Lake Powell Pipeline

Draft Study Report 22
Alternatives Development

March 2011

Alternatives Development Study Report
Table of Contents

Tables

Figures

Chapter 1
Introduction

1.1 Introduction

This report documents the development of a reasonable range of alternatives to the proposed Lake Powell Pipeline (LPP) (the Proposed Action). The Proposed Action and these alternatives will be analyzed in an environmental impact statement (EIS) to be prepared by the Federal Energy Regulatory Commission (Commission) in compliance with the National Environmental Policy Act (NEPA). The requirements for this study report are described in Study Plan 22, Alternatives Development, approved by the Commission's January 21, 2009, Study Plan Determination.

The implementing regulations for NEPA (40 CFR 1500 through 1508) require federal agencies to consider alternatives to the Proposed Action (U.S. GPO, 2005). The alternatives must meet water needs for the same projected population as the Proposed Action. The Proposed Action would deliver 86,249 acre-feet per year to three participating water conservancy districts, the Washington County Water Conservancy District (WCWCD), Kane County Water Conservancy District (KCWCD) and Central Iron County Water Conservancy District (CICWCD). The project would use a portion of the State of Utah's unallocated Colorado River water rights to deliver water to Washington County from Lake Powell and also includes the Kane County Pipeline (KCP) and Cedar Valley Pipeline (CVP). Figure 1-1 shows each district's service area. The LPP project water would meet the needs of growing populations in communities served by WCWCD through 2037, and in KCWCD and CICWCD through 2060. The No Action alternative would not meet the water needs of the projected future population.

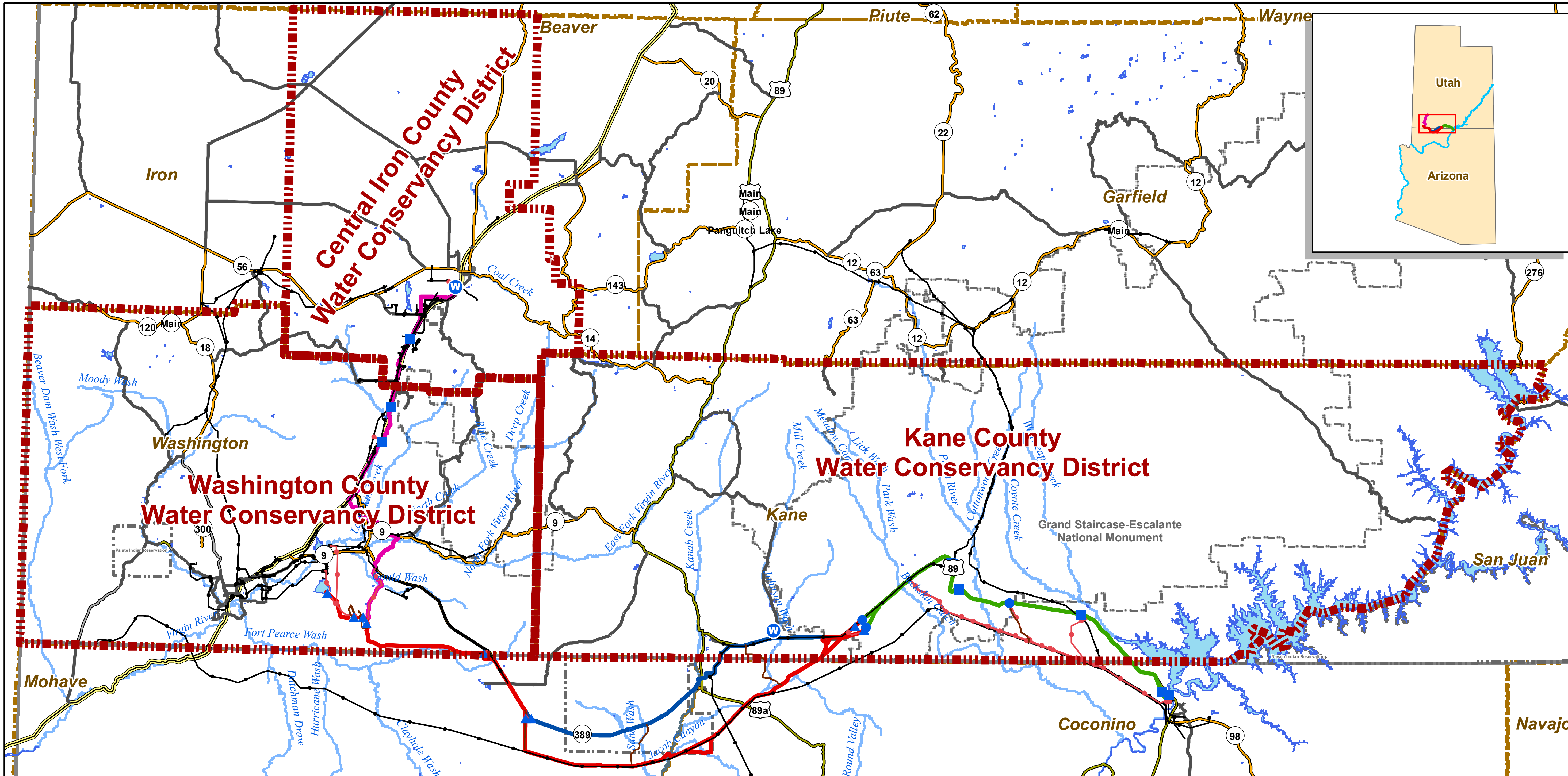
1.2 Summary of Projected Population and Water Use

This analysis must develop alternatives that will meet water demands for the LPP participants. Table 1-1 provides the projected population levels and the projected water demand, with and without conservation, for WCWCD, CICWCD and KCWCD from 2010 to 2060. The population projections, developed by the Utah Governor's Office of Planning and Budget (GOPB), are based on 2008 population estimates.

1.2.1 WCWCD

WCWCD's service area includes all of Washington County, with a population that is projected to grow at an annual rate of 3.4 percent, while the state's population is expected to grow at an annual rate of 1.7 percent during the next 50 years. The Washington County population, estimated at 150,079 in 2008, is projected to reach 860,378 in 2060 (an increase of 473 percent) (GOPB 2008). Washington County's population grew approximately 560 percent between 1970 and 2000 based on U.S. Census Bureau data. Approximately 57 percent of the projected population increase between 2008 and 2060 would result from an increase in projected net in-migration (about 404,806 persons). Washington County is projected to have the third largest population increase among 29 counties in the state throughout the LPP planning horizon. Therefore, WCWCD is expected to increase its service area population accordingly.

Based on GOPB population projections, the WCWCD service area will increase its share of the state's total population from 5.7 percent in 2008, to 10 percent by 2060, again demonstrating that the county is projected to grow significantly faster than the state average. The city of St. George, the largest city in the county, is projected to experience a population increase from 72,711 in 2008 to 431,239 by 2060.



Water Treatment Facility
Project Pump Station
Project Regulating Tank
Project Hydro Station
Project Transmission Line
Existing Transmission Line

Water Conservancy Districts
Water Conveyance
Hydro System - South Alignment Alternative
Hydro System - Highway Alignment Alternative
KCWCD Pipeline System
Cedar Valley Pipeline

Interstate
US Highway
ST Highway
Hwy
Major Road
Access Roads

Hurricane Cliffs Forebay/Afterbay
Lakes & Reservoirs
Major Rivers & Streams

National Park/Monument
GSENM-Boundary
Tribal Lands
State Boundaries
County Boundaries

FERC Project Number:
12966-001
BLM Serial Numbers:
AZA-34941
UTU-85472

0 3.75 7.5 15 22.5 30 Miles

N

Lake Powell Pipeline Project

Spatial Reference: UTM Zone 12N, NAD-83

UDWR **Figure 1-1** MWH

Lake Powell Pipeline Participating Water Conservancy Districts Service Areas

The State of Utah has initiated a state-wide water conservation program with the goal of a 25 percent reduction in per capita consumption by 2050. WCWCD instituted a water conservation program in 1995 consisting of appliance replacement, restaurant washing device replacement, smart landscape watering techniques, pricing strategies, and other programs. The baseline per capita use leading to the conservation achievements was 302.3 gallons per day for 2005. WCWCD estimates it has achieved approximately 13 percent reduction in per capita consumption to date resulting from its water conservation program.

1.2.2 CICWCD

CICWCD's population is projected to increase at an annual rate of 2.77 percent during the next 50 years. The District's population, which was estimated at 40,358 in 2008, is projected to reach 150,936 by 2060 (an increase of 274 percent) (GOPB 2008). About 56 percent of the projected population increase between 2008 and 2060 is attributed to an increase in projected net in-migration (about 61,518 persons).

Based on GOPB population projections, the District will increase its share of the State's total population from 1.7 percent in 2008 to 4.4 percent by 2060, which demonstrates that the District's population is projected to grow significantly faster than the state average.

CICWCD recently initiated a water conservation program in 2005 to accomplish the state's water conservation goals. It has started using pricing strategies to encourage conservation. CICWCD's 2008 per capita base line use was 243.5 gallons per day.

1.2.3 KCWCD

It is projected that KCWCD's population will grow at an annual rate of 1.9 percent over the next 50 years. The District's population, which is estimated at 6,582 in 2008, is projected to reach 17,276 by 2060 (an increase of 162 percent) (GOPB 2008). About 26 percent of the population increase between 2008 and 2060 is attributed to an increase in projected net in-migration (about 2,817 persons).

Based on GOPB population projections, the District's share of the state's total population will decline from 0.24 percent in 2008 to 0.16 percent by 2060, which demonstrates that the District is projected to grow at a slower rate than the state average.

KCWCD's 2008 per capita baseline use was the highest of the three districts at 430.3 gallons per day.

