Local Waters Alternative to the Lake Powell Pipeline 2.0

July 1, 2021

WESTERN RESOURCE ADVOCATES
PROTECTING THE WEST'S LAND, AIR, AND WATER

WaterDM
DEMAND MANAGEMENT

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Acknowledgements
WaterDM and Western Resource Advocates gratefully acknowledge the guidance, review, and recommendations provided by John Gerstle, C.E., MNIF, David Rosenberg, Ph.D., John Berggren Ph.D., and Jane Whalen of Conserve Southwest Utah.

Cover photo: Sand Hollow State Park and Reservoir, Washington County, Utah (www.utah.gov)

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The Lake Powell Pipeline Project is proposed to deliver 86,249 acre-feet (AF) of water annually from Lake Powell to Washington County, Utah to supplement approximately 100,000 AF of local surface water supplies to meet a forecast water demand in 2075 of 184,593 AF.

In 2019, the 171,040 residents of Washington County used a total of 57,373 AF. The Washington County Water Conservancy District (WCWCD) forecasts that by 2075, 594,660 people in Washington County will need 184,593 acre-feet of water. They have proposed the Lake Powell Pipeline to fill the gap.

Lake Powell Pipeline is an Expensive and Uncertain Future Supply

Despite its massive size, Lake Powell sits in a vortex of climate change and interstate water policy that makes it a highly uncertain future supply. The entire Colorado River Basin is imperiled by the impacts of climate change. Scientists understand it took years to fill Lake Powell and it may never fully refill again.[1] The Lake Powell Pipeline may be delayed for years. It may never be successfully constructed. If it is constructed, and regardless of Utah's assumed Colorado River entitlement, the Lake Powell Pipeline will still be the most recent and junior withdrawal on the system and will remain under the microscope and a lightning rod for conflict.

In 2021, bad forecasts for the Colorado River system have swiftly become dire. The US Bureau of Reclamation forecasts Lake Powell to be at 29% of capacity by the end of September 2021, the lowest level since the reservoir first started filling in 1963. The WCWCD's stated belief that the Colorado River and Lake Powell offer "the most reliable water supply in the Western US" [2] is highly questionable.

The Utah Board of Water Resources has proposed that the Lake Powell Pipeline, which draws from the same overallocated Colorado River Basin as the Virgin River, offers improved system reliability and supply diversity for Washington County. This is a questionable notion at best and ignores the impacts of climate change on the entire basin[3] and the fact that the Virgin River and the Colorado River are inextricably linked.

The Lake Powell Pipeline also presents a significant financial risk to the region. Paying for the estimated $2 billion (and growing) project will fall upon impact fees, water sales, and property taxes paid by current and future Washington County residents. Impact fees and water sales are

[1] Salt Lake City Tribune. 1/20/2019. https://www.sltrib.com/news/environment/2019/01/20/lake-powell-could-become/ (accessed 3/5/21)

[2] Statement by Zach Renstrom, General Manager of the WCWCD to the Washington County Republican Women's Luncheon. 3/4/2021.

[3] Milly, P.C. and K. A. Dunne. 2020. Colorado River flow dwindles as warming-driven loss of reflective snow energizes evaporation. Science. 13 MAR 2020 : 1252-1255

both dependent upon population growth forecast by the Kem Gardner Policy Institute[4] and inflated assumptions about future water demand produced by the WCWCD. If the projected population growth and/or projected water demand does not materialize, repayment of the Lake Powell Pipeline becomes more challenging for the WCWCD and much more costly for existing customers.

A Better Option: The Local Waters Alternative 2.0

Rather than build the Lake Powell Pipeline, Washington County, and the WCWCD have the excellent option of relying on local water supplies. The 2013 Local Waters Alternative to the Lake Powell Pipeline proposed greater water efficiency and a reliance on local supplies to meet future demand.[5] WaterDM prepared a revised portfolio of future water supply and demand management options which update and build upon the Local Waters Alternative. The Local Waters Alternative 2.0 analysis concurs with the key recommendations in the 2013 Local Waters Alternative report in finding that a combination of local water supply resources and sensible and cost-effective demand management options can provide a reasonable, reliable water supply to meet the 2075 forecast future population of Washington County at a much lower cost and less risk.

Aside from minimum flow requirement for fish and other species, Utah claims the entire contents of the Virgin River and Kanab Creek and this claim does not appear to be in dispute. The Lake Powell Pipeline, in comparison, is such a highly contentious project that all six fellow Colorado River Basin states have written the Secretary of the Interior requesting that she block the Bureau of Reclamation from completing its ongoing environmental impact statement until the seven states achieve a "consensus regarding outstanding legal and operational concerns" having to do with the pipeline's moving water from the Colorado River's Upper Basin to the southwest corner of Utah, draining into the Lower Basin.[6]

Local Waters 2.0 Means: Utilize the Virgin River System

The best way for the WCDWD and municipalities in Washington County to account for long-term uncertainty is to take advantage of available local resources and to implement cost-effective water demand management policies. The local supply that Washington County controls, the Virgin River, provides a more certain, resilient, and cost-effective long-term supply option than the Lake Powell Pipeline.

The Virgin River system offers greater robustness for water users in Washington County, under a wide variety of future situations and circumstances, than relying on the Lake Powell Pipeline. The Local Waters Alternative 2.0 includes all the existing water rights holdings of the WCWCD

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[4] The Kem C. Gardner Policy Institute, part of the David Eccles School of Business at the University of Utah, prepares economic, demographic, and public policy research including the population estimates relied upon by the WCWCD for the Lake Powell Pipeline DEIS.

[5] Nuding, A. 2013. The Local Waters Alternative to the Lake Powell Pipeline. Western Resource Advocates.

[6] Salt Lake City Tribune. 9/9/2020. https://www.sltrib.com/news/environment/2020/09/09/surrounding-states-bash/ (accessed 3/5/21)

and the other water providers in Washington County, and identified local projects and agricultural transfers already planned and available to the WCWCD along with the additional supply recommendations below.

The Local Waters Alternative 2.0 proposes:

1. Cap secondary water systems at their current size. Focus on expanding potable supply.
2. Store excess Virgin River water in high-flow years.
3. Further explore and expand aquifer storage and recovery.
4. Expand capability for wastewater reuse – to be scaled as required.
5. Cost-effective water demand management.

This revised portfolio provides a reliable future supply of *at least* 111,212 AF of culinary water[7] and an ongoing 15,693 AF of secondary water, which is sufficient supply to meet anticipated average year future demands, and offers a much less expensive, less risky, locally controlled approach for providing water into the future.

Local Waters Alternative 2.0 Means: Manage Water Demand in Washington County

The 2013 Local Waters Alternative proposed a 1% increase in efficiency per year for Washington County[8], which is the typical level of improvement achieved by water providers across the United States over the past 20 years.[9] For the Local Water Alternative 2.0, WaterDM developed a separate analysis of potential demand reductions that can be achieved in Washington County over the next 50 years and found that the 1% annual per capita reduction proposal is reasonable and achievable and is an important part of the best, least risky, and most resilient local supply option.

In the Local Water Alternative 2.0, WaterDM proposes a series of measures and policies to improve water demand management in Washington County and to help manage demand, particularly outdoor use, into the future. Key components of the recommended water demand management options are:

- A regional approach to water demand management
- Strong development and landscape codes
- Water budget-based rates
- Water loss control
- Landscape transformation for climate-adaptation
- Incentives for low-income toilet replacement
- Customer leak detection and monitoring

[7] Additional water reuse could be developed beyond what is proposed by WaterDM and provide a future supply cushion if required.

[8] Nuding. A. 2013.

[9] DeOreo, W.B., P. Mayer, J. Kiefer, and B. Dziegielewski. 2016. Residential End Uses of Water, Version 2. Water Research Foundation. Denver, CO.

The Local Waters Alternative 2.0 analysis of water demand and water rates in Washington County shows that the WCWCD's annual water conservation budget could be invested more effectively. One reason for high water demand in Washington County is the comparatively low cost of water charged for high levels of irrigation use. For the Local Water Alternative 2.0, WaterDM compared the expected monthly water bill for a customer who uses 40,000 gallons in one month (a significant volume) and found that customers in Washington County pay hundreds of dollars less than customers in peer communities using the same volume of water. Customers in Washington County using secondary water pay even less. The lack of a price signal for high volumes of irrigation and outdoor use is one reason water demand in Washington County is higher than in many other parts of the western and southwestern U.S.

Local Waters Alternative 2.0 Means: Rely on Realistic Water Demand Forecast

The Draft Environmental Impact Statement (DEIS) prepared by Reclamation[10] failed to include the impacts of ongoing water efficiency after 2045, improperly inflated secondary water demand, and projected a remarkably high level of system water loss that is never shown to improve over 50 years. The result is a highly inflated and unrealistic demand forecast for Washington County.

For the Local Water Alternative 2.0, WaterDM developed a separate water demand forecast for Washington County that includes the impacts of water loss control and ongoing water efficiency beyond 2045, which were missing from the DEIS forecast.

The Local Waters Alternative 2.0 forecast uses the same population forecast as the DEIS and includes the same population in 2075 of 594,660. The Local Waters forecast starts from the same assumed 2020 level of water use as the DEIS and the two forecasts track closely initially. From 2025 – 2045, the Local Waters 2.0 forecast includes improvements to water loss control practices and building, plumbing, and landscape codes which assure new construction in Washington County will be water efficient from the start.

Starting in 2045, the DEIS assumes that no additional efficiency improvements are possible, and it simply extends a value of 240 gallons per capita per day (gpcd) out to 2075 to develop the final demand estimate. The DEIS assumes that new customers in Washington County will use water just as inefficiently as existing customers without change or improvement for 35 years.

The Local Waters 2.0 forecast includes ongoing efficiency improvements for existing customers in Washington County and it assumes that new customers will join the system as water efficient users from the start due to building and plumbing and landscape development codes. The Local Waters 2.0 forecast for total per capita demand in 2075 (potable + secondary) is 183.5 gpcd and a potable demand alone will be 146.4 gpcd. For comparison, this level of use is about the same as what is used in Grand Junction Colorado today, according to the data from a 2018 study

[10] Reclamation. 2020. Lake Powell Pipeline Project, Draft Environmental Impact, Statement, Coconino and Mohave Counties, Arizona, Kane and Washington Counties, Utah. U.S. Department of the Interior, Bureau of Reclamation. June 2020.

commissioned by the WCWCD (the Maddaus Report)[11]. The Local Waters 2.0 forecast also aligns closely with the demand forecast prepared in the 2013 Local Waters Alternative and confirms the reasonableness of the 1% per year efficiency proposal.

In 2075, the Local Waters Alternative 2.0 forecast estimates that water use in Washington County will still be higher than many comparable utilities with additional conservation potential remaining. It is quite possible per capita use in Washington County will be even lower in 2075 than the level included in the Local Waters 2.0 forecast.

Local Supply Option Less Vulnerable, More Robust

The Local Waters 2.0 analysis shows the local supply option to be less vulnerable, more robust, and more resilient than the expensive and highly uncertain Lake Powell Pipeline. A local water supply option with the recommended water demand management measures offers significant advantages to Washington County water users and advantages that have been ignored as plans for the Lake Powell Pipeline are promoted. There are substantial financial, legal, and political risks associated with the Lake Powell Pipeline. The local supply option significantly alleviates these issues.

The current and future water users in Washington County will be better served today and into the future by adopting a plan optimizing local resources and manage demands.

[11] Maddaus Water Management Inc. 2018. Water Conservation Programs: A Comparative Evaluation. Prepared for the Washington County Water Conservancy District.

LOCAL WATER ALTERNATIVE 2.0 FOR WASHINGTON COUNTY, UT

The Lake Powell Pipeline Proposal

The Lake Powell Pipeline Project is proposed to deliver 86,249 acre-feet (AF) of water annually from Lake Powell to Washington County, Utah to supplement approximately 100,000 AF of local surface water supplies to meet a forecast water demand in 2075 of 184,593 AF.[12] The preferred alignment of the Lake Powell Pipeline would withdraw water near the Glen Canyon Dam in Page, Arizona and would run 141 miles crisscrossing Utah and Arizona before reaching Washington County.

The Washington County Water Conservancy District (WCWCD) is the sole project participant in the Lake Powell Pipeline. Kane County Water Conservancy District was previously a project participant but withdrew in April 2020 after Reclamation determined that projected demand in 2060 did not outpace the estimated future reliable water supply of Kane County.[13]

Washington County, Utah

Washington County is in the southwestern corner of Utah and borders Arizona and Nevada. Terrain in Washington County is rocky and arid, with little area devoted to agriculture. Washington County is made up of three major geographic areas, the Colorado Plateau in the east-northeast, the Great Basin in the northwest and the Mojave Desert in the south-southwest.

Most of the population is centered in the south-central part of the county near the Arizona border around St. George. The climate of this section of the county is typical of the Mojave Desert in which it lies; its annual rainfall is 8 inches, and it is the lowest elevation in Washington County, making it particularly hot and dry compared to the rest of the county. Most homes are in subdivisions characteristic of a growing urban sprawl.[14]

The WCWCD supplies water wholesale to local providers and retail directly to select customers in Washington County. Most of the WCWCD's water is delivered to municipal utilities who provide retail water service to about 90% of the county's population. WCWCD's municipal customers include the communities of St. George, Washington, Hurricane, Ivins, Santa Clara, La Verkin, Toquerville and Leeds.[15]

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[12] Reclamation. 2020. Lake Powell Pipeline Project, Draft Environmental Impact, Statement, Coconino and Mohave Counties, Arizona, Kane and Washington Counties, Utah. U.S. Department of the Interior, Bureau of Reclamation. June 2020. Table 6.2-2 Future Water Requirements of the Washington County Water Conservancy District.

[13] Reclamation. 2020. LPP DEIS. p.3.

[14] https://en.wikipedia.org/wiki/Washington_County,_Utah (accessed 2/10/2021).

[15] https://www.wcwcd.org/about-us/customers/municipal/ (accessed 2/10/2021).

Water Supply

The available water supply for the Washington County Water Conservancy District includes resources from the WCWCD itself and resources belonging to municipalities in Washington County such as the cities of St. George and Hurricane. The current water supply for the WCWCD and municipalities comes from a combination of surface water and groundwater diversions from the Virgin River watershed, a tributary of the Colorado River.

The Utah portion of the Kanab Creek/Virgin River Basin covers about 3,500 square miles and spans three counties: Washington, Iron, and Kane. The Virgin River and Kanab Creek drainages are tributaries of the Colorado River entering the mainstream at Lake Mead. The Virgin and Kanab drainages sit geographically in the Lower Basin of the Colorado River. [16]

Utah believes it has the right to develop and use the flows of the Virgin River based on the decree in Arizona v. California which left the tributaries of the Boulder Canyon Project Act (Lake Mead) to the exclusive use of the state in which they arise.[17]

The Virgin River

How much water is available from the Virgin River? The 1993 Utah State Water Plan for the Kanab Creek / Virgin River Basin states that long-term annual flows of the Virgin River near Virgin, UT to be 130,610 AF and near St. George, UT to be 126,675 AF. The total water diversions from the broader Virgin/Kanab basin at that time were: 20,330 AF for culinary/potable, 15,960 for secondary/raw water irrigation, and 133,300 AF for agricultural irrigation. Total depletions for these uses were 73,050 AF.[18]

The 2018 Evaluation of the Potential Conversion of Irrigation Water to Municipal Use in the Virgin River Basin measured the long-term annual flows of the Virgin River near Virgin, Utah (1988-2017) to be 123,400 AF.[19] The report stated that if a full water supply is available, total potential annual agricultural diversions would be about 74,700 AF with a depletion 42,900 AF and that another 21,400 AF (11,700 AF depletion) of water has already been converted from irrigation to municipal uses.[20]

Flow data from the USGS gauge at St. George, Utah (ID No. 09413500) are available starting in late 1991.[21] Average annual flows from 1991 – 2020 were 126,287 AF, remarkably similar to the average from the 1993 Utah State Water Plan which was based on a much older data set and

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[16] Anderson, L.D. 2002. Utah's Perspective - The Colorado River. Utah Division of Water Resources.

[17] Anderson, L.D. 2002.

[18] Utah DNR. August 1993. State Water Plan Kanab Creek / Virgin River. Utah Department of Natural Resources. Salt Lake City. (p 2-3).

[19] Olds, J. 2018. Evaluation of the Potential Conversion of Irrigation Water to Municipal Use in the Virgin River Basin, Washington County. (Attachment E to January 2019 Water Use Conservation Update) (December 2018)

[20] Olds, J. 2018.

[21] https://waterdata.usgs.gov/usa/nwis/uv?09413500 accessed Feb. 2021.

the 2018 study, which is based data from 1988-2017. However, from 2011 – 2020 average annual flows of the Virgin River at St. George were 105,715 AF, more than 20,000 AF less than the long-term average. Figure 1 shows the annual flow volume of the Virgin River from 1991 – 2020.

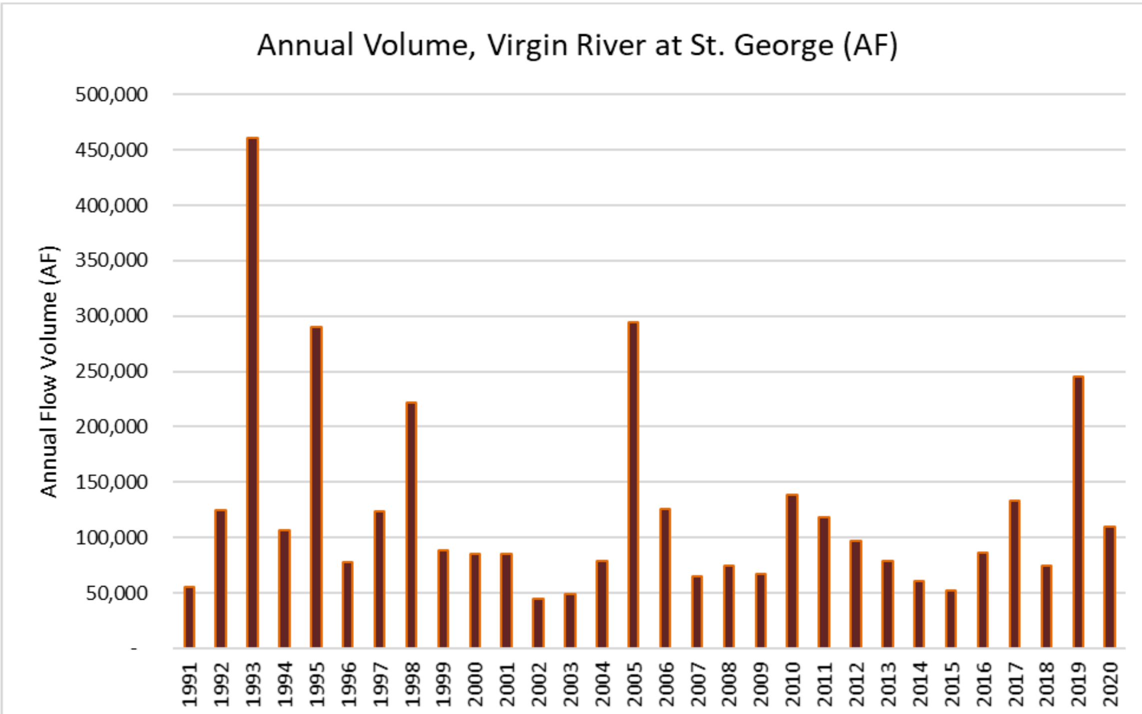

Figure 1: Annual flow volume of the Virgin River at St. George (source USGS)

Just like the rest of the Upper and Lower Colorado River Basin, climate change is impacting precipitation, river flows, and runoff in southern Utah. Flows on the Virgin River that are below the recent 10-year average of 105,715 AF should be expected more frequently in the future due to climate change, just as lower flows have been forecast across the Colorado River Basin.[22]

Existing Supply

As shown in Table 1 which is reproduced from the Draft Environmental Impact Statement (DEIS) prepared by Reclamation, the total current reliable water supplies for the WCWCD are 59,172 AF of potable culinary water and 8,505 AF of raw secondary water for irrigation. The DEIS estimates total current reliable supplies of the WCWCD at 67,677 AF.

[22] Udall, Bradley & Overpeck, Jonathan. (2017). The 21st Century Colorado River hot drought and implications for the future. Water Resources Research. 53. 10.1002/2016WR019638.

Table 1: Current Water Supplies for WCWCD produced from *Table 4.2-1* from the DEIS

Table 4.2-1 Current Water Supplies for Washington County Water Conservancy District

Current Supplies	Reliable Culinary Water Yield (acre-feet/year)	Reliable Secondary Water Yield (acre-feet/year)
Quail Creek and Sand Hollow Reservoirs (a),(b)	24,922	0
Sand Hollow No-Recharge Groundwater (c)	4,000	0
Cottam Well Field	875	0
Kayenta (Ence Wells) Water System	250	0
Crystal Creek Pipeline	2,000	0
Toquerville Secondary untreated Water System	0	178
Other Washington County Municipal Providers	27,125	8,327
Subtotals	**59,172**	**8,505**
Total Current Supplies	**67,677**	

Notes:
(a) Reliable yield for Quail and Sand Hollow Reservoirs includes yields from Kolob and Meadow Hollow Reservoirs.
(b) Reliable yield determined using a 50th percentile climate change scenario with a 10 percent shortage condition.
(c) Supply utilizes existing water rights and natural basin recharge.

As calculated from Table 1, the WCWCD's reliable potable/culinary water yield is 32,047 AF which corresponds to the volume reported in the 2015 WCDWD Water Conservation Plan.[23] The member providers of the WCWCD possess their own municipal water supplies which total 27,125 AF as reported in the DEIS.

Future Supply

The DEIS minimizes future water supply options available in Washington County. As shown in Table 2, which is reproduced from the DEIS prepared by Reclamation, the planned local water supply projects of the WCWCD and its members, without the Lake Powell Pipeline, are 13,670 AF of potable culinary water and 17,380 AF of raw secondary water for irrigation. The DEIS estimates the planned local water supply projects of the WCWCD and its members will create a reliable future supply of just 31,050 AF.

[23] Washington County Water Conservancy District. December 2015. Water Conservation Plan. (Table 2-1).

Table 2: Local Planned Project by Washington County WCD produced from *Table 4.2-2* from the DEIS

Table 4.2-2 Local Planned Projects by Washington County Water Conservancy District

Future Planned Supplies	Reliable Culinary Water Yield (acre-feet/year)	Reliable Secondary Water Yield (acre-feet/year)
Ash Creek Pipeline [(a)]	2,840	0
Sand Hollow Recharge and Recovery	3,000	0
Westside (Gunlock Wells) Arsenic Treatment	5,000	0
Groundwater Well Development	2,830	0
Maximize Existing Wastewater Reuse	0	7,300
Agricultural Conversion from Development [(b)]	0	10,080
Subtotals	**13,670**	**17,380**
Total Future Supplies	**31,050**	

Notes:
(a) Reliable yield determined using a 50th percentile climate change scenario with a 10 percent shortage condition.
(b) The estimated supply is 12,880 acre-feet/year with 90 percent reliability. However, it was estimated that approximately 2,800 acre-feet/year of this supply is currently in use and has been accounted for in the reliable secondary untreated supply.

Agricultural Conversion

The 2018 Evaluation of the Potential Conversion of Irrigation Water to Municipal Use in the Virgin River Basin estimated the amount of irrigation water that could potentially be converted to municipal uses in the Virgin River Basin. This report concludes that an estimated 23,200 AF of potential municipal depletions (e.g., consumptive use) from current irrigation water could be potentially converted to municipal use in the future.[24]

The 2018 Evaluation Report screened out junior water rights and rights of poor quality through the analysis process to ensure the available water would be suitable for municipal uses. The report states that the 23,200 AF of potential municipal depletions represents a "reliable water supply that should be expected even during times of drought with manageable shortages." The report further states that if municipalities (or the WCWCD) have "other sources to augment" the 23,200 AF "available from later priority water rights, then additional supplies could be made available."[25]

Combined Existing and Planned Future Supplies of the WCWCD and Municipalities Without the Lake Powell Pipeline

Based on information from the DEIS and subsequent official updates the combined existing and planned future supplies of the WCWCD and its members is 121,905 AF. This includes existing and planned reliable culinary and secondary yield. These supplies are summarized in Table 3.

[24] Olds, J. 2018.

[25] Olds, J. 2018.

Table 3: Combined existing and planned future supplies of the WCWCD and municipalities without the Lake Powell Pipeline

Water Supply	Reliable Culinary Water Yield (AF)	Reliable Secondary Water Yield (AF)
Current Supplies of the WCWCD	32,047	178
Current Supplies of Washington County Municipal Providers	27,125	8,505
Planned Local Projects	13,370	17,380
Agricultural conversion	23,300	
Total	**95,842**	**26,063**

Additional Supplies Not Reported in the DEIS

The WCWCD and municipalities hold substantial additional surface and groundwater rights not included in the DEIS. The DEIS does not discuss the full extent of water resources currently available to the WCWCD and municipalities in its focus the Lake Powell Pipeline. For the Local Water Alternative 2.0, WaterDM reviewed the water rights holdings of the WCWCD as well as their reservoir capacity and publicly reported groundwater potential and estimated that there are at least 50,000 AF - 150,000 AF or more of additional water supplies available and belonging to the WCWCD and municipalities than are reported in the DEIS. Some of this water may require additional treatment and conveyance but could still be part of a cost-effective local supply solution.

