of programs, the following four key measures will embed water conservation into the structure of the community, beyond basic appliance replacement incentives and education efforts. Specifically, it is recommended that Washington County water providers and cities:

1) Implement an increasing block conservation rate structure, or improve existing rate structures, to send a stronger price signal to customers;
2) Meter all water - culinary and secondary - so that providers can document and track where water is used. With this information, utilities can identify leaks or other sources of unaccounted for water, and develop the most effective conservation programs appropriately targeted at the residential, commercial, industrial and institutional sectors;
3) Embed water efficiency into public spaces and new developments; and,
4) Implement smart growth principles.

[28] MWH. 2011. Lake Powell Pipeline Study: Water Needs Assessment. Draft Study 19. Prepared for Utah Division of Water Resources. Pg 5-13.

The first two are directly controllable by municipal water utilities servicing their customers. The latter two require cooperation with local, and perhaps state, planning agencies. In all cases, the WCWCD can play a helpful and pivotal role in the success of each measure.

Recommendation 1. Implement Conservation-Oriented Rate Structures

Effective conservation rate structures feature a low, affordable rate for the first block of water use, which typically covers the amount of water used indoors, and then increases the rate substantially for subsequent volumes of water used, sending a strong signal to customers about the value of water. This has been a key strategy for reducing water use in western communities; water rates are one of the most effective - and cost effective[29] - conservation measures. Moreover, this is a low/no cost strategy to encourage conservation, and bolsters a utility's ability to encourage conservation practices and use of water-efficient devices. When designed properly, conservation rate structures also provide a stable revenue stream for the utility.

WCWCD has implemented a conservation oriented block rate structure. However, its effect is weakened significantly because: 1) about half of WCWCD's revenue is derived from property taxes, which effectively subsidizes the cost of water, keeping the price per gallon very low[30], and 2) WCWCD is primarily a wholesaler, and *conservation oriented* block rate structures have not been replicated by the largest city, St George, nor by the cities of Santa Clara, Hurricane, Ivins, La Verkin, Leeds, Virgin and Washington.[31] Although most of these cities have adopted "increasing block rate structures", they are not *conservation oriented*, in that they are not yet designed to provide an adequate price signal when a customer uses excessive amounts of water. Figure 7 illustrates the difference between these kinds of rate structures. The marginal price indicates the cost for each 1,000 gallons of water used, across increasing levels of water use, up to a maximum of 50,000 gallons per month. St. George, Santa Clara and Hurricane have relatively flat rate structures compared to Tucson and the WCWCD. Flat rate structures do not send a price signal to customers when they use large amounts of water. This is in direct contrast to residents of Tucson, AZ, for example, whose customers see the average price of water increase significantly as their water use increases.

[29] Mayer, P. 2009. Cost/Benefit Analyses for Water Conservation Planning. Presentation to Colorado WaterWise Conference: The Water Conservation Yardstick, April 2-3.
[30] The Utah Taxpayer Association. 2011. The Utah Taxpayer. Vol 61.
[31] MWH. 2011. Lake Powell Pipeline Study: Water Needs Assessment. Draft Study 19. Prepared for Utah Division of Water Resources. pg 5-7 & 5-8; http://www.ivins.com/utilities/business-license/128-utility-rates ; http://www.laverkin.org/attachments/082_fee%20schedule%20update%20080211.pdf ; http://www.leedswater.com/RATES_FEES.html ; www.virginutah.org/UTILITIES.html ; http://washingtoncity.org/services/index2.php?sub=FeeSchedule&key=3.

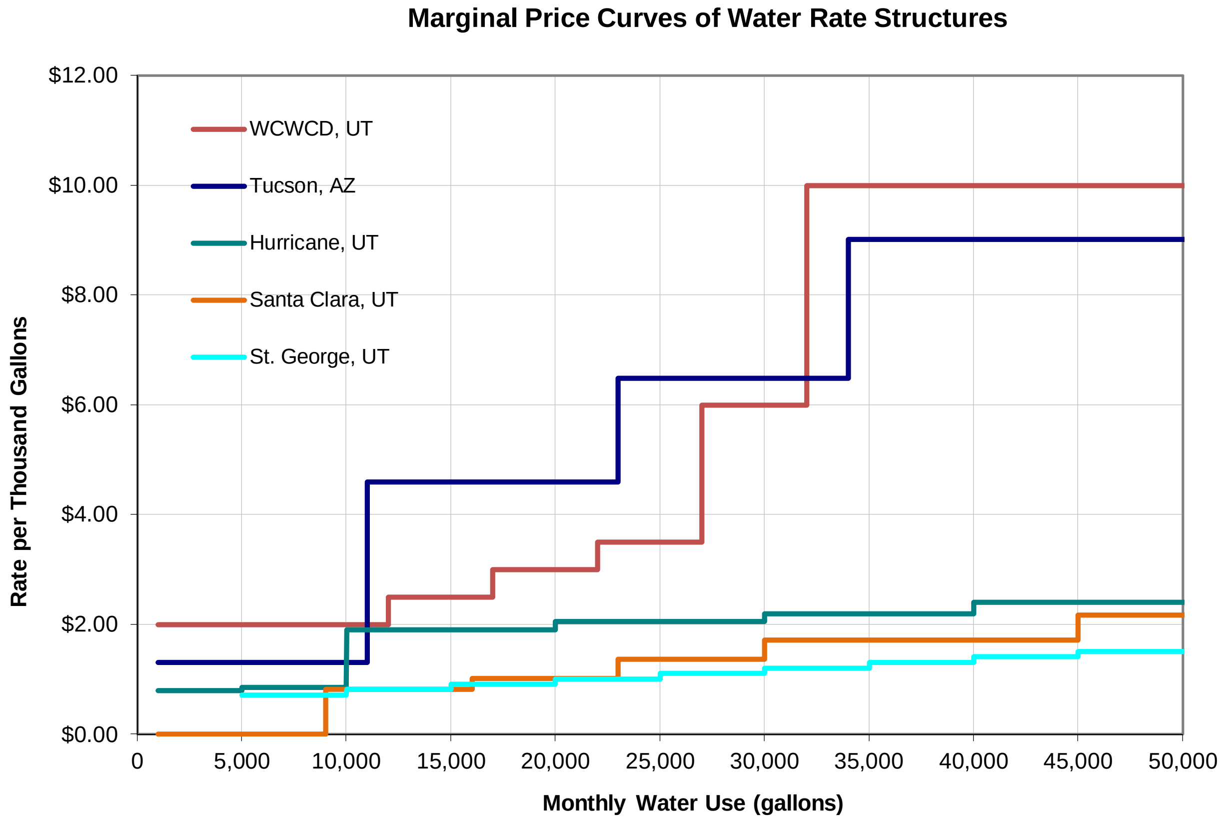

Figure 7. The price structures of water in St. George, Santa Clara, and Hurricane UT are relatively flat and do not send a price signal to customers when they use excessive amounts of water. This is in contrast with a conservation oriented rate structure, like in Tucson, AZ.[32]

Another way to see the effect of rate structures is to look at the average price curve, which is the average cost per 1,000 gallons and factors in the fixed price as well as the variable rate structure. A conservation oriented rate structure would result in the average price per gallon going up as consumption increases, communicating to the customer that the more water they use, the more expensive each gallon of water becomes. The communities of St. George, Santa Clara and Hurricane however do not have conservation oriented rate structures, and so the average price per gallon actually decreases or remains flat as more water is used sending no "price signal" to the customer.

[32] Tucson Water 2009 water rates.

