DONNER SUMMIT PUBLIC UTILITY DISTRICT

NOVEMBER 2023

DRAFT
WATER SUPPLY RESILIENCY STUDY

PREPARED BY

GEI Consultants

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ACRONYMS AND ABBREVIATIONS

AF	Acre-Feet
AFY	Acre-Feet per Year
cfs	Cubic Feet per Second
CT	Central Tendency
DR	Drought Risk
DSOD	California Division of Safety of Dams
DSPUD	Donner Summit Public Utilities District
DWR	California Department of Water Resources
gpm	Gallons per Minute
IT	Intertie
msl	Mean Sea Level
NAVD 88	North American Vertical Datum 1988
SB 552	Senate Bill 552
SGMA	Sustainable Groundwater Management Act
SLCWD	Sierra Lakes County Water District
SWRCB	State Water Resources Control Board
UWMP	Urban Water Management Plan
WCR	Well Completion Report
WSCP	Water Shortage Contingency Plan
WWTP	Wastewater Treatment Plant

1 INTRODUCTION

1.1 STUDY AREA

Lake Angela, located in the southern part of Nevada County and just north of the Placer County line, is the sole source of water supply for Donner Summit Public Utilities District (DSPUD or District), serving approximately 360 domestic water customers in the Donner Summit area. Lake Angela is located in the headwaters of the South Yuba Watershed, residing on Donner Summit at an elevation of 7,195 feet and located near the crest of the Sierra Nevada Mountains. The lake is bordered by Donner Pass Road to the south, Donner Ski Ranch to the west, the Pacific Crest Trail to the east, and Interstate 80 to the north (see Figure 1-1).

1.2 PURPOSE OF THE STUDY

DSPUD faces many challenges when it comes to maintaining an adequate, reliable, high-quality water supply. Lake Angela, which serves as the District's sole source of supply, has experienced algal blooms in the past which has resulted in water quality impacts. The District's water supply reliability is also threatened by the impacts from drought, which are expected to be exacerbated by future climate conditions. Moreover, Senate Bill 552 (SB 552) (California Water Code Section 10609.60 et seq.) which was signed in September 2021 requires that no later than January 1, 2027, the District have at least one backup water supply or a water system intertie that meets current water quality requirements and is sufficient to meet average daily demand. The goals of this water supply resiliency study (study) are to evaluate the vulnerability of the District's water supply due to risks from water quality, drought, and climate change, and identify potential sources of water to address these impacts and the requirements of SB 552.

