



— BUREAU OF —
RECLAMATION

Lake Powell Pipeline Project Appendix B: Purpose and Need Report

**Coconino and Mohave Counties, Arizona
Kane and Washington Counties, Utah**



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1 Introduction

1.1 Objective of this Report

The overall objective of this report is to assess the water needs of the Project Participants, determine to what extent the Lake Powell Pipeline (LPP) Project would meet those water needs, and define the purpose and need statement for the LPP Project Draft Environmental Impact Statement (DEIS). This report outlines the process used to determine the underlying need to which the Bureau of Reclamation (Reclamation) and the cooperating agencies are responding and Reclamation's vetting of that process. Originally, the Kane County System was included in the project; however, as a result of Reclamation's evaluation of Kane County Water Conservancy District's (KCWCD) supply and demand and a letter received from the general manager of the KCWCD, the Kane County System was removed (see analysis below).

1.2 Lake Powell Pipeline Project Participants

The Utah Board of Water Resources (UBWR) is the policy-making body of the Utah Division of Water Resources (UDWRe) and is the Project Proponent. The Project Participants (or simply "Participants") for the LPP Project include the Washington County Water Conservancy District (WCWCD) and KCWCD.

2 Proposed Lake Powell Pipeline Project

The LPP is a proposed water delivery pipeline that begins at Lake Powell near Glen Canyon Dam in Page, Arizona, and ends at Sand Hollow Reservoir near St. George, Utah. The pipeline would deliver up to 86,249 acre-feet of water from Lake Powell to Washington and Kane Counties in Utah, with the objective to satisfy future water demands of growing populations in those counties. Up to 82,249 acre-feet of water would be delivered to WCWCD's service area and up to 4,000 acre-feet would be delivered to the Kanab/Johnson Creeks Sub-basin service area of the KCWCD. Two pipeline alignments have been proposed: the Southern Alternative and the Highway Alternative. Both alternatives begin and end in the same location and would be capable of delivering the same amount of water on the same demand schedule. Therefore, the rest of the individual components of the LPP Project are not discussed further. Those details are provided in the LPP Plan of Development (UDWRe 2020a; provided as Appendix E, Plan of Development) and Chapter 2, Alternatives Development and Screening, of the LPP DEIS.

2.1 Project Proponent Objectives

The UBWR proposes building the LPP to meet future water demands through 2060 and beyond. In addition, the LPP is intended to achieve other prudent planning objectives, consistent with the UBWR's mission (UBWR 2019; UDWR 2019), which include:

1. Diversifying the regional water supply portfolio by providing a second source of water for Washington County;
2. Providing for system reliability by developing a secure source of water;
3. Providing for system redundancy in the event of system failure due to disasters or aging infrastructure;
4. Accounting for climate change scenarios; and
5. Accounting for long-term uncertainty when considering the summed effect of the vulnerability to the water supply.

Other large water districts/suppliers in Utah that operate and maintain some of Reclamation's federal projects have similar objectives in both their day-to-day and long-term plans (e.g., Jordan Valley Water Conservancy District 2019).

3 Methods for Need Assessment

3.1 Study Team

The study team tasked with vetting the information that was provided by the Project Participants included two civil engineers from Reclamation that are experienced in hydrology modeling and reservoir operations.

3.2 Study Approach

Each Project Participant provided information and data regarding supply and demand scenarios for their respective service areas (see Figure 3.2-1). One engineer reviewed the supply information and the other engineer reviewed the demand information for each Project Participant. Water needs were then determined by subtracting supply from demand. Where a quantitative method was not used by the Project Participants, the Reclamation team used their years of experience and professional judgment to determine whether the information provided and the conclusions derived were reasonable.