Table 1-1
Projected Population and Water Demands

2008 Population Projections				WCWCD		CICWCD		KCWCD	
Year	WCWCD	CICWCD	KCWCD	Demand (ac-ft/yr)	Demand w/ Cons. (ac-ft/yr)	Demand (ac-ft/yr)	Demand w/ Cons. (ac-ft/yr)	Demand (ac-ft/yr)	Demand w/ Cons. (ac-ft/yr)
2010	168,078	45,358	6,893	61,810	60,911	12,874	12,694	3,573	3,480
2011	179,257	46,946	7,078	65,920	64,770	13,307	13,084	3,662	3,548
2012	190,435	48,534	7,264	70,031	68,605	13,740	13,471	3,751	3,615
2013	201,614	50,122	7,449	74,142	72,417	14,174	13,855	3,841	3,681
2014	212,792	51,709	7,634	78,253	76,204	14,607	14,237	3,930	3,746
2015	223,971	53,297	7,820	82,364	79,968	17,040	16,617	4,019	3,810

Table 1-1
Projected Population and Water Demands

2008 Population Projections				WCWCD		CICWCD		KCWCD	
Year	WCWCD	CICWCD	KCWCD	Demand (ac-ft/yr)	Demand w/ Cons. (ac-ft/yr)	Demand (ac-ft/yr)	Demand w/ Cons. (ac-ft/yr)	Demand (ac-ft/yr)	Demand w/ Cons. (ac-ft/yr)
2016	235,150	54,885	8,005	86,475	83,708	17,473	16,994	4,108	3,873
2017	246,328	56,473	8,190	90,586	87,423	17,906	17,368	4,198	3,935
2018	257,507	58,061	8,375	94,696	91,115	18,339	17,740	4,287	3,996
2019	268,685	59,649	8,561	98,807	94,783	18,773	18,110	4,376	4,056
2020	279,864	61,236	8,746	102,918	98,427	20,206	19,477	4,466	4,115
2021	293,429	62,969	8,911	107,906	102,884	20,679	19,879	4,545	4,163
2022	306,993	64,702	9,076	112,895	107,312	21,151	20,278	4,625	4,212
2023	320,558	66,434	9,240	117,883	111,710	21,624	20,675	4,704	4,259
2024	334,122	68,167	9,405	122,871	116,080	22,097	21,069	4,784	4,305
2025	347,687	69,900	9,570	127,860	120,420	23,069	21,960	4,863	4,351
2026	361,252	71,632	9,735	132,848	124,732	23,542	22,348	4,942	4,395
2027	374,816	73,365	9,900	137,836	129,015	24,015	22,734	5,022	4,439
2028	388,381	75,097	10,064	142,824	133,268	24,487	23,116	5,101	4,481
2029	401,945	76,830	10,229	147,813	137,493	24,960	23,497	5,181	4,523
2030	415,510	78,563	10,394	152,801	141,688	26,433	24,874	5,260	4,564
2031	429,926	80,590	10,558	158,102	146,144	26,986	25,323	5,339	4,604
2032	444,342	82,617	10,722	163,404	150,569	27,539	25,768	5,418	4,643
2033	458,758	84,644	10,886	168,705	154,963	28,092	26,211	5,497	4,681
2034	473,174	86,671	11,050	174,007	159,327	28,645	26,650	5,576	4,718
2035	487,590	88,698	11,214	179,308	163,659	29,698	27,586	5,655	4,755
2036	502,006	90,725	11,378	184,609	167,961	30,250	28,018	5,734	4,790
2037	516,422	92,752	11,542	189,911	172,232	30,803	28,448	5,814	4,825
2038	530,838	94,779	11,706	195,212	176,472	31,356	28,874	5,893	4,858
2039	545,254	96,806	11,870	200,514	180,681	31,909	29,297	5,972	4,891
2040	559,670	98,833	12,034	205,815	184,859	33,462	30,717	6,051	4,923
2041	574,670	101,251	12,257	211,331	189,199	34,122	31,229	6,158	4,977
2042	589,671	103,670	12,481	216,848	193,507	34,782	31,738	6,266	5,030
2043	604,671	106,089	12,704	222,364	197,782	35,442	32,243	6,374	5,081
2044	619,672	108,507	12,927	227,880	202,026	36,102	32,743	6,481	5,131
2045	634,672	110,926	13,151	233,396	206,238	37,262	33,740	6,589	5,180
2046	649,672	113,345	13,374	238,913	210,417	37,922	34,233	6,696	5,228
2047	664,673	115,764	13,597	244,429	214,564	38,581	34,723	6,804	5,275
2048	679,673	118,182	13,820	249,945	218,679	39,241	35,208	6,912	5,321
2049	694,674	120,601	14,044	255,462	222,763	39,901	35,690	7,019	5,365

Table 1-1
Projected Population and Water Demands

2008 Population Projections				WCWCD		CICWCD		KCWCD	
Year	WCWCD	CICWCD	KCWCD	Demand (ac-ft/yr)	Demand w/ Cons. (ac-ft/yr)	Demand (ac-ft/yr)	Demand w/ Cons. (ac-ft/yr)	Demand (ac-ft/yr)	Demand w/ Cons. (ac-ft/yr)
2050	709,674	123,020	14,267	260,978	226,814	40,561	36,167	7,127	5,408
2051	724,744	125,811	14,568	266,520	230,855	41,322	36,729	7,272	5,478
2052	739,815	128,603	14,869	272,062	234,864	42,084	37,287	7,417	5,546
2053	754,885	131,395	15,170	277,604	238,840	42,846	37,840	7,562	5,613
2054	769,956	134,186	15,471	283,146	242,785	43,607	38,389	7,707	5,678
2055	785,026	136,978	15,772	288,688	246,697	44,369	38,933	7,852	5,741
2056	800,096	139,770	16,072	294,230	250,577	45,130	39,473	7,997	5,803
2057	815,167	142,561	16,373	299,772	254,425	45,892	40,009	8,142	5,863
2058	830,237	145,353	16,674	305,314	258,240	46,654	40,540	8,287	5,921
2059	845,308	148,144	16,975	310,856	262,024	47,415	41,066	8,432	5,978
2060	860,378	150,936	17,276	316,398	265,775	48,177	41,588	8,577	6,033

Note:
ac-ft/yr = acre-feet per year

Chapter 2
Planned and Potential Future Water Supply Projects

2.1 Introduction

Each of the three participating water conservancy districts has existing plans for water supply projects to be executed in the short term and has identified future water supply and development projects within the LPP planning horizon (MWH 2008). These projects are described in the following sections.

2.1.1 WCWCD

WCWCD's project planning within the planning horizon is designed to maximize locally available water supply. Two major construction projects are planned. The Ash Creek Project will consist of constructing a pipeline system to replace open ditches on Leap Creek, South Ash Creek and Wet Sandy Creek, and to bring water from the existing Ash Creek Reservoir to a new 3,000 acre-foot storage reservoir to be constructed near Anderson Junction. At full development, the project is expected to supply 5,000 acre-feet per year of secondary water to the WCWCD service area. The 5,000 acre-feet per year of culinary quality spring water previously used to meet these secondary water demands will then be available to meet culinary demands. The Warner Valley Project will consist of constructing a 45,000 acre-foot storage reservoir near the Washington Fields Diversion that will store water rights of the WCWCD, the St. George and Washington Canal Company, reuse water and Santa Clara Project Water that exceeds existing storage demands. WCWCD has available water rights to divert up to 40,000 acre-feet of low quality water annually from the Virgin River at the Washington Fields Diversion. This project will provide for more efficient storage, management, blending and conservation of these water resources.

WCWCD has recently constructed a diversion and a 12-mile pipeline to capture water from Crystal Creek for conveyance to Kolob Reservoir. The use of storage space in Kolob Reservoir will allow for maximum yield and better management of water releases. The yield of the diversion is estimated to be 2,000 to 3,000 acre-feet per year of new water and will be used to meet culinary demands.

Maximization of existing wastewater reuse capacity would potentially satisfy up to 1,700 acre-feet of additional secondary water use demand within the WCWCD service area based on full utilization of the St. George Wastewater Treatment Plant up to 10 million gallons per day (mgd). Full utilization of water from this project would require installing a separate network of reclaimed water distribution pipelines and pump stations to serve customers from the main reclaimed water trunk line in St. George. Wastewater reuse would make additional culinary supply available by offsetting secondary demand currently being met with culinary water. The 2060 potential wastewater reuse quantity is projected to be 54,500 acre-feet per year, assuming there is sufficient capacity to store and provide for beneficial use all of the available return flows. The Warner Valley Reservoir would provide a substantial portion of the storage capacity (approximately 45,000 acre-feet).

Agricultural conversions would augment future water supply for WCWCD. Supplies from agricultural conversions could be made available through urban development over existing agricultural lands. An additional 12,400 acre-feet per year is projected to be available from converting agricultural lands to municipal development by 2037.

The planned expansion of the Sand Hollow Well Field through the use of existing and new wells will bring the project yield up to the maximum allowable yield of 8,000 acre-feet per year. This water has

already been accounted for in existing water supply totals and therefore is not considered to provide additional water supply to WCWCD.

2.1.2 CICWCD

Some entities within the CICWCD service area have not fully developed their appropriated Cedar Valley aquifer groundwater rights. Water rights totaling 40,000 acre-feet have been appropriated while the assumed sustainable yield of the aquifer is estimated at 37,600 acre-feet per year. The reliable potable supply due to infrastructure limitations of the aquifer is 34,000 acre-feet. The Utah State Engineer may implement a groundwater management program that manages the basin in accordance with the assumed sustainable yield and reliable potable supply, resulting in curtailment of junior groundwater rights until the total withdrawals are equal to the sustainable yield. Assuming this occurs, the total undeveloped yield from existing appropriated groundwater rights would be approximately 3,600 acre-feet per year. It is assumed that existing wells would be reconfigured and new wells would be added to fully develop these existing water rights.

Future M&I development replacing existing agricultural land could provide approximately 14,000 acre-feet of water per year by 2060. Included in this amount is approximately 600 acre-feet per year that Enoch City acquired in 2008. Agricultural land northwest of Cedar City appears to have the highest likelihood of converting to M&I purposes because of its proximity to the City and location within the planned annexation boundaries of the City. The timing of the agricultural conversions is unknown and will be dictated by future economic conditions and land values, although implementation and enforcement of a groundwater management plan by the Utah State Engineer as described above could prioritize the replacement of any M&I water rights that are curtailed.

Purchasing irrigated land to acquire existing appropriated groundwater rights ("buy and dry") could provide an additional 7,000 acre-feet per year by 2060, including 295 acre-feet per year purchased by Enoch City in 2008. This alternative is considered a last resort because of a CICWCD policy reflecting the strong commitment to agriculture in the Cedar Valley. Implementation and enforcement of a groundwater management plan by the Utah State Engineer could create enough economic pressure to change the District's policy. Except for the 295 acre-feet per year acquired by Enoch City, this option was not considered to be a planned future water supply project for purposes of this analysis.

Wastewater reuse is not an existing source of supply for CICWCD. The Cedar City regional wastewater treatment plant located approximately 10 miles north of Cedar City currently provides secondary treatment of wastewater and the treated effluent is land applied on crops and natural vegetation close to the wastewater treatment plant. The non-consumptive portion of the effluent land application is a source of Cedar Valley groundwater recharge, and therefore, would not be available for reuse. The maximum future potential of wastewater reuse is approximately 2,500 acre-feet per year based on the consumptive portion of future wastewater effluent and future secondary demands. This would require expansion of the existing Cedar City regional wastewater treatment plant and expansion of the existing secondary water distribution system. CICWCD is not currently proposing wastewater reuse as a future water supply, and consequently, this option was not considered to be a planned future water supply project for purposes of this analysis.