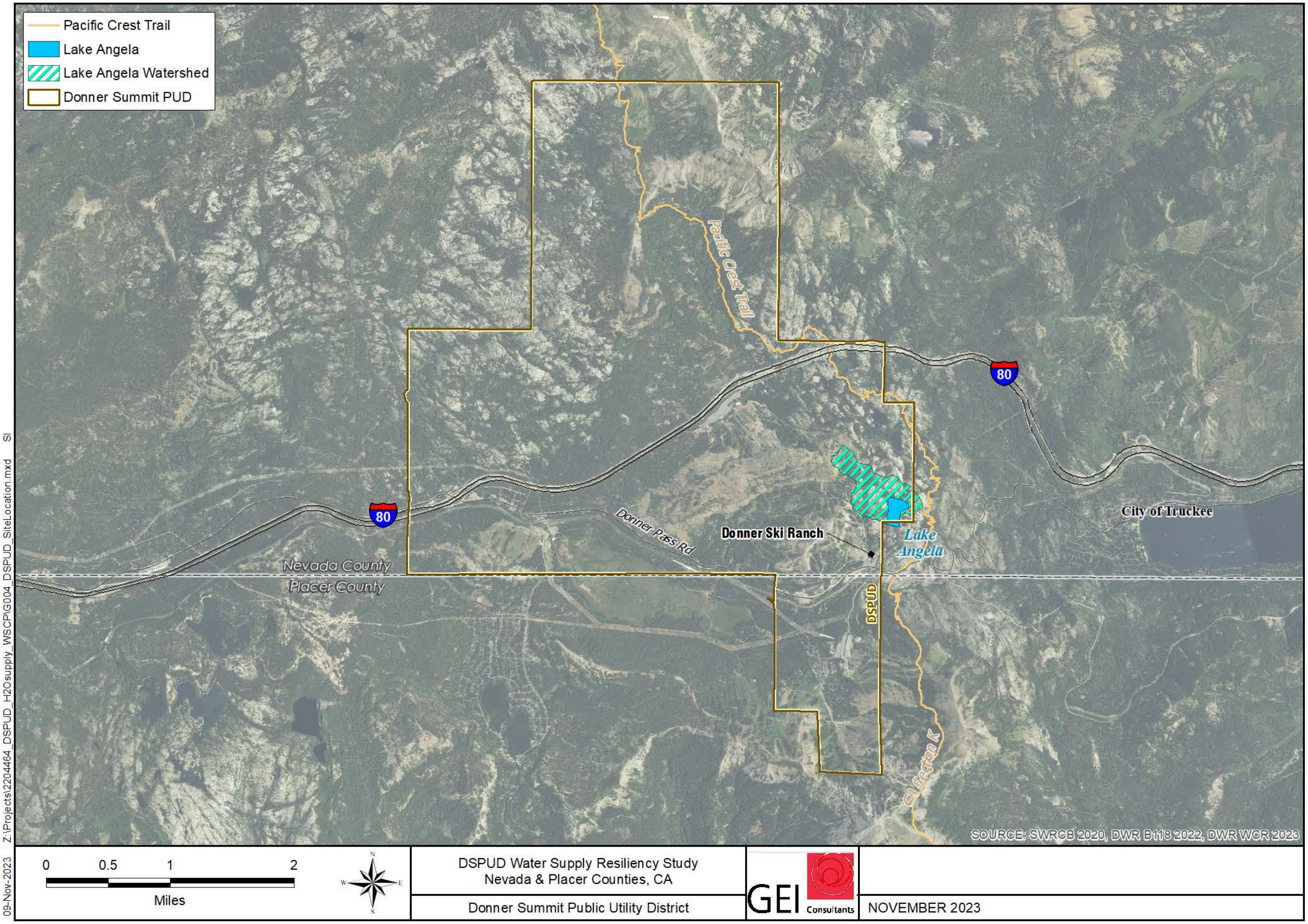

Figure 1-1. Site Map

1.3 STUDY ORGANIZATION

This study is organized into seven chapters:

- **Chapter 1 – Introduction:** This section provides an overview of the study area and describes the purpose and scope of the study.
- **Chapter 2 – Drought Risk Evaluation:** This section assesses the risk of drought and climate change impacts to DSPUD and provides accompanying recommendations.
- **Chapter 3 – Water Quality Risk Evaluation:** This section assesses the risk of water quality impacts to DSPUD and provides accompanying recommendations.
- **Chapter 4 – Identification of Potential Water Supply Solutions:** This section provides an overview of potential permanent and short-term water supply solutions that may be available to supplement the District's existing water supply.
- **Chapter 5 – Evaluation of Water Supply Solutions:** This section provides an evaluation of water supply solutions selected for evaluation.
- **Chapter 6 – Summary and Conclusions:** This section provides a summary of the study's findings and outlines next steps.

2 DROUGHT RISK EVALUATION

This chapter describes the operations simulation model used to evaluate the risk of drought and climate change impacts to DSPUD. The drought risk evaluation was conducted by incorporating existing and future conditions scenarios into the operations simulation model. Using the results from these scenarios, drought risks and recommendations are also provided.

2.1 MODEL DEVELOPMENT

To evaluate the risk of drought and climate change impacts, an operations simulation model was developed which incorporates current and future demands under historic and projected climate change hydrologic scenarios. These scenarios were tested over a period containing water years 1976 to 2021 to include the hydrologic variability which occurs in the basin. Table 2-1 provides a summary of the assumptions used for the two scenarios that were explored as part of the drought risk evaluation. Development of the historic and future hydrology datasets is described in Section 2.1.1 and 2.1.2, and the development of the demands under existing and future conditions is described in Section 2.1.5.