Water Supply Excluded

First, the WCWCD avoids reporting all of its potential water supply in the DEIS by only disclosing water meeting specific minimum EPA water quality requirements, when in fact it possess numerous water supplies of lower quality.[26] Water treatment methods continue to advance and treating water of lower quality is an obvious alternative to the Lake Powell Pipeline that the DEIS has ignored.

147 Individual Water Rights

The WCWCD holds more than 147 individual water rights, many of which are not reported in the DEIS.[27] A complete listing of these 147 water rights is provided in Appendix B. The water rights include small and large, approved and unapproved and withdrawn groundwater and surface water rights. For the Local Water Alternative 2.0, WaterDM reviewed the rights in this

[26] "Water supplies that meet the EPA's secondary untreated MCL for drinking water of TDS less than 500 mg/L are deemed usable for culinary purposes in this assessment." – MWH. 2016. Lake Powell Pipeline Water Needs Assessment. Final. Utah Division of Water Resources.

[27] WCWCD. 2009. Washington County Water Conservancy District Change of Address (involving 147 District Water Right). https://www.waterrights.utah.gov/docimport/0525/05256641.pdf.

portfolio using the Utah Division of Water Resources online search tool and found the WCWCD's water rights holdings to include:[28]

- 10,000 AF from Ash Creek and the Upper Ash Creek Reservoir (81-351)
- 31,820 AF from the Virgin River and Quail Creek (81-1381 and 81-1382)
- 28,891 AF from the Virgin River (81-2273)
- Unapproved rights totaling 60,000 AF from Beaver Dam Wash and Ft. Pearce Wash. (81-3693 and 81-3699)
- 15,000 AF from Sand Hollow Reservoir/Groundwater Recharge and Sand Hollow Reservoir/Ground Water Recovery Wells (81-4428 and 81-4436)
- 15,000 AF from Sand Hollow Reservoir/Sand Mountain Navajo/Kayenta Aquifer (RC004)
- 50,000 AF from the Virgin River via Quail Lake diversion (81-4211 (a22832))
- More than 130 additional WCWCD water rights holdings from across the region.

The WCWCD holds water rights from the Virgin River and its tributaries that total more than 100,000 AF through multiple water rights holdings, yet it reports just 32,047 AF as its reliable culinary yield in the DEIS.

The municipalities possess their own water supplies which total 27,125 AF as reported in the DEIS and these agencies also hold additional water rights not listed in the DEIS.

Further, The State of Utah Board of Water Resources holds a Virgin River water right 81-507 amounting to 147,500 AF.

Quail Creek and Sand Hollow Reservoirs

Quail Creek Reservoir has a capacity of 40,000 AF and Sand Hollow Reservoir has a capacity of 50,000 AF for a combined capacity of 90,000 AF. Both of these reservoirs typically fill every year with water from the Virgin River basin.[29] In the DEIS, the declared combined yield of these reservoirs in declared to be 26,922 AF – just 30% of capacity. In most years, these reservoirs can provide substantially more water than has been declared in the DEIS.

Substantial Groundwater Supply

The WCWCD has groundwater rights and systems not included in the DEIS. Groundwater reserves in Washington County provide a robust backup supply that can be used to supplement during times of surface water shortage.

A 2015 report from Fitch Ratings noted that, "the district is operating a groundwater recharge program that currently provides access to 100,000 AF of stored water and will ultimately

[28] Utah Division of Water Rights, Water Rights Search - https://www.waterrights.utah.gov/search/.

[29] Statement by Zach Renstrom, General Manager of the WCWCD, to the Washington County Republican Women's Luncheon. 3/4/2021.

provide up to 300,000 AF."[30] The Fitch report was based on information provided by the WCWCD itself to the credit rater.

A 2005 report from the WCWCD stated that there are groundwater rights claims of more than 300,000 AF within the Navajo/Kayenta and Upper Ash Creek aquifers:

> *Based on the Utah Division of Water Rights point of diversion coverage, there are 1,276 active underground water rights with points of diversion within the Navajo/Kayenta and the Upper Ash creek aquifers. These water rights claim 590 CFS or 332,760 acre-feet/year from the petitioned aquifers. Accounting for the fact that some water rights declare more than one type of use, there were 160 commercial water rights, 249 stock watering rights, 296 domestic rights, and 969 Irrigation rights (DWR Database, 2000). The Utah Division of Drinking Water indicated there are 23 public water systems with 49 public drinking water wells with water quality data.* – Washington County Water Conservancy District. 2005. Petition for the Classification of the Navajo/Kayenta and Upper Ash Creek Aquifers[31]

The DEIS does not discuss the full extent of groundwater resources in Washington County now and into the future and thus does not provide a complete picture of the water supply condition.

Additional Local Sources of Reliable Supply for Washington County

There are reasonable and reliable local alternatives to the Lake Powell Pipeline that are far less expensive and environmentally damaging. The local supply options recommended in the Local Water Alternative 2.0 include capping secondary water systems, diverting more water from the Virgin River in wet years, treatment and utilization of secondary water, water reuse, aquifer storage, and recovery and demand management measures which are discussed later in this report.

Cap Secondary Water Systems and Treat Future Secondary Water to Culinary Quality

In the hotter and drier future, Washington County's potable/culinary supply should be maximized, and outdoor demands reduced. The first and most obvious water management changes that should occur in Washington County (if the Lake Powell Pipeline is built or not) are:

1. Secondary water systems should be capped at their current size.

[30] Business Wire. 2015. Fitch Affirms Washington County Water Conservancy Dist, UT's LTGOs at 'AA+'; Outlook Stable. https://www.businesswire.com/news/home/20150522005845/en/Fitch-Affirms-Washington-County-Water-Conservancy-Dist-UTs-LTGOs-at-AA-Outlook-Stable

[31] Hansen, Allen & Luce, Inc. July 2005. Petition for the Classification of the Navajo/Kayenta and Upper Ash Creek Aquifers. Prepared for the Washington County Water Conservancy District.

2. Municipal landscape design rules should be adopted to ensure future landscapes are better adapted to local climate conditions and require substantially less supplementary water.[32]
3. Proposed future secondary water should be treated and used for culinary purposes.

Across the western US, water users are working to reduce, not increase outdoor water use. Secondary supply systems are a remnant of a historical era when water was thought to be more plentiful (and cheap) than it is today. In the future, in the arid urban west, many secondary supply systems will be converted to support urban potable uses, including in Washington County. This transformation could be accomplished strategically and in a coordinated manner that maximizes utilization of secondary water where it is located.

To ensure reduced municipal irrigation demands into the future, landscape design codes should be adopted that mandate climate-appropriate landscapes. Examples of just a few water providers in the Colorado River Basin that have strict landscape codes include:

- City of Las Vegas, Nevada[33]
- Salt Lake County, Utah[34]
- Los Angeles, (and all major cities) California[35,36]

The WCWCD should implement a water budgeting approach to landscape water management to determine the water requirement of current and future landscapes and help customers manage water use to reasonable volumetric targets. A 2018 report from Western Resource Advocates illustrates approaches to successfully integrating water efficiency and land use planning.[37] It is easier and more cost effective to install appropriate landscaping on new

[32] Landscape design rules to limit outdoor use have been implemented by water providers throughout the Colorado River Basin including: Las Vegas Valley Water District, the Southern Nevada Water Authority, LADWP, San Diego County Water Authority, and many others.

[33] https://library.municode.com/nv/las_vegas/codes/code_of_ordinances?nodeId=TIT14PUSE_CH14.11DRPL_14.11.150NETUINES

[34] Chapter 19.77 - WATER EFFICIENT LANDSCAPE DESIGN AND DEVELOPMENT STANDARDS https://library.municode.com/ut/salt_lake_county/codes/code_of_ordinances?nodeId=TIT19ZO_CH19.77WAEFLADEDEST

[35] City of Los Angeles Landscape Ordinance. Ordinance No. 170,978 https://planning.lacity.org/odocument/3de931fb-5553-4db1-8d0b-a1b4fcfaf0d5/Landscape_Guidelines_%5BCity_of_Los_Angeles_Landscape_Ordinance_Guidelines%5D.pdf

[36] California Model Water Efficient Landscape Ordinance. https://water.ca.gov/Programs/Water-Use-And-Efficiency/Urban-Water-Use-Efficiency/Model-Water-Efficient-Landscape-Ordinance

[37] Western Resource Advocates. 2018. Integrating Water Efficiency Into Land Use Planning in the Interior West: A Guidebook for Local Planners. https://westernresourceadvocates.org/publications/integrating-water-efficiency-into-land-use-planning/

construction at the time of construction rather than to wait and later pay to replace existing water wasting landscapes.

Capping secondary water use at current levels of approximately 15,663 AF (average of recent annual secondary water use from Table 6), provides up to 10,192 AF of additional reliable new potable supply. Reducing future irrigation demand that might have used this water and planning to convey and treat secondary water to culinary quality in the future is a necessary management step. Secondary water systems can continue to use water and potentially expand as long as average secondary demand does not exceed about 15,663 AF per year. By using secondary water more efficiently, Washington County can effectively stretch this supply and continue irrigation of lands currently receiving secondary water.

Store Virgin River Water in High-Flow Years

The variability in the hydrologic record indicates there will be above average flow years in the future, but they may occur less frequently. For instance, data from the USGS indicate that from 2011 – 2020 average annual flows of the Virgin River at St. George were 105,715 AF, more than 20,000 AF less than the long-term average.[38] The DEIS states:

> *The Virgin River gage in Virgin, Utah is located upstream from any major diversions. The long-term mean annual streamflow at this gage is 182 CFS. Annual streamflow is usually greater than 100 CFS and in high water years can exceed 300 to 400 CFS.*[39]

In the hotter and likely drier future, the WCWCD and municipalities must develop systems for diverting and storing water opportunistically in wet years when flows are high and water is available. Underground storage using aquifer storage and recovery techniques would be the best option for longer term storage and utilization of water from the Virgin River, but all available storage options should be considered.

The purpose of this proposed opportunistic storage, and of most groundwater resources in Washington County in the future, should be to provide safe yield supply in normal years and essential backup supply during dry years when Virgin River flows are below average.

Aquifer Storage and Recovery

Managed aquifer recharge and recovery is already being pursued in Washington County[40] and should be expanded in the future to maximize utilization of underground storage to the extent

[38] https://waterdata.usgs.gov/usa/nwis/uv?09413500 accessed Feb. 2021.

[39] US Bureau of Reclamation. 2020. Lake Powell Pipeline Project, Draft Environmental Impact, Statement, Coconino and Mohave Counties, Arizona, Kane and Washington Counties, Utah. U.S. Department of the Interior, Bureau of Reclamation. June 2020.

[40] The 2016 Final Water Needs Assessment states, "The Sand Hollow well field includes 13 wells that draw water from pre-reservoir groundwater rights and from water recharged to the Navajo Sandstone Aquifer by Sand Hollow Reservoir. Water is chlorinated and pumped to two storage tanks with a total of 3 million gallons of storage capacity prior to delivery to RWSA municipal customers and Sky Ranch and Cliff Dwellers retail customers."

possible. Managed aquifer storage and recovery offers significant advantages over surface water storage, such as eliminating evaporative losses and reducing environmental concerns associated with reservoir projects.

An ongoing evaluation of aquifer storage and recovery at Sand Hollow is reported by USGS.[41] The 2016 Final Water Needs Assessment estimated that there is approximately 106,000 AF stored in the aquifer that could be used. As is proposed for the storage of excel Virgin River flows, the Water Needs Assessment recommends most of the recharged water stored in the Navajo Sandstone Aquifer be reserved for use during dry periods to compensate for any deficit between annual supply and demand.[42]

The success of the managed storage and recovery project at Sand Hollow Reservoir proves this method of water storage is not only feasible for Washington County, but can generate significant volumes of stored water. Additional advantageous locations should be explored so that excess surface water flows can be opportunistically stored.

Adding underground water storage will increase reliability and enable Washington County to better and more easily manage through drought periods when flows on the Virgin River are below requirements.

Wastewater Reuse

As shown in Table 2, the DEIS lists an additional 7,300 AF of reliable secondary water yield that will be available. Additional wastewater reuse capacity has long been proposed and planned for by the WCWCD and the City of St. George.

Most recently, the 2019 Sewer Master Plan prepared for St. George by Bowen Collins & Associates recommended the City continue exploring a satellite/decentralized treatment plant that would provide additional reuse capacity.[43] The report noted that while potentially more expensive than expanding the centralized facility, a satellite wastewater facility could treat and deliver reuse quality water closer to where it is needed. For example, the City of Hurricane could treat wastewater from its existing sewer lagoons to produce reuse water for local golf courses that currently rely on potable supply.

Plans for reusing water from the Lake Powell Pipeline, should it be completed, have also been put forward in the 2016 final Water Needs Assessment which proposed an additional 17,120 AF of reuse.[44]

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[41] USGS. 2018. Assessment of Managed Aquifer Recharge at Sand Hollow Reservoir, Washington County, Utah, Updated to conditions Through 2016. Prepared in Cooperation with the Washington County Water Conservation District. Open-File Report 2018-1140.

[42] MWH. 2016. Lake Powell Pipeline Water Needs Assessment. Final. Utah Division of Water Resources.

[43] Anderson, A. 2019. Sewer Master Plan, City of St. George. Bowen Collins & Associates.

[44] MWH. 2016. Lake Powell Pipeline Water Needs Assessment. Final. Utah Division of Water Resources.

Even without the Lake Powell Pipeline, additional wastewater reuse could be accomplished in the future if additional supplies are needed. WaterDM estimates that up to an additional 15,000 AF per year of wastewater reuse could be developed. It can be developed far in the future using indirect or even direct potable reuse methods as they become permissible. Additional water reuse represents a valuable variably sized supply cushion which is available to Washington County in the future, if needed.

Revised Supply Portfolio for Washington County

Rather than build the Lake Powell Pipeline, Washington County and the WCWCD have the excellent option of relying on local water supplies. The Local Waters Alternative 2.0 includes a revised portfolio of future water supply, updated demand management programs, and revised demand forecast presented later in this report. This combination provides a reliable water supply to meet the forecast future population of Washington County with much lower cost with higher reliability and less risk.

The differences between Table 3 (based on information from the DEIS and subsequent official updates) and the revised portfolio in Table 4, are that the revised portfolio includes:

1) A cap on additional secondary supply projects
2) A shift of 10,192 AF from planned secondary to planned culinary projects
3) Additional wastewater reuse (could be expanded to more than 15,000 AF if necessary)
4) Additional 50,000 AF – 150,000 AF of water supply not included in the DEIS[45]

This revised portfolio provides a reliable future supply of 111,212 AF of culinary water and 15,693 AF of secondary water.

[45] Listing of 147 water rights owned by the WCWCD is provided in Appendix B.

Table 4: Local Waters Alternative 2.0 - revised portfolio of existing and potential future reliable supplies of the WCWCD and municipalities, without the Lake Powell Pipeline

Water Supply	Reliable Culinary Water Yield (AF)	Reliable Secondary Water Yield (AF)
Current Supplies of the WCWCD	32,047	178
Current Supplies of Washington County Municipal Providers	27,125	8,505
Planned Local Projects	23,740	7,010
Agricultural conversion	23,300	
Subtotal	106,034	15,693
Additional Wastewater Reuse	5,000 – 15,000	
Total	111,212 – 121,212	15,693
Additional groundwater and surface water supplies not included in the DEIS	50,000 – 150,000 AF	
Total Supply = Culinary + Secondary	**176,905 – 286,905 AF**	

Figure 2 shows a comparison of the reliable water yields from the DEIS (Table 3) and the Local Waters Alternative 2.0 (Table 4). The notable differences in the Local Water Alternative 2.0 are the conversion of some planned local projects from secondary to culinary and the inclusion of wastewater reuse, scaled to the requirements of the local community.

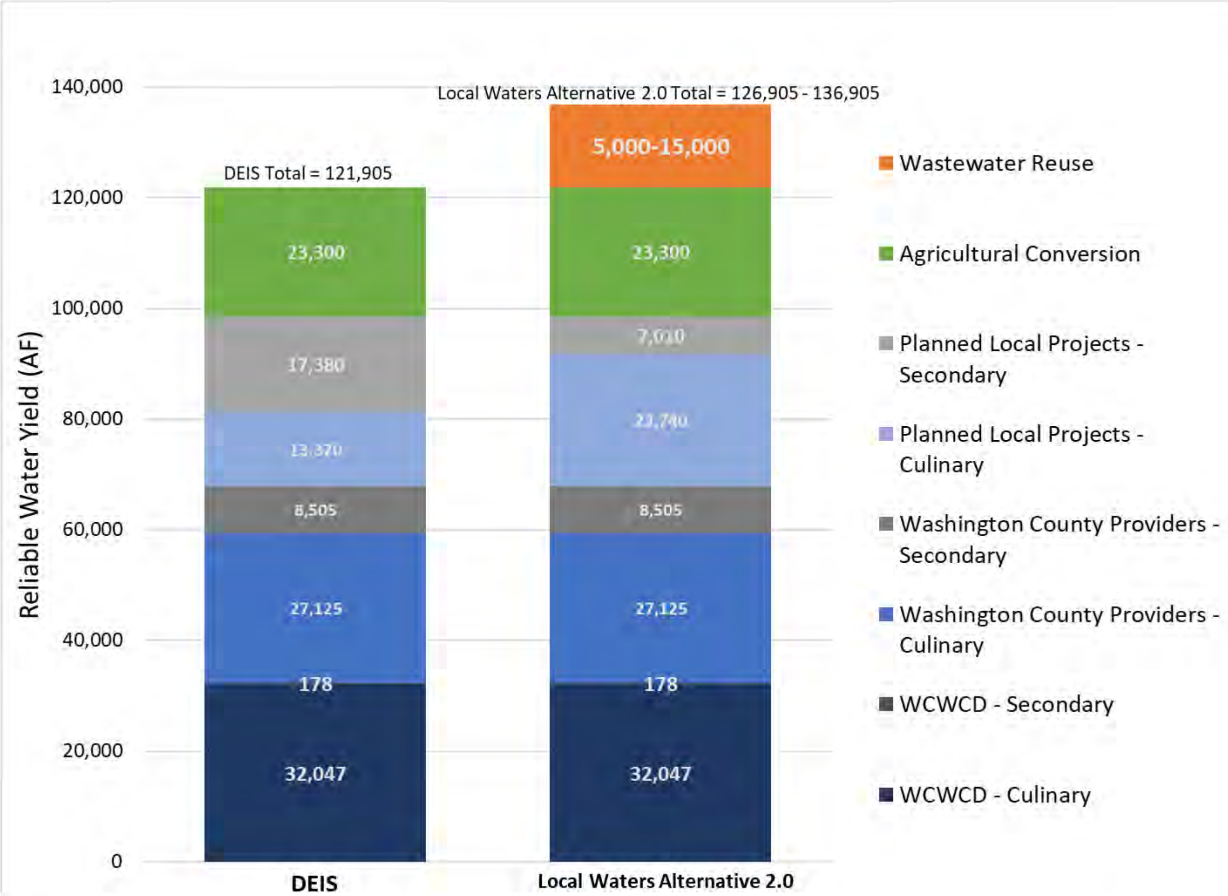

Figure 2: Reliable water yield comparison, DEIS and Local Waters Alternative 2.0

Figure 3 shows the reliable water yield comparison with the inclusion of some of the surface and groundwater rights not included in the DEIS. The revised portfolio provides sufficient reliable supply to meet anticipated average year future demands, and offer a much less expensive, less risky, locally controlled approach for providing water into the future.

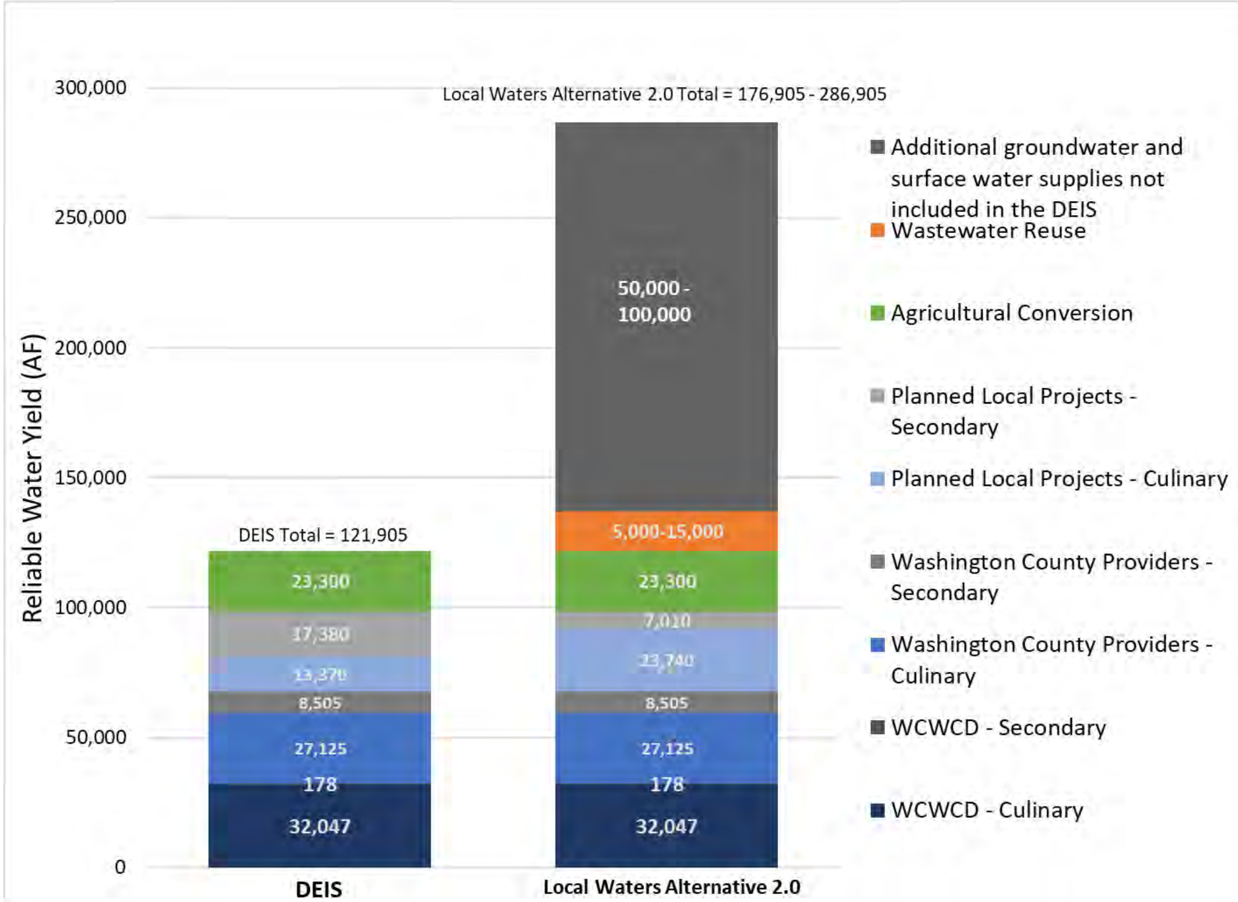

Figure 3: Reliable water yield comparison, DEIS and Local Waters Alternative 2.0 including additional groundwater and surface water supplies not included in the DEIS

Additional Wastewater Reuse Treatment Requirements

The Local Water Alternative 2.0 portfolio includes between 5,000 and 15,000 AF of additional wastewater reuse (Table 4) treated to culinary standards without the use of reverse osmosis (RO). Other technologies have been proven to safely treat recycled water to culinary standards with costs significantly lower than reverse osmosis. Additionally, these treatment processes do not generate a constant brine waste stream which is often challenging and costly to dispose of for inland communities such as those in Washington County.

Non-RO treatment processes including ozonation and biologically activated carbon filtration (O^3/BAF) can produce highly purified culinary water at significantly lower cost[46,47,48]. The Water Research Foundation reported that costs are often less than half for O^3/BAF-based treatment compared to processes including reverse osmosis. Interest in non-RO treatment is not only gaining interest around the United States, but also in Utah. In 2019, South Jordan City's Pure SoJo Direct Potable Reuse (DPR) Demonstration Project[49] used a non-RO processes to treat wastewater effluent to produce high quality purified drinking water for consideration as a future alternative water supply. As communities around the country, including in Utah, look to optimize their existing water supplies through potable reuse, safe and effective non-RO treatment will help ensure this supply option is cost-competitive compared to other new supply alternatives.