CICWCD has filed for additional water rights in the Pine, Hamlin and Wah-Wah Valleys west and northwest of Cedar City, also known as the West Basin groundwater rights. The CICWCD has filed for water rights totaling 27,000 acre-feet per year; however, the Utah Division of Water Rights has received numerous protests on these filings and adverse comments during public hearings, and the future development of these water rights by CICWCD is highly uncertain. It is assumed that significant conveyance infrastructure would be required to deliver this supply to CICWCD. This option was not

considered to be a planned future water supply project for purposes of this analysis because of the significant uncertainty of these water right acquisitions.

2.1.3 KCWCD

KCWCD intends to fully develop existing, adjudicated groundwater rights within its four subbasins: East Fork Virgin River, Kanab Creek, Johnson Canyon and Wahweap Creek basins. The total sustainable groundwater yield of the four subbasins is approximately 49,000 acre-feet per year. Of this amount, approximately 8,100 acre-feet per year are currently unused and are available for future development.

KCWCD is currently constructing the 4,000 acre-foot capacity Jackson Flat Reservoir south of Kanab. The reservoir would store and supply secondary and agricultural irrigation water to commercial/industrial/institutional (CII) users that are currently served by well water. The reservoir would store approximately 7,500 acre-feet per year of surface water diversions that have typically been used by the Kanab Irrigation Company to maximize the efficiency of those diversions. The reservoir construction has been delayed as mitigation measures are implemented for archaeological resources discovered during project excavation activities.

In addition to developing new groundwater supplies, existing agricultural water supplies could be converted to M&I use, either through growth over currently irrigated lands or through “buy and dry” programs. It is estimated that approximately 2,710 acre-feet per year is available for conversion to M&I uses from existing irrigated agricultural land, based on the amount of agricultural land in general proximity to urban areas.

Chapter 3
Conceptual Project Alternatives

3.1 Introduction

The conceptual project alternatives for the three water conservancy districts are comprised of variations of the No Lake Powell Water Alternative, which entails a combination of actions to increase culinary supply, reduce culinary usage, increase secondary usage and undertake wastewater reclamation/reuse programs. The conceptual alternatives are evaluated to determine their ability to meet the equivalent population water needs of the districts under the LPP Proposed Action.

3.1.1 Equivalent Population Water Needs

The equivalent population of each district is the population level at which no additional water supplies are available to meet water needs. This assumes all conservation goals have been met, all water rights have been fully developed, planned agricultural water conversions have been fully completed, pending storage projects have been fully developed, identified wastewater reclamation/reuse opportunities have been fully exploited, and finally, all secondary conversions have been made.

3.1.1.1 WCWCD Equivalent Population Water Needs

The equivalent population of WCWCD if the LPP is not constructed (i.e., no LPP equivalent population) is 279,864. It is estimated that this population would occur in 2020 and corresponds to a combined culinary and secondary water demand of 98,427 acre-feet per year. If the LPP is constructed, the WCWCD equivalent population is 516,422, and is estimated to occur in 2037. This corresponds to a culinary and secondary water demand of 172,232 acre-feet per year.

3.1.1.2 CICWCD Equivalent Population Water Needs

The CICWCD equivalent population if the LPP is not constructed is 66,434. It is estimated that this population would occur in 2023 and corresponds to a culinary and secondary water demand of 20,675 acre-feet per year. If the LPP is constructed, the CICWCD equivalent population is 150,936, estimated to occur in 2060. This corresponds to a culinary and secondary demand of 41,588 acre-feet per year.

3.1.1.3 KCWCD Equivalent Population Water Needs

The KCWCD equivalent population if the LPP is not constructed is greater than 17,276. It is estimated that this population would occur beyond 2060 with a corresponding culinary and secondary water demand of greater than 6,033 acre-feet per year. If the LPP is constructed, the KCWCD equivalent population is also greater than 17,276, estimated to occur beyond 2060.

3.2 Baseline Projects

3.2.1 WCWCD Baseline Projects

The conceptual project alternatives for WCWCD include the following projects identified in Section 2.1.1: completing the Ash Creek Project, completing the Warner Valley Reservoir Project, maximizing

wastewater reuse, groundwater well field completion, and agricultural conversions from municipal development replacing agricultural land uses (MWH, 2008). Current and planned water conservation activities and programs are assumed to continue. These form a "baseline" group of projects, activities and programs that would occur whether or not the No Lake Powell Water Alternative is pursued. It should be noted that these baseline projects, activities and programs are the same assumed to occur under the LPP Proposed Action.

Table 3-1 shows the existing water supplies for WCWCD, along with the water supplies made available from the development of the baseline projects. Equivalent population water needs are also shown with and without the construction of the LPP. The WCWCD conceptual No Lake Powell Water Alternatives are evaluated on their ability to meet these water demand targets.

Table 3-1
WCWCD Water Need Summary

WCWCD	Existing Supply ac-ft/yr	Ash Creek Pipeline ac-ft/yr	Waste-water Reuse Expansion to Existing 10 mgd Capacity ac-ft/yr	Agricultural Conversion ac-ft/yr	Additional Wastewater Reuse Expansion beyond Existing Capacity - Existing Supplies ac-ft/yr	Future Supply ac-ft/yr	Equivalent Population Water Need ac-ft/yr	Shortage ac-ft/yr
2020	75,992	3,830	7,300	2,170	0	89,290	86,340[a]	0
2037	75,992	3,830	7,300	5,530	30	92,680	148,380[b]	55,700
2060	75,992	3,830	7,300	10,080	7,230	104,430	232,830	128,400

Notes:
[a]Without construction and operation of the LPP
[b]With the construction and operation of the LPP
ac-ft/yr = acre-feet per year

Figure 3-1 shows the water supply and demand for WCWCD from 2005 through the year 2060 without water from Lake Powell. The figure illustrates the need for additional water sources beginning in the year 2020 if the Lake Powell Pipeline is not constructed.

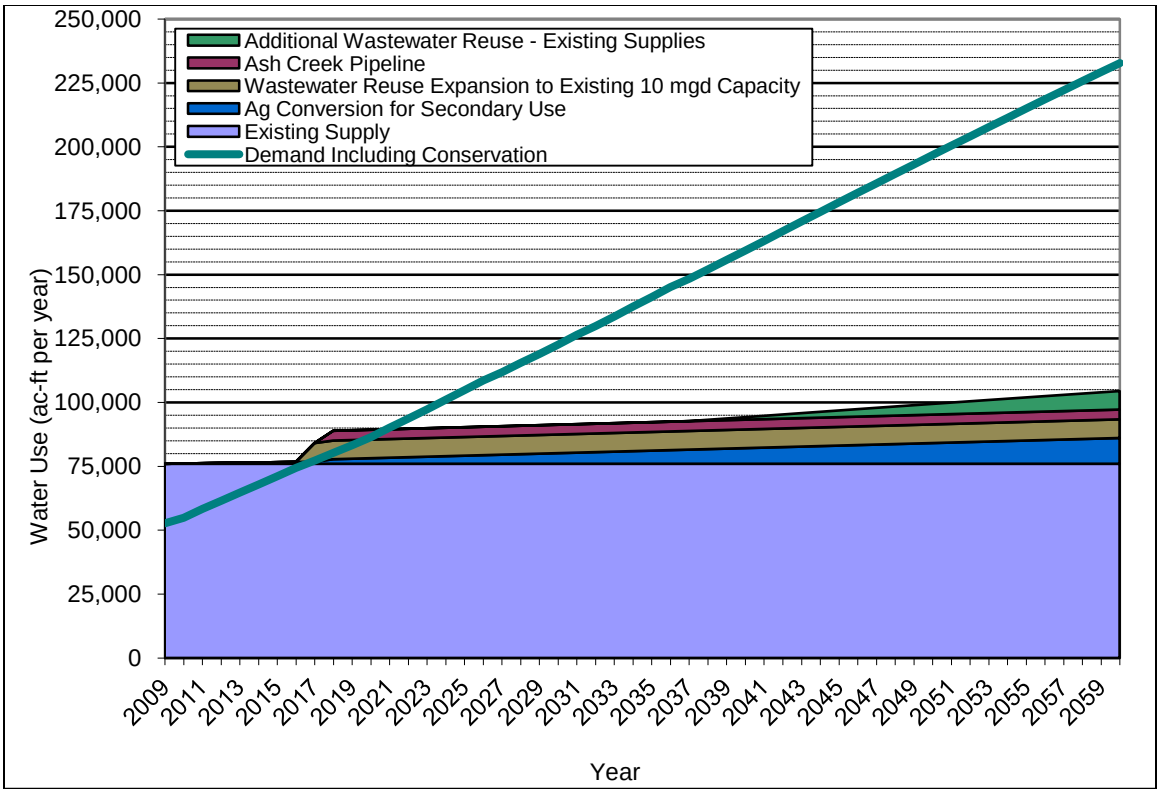


Figure 3-1
WCWCD Water Supply & Demand without LPP Water

3.2.2 CICWCD Baseline Projects

The conceptual project alternatives for CICWCD include the following projects identified in Section 2.1.2: full development of existing groundwater rights, agricultural conversion as development occurs, and "buy and dry" programs (MWH, 2008). Current water conservation activities and programs are assumed to continue. These projects, activities and programs comprise the "baseline" for CICWCD, and the same are assumed to occur under the LPP Proposed Action.

Table 3-2 shows the existing water supplies for CICWCD, along with the water supplies made available from the development of the CICWCD baseline projects. Equivalent population water needs are also shown with and without the construction of the LPP. The CICWCD No Lake Powell Water Alternative is evaluated on its ability to meet these water demand targets.

Table 3-2
CICWCD Water Need Summary

CICWCD	Existing Supply ac-ft/yr	Agricultural Conversion ac-ft/yr	Full Development of Existing Groundwater Rights ac-ft/yr	Buy & Dry ac-ft/yr	Waste-water Reuse - Existing Supplies ac-ft/yr	Future Supply ac-ft/yr	Equivalent Population Water Need ac-ft/yr	Shortage ac-ft/yr
2023	12,150	4,050	3,610	300	0	20,110	18,670[a]	0
2060	12,150	14,060	3,610	300	1,970	32,090	39,770[b]	7,680

Notes:
[a]Without construction and operation of the LPP
[b]With construction and operation of the LPP
ac-ft/yr = acre-feet per year

Figure 3-2 shows the water supply and demand without Lake Powell water for CICWCD from 2005 through the year 2060. The figure demonstrates the need for water reuse and agricultural "buy and dry" programs beginning in 2023 if the Lake Powell Pipeline is not constructed.