Table 2-1. Drought Risk Evaluation Scenarios

Scenario No.	Scenario	Facilities	Hydrology	Study Period	Demand
DR-1	Existing Conditions	Existing	Historic	1976-2021	Historic (2017 – 2021 average)
DR-2	Future Conditions	Existing	2040 Climate Change	1976-2021 modified by climate change factors	Future based upon planning documents

Note: DR = drought risk

2.1.1 HYDROLOGY

As part of the model development, two hydrology datasets were developed. The first data set is a representation of historic inflow to Lake Angela derived from the Kidd Lake inflow data created as part of the inflow dataset for Nevada Irrigation District's Federal Energy Regulatory Commission Relicensing effort of the Yuba-Bear Project, updated for their current *Plan for Water* effort. This dataset was developed by using the methods described in the *Hydrologic Analysis Technical Memorandum – Final Report for Nevada Irrigation District* dated November 12, 2020. The dataset extends through 2021 and includes an inflow time series to Kidd Lake. Kidd Lake is about 5 miles west of Lake Angela with similar watershed characteristics and watershed areas. Lake Angela has a watershed area of 0.225 square miles and an elevation of 7,210 ft mean sea level (msl). Kidd Lake has a watershed area of 1.9 square miles and an elevation of about 6,640 ft msl. One significant difference is the elevation of the watersheds of the two lakes. Lake Angela's watershed reaches over 7,600 ft msl, while Kidd Lake's watershed highest point is 6,750 ft msl.

Initially, the Kidd Lake inflow dataset was scaled by watershed area to develop a daily inflow dataset for Lake Angela from 1976 through 2021 using Eq. 1:

Eq. 1 $\text{Inflow}_{KL} \times (\text{Watershed Area}_{LA} / \text{Watershed Area}_{KL})$

Where:

Inflow_{KL} equals the time series inflow to Kidd Lake

$\text{Watershed Area}_{LA}$ equals the watershed area of Lake Angela (0.225 sq mi)

$\text{Watershed Area}_{KL}$ equals the watershed area of Kidd Lake (1.9 sq mi)

The resulting inflow, shown in blue in Figure 2-1, was used in the model simulation with historic demand.