Treatment of Additional Groundwater and Surface Water Supplies Not Included in the DEIS

The Local Water Alternative 2.0 analysis shows that 50,000 - 150,000 AF or more of additional supplies were not included in the DEIS that would potentially be available to meet Washington County's future demands. Though the analysis finds that these supplies will likely be unnecessary, if additional supplies beyond those included in our revised portfolio are required, the quality will vary depending on the source. Any highly saline sources that would require significant treatment including reverse osmosis should be the last to be incrementally phased in due to costs.

To protect rate payers from unnecessary financial burdens, fiscally responsible water utilities should only pursue more costly water supplies after all other viable and less expensive supply options have been exhausted. Thus, if reverse osmosis or a similarly expensive treatment technology were to be needed sometime in the future to provide a small portion of culinary water to Washington County residents, it would only be used after all other less expensive supply and treatment options have first been implemented.

[46] Water Research Foundation. 2019. Ozone Biofiltration for DPR: Non-RO-based treatment schemes involving ozone-BAF can produce high-quality potable water at significant cost savings. Advances in Water Research. January-March 2019, 29 (1), 22-23. https://www.advancesinwaterresearch.org/awr/january-march_2019__volume_29__number_1/MobilePagedArticle.action?articleId=1467713#articleId1467713

[47] Water Research Foundation. 2018. Potable Reuse Using Ozone-Biofiltration. WateReuse, The Water Research Foundation. September 26, 2018. WateReuse Webcast Series. https://watereuse.org/wp-content/uploads/2018/09/Webcast-Potable-Reuse-Ozone-Biofiltration.pdf

[48]Steinle-Darling, E. 2018. Pure Water Proof: Non-RO Demonstration for DPR in Altamonte Springs, Florida. Arizona Water Reuse 2018 Symposium. July 23, 2018 presentation. https://cdn.ymaws.com/www.azwater.org/resource/group/92514c23-27f9-41f5-b34a-72567b22b1b2/symposium_2018/S2A1_Steinle-Darling_Altamon.pdf

[49] South Jordan City. 2020. Overview of South Jordan Water Conservation Program & DPR Demonstration Project, South Jordan Utah ppt https://www.utah.gov/pmn/files/505541.pdf

Utah Division of Water Resources Comments on Supply Diversity

The 2019 Water Conservation Update prepared by the Utah Board of Water Resources stresses the need for the Lake Powell Pipeline as a "second water source" and part of a diverse water supply for Washington County.[50] The update lists four "prudent planning objectives" the Lake Powell Pipeline will achieve:[51]

1. Provide for System Diversity/Reliability
2. Provide System Redundancy
3. Account for Climate Variability
4. Account for Long-Term Uncertainty

System Diversity and Reliability

The reliability of a water supply can be defined as the number of instances that the available supply is considered satisfactory, divided by the total number of instances in the time series.[52] The source of supply for both the Virgin River and the Lake Powell Pipeline is the Colorado River Basin. The climatologic reliability of these water supplies is inextricably linked. Politically, the local supply from Virgin River is far more reliable and certain for Washington County than the over-appropriated and federally managed supply in Lake Powell in many respects.

The entire Colorado River Basin is imperiled by the impacts of climate change. Scientists expect Lake Powell will likely never fully refill again.[53] If the Lake Powell Pipeline is built, will the water be there to pump? The Utah Board of Water Resources has proposed that the Lake Powell Pipeline, which draws from the same overallocated Colorado River Basin as the Virgin River, represents improved system reliability and supply diversity for Washington County. This is a questionable notion at best and ignores the impacts of climate change on the entire basin[54] and the fact the Virgin River and the Colorado River are inextricably linked.

There is a close relationship between annual flow in the Virgin River and the annual unrestricted flow into Lake Powell. Figure 4 plots the annual unregulated inflow into Lake Powell as reported by the US Bureau of Reclamation vs. the annual flow of the Virgin River measured at St. George by the US Geological Survey. A linear correlation produces a coefficient

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[50] Utah Board of Water Resources. 2019. Attachment C. Water Needs Assessment: Water Use and Conservation Update, Response to Comments.

[51] Utah Board of Water Resources. 2019. Attachment C.

[52] Wheeler, K. et. al. 2021. Alternative Management Paradigms for the Future of the Colorado and Green Rivers. White Paper No. 6. Center for Colorado River Studies. Utah State University

[53] Salt Lake City Tribune. 1/20/2019. https://www.sltrib.com/news/environment/2019/01/20/lake-powell-could-become/ (accessed 3/5/21)

[54] Milly, P.C. and K. A. Dunne. 2020. Colorado River flow dwindles as warming-driven loss of reflective snow energizes evaporation. Science. 13 MAR 2020 : 1252-1255

of determination (R^2) of 0.76 indicating a close relationship between these two factors. Other studies have also noted these relationships across the Colorado River Basin.[55]

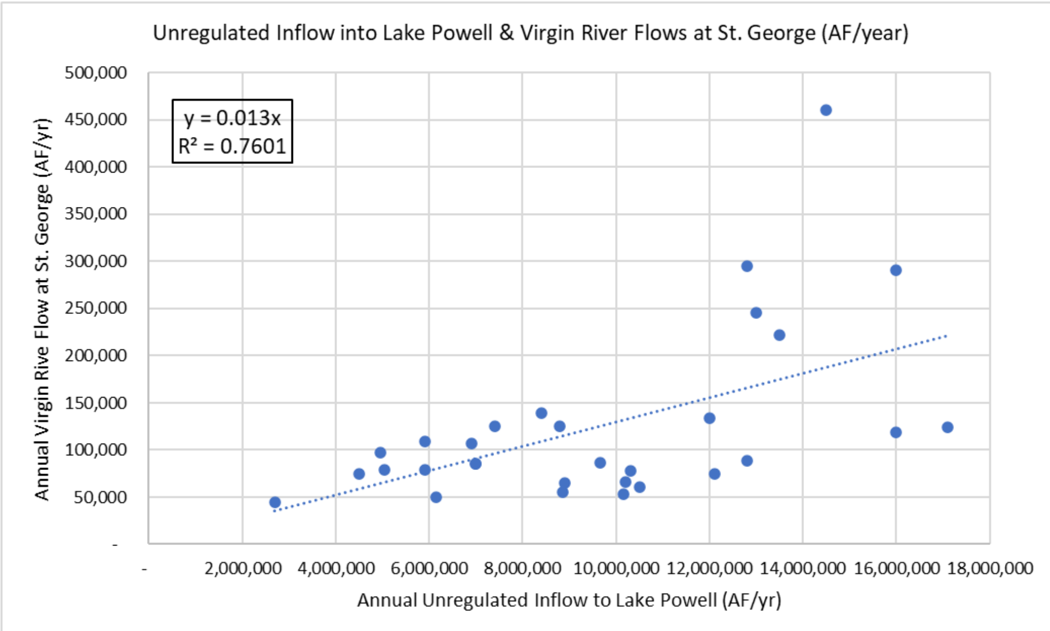

Figure 4: Linear correlation between annual Lake Powell inflow and annual Virgin River Flows

Because they are climatologically linked, low flow and high flow years are likely to coincide. As Lake Powell levels sink due to climate change, equalization, and power production requirements, is it clear the primary advantage of the Virgin River as a water supply for Washington County over Lake Powell and the Upper Colorado River Basin now and into the future will be local control. Utah owns and controls the contents and fate of the waters of the Virgin River. Aside from minimum flow requirement for fish and other species, Utah has substantial seasonal water rights it can capture and local supplies it has yet to develop. The Lake Powell Pipeline, in comparison, is such a highly contentious project that all six fellow Colorado River Basin states have written the Secretary of the Interior requesting that the Bureau of Reclamation pause in completing its ongoing environmental impact statement until the seven states achieve a "consensus regarding outstanding legal and operational concerns" having to do with the pipeline's moving water from the Colorado River's Upper Basin to a corner of Utah draining into the Lower Basin.[56]

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[55] Xiao, M., Udall, B., & Lettenmaier, D. P. (2018). On the causes of declining Colorado River streamflows. Water Resources Research, 54, 6739– 6756. https://doi.org/10.1029/2018WR023153

[56] Salt Lake City Tribune. 9/9/2020. https://www.sltrib.com/news/environment/2020/09/09/surrounding-states-bash/ (accessed 3/5/21)

The US Bureau of Reclamation reported on April 15, 2021 that Lake Powell stands at 36% of its live capacity, 133 feet from full pool.[57] Forecasts indicate lake levels will continue dropping and the first ever shortage declaration is likely.[58] The WCWCD's stated belief that the Colorado River and Lake Powell offer "the most reliable water supply in the Western US" [59] is simply not true. In fact, the Colorado River is greatly imperiled and likely to be the focus of great conflict in the coming years. Flows on the Colorado River continue to decline due to climate change.[60] The reliability of water from Lake Powell and the Lake Powell Pipeline is uncertain at best with very real regional political challenges and competing demands from neighboring states and water users.

The water for the Lake Powell Pipeline is not really from a diverse source and because of the political realities of the Colorado River, the Lake Powell Pipeline does not offer the reliability wished for by the WCWCD and the State of Utah.

Provide System Redundancy

Is a pipeline that delivers water from the same greater watershed as the Virgin River truly a redundant supply? Even under the best circumstances, the close correlation shown in Figure 4 shows that the Virgin River and the Lake Powell Pipeline share co-vulnerabilities when it comes to a climate drought. Given the costs and uncertainties associated with the Lake Powell Pipeline, suggesting that it provides reasonable or affordable redundancy goes against the facts.

At an estimated cost to taxpayers of $2.24 billion (and growing whenever recalculated) the Lake Powell Pipeline offers questionable redundancy at caviar and champagne prices. Assuming it can be completed, and that water remains in Lake Powell to deliver, the Lake Powell Pipeline would offer rate payers of Washington County some of the most expensive system redundancy imaginable.

Account for Climate Variability

The Virgin River and Lake Powell both experience many of the same broad reaching climate trends impacting supply and runoff as shown in Figure 4. The Lake Powell Pipeline does not in fact provide any buffer for the climate variability that impacts the Virgin River because they are subject to the same long-term climate change-impacted trends and even the same inter-annual variability. If anything, because of the multiple and competing demands on Lake Powell and

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[57] USGS 2021. April 24 Month Study. USGS Water Resources Group, Salt Lake City, UT. https://www.usbr.gov/uc/water/crsp/studies/24Month_04.pdf

[58] https://www.azcentral.com/story/news/local/arizona-environment/2021/04/23/snow-and-shrinking-flows-colorado-river-shortage/7294203002/

[59] Statement by Zach Renstrom, General Manager of the WCWCD to the Washington County Republican Women's Luncheon. 3/4/2021.

[60] Milly, P.C. and K. A. Dunne. 2020

potential for litigation, it offers a far less secure and climate resilient supply for the WCWCD than to simply rely upon and maximize use of the local Virgin River.

Account for Long-Term Uncertainty

There is tremendous long-term uncertainty associated with Lake Powell and the Colorado River today. Currently at just 39% of live capacity, it is likely that Lake Powell will never refill. The Utah office of the Legislative Auditor stated in 2019, "While the WCWCD has the potential to generate sufficient revenue to repay the LPP's cost, revenue is dependent on many factors WCWCD does not control. WCWCD will rely on three sources of revenue to replay the pipeline cost: impact fees, water sales, and property taxes. Impact fees are influenced by population and economic growth. The growth from water sales will be dependent on population growth and changes in water consumption."[61]

The WCWCD cannot ensure that the future population growth will occur. Furthermore, it is actively seeking to reduce the very same demand it anticipates, through water conservation and pricing programs. If the projected population growth does not materialize and the conservation efforts of the citizens of Washington County are successful, repayment of the Lake Powell Pipeline becomes more challenging for the WCWCD and much more costly for existing customers. The Lake Powell Pipeline increases long-term uncertainty and the potential for financial insolvency.

In fact, water consumption is the one and only factor that the WCDWD has significant control over today and into the future. The WCWCD can further implement programs and policies to reduce water use in the future. This is a proven and effective approach to managing supply constraints which offers great opportunity for the WCWCD.

Despite its massive size, Lake Powell sits in a vortex of climate change and interstate water policy that make it a highly uncertain future supply. The WCDWD and municipalities currently hold rights to a reliable water supply from the Virgin River that is 30,000 acre-feet larger than the volume used to supply the City of Tucson in 2019 with a population of 731,000, 6.8 million tourists per year,[62] and 35 golf courses[63] (many irrigated with recycled water).[64] The best way for the WCDWD and municipalities to account for long-term uncertainty and to ensure fiscal security is to optimize use of available local resources and to implement and cost-effective water management policies. The local supply that it controls – the Virgin River if fully optimized – provides a more certain, resilient, and cost-effective long-term supply option than the risky Lake Powell Pipeline.

[61] State of Utah Office of the Legislative Auditor General. August 2019.

[62] https://www.kold.com/2019/07/25/arizona-pima-county-report-record-year-tourism/ (accessed 3/11/2021)

[63] https://www.golflink.com/golf-courses/az/tucson (accessed 3/11/2021)

[64] https://www.tucsonaz.gov/water/reclaimed-water-facts (accessed 3/11/2021)

Water Supply Metrics – Lake Powell Pipeline vs. Virgin River and Local Resources

When considering the Lake Powell Pipeline proposal vs. relying on the Virgin River and maximizing local resources, there are additional water supply metrics that should be considered beyond those discussed by the Utah Board of Water Resources in Appendix C. These additional metrics are: resilience, vulnerability, and robustness and each will be addressed individually.[65]

Resilience

Resilience is the ability of a system and its components to anticipate, absorb, accommodate, or recover from the effects of a potentially hazardous event in a timely and efficient manner.[66] Resilience measures the likelihood of system recovery from an unsatisfactory state.

For the Virgin River, an unsatisfactory state would be equivalent to a drought period in which there is insufficient flow to meet demand requirements. For Lake Powell and the Lake Powell Pipeline, an unsatisfactory state would be equivalent to a lake level below the power generation level or a Lower Basin compact call.

The Virgin River has a much greater likelihood of rapid system recovery from the unsatisfactory state of low flows than the Colorado River and Lake Powell system. The Virgin River flows vary year to year and a rebound within 12 months is a reasonable expectation. The much larger Colorado River system and the rules of equalization mean that the Lake Powell and Lake Mead system responds much more slowly. Starting in 1963, it took Lake Powell 17 years to fill and it has yet to recover at all from significant declines throughout the 21st century.

The Virgin River system is a more resilient supply than the proposed Lake Powell Pipeline because it is far more likely to recover quickly from an unsatisfactory state.

Vulnerability

Vulnerability is defined as the propensity or predisposition for a water supply to be adversely affected in general by any external factors.[67] Both the Virgin River and associated local water supplies and the greater Colorado River system including Lake Powell have vulnerabilities, but there are important differences to consider.

The Virgin River is vulnerable to climate change and climate variability, but the water it yields belongs to the state of Utah. Aside from minimum flow requirement for fish and other species, Utah has high-seasonal water rights it could capture and more water rights it could develop.

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[65] Wheeler, K. et. al. 2021. Alternative Management Paradigms for the Future of the Colorado and Green Rivers. White Paper No. 6. Center for Colorado River Studies. Utah State University.

[66] Lavell A., et al. 2012. Climate change: new dimensions in disaster risk, exposure, vulnerability, and resilience. Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK, and New York, NY, USA.

[67] Lavell et al., 2012.

This enables the WCWCD and others to optimize and maximize use of this resource including capturing and storing high flows.

The Colorado River system including Lake Powell is also vulnerable to the same climate change and climate variability as the Virgin River, but the water in the Colorado belongs to a consortium of states, tribes, and multiple nations, each with an established rightful claim. Climate change is causing flow declines in the Colorado and additional declines are likely to occur[68] creating greater conflict and competition between water users. Unlike the Virgin River, the Colorado River system is over-allocated and far outside the control of Washington County and the WCWCD.

The Lake Powell Pipeline has not been built and remains an uncertain proposition which itself is a significant vulnerability. Legal challenges to the Lake Powell Pipeline should be expected and neighboring states have already indicated their willingness to contest the proposal. The State of Utah and Washington County would be well advised to look into the legal fees associated with the most recent US Supreme Court water case, FL v. GA, 142 original, in which Georgia and Florida have each spent more than $50 million.[69] The Lake Powell Pipeline is vulnerable to being caught in expensive litigation and never being built. The WCWCD's focus and reliance on this specific water supply proposal itself creates real vulnerability for the people of Washington County as more reliable local supply options are neglected.

If constructed, water supply for the Lake Powell Pipeline could be far less certain and assured than supplies from the Virgin River because of the numerous competing interests involved and potential for litigation on multiple fronts. Regardless of Utah's entitlement, the Lake Powell Pipeline will still be the most recent and junior withdrawal on the system and thus constantly subject to debate and attack as climate change continues to impact an overallocated Colorado River Basin system.

While these supplies share some vulnerabilities, over the long-term the Lake Powell Pipeline and the supply from the Colorado River system faces far greater vulnerabilities and risks than the Virgin River system.

Robustness

The robustness of a water supply strategy of plan measures the ability to perform across a wide range of uncertain future conditions.[70] Robustness analysis can be used to identify water supply options that are acceptable under the widest variety of circumstances and it can also be a metric of overall system performance.

[68] Wheeler, K. et. al. 2021.

[69] https://www.ajc.com/news/georgia-news/florida-georgia-bring-water-rights-grievances-back-to-supreme-court/ (accessed 3/11/2021)

[70] Lavell et al., 2012.

As discussed above, both the Virgin River and the greater Colorado River system including Lake Powell and Lake Mead face similar challenges and risks due to climate change and increasing temperatures. Because the Lake Powell Pipeline proposal sits in the vortex of climate change and interstate water policy it is in fact a highly uncertain future supply. It may be delayed for years. It may never be successfully constructed. If it is constructed, and regardless of Utah's entitlement, the Lake Powell Pipeline will still be the most recent and junior withdrawal on the system and will remain a lightning rod for conflict.

Maximizing use of the Virgin River system for potable supply would offer greater robustness under a wide variety of future situations and circumstances. This would include:

1. Planned local projects
2. Agricultural conversion
3. A cap on secondary water systems at their current size
4. Storing Virgin River water in high-flow years
5. Exploring and expanding aquifer storage and recovery
6. Expanding capability for wastewater reuse
7. Cost-effective water demand management

Development of Virgin River and local resources faces none of the opposition and political challenges of the Lake Powell Pipeline and offers the greatest potential to provide future water supply under uncertain future conditions. A local supply strategy is a more robust approach for Washington County than the expensive and uncertain Lake Powell Pipeline.

Water Demand

This section of the report addresses historic and future water demand in Washington County.

Total Water Demand

The 1993 Virgin River Plan reported the total withdrawals from the Virgin River and Kanab Creek Basin was 159,590 AF with depletions of 73,050 AF. In 2002, the Utah Division of Water Resources reported the total withdraws to be 168,656 AF with depletions of 77,200 AF. These data are shown in Table 5.

Table 5: Historic water demand in Washington County, Utah

Year	Document/ Source	Geography	Culinary/ Potable (AF)	Secondary (AF)	Irrigation (AF)	Total (AF)	Depletions (AF)
1993	Virgin River Plan	Kanab Creek/Virgin River Basin	20,330	15,960	123,300	159,590	73,050
1993	Virgin River Plan	Virgin River Basin (long-term average discharge)				155,000	
2000	Utah's Perspective on the CO River	Kanab Creek/Virgin River Basin				168,656	77,200

More recently, the Utah Division of Water Resources Open Data offers comparable municipal consumption data for Washington County. Agricultural withdrawals were not readily available. The 2018 Evaluation of the Potential Conversion of Irrigation Water to Municipal Use in the Virgin River Basin reported that 74,700 AF represents the potential annual diversion of existing irrigation water rights holders in the basin.[71] These data are shown in Table 6 along with an estimate of 2020 demand prepared by the Utah Division of Water Resources.

[71] Anderson, L.D. 2002. Utah's Perspective The Colorado River. Utah Division of Water Resources.

Table 6: Water demand in Washington County, Utah, 2016 - 2019

Year	Document/ Source	Geography	Culinary/ Potable (AF)	Secondary (AF)	Irrigation (AF)*	Total (AF)
2016	Utah DNR Open Water Data	Washington County	41,456	16,981	74,700	133,137
2017	Utah DNR Open Water Data	Washington County	43,169	15,375	74,700	133,244
2018	Utah DNR Open Water Data	Washington County	45,247	17,318	74,700	137,265
2019	Utah DNR Open Water Data	Washington County	44,276	13,097	74,700	132,073
2020	Utah's Perspective on the CO River	Kanab Creek/Virgin River Basin				201,426**

*Irrigation demand based on the 2018 Evaluation of the Potential Conversion of Irrigation Water to Municipal Use in the Virgin River Basin. 74,700 AF represents the potential annual diversion of existing irrigation water rights holders in the basin.

**Forecast of 2020 demand from Anderson, L.D. 2002. Utah's Perspective The Colorado River. Utah Division of Water Resources.

The four-year demand record of the municipal sector in Washington County including both culinary/potable and secondary/raw water is shown in Figure 5.

The average contribution of each category of use from 2016-2019 is shown in Figure 6. Potable/culinary use for the residential sector and secondary water use for irrigation across all sectors accounted for 83% of the water demand in Washington County over this period. The potable/culinary demands of the commercial, institutional, and industrial sector combined accounted for 17% of total demand.

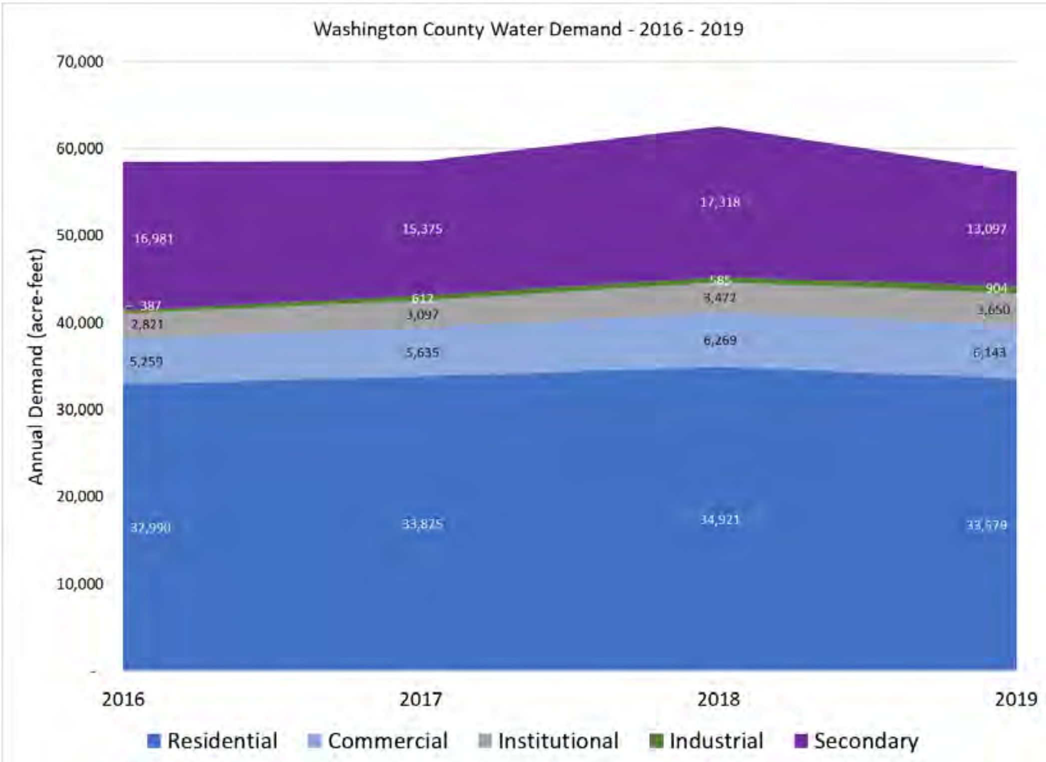

Figure 5: Municipal water demand in Washington County, Utah, 2016 – 2019

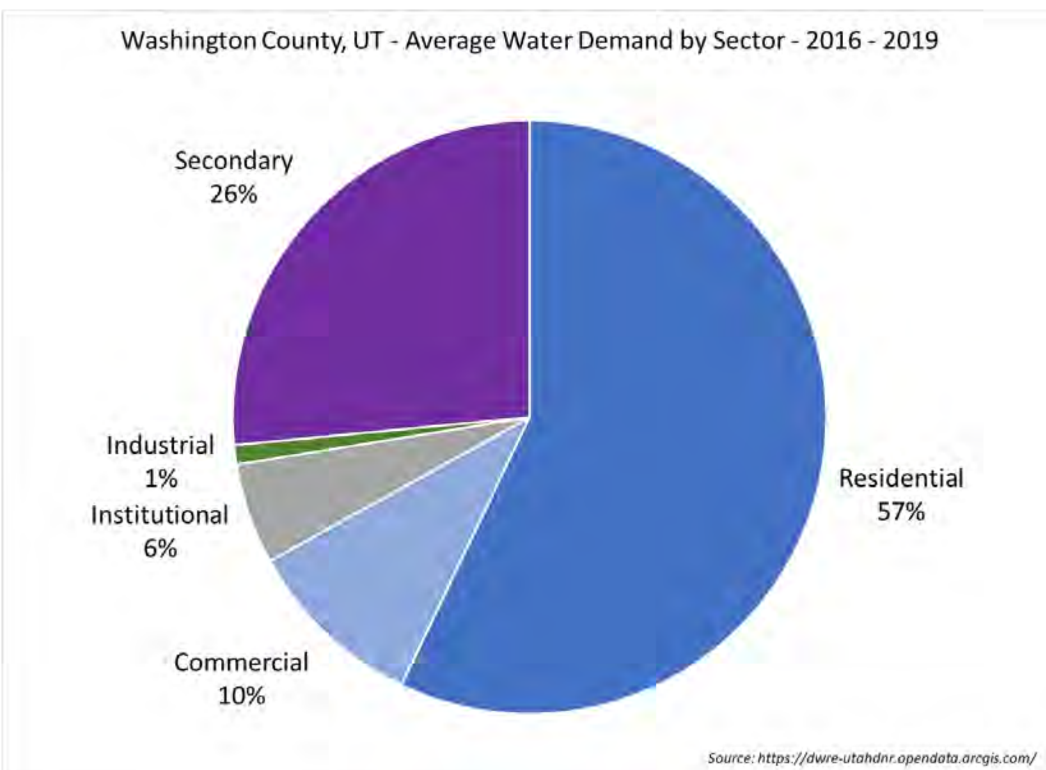

Figure 6: Pie chart of average municipal water demand by sector in Washington County, Utah, 2016 – 2019

Per Capita Water Use

For the Local Waters Alternative 2.0, WaterDM prepared an independent calculation of per capita water use based on the most recent demand data for Washington County from the State of Utah and November 2020 updated demographic county population profiles from the Kem C. Gardner Policy Institute. Gallons per capita per day in Washington County from 2016 – 2019 is shown in Table 7. Culinary/potable per capita use has increased from 2016 – 2019 starting at 229.2 gpcd and increasing to 236.2 gpcd in 2019 – a 3% increase. These data suggest that efforts to increase water use efficiency in Washington County over the past five years have not been successful at reducing potable use at the customer level.