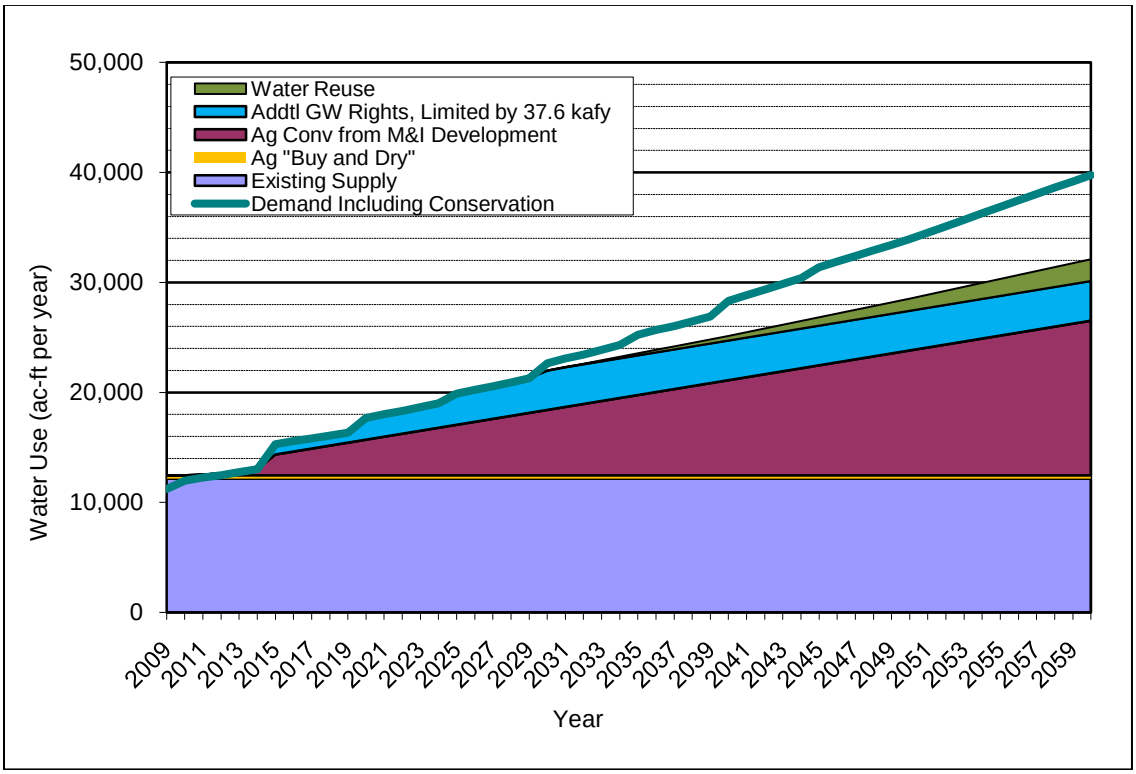


Figure 3-2
CICWCD Water Supply & Demand without LPP Water

3.2.3 KCWCD Baseline Projects

The conceptual project alternatives for KCWCD include the following project identified in Section 2.1.3: full development of existing groundwater rights. Current water conservation activities and programs are assumed to continue. The full development of existing groundwater rights and ongoing water conservation activities and programs will serve as the "baseline" for KCWCD, and the same are assumed to occur under the LPP Proposed Action (MWH, 2008).

Table 3-3 shows the existing water supplies for KCWCD, along with the water supplies made available from the development of the baseline project, activities and programs. Equivalent population water needs are also shown with and without the construction of the LPP. The No Lake Powell Water alternative is evaluated on its ability to meet these water demand targets.

Table 3-3
KCWCD Water Need Summary

KCWCD	Existing Supply ac-ft/yr	Full Development of Existing Groundwater Rights ac-ft/yr	Future Supply ac-ft/yr	Equivalent Population Water Need ac-ft/yr	Shortage ac-ft/yr
2020	4,040	50	4,090	4,090[a]	0
2060	4,040	1,810[c]	5,850	5,850	0

Notes:
[a]Without construction and operation of the LPP
[b]With construction and operation of the LPP
[c]8,100 acre-feet per year potentially available
ac-ft/yr = acre-feet per year

Figure 3-3 shows the water supply and demand for KCWCD from 2005 through the year 2060 without water from Lake Powell. The figure shows the district's need to develop additional groundwater supplies to deliver water beginning in 2052.

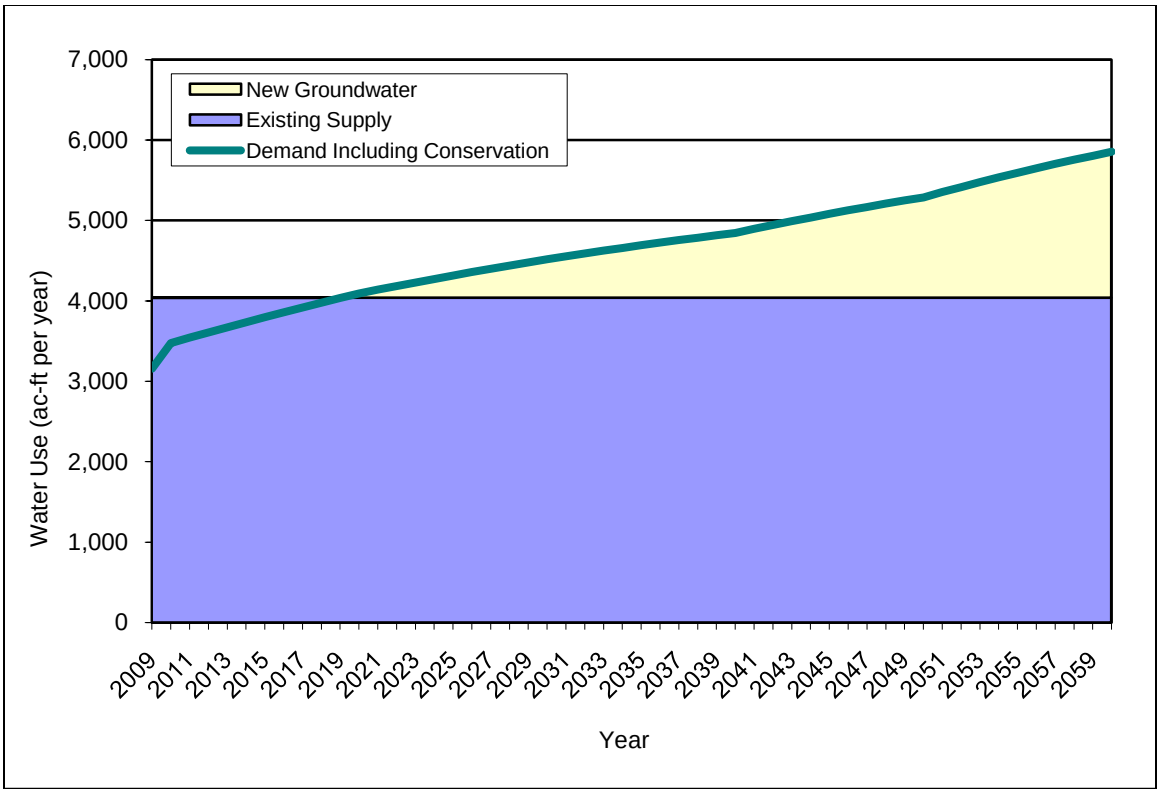


Figure 3-3
KCWCD Water Supply & Demand without LPP Water

3.3 Description of the Conceptual No Lake Powell Water Alternatives

The conceptual No Lake Powell Water Alternatives would vary, depending on each participant's available options, but would involve combinations of options, such as developing any remaining available surface water and groundwater supplies, developing reverse osmosis treatment of existing low quality water supplies in the WCWCD service area, and virtually eliminating residential outdoor watering in the WCWCD and CICWCD service areas. These alternatives must meet the LPP Proposed Action equivalent population water need without diverting the State of Utah's water from Lake Powell. Baseline projects identified in Section 3.2 would continue to be implemented.

3.3.1 WCWCD Conceptual No Lake Powell Water Alternatives

The WCWCD would not receive any of the State of Utah's Colorado River water from Lake Powell under the conceptual No Lake Powell Water Alternatives. The WCWCD would implement currently planned future water development projects (baseline projects) and continue to implement currently mandated conservation goals. Beginning in 2020, WCWCD's existing and baseline project supplies would total 96,529 acre-feet of water supply per year, while demand would be 98,427 acre-feet per year. The WCWCD water supply shortage in 2037 would be approximately 70,000 acre-feet per year, roughly equal to the WCWCD maximum share of the LPP water. Therefore, the WCWCD conceptual No Lake Powell Water Alternatives must develop approximately 69,000 acre-feet of water per year to meet the comparable water supply that would be provided under the LPP Proposed Action. The following subsections describe components of the WCWCD conceptual No Lake Powell Water Alternatives.

3.3.1.1 Reverse Osmosis Treatment of Virgin River Water

To address the water supply shortages beginning in 2020, WCWCD could develop a reverse osmosis (RO) advanced water treatment facility to treat up to 40,000 acre-feet per year of Virgin River water that contains high total dissolved solids (TDS) concentration and other contaminants. The RO advanced water treatment facility would produce up to 36,279 acre-feet of water per year suitable for M&I use (MWH 2010). The WCWCD's Warner Valley Reservoir would be available to deliver water to the RO advanced water treatment facility. The 3,721 acre-feet per year of brine by-product from the RO treatment process would require evaporation and disposal meeting State of Utah water quality regulations.

3.3.1.2 Reverse Osmosis Treatment of Future Reclaimed Wastewater Effluent

The existing St. George Wastewater Treatment Plant sends a portion of its treated effluent to the St. George Wastewater Reuse Plant for additional treatment and reuse as secondary irrigation water. The maximum capacity of the existing Reuse Plant is 3,360 acre-feet per year. The reuse water is used as a secondary irrigation water supply from April through October, and currently is not stored during the winter months. The City of St. George has received permits to construct two storage reservoirs to store the reuse water during the winter months and increase the annual reuse of treated effluent. The reuse water would also be stored in the Warner Valley Reservoir.The maximum projected wastewater treatment plant effluent available for use in 2060 is projected to be 54,500 acre-feet per year. This projected water reuse supply is estimated based on: 1) the projected 2060 combined populations of St. George, Washington, Ivins and Santa Clara, which are the communities served by the St. George Wastewater Treatment Plant; 2) the 2005 total M&I water use less 16 percent conservation; and 3) and a 27 percent wastewater effluent to total M&I water supply ratio. The maximum projected wastewater treatment plant effluent available for reuse in 2020 is projected to be 20,200 acre-feet per year, increasing to 35,340 acre-feet per year by 2037. The RO treatment of 35,340 acre-feet per year wastewater reuse effluent would yield approximately 31,806 acre-feet of product water and 3,534 acre-feet of brine for evaporation and disposal. The RO treated effluent could then be disinfected and delivered for culinary use. This potential component of the No Lake Powell Water Alternative would require a new RO treatment facility or increasing the capacity of an RO facility treating water stored in Warner Valley Reservoir, and also could face a significant public acceptance challenge as well as regulatory approvals.