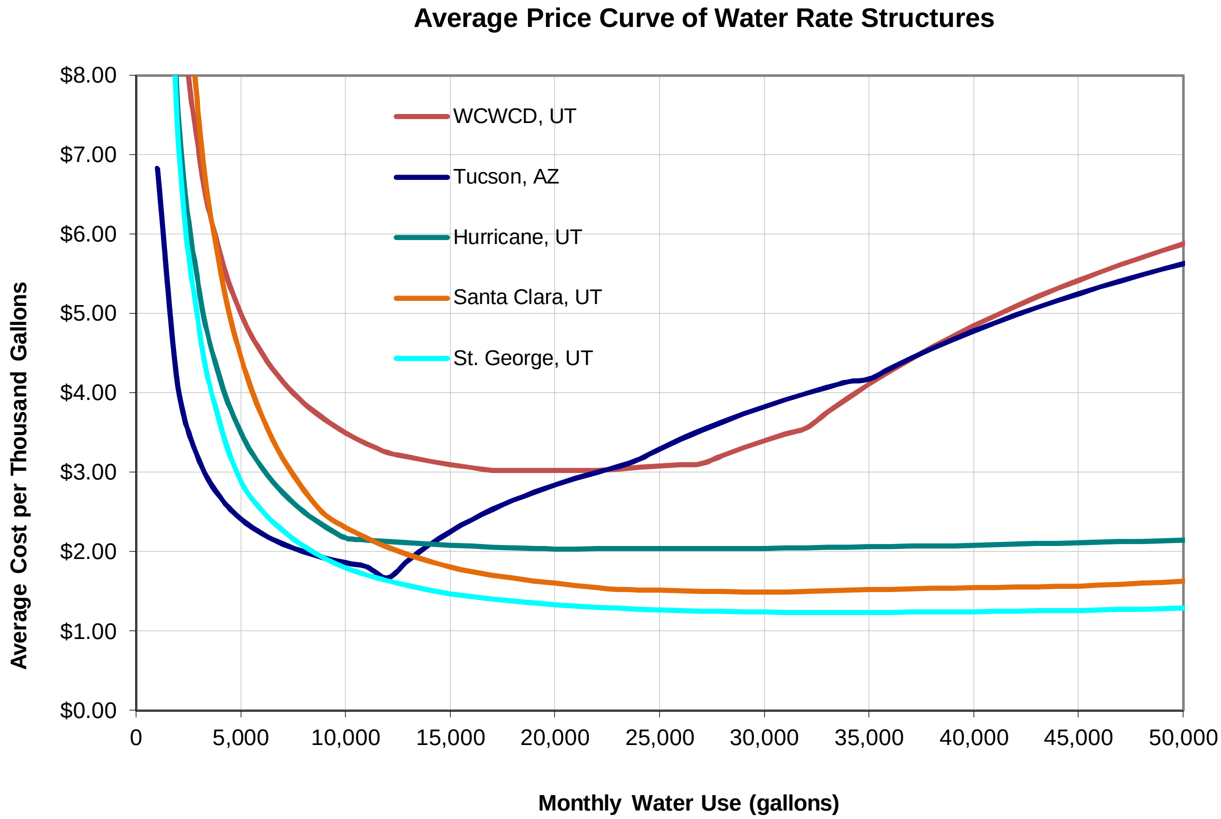

Figure 8. The average cost of water for residents in St. George, Santa Clara and Hurricane discourages efficient water use. The average costs decrease or remain flat as consumption increases (above 10,000 gallons per month). In contrast, WCWCD and Tucson, AZ price structure result in the average cost per 1,000 gallons going up as consumption increase above 10,000 gallons per month.

Recommendation 2. Meter & Report Culinary & Secondary Water

Metered data is a critical component of effective water conservation. There are significant short-comings in data reported by Washington County, signifying the need for accurate water use. Accurately metering and reporting water use data is a good business practice and necessary for designing equitable rate structures, designing effective conservation programs and detecting water losses. Detailed data on water use will not only enhance water utilities' understanding of where and when water is used, but it can also identify the largest users, creating the opportunity to achieve the largest gains in efficiency. In addition to retaining this information at the utility level, customers can be provided information about their own use in comparison with others' use to inspire water and financial savings.

The importance of metering systems was clearly demonstrated by Denver Water in Colorado, which estimated that 44 percent of the water savings they achieved in 1999 was attributed to their universal metering program.[33] Metering programs can help to reduce leakage in the system as well. In one example, water losses in Tucson moved from 12.5% down to 9%, saving about 4,000 AFY after several years of monitoring and metering. [34] Water loss management is almost always cost-effective because it not only reduces non-revenue water (water treated by the provider but no one pays for), but also saves the energy that was used to pump and treat that lost water.

At the most basic level, every water customer in Washington County should be metered. While this may seem obvious (for billing purposes), this kind of data was not aggregated and furnished for the benefit of the study plans for the Lake Powell Pipeline. New multi-family units (e.g. apartments) should also be sub-metered, and ideally secondary water should be metered as well. Automatic Meter Reading and Advanced Metering Infrastructure (AMR/AMI) is one widely used method that can take many different forms, and is recommended for its ease and the frequency with which data can be collected.

Recommendation 3. Embed Water Efficiency into Public Spaces and New Developments

Well-designed and properly managed water efficiency standards can play a unique role in achieving water use reductions. Because outdoor watering accounts for a significant amount of water use in Washington County (estimated to be 60% in 2005[35]), it should be a primary area of focus. Municipalities can determine the way public spaces are managed and how new developments are designed, and water providers can help shape and influence these land use decisions. Many stakeholders may be engaged with this process, such as water providers, elected officials, city planners, private industry and the general public. As the primary water provider for Washington County, WCWCD can help build consensus among the municipalities to increase water efficiency, for example by adopting effective ordinances. St. George has helped to set a precedent in the County by enacting the Landscape Standards Ordinance[36] but much more can be done. Importantly, ordinances are a relatively low-cost method to achieve water savings. The following list provides examples from other regions where water efficiency has been embedded into public spaces and new developments through standards or ordinances: [37]

- Low Water Use Landscaping Standards in Public Areas
- Water Tampering/Water Waste Restrictions

[33] Maddaus Water Management, Inc. (prepared for Denver Water), *Qualitative Review of Water Conservation Program,* May 2001, at 1-8.
[34] http://cms3.tucsonaz.gov/water/ and personal communications.
[35] Utah Division of Water Resources. 2005 Kanab Creek/Virgin River M&I Water Use Report.
[36] St. George City Code, Title 10 Chapter 25.
[37] WRA. 2010. Arizona Water Meter: A Comparison of Water Conservation Programs in 15 Arizona Communities.

- Plumbing Code Standards (beyond the 1990 Uniform Plumbing Code)
- Water Features/Water Intensive Landscaping Limitations
- Model Home Landscape Requirements (for new residential developments)
- On-site Graywater/Water Harvesting Requirements
- Car Wash Recycling Requirements
- Landscape Watering Restrictions
- Hot Water Recirculation Device Requirements
- Non-Residential Landscape Water-Use Efficiency Standards
- Water Use Plans for New Large Non-Residential Users
- EPA's WaterSense New Home Specifications

Recommendation 4. Implement Smart Growth Principles

The way in which a community grows can have a significant impact on future water demands. New, denser developments place much less demand on water distribution systems than traditional suburban development with large irrigated areas. Vision Dixie is a collaborative planning effort that incorporated a number of smart growth principles, with an explicit goal of relieving high water demands. Efforts such as these serve as a model to city and county planners, and should be looked to for guidance in urban planning.

Another example of a smart growth development is the Community of Civano that was built in in Tucson, Arizona. It was designed to be aesthetic, community oriented, and water and energy efficient. Residents there use an average of 52 gpcd of potable water and 25 gpcd of reclaimed water.[38] Thus, developers in Washington County can also play a significant and positive role in shaping the efficiency of new homes built in the region.

Summary of the 1% Conservation Alternative

In summary, the 1% water conservation alternative is a feasible and responsible solution to the water management issues facing Washington County. If implemented, it would result in total demand of 115,000 AFY in 2060, with a system-wide water use rate of 176 gallons per capita per day, similar to other communities' rates of water use today.

[38] Western Resource Advocates. 2003. Smart Water: A Comparative Study of Urban Water Use Efficiency Across the Southwest.

C. Future Supplies

This section presents an analysis of future supplies for Washington County, and includes both reuse (recycled) water and agricultural-urban water transfers. The reuse volume reflects the lower level of water use under the 1% conservation scenario. And, water supplies made available from agriculture lands is predicted to be greater than what was predicted in Draft Study Report 19. These future supplies, along with water conservation, can be phased in over time as needed, thereby providing water managers with options that are more flexible than the Lake Powell Pipeline. This is especially important given the uncertain economic development and population growth (as underscored by the recent significant shift in GOPB population projections). Thus, pursuing additional water supplies in an incremental, diversified approach is preferable to relying on a single, large project that may unduly commit residents to high repayment obligations.

Table 7. Total Future Water Supplies in the Local Waters Alternative ranges from 116,300 – 138,000 AFY, exceeding projected demands after conservation (about 115,000 AFY). All values have been independently rounded to the nearest hundred.