Table 7: Per capita water use in Washington County, 2016 - 2019

Year	Culinary/ Potable (AF)	Secondary (AF)	Population	Culinary/ Potable gpcd	Secondary gpcd	Total gpcd
2016	41,456	16,981	154,614	229.2	71.3	300.5
2017	43,169	15,375	160,373	230.8	94.5	325.3
2018	45,247	17,318	165,592	232.7	82.9	315.6
2019	44,276	13,097	171,040	236.2	90.4	326.6
			Average	***232.2***	***84.8***	***317.0***

DEIS Water Demand Forecast

Forecast Population and Water Requirements

The Lake Powell Pipeline Project is proposed to deliver 86,249 acre-feet (AF) of water annually from Lake Powell to Washington County, Utah to supplement local surface water supplies to meet a forecast water demand in 2075 of 184,593 AF.

As shown in Table 8, which is reproduced from Reclamation's DEIS, this volume of water is ostensibly required to meet a forecast 2075 population in Washington County of 594,660 people, a 293% increase over 60 years.

As part of the DEIS forecast, per capita water use (inclusive of all uses except system losses) starts at 302 gallons per capita per day (gpcd) in 2015 and is reduced by 20% to 240 gpcd by 2045. After year 2045 there are no additional efficiency improvements and gpcd is forecast to remain at 240 gpcd through 2075. System water losses start at 15.4% in 2015 and continue unchanged through 2075.

Table 8: Future Water Requirements for Washington County WCD produced from *Table 6.2-1* from the DEIS

Table 6.2-1 Future Water Requirements for Washington County Water Conservancy District

Year	WCWCD Service Area Population - Baseline Projection (calculated using the Gardner estimate multiplied by UDWRe system ratio)	GPCD per Applied Analysis that includes 20% conservation	System loss from Applied Analysis model	Demand (acre-feet) with System Loss
2015	151,360	302	0.154	59,038
2020	182,689	296	0.154	69,791
2025	214,408	283	0.154	78,483
2030	246,338	271	0.154	86,370
2035	280,731	260	0.154	94,289
2040	314,199	250	0.154	101,326
2045	348,064	240	0.154	107,999
2050	383,226	240	0.154	118,909
2055	420,257	240	0.154	130,399
2060	458,960	240	0.154	142,408
2065	500,349	240	0.154	155,250
2070	545,470	240	0.154	169,251
2075	594,660	240	0.154	184,513

Key:
GPCD = gallons per capita per day
UDWRe = Utah Division of Water Resources
WCWCD = Washington County Water Conservancy District

Using the data in Table 8, WaterDM prepared Figure 7, which shows the DEIS forecast from 2015 – 2075. A 20% conservation factor is applied through 2045, but once the 20% conservation factor ends, demand in Washington County is forecast to increase steeply and unabated for another 30 years. Under this forecast Washington County increases demand in each sector proportionally over time and is predicted to have annual water losses of more than 24,000 AF by year 2075, which is more than the potable demands of the commercial and industrial sectors combined.

Figure 7 shows a tripling of water demand in Washington County and assumes that more than 500,000 future residents will only increase efficiency modestly over the next 25 years and that beyond that, no additional efficiency will occur, in spite of high water rates necessitated by expensive infrastructure like the Lake Powell Pipeline, a dry desert climate, and codes and standards that have reduced demand and will continue to reduce demand across the United States. The forecast also includes a staggering 293% population increase over the forecast period.

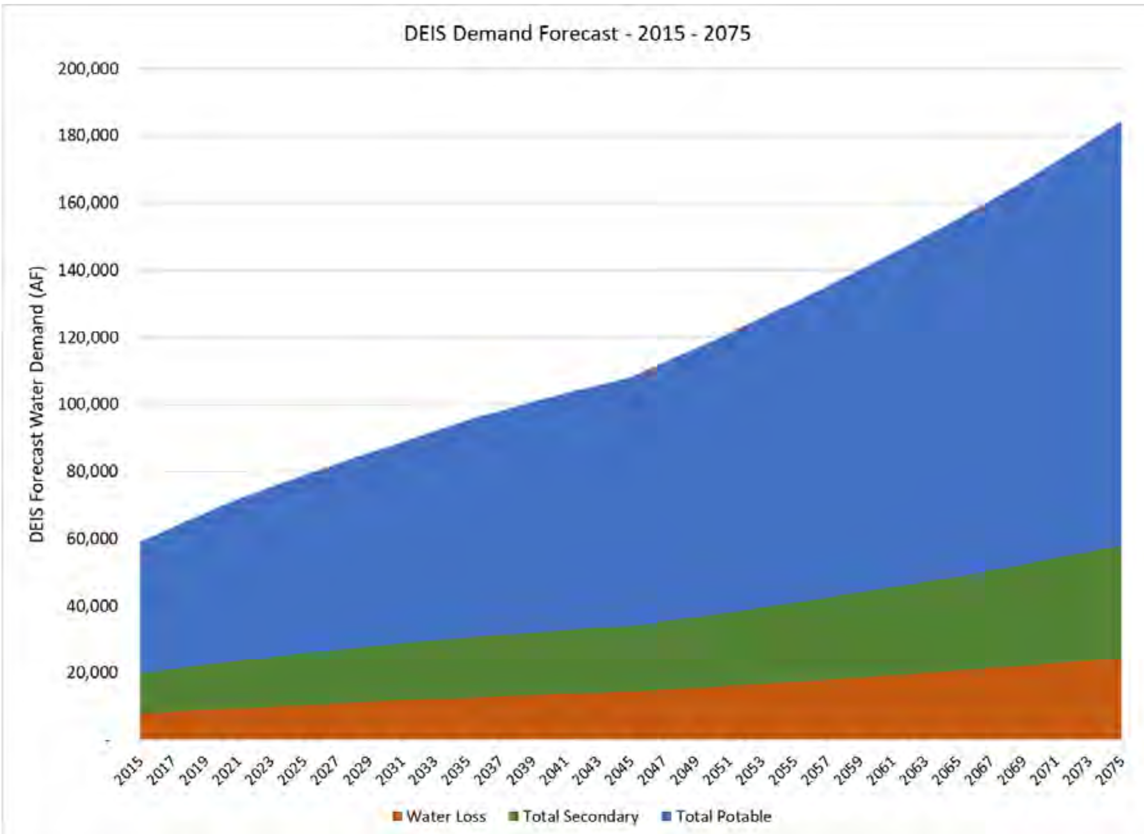

Figure 7: DEIS water demand forecast for Washington County, Utah (2015 – 2075)

WaterDM reviewed each component of the DEIS water demand forecast shown in Table 8 for reasonableness and accuracy as is required to justify construction of a $2 billion infrastructure project.

Per Capita Use Forecast

As part of the DEIS forecast, per capita water use (inclusive of all uses except system losses) starts at 302 gpcd in 2015 and is reduced by 20% to 240 gpcd by 2045. After year 2045 there are no additional efficiency improvements and gpcd is forecast to remain at 240 gpcd through 2075. The reasonableness of this forecast must be considered in the context of changes in water demands that occurred over the past 25 years and comparisons with other water providers in the western US.

System Per Capita

Annual system per capita use is calculated by taking the total volume of water produced in a year for a water system and dividing that volume by the population and 365 days (or 366 during a leap year). Water production volumes are usually measured at water treatment plants before water is put into the distribution system and thus system per capita use typically includes system water losses that occur as water is transported to customers. The per capita use values presented in the DEIS are inclusive of all water use (residential, commercial, irrigation, etc.)

with the notable exception of system water losses which the DEIS separates into a distinct category.

Per Capita Use Has Declined Nationally

The US Geologic Survey publishes national water use data every five years and Figure 8 shows the public supply withdrawals in the US and population for 1950 through 2015, the most recent year for which data are available. Public supply withdrawals peaked in 2005 and declined in 2010 and 2015.

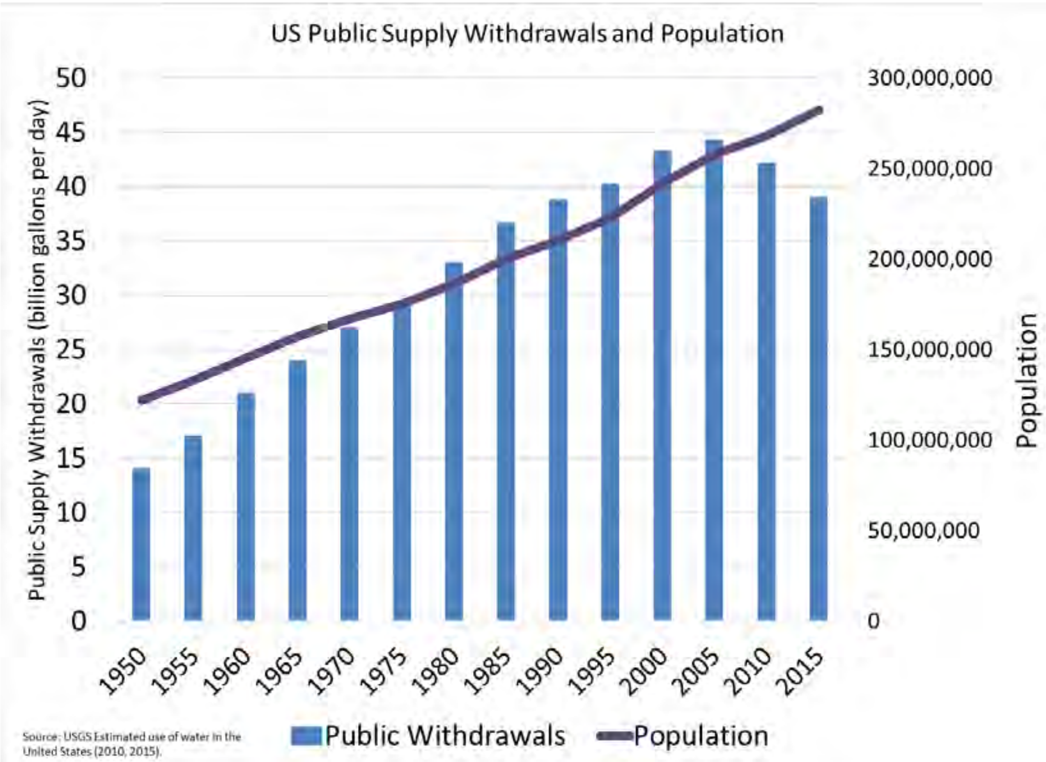

Figure 8: US Public Supply Withdrawals and Population, 1950 – 2015

Figure 9 shows the same US public supply withdrawals along with the average annual gallons per capita per day. Nationally, per capita use peaked in 1985 at about 184 gpcd and by 2015 had declined to less than 140 gpcd. The DEIS forecasts the 2075 gpcd in Washington County to be 71% higher than the national average in 2015.

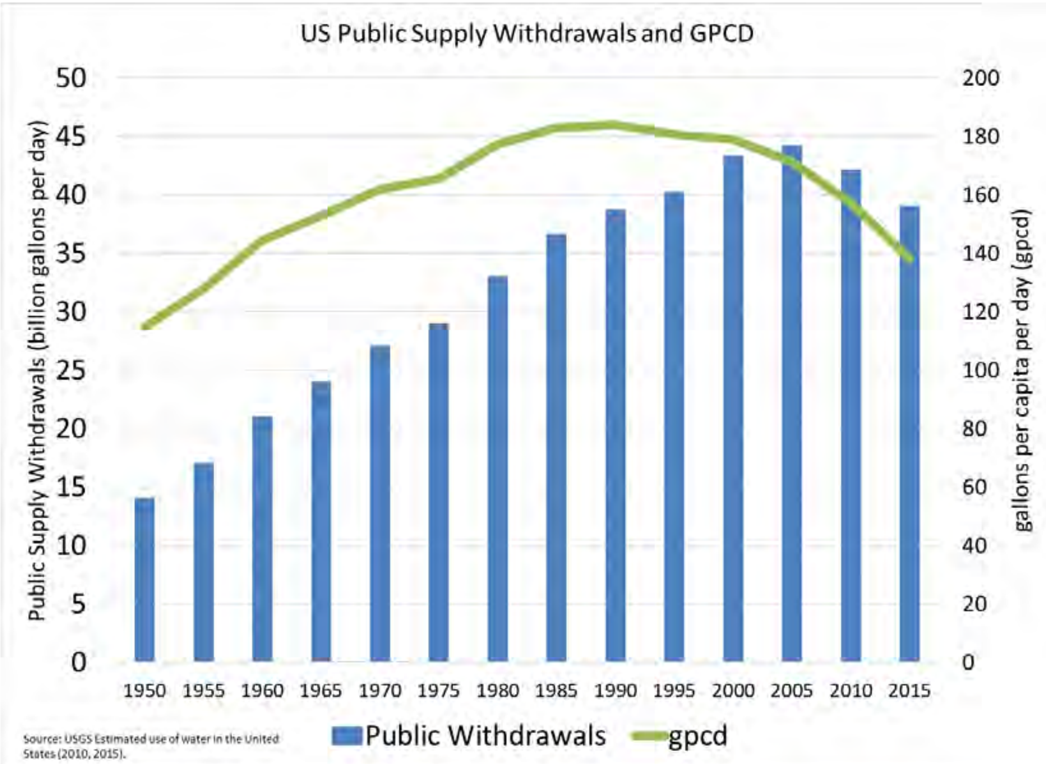

Figure 9: US Public Supply Withdrawals and gpcd, 1950 – 2015

Residential water use in Utah remains among the highest in the US according to the USGS as shown in Figure 10, which was prepared by the City of Tucson to understand how water use around the western US compares. This suggests that Utah, as a state, and Washington County as the highest water using region in the state, have ample room for increased efficiency in the future. Water efficiency is the norm up and down the Colorado River basin as supplies have dwindled as a result of drought and climate change.

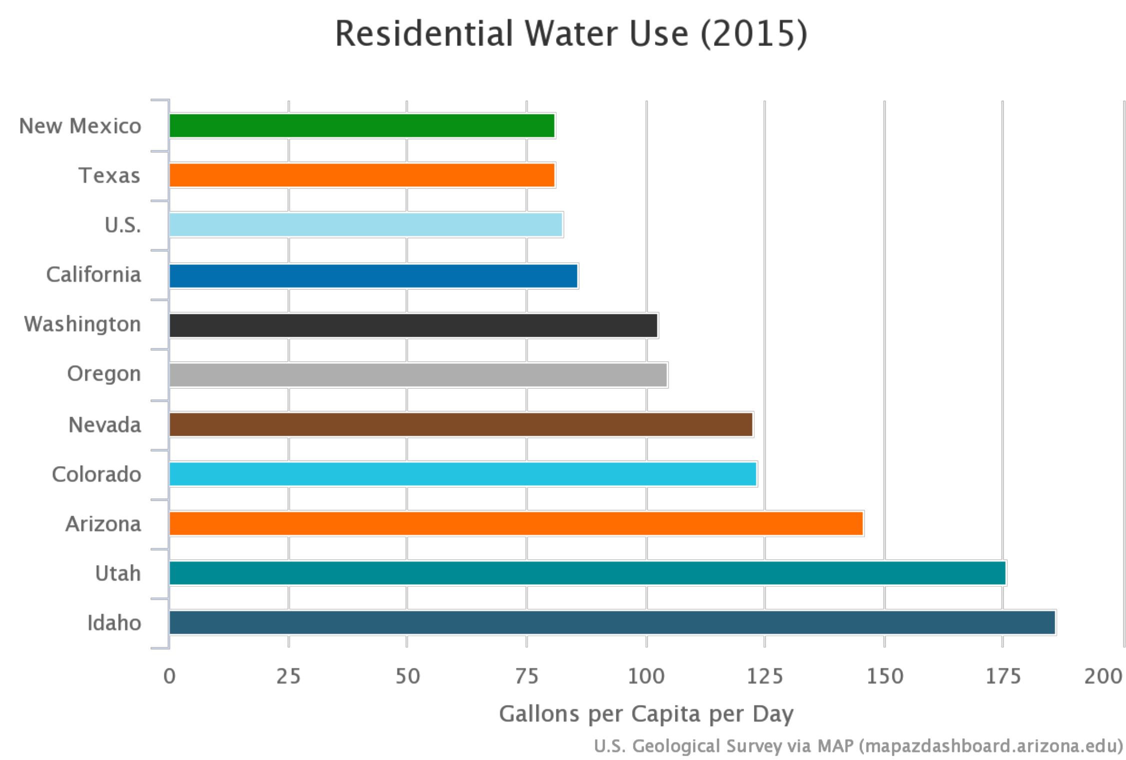

Figure 10: Comparison of per capita residential water use in the US, 2015.[72]

Per Capita Comparisons Show High Usage in Washington County

To better understand the scale of the forecast gpcd values in the DEIS, these data were compared against per capita use from cities that participated in the 2016 Residential End Uses of Water Study.[73] Per capita use was calculated for this study using the same approach as the DEIS with water losses explicitly excluded, but all other uses (residential, commercial, irrigation, etc.) included. The most "apples to apples" comparison of gpcd is to compare potable gpcd, and this and other comparisons are presented in Table 9: Per capita comparisons. In 2015, potable water use by itself in Washington County averaged 231 gpcd, placing it among the highest levels of per capita use of comparable western cities as shown in Table 9.

It should be noted that most western cities have concluded that such high levels of per capita water use are unsustainable (not to mention expensive) in arid environments and they have all implemented metering, conservation pricing, and various other water efficiency programs to reduce demand and extend existing supplies. The DEIS in recognition of this, applies a steady reduction factor until a 20% reduction is achieved in 2045.

[72] https://mapazdashboard.arizona.edu/infrastructure/residential-water-use

[73] DeOreo, W.B., P. Mayer, J. Kiefer, and B. Dziegielewski. 2016. Residential End Uses of Water, Version 2. Water Research Foundation. Denver, CO

Even with the conservation factor applied, the DEIS forecast total per capita use for Washington County in year 2075 is higher than any utility that participated in the 2016 Residential End Uses Study, including Scottsdale, Arizona, which in addition to having high water use also has a well-funded and staffed utility-sponsored water efficiency program.[74]

Table 9: Per capita comparisons, ranked in descending order

Agency	Population	gpcd
Washington County WCD - 2015 potable + secondary + water loss	**151,360**	**348.2**
Washington County WCD - 2015 potable + secondary	**151,360**	**302.0**
Washington County WCD - 2075 potable + secondary + water loss forecast	**594,660**	**277.0**
Scottsdale, AZ – 2010 potable	217,385	273.1
Henderson, NV – 2010 potable	277,502	256.9
Washington County WCD - 2075 potable + secondary forecast	**594,660**	**240.0**
Washington County – 2019 potable	**171,040**	**236.2**
Washington County WCD - 2015 potable	**151,360**	**231.0**
Colorado Springs, CO – 2010 potable	441,000	212.3
Washington County WCD - 2075 potable forecast	**594,660**	**190.0**
Fort Collins, CO – 2010 potable	129,000	157.9
Denver, CO – 2010 potable	1,174,000	156.7
Tacoma, WA – 2010 potable	317,450	150.0
Otay, CA – 2010 potable	198,616	149.9
Mountain View, CA – 2010 potable	72,800	132.6
Aurora, CO – 2010 potable	325,078	126.6
Austin, TX – 2010 potable	886,768	121.9
Tucson, AZ – 2019 potable	739,485	119.0
San Diego, CA – 2010 potable	1,312,000	118.2
Santa Barbara, CA – 2010 potable	91,416	115.0
San Antonio, TX – 2010 potable	1,360,000	105.7
Philadelphia, PA – 2010 potable	1,500,000	104.5
Chicago, IL – 2010 potable	5,300,000	98.4
Sacramento, CA – 2010 potable	430,437	91.4
Portland, OR – 2010 potable	915,800	61.0

Sources: Table 6.2-2 Future Water Requirements of the Washington County Water Conservancy District., DeOreo, W.B., P. Mayer, J. Kiefer, and B. Dziegielewski. 2016. Residential End Uses of Water, Version 2. Water Research Foundation. Denver, CO

[74] https://www.scottsdaleaz.gov/water/rebates

Water Efficiency Impacts Not Considered After 2045

The forecast for Washington County in year 2075 would place its water use among the very highest water using communities in the western US today and in the future. With the Lake Powell Pipeline, Washington County must necessarily also have high water rates. A strong price signal through rates is proven effective at reducing consumption, even in communities with second homes and significant volumes of irrigation. Yet the DEIS shows no efficiency improvements or demand reductions in Washington County for a 30-year period.

It is unclear why efficiency improvements are stopped in 2045. This is neither reasonable, nor realistic, particularly given the anticipated impacts of climate change, which will drive up the cost of providing water, will reduce supplies, and will also increase demands through additional evapotranspiration (ET) requirements. All of the new demand in Washington County will come from new residents and new buildings that will be constructed in compliance with modern plumbing codes and standards. These national codes and standards, such as the 1992 Energy Policy Act require that all toilets sold in the US use 1.6 gallons or less per flush. Stores like Home Depot only offer EPA WaterSense certified toilets that use 1.28 gallons per flush or less. New buildings will necessarily be more water efficient than old buildings. Assuming future water use in 2075 will be the same as it was in 2045 without efficiency improvement is not reasonable and not a sound basis for least-cost infrastructure planning.

Recent failures of demand forecasting (discussed below) have exposed demand forecasting methods that fail to include long term efficiency improvements. Water efficiency and efficiency improvements are now standard considerations for most demand forecasts. These forecasting failures have been largely due to inflated future per capita demands and inflated population forecasts – two problems evident in the DEIS.

Secondary Water Use Improperly Forecast

Baked into the DEIS demand forecast is a substantial component of secondary water use. As shown in Figure 7, secondary water use accounts for about 20% of 2015 demand once water losses are included.

Secondary water is defined as "non-potable or untreated water that does not meet EPA Safe Drinking Water requirements. Generally, irrigation and canal companies deliver secondary water through open ditch systems or pressurized pipelines for irrigation of lawns, gardens, landscape, parks, cemeteries, golf courses, and other open areas."[75]

Because secondary water use is imbedded into the 2015 water demand of 302 gpcd (71 gpcd is secondary water), secondary water demand is automatically increased throughout the 60-year forecast. In Washington County today, most of the secondary water is supplied by irrigation companies with limited water rights. Because these water rights are limited, these supplies cannot possibly grow proportionally with population into the future as shown in Figure 7, yet they have been improperly imbedded into the 2015 baseline demand.

[75] 2015 Municipal and Industrial Water Use Data. 2020 version 3. Utah Division of Water Resources, p. 5.