3.3.1.3 Restricting Water Use for Outdoor Residential Watering

The remaining needed water supply of 32,721 acre-feet per year to meet WCWCD 2037 demands would have to be obtained by virtually eliminating outdoor residential water use in the WCWCD service area. The Utah Division of Water Resources (UDWR) estimated 2005 culinary water use for residential outdoor watering in the communities served by WCWCD was 97.4 gallons per capita per day (gpcd) (UDWR 2009). This culinary water use rate is reduced by 30.5 gpcd to account for water conservation attained from 2005 through 2020, yielding 71.5 gpcd residential outdoor water available for conversion to other M&I uses. The equivalent water use rate reduction to generate 32,721 acre-feet per year of conservation is 56.6 gpcd for the 2037 population within the WCWCD service area. Therefore, the existing rate of residential outdoor water use of 97.4 gpcd would be gradually reduced and restricted to 10.3 gpcd beginning in 2020, which could result in an 85.4 percent reduction in residential outdoor watering between 2020 and 2037.

The restriction on outdoor residential watering throughout the WCWCD service area would require several other related actions, all of which would be viewed as draconian by existing residents. The WCWCD would have to adopt procedures to ensure restriction of the use of culinary water for residential outdoor watering to 10.3 gpcd. Such a policy would be highly unpopular with residents in the WCWCD

service area, in part because existing residential users would be required to give up the water previously allocated for their use in order to accommodate future residential users and also because the impacts on the quality of the surrounding environment would be significant. The restriction of outdoor watering to 10.3 gpcd would allow only minimal outdoor vegetation, all of which must be desert xeriscape species. Most of the existing landscaped area would have to be hardscaped, in the form of rock cover, concrete or other surface protection, to avoid perpetuation of dust and weeds. Converting existing landscapes would impose substantial costs, unless a decision were made to allow landscapes to be dried up and inevitably turn to dust and weeds. Some options might include a turf buy-back program and credits and/or payments to residents for removing existing landscaping from residential yards and replacing it with hardened landscaping. Desert xeriscape landscaping could not include grass turf or any of the existing shade trees and virtually none of the ornamental shrubs and plants that comprise much of the residential landscaping throughout the greater St. George metropolitan area. Virtually no vegetative shade of any sort would be available and only miniscule vegetable gardening could occur. WCWCD would have to develop and maintain a program to enforce restrictions on use of culinary water for residential outdoor watering. Such a program would involve mandatory inspections and audits of residential properties to verify outdoor water use, investigations of violations, fines for violations, and other activities to make sure culinary water distributed to residential water users does not exceed 10.3 gpcd for outdoor watering. Additionally, each residential connection throughout the WCWCD service area would be required to have a water meter for the District to monitor the use of culinary water. The costs of restricting outdoor water use, re-landscaping, enforcement, water meter installation and monitoring, and other related actions would be borne by the existing and future water users within the WCWCD service area.

3.3.1.4 Importing Available Groundwater from Kane County

Another conceptual No Lake Power Water Alternative for WCWCD would to use available groundwater imported into the WCWCD service area from Kane County. KCWCD will utilize approximately 2,000 acre-feet per year of the available 8,100 acre-feet per year of its undeveloped existing groundwater rights to meet the LPP equivalent population water need through 2060. The remaining 6,100 acre-feet per year could potentially be conveyed by a new pipeline to the WCWCD service area to offset its unmet demand. This alternative could offset the restriction on use of culinary water for outdoor residential watering. In addition to developing and maintaining the water conveyance system (pump stations, pipelines and energy recovery), WCWCD would have to develop the groundwater supply wells and negotiate agreements with KCWCD to transfer the water in the WCWCD service area. This project also would face a significant public acceptance challenge in Kane County.

3.3.1.5 Summary of WCWCD Conceptual No Lake Powell Water Alternatives

The conceptual No Lake Powell Water Alternatives for WCWCD would consist of several components to yield a 69,000 acre-foot annual water supply equivalent to the WCWCD portion of the LPP Proposed Action. One combination of components would involve RO treatment of wastewater reuse effluent (31,806 acre-feet of product water) and RO treatment of Virgin River water (36,279 acre-feet of product water) plus a 1.6 gpcd restriction on residential outdoor water use (yielding 915 acre-feet per year) to provide the 69,000 acre-feet of water equivalent to the LPP Proposed Action.

Another combination of components would involve RO treatment of Virgin River water and restricting residential outdoor use of culinary water. The 36,279 acre-feet per year of RO product water from the Virgin River and 32,721 acre-feet per year resulting from restrictions on residential outdoor use of culinary water would equal 69,000 acre-feet per year of M&I water to help meet WCWCD demands through 2037. Additionally, delivery of available Kane County groundwater via a pipeline system into the

WCWCD service area could offset a portion of the culinary grade water restrictions on residential outdoor watering.

3.3.2 CICWCD Conceptual No Lake Powell Water Alternative

The CICWCD would not receive any of the State of Utah's Colorado River water from Lake Powell under the conceptual No Lake Powell Water Alternative. The CICWCD would implement future water development projects currently planned by the District (baseline projects). Beginning in 2023, CICWCD would have a total 20,663 acre-feet of water supply per year, while demand would be 20,675 acre-feet per year with the incorporation of required progressive conservation goals. The CICWCD water supply shortage in 2060 would be 11,470 acre-feet per year. Therefore, the CICWCD No Lake Powell Water Alternative must develop 11,470 acre-feet of water per year to meet comparable supply and demand limits to the LPP Proposed Action. The following subsections describe components of the CICWCD conceptual No Lake Powell Water Alternative.

3.3.2.1 Restricting Culinary Water Use for Outdoor Residential Watering

The needed water supply of 11,470 acre-feet per year to meet CICWCD demands through 2060 could be obtained by reducing and restricting outdoor residential water use in the CICWCD service area. These measures would be necessary beginning in 2023. The UDWR estimated 2005 culinary water use for residential outdoor watering in the communities served by CICWCD at 84.5 gpcd (UDWR 2007a). A portion of this residential outdoor water could be converted to other M&I uses. The equivalent water use rate to obtain 11,470 acre-feet per year is 67.8 gpcd for the 2060 population within the CICWCD service area. Therefore, the existing rate of residential outdoor water use could be gradually reduced and restricted to 16.7 gpcd beginning in 2023, an 80 percent reduction in the residential outdoor water use rate between 2023 and 2060. The 11,470 acre-feet per year of reduced residential outdoor water use could help meet the CICWCD demands through 2060.

The restriction on outdoor residential watering throughout the CICWCD service area would require several other related actions, all of which would be viewed as draconian by existing residents. The CICWCD would have to adopt procedures to ensure restriction of the use of culinary water for residential outdoor watering to 16.7 gpcd between 2023 and 2060. Such a policy would be highly unpopular with residents in the CICWCD service area, in part because existing residential users would be required to give up the water previously allocated for their use in order to accommodate future residential users and also because the impacts on the quality of the surrounding environment would be significant. The restriction of outdoor watering to 16.7 gpcd would allow only minimal outdoor vegetation, all of which must be desert xeriscape species. Most of the existing landscaped area would have to be hardscaped, in the form of rock cover, concrete or other surface protection, to avoid perpetuation of dust and weeds. Converting existing landscapes would impose substantial costs, unless a decision were made to allow landscapes to be dried up and inevitably turn to dust and weeds. Some options might include a turf buy-back program and credits and/or payments to residents for removing existing landscaping from residential yards and replacing it with hardened landscaping. Desert xeriscape landscaping could not include grass turf or any of the existing shade trees and virtually none of the ornamental shrubs and plants that comprise much of the residential landscaping throughout the greater St. George metropolitan area. Virtually no vegetative shade of any sort would be available and only miniscule vegetable gardening could occur. CICWCD would have to develop and maintain a program to enforce restrictions on use of culinary water for residential outdoor watering. Such a program would involve mandatory inspections and audits of residential properties to verify outdoor water use, investigations of violations, fines for violations, and other activities to make sure culinary water distributed to residential water users does not exceed 16.7 gpcd for outdoor watering. Additionally, each residential connection throughout the CICWCD service

area would be required to have a water meter for the District to monitor the use of culinary water. The costs of restricting outdoor water use, re-landscaping, enforcement, water meter installation and monitoring, and other related actions would be borne by the existing and future water users within the CICWCD service area.

3.3.2.2 Development of West Basin Groundwater Rights

Another possible water supply option to meet the CICWCD projected water demand is to acquire water rights from the Wah-Wah, Pine, and Hamlin valleys (West Basin groundwater rights). CICWCD has filed applications for water rights in these three valleys, and the applications for the Wah-Wah and Pine Valley water rights have been advertised. The application for the Hamlin Valley water rights has not been advertised at the request of CICWCD. If CICWCD developed these water rights, a water conveyance system consisting of pump stations, pipelines and appurtenances would be required to deliver the groundwater to their service area. The West Basin water right applications are the subject of numerous protests to the Utah Division of Water Rights and are not considered further in this analysis.

3.3.2.3 Summary of CICWCD Conceptual No Lake Powell Water Alternative

The No Lake Powell Water Alternative for CICWCD would consist of gradually restricting use of culinary water for residential outdoor watering to yield up to 11,470 acre-feet of water annually to meet M&I demands through 2060. The CICWCD restrictions on residential outdoor use of culinary water would yield the quantity of water equivalent to the quantity of water that would be delivered under the LPP Proposed Action to meet CICWCD projected M&I water demands in 2060.

3.3.3 KCWCD Conceptual No Lake Powell Water Alternative

KCWCD would not receive any of the State of Utah's Colorado River water from Lake Powell under the conceptual No Lake Powell Water Alternative. The KCWCD would use existing water supplies and implement future water development projects currently planned by the District (baseline projects). The KCWCD has adequate existing groundwater rights and supplies to meet the projected M&I water demand of 6,033 acre-feet per year within the KCWCD service area through 2060 (LPP equivalent population water need). Therefore, the KCWCD conceptual No Lake Powell Water Alternative is the same as the No Action Alternative and requires no further analysis.