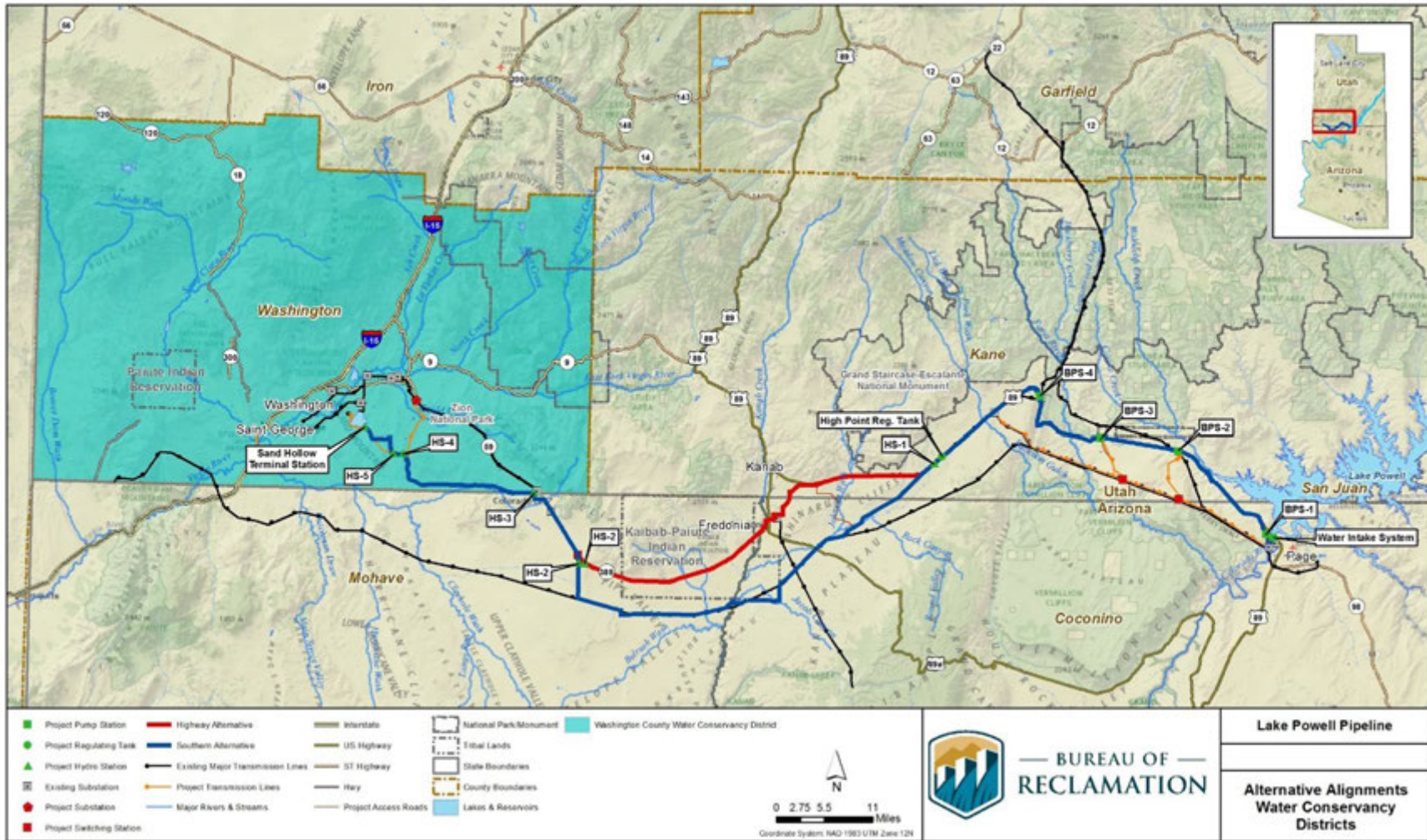


Figure 3.2-1 Service Areas for the Project Participants

3.2.1 Water Supply

The Project Participants provided supply information using different approaches. KCWCD's supply is largely from groundwater resources. No model or climate change component is quantitatively applied to their groundwater supply. Water supply data was collected from UDWR's 2018 Municipal and Industrial (M&I) Use Report and KCWCD water managers and operators (UDWR 2018).

The WCWCD primarily derives their water supply from surface water resources (Virgin River), although some groundwater sources provide a portion of their supply. In addition, the UDWR developed the Virgin River Daily Simulation Model (VRDSM) to estimate reliable yield for WCWCD's supply. The VRDSM now includes a climate change component for the surface water supplies. Vetting WCWCD's supply information, therefore, included reviewing the VRDSM assumptions and inputs, outputs, and resulting data.

3.2.2 Water Demand

Base annual water demand was based on population projections from the University of Utah Kem C. Gardner Policy Institute (Gardner Institute 2017). Other factors were included as well for the WCWCD, including water usage rate (gallons per capita per day [gpcd]), conservation, system loss, and a 15-year reserve planning buffer. Factors for KCWCD were the same except for conservation and the lack of a 15-year buffer. Vetting demand information, therefore, included determining whether estimates and the approach (e.g., rate of conservation, inclusion of a reserve buffer) were reasonable in light of the Districts' need to provide reliable water supplies to customers in their service areas and also plan against uncertainties related to climate change, reductions in water quality, reliance on a single source, unexpected population growth or economic expansion, and potential interruptions in supply.