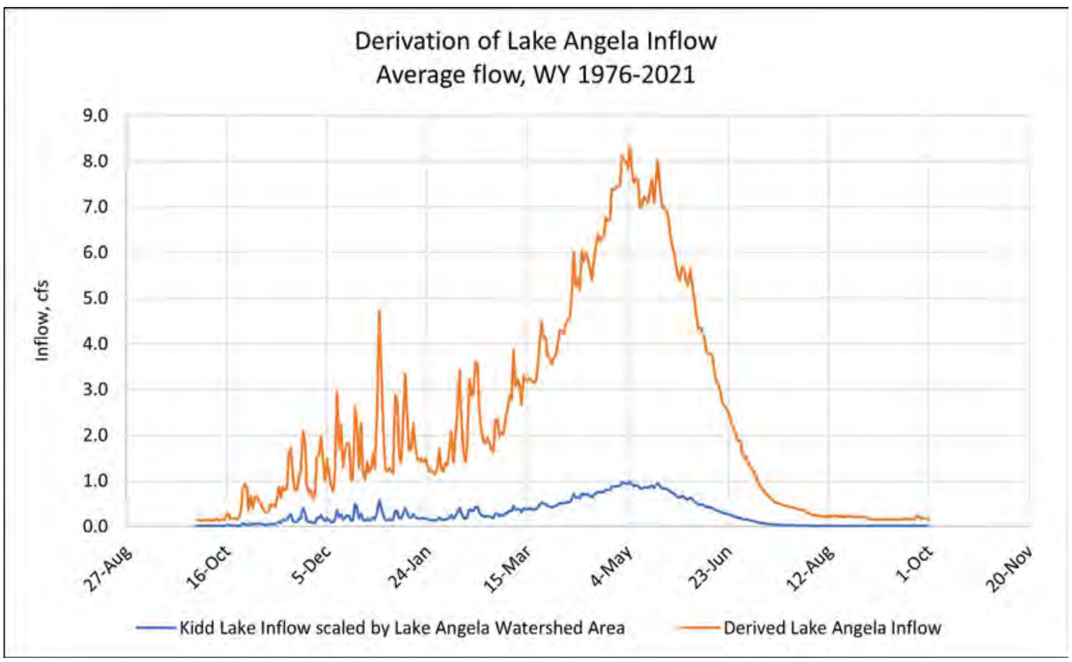

Figure 2-1. Lake Angela Inflow

The simulation model was used to test the Lake Angela Inflow hydrology dataset by comparing model operations to the historic storage data using historic deliveries. Figure 2-2 illustrates the simulated storage compared to the historic storage. The gray lines show the intermittent historic Lake Angela storage. The orange line represents the simulated storage using the scaled Kidd Lake inflow and the historic consumptive deliveries. Using the scaled hydrology data results in storage volumes that are much lower than historic. The results indicate that the scaled approach produces inflows that are much lower than actual inflows. A second validation study was performed using the full Kidd Lake inflow dataset. The blue line illustrates the resulting storage which very closely matches the historic storage. Although Figure 2-2 only shows 2014, these trends are similar for the 2009 to 2015 period where both historic storage and historic delivery data are available. The full derived Lake Angela inflow dataset demonstrates a better fit for the Lake Angela inflow than the scaled Kidd Lake inflow. The derived inflow dataset was chosen as a suitable dataset for the Lake Angela inflow for this analysis.