Supply Alternative:	Culinary (AFY)	Secondary (AFY)
WCWCD Current Supplies and Ash Creek	78,400	7,500
Reuse		16,900
Agricultural Water Transfers		13,700 - 35,200
Sub-Totals	78,400	38,000 – 59,600
Total	116,300- 138,000	

Importantly, if 116,300 AFY are developed then the percent of potable water to total water (about 67%) is lower than it was in 2005 (about 82%). If 138,000 AFY are developed (though additional water from agriculture), then the percent of potable water supplies drops to 57% because most agricultural water is secondary quality. However secondary water can be treated to potable levels, blended with potable supplies, or allowed to percolate into the ground, recovered and then treated. Yet another option is to expand secondary water uses in outdoor irrigation, since culinary water is often used currently. This would require expansions of secondary delivery systems, and many such plans are already in place in a numbers of towns in Washington

County.[39] Given that the County was initially planning on over 27,000 AFY of reuse water,[40] expansion of such systems is a feasible option.

Reuse

The Local Waters Alternative's projected volume of reuse is less than the project applicant's projected volume because this Alternative reflects both the change in water use habits as a result of the proposed higher level of conservation (35 gpcd indoors) and the revised population estimate. Reuse water in Washington County would come from all the communities identified in Draft Study Report 19 that currently are, or can be, served in the future: St. George, Washington, Santa Clara, and Ivins.[41] This analysis assumes that 90% of water used indoors returns to the system as wastewater and would be treated at a reuse treatment plant,[42] and that small volumes of water used indoors in commercial buildings could be reused.[43] This results in an estimated 16,900 AFY of reuse water in the year 2060. Current reuse levels are an estimated 3,900 AFY, and the St. George Regional Water Reclamation Facility's capacity is 7,800 AFY. An expansion of this plant could result in a capacity of 11,200 AFY, and it is stated in Draft Study Report 19 that any water beyond this volume would require an additional treatment plant.[44] Since the Local Waters Alternative proposes developing 3,300 AFY of reuse water beyond the current treatment plant capacity, it is likely that another plant would be needed. This new plant would also have been built under the original projections by WCWCD, since their projected volume of reuse water was over 34,900 AFY in 2060.

Agricultural-Urban Water Transfers

The volume of water available from the conversion of agricultural lands was estimated in Draft Study Report 19 to be 10,080 acre feet per year by 2060. However, there are numerous data inconsistencies related to this estimate, as explained in Appendix D. Thus, this estimate is revisited under this Alternative, resulting in an estimated 13,600 acre-feet per year by 2060. Draft Study Report 6: Land Use Plans and Conflict was also revisited to estimate the amount of land (in acres) needed to accommodate the future population under the most recent projection scenario. The results show that the land needs are greater than the amount of land that is readily

[39] MWH. 2011. Lake Powell Pipeline Study: Water Needs Assessment. Draft Study 19. Prepared for Utah Division of Water Resources. Section 4.1.5.4 Potential Secondary Water Systems.
[40] Ibid. pg ES-16.
[41] MWH. 2011. Lake Powell Pipeline Study: Water Needs Assessment. Draft Study 19. Prepared for Utah Division of Water Resources. Table 4-6, pg 4-50.
[42] The communities listed represent 75% of the population in the county today, and the same ratio is assumed in the future. 35 gpcd is a conservative rate of indoor water use, and 90% of indoor water use was assumed to be available for reuse due to losses though consumption and evaporation.
[43] A very conservative rate of one minute of faucet use and one toilet flush per capita per day was assumed in the commercial sector, to account for bathroom and kitchen area uses.
[44] MWH. 2011. Lake Powell Pipeline Study: Water Needs Assessment. Draft Study 19. Prepared for Utah Division of Water Resources. Pg 4-31 and pg. 6-4.

available to be developed, without conflict. A "conflict" indicates that a parcel of land is suitable for more than one land use (e.g. urban development, agriculture, or conservation). Thus there is a possibility that more agricultural lands will need to be converted to accommodate future population growth than was predicted. Importantly, this analysis provides a connection between Studies 6 and 19 so that the impact of future growth onto agricultural lands is connected to the water made available from that conversion. In contrast, the project applicants made no connection between the results of these two studies.

Revised Estimate of Water from Agricultural Lands

Draft Study Report 19 presented inconsistent data regarding the water available from agricultural land conversion, therefore this volume is re-calculated. Draft Study Report 19 initially estimates that 3,840 acres of agricultural land will be converted between 2005 and 2060, producing 17,290 AFY. However, in the reported planned future water supplies, only 10,080 AFY are presumed available, and this inconsistency is not explained. Thus, it is more reasonable to account for the water that is expected to be derived between 2010 and 2060, approximately 3,020 acres which results in about 13,600 AFY based on the "duty of water" methodology used in Draft Study Report 19. The duty of water is the average amount of water applied to an acre of crop – estimated to be 4.5 acre-feet of water per acre. See Appendix D for more on the duty of water, and for all calculations in this section. This 13,600 AFY of water, in combination with all other future water supplies, will slightly exceed projected demand in 2060, under the Local Waters Alternative.

Land Use

Draft Study Report 6 modeled a total of seven land development scenarios to quantify the area of land needed to accommodate future population growth, and to quantify the acreage available from undeveloped lands, conservation lands and agricultural lands. [45] The scenarios modeled different levels of housing density, and included or excluded development on hazardous rock and soil types. This analysis has been revised to reflect the latest population projections, and features the scenario that incorporates smart growth and excludes development onto hazardous rock and soil areas. (See Appendix D for details).

The revised analysis shows that a total of 57,500 acres will need to be developed by 2060 to accommodate the future population, however only 45,500 acres were identified as developable without conflict. Thus, the remaining 12,000 acres could be developed from lands that are suitable to both urban development and agriculture or natural conservation areas.[46] Of the

[45] Utah Board of Water Resources. 2011. Draft Study Report 6: Land Use Plans and Conflicts. Pg 2-5.

[46] According to Draft Study Report 6, a few hundred acres of land that are well suited to conservation protection areas are also suitable for agricultural or municipal interests, but since the area is relatively small, it is not included here.

12,000 acres need for development, 3,020 acres will come from agriculture and the remainder (8,980 acres) could come from agricultural lands, conservation lands, growth onto hazardous rock and soil regions, denser development than was modeled, or some combination thereof.

The manner in which land will be developed is uncertain, but there are indications that more agricultural land conversions will take place than was estimated in Draft Study Report 19. Past trends show that the rate of agricultural land conversion in Washington County was more than 3 times faster than the State's predicted rate.[47] Despite this, Draft Study Report 19 relies on the State's same predicted rate of conversion through 2060. So, this Alternative assumes that 3,020 acres of agriculture is the <u>minimum</u> acreage that will be converted.

Additional Water from Agricultural Lands

It is plausible that even more agricultural lands will be developed. This alternative characterizes any water above the 13,600 AFY as "potential" additional agricultural water, which can help to provide a buffer around predicted demands. Some water utilities plan for a 20% buffer around demands, and in this case it would be achieved by converting an additional 4,800 acres of agricultural lands such that it provides 21,600 acre-feet of water. This would bring total supplies from agricultural conversions up to 35,200 AFY, and would require a total of 7,800 acres. In 2007, 13,810 acres of agricultural were said to exist.[48]

It is important to bear in mind that the permanent conversion of agricultural lands, often referred to as "buy-and-dry," is not the only option. The county could develop more densely and reduce the number of acres permanently converted from agriculture. In addition, municipalities can lease water on a temporary or interruptible basis from agricultural water rights holders instead. In recent years, growing cities throughout the West have acquired agricultural water through long-term leases, short-term "dry year" leases, interruptible supply agreements, long-term rotational fallowing agreements (leases), water banks, deficit/partial irrigation practices, and alternate cropping types.[49] Appendix E provides examples of these types of cooperative agreements in more detail. These water sharing agreements are becoming more common in the West because of the benefits they offer over traditional "buy and dry" practices. Specifically, they can provide reliable water supplies to growing cities while providing farmers with financial stability.

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[47] In Draft Study Report 19, one projection of agricultural land conversion was based on the Utah State Water Plan's projected agricultural-land conversion rate, 0.54 % per year, from 1990 through 2040. However it is not mention that between 1990 and 2007 the rate of agricultural conversion was 1.66%, more than 3 times higher. The result is the predicted number of acres to be converted by 2040 was <u>already exceeded</u> in 2007.

[48] MWH. 2011. Lake Powell Pipeline Study: Water Needs Assessment. Draft Study 19. Prepared for Utah Division of Water Resources. Pg. 4-42.