3.2.3 Water Needs

The future water need (or supply deficit) in each Participant's service area was calculated by subtracting the estimated water supply in 2060 from the estimated water demand in 2060. Adding the water needs together provided the amount of water needed for the overall Proposed Project. After calculating the future water need, the amount of LPP water allotted to each Project Participant was applied to their respective deficits. This identified the contribution of the Proposed Project to satisfying the water supply deficit and whether a deficit remained or if the Proposed Project would result in a surplus. Vetting this portion of the process was simply a determination that the correct mathematical operations were used.

4 Water Supplies

4.1 Kane County Water Conservancy District

The KCWCD was formed in 1992. The KCWCD boundary encompasses all of Kane County. Kane County is geographically large and diverse county that encompasses pieces of multiple Utah water rights adjudication subdivisions or sub-basins. These sub-basins include the following:

- East Fork Virgin River;
- Kanab/Johnson Creeks;
- Zion;
- Paria River;
- Escalante;
- Boulder; and
- An unassigned/unnamed basin.

The KCWCD and other water providers in the county manage and provide water supplies to communities and rural areas throughout the sub-basins. Existing KCWCD water supply customers include rural developments located in the Cedar Mountain and Johnson Canyon areas. The KCWCD owns and operates wells in the Johnson Canyon area to meet these demands. The KCWCD has a connection to the Kanab City water supply and plans to supply water in the future to this municipal customer. This needs analysis focuses on supplies and demand in the Kanab/Johnson Creeks sub-basin, which encompass Kanab City and the Johnson Canyon area.

4.1.1 Current Operations and Delivery System

All existing M&I supplies in Kane County, including those in the Kanab/Johnson Creeks sub-basin, are derived from groundwater resources (wells and springs). Most current groundwater supplies are pumped from the Navajo Sandstone Aquifer.

4.1.2 Current, Planned, and Future Supply

Current supply minus 10 percent shortage is estimated at 2,278 acre-feet per year based on UDWR M&I Water Use 2018 data (UDWR 2018). Planned reliable supply was estimated by KCWCD water managers and operators. Future reliable supply was a sum of the current and planned supplies, totaling 4,123 acre-feet per year (see Table 4.1-1 below).

Table 4.1-1 Current, Planned, and Future Supplies for Kane County Water Conservancy District

Supply	acre-feet per year
Current (2020) Reliable Supply with 10% Reserve	2,278
Planned Reliable Supply with 10% Reserve	1,845
2060 Reliable Supply with 10% Reserve	4,123

4.2 Washington County Water Conservancy District

The WCWCD is a public non-profit agency, charged under state law with conserving, developing, managing, and stabilizing water supplies within the county to establish a safe, sustainable water supply for human use and for a healthy natural environment in the Virgin River basin. The WCWCD is primarily a wholesaler of water to local water providers. As a political subdivision of the state, the WCWCD operates under the Water Conservancy District Act (Utah Code Annotated [UCA] § 17B-2a-1001 et seq.), Limited Purpose Local Government Entities – Local Districts (UCA § 17B-1-101 et seq.), Open and Public Meetings Act (UCA § 52-4-1 et seq.) and other statutes generally applicable to public agencies. The WCWCD has the limited purposes and powers set forth in Utah law applicable to limited purpose local government entities and has no general police powers or governing authority.

4.2.1 Current Operations and Delivery System

The cities and towns in Washington County have historically developed independent water collection and treatment systems; however, since WCWCD's first project in the mid-1980s, the major municipal water systems have become increasingly integrated. The majority of WCWCD system water is delivered to municipal customers who serve over 85 percent of the population of the county. WCWCD water supply systems include the following major facilities.

Quail Creek Water Treatment Plant. The Quail Creek Water Treatment Plant is an integral component of WCWCD's water system. This 60-million-gallon-per-day (mgd) plant can receive water from three sources: Quail Creek Reservoir, Sand Hollow Reservoir, and the Virgin River. The plant delivers culinary water to Regional Water Supply Agreement municipal customers. Located just below Quail Creek Reservoir, this conventional filtration plant will eventually be expanded to treat 80 mgd.