3.4 Description of No Action Alternative

The No Action Alternative is different than the conceptual No Lake Powell Water Alternatives. Under the No Action Alternative, the Utah Board of Water Resources' Colorado River water rights consisting of 86,249 acre-feet per year would not be diverted from Lake Powell and would continue to flow into the Lake until the water is used for another State of Utah purpose or released according to operating guidelines. No new intake, water conveyance or hydroelectric features would be constructed or operated under the No Action Alternative. The conceptual No Lake Powell Water Alternatives would require the WCWCD and CICWCD to take other actions to develop water supplies to meet the same need that would be met under the LPP Proposed Action. The No Action Alternative is always evaluated in federal EISs prepared for NEPA compliance. Future population growth as projected by the Utah Governor's Office of Planning and Budget (GOPB) would continue to occur in southwest Utah. Baseline projects identified in Section 3.2 would continue to be implemented.

3.4.1 WCWCD No Action Alternative

The WCWCD would not receive any of the State of Utah's Colorado River water from Lake Powell under the No Action Alternative. The WCWCD would implement other future water development projects currently planned by the District (baseline projects). Existing and baseline project supplies under the No Action Alternative would meet projected M&I water demand within the WCWCD service area through approximately 2020 (No LPP equivalent population water need). The 2020 total water supply would be approximately 96,529 acre-feet per year. Each baseline project would be phased as needed and as possible to meet the M&I demand associated with the forecasted population. The No Action Alternative would not provide adequate water supply to meet projected water demands from 2020 through 2037 (LPP equivalent population water need). There would be a potential water shortage of approximately 70,181 acre-feet per year in 2037 under the No Action Alternative.

3.4.2 CICWCD No Action Alternative

The CICWCD would not receive any of the State of Utah's Colorado River water from Lake Powell under the No Action Alternative. The CICWCD would implement future water development projects currently planned by the District (baseline projects). It is assumed the Utah State Engineer would act to limit existing and future groundwater pumping from the Cedar Valley aquifer in an amount not exceeding the assumed sustainable yield of 37,600 acre-feet per year. Existing and baseline project supplies under the No Action Alternative would meet projected M&I water demand within the CICWCD service area through approximately 2023 (No LPP equivalent population water need). The 2023 total water supply would be approximately 20,663 acre-feet per year. Each baseline project would be phased in as needed and as possible to meet the M&I demand associated with the forecasted population. The No Action Alternative would not provide adequate water supply to meet projected water demands from 2023 through 2060 (LPP equivalent population water need). There would be a potential water shortage of approximately 11,470 acre-feet per year in 2060 under the No Action Alternative.

3.4.3 KCWCD No Action Alternative

The KCWCD would not receive any of the State of Utah's Colorado River water from Lake Powell under the No Action Alternative. The KCWCD would use existing water supplies and implement future water development projects currently planned by the District (baseline projects). Existing water supplies (4,039 acre-feet per year) and 1,994 acre-feet per year of new groundwater (8,100 acre-feet per year is potentially available) would meet the projected M&I water demand of 6,033 acre-feet per year within the KCWCD service area through 2060 (LPP equivalent population water need).

Chapter 4
Evaluation of the Conceptual No Lake Powell Water Alternatives

4.1 Introduction

The conceptual No Lake Powell Water Alternatives are evaluated for technical feasibility, total relative cost, environmental, and land use considerations. All of the identified components of the conceptual No Lake Powell Water Alternatives are technically feasible. Total relative cost is expressed in terms of a relative cost ratio and should be considered preliminary because of the limited knowledge of the scope of work, bidding environment at time of construction, and the variable timing on when construction could occur. The relative cost ratio compares the relative cost of the each conceptual No Lake Powell Water Alternative to the relative cost of the LPP Proposed Action. The relative cost ratio of delivering LPP water through the Proposed Action has been assigned a value of 5.00. Relative cost ratios greater than 5.00 represent alternative water supplies that are less expensive to develop than the LPP Proposed Action, and ratios less than 5.00 represent alternative water supplies that are more expensive to develop. Environmental and land use considerations of the conceptual No Lake Powell Water Alternatives are based on preliminary analyses.

The baseline projects are included in the No Action, LPP Proposed Action and conceptual No Lake Powell Water Alternatives; therefore, the costs and environmental and land use considerations of these projects are not discussed further and are not used for comparison in this evaluation.

4.1.1 Technical Feasibility

4.1.1.1 WCWCD Technical Feasibility

The WCWCD conceptual No Lake Powell Water Alternatives would be technically feasible. The RO water treatment facility could be designed, constructed and operated beginning in 2020 to produce the needed product water and dispose of the brine from the RO process. Although RO treatment of reclaimed wastewater is technically feasible, it is not a reasonable alternative component at this time because it could not be permitted by regulatory agencies. The restrictions on residential outdoor watering could be implemented to meet the projected water supply need beginning in 2020. Hardening existing and future residential landscapes would be challenging but technically feasible. All trees, ornamental shrubs, grass and other existing “non-desert” vegetation would have to be removed from residential landscapes to accomplish the conversion. Conveyance of available groundwater from Kane County to Washington County would meet significant opposition but is technically feasible, involving water wells, pumping stations, and a pipeline.

4.1.1.2 CICWCD Technical Feasibility

The CICWCD conceptual No Lake Powell Water Alternative would be technically feasible. Restricting residential outdoor water use is technically feasible. Converting existing and future traditional residential landscapes to xeriscape landscapes would be challenging but technically feasible. All trees, ornamental shrubs, grass and other existing “non-desert” vegetation would have to be removed from residential landscapes to accomplish the conversion.

4.1.1.3 KCWCD Technical Feasibility

The KCWCD would not require water development projects in addition to the baseline projects to meet the LPP equivalent population water need. The potential future groundwater development projects are technically feasible.

4.1.2 Total Relative Cost

4.1.2.1 WCWCD Total Relative Cost

The reverse osmosis (RO) treatment of Virgin River water, including brine disposal and operations and maintenance (O&M), is estimated to have a relative cost ratio of 0.73. RO treatment of reclaimed wastewater to eventual culinary use, including brine disposal and O&M, is estimated to have a relative cost ratio of 0.73. The costs associated with restricting residential outdoor water use of culinary water include the costs the District would incur to develop, issue and enforce regulations and the costs associated with changing landscaping practices. Restricting residential outdoor water use and removing lawns and plants, shrubs, and trees and replacing them with hardened surfaces and minimal desert xeriscape landscaping would result in an estimated relative cost ratio of 0.29. Purchasing and conveying available groundwater from Kane County to Washington County by pipeline would have an estimated relative cost ratio of 0.29. Therefore, the total estimated relative cost ratio for the WCWCD conceptual No Lake Powell Water Alternatives would be 0.36 for RO treatment of Virgin River water and reused wastewater effluent plus a 1.6 gpcd restriction on residential outdoor watering to meet the 69,000 acre-foot demand in 2037, 0.42 for the RO plant using Virgin River water and restricting residential outdoor water use, and 0.42 for the RO plant using Virgin River water, conveying groundwater from Kane County to Washington County and restricting residential outdoor water use. A smaller relative cost ratio represents a more costly alternative; therefore, implementing the RO treatment of Virgin River water and restricting residential outdoor water use is the most cost effective conceptual No Lake Powell Water Alternative for WCWCD.

4.1.2.2 CICWCD Total Relative Cost

The cost for CICWCD to restrict residential outdoor water use and remove lawns and plants, shrubs, and trees having a high water demand and replace them with xeriscape landscaping would result in a total estimated relative cost ratio of 0.48. The shortage of 11,470 acre-feet per year of water through the year 2060 would need to be made up solely by implementing regulations and landscaping changes under this alternative. The total estimated relative cost ratio for the CICWCD conceptual No Lake Powell Water Alternative is 0.48.

4.1.2.3 KCWCD Total Relative Cost

KCWCD would have no additional costs beyond the costs to develop its baseline projects.

4.1.3 Environmental Considerations

4.1.3.1 WCWCD Environmental Considerations

Environmental considerations associated with the WCWCD conceptual No Lake Powell Water Alternatives include potential impacts on Virgin River hydrology and water quality, groundwater levels, geology and soils, listed aquatic and wildlife species and their designated critical habitat, riparian and

wetland areas, wildlife associated with the Virgin River riparian corridor and throughout the St. George metropolitan area, aquatic resources in the Virgin River, vegetation communities, air quality, noise, archaeological resources and historic-era resources, soil resources, visual resources, energy resources, and socioeconomics. Non-point source runoff and related recharge could improve groundwater and surface water quality because of reduced fertilizer use, reduced pesticide use and reduced outdoor watering associated with restricting residential outdoor watering and converting traditional residential landscapes to hardened surfaces with minimal desert xeriscape accents. However, groundwater levels could decline by reduced recharge resulting from the restrictions on residential outdoor watering. Structures built on high- and moderate-hazard rocks and soils could experience concrete foundation heaving because of reduced subsurface water. Reductions in return flows to the Virgin River flows resulting from less irrigation of landscape and associated changes in water quality could affect listed aquatic and wildlife species and their designated critical habitats in and along the Virgin River. Riparian and wetland areas along the Virgin River could be affected by the decrease in Virgin River flows, which in turn could adversely affect wildlife resources that inhabit the riparian and wetland areas. Wildlife resources would be affected by the conversion of traditional residential landscapes to hardened surfaces with minimal desert xeriscape accents throughout the residential areas. Wildlife resources also could be affected by operation of the brine evaporation ponds associated with the RO treatment system. Aquatic resources in the Virgin River could be affected by the reductions in stream flows and associated changes in river water temperatures. Vegetation communities in the St. George metropolitan area would be affected by the conversion from traditional residential landscapes to hardened landscapes with limited desert xeriscape accents. Air quality would be temporarily affected by pipeline and pump station, RO treatment facility and xeriscape landscape construction activities. Air quality could be permanently affected by the conversion to desert xeriscape landscapes, resulting in increased airborne particulate matter generated from increased exposed soil areas. Noise levels would temporarily increase during construction activities. Archaeological and historic-era resources could be affected by construction of pipelines, pump stations, the RO treatment facility and brine evaporation ponds. Soil resources could be eroded during facility construction and during conversion from traditional residential landscapes to hardened surfaces with minimal desert xeriscape accents. Depending on the amount of funds made available for landscape conversions, long-term soil erosion would occur to some degree from desert xeriscape landscapes through wind and precipitation runoff erosional processes. The elimination of existing landscapes through either intentional replacement with xeriscape, which is more susceptible to weeds, or through lack of water, would result in increased weed production. Visual resources within the St. George metropolitan area would be affected by the conversion of traditional residential landscapes to hardened surfaces with minimal desert xeriscape landscapes in terms of color, texture, line and form, plus visibility could decrease during windstorms from increased airborne particulates. The temperature amelioration offered by existing landscaping would be lost, leading to higher temperatures and more power demands as use of air conditioning increases. More water would be consumed in connection with power production, although the source water may be located in a different area. Significant energy resources would be permanently consumed to power the RO water treatment facility, and a commitment of energy would be made to pump available groundwater and convey it from Kane County to Washington County. Socioeconomic resources would be affected by converting traditional residential landscapes to desert xeriscape landscapes through changing property values, significantly increased water rates, enforcement of residential outdoor watering restrictions and concomitant social costs as residents lose their sense of community and pride and as resentment of new residents grows. Residential yards would be uninhabitable during the hot summer months. Residential vegetable gardens would be eliminated because 10.3 gpcd would not provide enough water to sustain the plant growth during the hot summer months. Construction and operation of the RO water treatment facility would significantly increase water rates for all water users.