[49] CDM, 2011. Colorado's Water Supply Future Colorado Water Conservation Board Alternative Agricultural Water Transfer Methods Grant Program Summary, Final Report. May 2011.

IV. COST ANALYSIS

This section outlines the costs of the Local Waters Alternative and compares it with the Lake Powell Pipeline. The Local Waters Alternative is very likely to cost significantly less than the proposed pipeline, though this analysis is constrained by the limited data available for the cost of conservation, reuse and infrastructure. The present value cost of the Local Waters Alternative - which does not include necessary infrastructure costs - is estimated to be about one-third the present value cost of the pipeline, and every effort was made to be conservative in this estimate. Infrastructure and treatment costs for secondary water distribution (from reuse and agricultural water transfers) were not possible to reasonably estimate, however much of it would likely have been developed under the original pipeline scenario proposed by the project applicants. The following sections provide estimates of the cost of conservation (to the utility and customers), reuse, and agricultural water transfers. It concludes with a comparison of the total costs of the Local Waters Alternative and the Lake Powell Pipeline.

Importantly, pursuing additional water supplies in an incremental fashion is less financially risky for the utility, the financial backers, and the water customers. Utilities face a lot of uncertainty with respect to their future water supplies and demand forecasting. Supply uncertainties in Washington County includes drought and climate change, and demand uncertainty arises largely from the boom and bust cycles of population growth. The financial risk associated with these forecasts is greater if a single, large project is built. This approach could unduly commit residents to high repayment obligations if demands or supplies are very different than projected. In contrast, the flexible and incremental nature of the Local Water Alternative allows supplies to be developed in connection with demand, significantly reducing the financial risks associated with this alternative.

A. CONSERVATION

The cost of conservation was derived from information included in the Washington County Water Management and Conservation Plan, updated in 2010. Within this Plan, WCWCD included portions of commissioned study on water conservation program options and costs, which was developed by Maddaus Water Management. Because only portions of this study were included, the data available were limited. The data was adjusted to create an "apples-to-apples" comparison with the Lake Powell Pipeline, but it is worth noting the original results of this study, which estimates conservation to be about 1/3 the cost of the Powell Pipeline on an annualized per acre-foot basis:

> The average cost of water saved to the utility (present value basis) for all [conservation] programs ranges from a very attractive $92 to $122 per AF (less than the $620 projected

> price of the Lake Powell water)….The average community cost of water saved ranges from an attractive $261 to $447 per AF.[50]

A similar result was reported in Draft Study Report 10: Socioeconomics and Water Resource Economics, but strangely, no further explanation of the cost of conservation is provided:

> The marginal cost spread, for alternative water resources, is great, with some conservation features being under $250/acre-foot…. The NED base [Lake Powell Pipeline] Project costs, without power benefits included, suggest costs approaching$1,100/acre-foot.[51]

The analysis presented here reports the total costs of conservation in the Local Waters Alternative, unlike the above studies which annualize the cost per acre-foot. But to derive the total cost of conservation, the one-time cost to conserve one acre-foot of water was applied to every acre-foot of water saved, beyond what is already planned by Washington County. In Draft Study 19 Washington County reportedly anticipated conserving a little bit more than was originally mandated by the State (a 25% per capita reduction by 2050). This level of conservation will occur regardless of whether the Lake Powell Pipeline is constructed, so the cost to conserve this water is not included in the alternative cost. Only the additional water saved through more aggressive conservation measures is included in this analysis. Notably, the recent change in the State's conservation target (a 25% per capita reduction by 2025) will bring the County's conservation targets more closely in line with the Alternative's targets, thereby reducing the cost of conservation associated with the Alternative through 2025. However since the conservation goals beyond 2025 are unknown, this policy shift is not accounted for in the economic analysis.

Using the Maddaus conservation study, the estimated one-time cost to save one acre-foot is $3,824 for the utility, and $13,980 for the community, the latter of which includes costs to both customers and the utility. These conservation cost estimates are roughly in line with reported costs of conservation in Colorado, which range from about $5,000 - $10,000 per acre foot.[52] The one-time cost reflects utility administration, rebates, education, and customer expenses associated with purchasing water-efficient appliances or materials. The financial investment is a one-time occurrence, but it is assumed that the water continues to be saved every year through 2060. Appendix F explains the method in more detail.

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[50] Washington County Water Conservancy District. 2010. Water Management and Conservation. Appendix A, Section 7.

[51] Utah Board of Water Resources. Modified Draft Study Report 10. Socioeconomics and Water Resource Economics. February 2012. pg ES-2. These values reflect utility costs, community costs were not estimated.

[52] Colorado Water Conservation Board, 2011. "Appendix L – SWSI 2010 Municipal and Industrial Water Conservation Strategies" in Colorado's Water Supply Future, Statewide Water Supply Initiative 2010. Denver, CO. January.

All future investments in conservation were then discounted back to their present value in 2010. The same two discount rates that were used in Draft Study Report 10 are used here; the 4.14% discount rate reflects Utah's calculated real discount rate, and the 3% real discount rate reflects a social time preference.[53] The results are provided in the Table 5.

Table 5. The Local Waters Alternative estimates the cost of conservation to the community (which includes the utility and customers) is less than $300,000,000, in 2010 present value. The cost to the utility is significantly lower. All costs shown in millions.

Discount Rate	Utility Costs, 2010$	Community Costs, 2010$
3%	$83.0	$303.3
4.14%	$67.2	$245.8

B. Reuse

The Local Waters Alternative projects a total of 16,900 acre-feet of reuse water by 2060, which would necessitate building a new reuse facility with a capacity of about 10 million gallons per day (mgd). Although the construction of this type of facility is likely a part of Washington County's plans for the future (the County estimated developing upwards of 34,900 AF of reuse water), no cost estimates for building a reuse facility were provided in the Draft Study Reports. Draft Study Report 10 did estimate the cost to build a *reverse osmosis* plant, but this is a higher level of treatment and has a much higher capacity of 36 mgd. The estimated costs ranged from about $192 million to $362 million, which includes capital costs as well as operations, maintenance and replacement (OM&R) costs. This would be significantly more expensive, and therefore it is not an adequate proxy.

The Colorado Water Conservation Board's *Reconnaissance Level Cost Estimates Report* estimated the cost for reuse water on per acre-foot basis.[54] The higher cost estimate is used here - $13,500 per acre-foot as opposed to $7,000 per acre foot – and this reflects the cost to divert water, treat it to potable standards, and convey it locally. It results in an estimated cost of $151 million for a 10 mgd plant. Based on actual cost of other facilities and other estimates (see Appendix F), this appears to be a high but reasonable cost estimate. Notably, the cost to build the

[53] Utah Board of Water Resources. Modified Draft Study Report 10. Socioeconomics and Water Resource Economics. February 2012.

[54] CDM. 2010. *Appendix N - Reconnaissance Level Cost Estimates for Agricultural and New Supply Strategy Concepts.* Prepared
for Colorado Water Conservation Board. June 4. http://cwcb.state.co.us/water-management/water-supply-planning/Documents/SWSI2010/Appendix%20N_Reconnaissance%20Level%20Cost%20Estimates%20for%20Strategy%20Concepts.pdf

reuse facility in St. George was attached to existing infrastructure and cost only $4.2 million.[55] With the increase in population, it is possible that a new waste water treatment plant would need to be built anyway, and a reuse facility could similarly be added on for a very modest cost. Estimating the cost of distribution infrastructure is difficult, but since $151 million is a high-end estimate, it may adequately account for those costs. Appendix F provides full details regarding these data.

The estimated annual O&M costs are 1.25% of capital costs, based on the relative O&M costs reported in Draft Study Report 10. The costs were applied over time, and discounted to 2010 present value. The estimated total cost to build a new reuse facility is below.

Table 6. The Local Waters Alternative estimates the cost to build and maintain a reuse facility is at most $150 million in 2010 present value. All figures are in millions of dollars.

Discount Rate	Capital & O&M Costs, 2010$
3%	$151.5
4.14%	$130.1

C. Agricultural Land Conversions

The Local Waters Alternative assumes that 13,600 acre-feet are highly likely to become available through agricultural land conversions, and as much as 35,200 acre-feet could become available through either land conversions or through water leasing. The cost to *lease* water was not assessed in Draft Study Report 10; only the cost of water in “water markets,” which seems to be the cost to *purchase* water rights from rights holders. The water market cost estimate ranged from $2,500 - $5,000 per acre-foot, and so the average value was applied ($3750/AF). Importantly, the cost to lease water would likely be substantially lower. Again, these future costs are discounted back to 2010. This resulted in a total present value cost of $55.5 million under a 3% discount rate, and a cost of $34.4 million under a 4.14% discount rate.