Quail Creek and Sand Hollow System. Quail Creek and Sand Hollow Reservoirs are a combined system, receiving Virgin River water from the Quail Creek Diversion structure through a pipeline network. Water delivery to these off-stream reservoirs is limited by the capacity and operational requirements of the diversion structure and pipeline system. Quail Creek Reservoir has a capacity of 40,000 acre-feet and supplies raw water to the Quail Creek Water Treatment Plant. Sand Hollow Reservoir has a 50,000-acre-foot capacity with an active pool of about 30,000 acre-feet and a drought pool of 20,000 acre-feet reserved for extreme drought. The drought pool is included in the reliable yield for Sand Hollow Reservoir. In addition, the reservoir serves as a groundwater recharge facility to the Navajo Sandstone Aquifer, which currently stores about 140,000 acre-feet with an estimated future capacity of about 300,000 acre-feet. Water may be delivered from Sand Hollow to Quail Creek Reservoir or directly to the Quail Creek Water Treatment Plant.

Kolob Reservoir. Kolob Reservoir, 5,585 acre-feet, on a tributary of the Virgin River, was built in 1957 and later acquired by the WCWCD. Water from the reservoir is released to the Virgin River for diversion at the Quail Creek diversion structure for storage in Quail Creek and Sand Hollow reservoir.

Crystal Creek Pipeline. Water is diverted from Crystal Creek and conveyed through a 12-mile pipeline to Kolob Reservoir to augment deliveries to Quail Creek and Sand Hollow Reservoirs. The yield for the Crystal Creek Pipeline was assumed to be “new water” that would otherwise not be diverted from the Virgin River, because it utilizes excess capacity in Kolob Reservoir.

Meadow Hollow Reservoir. Meadow Hollow Reservoir, 600 acre-feet, is located on Spring Creek and LaVerkin Creek in Iron County and was built in 1948 for irrigation purposes.

Ash Creek Reservoir. Ash Creek Reservoir is a 3,275-acre-foot reservoir that receives snowmelt and peak flow runoff from the Ash Creek drainage basin. The reservoir seldom fills, does not retain water, and the storage capacity has been restricted significantly because of dam safety concerns by the Utah State Engineer. The Ash Creek Pipeline is currently proposed to convey water from Ash Creek Reservoir to the proposed Toquer Reservoir near Anderson Junction.

Sand Hollow Wells. The Sand Hollow well field includes 18 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 Regional Water Supply Agreement municipal customers and Sky Ranch and Cliff Dwellers retail customers. Currently it is estimated that there are approximately 140,000 acre-feet stored in the aquifer that could be used for this purpose. Most of the recharged water stored in the Navajo Sandstone Aquifer would be reserved for use during dry periods to compensate for any deficit between annual supply and demand.

Cottam Wells System. The Cottam Well System delivers water from two wells via pipeline to Toquerville, LaVerkin, and Hurricane and Virgin and, if needed, to Leeds. This system also supplies water to about 20 customers in WCWCD’s retail system, Casa de Oro, near Leeds.

Kayenta (Ence Wells) Water System. The Kayenta Wells (also known as the Ence Wells) are two wells with a total pumping capacity of 310 gallons per minute located within the incorporated boundary of Ivins. They provide water to the residential community of Kayenta.

Regional Pipeline Transmission System. The Regional Pipeline transmission system (pipeline, 500,000-gallon tank, and two pump stations) conveys water from the Quail Creek Water Treatment Plant and Sand Hollow Wells to St. George, Santa Clara, Washington, and Ivins.

Retail Water Systems. The WCWCD delivers retail water to the residential communities of Sky Ranch and Cliff Dwellers, south of Hurricane, the Casa de Oro subdivision near Leeds and certain areas on Kolob plateau.

St. George Wastewater and Reuse Treatment Plants. Utah water law specifies that original water rights owners retain ownership after the first-use water has been treated for reuse so the St. George Treatment Plant relies upon agreements reached with WCWCD and municipal entities to distribute the reclaimed water. The St. George Wastewater Treatment Plant (WWTP) produces Type II effluent using an extended aeration treatment process that uses physical and biological processes to treat sewage. The current design capacity of the WWTP is about 17 mgd. The wastewater effluent is either treated by the reuse plant or discharged to the Virgin River. St. George completed the reuse plant in 2006 to treat water from the WWTP for reuse as secondary untreated water, in conjunction with the Shivwits Band of Paiute Indians water rights settlement on Santa Clara River water, under

which St. George agreed to deliver 2,000 acre-feet of reuse water annually to the Shivwits Band of Paiute Indians.