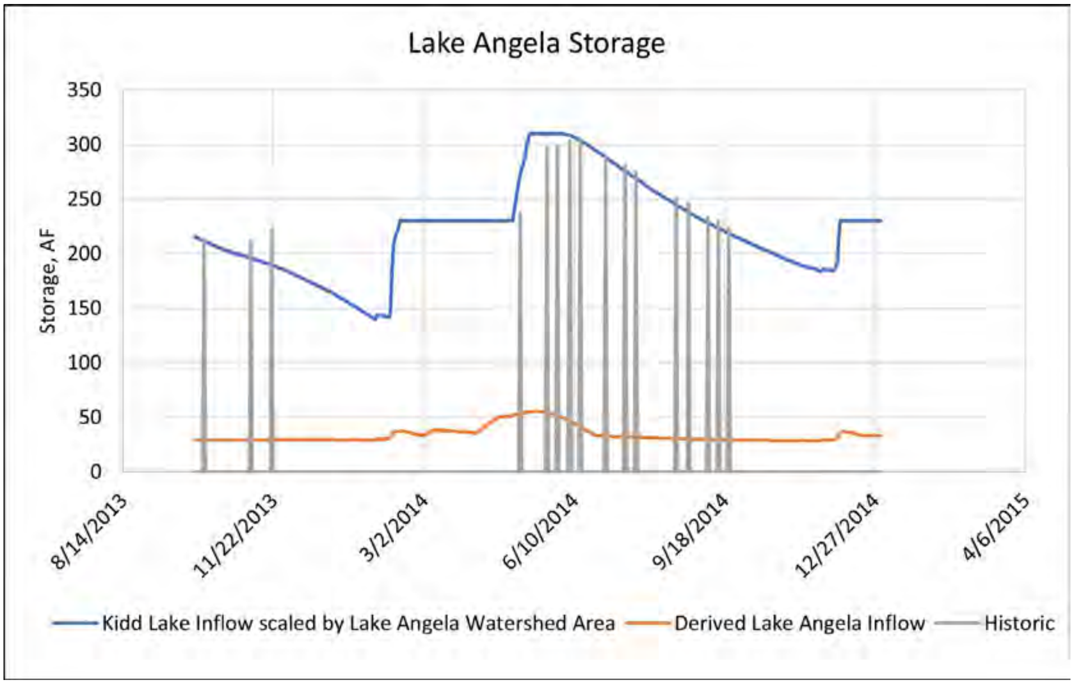

Figure 2-2. 2014 Simulated Lake Angela Storage vs Historic Storage

2.1.2 CLIMATE CHANGE HYDROLOGY

Climate change adjusted hydrology was developed using CalSim 3 2040 Central Tendency for the U.S. Geological Survey Gage at South Yuba River at Cisco Grove. This dataset was developed for the *2021 California Department of Water Resources (DWR) Delivery Capability Report*. The 2040 Central Tendency (or 2040 CT) data at Cisco Grove was disaggregated into daily timestep data and adjusted for the historic Lake Angela inflow dataset. The study period for this climate change dataset is October 1, 1975 to September 30, 2015. Because the CalSim dataset only has data through 2015, years similar to 2016 through 2021 were identified to extend the record through 2021.

Figure 2-3 illustrates the historic unimpaired inflow to Lake Angela compared to the 2040 level of climate change hydrology. The total volume of the climate change hydrology is 0.2 percent less than the historic hydrology. The most significant change is the shift in runoff pattern. This shift reflects the diminished snowpack expected in the future, resulting in a potential need for changes in operations or a replacement of the snowpack storage.

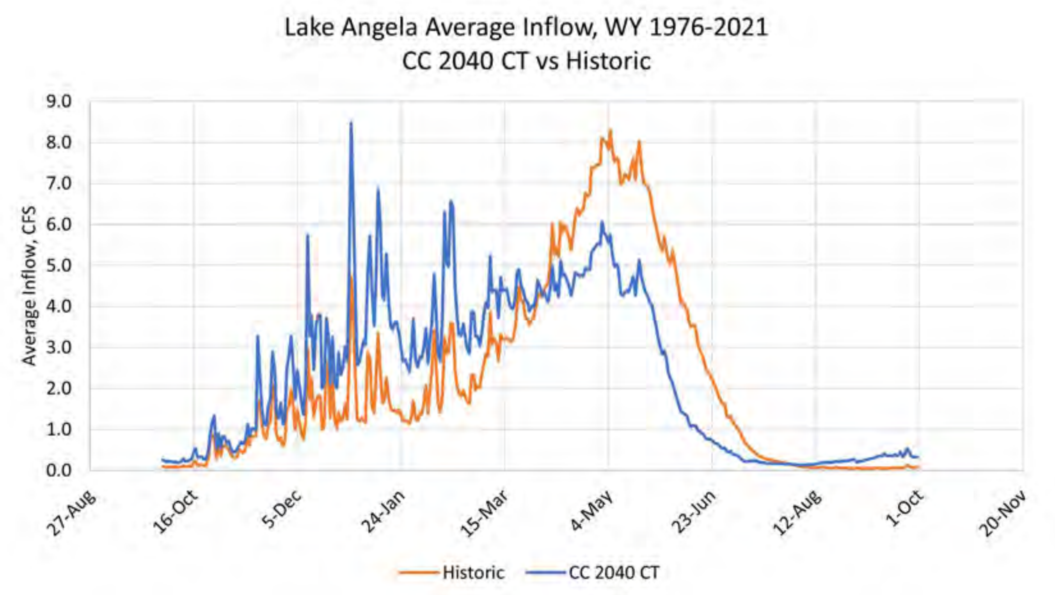

Figure 2-3. Climate Change 2040 CT vs Historic

These inflow datasets contain watershed runoff modeling results for two climate conditions as shown in Table 2-2.

Table 2-2. Climate Conditions

Condition	Description
Historical	Historical representation of Lake Angela inflow from Kidd Lake Inflow
2040 Future Conditions	Future conditions projected climate for a thirty-year period centered on 2040 (2025-2055)

Figure 2-4 shows how the two datasets compare. The climate change scenario volume is almost identical to the historic hydrology.