There may be additional costs associated with new infrastructure to transport or distribute water coming from agriculture. In addition, treatment will be needed in some or all cases to bring water up to secondary standards. These costs are not estimated because the manner in which that might occur (e.g. by blending with cleaner water sources, utilizing existing treatment plants, etc.) is not known.

[55] Chandler. M., Ford, B. Water Reuse – a multifaceted resource. Presentation by Bowen Collins and Associates, and the City of St. George. https://pncwa.memberclicks.net/assets/2010ConfTechPresentations/Session09/2010%20pncwa-%20session%209-2%20-%20reuse%20-%20mike%20chandler.pdf Accessed November 7, 2012.

D. Lake Powell Pipeline

Draft Study Report 10 examined the cost of the Lake Powell Pipeline under four configurations and under two discount rates, for a total of eight cost scenarios. The simplest, least expensive configuration was chosen to ensure a conservative estimate. Moreover, only the portion of the project that Washington County will be paying for was considered, since this county is the focus of this alternative. Thus, the portion attributable to Iron County and Kane County was subtracted based on the State of Utah's Opinion of Probable Costs, released in 2008.[56] While this data is relatively old, no other source with equally detailed information was found. Under the lowest cost scenario (which includes O&M costs), the Washington County portion would be $1,512,800,000 under a 3% discount rate, and $1,261,300,000 under a 4.14% discount rate. These estimates include all costs identified in Draft Study Report10, such as capital costs and operations and maintenance, but does not include the cost to finance the project (i.e. interest and transaction costs) which will further increase the pipeline costs significantly.

E. Comparison of Costs

The estimated cost of the Local Waters Alternative is about one third the cost of the Lake Powell Pipeline. While there are some uncertainties and many assumptions embedded in this economic analysis, it clearly demonstrates that the proposed alternative is indeed worthy of consideration as a viable alternative. Conservative estimates were made throughout this economic analysis, such as taking the lowest cost of the pipeline and the highest costs of conservation and reuse. Although the actual costs of the Local Waters Alternative do not include all potential infrastructure needs, those total costs are still likely to be lower, if not significantly lower, than the cost of building the pipeline.

Table 7. The cost of the Local Waters Alternative is about 1/3 the cost of the Lake Powell Pipeline. All costs shown in millions.

	3% Discount Rate	**4.14% Discount Rate**
Community Conservation Costs	$294.4	$236.1
Reuse	$151.5	$130.1
Agriculture	$55.5 +infrastructure costs	$34.4 +infrastructure costs
Alternative Total	**$510.4 +infrastructure costs**	**$410.3 +infrastructure costs**
LPP	**$1,512.8**	**$1,261.3**

[56] Opinion of Probable Costs http://www.water.utah.gov/lakepowellpipeline/projectupdates/June2008OPCCSummary%20r1.pdf

V. CONCLUSION

The Local Waters Alternative provides a pathway for Washington County to meet projected water needs in a flexible, local and cost effective manner through the year 2060. In using this approach, water managers will be able to exceed demands through a combination of conservation, reuse, and agricultural water transfers. Implementing an aggressive yet achievable water conservation program over the course of 50 years will result in a demand that is 27% lower than projected by the applicants. And, this could cost roughly two thirds less than the Lake Powell Pipeline. The Local Waters Alternative demonstrates the lack of need for this pipeline and the feasibility and cost-effectiveness of alternative supplies. This alternative should be included in the No Action Alternative in the forthcoming Draft EIS.

In addition, there are many deficiencies in the draft study documents that call into question the basic facts about Washington County's supplies and demands. These deficiencies are documented in detail in the Appendices. Here we summarize our requests for improved data and studies:

Critique 1: Draft Study Report 19: Water Needs Assessment does not provide reliable data on water use or water supply, and it contains errors and inconsistencies.

- **Measured water use data – potable and secondary water - should be submitted to FERC, to determine actual, current water usage, such as gpcd, throughout the County.**
- **Reliable and consistent water supply data for existing resources and future potential sources should be submitted to FERC.**

Critique 2: Draft Study Report 22: Alternatives Development does not examine a reasonable range of options, or reasonable combinations of options, and it predicated on an opaque cost-benefit analysis.

- **The cost of conservation should be analyzed in a manner consistent with other alternative supply options.**

Critique 3: Draft Study Report 6: Land Use Plans and Conflicts is not aligned with the presumed acres of agricultural lands that will be converted.

- **The area and types of land needed for future development should be in line with assumed acres of agricultural conversions.**

Critique 4: Draft Study Report 10: Socioeconomics and Water Resource Economics does not provide any detail about the cost of conservation except to say that it may be a little as 1/5 of the cost of the Lake Powell Pipeline.

- **Alternatives to the Lake Powell Pipeline should examine a broader range of combinations of supply option, such as what is provided in this Alternative.**

With a complete set of reliable and measured water data from Washington County, a fair assessment of the Purpose and Need for this project can be made. We formally request that the project applicants be required to provide better data and analyses in support of their application with FERC, and that the Local Waters Alternative be incorporated into FERC's No Action Alternative.

APPENDICES

The following appendices provide additional details regarding the data and information presented in this Alternative.

Appendix A: Water Supply Data Inconsistencies
Appendix B: Water Supply Estimation Critique
Appendix C: GPCD Analysis
Appendix D: Agricultural Land Conversion Calculations
Appendix E: Temporary Agricultural Water Transfers
Appendix F: Economic Analysis

APPENDIX A: Water Supply Data Inconsistencies

The data provided in Draft Study Report 19 Water Needs Assessment regarding current supplies in Washington County, UT is highly inconsistent. While it appears there may be ways to understand and correct the data presented, it is unreasonable to present such inconsistent data on current water supplies when claiming a need for additional water supplies. The reported water data from Washington County is inadequate.

The table below documents the variety of figures reported. In some cases, it seems that the terms "WCWCD" (Washington County Water Conservancy District) and "Washington County" were confused and used interchangeably, and these have been corrected.

Table A1. The water supply data reported in Draft Study Report 19 is highly inconsistent, as shown here.

	Reference #	Culinary	Secondary	Implied Total Supplies
Current **WCWCD** Water Supplies	1	33,550 (Table ES-10, Table 4-2*)	6,560 (Table ES-10)	40,110
	2	45,450 (Table 4-2**)	(assumed same as above)	52,010
Current **Washington County** Water Supplies	1	74,560 (Table ES-10†, Table 4-2†)	7,450 (Table ES-10)	82,010
	2	62,650 (Table 4-2)	(assumed same as above)	70,100
	3	--	--	75,990 (Table 6-2)

†This value can be found in text associated with the tables cites, either directly above or below the actual table.
* The value reported in Table 4-2 is actually 10 AFY higher, but this is assumed to be another error.
** This value was obtained by adding the two reported potable supplies in Table 4-2: 3,750 and 41,700 AFY.

Table 4-2 in Draft Study Report 19 provides the most comprehensive list of water supplies for Washington County, which is nearly an exact replication of Table 14 from the DWRe Kanab Creek Virgin River M&I 2005 report, though this is not explicitly stated in Draft Study Report 19. However, Draft Study Report 19 tallies the total surface water supplies as being 33,540, almost 12,000 AFY less than the correct summation. Secondly, the introductory paragraph states that total, reliable potable supplies in Washington County are 74,560, yet in the Table 4-2 states the total is 62,650. The larger number reflects the larger WCWCD estimate, and is reported throughout Draft Study Report 19 (pgs ES-15, 4-11). In one original source, the WCWCD *Water*

Management and Conservation Plan, updated in 2010, reports that available resources for the County are "approximately 83,910 AF per year."[57]

After detailed review of Draft Study Report 19 and the documents cited, it seemed that the primary discrepancy in Draft Study Report 19 arose from WCWCD's reported potable supplies. Draft Study Report 19 reports 33,550 AFY, yet the original studies from which these were data were derived[58] cite a potable water supply that is 10,000-12,000 AFY higher. Draft Study Report 19 states that 5,000 AFY from Sand Hollow Wells are now being reserved for critical drought periods, however no citation is provided and this is not mentioned even in WCWCD's 2010 Water Management and Conservation Plan. The remaining missing AFY are unaccounted for, but seem to reside somewhere in the Quail Creek and Sand Hollow Reservoirs system.