4.2.2 Virgin River Daily Simulation Model

The VRDSM is a mean daily simulation model of the Virgin River developed by the UDWR. The model is a FORTRAN-based yield model used to evaluate potential changes in operations on the Virgin River in southwest Utah. The model simulates the river system from the Virgin River at Virgin gage to the Utah-Arizona state line for a 78-year period from 1941 to 2018. The model simulates the Quail Creek project, Sand Hollow Reservoir, pump-back from the Washington Fields diversion to Sand Hollow Reservoir, hydropower plants in operation within the WCWCD and instream flow requirements (UDWR 1998). The model has the capability to simulate additional regulating storage, an expanded secondary system for the St. George area and the import of Lake Powell reservoir water to Sand Hollow Reservoir by the LPP.

Inflow to the model includes streamflow records from the Virgin River at the Virgin gage and the main Virgin River tributary inflow, including Ash Creek/LaVerkin Creek, Quail Creek/Leeds Creek and the Santa Clara River. The U.S. Geological Survey stream gage located on the Virgin River near the town of Virgin (USGS 09406000) provides long-term records for the Virgin River at Virgin (1909 to 1971 and then 1979 to the present). Discontinued streamflow records (1972 to 1978) were estimated using the Virgin River near Hurricane gage, which began in 1967, and equations from the model. Short-term records are available on Ash Creek and LaVerkin Creek. Missing data were estimated with correlations to the Virgin gage. Missing years at the Santa Clara River gage (1941 to 1950 and 1955 to 1983) were filled in from the UDWR monthly model of the Santa Clara River. The monthly flows from the model were divided by the number of days in the month to obtain the daily inflows (UDWR 1998).

Flow is diverted year-round in the Quail Creek pipeline to provide flows to the Hurricane and LaVerkin diversions, Pah Tempe hydropower flows and flow to Quail Creek Reservoir. If the natural flow is less than 86 cubic feet per second at the Washington Fields Diversion, no water is diverted to Quail Creek Reservoir (UDWR 1998).

The VRDSM can be configured to analyze local surface water yields under various conditions or to analyze effects of specific operations on the Virgin River. For the yield analysis in this DEIS, VRDSM simulates the maximum water supply yield in the St. George area with a specified maximum shortage in the worst year (10 percent in the Proposed Project simulations). This simulation produces a 90 percent reliable yield of local surface water supplies for further planning studies.

4.2.3 Current Supply

Washington County water supplies come from a combination of groundwater (springs and wells) and surface water (direct diversions and reservoirs; Table 4.2-1). The Navajo Sandstone Aquifer and shallow alluvial aquifers in the Virgin River Basin provide groundwater resources. Surface water sources consist of the Virgin River and its tributaries. Groundwater supplies developed by public drinking water systems are generally of high quality and can be used directly for culinary uses after disinfection. Surface water supplies are used directly to meet secondary untreated water demands or are treated to meet culinary demands.

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.

4.2.4 Local Planned Projects to Increase Future Water Supply

Because most of the readily available water in the county has been developed and most of the county is closed by the state engineer to the acquisition of new water rights, the municipalities generally rely upon the WCWCD for future water supplies, most of which will need to be provided through large water projects that require a regional funding base (Table 4.2-2).

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.

4.2.5 Projected Water Supply without LPP

The total reliable current and planned water supplies from the local Virgin River basin equals 98,727 acre-feet per year, which is the summed total of the current reliable water supply (67,677 acre-feet) and the estimated reliable water supply from future non-LPP projects (31,050 acre-feet).

5 Water Conservation

5.1 Participant Water Conservation Practices

5.1.1 Kane County Water Conservancy District

The Districts have pursued conservation objectives for many years. The KCWCD and the City of Kanab have developed conservation plans for the Johnson Creek and Kanab Creek areas. The City of Kanab adopted a water conservation plan in 1999 and revised it in 2009. The water conservation plan addresses past water conservation measures, opportunities to develop and implement management conservation measures, and short- and long-term goals for efficient water use. The primary conservation measures of the City of Kanab focus on system efficiency upgrades, education, well management, and residential water device and landscaping requirement. Conservation efforts for the KCWCD focus on management of household usage and outside usage via education and rate structuring, facilitation of water rights transfers and acquisition of new water rights, and maintenance and system upgrades.