4.1.3.2 CICWCD Environmental Considerations

Environmental considerations associated with converting traditional residential landscapes to xeriscape landscapes under the CICWCD conceptual No Lake Powell Water Alternative include potential impacts on groundwater levels, water quality, vegetation communities, air quality, noise, soil resources, visual resources, and socioeconomics. Groundwater levels could be affected by reduced recharge resulting from the restrictions on residential outdoor watering. Reductions in return flows to Cedar Valley streams could affect riparian vegetation and the wildlife inhabiting riparian areas. Non-point source runoff and related recharge could improve groundwater and surface water quality because of reduced fertilizer use, reduced pesticide use and reduced outdoor watering associated with restricting residential outdoor watering and converting traditional residential landscapes to xeriscape landscapes. Vegetation communities in the Cedar Valley would be affected by the conversion from traditional residential landscapes to xeriscape landscapes. Air quality would be temporarily affected by xeriscape landscape construction activities. Air quality could be permanently affected by the conversion to desert xeriscape landscapes, resulting in increased airborne particulate matter generated from increased exposed soil areas. Noise levels would temporarily increase during construction activities. Soil resources could be eroded during facility construction and during conversion from traditional residential landscapes to xeriscape landscapes. Long-term soil erosion could occur from xeriscape landscapes through wind and precipitation runoff erosional processes. Visual resources within the Cedar Valley area would be affected by the conversion of traditional residential landscapes to xeriscape landscapes in terms of color, texture, line and form, plus visibility could decrease during windstorms from increased airborne particulates. Socioeconomic resources would be affected by converting traditional residential landscapes to desert xeriscape landscapes through changing property values, significantly increased water rates, enforcement of residential outdoor watering restrictions and concomitant social costs as residents lose their sense of community and pride and as resentment of new residents grows. Residential yards would be uninhabitable during the hot summer months. Residential vegetable gardens would be eliminated because 16.7 gpcd would not provide enough water to sustain the plant growth during the hot summer months.

4.1.3.3 KCWCD Environmental Considerations

The KCWCD environmental considerations include potential groundwater depletion from local aquifers. This would only be a concern if the withdrawal of groundwater from an aquifer exceeds the aquifer recharge rate. It appears the aquifers identified for KCWCD future development of groundwater supplies are adequate to meet the identified water needs and they receive recharge in excess of future withdrawals.

4.1.4 Land Use Considerations

4.1.4.1 WCWCD Land Use Considerations

Land use considerations associated with the WCWCD conceptual No Lake Powell Water Alternatives would include loss of large areas of grazing land from constructing and operating the RO water treatment facility, evaporation ponds and brine disposal. Converting traditional residential landscapes to hardened surfaces with minimal desert xeriscape features would alter the vegetation composition on land parcels, but would not change the residential land use designations or classifications. Constructing and operating a water conveyance pipeline from Kane County to Washington County would restrict future land use along the pipeline right-of-way.

4.1.4.2 CICWCD Land Use Considerations

The CICWCD conceptual No Lake Powell Water Alternative would not change existing land use. Converting traditional residential landscapes to hardened surfaces with minimal desert xeriscape features would alter the vegetation composition on land parcels, but would not change the residential land use designations or classifications.

4.1.4.3 KCWCD Land Use Considerations

There would be no land use changes associated with the KCWCD conceptual No Lake Powell Water Alternative.

Chapter 5
Conceptual No Lake Powell Water Alternatives Screening

5.1 Introduction

The conceptual No Lake Powell Water Alternatives are screened in this chapter using criteria established to evaluate the relative merits of each alternative. The screening process involves systematic rating of the conceptual No Lake Powell Water Alternatives using six screening criteria: 1) ability to meet projected water demands; 2) technical feasibility; 3) relative cost; 4) environmental considerations; 5) land use considerations; and 6) social acceptance. The screening methodology allows the alternatives to be consistently evaluated according to established criteria to determine each District's No Lake Powell Water Alternative for analysis in the other study reports and the Environmental Impact Statement (EIS).

5.1.1 Screening Criteria Definitions and Screening Evaluations

The screening criteria defined in the following subsections allow for consistent evaluation of the conceptual No Lake Powell Water Alternatives. Summary screening evaluations of the conceptual No Lake Powell Water Alternatives are included for WCWCD and CICWCD in each subsection. The KCWCD No Action Alternative meets the LPP equivalent population water needs, therefore no alternatives are evaluated or screened for KCWCD.

5.1.1.1 Ability to Meet Projected Water Demands

The ability to meet projected water demands is defined as having the quality or state of being able to reliably perform at a level meeting the future water demand. A No Lake Powell Water Alternative with the ability to meet projected water demands would provide a reliable water supply comparable to the LPP Proposed Action.

The WCWCD conceptual No Lake Powell Water Alternatives would meet the projected water demand through 2037. This is the same year through which the LPP Proposed Action would meet the projected water needs of the population served by the WCWCD.

The CICWCD conceptual No Lake Powell Water Alternative would meet the projected water demands through the year 2060. This is the same year through which the LPP Proposed Action would meet the projected water needs of the population served by CICWCD.

5.1.1.2 Technical Feasibility

Technical feasibility is defined as being able to use available technology to successfully achieve established performance objectives. A No Lake Powell Water Alternative with technical feasibility would be capable of being completed using available technology to achieve water quantity and quality objectives comparable to those provided under the LPP Proposed Action.

All of the conceptual No Lake Powell Water Alternatives are technically feasible. The WCWCD conceptual No Lake Powell Water Alternative involving reclaimed wastewater and treating it using RO advanced water treatment for culinary use is the most technically challenging method of meeting projected water demands, however it would not be approved by regulatory agencies because no "toilet to faucet" treatment plants have been approved. Developing and operating RO advanced water treatment of

Virgin River water would be technically challenging and could be approved by regulatory agencies. Design and operation of a pipeline to convey available Kane County groundwater to Washington County would face similar technical challenges. Restricting residential outdoor water use to reduce water consumption by converting traditional residential landscaping practices to hardened surfaces with minimal xeriscape landscapes is the least technically challenging alternative, provided, however, that the actions necessary to accomplish the change would be extremely challenging as a practical matter because of social opposition and the challenges posed by eliminating shade trees that have existed since the first pioneers arrived in Washington County, vegetable gardens, turf and other people-friendly landscape, and convincing residents to perform the tasks necessary to achieve these changes.

5.1.1.3 Relative Cost Rating

Relative cost is defined as the total present worth probable cost of an alternative relative to the total present worth probable cost of the LPP Proposed Action. The relative cost rating incorporates an inverse function to allow each relative cost to be compared on a 0 to 5 rating scale. A No Lake Powell Water Alternative with a low relative cost rating would be less cost-effective than a No Lake Powell Water Alternative with a higher relative cost rating.

For the WCWCD, using RO advanced water treatment of Virgin River water and restricting residential outdoor watering with culinary grade water would have the most favorable relative cost rating and would be the most cost effective No Lake Powell Water Alternative. The relative costs of converting traditional residential landscapes to desert xeriscapes are considered part of the overall cost of restricting residential outdoor water use. RO advanced water treatment of reclaimed wastewater effluent would have a lower relative cost rating because the volume of RO treated water would be significantly increased, resulting in higher capital and operating costs than treating only Virgin River water with RO.

For CICWCD, restricting residential outdoor use of culinary water is the only available alternative to extend the available water supply to meet future population demands. Therefore, water use restrictions accompanied by converting traditional residential landscapes to xeriscape landscapes are the most cost effective means of meeting future water demand.

5.1.1.4 Environmental Considerations

Environmental considerations are defined as broadly assessed environmental impacts on physical, biological and socioeconomic resources that could result from implementing an action. A No Lake Powell Water Alternative with fewer potential environmental impacts and less intense projected effects on other resources receives a higher rating for environmental considerations compared to an alternative with numerous potential environmental impacts and significant projected effects on other resources.

The WCWCD conceptual No Lake Powell Water Alternatives vary in their potential effects on environmental resources. All three alternatives would involve treating Virgin River water using a RO advanced water treatment process, which could affect Virgin River hydrology, water quality, listed aquatic and wildlife species and their designated critical habitats, riparian and wetland areas, wildlife, aquatic resources, archaeological resources and historic-era resources, energy resources and socioeconomic resources. The RO advanced water treatment of reclaimed wastewater effluent would have additional effects on all of the same resources, with increased impact intensity because of the incremental treatment requirements. Restricting residential outdoor use of culinary water could affect Virgin River hydrology, water quality, groundwater levels, listed aquatic and wildlife species and their designated critical habitats, riparian and wetland areas, wildlife, aquatic resources, vegetation communities, air quality, soil resources, visual resources, and would have significant adverse impacts on socioeconomic

resources. Developing and conveying available groundwater from Kane County to Washington County could affect groundwater levels, vegetation communities, wildlife, listed wildlife and plant species, archaeological resources and historic-era resources, soil resources, visual resources, energy resources and socioeconomic resources. The conceptual No Lake Powell Water Alternative with the least potential affect on environmental resources would involve RO advanced water treatment of Virgin River water and restricting residential outdoor watering. The WCWCD conceptual No Lake Powell Water Alternative involving developing and conveying available Kane County groundwater to Washington County would cause additional impacts on resources that would not be offset by 1.6 gpcd restriction on residential outdoor water use. The No Lake Powell Water Alternative involving RO advanced water treatment of Virgin River water and RO advanced water treatment of reclaimed wastewater effluent would have the greatest potential effect on environmental resources because the RO treatment facilities would double in capacity, area and direct effects on resources.

The CICWCD conceptual No Lake Powell Water Alternative could affect hydrology, water quality, groundwater levels, riparian and wetland areas, wildlife, aquatic resources, vegetation communities, air quality, soil resources, visual resources, and socioeconomic resources. The potential adverse effects on environmental resources are not further considered in screening because this is the only No Lake Powell Water Alternative available to the CICWCD to meet their projected water demands.