In addition, there is a discrepancy between supply data presented Draft Study 19 and 22. Draft Study 19 states that Ash Creek will provide 3,000 acre-feet per year, whereas Draft Study 22 states it will provide 5,000 acre-feet per year.[59] This discrepancy should be reconciled.

[57] Washington County Water Conservation District. 2010. Water Management and Conservation Plan. Pg. 6.
[58] Washington County Water Conservation District. 2010 Water Management and Conservation Plan; WCWCD Capital Financing Program Amended 2006; DWRe 2009 Municipal and Industrial Water Supply and Uses in the Kanab Creek/Virgin River Basin (data from 2005); DWRe 2009 State of Utah Municipal and Industrial Water Supply and Use Studies (data from 2005).
[59] Utah Board of Water Resource. March 2011. Draft Study Report 22 Alternatives Development. Pg 2-1

APPENDIX B: Water Supply Estimation Critique

The Utah Division of Water Resources (DWRe) developed an estimation methodology for reliable supply of surface and groundwater resources. The reliable yield of water is based on the lesser value of three criteria: hydrologic capacity of the water source, the physical capacity of the water system, or the amount allowed by the collective water rights.[60] This same methodology of water supply accounting was used in Draft Study Report 19. However, this methodology may significantly underestimate current and future supplies because in many cases the current physical capacity of the water system infrastructure is the limiting factor. Infrastructure can change, however, and should not necessarily be a proxy for reliable yield of water. This and other questionable estimation methods used in Draft Study Report 19 are described below.

Surface Supplies

All current surface supply volumes in Draft Study Report 19 were provided under a 90% reliability estimate. The method by which this 90% was determined in not explained (i.e. it could be 90% of historic average flows, or yield available 90% of the time, etc.). Moreover, given the DWRe's supply estimation methodology outline above, it is not clear which of the three criteria were used in determining the reliable supply. Draft Study Report 19 does not provide this information, nor is it explained whether the 90% was taken after the DWRe's reliable supply methodology was already applied. While the actual methodology used to estimate surface supplies may be valid, Draft Study Report 19 does not provide enough clear information to allow others to make that assessment.

Groundwater

According to Draft Study Report 19, the basin is already over appropriated and no additional groundwater withdrawals are planned for future supplies. Therefore, groundwater is only listed under current supplies. However, the groundwater data provided has some questionable assumptions regarding estimates of availability. Draft Study Report 19 states that the current, reliable supply from groundwater wells is calculated by taking one-half of the maximum capacity, and the wells or pumps are the limiting factor.[61] This therefore does not take into account the physical capacity of the aquifer to yield water, nor does it take into account the current rights held by the water provider. Thus, 50% of maximum yield "today" may significantly understate the potential future safe yield. Safe yield can be defined as an amount that can be withdrawn from an aquifer without negative effects such as decreased river flows, lowering of the water table, exceeding recharge rates, etc. Washington County Water Conservancy District's current ground water supplies are reported to be 6,750[62] and yet recharge

[60] DWRe. 2009. Municipal and Industrial Supply in the Kanab Creek/Virgin River Basin. (Data from 2005)
[61] MWH. 2011. Lake Powell Pipeline Study: Water Needs Assessment. Draft Study 19. Prepared for Utah Division of Water Resources. Table 4-2.
[62] *Ibid.* Table ES-10

rates in the Virgin River Basin are said to be 155,000 AFY, according to the WCWCD.[63] While it is clear the WCWCD does not hold rights to most of the water in Washington County, it still seems likely that future potential yield from groundwater could be higher than what is presented in Draft Study Report 19. More information about groundwater supplies needs to be provided to ensure accurate estimates of current and future yields.

Water Rights

There are questions regarding the analysis of water rights holders in Washington County. The estimated total supplies for Washington County do not appear to include water rights owned by private land owners, yet these populations are presumably accounted for in future population projections. If this is the case, then total current/future water supplies would be under estimated.

In addition, these water rights could theoretically be transferred to water utilities in the future, thereby increasing future potable supply. However, Draft Study Report 19 makes no mention of why private rights might never be converted to public utility water rights by 2060.[64] This issue bears further explanation, and should be included in a complete inventory of water supplies in the County.

Toquerville

The city of Toquerville is a reported to have current secondary supplies of only 160 AFY, 1/3 of system capacity. However, they have rights up to 2,000 AFY, but their future potential supply is only counted as 480 AFY. It may prove impossible for Toquerville to *physically* obtain 2,000 AFY, but there is no justification provided for using the lower estimate when their legal rights are higher. The low estimation seems to have been linked to limitations in their current infrastructure, which is not a sound estimation of future potential water supplies. Moreover, this methodology (i.e. limiting future potential by system capacity, as opposed to water rights or hydrologic capacity) may have been applied to numerous cities, thereby substantially underestimating future potential supplies.

Future Reuse

There is a wide variety of estimates for reuse provided in Draft Study Report 19. One estimate is significantly lower, while three other estimates are higher. The lower estimate is 7,320 AFY instead of 27,620 AFY (Table ES-15 in Draft Study Report 19), and the explanation is that the potential volume of reuse water is limited by demand. This is an unsatisfactory explanation, since the county has five decades to encourage the utilization of reuse water, and this number seems to be based on current demand. Or this may simply be a typo of significant proportions.

The next estimate is located in the footnotes of this same table (Tables ES-15), in which the stated potential is 33,910 AFY. And in Table ES-11 there are statements which say that the

[63] Washington County Water Conservation District. 2010. Water Management and Conservation Plan. pg 31
[64] Utah Division of Water Resources. 2011, Letter of Response to Comments on the Draft Study Reports and Initial Study Report Meeting. pg 237.

maximum potential for the reuse facility would be the treatment of all the effluent from the surrounding St. George communities, which could require a 40 mgd (million gallons per day) reuse facility. A 40 mgd facility would deliver, at a maximum, 44,800 AFY.[65] The variety of estimates for reuse is confusing, and needs to be clarified.

[65] MWH. 2011. Lake Powell Pipeline Study: Water Needs Assessment. Draft Study 19. Prepared for Utah Division of Water Resources. Section 4.1.4.3, and Table ES-11

APPENDIX C: GPCD Analysis

Analysis of Temporary Population's Effect on Washington County's GPCD

Water use in Utah is classified as culinary or secondary, indoor or outdoor, and residential, commercial, industrial, or institutional. Data provided in DWRe's Kanab Creek/Virgin River Basin reports[66] provides details about the water used in each of these categories. This is the most well defined source of water use data for Washington County available (despite being almost a decade old), and is relied upon here to help develop the analysis of per capita water use rates in Washington County that exclude the temporary population.

Washington County has a 27% temporary population[67] that is not accounted for in the typical per capita water use rate calculation, measure in gallons per capita per day (gpcd). When adjusting for this temporary population, by assuming indoor use for 5 months and outdoor use for 12 months, the total system-wide potable use is 208 gpcd and the total residential use is 141 gpcd (see Table C3). Comparing these adjusted numbers with those presented in Figure 4and Figure 5, Washington County's water use rate is still at the high end of the spectrum despite the fact that none of the other cities have included this adjustment, <u>and</u> the data from the other cities is primarily from 2006 and 2008, whereas Washington County data is from 2010. That is to say, these other cities have far surpassed Washington County's achievements in conservation long ago.

Tables C1 shows the original data provided by DWRe in 2005. Table C2 uses the ratios from C1 and applies it to the 2010 gpcd. Table C3 adjusts for the temporary population in 2010 to derive residential and system-wide water use rates.

Table C1. The original 2005 data from DWRe is replicated here, which is the basis for subsequent temporary-population adjusted calculations.

2005 DWRe Data - GPCD			
	Culinary	Secondary	Total
Res Indoor	71.9	0	71.9
Res outdoor	97.4	15.8	113.2
Commercial	61.4	9.5	70.9
Institutional	15.5	26	41.5
Industry/stock water	3.7	1	4.7
Subtotals	249.9	52.3	**302.2**

[66] Utah Department of Natural Resources, Division of Water Resources (DWRe). 2009. Municipal and Industrial Water Supply and Uses in the Kanab Creek/Virgin River Basin (Data Collected for Calendar Year 2005).
[67] MWH 2008.

Table C2. This shows how the reported 2010 per capita rate of water use, 291.6 gallons per capita per day (gpcd), is allocated in proportion to the original 2005 data in Table C1.