5.1.2 Washington County Water Conservancy District

The WCWCD and its municipal partners have invested over \$60 million in recent conservation efforts. Washington County was the first Utah county to meet the statewide water conservation goal of reducing per capita water use 25 percent by 2025. In August of 1993, facing rapid population growth and a limited water supply, WCWCD approved a Water Resource Management, Development, and Protection Plan, which states, “The District shall develop a water conservation plan which promotes public education and information dissemination concerning water conservation; and promotes the adoption of technologies, practices, and devices which will yield improvements in the efficiency and management of water use.” That same month, the WCWCD board called on community citizens to form a Water Conservation and Drought Management Committee. Their efforts resulted in the 1996 Water Conservation Plan, the first of its kind in Utah, followed by updates in 2005, 2010, and 2015.

WCWCD’s 2015 Water Conservation Plan (WCWCD 2015) includes the following measures:

- Promotion of universal metering;
- Secondary water metering;
- Smart controller irrigation technology;
- Time of day watering ordinances;
- Requirement of a water conservation plan for municipal customers;
- Water efficient landscape workshops;
- Public information programs/school education;
- Residential and commercial system water audits, leak detection, and repair;
- Free outdoor irrigation efficiency audits for residences and businesses;
- Incentive water conservation pricing;
- Landscape ordinance requirements;
- Incentives to reduce irrigated landscape area in new development (water conservation easements);

- Full-time water conservation manager;
- Water conservation demonstration gardens with two full-time horticultural educators;
- Water Smart irrigation rebate program;
- Water Smart commercial upgrades equipment rebate;
- Training and certification of landscape training professionals;
- Financial incentives for irrigation upgrades;
- Large landscape conservation programs and incentives;
- U.S. Environmental Protection Agency WaterSense appliance rebates;
- Statewide water-wise plant list and tagging program;
- Public athletic fields conversion to artificial turf grant program;
- WaterSense toilet/urinal rebates;
- Multi-family high-efficiency washer rebate program;
- Funding for local and statewide media campaigns;
- Horticultural classes, training, and awards;
- Maximize use of secondary water systems including using wastewater reuse; and
- Studying and establishing industry standards or practice for use of high salinity water for landscape.

The WCWCD periodically monitors the impact of its programs and considers new measures in response to community changes and technological advancements. The WCWCD’s current conservation goal is to reduce the 2015 gpcd water use in its service area by 20 percent by 2060.

5.2 Evaluation of Water Use Rates

UDWRe reports M&I water usage rates from around Utah in its yearly M&I Reports (UDWRe 2020c). Total system water use rates in 2015 to 2018 ranged between 301 gpcd and 313 gpcd for Washington County and 264 gpcd and 473 gpcd for the Kanab/Johnson Creeks sub-basin in Kane County (UDWRe 2015, 2016, 2017, 2018; see Table 5.2-1 and Table 5.2-2). Water use in an individual year is dependent on that year’s climate and economic activity, among other factors.

Table 5.2-1 Water Usage Rates (gallons per capita per day) for Kane County, Utah

Year	Residential Potable	Total Potable	Total Secondary	Overall Total
2015	142	239	65	304
2016	172	317	156	473
2017	147	210	68	279
2018	125	190	74	264
Average	146.5	239	90.75	330
2065 water usage rate goal from 2019 Regional Conservation Plan (UDWRe 2019b)				282
2060 water usage rate goal used in this report				283

In 2019, UDWRe published the Regional Conservation Plan in 2019 that provided conservation goals for each region in Utah (UDWRe 2019b). In that plan, the 2015 baseline water use rate for Washington County was approximately 302 gallons gpcd and approximately 358 gpcd for Kane County. The 2065 conservation goal for Washington County was 236 gpcd. WCWCD’s

conservation goal of 20 percent by 2060, or 240 gpcd, is in line with the regional goal and is used in this purpose and need report. The 2065 conservation goal for Kane County was 282 gpcd. A Kane County goal of 283 gpcd by 2060 is used in this report.

Table 5.2-2 Water Usage Rates (gallons per capita per day) for Washington County, Utah

Year	Residential Potable	Total Potable	Total Secondary	Overall Total
2015	179	231	72	303
2016	177	222	91	313
2017	177	226	81	307
2018	168	218	83	301
Average	175.25	224.25	81.75	306
2065 water usage rate goal from 2019 Regional Conservation Plan (UDWRe 2019b)				236
2060 water usage rate goal used in this report				240

6 Water Demand

Water demand is based on different circumstances for the respective Project Participants’ service areas.

6.1 Kane County Water Conservancy District

6.1.1 Demographic Projections

The University of Utah Kem C. Gardner Policy Institute provided population projections in 2017 for Kane County through 2060. Baseline projections for Kane County during that time period are provided in Table 6.1-1.