Even with the 20% conservation factor applied through 2045, secondary water use is increased with population throughout the demand forecast and after 2045 because of the forecasting methodology. This is not reasonable. The Lake Powell Pipeline should not be constructed to provide secondary water use for irrigation companies. The Lake Powell Pipeline should be properly considered as a primary potable supply only. Water from the Lake Powell Pipeline will be too expensive and high valued to sell as secondary water for irrigation. Use of secondary water is seasonal, thus including it as part of the annual gpcd is misleading from the perspective of supply timing as well.

Secondary water is a separate supply and thus demand for secondary water should be determined distinctly from the potable demand into the future. Lumping them together, as has been done in the DEIS, is improper from multiple planning and forecasting perspectives. This should be corrected. Analysis prepared for the Local Waters Alternative 2.0 estimates that including secondary water in the demand forecast has improperly inflated per capita demands in the DEIS by at least 20%.

Future Per Capita Use Improperly Inflated

If more than 500,000 people live in Washington County Utah in 2075 and use an average of 277 gpcd (including water losses) it will be one of the most water-inefficient communities in America in that year or any year. It is not reasonable to plan for such inefficiency and profligate water use.

The future per capita use presented in the DEIS has been improperly inflated given that 30 years of potential efficiency gains are ignored, secondary water use is incorrectly included and allowed to increase, and water loss is never addressed.

System Loss Forecast

In the DEIS, a 15.4% water loss factor is applied each year to account for real losses in the system. The 15.4% water loss factor, presumably based on current water loss rates*, does not change over the 60-year period of the forecast* and is applied to both potable and secondary water use. As shown in Figure 7, the DEIS predicts real annual water losses (e.g., the physical loss of water from the system) of more than 24,000 AF by year 2075, which is an astonishingly high volume, and more than the potable demands of the commercial and industrial sectors combined.

The Lake Powell Pipeline is a $2 billion dollar project (and counting) and the DEIS forecast states that 15.4% of the product or value delivered through this LPP will be lost each year. This implies that approximately $300 million in value of the initial $2 billion dollar project will be wasted along with additional value of the operation, maintenance, and repair costs wasted over the life of the project. The economic consequences of $300 million in water losses are simply too large to ignore. State and national policies are increasing accountability for water loss and requiring utilities to reduce real loss to the extent it is economically reasonable. In 2020, Utah passed HB

40, which will improve water loss accounting across the state.[76] This increased scrutiny of water losses will apply to Washington County.

The starting point for water loss in Washington County, 15.4%, is an extremely high level of real losses for a system to endure. For many years an industry rule of thumb was that anything above 10% "unaccounted for water" constituted a real problem. Over the past 20 years water loss accounting has improved and advanced, which has improved understanding of typical water loss rates, though they vary tremendously depending upon the age of a water system. Properly designed and installed new distribution systems have lower levels of loss than older water systems and managing system pressure has a significant impact.

It is unreasonable that water loss levels for Washington County do not improve over time in the DEIS forecast. This implies that this high level of waste and loss is tolerable, acceptable, and affordable, none of which is true. More properly, the DEIS forecast should show a decreasing level of water loss over time until a level below 10% is achieved. A level of 6% - 8% would not be an unreasonable target for a well-managed system with many new components. Maintaining a loss level of 15.4% unreasonably and unnecessarily inflates the final demand forecast by at least 5.4% - 9.4%.

Significance of Forecast Accuracy

The accuracy of the water demand forecast, and the Gardener Policy Institute population forecast are central to the statement of need and the repayment feasibility of the Lake Powell Pipeline. The Utah Office of the Legislative Auditor stated in 2019:

> *While the WCWCD has the potential to generate sufficient revenue to repay the LPP's cost, revenue is dependent on many factors WCWCD does not control. WCWCD will rely on three sources of revenue to replay the pipeline cost: impact fees, water sales, and property taxes. Impact fees are influenced by population and economic growth. The growth from water sales will be dependent on population growth and changes in water consumption.*[77]

The 2019 performance audit makes it clear that repayment of the Lake Powell Pipeline is dependent upon the accuracy of the Gardener Policy Institute forecast and assumptions about future per capita water use. Importantly, neither of these factors is fully under the control of the WCWCD. If the projected population growth and/or projected water demand does not materialize, repayment of the Lake Powell Pipeline becomes more challenging for the WCWCD and much more costly for existing customers. The elasticity of outdoor water use is well

[76] https://le.utah.gov/~2020/bills/static/HB0040.html

[77] State of Utah Office of the Legislative Auditor General. August 2019. Report to the Utah Legislature Number 2019-05. A Performance Audit of the Repayment Feasibility of the Lake Powell Pipeline.

established.[78] As water becomes more costly, people use less. Once available, population data from the 2020 census will help determine if Washington County remains on the growth trajectory forecast by the Gardener Policy Institute.

The factors that combine to create a greatly inflated demand forecast in the DEIS are not unique. Water utilities have struggled with making accurate demand forecasts since the mid-1980s when federal plumbing codes and energy standards began reducing the water used for toilets, showers, faucets, clothes washers, dishwashers, and more.

An August 2020 Pacific Institute report found that California water providers consistently inflated forecasts of future demand even as they tried to incorporate the impacts of efficiency. On average, the report found water suppliers projected that per capita demand would decline by less than one percent per year; but actual per capita demand declined twice as fast.[79] The report states:

> *Urban water suppliers routinely overestimated future water demand, projecting increases in water demand even as actual demand declined. The is largely due to inflated estimates of future per capita demand, although overestimates of population are also a contributing factor.*[80]

The consequences of an unrealistic and inflated demand forecast can be significant and can impact a community for years to come. The report states:

> *Overestimates of future water demands have important implications for local communities and the state. Specifically, they can result in unneeded water supply and treatment infrastructure, higher costs to ratepayers, and unnecessary adverse environmental impacts.*[81]

The consequences of the inflated water demand in the DEIS include all the problems noted by the Pacific Institute such as over-sized expensive infrastructure, higher costs to rate payers, and unnecessary environmental impacts. Even if the Lake Powell Pipeline is constructed and the full population forecast appears, future per capita use is likely to be substantially lower than forecast in the DEIS. An unrealistic population forecast, and unreasonably high levels of water loss compound the problem and further inflate demands to unrealistic levels compared with communities across the western US.

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[78] Howe, C.W. 1982. The Impact of Price on Residential Water Demand: Some New Insights. Water Resources Research, 18(4):713-16; and Howe, C.W. and F.P. Linaweaver. 1967. The Impact of Price on Residential Water Demands and its Relation to System Design and Price Structure. Water Resources Research, 3(1):13:32.

[79] An Assessment of Urban Water Demand Forecasts in California. August 2020. Pacific Institute. Oakland, CA.

[80] An Assessment of Urban Water Demand Forecasts in California. August 2020. Pacific Institute. Oakland, CA. (p.8)

[81] An Assessment of Urban Water Demand Forecasts in California. August 2020. Pacific Institute. Oakland, CA. (p.8)

Current Water Demand Management in Washington County

Washington County must start planning now to use less water in the future. Current levels of water use are significantly higher than peer communities with similar climates. Projecting these inefficient levels of use into the future is unreasonable. Perhaps because of its focus on the Lake Powell Pipeline, the WCWCD has not chosen to seriously explore and integrate meaningful water efficiency into its long-range planning and thinking. Reasonable and reliable local alternatives to the Lake Powell Pipeline are available that are far less expensive and environmentally damaging. Rather than spend $2 billion (and counting) to construct the Lake Powell Pipeline, the WCWCD and municipalities should implement more impactful water efficiency and demand management programs than they currently offer.

The next sections of the report review the water conservation and demand management programs of the WCWCD and municipalities and proposes significant revisions and improvements that should be implemented to ensure future efficiency and demand reductions.

Definition: Water Demand Management

Water demand management includes five core components listed below.[82] These core components incorporate water efficiency, water conservation, drought response and more.

1. **Technical efficiency** - Reducing the quantity or quality of water required to accomplish a specific task (e.g., a high-efficiency toilet or clothes washer).
2. **Behavioral efficiency** - Adjusting the nature of the task so it can be accomplished with less water or lower quality water (e.g., a shorter shower).
3. **Water loss and leakage control** - Reducing losses in movement from source through use to disposal including reducing leakage in the distribution system and customer-side leaks.
4. **Peak management** - Shifting time of use to off-peak periods.
5. **Drought response** - Increasing the ability of the system to operate during droughts.

The WCWCD and municipalities will need all these components in the coming years to deal with the water challenges of the future, if the Lake Powell Pipeline is built or not.

WCWCD Water Conservation Program

The WCWCD states that "Water conservation has been a hallmark of the District's focus since 1993."[83] The WCWCD has a staffed water conservation program and an annual budget of $643,543.[84] Key components of the program include:

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[82] Adapted from Brooks, D.B. 2007. An Operational Definition of Water Demand Management. International Journal of Water Resources Development. Volume 22, 2006 - Issue 4

[83] WCWCD. December 2015. Water Conservation Plan Update

[84] Maddaus Water Management Inc. 2018. Water Conservation Programs: A Comparative Evaluation. Prepared for the Washington County Water Conservancy District.

- Metering of potable and secondary water connections.
- Non-promotional rates and tiered pricing of water.
- Water budgets and budget-based rates for golf courses
- Impact fees and optional conservation easement limiting landscapes at new developments.
- Time of day irrigation restrictions.
- Public information and school education programs.
- Certification and training for landscape professionals - QWEL.
- Financial incentives (rebates, etc.)
    - Smart irrigation control technology
    - Irrigation system upgrades
    - Commercial equipment
    - Efficient toilets and clothes washers
    - Tree planting

Comparative Evaluation of Water Conservation Programs

A 2018 report prepared by Maddaus Water Management Inc. (Maddaus Report) compared expenditures program components of the WCWCD's water conservation program with several other cities in the west.[85] The Maddaus Report is largely qualitative and did not use a standard metric of comparison such as the AWWA G480 Water Conservation Program Management Standard to compare program implementation. It also did not compare water demand trends or the estimated water savings associated with each program, perhaps most valuable measures of program effectiveness. The Maddaus Report did provide a single snapshot in time water demand comparison as well as useful reference points on conservation program expenditures. The key summary table from the Maddaus Report with the addition of calculated gpcd (using values from the Maddaus Report itself) is presented in Table 10.

A challenge when comparing the WCWCD with other water providers is that the WCWCD is a wholesale provider which offers some retail service, and many water conservation programs are implemented at the local level by retail providers. The Maddaus Report did include the Southern Nevada Water Authority which is a wholesale provider and it also included Tucson Water which is both a retail and wholesale provider.[86] The Maddaus Report surveyed water providers in the west including the Southern Nevada Water Authority, Tucson Water, the City of Grand Junction, and Phoenix Water Services which all rely on water from the Colorado River Basin and face arid annual climate conditions.

The Maddaus Report concludes that the WCWCD's water efficiency program is, "on par" with other "notable" programs in the western US and "exceeds" programs of entities of similar

[85] Maddaus Water Management Inc. 2018

[86] Tucson Water is incorrectly listed as providing only retail service in the 2018 Maddaus Report when in fact It provides primarily retail with some wholesale service.

size.[87] Recommendations from the report include reducing water loss across the county, modest fixture giveaways, rebates for water efficient plants, partnerships with the local energy utility, water efficient ordinances for new development, partnerships with restaurants and hotels, and continued use of wastewater reuse including smaller on-site wastewater reuse systems.

The Maddaus Report fails to mention that per capita water use in Washington County, calculated using the numbers reported in the Maddaus survey, is 286.3 gpcd which is by far the highest in the comparison group. In fact, the Maddaus Report number, per capita use in Washington County is more than double the per capita use in Tucson, Albuquerque and El Paso and is more than 40% higher than per capita use in the Southern Nevada Water Authority, the closest comparison as shown in Table 10. This is the same result shown in the Table 9 per capita use comparisons prepared by WaterDM. Water use in Washington County is far less efficient than in many other parts of the US, irrespective of the programs the WCWCD has implemented.

The Maddaus Report also neglects the troubling increasing trend in per capita use in Washington County which further indicates that conservation and efficiency programs are not being effective. As shown in Table 7, in 2019 both potable gpcd and total gpcd in Washington County were higher than in any of the past three years. Potable gpcd in Washington County increased in each year from 2016 – 2019, a trend that cuts against the increasing efficiency measured in other cities in the western US. This is an indication that water efficiency programs in Washington County need to be significantly revamped and improved. The qualitatively focused Maddaus Report does not discuss the fact that per capita water use in Washington County is increasing by all measures, even as the WCWCD is spending more than $640,000 annually to reduce demand.

The reported water conservation program expenditures per capita served for the WCWCD were $3.88 per person per year. While this is a higher rate of expenditure than some other utilities, for a wholesale provider in a water scare environment with some of the highest levels of water use in America, it is insufficient. The WCWCD's per capita conservation expenditures are 45% less than the $7.00 per capita spent by fellow wholesale provider the Southern Nevada Water Authority, the single best comparison in the Maddaus Report since it compares wholesale providers both using water from the Colorado River. Another good comparison in the Maddaus Report is Tucson Water, which is an example of a community that has adapted its water use profile to a desert climate. The WCWCD spent 27% less per resident on water efficiency than Tucson Water.[88]

Another missing component in the Maddaus Report is a meaningful comparison of the cost of water for customers in Washington County and the other comparison cities. One of the most effective methods for reducing demand is through pricing that increases as outdoor water use

[87] Maddaus Water Management Inc. 2018

[88] Maddaus Water Management Inc. 2018

increases.[89] For the Local Waters Alternative 2.0, WaterDM prepared a comparison of the potable/culinary water rates and typical water bills single-family households receive from Washington County water providers such as St. George, Hurricane, Ivins, Santa Clara, and Toquerville with the typical water bills from the agencies included in the Maddaus Report. This comparison is presented in Table 11 and in Figure 11.

Water providers in Washington County and in the comparison cities from the Maddaus Report all have inclining block rate structures which are designed to incentivize conservation. The notable difference between Washington County providers and the comparison group is in the cost of water once usage becomes greater than 10,000 gallons per month. Typical single-family indoor use ranges from 3,000 – 9,000 gallons per month, so usage above 10,000 gallons is likely to be irrigation and outdoor use. As shown in Figure 11, typical water bills for usage of 20,000 gallons or 40,000 gallons in a month in Washington County are substantially lower than in the comparison utilities from the Maddaus Report. In St. George, La Verkin, and Santa Clara a residential customer can use more than 40,000 gallons in a single month and the expected water bill will be less than $100. The exact same use in El Paso, TX would cost about $365. In Santa Fe, NM this volume of use costs $777.

Among Washington County provider, Ivins and Toquerville currently have the steepest pricing increase for outdoor use. A customer who uses 40,000 gallons in a month would pay about $150 in Ivins and $175 in Toquerville. In St. George, 40,000 gallons of use costs a residential customer about $95, in La Verkin it is $87, and in Santa Clara it is about $85.

The comparison shows that water for outdoor use is inexpensive in Washington County compared with other places in the west (except Salt Lake City), and this factor alone largely explains why water use in Washington County is higher than in the comparison utilities. Furthermore, this analysis only considers potable/culinary water. In Washington County, secondary water is priced even cheaper than potable/culinary, effectively incentivizing more use. Outdoor water use in Washington County is the single aspect of demand that must be more effectively managed and reduced in the future. Outdoor water use is the most discretionary component of residential demand, and in hot and dry communities across the western US (selected for comparison by the WCWCD's own consultant) the price of water used for outdoor use is set significantly higher than it is in Washington County.

[89] Howe, C.W. 1982. The Impact of Price on Residential Water Demand: Some New Insights. Water Resources Research, 18(4):713-16; and Howe, C.W. and F.P. Linaweaver. 1967. The Impact of Price on Residential Water Demands and its Relation to System Design and Price Structure. Water Resources Research, 3(1):13:32.

Table 10: Surveyed agency information and calculated gpcd from 2018 Maddaus Report[90]

	Albuquerque Bernalillo County Water Utility Authority	Colorado Springs Utilities	El Paso Water	City of Grand Junction	City of Phoenix Water Services Department	Salt Lake City Department of Public Utilities	City of Santa Fe	Southern Nevada Water Authority	City of Tucson	Washington County Water Conservancy District
State	New Mexico	Colorado	Texas	Colorado	Arizona	Utah	New Mexico	Nevada	Arizona	Utah
Major Metro Region(s)	Albuquerque	Colorado Springs	El Paso	Grand Junction	Phoenix	Salt Lake City	Santa Fe	Las Vegas	Tucson	St. George
Number of Agencies Served	1	1	1	1	1	1	1	7	1	7
Service Type Provided	Retail and two small wholesale accounts	Retail	Primarily retail, some wholesale	Retail	Retail	Primarily retail, some wholesale	Retail	Wholesale	Retail	Primarily wholesale, some retail
Service Area Size (sq mi)	190 sq mi	195 sq mi	250 sq mi	9 sq mi	661 sq mi	136 sq mi	53 sq mi	822 sq mi	390 sq mi	200 sq mi
Annual Conservation Budget	$1,615,000	$850,000	$1,188,600	$13,500	$915,5333	$346,700	N/A	$15,831,200	$4,000,000	$643,543
Conservation Spending ($/capita)	$2.45	$1.81	$1.51	$0.48	$0.56	$0.62	N/A	$7.00	$5.33	$3.88
Full-time Equivalent Conservation Staff	8.5	6.25	10	0.5	5	1	N/A	20	4	5.75
Average System Demand (MGD)	87.5	78.6	102.3	5.3	276	61.1		455	89.3	43.8
Approx. Population Served	658,238	470,513	787,208	28,215	1,648,611	316,402	83,878	2,262,962	750,000	153,000
Approx. gpcd	132.9	167.1	130.0	187.8	167.4	193.1		201.1	119.1	286.3
Data Year	2015	2015	2013	2018	2017	2016	2017	2017	2017	2015

[90] Maddaus Water Management Inc. 2018. P. 4

Table 11: Single-family potable/culinary water rates and estimated monthly bills from Washington County and agencies in Maddaus Report

Agency	Monthly Base Rate/Charge	Info about Base	Tier 1 Rate	Highest Tier Rate	# of Tiers	Bill for 5,000 gal.	Bill for 10,000 gal.	Bill for 20,000 gal.	Bill for 40,000 gal.
Toquerville	$36.21	includes 0 - 10,000 gal	$4.00 (10 - 30,000)	$6.00 (over 30,000)	2	$36.21	$36.21	$76.21	$176.21
City of Santa Clara	$32.00	Includes 5,000 gal	$0.60 (5-9,000)	$3.45 (over 60,000)	7	$32.00	$35.53	$47.83	$87.31
Ivins	$16.91		$2.04 (0 - 7,000)	$4.38 (over 30,000)	4	$27.11	$39.26	$69.41	$146.61
St. George	$20.75		$1.00 (0 - 7,500)	$3.55 (over 45,000)	7	$25.75	$43.25	$68.75	$94.25
La Verkin	$35.25		$1.18 (0 - 20,000)	$1.76 (over 35,000)	3	$41.15	$47.05	$58.85	$84.75
Las Vegas Valley WD	$11.72 + 0.25% of total bill		$1.34 (0 - 5,000)	$5.27 (over 20,000)	4	$18.47	$30.45	$66.03	$154.32
Tucson Water*	$16.33		$2.07 (0 - 5,250)	$12.93 (over 22,440)	4	$30.82	$57.56	$208.58	$570.62
Denver Water	$16.46		$2.39 (0 - 5,000)	$5.74 (over 20,000)	3	$28.41	$49.91	$92.91	$207.71
Grand Junction	$35.04	includes 3,000 gal	$3.24 (3 - 10,000)	$4.48 (over 20,000)	3	$41.52	$57.72	$96.12	$185.72
Phoenix*	$4.64	includes 4,500 gal	$3.20 (low season)	$4.09 (high season)	3	$7.84	$30.24	$82.46	$196.98
Santa Fe	$18.42		$6.06 (0 -7,000)	$21.71 (over 7,000)	2	$48.72	$125.97	$343.07	$777.27
El Paso*	$7.98	includes 3,000 gal	$2.40 (3,000 - 8,000)	$8.13 (over 12,500)	3	$15.18	$41.85	$137.78	$365.42
Salt Lake City*	$9.28		$1.37 (0 -7,500)	$2.73 (over 45,000)	4	$18.87	$30.46	$56.64	$129.16
Colorado Springs*	$23.21		$4.56 (0 - 7,500)	$9.65 (over 19,000)	3	$55.13	$94.53	$194.20	$464.40

*These utilities bill in CCF (or CF). Tiered rates are published per CCF rates.
Rates are for 5/8” service and in some cases apply to ¾” or 1” service.
Based on published water rates as of 3/20/2021, accessed for each utility from their official web site.

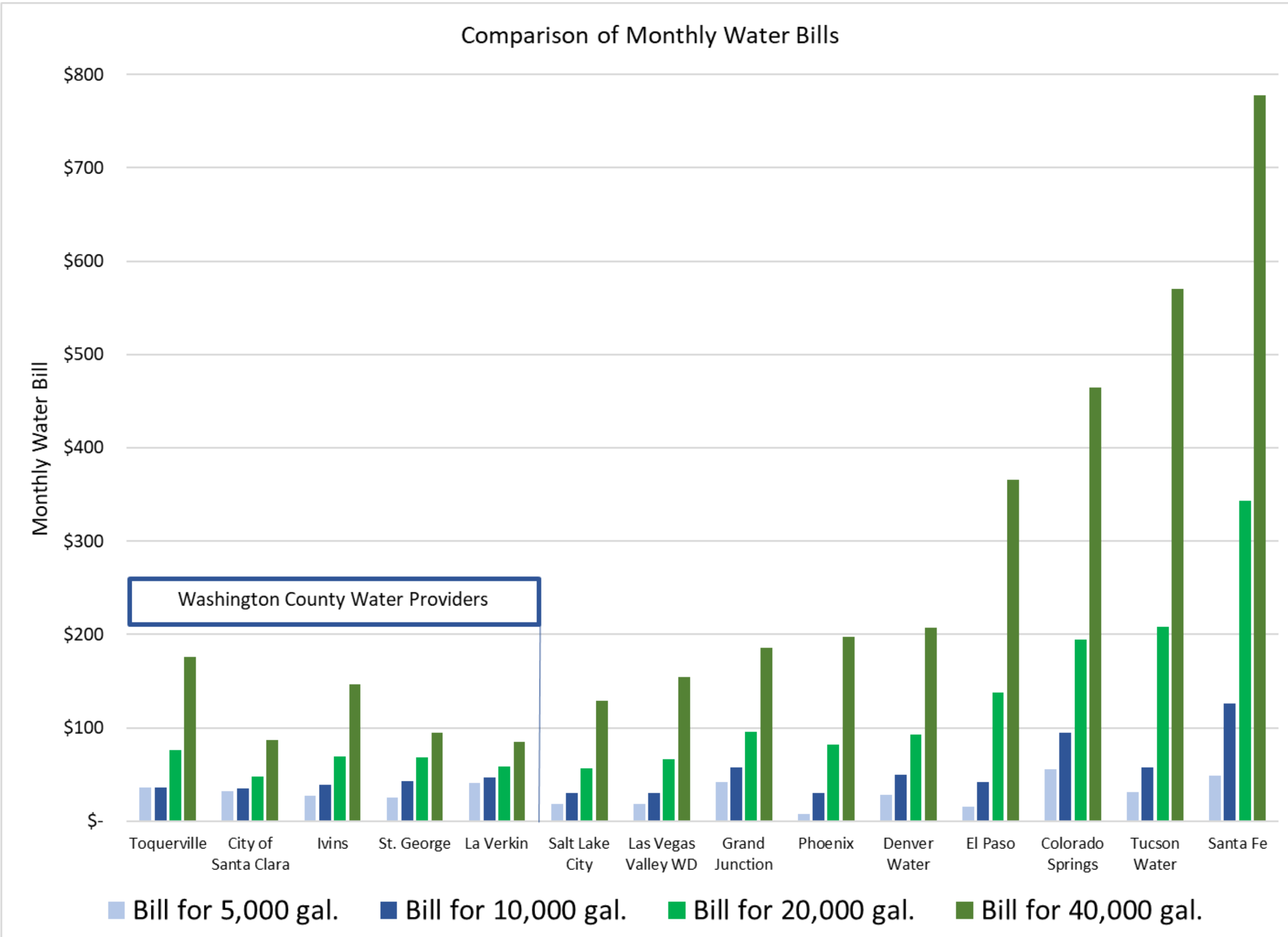

Figure 11: Comparison of single-family potable/culinary estimated monthly bills from Washington County and agencies in Maddaus Report

What Hypothetical Population Could Be Served by 120,000 AF?

The DEIS reports reliable water supply for the WCWCD of approximately 120,000 AF. For many water providers in the west, this would be an ample supply into the future to cover a population similar to Washington County. How many people in Tucson or Las Vegas or Denver could be served by 120,000 AF of supply, given their reported usage?