5.1.1.5 Land Use Considerations

Land use considerations are defined as broadly assessed changes in land use that could result from implementing an action. A No Lake Powell Water Alternative with little or no change in land use receives a higher rating for land use considerations compared to an alternative with large changes in land use.

Converting traditional residential landscaping to hardened landscape with desert xeriscape accents within the WCWCD service area would radically alter vegetation composition on residential land parcels, although it would not change the residential land use designation of the parcels. This component of the No Lake Powell Water Alternatives would have the least effect on land use. Constructing and operating RO advanced water treatment facilities would change land uses over a large area and would permanently commit existing agricultural land to brine evaporation ponds. The RO treatment of Virgin River water and brine disposal would require less land area than RO treatment of the combined Virgin River water and reclaimed wastewater effluent sources and associated brine evaporation ponds. Constructing and operating a water conveyance pipeline from Kane County to Washington County could change existing land use and permanently restrict future land use along the pipeline corridor. This component of a No Lake Powell Water Alternative would have a moderate effect on land use.

Converting traditional residential landscaping to xeriscape landscapes in the CICWCD service area would alter the vegetation composition on residential land parcels, but would not change the land use designation of the residential parcels.

5.1.1.6 Social Acceptance

Social acceptance is defined as broad public approval of an action that either directly or indirectly affects stakeholders (residents, non-residents, and other people affected by the action). The actions may include new regulations, imposing restrictions, increasing user costs, increasing user rates, granting licenses and permits, constructing new facilities, and implementing other changes in existing practices. A No Lake Powell Water Alternative involving highly controversial changes would receive a lower rating compared to an alternative involving non-controversial changes.

The WCWCD conceptual No Lake Powell Water Alternatives all would have zero to low social acceptance. The No Lake Powell Water Alternative involving RO advanced water treatment of reclaimed wastewater effluent would have no social acceptance because of the direct use of treated wastewater effluent ultimately for drinking water supply, the high costs of RO treatment, the increased user rates to pay for RO treatment, and the difficulty in obtaining regulatory approval for direct use. The No Lake Powell Water Alternatives involving RO advanced water treatment of Virgin River water would have slightly higher social acceptance than the RO advanced water treatment of reclaimed wastewater effluent, because the water supply would originate from the Virgin River but would be accompanied by the high costs of RO treatment and increased user rates to pay for the RO treatment. The No Lake Powell Water Alternatives involving restricting residential outdoor use of culinary water resulting in converting traditional residential landscapes to desert xeriscape landscapes is expected to have low social acceptance, because of the regulatory restrictions, monitoring and enforcement, high costs, heat impacts and virtually complete destruction of the shade trees, turf and vegetable and ornamental gardens accompanying this alternative. The No Lake Powell Water Alternative involving conveying available groundwater from Kane County to Washington County is anticipated to have low social acceptance because of the transfer of water from one county to another and the relatively high cost of conveying a relatively small quantity of water.

The CICWCD No Lake Powell Water Alternative involving restricting residential outdoor use of culinary water resulting in converting traditional residential landscapes to xeriscape landscapes is expected to have low social acceptance. The regulatory restrictions, monitoring and enforcement, high costs of converting landscapes and increased user rates associated with this alternative would not receive broad public approval.

5.2 Screening Process Summary

The screening process involved developing and using a numeric rating scale to represent the ratings for each screening criterion. The conceptual No Lake Powell Water Alternatives are assigned a numeric rating score from 0 to 5 representing the screening criteria defined and screening evaluations provided in Section 5.1. An assigned numeric rating score of 0 represents the lowest possible rating in the screening process. An assigned numeric rating score of 5 represents the highest possible rating in the screening process. The total numeric rating for each conceptual alternative represents a composite, unweighted numeric rating for the screening criteria. The highest possible total numeric rating in the screening process is 30. The conceptual No Lake Powell Water Alternative with the highest total numeric rating is the recommended No Lake Powell Water Alternative for analysis in the study reports and the environmental impact statement that will be prepared to meet NEPA compliance requirements.

5.2.1 WCWCD No Lake Powell Water Alternatives Screening Process Results

Table 5-1 shows the screening results for the WCWCD conceptual No Lake Powell Water Alternatives.

Table 5-1
WCWCD Conceptual No Lake Powell Water Alternatives Screening

WCWCD No Lake Powell Water Alternative	Screening Criteria						Total Rating
	Ability to Meet Water Demand	Technical Feasibility	Total Relative Cost	Environmental Considerations	Land Use Considerations	Social Acceptance	
Virgin River RO & Residential Watering Restrictions	5	5	0.4	2	3	0	15.4
Virgin River RO & Wastewater RO	5	3	0.4	2	3	0	13.4
Virgin River RO & Kane County Pipeline & Residential Watering Restrictions	5	4	0.4	2	3	0	14.4

The No Lake Powell Water Alternative with the highest total numeric rating is the combination of RO advanced water treatment of Virgin River water and restricting residential outdoor use of culinary water, which would require issuing regulations and converting traditional residential landscapes to desert xeriscape landscapes to meet the projected future water demand.

5.2.2 CICWCD No Lake Powell Water Alternatives Screening Process Results

The CICWCD has only one No Lake Powell Water Alternative to meet projected water demand through 2060, therefore, an alternatives screening table was not developed. After the CICWCD completes "baseline" planned future water development projects, restricting residential outdoor use of culinary watering must be implemented by issuing regulations and converting traditional residential landscapes to xeriscape landscapes to meet the projected future water demand.

5.2.3 KCWCD No Lake Powell Water Alternatives Screening Process Results

The No Action Alternative meets the LPP equivalent population water need for KCWCD. No additional alternatives were evaluated.

Chapter 6
Recommended No Lake Powell Water Alternatives for NEPA Analysis

The recommended No Lake Powell Water Alternatives for WCWCD, CICWCD and KCWCD consist of the following components to meet each district's projected water demand without the Lake Powell Pipeline project. These recommended No Lake Powell Water Alternatives are analyzed in the LPP draft study reports and will be analyzed in the environmental impact statement prepared by the Federal Energy Regulatory Commission to meet their NEPA compliance requirements.

6.1 Recommended No Lake Powell Water Alternative for WCWCD

The recommended No Lake Powell Water Alternative for WCWCD consists of RO treatment of Virgin River water and restricting residential outdoor use of culinary water. The components of the recommended No Lake Powell Water Alternative for WCWCD are described in the following paragraphs.

The WCWCD would develop a RO advanced water treatment facility near the Washington Fields Diversion in Washington County, Utah to treat up to 40,000 acre-feet per year of Virgin River water with high total dissolved solids (TDS) concentration and other contaminants. The RO advanced water treatment facility would produce up to 36,279 acre-feet per year of water suitable for M&I use. The WCWCD would develop the planned Warner Valley Reservoir to store the diverted Virgin River water, which would be delivered to the RO advanced water treatment facility. The remaining 3,721 acre-feet per year of brine by-product from the RO treatment process would require evaporation and disposal meeting State of Utah water quality regulations.

The remaining needed water supply of 32,721 acre-feet per year to meet WCWCD 2037 demands would be obtained by reducing and restricting outdoor residential water use in the WCWCD service area. The Utah Division of Water Resources (UDWR) estimated 2005 culinary water use for residential outdoor watering in the communities served by WCWCD was 97.4 gallons per capita per day (gpcd) (UDWR 2008a). This culinary water use rate is reduced by 30.5 gpcd to account for water conservation attained from 2005 through 2020, yielding 71.5 gpcd residential outdoor water use available for conversion to other M&I uses. The equivalent water use rate reduction to generate 32,721 acre-feet per year of conservation is 56.6 gpcd for the 2037 population within the WCWCD service area. Therefore, beginning in 2020, the existing rate of residential outdoor water use would be gradually reduced and restricted to 10.3 gpcd, or an 89.4 percent reduction in residential outdoor water use. The restriction on residential outdoor use of culinary water would require converting traditional residential landscapes to desert xeriscape landscapes.

The combined 36,279 acre-feet per year of RO product water and 32,721 acre-feet per year of reduced residential outdoor water use would equal 69,000 acre-feet per year of M&I water to help meet WCWCD demands through 2037.

6.2 Recommended No Lake Powell Water Alternative for CICWCD

The recommended No Lake Powell Water Alternative for CICWCD consists of restricting residential outdoor use of culinary water. This component of the recommended No Lake Powell Water Alternative for CICWCD is described in the following paragraph.

The needed water supply of 11,470 acre-feet per year to meet CICWCD 2060 demands would be obtained by reducing and restricting outdoor residential water use in the CICWCD service area. The UDWR estimated 2005 culinary water use for residential outdoor watering in the communities served by CICWCD was 84.5 gpcd (UDWR 2007). A portion of this residential outdoor water would be converted to other M&I uses. The equivalent water use rate to obtain 11,470 acre-feet per year is 67.8 gpcd for the 2060 population within the CICWCD service area. Therefore, the existing rate of residential outdoor water use would be gradually reduced and restricted to 16.7 gpcd beginning in 2023, an 80 percent reduction in the residential outdoor water use rate between 2023 and 2060. The 11,470 acre-feet per year of reduced residential outdoor water use would be used to help meet the CICWCD demands through 2060. The restriction on residential outdoor use of culinary water would require converting traditional residential landscapes to xeriscape landscapes.

6.3 Recommended No Lake Powell Water Alternative for KCWCD

The recommended No Lake Powell Water Alternative for KCWCD consists of developing the available groundwater resources to meet projected water demand through 2060. This alternative is the same as the No Action Alternative for KCWCD.

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Abbreviations and Acronyms

Abbreviation/Acronym	Meaning/Description
ac-ft/yr	acre-feet per year
BLM	U.S. Bureau of Land Management
BPS	Booster Pump Station
CBPS	Cedar Booster Pump Station
CFR	Code of Federal Regulations
CII	Commercial/Industrial/Institutional
CICWCD	Central Iron County Water Conservancy District
CVP	Cedar Valley Pipeline
Commission	Federal Energy Regulatory Commission
GOPB	Governor's Office of Planning and Budget
gpcd	gallons per capita per day
GPO	Government Printing Office
GSENM	Grand Staircase-Escalante National Monument
EIS	Environmental Impact Statement
HS	Hydro System
KCP	Kane County Pipeline
KCWCD	Kane County Water Conservancy District
LPP	Lake Powell Pipeline
M&I	Municipal and Industrial
mgd	million gallons per day
MSL	Mean Sea Level
NEPA	National Environmental Policy Act
O&M	Operations and Maintenance
RO	Reverse Osmosis
TDS	Total Dissolved Solids
UDWR	Utah Division of Water Resources
WCWCD	Washington County Water Conservancy District

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