6.1.2 Future Water Requirements

Estimation of total annual water demand in 2060 for Kane County was based on the following generalized equation:

$$total\ annual\ demand = \frac{population * population\ coefficient * gpcd}{gpcd\ to\ annual\ demand\ conversion\ coefficient}$$

The KCWCD does not include a reserve buffer in their water planning.

Table 6.1-1 Future Water Requirements for Kane County Water Conservancy District

Year	Kane County Population ([Gardner Institute 2017] estimate and projection)	Percent of Kane County residents in Kanab/Johnson Canyon areas (% population) taken from 2016 LPP Water Needs Assessment ^(a)	Kanab/Johnson Creeks Sub-basin Population	County-wide GPCD per State's Regional Goals (2019 Regional Conservation Plan)	Kanab/Johnson Creek Sub-basin Demand (acre-feet)
2015	7,272	0.73	5,309	358	2,129
2020	8,165	0.73	5,961	340	2,270
2025	8,684	0.73	6,340	322	2,287
2030	9,152	0.73	6,681	304	2,275
2035	9,611	0.73	7,016	297	2,330
2040	9,910	0.73	7,234	289	2,342
2045	10,179	0.73	7,430	288	2,394
2050	10,437	0.73	7,619	286	2,442
2055	10,736	0.73	7,838	285	2,500
2060	11,093	0.73	8,098	283	2,571

Note:

(a) UBWR 2016

Key:

GPCD = gallons per capita per day

LPP = Lake Powell Pipeline

6.2 Washington County Water Conservancy District

6.2.1 Demographic Projections

The University of Utah Kem C. Gardner Policy Institute provided population projections in 2017 for Washington County that show dramatic increases (almost threefold) in the population through 2065. Baseline projections for that time period are provided in Table 6.2-1.

6.2.2 Future Water Requirements

Estimating total annual water demand in 2060 for Washington County was based on the following generalized equation:

$$total\ annual\ demand = \frac{population * gpcd * system\ loss\ coefficient}{gpcd\ to\ annual\ demand\ conversion\ coefficient}$$

Water demand in 2060 must include population projections out to 2075 because the WCWCD incorporates a 15-year reserve buffer. To estimate the population from 2061 to 2075, a constant rate of increase of approximately 1.0174 was applied to the previous year's population projection. This value was used because it was the rate of increase between 2059 and 2060 (the last year before the planning period ends) and because it was the lowest rate of population increase from 2020 to 2060, therefore, representing a conservative estimate.

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

7 Participant Water Needs

Participant water needs were determined by subtracting the estimated water supply in 2060 from the estimated water demand in 2060.

7.1 Kane County Water Conservancy District

Estimated future reliable water supply without the LPP surpasses the estimated future demand in 2060, resulting in an estimated surplus of 1,553 acre-feet in 2060 (see Table 7.1-1). This demonstrates that there is no need for LPP water for KCWCD at this time. Therefore, the Kane County System portion of the Proposed Project was removed. The 4,000 acre-feet of water that would have been delivered to the KCWCD service area is now proposed to be sent to Sand Hollow Reservoir, if needed at full demand. Reclamation has concluded, utilizing the professional expertise and judgement of the agency’s study team, that the results derived from this report for KCWCD are reasonable and accurate, given the information, data, and methods available at this time.

Table 7.1-1 Projected Supply Surplus in 2060 for Kane County Water Conservancy District

KCWCD Reliable Annual Water Supply (acre-feet) ^(a)	KCWCD Demand and Reserve (acre-feet)	KCWCD Supply Surplus without LPP (acre-feet)	KCWCD Supply Surplus with LPP (acre-feet)
4,123	2,571	1,553	5,553

Note:

(a) Average yield with up to 10% shortage represents reliable yield for KCWCD projects.

Key:

KCWCD = Kane County Water Conservancy District

LPP =Lake Powell Pipeline

7.2 Washington County Water Conservancy District

7.2.1 Projected Shortages in Reliable Yield

The projected shortage, or deficit, in reliable yield for the WCWCD was determined by subtracting the 2060 reliable annual water supply from the 2060 demand. Depending on the climate change scenario, the total annual deficit ranged from 112,997 acre-feet to 53,625 acre-feet (see Table 7.2-1).