Using potable production data from the Maddaus Report, WaterDM calculated the hypothetical population in each of the comparison communities that could be served by 120,000 AF of supply, which approximates the reported current available supply in Washington County. This analysis shows how many people could be served today in each of these communities with the approximate volume of supply available to Washington County.

The results are presented in Figure 12 and they show that all of the comparison communities identified in the Maddaus Report could serve a hypothetical population of more than 500,000 people with 120,000 AF supply. This compares to WCWCD estimates that it could only serve a future population of 374,000 with this volume because of excessive outdoor water use.

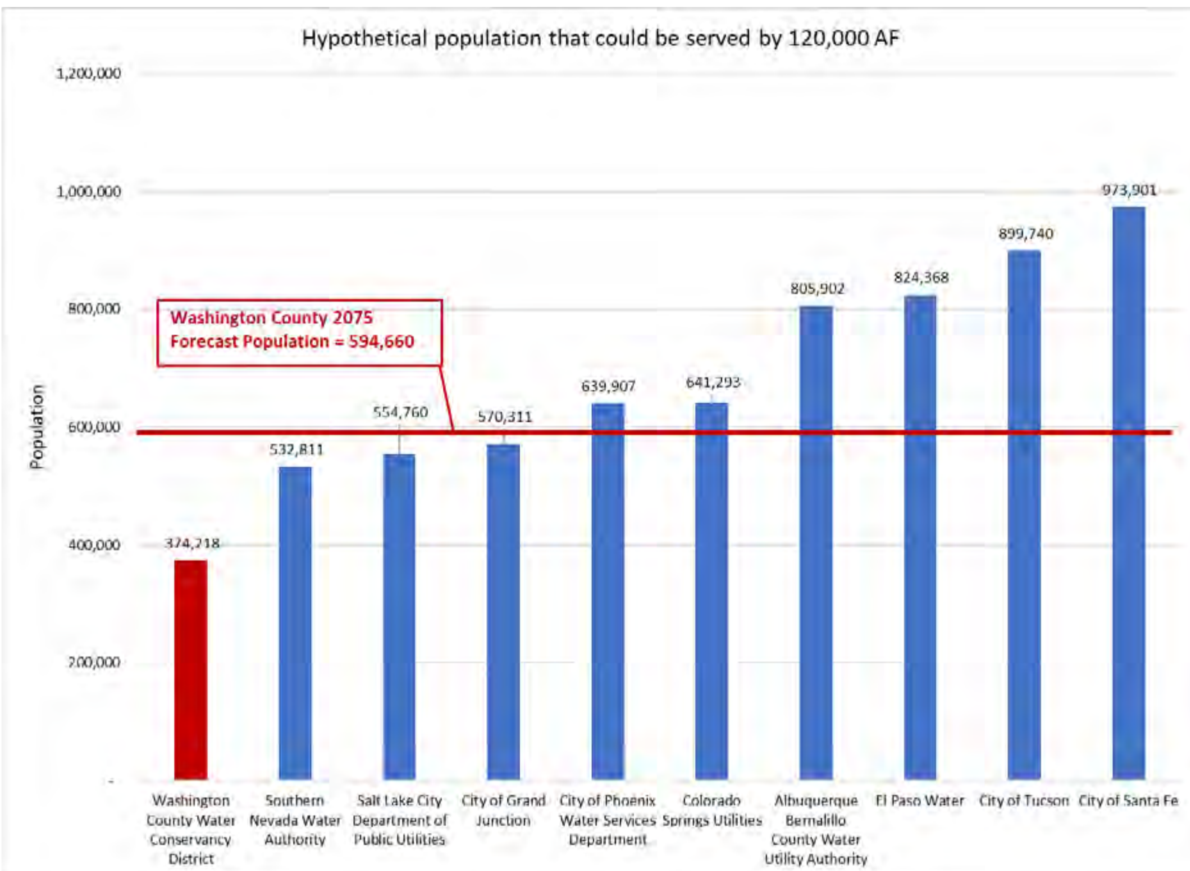

Figure 12: Hypothetical population that could be served with 120,000 AF[91]

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[91] Calculated using gpcd derived from Maddaus Report.

A lower level of average consumption is also to be expected as Washington County grows and densifies. Adding another 300,000 residents in the next 50 years will require a different style of development. With a population of 550,000, the typical home in Washington County will be smaller with a smaller landscape. Even if the Lake Powell Pipeline is constructed, water rates in Washington County must necessarily increase to pay for the new supply. As a result of those price and rate increases, elastic components of water demand such as outdoor use will decrease.

The Maddaus Report did not go deep enough with its analysis to demonstrate if water use in Washington County is reasonable or if water pricing in Washington County is designed to incentivize efficient use. The report's superficial finding that conservation spending and implementation is "on par", ignores the elephants in the room - the exceptionally high outdoor water use levels in Washington County and the troubling trend towards increased potable gpcd from 2016 - 2019. The Maddaus Report only scratched the surface with its comparisons and notably failed to make the important analysis of typical water bills under different volumes of usage. WaterDM's analysis and comparison of water demand (using data from the Maddaus Report) and water rates in Washington County and the comparison utilities shows the high levels of water use and comparatively low cost of water in Utah.

If Washington County can adapt its water use patterns over the next 50 years to be similar to those in Grand Junction or Salt Lake City or Colorado Springs, then the volume of supply provided from the Virgin River and other local resources will be more than sufficient to meet the future population anticipated in the Gardner Center forecasts. This demonstrates that this level of consumption is not only possible, but also typical of communities in the western US – a normal level of water use. By adapting its water demand to a similar level as other communities across the US, the WCWCD can avoid the expensive, risky, and controversial Lake Powell Pipeline and thrive and grow within the available current supply.

Utah Division of Water Resources Comments on Water Conservation

The 2019 Appendix C Response to Comments prepared by the Utah Board of Water Resources cites the Maddaus Report and lauds the water conservation efforts of the WCWCD.[92] There are numerous problems with these response comments.

Appendix C praises Washington County as the "first in Utah to meet the statewide water conservation goal of reducing water use 25% by 2025," and states that the WCWCD is "leading the state of Utah in terms of water use reductions."[93] These statements go against the data as reported by Washington County and the Utah DNR and presented in Table 7. Water use in Washington County is increasing and becoming less efficient, not decreasing. In 2016, potable per capita water use in Washington County was 229.2 gpcd and total gpcd (potable +

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[92] Utah Board of Water Resources. 2019. Attachment C. Water Needs Assessment: Water Use and Conservation Update, Response to Comments.

[93] Utah Board of Water Resources. 2019. P. 5

secondary) was 300.5 gpcd. In 2019, potable use increased to 236.2 gpcd and total use increased to 326.6 gpcd – an 8.7% increase in per capita use in four years.

Appendix C states that for Washington County, "Going forward, additional use reductions will be more difficult and costly to achieve."[94] This is statement is unsupported by the facts at hand. Washington County has among the highest rates of water use in America as shown in Table 9. Communities with usage this high have tremendous potential for cost-effective demand reductions far into the future as the community adapts to the arid environment in which it is located. Tucson Water served more than 730,000 people in 2019 using less water than Washington County currently has available.

Appendix C criticizes efforts to compare Washington County's water use with other communities in the west because of differing factors such as climate, population density, soils, and other factors.[95] Ironically, two pages earlier, Appendix C cites the Maddaus Report as support for the efficacy of water efficiency programs in Washington County. In fact, it is common practice to compare water use between providers and to benchmark performance based on measurable criteria such as total production and gallons per capita per day. This is what was done in the Maddaus Report and this is what has been done in this report and many others including the WCWCD.

Care must be taken to develop fair "apples to apples" comparisons, which for Washington County must clearly delineate between potable and secondary use. But arguments that Washington County is somehow different or exceptional from other communities in the west because it has a dry climate, desert conditions, second homes, resorts, pools, golf courses, and such and is thus immune to national trends towards higher efficient water use are inappropriate. Tucson, Las Vegas, Denver, and Los Angeles all share these characteristics with Washington County, and use substantially less per capita as shown in Table 9. Water is a precious and expensive commodity and least cost planning principles must be applied when considering expensive infrastructure projects such as the Lake Powell Pipeline.

Appendix C incorrectly suggests that increased conservation and water efficiency would be "higher than more balanced approaches to meeting water demand."[96] A "more balanced approach" is not offered but is presumably the Lake Powell Pipeline given the intent and tenor of the DEIS. The draconian measures proposed in Appendix C such as "elimination" of "grass, trees, and ornamental shrubs" are a false choice. The Utah Board of Water Resources has produced a high-cost "scary" conservation scenario that improperly includes externalities like energy use from hypothesized increased temperatures due to "heat island effect".[97] It also conflates utility and costs and despite eleven citations is not based upon actual program implementation costs from successful programs across the West, or measured data. This

[94] Utah Board of Water Resources. 2019. P. 5

[95] Utah Board of Water Resources. 2019. P. 7

[96] Utah Board of Water Resources. 2019. P. 10

[97] Such externalities could also be applied to the Lake Powell Pipeline, but were not considered in the DEIS.

analysis is not an accurate (or honest) assessment of water conservation potential or costs of Washington County and reflects Utah's single-minded approach to the Lake Powell Pipeline proposal.

Communities across the western US from Tucson to Los Angeles to Las Vegas to Denver have found effective ways to adapt urban landscapes to local climate conditions and available water supplies. All of these communities have thriving landscapes, multiple-golf courses, and millions of visitors each year. All of these communities use substantially less water per capita than Washington County as shown in Table 9. The hypothetical costs envisioned in Table 3 of Appendix C are based on "conceptual" estimates, "quotes", and assumptions which are unsupported by evidence, data, or facts. Table 3 is not a reliable estimate of the future costs of water efficiency and outdoor use restrictions.

Washington County has an ample local water supply to meet its future needs, if it can successfully and steadily reduce water demand as other communities in the west have done. The current water conservation program offered by the WCWCD expended approximately $2.5 million from 2016 – 2019 for a variety of programs and incentives and yet per capita water use in Washington County increased. The status quo when it comes to water conservation, efficiency and demand management in Washington County has not been successful and substantial changes are warranted from the WCWCD and municipalities. Specifically, a regional approach to water efficiency must be adopted and the culture around water use in the community must change and adapt to match local climate and water supply conditions.

The Local Water Alternative 2.0 includes a set of detailed recommendations to rework and improve water demand management in Washington County. All of the Local Waters 2.0 recommendations can be implemented at no additional cost or at a low additional cost. All recommendations are cost-effective when considered in concert with supply augmentation recommendations discussed earlier in this report and compared with the Lake Powell Pipeline. The combination of supply augmentation and improved water demand management offers a path forward for Washington County where growth can be realized using available local water resources.

Recommended Water Demand Management for Washington County

The WCWCD and municipalities spend a lot of time, energy, and money on water planning but to date have never seriously integrated or incorporated demand management into their long-term planning. As part of the DEIS forecast, per capita water use (inclusive of all uses except system losses) starts at 302 gpcd in 2015 and is reduced by 20% to 240 gpcd by 2045 through conservation. But after year 2045 there are no additional efficiency improvements and gpcd is forecast to remain at 240 gpcd through 2075. Other problems with the forecast include the improper inflation of secondary water (which must be capped as discussed earlier) and an unreasonably high rate of water loss that never improves over 50+ years.

Future water planning efforts in Washington County must utilize integrated water resources planning principles outlined in the AWWA M50 Water Resources Planning manual.[98] Supply options including demand management and conservation must be considered alongside infrastructure options such as the Lake Powell Pipeline. Demand forecasts that incorporate the future impacts of conservation must be prepared.

There will be zero additional cost associated with this proposal. Current water planning funds can be used for this purpose.

Regional Approach to Water Demand Management

As a primarily wholesale water provider, the WCWCD must partner with municipalities to develop and implement effective water demand management programs. Washington County must adapt a regional approach to water demand management planning and implementation that directly involves all local water utilities.

A regional approach starts with a regional water efficiency plan. A regional plan should be prepared, similar to regional efficiency plans prepared across watersheds in Colorado and other states, that outlines a coordinated effort across the WCWCD and municipalities in Washington County.[99] The plan should set out the mechanism for the WCWCD and municipalities to coordinate on program implementation and it should lay out a clear set of demand reduction goals to be achieved as well as a method for measuring when and if goals are being achieved.

Water efficiency and conservation program measures should be implemented regionally across Washington County in a coordinated manner. An effective water efficiency public campaign, along the lines of Denver Water's "Use Only What you Need" campaign should be implemented across Washington County. Residents and visitors alike must be educated that Washington County is situated in a desert with a limited water supply that must be used carefully. Washington County must work to cultivate a new culture of water efficiency and conservation.

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[98] AWWA. 2017.Manual of Water Supply Practices M50 Water Resources Planning. Third. Edition. American Water Works Association. Denver, Colorado.

[99] Element Water Consulting. 2015. Regional Water Efficiency Plan, Roaring Fork Watershed, Colorado. Roaring Ford Water Conservancy and the Colorado Water Conservation Board.; Grand Valley Regional Water Conservation Plan. 2018. Colorado Water Conservation Board, Denver, Colorado.

A regional approach to water efficiency planning and implementation is an essential step towards this cultural change.

There should be no additional costs associated with a shift to a regional focus as it can be undertaken by current staff without increasing planning budgets. The WCWCD's annual conservation budget of approximately $650,000 per year must grow proportionally with population to ensure effectiveness, but the current per customer level of investment appears to be appropriate. Depending upon program implementation levels in the future, additional conservation staff at the WCWCD and/or the local utility will be needed.[100]

Strengthen Development and Landscape Codes

All new buildings and landscapes in Washington County should be water efficient from the moment they first connect so that there will never be a future need for retrofit incentives. Development and landscape codes are the best way to achieve this goal.

Minimally, development codes in Washington County must specify that all fixtures installed meet EPA WaterSense specifications for water use and performance and that new properties are given an annual outdoor water budget based on their irrigable area and a designated volume per square foot. Existing landscape ordinances in Washington County must be strengthened and adapted as secondary water use is capped. Many examples of strong, effective landscape code regulations are available from neighboring states like Colorado, New Mexico, and California.[101,102] These communities started in a similar position to the WCWCD and were resistant to the shift to more water efficient and climate appropriate landscaping and were concerned about customer response. Through education, effective price signals, and customer technical assistance water providers across the west have found landscape transformation to be an effective and well accepted approach for decreasing outdoor water use. The WCWCD could speak with providers like the Southern Nevada Water Authority and use them as resources for landscape transformation moving forward.

There will be little or no cost associated with developing codes and ordinances because so many good examples are available from simple internet searches. The WCWCD could require landscape ordinances and other conservation measures when it sells water to municipalities. Building inspectors can be trained to check for compliance with these ordinances and codes as part of the normal inspection process to ensure effectiveness.

Water Budget-Based Rates

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[100] Any additional conservation program costs can be properly weighed against the $2 billion (and growing) cost of the Lake Powell Pipeline and the inherent risk associated with it because of climate change and political uncertainty.

[101] Colorado SB103 requires that by September 1, 2016 a person shall not sell a new low-efficiency plumbing fixture in Colorado. The intent of the law is to require manufacturers to sell only WaterSense labeled fixtures to distributors, wholesalers, retailers, developers, and homebuilders in the state of Colorado.

[102] California Water Efficient Landscape Ordinances (WELOs). Numerous utilities across the state have created ordinances to ensure water efficiency.

Water rates across Washington County are largely designed and administered by member utilities of the WCWCD such as Ivins, Hurricane, and St. George. As shown in Table 11 and Figure 11, water rates for outdoor use in Washington County are extremely low compared with other water utilities in the west.

Washington County values its irrigated landscapes and desires to continue outdoor use and irrigation into the future, but this use must be for legitimate water requirements. Excessive and wasteful outdoor use must become much more costly in the future, and thus eliminated. The proven utility-scale approach to managing outdoor water use and pricing outdoor use fairly and effectively is customer-specific water budgets and water budget-based rates. The WCWCD understands the concept of water budgets for managing and pricing irrigation and currently implements water budgets and water budget-based rates for some golf courses.

To ensure the long-term efficiency and management of outdoor water use, water budget-based rates must be implemented across Washington County by all retail water providers, preferably in a consistent and coordinated manner. The WCWCD should take the lead by using existing geographical information systems (GIS) or by augmenting existing GIS coverage so that the irrigable area for every water user in Washington County can be determined and a reasonable outdoor water budget developed.

Water budgets are a water management tool used to estimate the volume of water a building and or a landscape will reasonably require through the year. The landscape water budget considers the size of the landscape, the landscape water requirement, climate, and other factors. When implemented in conjunction with a tiered rate structure, water budgets are a proven and effective tool for managing and reducing outdoor use at the utility scale.[103]

Indoor water budgets are also useful and should be considered by Washington County. The building (indoor) water budget considers the number of people and other factors. Water budgets are used informationally to communicate with customers or connected to an inclining block rate billing structure. Water budget-based rates are particularly effective because when paired with tiered rate structure customers receive both an informational and financial incentive to reduce use.

From the utility perspective, water budgets provide a way to assess the efficiency of outdoor use across the entire service area and to manage outdoor use as required. During wet years water budgets can be increased and in dry years they can be reduced. Importantly, water budgets offer a mechanism for proportional, equitable, and effective management of outdoor demand during drought.[104] If, say, a utility needs to reduce outdoor use by 20% during a drought (or other supply emergency), landscape water budget allocations can be reduced by 20% and this will impact customers differentially based on their landscape size. For customers

[103] Mayer, P.W. et. al. 2008. Water Budgets and Rate Structures: Innovative Management Tools. Journal of the American Water Works Association. May 2008. Vol. 100, No. 5.

[104] Bamezai, A. L. Maddaus, et. al. 2020. Use and Effectiveness of Municipal Irrigation Restrictions During Drought. Alliance for Water Efficiency. Chicago, Il.

with large landscapes, a 20% reduction will be a larger volume than a 20% reduction for a customer with a small landscape. The water budget also provides the utility a mechanism for measuring drought compliance for every customer.

The WCWCD and municipalities must work together to develop and implement water budgets and water budget-based tiered rates. Water use within the water budget can be priced at tier 1 and 2 and usage above the budget can be priced in higher tiers that increase steeply.

Depending upon the GIS capability that already exists at the WCWCD, water budgets may be inexpensive to develop and the data may already exist to develop reasonable landscape water budgets. Developing a water budget-based tiered rate structure costs the same as any water rate structure and is a standard utility operating expense, not a new cost. Additional billing software capability may be required, but as water budget rate structures are now common across the US, there are many billing software options. Once the budgets values themselves are developed using the GIS, water budget rates can be implemented as part of a new billing system without additional expense.

Water Loss Control

In the DEIS, a 15.4% water loss factor is applied each year to account for real losses in the system. The 15.4% water loss factor, presumably based on current water loss rates, does not change over the 60-year period of the forecast and is applied to both potable and secondary water use. As shown in Figure 2, the DEIS predicts real annual water losses (e.g., the physical loss of water from the system) of more than 24,000 AF by year 2075, which is an astonishingly high volume and more than the potable demands of the commercial and industrial sectors combined.

Water loss control is an area of water management that must be improved in Washington County. This issue was also the top recommendation in the Maddaus Report. Over the next sixty years, the WCWCD and Washington County must work to reduce their water loss to 8%. To achieve this, the WCWCD must work to hold the annual volume of water loss steady, even as the system grows. Investments in water loss control should be made at the economic level where the benefits outweigh the costs. Water loss control for both the potable and secondary water systems must be considered.

The WCWCD and municipalities much each implement programs to detect and minimize water loss in the culinary and secondary water distribution systems. Each agency must have a written plan for implementation to reduce real and/or apparent losses within the system. Th3 plan should be developed with best practices, actions, and goals.[105]

[105] AWWA. 2021. ANSI/AWWA G480-20 Water Conservation and Efficiency Program Operation and Management. AWWA Management Standard. American Water Works Association. Denver, CO.

The WCWCD and each member agency must prepare an annual water loss audit report of the system using the AWWA/IWA Water Audit Method[106] to identify apparent and real water losses. Each agency must identify the system boundaries for an audit and conduct separate audits where there are distinct distribution systems serviced by the utility. The process of independent water audit validation should be adopted to ensure data quality and continual improvement.[107] Each audit produced should be independently reviewed and validated each year.

As a final step to ensure accountability and progress, each validated water loss audit reporting worksheet produced should be made publicly available on the WCWCD and/or member agency websites.[108]

The audit process is an essential step in managing and reducing water losses. The water audit will reveal where investments in water loss control should be made each year so that losses can be economically reduced. Through this process of annual water loss audits and continual improvement water loss can be reduced across Washington County in a cost-effective manner.

Incentivize Gradual Transformation to Climate-Adapted Landscapes

The hotter and drier climate of the future will require climate-adapted landscapes. In Washington County landscapes must gradually evolve over the coming years so that they require less supplemental irrigation. Landscapes should be planned and planted to adapt to the desert climate in Washington County. The WCWCD already provides landscape and irrigation trainings and workshops, the next step is to develop a strategy to gradually transform landscapes and landscape irrigation in Washington County to rely on less water and meet the climate challenges of the future.

Climate adapted landscape does not mean rock and mulch. Beautiful low-water demand landscapes, which include new varieties of low-water requirement turf and ornamental plants, are becoming standard across the western US. In water scare regions like Washington County, traditional high-demand turf landscapes (a concept imported from England) are being phased out except for playing fields, parks, and fairways. Colorful, functional, climate-adapted landscapes are taking their place. Landscape transformation programs across the country have been found an effective method of reducing water demand, and a wide variety of cost-sharing models have been developed.[109] The WCWCD conservation gardens provide some excellent examples. The Garden at Tonaquint Park and the Red Hills Desert Garden (Figure 13),[110] which

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[106] AWWA. 2016. M36 Water Audits and Loss Control Program. Manual of Water Supply Practice. American Water Works Association. Denver, CO.

[107] Sturm, R. et. al. 2017. Level 1 Water Audit Validation: Guidance Manual. Water Research Foundation. Denver, CO.

[108] AWWA. 2021. ANSI/AWWA G480-20

[109] Chesnutt, T. et. al. 2019. Landscape Transformation: Assessment of Water Utility Programs and Market Readiness Evaluation. Alliance for Water Efficiency. Chicago, IL.

[110] Source: https://www.wcwcd.org/conservation/gardens/ (accessed 5/11/21)

are both projects of the WCWCD, offer visitors demonstration gardens which showcase water-efficient landscapes while educating community members on water conservation, growing, planting, and pruning tips, best irrigation practices, native and climate-appropriate vegetation types, and more.

The WCWCD should re-direct a portion of its water conservation program funding into a well-planned landscape transformation program. This program should include loans and grants and cost-sharing arrangements and should be focused on existing landscapes.[111] High-visibility

Figure 13: The Garden at Tonaquint Park and the Red Hills Desert Garden, water conservation-oriented projects of the WCWCD.

landscapes on transit routes and in public view should be an emphasis. The goal of the program over time should be to help change the culture around landscapes and outdoor water use in Washington County with greater emphasis on climate adaptation and water efficiency.

Incentivize Toilet Replacement for Low-Income Customers

Replacing old inefficient toilets has been shown to be one of the most effective measures for reducing indoor demand.[112] Indoor water use efficiency can be improved by ensuring that over time all toilets in Washington County are high-efficiency models that use less than 1.3 gallons per flush.

The state of Utah could assist in this effort by passing legislation similar to the states of California, Colorado, Texas, Georgia, and others, which require that only high-efficiency fixtures be sold. These measures ensure increased efficiency and maintained savings over time as fixtures age and are replaced.

In addition to promoting policy and legislation to reduce indoor demand, the WCWCD should create a toilet replacement incentive program aimed at existing multi-family and lower income customers. These customers are often among the last to replace old inefficient fixtures and

[111] New landscapes will start from a state of higher efficiency due to strengthened landscape codes and ordinances discussed earlier.

[112] DeOreo, W., P. Mayer, et. al. 2016. Residential End Uses of Water, Version 2. Water Research Foundation. Denver, Colorado.

appliances. As water rates increase in the future, reducing indoor demand will also help maintain affordability.

The WCWCD should re-direct a portion of its existing water conservation program funding to establish a toilet replacement program targeted at low-income customers across Washington County.

Customer Leak Detection and Abnormal Usage Alerts

Research shows that customer-side leakage accounts for about 10% of indoor residential water use.[113] Rapid detection and alerts will help reduce customer leaks. Leak alerts and detection can be accomplished through deployment of advanced metering infrastructure (AMI) by water utilities, or at the customer level by installation of devices like Flume[114] or Phyn[115] which detect leaks.

Using AMI to detect leaks is the most far-reaching approach because it has the potential to impact all customers. In many situations an investment in AMI may not make sense for a water utility, even if leak detection can be accomplished. For Washington County, encouraging installation of consumer-level leak detection devices may be a more cost-effective approach to reducing customer leakage over the next ten years. AMI technology is rapidly evolving and broadband Wi-Fi could reduce implementation costs for water utilities. The WCWCD and municipalities can strategically deploy new technology over the coming years to reduce customer leaks. This effort does not require additional expenditures beyond what would normally be spend on metering and meter reading systems. In the short term, the WCWCD could chose to re-direct a portion of its conservation funding to incentivize installation of customer-level leak detection devices as is done in Texas, California, and across the west.