2010 GPCD			
	Culinary	Secondary	Total
Res Indoor	69.4	0.0	69.4
Res outdoor	94.0	15.2	109.2
Commercial	59.2	9.2	68.4
Institutional	15.0	25.1	40.0
Industry/stock water	3.6	1.0	4.5
Subtotals	241.1	50.5	**291.6**

Table C3. This shows that the rate of water use changes to 254.3 gpcd when temporary residents are excluded from the calculation.

2010 GPCD POPULATION ADJUSTED - 27% residents removed for 5 months of indoor use and 12 months of outdoor use			
	Culinary	Secondary	Total
Res Indoor	61.6	0.0	61.6
Res outdoor	68.6	11.1	79.7
Commercial	59.2	9.2	68.4
Institutional	15.0	25.1	40.0
Industry/stock water	3.6	1.0	4.5
Subtotals	208.0	46.3	**254.3**

Analysis of Climatic Effects on GPCD

Washington County also justifies their higher water use due to the aridity of the region and the long, hot summers. However, many of the cities listed in Figure 4and Figure 5 have similarly arid climates. Washington County does not have the highest average temperature, or the lowest rainfall, or the highest evapotranspiration rate when compared with Albuquerque, Tucson, or the Las Vegas. But, it does have the highest residential water use, highest outdoor water use, and highest system-wide water use (Table C4.). Washington County's outdoor water use is almost triple that of Albuquerque's and total water use is almost double that of Tucson's.

Table C4. Washington County's outdoor use is the highest even though it does not have the most extreme climate compared with other Southwest Communities.[68]

Entity	Total Res. Use (gpcd)	Outdoor Use (gpcd)	System-wide Use (gpcd)	Avg. Annual Temp (F)	Avg. Annual Precip. (in)	Annual ET (in)
Albuquerque	110	42	173	56.0	8.9	38.1
Las Vegas	174	105	276	68.0	4.5	74.8
Tucson	114	57	156	68.4	12.0	58.0
Washington County	179	109	241	61.8	8.0	55.0

Comparing water use in other Southwest communities to Washington County can provide valuable insight into the potential for water conservation. Tucson, Albuquerque, and Las Vegas have similar average temperatures and rainfall as southwestern Utah, yet there is a significant difference between the rates of water use.

The Alternative does not use the population-adjusted gpcd because 1) Draft Study Report 19 does not, and 2) no other communities do, including Las Vegas which has an extremely high tourist population, and a similar climate. Lastly, the percent of the population that relies on self-supplied water (i.e. personal wells or self-supplied industrial water) is included in population projections and future demand scenarios, even though they are not reliant on any community system water. Presently this population is quite small (0.3%), but it also is not adjusted for in the future population or demand analysis.

[68] Western Resource Advocates. 2006. Water in the Urban Southwest: An Updated Analysis of Water Use in Albuquerque, Las Vegas Valley, and Tucson.

APPENDIX D: Agricultural Land Conversion Calculations

Duty of Water

In Draft Study Report 19 the "duty of water" is defined to be the amount of water (in acre-feet) used per acre of agricultural land. The duty of water in Washington County, as reported in Draft Study Repot 19, was derived from 1990 data, in which the "duty of water' ranged from 3 to 6 AF/ac, so a simple average of 4.5 was used throughout the analysis in Draft Study 19 and this Local Waters Alternative. However, 3 and 6 AF/ac is a very significant range; just a 0.5 AF/ac difference could result in thousands of acre-feet per year more or less than what is expected from land conversions.[69] Thus, this aspect of the analysis needs to be studied much more carefully.

Oftentimes a percentage of agricultural water used is not transferrable, due to evapotranspiration, return flow or legal requirements, or other issues. None of this was mentioned or explicitly accounted for in Draft Study Report 19, although it may be embedded in the 4.5 AF/ac value. Thus, the definition of the "duty of water" requires further explanation by project applicants.

Recalculation of Water from Agricultural Land Conversions

The estimated agricultural conversions in Draft Study Report 19 revealed some inconsistencies. The originally predicted acreage of agricultural conversion was 3,840 between 2005 and 2060.[70] Based on the reported "duty of water"[71] this implies 17,280 AFY of water from agricultural conversions. However since this is based on 2005 levels, presumably a small portion of this has already been converted. The study should have provided estimates starting in 2010, to keep within the time frame that is being planned for.

In contrast with these figures, the total volume of water reported in future water supplies is only 10,080 AFY from agricultural conversions. It is based on conversion of agricultural land from one region called Washington Fields. Using the "duty of water", 10,080 AFY would be correlated with 2,240 acres, in the Washington Fields area. Reportedly 622 acres in Washington Fields were already converted between 2005 and 2010 (derived using the same duty of water ratio), bringing the total up to 2,862 – much lower than the projected 3,840 acres that are expected to be converted.

No explanation is provided as to why water from all 3,840 acres (from 2005) are not accounted for in Draft Study Report 19, and it is not possible to discern how much of that land truly has

[69] MWH. 2011. Lake Powell Pipeline Study: Water Needs Assessment. Draft Study 19. Prepared for Utah Division of Water Resources. Pg 4-42

[70] *Ibid.*

[71] 4.5 acre-feet per acre is the reported volume of water available per acre of agricultural land converted. There are no reductions made as per the methodology employed in Study 19, and thus the methodology is replicated here.

already been converted between 2005 and 2010. These conclusions are derived from the data provided in Table 4-4 in Draft Study Report 19, and it assumes a constant rate of conversion between 2007 (which reported 13,810 acres of extant agricultural land) and 2060 (predicted to have 10,610 acres remaining). This results in 3,020 acres of agricultural land being converted between 2010 and 2060. However, Draft Study Report 19 again provides two conflicting numbers for remaining acreage in 2007: 13,810 acres and 12,740 acres.[72] Thus, there are significant data inaccuracies, which need to be corrected. The conclusion is that the 3,020 acres of agricultural land will provide water at a ratio of 4.5 acre-feet of water per acre, and this results in 13,590 acre-feet of water. This is the same methodology employed in Draft Study Report 19.

Land Development Scenarios and Calculations

Draft Study Report 6 analyzed a variety of land use scenarios for Washington County, based on population projections from 2008. Scenario 3B was elected because (1) Scenario 3 (A and B) was the only scenario which quantified the acreages of land that would be suitable to both urban and agricultural interests, and (2) Scenario 3B does not allow for growth on soil and rock hazard area, which is in keeping with modern land use planning methods.[73]

The scenarios are summarized here:

Scenario 1	*Sprawl* model, allows growth on soil and rock hazard areas
Scenario 2A	Smart growth, allows growth on soil and rock hazard areas
Scenario 2B	Smart growth, allows **no** growth on soil and rock hazard areas
Scenario 3A	Smart growth, allows growth on soil and rock hazard areas, identifies areas of conflict
Scenario 3B	Smart growth, allows **no** growth on soil and rock hazard areas, identifies areas of conflict
Scenario 4A	Smart growth, allows growth on soil and rock hazard areas, identifies areas of land use preference
Scenario 4B	Smart growth, allows **no** growth on soil and rock hazard areas, identifies areas of land use preference

Population and density data for scenario 3B was derived Table 4-11 in Draft Study Report 6. Since this Draft Study Report was developed under much higher population projections, the data– such as the appropriate population density and acres of land needed - was scaled in proportion to the new population projections. The calculations resulted in an average density of 2.53 housing units per acre, with 2.55 persons per household across the county, including existing and future development. This results in 6.47 people per acre, and based on GOPB population projection this implies a total developed area (new and existing) of roughly 89,900

[72] MWH. 2011. Lake Powell Pipeline Study: Water Needs Assessment. Draft Study 19. Prepared for Utah Division of Water Resources. Pg 4-42
[73] Utah Board of Water Resources. 2011. Draft Study Report 6: Land Use Plans and Conflicts. Pg 3-20

acres. Existing development is about 32,400 acres[74], so this means 57,500 acres are needed to be developed. According to Scenario 3B, 45,500 acres can be developed without conflict, which leaves about 12,000 acres coming from areas that are also suitable for agriculture or conservation.

[74] Utah Board of Water Resources. 2011. Draft Study Report 6: Land Use Plans and Conflicts. Figure 3-6

APPENDIX E: Temporary Agricultural Water Transfers

Farmers and water providers that do not want to permanently transfer agricultural water to municipal users have several alternative options, including rotational fallowing agreements, water leases, water banks tied to agricultural efficiency and alternate cropping practices.