7.2.2 Lake Powell Pipeline Project Contribution to Reliable Yield

The Proposed Project would directly contribute up to 86,249 acre-feet of water to the WCWCD service area, with 73,000 acre-feet delivered to Sand Hollow Reservoir and 13,249 acre-feet to Apple Valley. With potential reuse of LPP water, WCWCD estimates up to approximately 28,830 acre-feet would be available to meet secondary demands. This reuse supply would not be available without the Proposed Project. Assuming reuse of all 28,830 acre-feet of LPP water, the LPP would increase the reliable water supply of WCWCD by 115,079 acre-feet.

Table 7.2-1 Projected Water Supply Deficit in 2060 for Washington County Water Conservancy District

WCWCD 2060 Reliable Annual Water Supply (acre-feet) ^(a)	Climate Change Scenario ^(b)	Climate Change Type	WCWCD 2060 Demand and Reserve (acre-feet)	WCWCD 2060 Supply Deficit (acre-feet)
71,516	10th	Hotter, Drier	184,513	112,997
88,022	30th			96,492
98,727	50th	Median		85,786
112,196	70th	Warmer, Wetter		72,318
130,888	90th			53,625

Notes:

(a) Average yield with up to 10 percent shortage represents reliable yield for WCWCD projects.

(b) Virgin River natural streamflow scenarios provided by Reclamation (2014).

Key:

WCWCD = Washington County Water Conservancy District

Table 7.2-2 Lake Powell Pipeline Contribution to Washington County Water Conservancy District’s Reliable Water Supply in 2060

Climate Change Scenario ^(a)	Climate Change Type	WCWCD 2060 Supply Deficit (acre-feet)	LPP Supply Contribution without Reuse of LPP Water (acre-feet)	Deficit (-) or Surplus (+) with LPP Supply but no Reuse of LPP Water (acre-feet)	LPP Supply Contribution with full Reuse of LPP Water (acre-feet)	Deficit (-) or Surplus (+) with LPP Supply with full Reuse of LPP Water (acre-feet)
10th	Hotter, Drier	112,997	86,249	-26,748	115,079	2,082
30th		96,492		-10,243		18,587
50th	Median	85,786		463		29,293
70th	Warmer, Wetter	72,318		13,931		42,761
90th		53,625		32,624		61,454

Note:

(a) Virgin River natural streamflow scenarios provided by Reclamation (2014).

Key:

LPP = Lake Powell Pipeline

WCWCD = Washington County Water Conservancy District

7.2.3 Conclusion

Under warmer, wetter climate change scenarios, the LPP would deliver a surplus of water to the WCWCD’s service area. However, these scenarios are unlikely according to recent scientific literature regarding climate change in the Colorado River basin (Udall and Overpeck 2017; Milly and Dunne 2020). Under the median or hotter, drier climate scenarios and without LPP reuse, the WCWCD service area would experience a surplus of 463 acre-feet or a deficit ranging from 10,243 acre-feet to 26,748 acre-feet. This should not be interpreted to mean that shortages to residents would be guaranteed, but rather that the 15-year reserve buffer would not be available in the majority of years (50th percentile and hotter, drier years). With reuse of all 28,830 acre-feet of LPP water, the WCWCD service area would experience a small deficit (2,082 acre-feet) or a large surplus (61,454 acre-feet) depending on the climate change scenario. However, without the Proposed Project, there would not be an opportunity for reuse of LPP water, therefore, the potential for a surplus is dependent on the Proposed Project being built.

In sum, the LPP would supply water to the WCWCD service area that would reduce the water deficits in some scenarios (hotter, drier climate scenarios) and could provide a surplus of water in other scenarios. Reclamation has concluded, utilizing the professional expertise and judgement of the agency’s study team, that the results derived from this report for WCWCD are reasonable and accurate, given the information, data, and methods available at this time.

8 Purpose and Need Statement

Under median climate change scenarios, approximately 86,000 acre-feet of water will be needed annually by 2060 to satisfy increased water needs of a growing population in Washington County, Utah. A more diverse and secure water supply is needed to mitigate vulnerabilities to unexpected demand and supply scenarios and ensure reliable water deliveries into the future.

9 References

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10 Acronyms

DEIS	Draft Environmental Impact Statement
gpcd	gallons per capita per day
KCWCD	Kane County Water Conservancy District
LPP	Lake Powell Pipeline
M&I	municipal and industrial
mgd	million gallons per day
Project Participants	Kane and Washington County Water Conservancy Districts
Reclamation	Bureau of Reclamation
UCA	Utah Code Annotated
UDWRe	Utah Division of Water Resources
VRDSM	Virgin River Daily Simulation Model
WCWCD	Washington County Water Conservancy District
WWTP	Wastewater Treatment Plant