Local Waters 2.0 Revised Demand Forecast

For the Local Waters Alternative 2.0, WaterDM prepared a separate water demand forecast for Washington County that includes the impacts of water loss control and ongoing water efficiency beyond 2045, which were missing from the DEIS forecast. The Local Waters 2.0 and DEIS forecasts are shown in Figure 14.

The Local Waters 2.0 forecast uses the same population forecast as the DEIS and includes the same population in 2075 of 594,660. The Local Water 2.0 forecast starts from the same assumed 2020 level of water use as the DEIS and the two forecasts track closely initially. From

[113] DeOreo, W., P. Mayer, et. al. 2016.

[114] https://flumewater.com/

[115] https://www.phyn.com/plus-smart-water-assistant/

2025 – 2045, the Local Waters forecast includes improvements to water loss control practices and building, plumbing, and landscape codes which assure new construction in Washington County will be water efficient from the start.

Starting in 2045, the DEIS assumes that no additional efficiency improvements are possible, and it simply extends a value of 240 gpcd out to 2075 to develop the final demand estimate. The DEIS assumes that new customers in Washington County will use water just as inefficiently as existing customers without change or improvement for 35 years.

The Local Waters 2.0 forecast includes ongoing efficiency improvements for existing customers in Washington County and it assumes that new customers will join the system as water efficient users from the start due to building and plumbing and landscape development codes. The Local Waters 2.0 forecast estimates total per capita demand in 2075 (potable + secondary) will be 183.5 gpcd and potable demand alone will be 146.4 gpcd. For comparison, this level of use is about the same as what is used in Grand Junction Colorado today according to the data from the Maddaus Report. This also aligns closely with the demand forecast prepared in the 2013 Local Waters Alternative and confirms the reasonableness of the 1% per year efficiency proposal.

Are such levels of demand possible for Washington County? Absolutely yes and many utilities across the west have already achieved this level of water use and lower. Table 12 shows the Local Waters 2.0 forecast gpcd in the context of other measured levels of water use across the US. In 2075, the Local Waters 2.0 forecast estimates that water use in Washington County will still be higher than many comparable utilities. It is quite possible per capita use in Washington County will be even lower in 2075 than WaterDM has forecast.

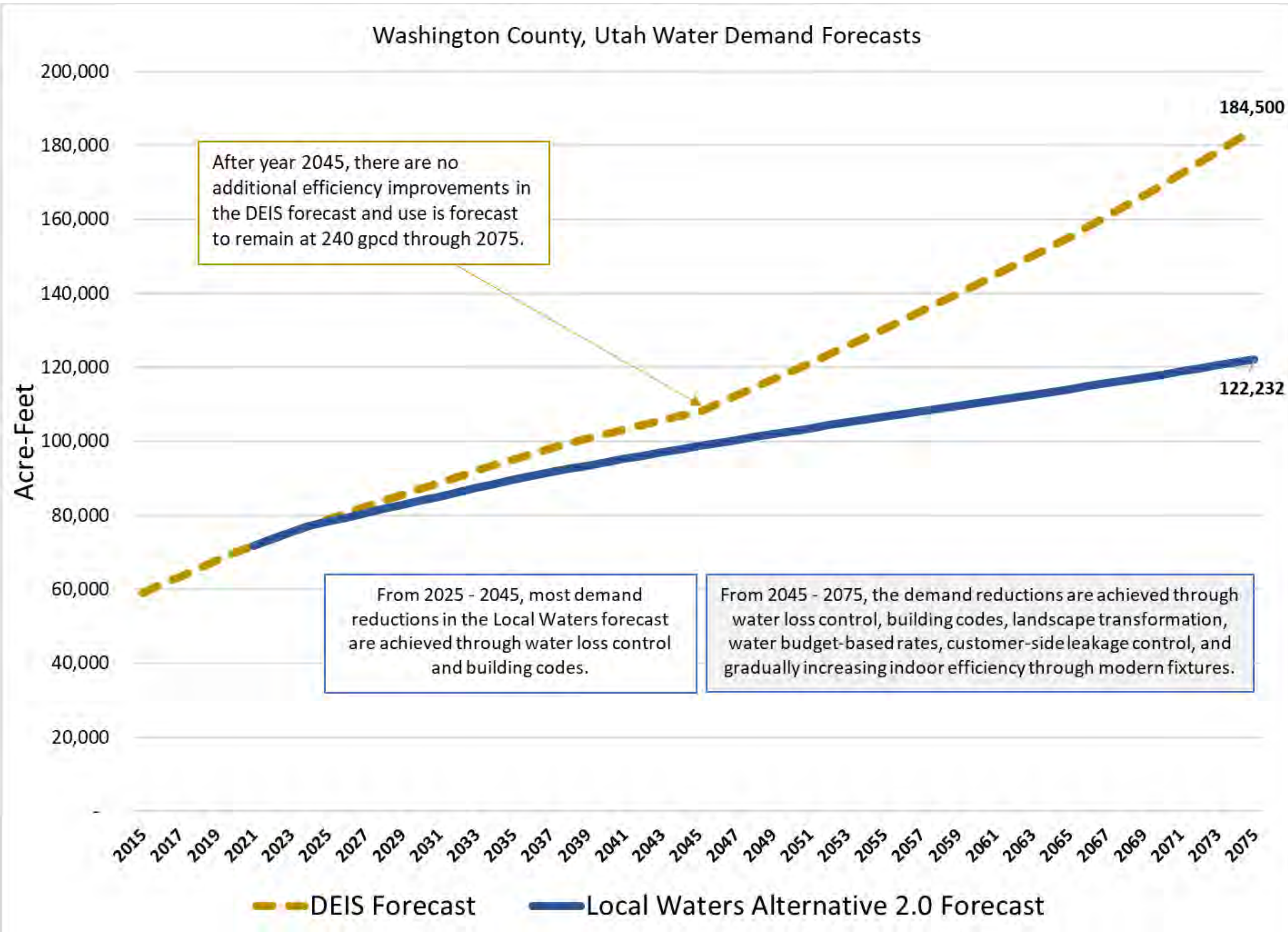

Figure 14: Local Waters Alternative 2.0 and DEIS Demand Forecasts

Table 12: Per Capita Comparisons including Local Waters Alternative 2.0 forecast, sorted in descending order

Agency	Population	gpcd
Washington County WCD - 2015 potable + secondary + water loss - DEIS	**151,360**	**348.2**
Washington County WCD - 2015 potable + secondary - DEIS	**151,360**	**302.0**
Washington County WCD - 2075 potable + secondary + water loss forecast - DEIS	**594,660**	**277.0**
Scottsdale, AZ – 2010 potable	217,385	273.1
Henderson, NV – 2010 potable	277,502	256.9
Washington County WCD - 2075 potable + secondary forecast - DEIS	**594,660**	**240.0**
Washington County – 2019 potable - DEIS	**171,040**	**236.2**
Washington County WCD - 2015 potable - DEIS	**151,360**	**231.0**
Colorado Springs, CO – 2010 potable	441,000	212.3
Washington County WCD - 2075 potable forecast - DEIS	**594,660**	**190.0**
Washington County WCD - 2075 potable forecast + secondary forecast – Local Waters 2.0	**594,660**	**183.5**
Fort Collins, CO – 2010 potable	129,000	157.9
Denver, CO – 2010 potable	1,174,000	156.7
Tacoma, WA – 2010 potable	317,450	150.0
Otay, CA – 2010 potable	198,616	149.9
Washington County WCD - 2075 potable forecast – Local Waters 2.0	**594,660**	**146.4**
Mountain View, CA – 2010 potable	72,800	132.6
Aurora, CO – 2010 potable	325,078	126.6
Austin, TX – 2010 potable	886,768	121.9
Tucson, AZ – 2019 potable	739,485	119.0
San Diego, CA – 2010 potable	1,312,000	118.2
Santa Barbara, CA – 2010 potable	91,416	115.0
San Antonio, TX – 2010 potable	1,360,000	105.7
Philadelphia, PA – 2010 potable	1,500,000	104.5
Chicago, IL – 2010 potable	5,300,000	98.4
Sacramento, CA – 2010 potable	430,437	91.4
Portland, OR – 2010 potable	915,800	61.0

Sources: Table 6.2-2 Future Water Requirements of the Washington County Water Conservancy District., DeOreo, W.B., P. Mayer, J. Kiefer, and B. Dziegielewski. 2016. Residential End Uses of Water, Version 2. Water Research Foundation. Denver, CO

Unlike the DEIS forecast which assumes that water loss and secondary use volumes will increase steadily for the next 50 years, the Local Waters 2.0 forecast includes a cap on secondary water use at current levels and a comprehensive water loss control program to keep loss levels close to what they are today. The disaggregated Local Water 2.0 forecast is shown in Figure 15 and potable use is further broken down into sectors in Figure 16.

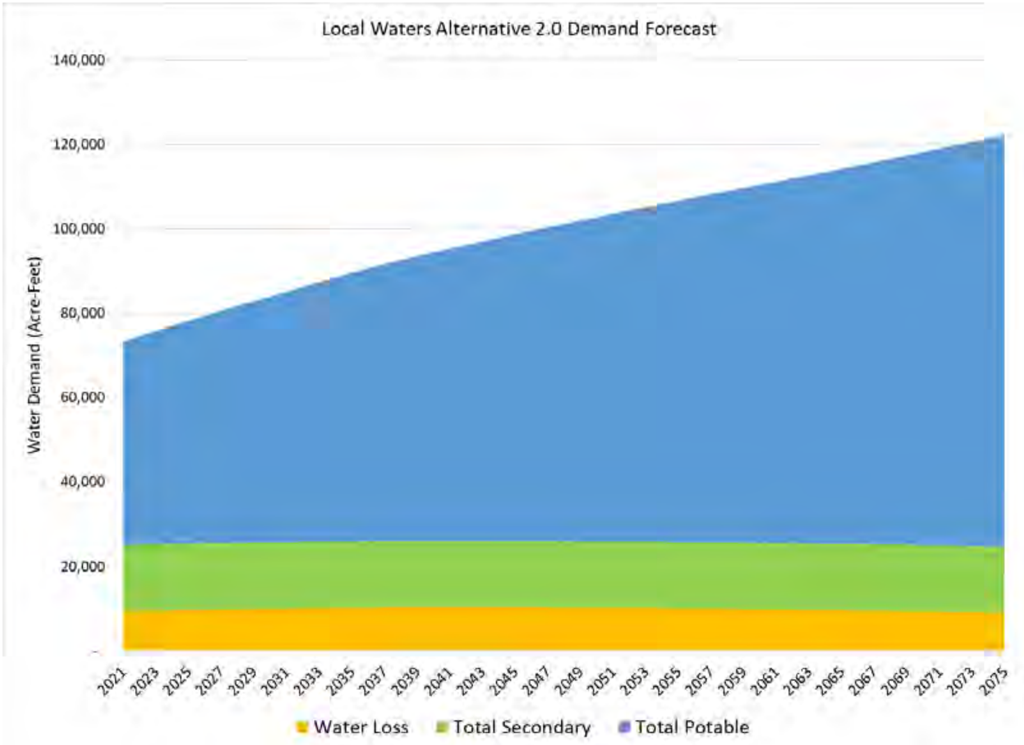

Figure 15: Local Waters Alternative 2.0 forecast for potable, secondary and water loss

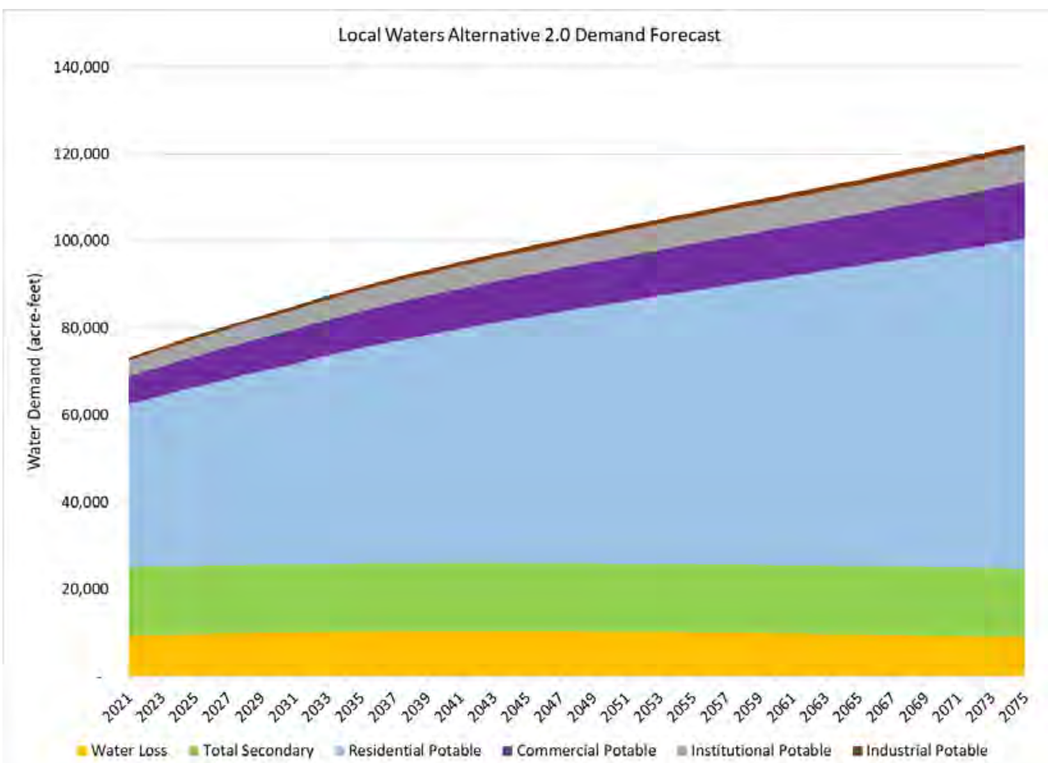

Figure 16: Local Waters Alternative 2.0 potable forecast by sector, with secondary and water loss

In the Local Waters 2.0 forecast, potable demand in all sectors continues to grow over time as population grows, but water use becomes more efficient. The biggest efficiency impacts are expected in the category of residential outdoor use. The Local Waters 2.0 forecast shows a gradual decline in per capita water demand in Washington County, bringing it more closely in line with the water demand of the peers identified in the Maddaus Report. The Local Waters 2.0 forecast shows that Washington County's total water demand including potable and secondary water use will be less than 125,000 AF in 2075.

Table 13: Local Waters Alternative 2.0 and DEIS demand forecasts for Washington County, Utah (2021 – 2075)

Year	Population	DEIS Forecast (acre-feet)					Local Waters 2.0 Forecast (acre-feet)				
		Potable	Secondary	Water Loss	Total	gpcd	Potable	Secondary	Water Loss	Total	gpcd
2021	189,033	48,132	14,070	9,579	71,781	339	48,132	14,070	9,579	71,781	339
2025	214,408	53,100	15,300	10,534	78,933	329	52,868	15,693	9,713	78,273	326
2030	246,338	58,862	16,633	11,626	87,122	316	58,237	15,693	10,018	83,948	304
2035	280,731	64,636	17,878	12,707	95,221	303	63,650	15,693	10,262	89,604	285
2040	314,199	69,606	18,803	13,615	102,024	290	68,339	15,693	10,350	94,381	268
2045	348,064	74,078	19,494	14,419	107,991	277	72,643	15,693	10,335	98,671	253
2050	383,226	81,561	21,463	15,876	118,900	277	76,769	15,693	10,248	102,709	239
2055	420,257	89,442	23,537	17,410	130,390	277	80,829	15,693	10,103	106,624	226
2060	458,960	97,679	25,705	19,014	142,398	277	84,777	15,693	9,896	110,366	215
2065	500,349	106,488	28,023	20,728	155,239	277	88,789	15,693	9,647	114,129	204
2070	545,470	116,091	30,550	22,597	169,239	277	93,021	15,693	9,367	118,081	193
2075	594,660	126,560	33,305	24,635	184,500	277	97,485	15,693	9,054	122,232	184

Conclusions

Local Supply is Sufficient and Resilient

Rather than build the Lake Powell Pipeline, Washington County and the WCWCD have the reliable option of focusing on local water supplies. The 2013 Local Waters Alternative to the Lake Powell Pipeline proposed greater water efficiency and a reliance on local supplies to meet future demand.[116] The Local Water Waters Alternative 2.0 includes a revised and updated portfolio of future water supply and demand management options which update and build upon the Local Waters Alternative. The Local Waters 2.0 analysis concurs with the key recommendations in the 2013 Local Waters Alternative report in finding that a combination of local water supply resources and sensible and cost-effective demand management options can provide a reasonable, reliable water supply to meet the forecast future population of Washington County with much lower cost and less risk.

Aside from minimum flow requirements for fish and other species, WCWCD has sufficient local supplies to grow. The Lake Powell Pipeline is such a highly contentious project that all six fellow Colorado River Basin states have written the Secretary of the Interior requesting to block the Bureau of Reclamation from completing its ongoing environmental impact statement until the seven states achieve a "consensus regarding outstanding legal and operational concerns" having to do with the pipeline's moving water from the Colorado River's Upper Basin to a corner of Utah draining into the Lower Basin.[117]

Lake Powell is an Uncertain Future Supply

Despite its massive size, Lake Powell sits in a vortex of climate change and interstate water policy that make it a highly uncertain future supply. The entire Colorado River Basin is imperiled by the impacts of climate change. Scientists expect Lake Powell will likely never fully refill again.[118] The Lake Powell Pipeline may be delayed for years. It may never be successfully constructed. If it is constructed, and regardless of Utah's entitlement, the Lake Powell Pipeline will still be the most recent and junior withdrawal on the system and will remain a lightning rod for conflict.

The US Bureau of Reclamation reported on February 12, 2021 that Lake Powell stands at 39% of its live capacity, 123 feet from full pool.[119] Forecasts indicate lake levels are likely to continue

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[116] Nuding, A. 2013. The Local Waters Alternative to the Lake Powell Pipeline. Western Resource Advocates.

[117] Salt Lake City Tribune. 9/9/2020. https://www.sltrib.com/news/environment/2020/09/09/surrounding-states-bash/ (accessed 3/5/21)

[118] Salt Lake City Tribune. 1/20/2019. https://www.sltrib.com/news/environment/2019/01/20/lake-powell-could-become/ (accessed 3/5/21)

[119] https://www.usbr.gov/uc/water/crsp/cs/gcd.html (accessed 3/4/2021)

dropping. The WCWCD's stated belief that the Colorado River and Lake Powell offer "the most reliable water supply in the Western US" [120] is simply not true.

If the Lake Powell Pipeline is built, will there be any water to pump? The Utah Board of Water Resources has proposed that the Lake Powell Pipeline, which draws from the same overallocated Colorado River Basin as the Virgin River, offers improved system reliability and supply diversity for Washington County. This is a questionable notion at best and ignores to the impacts of climate change on the entire basin[121] and the fact that the Virgin River and the Colorado River are inextricably linked.

The Lake Powell Pipeline also presents a significant financial risk to the region. Paying for the estimated $2 billion (and growing) project will fall upon impact fees, water sales, and property taxes. Impact fees and water sales are both dependent upon population growth predicted by the Kem Gardner Center and inflated assumptions about future water demand produced by the WCWCD. If the projected population growth and/or projected water demand does not materialize, repayment of the Lake Powell Pipeline becomes more challenging for the WCWCD and much more costly for existing customers.

Utilize the Virgin River System

The best way for the WCDWD and municipalities to account for long-term uncertainty is to make use of available local resources and to implement cost-effective water demand management policies. The local supply that it controls – the Virgin River – provides a more certain, resilient, and cost-effective long-term supply option than the risky Lake Powell Pipeline.

Optimizing use of the Virgin River system to provide potable supply offers greater robustness for water users in Washington County under a wide variety of future situations and circumstances than relying on the Lake Powell Pipeline.

The local water supply portfolio recommended in the Local Waters Alternative 2.0 includes:

1. Cap secondary water systems at their current size and focus on expanding potable supply.
2. Store excess Virgin River water in high-flow years.
3. Further explore and expand aquifer storage and recovery.
4. Expand capability for wastewater reuse – to be scaled as required.
5. Cost-effective water demand management.

[120] Statement by Zach Renstrom, General Manager of the WCWCD to the Washington County Republican Women's Luncheon. 3/4/2021.

[121] Milly, P.C. and K. A. Dunne. 2020. Colorado River flow dwindles as warming-driven loss of reflective snow energizes evaporation. Science. 13 MAR 2020 : 1252-1255

This revised portfolio provides a reliable future supply of *at least* 111,212 AF of culinary water[122] and an ongoing 15,693 AF of secondary water, sufficient reliable supply to meet anticipated average year future demands, and offers a much less expensive, less risky, locally controlled approach for providing water into the future.

Manage Water Demand in Washington County

The analysis of water demand and water rates in Washington County shows that even though the WCWCD spent about $2.4 million on water conservation from 2016 – 2019, total water use and per capita water use did not decrease in that four-year time period.

The primary reason for high water demand in Washington County is the comparatively low cost of water charged for high levels of irrigation use. For the Local Waters Alternative 2.0, WaterDM compared the expected monthly water bill for a customer who uses 40,000 gallons in one month and found that customers in Washington County pay hundreds of dollars less than customers in peer utilities using the same volume of water. Customers in Washington County using secondary water pay even less. The uniform lack of an effective price signal for high volumes of irrigation and outdoor use is the reason water demand in Washington County is higher than in many other parts of the west and southwestern US.

The 2013 Local Waters Alternative proposed a 1% increase in efficiency per year for Washington County,[123] which is the typical level of improvement achieved by water providers across the United States over the past 20 years.[124] The Local Waters Alternative 2.0 includes a separate analysis of potential demand reductions that can be achieved in Washington County over the next 50 years and found that the 1% reduction proposal is reasonable and achievable and is an important part of the best, least risky, and most resilient local supply option.

The Local Waters Alternative 2.0 includes a series of measures and policies to revamp and revitalize water demand management in Washington County and to help manage demand, particularly outdoor use, into the future. Key components of the recommended water demand management options are:

- Adopt a regional approach to water demand management
- Strengthen development and landscape codes
- Water budget-based rates
- Water loss control
- Landscape transformation for climate-adaptation
- Incentives for low-income toilet replacement
- Customer leak detection and monitoring

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[122] Additional water reuse could be developed beyond what is proposed by WaterDM and provides a future supply cushion if required.

[123] Nuding. A. 2013

[124] DeOreo, W.B., P. Mayer, J. Kiefer, and B. Dziegielewski. 2016. Residential End Uses of Water, Version 2. Water Research Foundation. Denver, CO

Realistic Water Demand Forecast

The Draft Environmental Impact Statement (DEIS) prepared by Reclamation failed to include the impacts of ongoing water efficiency after 2045, improperly inflated secondary water demand, and projected a remarkably high level of system water loss that is never shown to improve over 50 years. The result is a highly inflated and unrealistic demand forecast prepared to justify the Lake Powell Pipeline.

The Local Waters Alternative 2.0 contains a separate water demand forecast for Washington County that includes the impacts of water loss control and ongoing water efficiency beyond 2045, which were missing from the DEIS forecast. The Local Waters 2.0 forecast uses the same population forecast as the DEIS and includes the same population in 2075 of 594,660. The Local Waters 2.0 forecast starts from the same assumed 2020 level of water use as the DEIS and the two forecasts track closely initially. From 2025 – 2045, the Local Waters 2.0 forecast includes improvements to water loss control practices and building, plumbing, and landscape codes which assure new construction in Washington County will be water efficient from the start.

Starting in 2045, the DEIS assumes that no additional efficiency improvements are possible, and it simply extends a value of 240 gpcd out to 2075 to develop the final demand estimate. The DEIS assumes that new customers in Washington County will use water just as inefficiently as existing customers without change or improvement for 35 years.

The Local Waters 2.0 forecast includes ongoing efficiency improvements for existing customers in Washington County and it assumes that new customers will join the system as water efficient users from the start due to building and plumbing and landscape development codes. The Local Waters 2.0 analysis forecasts total per capita demand in 2075 (potable + secondary) will be 183.5 gpcd and potable demand alone will be 146.4 gpcd. For comparison, this level of use is about the same as what is used in Grand Junction, Colorado today according to the data from the Maddaus Report. This also aligns closely with the demand forecast prepared in the 2013 Local Waters Alternative and confirms the reasonableness of the 1% per year efficiency proposal.

Are such levels of demand possible for Washington County? Absolutely yes and many utilities across the west have already achieved this level of water use and lower. In 2075, the Local Waters 2.0 forecast estimates that water use in Washington County will still be higher than many comparable utilities with remaining efficiency potential. It is quite possible per capita use in Washington County will be even lower in 2075 than our analysis has forecast.