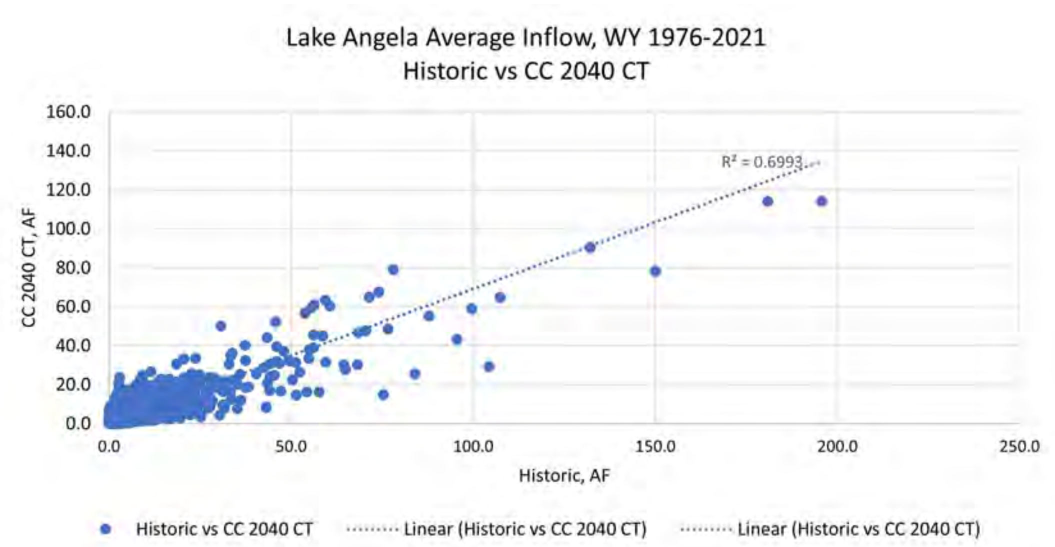

Figure 2-4. Historical versus 2040 Future Conditions

2.1.3 EVAPORATION

No evaporation rate data was available specifically for Lake Angela. As an estimate of evaporation, the DWR Bulletin 73, *"Evaporation from Water Surfaces in California"*, dated November 1979 combined with the Lake Valley Reservoir evaporation pattern from CalSim 3 was used. There is a fairly strong relationship between elevation and evaporation. Table 2-3 illustrates the estimated evaporation rates used for Lake Angela. According to Google Earth, Lake Angela is located at about 7,200 ft msl. Annual evaporation was estimated as 32.01 inches for the historical condition, and 32.98 inches for the 2040 future conditions. Neither the annual total nor the monthly rates are significantly different between the historic and 2040 climate change datasets.

Table 2-3. Evaporation Rates, inches

Month	Historic	2040 CT
Oct	2.53	2.62
Nov	0.94	0.98
Dec	0.49	0.51
Jan	0.37	0.38
Feb	0.74	0.76
Mar	1.33	1.36
Apr	2.47	2.52
May	3.58	3.69
Jun	4.57	4.73
Jul	5.89	6.04
Aug	5.26	5.41
Sep	3.86	3.97
Total	**32.01**	**32.98**

2.1.4 DIVISION OF SAFETY OF DAMS STORAGE REQUIREMENTS

Lake Angela operations are subject to the California Division of Safety of Dams (DSOD) Jurisdiction. Lake Angela must reduce storage capacity to 230 acre-feet (AF) from November 1 through April 30. Maximum capacity is 310 AF from May 1 to October 31. In addition, the District will operate the spillway gates considering how wet the year is. For example, when the year is very wet the spillway gates may remain open beyond April 30 to bypass large inflows to Lake Angela.

2.1.5 CONSUMPTIVE DEMANDS

Another stressor on the Lake Angela water supply are the consumptive demands summarized in the following sections and shown in Table 2-4.

2.1.5.1 EXISTING DEMANDS

The existing demands were developed by averaging the deliveries reported as beneficial use to the State Water Resources Control Board (SWRCB)[1]. Averaging

1 *https://ciwqs.waterboards.ca.gov/ciwqs/ewrims/listReportsForWaterRight.do?waterRightId=37062*

the deliveries for the 2017 to 2021 period on a monthly basis results in the *Existing Consumptive Demand, AF* column in Table 2-4. The District estimates that an additional 20 percent of the raw water supply is needed for backwashing the water treatment plant in addition to the consumptive demand. Total existing demand is 243 acre-feet per year (AFY).