In rotational fallowing agreements, an individual or group of farmers agree to fallow a portion of their land and then sell the unused portion of their water supply to municipalities. This process repeats year after year, with different land fallowed in each year. These types of agreements have worked well in California and are being investigated in several states and provide various benefits:

- Irrigators who are susceptible to fluctuating crop prices receive some financial stability;
- Irrigators rest cropland, benefitting soils and improving crop yields, while allowing for irrigation infrastructure improvements and critical maintenance operations that improve system efficiency; and
- Municipalities receive a steady supply of water, while establishing long-term economic ties that can support rural communities and the region.

Pursuing rotational fallowing agreements has the potential to ease some of the resistance from the agricultural community that can result under “buy and dry” (permanent) transfers. However, rotational agreements provide a more limited new water supply. For example, a three-year fallowing rotation involving all Washington County agricultural land would yield only one third of the water used in remaining agricultural land. In reality, not all farmers would likely participate, further shrinking the available water volumes.

Leasing water is one option for cooperation between agricultural water users and municipalities. Water can be leased out for long periods of time, for example a decade or more, or for shorter periods of time, such as one year when dry/drought conditions prevail. Dry year leases can be structured in various ways. For example, a farmer may agree to lease water to a city during a drought in exchange for regular annual payments from the city, even in normal water years. In a time of drought, the farmer fallows irrigated land and transfers the conserved water to the city, in exchange for a forbearance payment. These types of agreements provide certainty to cities during drought, but they do not provide new water supplies that meet long-term growing demands.

Agricultural water efficiency improvements could provide additional water supplies. Alternate cropping practices can free up water by switching a high water-using crop to a low-water using crop. Municipalities would pay for the efficiency improvements in agriculture, and then use the quantity of water saved for their own purposes.

There are also some challenges associated with agricultural water transfers. For example, some agricultural water supplies in Washington County have high levels of total dissolved solids (TDS). TDS levels greater than 500 mg/L may be unsuitable for culinary water treatment and levels greater than 1000 mg/L may be unsuitable for secondary uses. In addition, to maximize agricultural transfers, infrastructure needs will also have to be addressed. Exchanging water upstream on the Virgin River to be captured and recharged in an expanded Sand Hollow Aquifer Storage and Recovery (ASR) project may be an alternative to constructing additional pipelines, under an expanded agricultural-urban transfer program. Lastly, there are legal challenges to forging these agreements that can be a significant barrier. The State of Utah may be able to play an important role in facilitating these agreements.

APPENDIX F: Economic Analysis

Conservation

The Washington County Water Conservancy District published the *Washington County Water Management and Conservation Plan*, updated in 2010. This document quantifies current and future water supplies and demands. In Appendix A of this study, they included portions of a document developed by a consultant, Maddaus Water Management, who evaluated conservation program options and costs. A primary objective of this analysis was to examine how the County can achieve the State mandate to reduce per capita water use by 25% by 2050.

The consultants developed 3 conservation program scenarios, which had either 14, 25 or 37 conservation measures included. Each program was modeled to run for 30 years, and the associated water savings and costs were estimated based on penetration rates of the programs. An estimate of the cost to the utility and the "community costs" – which reflects costs to customers as well as the utility – were included.

The capital costs to the utility were reported in present value (2007) dollars. The utility's cost per acre-foot (which ranges from $92 - $122) represents the capital costs divided by the total volume of water saved *cumulatively* over a 30 year period. The 30 year Community Cost is similarly calculated. These results from the Maddaus study are reproduced in the table below. These are the primary figures from which the cost of conservation was derived for this Alternative.

Table G1. This table shows the costs of the three conservation programs modeled by Maddaus, in 2007$.

	# Conservation Measures	30 Year Present Value of Water Utility Costs	30 Year Utility Cost of Water Saved ($/AF)	30 Year Community Cost of Water Saved ($/AF)
Program A	14	$17,968,000	$ 92	$ 261
Program B	25	$29,238,000	$ 98	$ 328
Program C	37	$41,153,000	$ 122	$ 446

The total, cumulative water saved under Program C (337,320 AF) was calculated based on the 30 Year Present Value of Water Utility Costs and cost per acre foot. This was divided by 30 years to obtain the average water saved in a year (11,244 AF). The present value utility costs was then divided by that average (11,244 AF). This results in an estimated capital cost per an acre-foot saved. This was converted into a 2010 present value, based on the US Bureau of Economic

Analysis data[75], and obtained $3,824/AF. The same calculation method was used to estimate community costs (based on the same cumulative water savings) and obtained the result of $13,980/AF.

The reason for obtaining the capital cost per acre-foot saved is so that this cost could be applied to each acre-foot that would be saved over time (out to 2060) in the Local Waters Alternative for Washington County. Those future costs were then discounted back to 2010, so that it would be comparable to the cost analysis developed for the Lake Powell Pipeline. This estimate reflects the most expensive scenario modeled by Maddaus, even though some conservation measures - like the recommended rate structure changes - are cheaper

Reuse

The capital costs of various water reuse facilities are presented here, which was useful to provide context for the estimated reuse facility cost. The St. George Regional Water Reclamation Facility cost $4.2 million to construct in 2006. This facility was an addition to an existing wastewater treatment facility, therefore the costs are quite low compared with some other reuse facilities that have been built recently in the West. The costs for new reuse facilities vary widely, due to a variety of factors such as volume of water treated and likely water treatment technology.

Table G2. This table shows the range of capital costs for building a reuse or reverse osmosis treatment plant.

Source	Capital Cost, year	Facility capacity in million gallons per day (mgd)	Capital cost/unit water	Citation
St. George Regional Water Reclamation Facility	$4,200,000 in 2006	7 mgd	$600,000/mgd	City of St. George and Bowen Collins and Associates[76]
North Las Vegas Reuse facility	$240,000,000	25 mgd	$9,600,000/mgd	Las Vegas Review Journal[77]
Las Vegas	$37,000,000	10 mgd	$3,700,000/mgd	City of Las

[75] United States Department of Commerce, Bureau of Economic Analysis. Table 1.1.9. Implicit Price Deflators for Gross Domestic Product. www.bea.gov accessed on November 5, 2012

[76] Chandler. M., Ford, B. Water Reuse – a multifaceted resource. Presentation by Bowen Collins and Associates, and the City of St. George. https://pncwa.memberclicks.net/assets/2010ConfTechPresentations/Session09/2010%20pncwa-%20session%209-2%20-%20reuse%20-%20mike%20chandler.pdf Accessed November 7, 2012.

[77] Curtis, L. North Las Vegas Flow has no place to go. Las Vegas Review Journal. March 22, 2010. http://www.lvrj.com/news/north-las-vegas-flow-has-no-place-to-go-88803272.html Accessed November 7, 2012.

Durango Hills Water Resource Center				Vegas[78]
Reverse Osmosis – Low Estimate	$176, 900,000 in 2010$	36 mgd	$4,900,000/mgd	Draft Study Report 10
Reverse Osmosis – High Estimate	$341,200,000 in 2010$	36 mgd	$9,500,000/mgd	Draft Study Report 10
Colorado Water Conservation Board			$7,000/AF	CWCB. Reconnaissance Level Cost Estimates.[79]
Colorado Water Conservation Board			$13,500/AF	CWCB. Reconnaissance Level Cost Estimates.[80]

[78] City of Las Vegas Department of Public Works. Durango Hill Water Resource Center – A water recycling facility and distribution system. http://www.lasvegasnevada.gov/files/NWwaterresourcecenter.pdf Accessed November 7, 2012.

[79] CDM. 2010. *Appendix N - Reconnaissance Level Cost Estimates for Agricultural and New Supply Strategy Concepts*. Prepared for Colorado Water Conservation Board. June 4. http://cwcb.state.co.us/water-management/water-supply-planning/Documents/SWSI2010/Appendix%20N_Reconnaissance%20Level%20Cost%20Estimates%20for%20Strategy%20Concepts.pdf

[80] CDM. 2010. *Appendix N - Reconnaissance Level Cost Estimates for Agricultural and New Supply Strategy Concepts*. Prepared for Colorado Water Conservation Board. June 4. http://cwcb.state.co.us/water-management/water-supply-planning/Documents/SWSI2010/Appendix%20N_Reconnaissance%20Level%20Cost%20Estimates%20for%20Strategy%20Concepts.pdf