Local Supply Option is Best

WaterDM concludes that the local supply option is less vulnerable, more robust, and more resilient than the expensive and highly uncertain Lake Powell Pipeline. A local water supply option with the recommended water demand management measures offers significant advantages to Washington County water users that have been ignored as plans for the Lake Powell Pipeline are promoted. There are substantial financial, legal, and political risks associated with the Lake Powell Pipeline. The local supply option significantly alleviates these issues and is a matter of planning and political will.

The current and future water users in Washington County will be far better served today and into the future by abandoning the precarious and enormously expensive Lake Powell Pipeline and adopting a plan to use local resources and manage demands.

Appendix A – Materials Considered[125]

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Appendix B – Listing of 147 Water Rights of the WCWCD[126]

Count	WCWCD Water Rights	Description	Quantity (CFS)	Quantity (Acre-Feet)	Status	Change Document Notes
1	81-37 (a26026)	Ash Creek	3.0			Toquerville Spring Area and Ash Creek
2	81-48	LaVerkin Hot Sulphur Springs	2.5			
3	81-51 (a18455)	Ash Creek	8.0			1274.4 AF; Toquerville Spring
4	81-69	Laverkin Hot Mineral Springs	2.5			
5	81-70 (a38081)	Atkin Spring	0.5	11.3		Underground Water Wells (6) Existing
6	81-75	Peter's Leap Creek	0.5	38.7	Disallowed	
7	81-110	Virgin River	35.0			Hydropower Water Right, all 35 CFS must be returned
8	81-124	Virgin River	65.0			Hydropower Water Right, all 65 CFS must be returned
9	81-142	Big Creek (Kolob Creek)		4,000.0		
10	81-143 (a20326)	Virgin River		4,000.0		
11	81-179 (a21554)	Meadow Hollow (Iron County)		104.7		11.64 CFS or 739.1 AF; Adding LaVerkin Creek and Virgin River
12	81-180 (a21554)	Unnamed tributaries to Willow Creek (Iron County)	5.0	104.7		11.64 CFS or 739.1 AF; Adding LaVerkin Creek and Virgin River

[126] Based on: WCWCD. 2009. Washington County Water Conservancy District Change of Address (involving 147 District Water Right). https://www.waterrights.utah.gov/docimport/0525/05256641.pdf

Count	WCWCD Water Rights	Description	Quantity (CFS)	Quantity (Acre-Feet)	Status	Change Document Notes
13	81-283 (a21554)	Elisha & Myron Spring Areas (Iron County)		104.7		11.64 CFS or 739.1 AF; Adding LaVerkin Creek and Virgin River
14	81-351	Ash Creek / Upper Ash Creek Reservoir		10,000.0		
15	81-355 (a30888)	Crystal Creek (Iron County)	50.0	6,000.0		
16	81-490 (a34602)	Wright Spring	0.0	2.5		21.36 AF; Underground Water Well
17	81-574 (a18837)	Underground Water Wells	1.0	288.6		627.85 AF; 2 Existing Wells
18	81-583 (a34602)	Underground Water Wells	0.1	12.9	Water User's Claim	21.36 AF
19	81-615 (a34530)	Laverkin Creek	1.0	61.2		Virgin River
20	81-1112 (a23532)	Underground Water Wells (3 new, 1 existing) SE of Leeds Town	4.0			4 CFS 1448.0 AF
21	81-1137 (a29366)	Big Creek (Kolob Creek)	0.5	82.4		.4558 CFS or 275.87 AF
22	81-1178	Underground Water Well	4.0		Unapproved	
23	81-1303 (a21555)	Underground Water Well	0.2			98.952 AF
24	81-1381 (a20327)	Virgin River and Quail Creek		19,000.0		37.5 CFS or 21,000.0 AF
25	81-1382 (a14596)	Virgin River		12,820.0		Unapproved
26	81-1559 (a18837)	Underground Water Well	0.0	1.5		627.85 AF

Count	WCWCD Water Rights	Description	Quantity (CFS)	Quantity (Acre-Feet)	Status	Change Document Notes
27	81-1628 (a44965)	Underground Water Well south of Hurricane	.129*	93.3		2674.5 AF; Underground Water Wells and Virgin River
28	81-1669 (a18837)	Underground Water Well	0.4	223.6		627.85 AF; 2 Existing Wells
29	81-1671 (a18837)	Underground Water Well	0.1	30.2		627.85 AF; 2 Existing Wells
30	81-1732 (a18837)	Underground Water Well	0.1	25.2		627.85 AF; 2 Existing Wells
31	81-2152	Unnamed spring	0.0			
32	81-2153	Unnamed spring	0.0			
33	81-2158 (a44965)	Underground Water Well south of Hurricane	.0104*	7.5		2674.5 AF; Underground Water Wells and Virgin River
34	81-2187 (a44965)	Underground Water Well	0.2	45.0		2674.5 AF; Underground Water Wells and Virgin River
35	81-2273	Virgin River		28,891.5		
36	81-2318	Virgin River sw of Town of Virgin	250.0			
37	81-2424 (a44965)	Underground Water Wells sw of Hurricane	1.4	288.7		2674.5 AF; Underground Water Wells and Virgin River
38	81-2432 (a44965)	Underground Water Well	0.1	54.0		2674.5 AF; Underground Water Wells and Virgin River
39	81-2476	Virgin River	1.0	330.0		
40	81-2478	Quail Creek	0.3	95.9		
41	81-2547	Virgin River Warner Valley Project area			Withdrawn	
42	81-2548	Virgin River Warner Valley Project area			Withdrawn	
43	81-2713 (a21555)	Underground Water Well	0.2			99.0 AF

Count	WCWCD Water Rights	Description	Quantity (CFS)	Quantity (Acre-Feet)	Status	Change Document Notes
44	81-2714 (a18837)	Underground Water Well	0.2	58.7		627.85 AF; 2 existing wells
45	81-2816 (a21554)	Willow Creek (Iron County)	2.6			11.64 CFS or 739.1 AF, adding LaVerking Creek and Virgin River
46	81-2935 (a42542)	Underground Water Wells (2) Service Area of WCWCD	0.00895*	6.5		63.3 AF; Underground Water Wells (3)
47	81-2948 (a29366)	Big Creek (Kolob Creek)	0.262*	190.0		.4558 CFS or 275.87 AF
48	81-2952	North Fork of Virgin River (Kane County)	1.5			
49	81-3107 (a14441)	Virgin River	1.0	160.0		
50	81-3179	Sand Hollow Creek	0.3	77.1		
51	81-3561 (a31451)	LaVerkin Creek	0.4	88.2		1.5765 CFS or 409.266 AF; LaVerkin Creek and/or Virgin River
52	81-3562 (a31451)	LaVerkin Creek	0.2	55.8		1.5765 CFS or 409.266 AF; LaVerkin Creek and/or Virgin River
53	81-3576 (a31451)	LaVerkin Creek	0.1	63.0		1.5765 CFS or 409.266 AF; LaVerkin Creek and/or Virgin River
54	81-3577 (a31451)	LaVerkin Creek	0.1	27.0		1.5765 CFS or 409.266 AF; LaVerkin Creek and/or Virgin River

Count	WCWCD Water Rights	Description	Quantity (CFS)	Quantity (Acre-Feet)	Status	Change Document Notes
55	81-3578 (a31451)	LaVerkin Creek	0.1	18.6		1.5765 CFS or 409.266 AF; LaVerkin Creek and/or Virgin River
56	81-3579 (a31451)	LaVerkin Creek	0.0	8.4		1.5765 CFS or 409.266 AF; LaVerkin Creek and/or Virgin River
57	81-3589 (a31451)	LaVerkin Creek	0.2	52.2		1.5765 CFS or 409.266 AF; LaVerkin Creek and/or Virgin River
58	81-3590 (a31451)	LaVerkin Creek	0.2	37.8		1.5765 CFS or 409.266 AF; LaVerkin Creek and/or Virgin River
59	81-3618 (a44965)	Underground Water Well south of Hurricane		80.0		2674.5 AF; Underground Water Well and Virgin River
60	81-3623 (a44965)	Underground Water Well south of Hurricane		31.1		2674.5 AF; Underground Water Well and Virgin River
61	81-3625 (a44965)	Underground Water Well south of Hurricane		62.3	Water User's Claim	2674.5 AF; Underground Water Well and Virgin River
62	81-3629 (a44965)	Underground Water Well south of Hurricane		80.0		2674.5 AF; Underground Water Well and Virgin River
63	81-3630 (a44965)	Underground Water Well south of Hurricane		130.0		2674.5 AF; Underground Water Well and Virgin River
64	81-3693	Beaver Dam Wash	500.0	40,000.0	Unapproved	
65	81-3699	Ft. Pearce Wash		20,000.0	Unapproved	
66	81-3776	Wright Spring	0.0	18.0	Unapproved	
67	81-3799 (a44965)	Underground Water Well		6.8		2674.5 AF; Underground Water Well and Virgin River
68	81-3809 (a44965)	Underground Water Well	0.1	42.0		2674.5 AF; Underground Water Well and Virgin River

Count	WCWCD Water Rights	Description	Quantity (CFS)	Quantity (Acre-Feet)	Status	Change Document Notes
69	81-3813 (a42542)	Underground Water Wells (2) Within service area of WCWCD		1.0		63.29 AF; Underground Water Wells (3)
70	81-3819 (a44965)	Virgin River and Underground Water Wells (3)		274.1		2674.5 AF; Underground Water Well and Virgin River
71	81-3824	Underground Water Well (Existing), Dixie Springs	2.0		Unapproved	
72	81-3828	Underground Water Well, sw of Hurricane	5.0		Unapproved	
73	81-3829	Underground Water Well, sw of Hurricane	10.0		Unapproved	
74	81-3830	Underground Water Well, sw of Hurricane	10.0		Unapproved	
75	81-3832	Leap Creek		10,000.0	Unapproved	
76	81-3833	South Ash Creek		10,000.0	Unapproved	
77	81-3834	Wet Sandy		6,000.0	Unapproved	
78	81-3907 (a34602)	David Spring Area		6.0		21.36 AF; Underground Water Well
79	81-3920 (a44965)	Underground Water Well		45.0		2674.5 AF; Underground Water Well and Virgin River
80	81-3925 (a44965)	Underground Water Well		122.0		2674.5 AF; Underground Water Well and Virgin River
81	81-3927 (a18419)	Virgin River	1.0	500.0		Virgin River and Well
82	81-3928	Underground Water Well, Near Anderson Jct. on I-15	5.0		Unapproved	

Count	WCWCD Water Rights	Description	Quantity (CFS)	Quantity (Acre-Feet)	Status	Change Document Notes
83	81-3931 (a31451)	LaVerkin Creek	0.0	6.0		1.5765CFS or 409.266 AF; LaVerkin Creek and/or Virgin River
84	81-3932 (a31451)	LaVerkin Creek	0.2	52.3		1.5765CFS or 409.266 AF; LaVerkin Creek and/or Virgin River
85	81-3954 (a44965)	Underground Water Well, south of Hurricane		93.3		2674.5 AF; Underground Water Well and Virgin River
86	81-3955 (a44965)	Underground Water Well, south of Hurricane		12.8		2674.5 AF; Underground Water Well and Virgin River
87	81-3956 (a44965)	Underground Water Well, south of Hurricane		12.8		2674.5 AF; Underground Water Well and Virgin River
88	81-3957 (a44965)	Underground Water Well, south of Hurricane		8.0		2674.5 AF; Underground Water Well and Virgin River
89	81-3996 (a12603a)	Virgin River and Quail Creek		5,108.6		
90	81-4002 (a36905)	Underground Water Well	1.0	156.0		Underground Water Wells (6 existing)
91	81-4108 (a20559a)	Virgin River and Quail Creek	2.7	1,500.0		
92	81-4140 (a42542)	Underground Water Wells (2) , Within service area of WCWCD		0.3		63.3AF; Underground Water Wells (3)
93	81-4143 (a42542)	Underground Water Wells (2) , Within service area of WCWCD		0.5		63.3AF; Underground Water Wells (3)
94	81-4173 (a21555)	Underground Water Well, Washington	0.0	10.2		99.0 AF

Count	WCWCD Water Rights	Description	Quantity (CFS)	Quantity (Acre-Feet)	Status	Change Document Notes
95	81-4193 (a44965)	Underground Water Well, south of Hurricane		69.3		2674.5 AF; Underground Water Well and Virgin River
96	81-4199 (a42542)	Underground Water Wells (2), Within service area of WCWCD		0.5		63.3 AF; Underground Water Wells (3)
97	81-4200 (a42542)	Underground Water Wells (2), Within service area of WCWCD		0.5		63.3 AF; Underground Water Wells (3)
98	81-4201 (a42542)	Underground Water Wells (2), Within service area of WCWCD		0.5		63.3 AF; Underground Water Wells (3)
99	91-4202 (a42542)	Underground Water Wells (2), Within service area of WCWCD		0.5		63.3 AF; Underground Water Wells (3)
100	81-4203 (a42542)	Underground Water Wells (2), Within service area of WCWCD		1.0		63.3 AF; Underground Water Wells (3)
101	81-4204 (a42542)	Underground Water Wells (2), Within service area of WCWCD		0.5		63.3 AF; Underground Water Wells (3)
102	81-4205 (a42542)	Underground Water Wells (2), Within service area of WCWCD		1.5		63.3 AF; Underground Water Wells (3)
103	81-4206 (a42542)	Underground Water Wells (2), Within service area of WCWCD		0.5		63.3 AF; Underground Water Wells (3)
104	81-4211 (a22832)	Virgin River (via Quail Lake diversion)		50,000.0		

Count	WCWCD Water Rights	Description	Quantity (CFS)	Quantity (Acre-Feet)	Status	Change Document Notes
105	81-4231	Renumbered			Renumbered	This water right number voided - see file 81-3954
106	81-4232 (a42542)	Underground Water Wells (2), Within service area of WCWCD		0.5		63.3 AF; Underground Water Wells (3)
107	81-4233 (a42542)	Underground Water Wells (2), Within service area of WCWCD		0.5		63.3 AF; Underground Water Wells (3)
108	81-4241 (a42542)	Underground Water Wells (2), Within service area of WCWCD		0.5		63.3 AF; Underground Water Wells (3)
109	81-4243 (a44965)	Underground Water Well, south of Hurricane		70.7		2674.5 AF; Underground Water Well and Virgin River
110	81-4250 (a44965)	Underground Water Well		59.8		2674.5 AF; Underground Water Well and Virgin River
111	81-4360 (a24774)	Wallace, Tynan, and Bringhurst Spring #1		0.5		
112	81-4367 (a20559a)	Virgin River, Quail Creek	0.9	500.0		Virgin River, Quail Creek, and Wells (2)
113	81-4378 (a42542)	Underground Water Wells (2), Within service area of WCWCD		0.5		63.3 AF; Underground Water Wells (3)
114	81-4379 (a42542)	Underground Water Wells (2), Within service area of WCWCD		0.3		63.3 AF; Underground Water Wells (3)
115	81-4400 (a44964)	Underground Water Well, Harrisburg Dome Area		8.0		2674.5 AF; Underground Water Well and Virgin River

Count	WCWCD Water Rights	Description	Quantity (CFS)	Quantity (Acre-Feet)	Status	Change Document Notes
116	81-4428	Sand Hollow Reservoir / Groundwater Recharge		15,000.0	Renumbered	
117	81-4436	Sand Hollow Reservoir/Ground Water Recovery Wells		15,000.0	Renumbered	
118	81-4439 (a42542)	Underground Water Wells (2), Within service area of WCWCD		0.8		63.3 AF; Underground Water Wells (3)
119	81-4440 (a42542)	Underground Water Wells (2), Within service area of WCWCD		0.1		63.3 AF; Underground Water Wells (3)
120	81-4441 (a42542)	Underground Water Wells (2), Within service area of WCWCD		1.0		63.3 AF; Underground Water Wells (3)
121	81-4445 (a42542)	Underground Water Wells (2), Within service area of WCWCD		0.6		63.3 AF; Underground Water Wells (3)
122	81-4446 (a42542)	Underground Water Wells (2), Within service area of WCWCD		0.4		63.3 AF; Underground Water Wells (3)
123	81-4452 (a42542)	Underground Water Wells (2), Within service area of WCWCD		0.1		63.3 AF; Underground Water Wells (3)
124	81-4454 (a42542)	Underground Water Wells (2), Within service area of WCWCD		0.2		63.3 AF; Underground Water Wells (3)
125	81-4492 (a42542)	Underground Water Wells (2), Within service area of WCWCD		0.5		63.3 AF; Underground Water Wells (3)

Count	WCWCD Water Rights	Description	Quantity (CFS)	Quantity (Acre-Feet)	Status	Change Document Notes
126	81-4493 (a42542)	Underground Water Wells (2), Within service area of WCWCD		0.5		63.3 AF; Underground Water Wells (3)
127	81-4494(a42542)	Underground Water Wells (2), Within service area of WCWCD		0.5		63.3 AF; Underground Water Wells (3)
128	81-4495 (a42542)	Underground Water Wells (2), Within service area of WCWCD		0.5		63.3 AF; Underground Water Wells (3)
129	81-4511 (E4378)	Big Creek (Kolob Creek)		0.3		
130	81-4539 (a29176)	Underground Water Well, At Kolob Reservoir		0.3		
131	81-4547 (a29366)	Big Creek (Kolob Creek)		3.5		.4558 CFS or 275.9 AF
132	81-4557	Underground Water Well	0.3	113.0		
133	81-4572 (a42542)	Underground Water Wells (2), Within service area of WCWCD		0.5		63.3 AF; Underground Water Wells (3)
134	81-4594 (a44965)	Underground Water Well	1.3	260.6		2674.5 AF; Underground Water Well and Virgin River
135	81-4595 (a44965)	Underground Water Well	0.7			2674.5 AF; Underground Water Well and Virgin River
136	81-4596 (a44965)	Virgin River and Underground Wells (3), East of Harrisburg Dome	1.7			2674.5 AF; Underground Water Well and Virgin River
137	81-4611 (E4662)	Lapsed			Lapsed	
138	81-4647 (a44965)	Underground Water Well		15.0		2674.5 AF; Underground Water Well and Virgin River

Count	WCWCD Water Rights	Description	Quantity (CFS)	Quantity (Acre-Feet)	Status	Change Document Notes
139	81-4648 (a44965)	Underground Water Well		36.6		2674.5 AF; Underground Water Well and Virgin River
140	81-4679	Underground Water Well, near Santa Clara	0.4	108.0	Water User's Claim	
141	81-4695 (a42542)	Underground Water Wells (2), Within service area of WCWCD		1.8		63.3 AF; Underground Water Wells (3)
142	81-4731 (a42542)	Underground Water Wells (2), Within service area of WCWCD		0.1		63.3 AF; Underground Water Wells (3)
143	81-4732 (a42542)	Underground Water Wells (2), Within service area of WCWCD		0.3		63.3 AF; Underground Water Wells (3)
144	81-4786 (E5079)	Lapsed			Lapsed	
145	RC004	Virgin River, Sand Hollow Reservoir		15,000.0		
146	RC004-001	Sand Mountain Navajo/Kayenta Aquifer, Sand Hollow Reservoir		15,000.0		
147	89-1525	Colorado River (via Lake Powell) (Kane County)		100,000.0	Unapproved	
148	81-507	Virgin River		147,600.0		State of Utah water right

Appendix C – Resume of Peter Mayer, P.E.

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WORK EXPERIENCE

Principal, WaterDM. 2013-present.
Registered Professional Engineer, Colorado
Vice President, Aquacraft, Inc. Water Engineering and Management. 1995-2013

AFFILIATIONS

American Water Works Association
Associate Editor – AWWA Water Science Journal
Chair – M22 Meter Sizing Manual 4TH ed. Committee
Member – Water Conservation Division, Technology and Policy Committee, Customer Metering Practices Committee,
AWRA AWE, ASCE, Colorado Water Wise, Colorado Water Congress

AWARDS

- 2021 AWWA George Anderson Lifetime Award from Water Meter Standards Committee.
- 2019 AWE Distinguished Service Award
- 2013, 2010, 2008, 2006 – *Journal AWWA* Best Paper Award, Water Conservation
- 2013 ASCE-EWRI *Journal of Water Resources Planning and Management* Quentin Martin Best Research-Oriented Paper Award

SELECTED PROJECTS

- Expert Witness on Urban Water Management, FL v. GA, 142, Original. US Supreme Court (2016)
- Residential End Uses of Water Study Update, Water Research Foundation (2010-2016)
- End Use Research with Flume, Inc. (2021 and beyond)
- City of Fort Collins Single-Family Water Budgets (2021)
- Expert Reports Prepared for the Marina Coast Water District (2020-21)
- California Department of Water Resources Research Advisor (2019 – present)
- City of Northglenn Integrated Water Resources Plan (2019-2020)
- City of Tucson, Water Conservation and Integrated Resources Plan (2019 – 2020)
- Metropolitan Water District Demand Management Analysis (2018 – 2019)
- NYC Regional Conservation Planning, NYC Water Board, (2014-2019)

- Colorado State Water Supply Initiative (2010, 2017)
- Northern Water Conservation Planning Initiative (2017)
- City of Westminster Rate and Fee Cost of Service Study (2017)
- City of Austin Texas, Integrated Water Resources Plan (2016)
- Roaring Fork Regional Conservation Planning, CWCB, (2014-2015)
- Senior Technical Advisor, Alliance for Water Efficiency (2007-present)
- Eastern Municipal Water District – Water Efficient Guidelines for New Development (2012-13)
- Best Practices Guide for Colorado Water Conservation (2010)
- Water Budgets and Rate Structures – Innovative Management Tools (2006)
- Commercial and Institutional End Uses of Water, WRF (1998-2000)

SELECTED RECENT PUBLICATIONS

Mayer, P. S. Buchberger, S. Davis, and C. Douglas. 2020. Research Sheds Light on Age-Old Problem of Meter and Service Line Sizing. Journal of the American Water Works Association. September 2020.

Rupprecht, C., M.M. Hamilton, and P.W. Mayer. 2020. Tucson Examines the Rate Impacts of Increased Water Efficiency and Finds Customer Savings. Journal of the American Water Works Association. January 2020.

Mayer, P.W., S. Davis, S. Buchberger, C. Douglas. 2020. Assessing Water Demand Patterns to Improve Sizing of Water Meters and Service Lines. Final Report of Project 4689. Water Research Foundation, Denver, Colorado.

Douglas, C., S. Buchberger, and P. Mayer. Systematic Oversizing of Water Meters. 2019. AWWA Water Science Journal. December 2019.

Mayer, P.W. 2019. Water Demand Trends, Efficiency and the Future of American Water Use. Keynote Address. University Council on Water Resources (UCOWR) Annual Conference. Snowbird, UT.

Mayer, P.W. 2018. Water Management's Quiet Hero – the Water Meter. Contractor Magazine. November, 2018.

Mayer, P.W., et. al. 2018. Peak Day Water Demand Management Study Heralds Innovation, Connection, Cooperation. Journal of the American Water Works Association. May 2018 110:5.

Mayer, P.W., et. al. 2017. Peer Review of the Water Conservation Programs of the Metropolitan Water District of Southern California. Alliance for Water Efficiency. Chicago, IL.

Mayer, P.W. 2017. Water Conservation Keeps Rates Low in Tucson and Gilbert, Arizona. Alliance for Water Efficiency. Chicago, IL.

Mayer, P.W. 2016. Water Research Foundation Study Documents Water Conservation Potential and More Efficiency in Households. Journal of the American Water Works Association. October 2016 108:10.

DeOreo, W.B., P. Mayer, J. Kiefer, and B. Dziegielewski. 2016. Residential End Uses of Water, Version 2. Water Research Foundation. Denver, CO.

Mayer, P.W. et. al. 2014. Conservation Efforts Limit Rate Increases for Colorado Utility. Journal of the American Water Works Association. April 2014, 106:4. Denver, Colorado.

Suero F., P.W. Mayer, and D. Rosenberg. 2012. *Estimating and Verifying United States Households' Potential to Conserve Water*. Journal of Water Resources Planning and Management. 138(3), 299–306.

Mayer, P.W., et. al. 2010. *Improving Urban Irrigation Efficiency By Using Weather-Based "Smart" Controllers.* Journal of the American Water Works Association. February 2010. Vol. 102, No. 2.

Mayer, P.W. et. al. 2008. *Water Budgets and Rate Structures: Innovative Management Tools*. Journal of the American Water Works Association. May 2008. Vol. 100, No. 5.

Mayer, P.W., et. al. 2006. *Third-party Billing of Multifamily Customers Presents New Challenges to Water Providers.* Journal AWWA. August 2006, Vol. 98, No. 8.

EDUCATION

Master of Science, 1995, Water Resources Engineering, Department of Civil, Environmental and Architectural Engineering, University of Colorado, Boulder.

Bachelor of Arts, 1986, Oberlin College, Oberlin Ohio. Anthropology (Honors).