2.1.5.2 FUTURE DEMANDS

The future demand data set was developed using the Soda Springs Area Plan, dated October 25, 2016[2] for the portion of the District that exists in Nevada County. The Land Use designations from the Placer County General Plan were used for the portion of the District that exists in Placer County. The Nevada Irrigation District 2020 Urban Water Management Plan dated July 2021[3] was used as a reference to identify unit demands for the various service area types identified in both the Soda Springs Area Plan and the Placer County area. Total treated water demand within the Nevada County service area is 218 AFY. The service area within Placer County lies completely within the Sugar Bowl Ski Resort. Most of the parcels within the resort area with a treated water demand are residential. The Placer County Geographic Information System Department provided the land use designations within the Ski Resort[4]. The same demand factors within the Nevada Irrigation District 2020 Urban Water Management Plan were applied to the residential parcels within the Sugar Bowl Ski Resort to develop the future level demands. Total Placer County demand is anticipated to be 160.6 AFY. Total District (Nevada County + Placer County) demand is anticipated to be approximately 378.6 AFY. After adding water needed for backwashing the treatment plant, total demand is 454.3 AFY.

Build out demands are expected to be about 176 AFY more than the existing demand. With an anticipated increase in backwash water, that increase rises to 211 AFY more than existing demand. Table 2-4 summarizes the demands used for both the existing and future conditions.

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2 *https://www.nevadacountyca.gov/995/Soda-Springs-Area-Plan*

3 *https://www.nidwater.com/ag-urban-water-management-plans*

4 *http://maps.placer.ca.gov/Html5viewer/Index.html?configBase=http://arcgis/Geocortex/Essentials/REST/sites/LIS_Public/viewers/LIS_Base-Public/virtualdirectory/Resources/Config/Default*

Table 2-4. Existing and Future Consumptive Demands

Month	Existing Consumptive Demand, AF	Baskwash (20% of Demand), AF	Total Existing Demand, AF	Build out Consumptive Demand, AF	Baskwash (20% of Demand), AF	Total Future Demand, AF
Jan	23.7	4.7	28.4	44.2	8.8	53.1
Feb	16.2	3.2	19.4	30.2	6.0	36.3
Mar	17.5	3.5	21.0	32.7	6.5	39.3
Apr	15.2	3.0	18.2	28.4	5.7	34.1
May	14.4	2.9	17.3	26.9	5.4	32.3
Jun	18.3	3.7	22.0	34.3	6.9	41.1
Jul	18.3	3.7	21.9	34.2	6.8	41.0
Aug	16.9	3.4	20.3	31.7	6.3	38.0
Sep	14.1	2.8	16.9	26.4	5.3	31.6
Oct	14.8	3.0	17.8	27.7	5.5	33.3
Nov	14.6	2.9	17.5	27.3	5.5	32.8
Dec	18.5	3.7	22.2	34.6	6.9	41.5
Total Potable Water Demand	**202.5**	**40.5**	**243.0**	**378.6**	**75.7**	**454.3**

2.1.6 MODEL SCHEMATIC

The model schematic shown in Figure 2-5 illustrates the modeled facilities and linkage. The modeled facilities are overlayed on the watershed features to approximate the geographic location of the facilities. The schematic is made up of three node types and two link types, described below.

2.2 RESULTS

As previously summarized in Table 2-1, the drought risk evaluation explored two scenarios to evaluate the risk of drought and climate change impacts: scenario DR-1, which represents current historic hydrology and existing demands (existing conditions), and Scenario DR-2, which represents future climate change hydrology coupled with anticipated future demands (future conditions).

2.2.1 SCENARIO DR-1 - EXISTING CONDITIONS

As discussed in Section 2.1.5.1, this scenario uses a demand that was developed by averaging the actual historic demands for the 2017 to 2021 period. The average demand repeats for every year of the simulation. Figure 2-6 shows the annual delivery and demand for the period of record. In 1976, 1977, 1988, 2013, 2014 and 2015 there are shortages imposed. This was done in a manner that tries to mimic curtailments imposed by the SWRCB by looking at the April through July runoff.

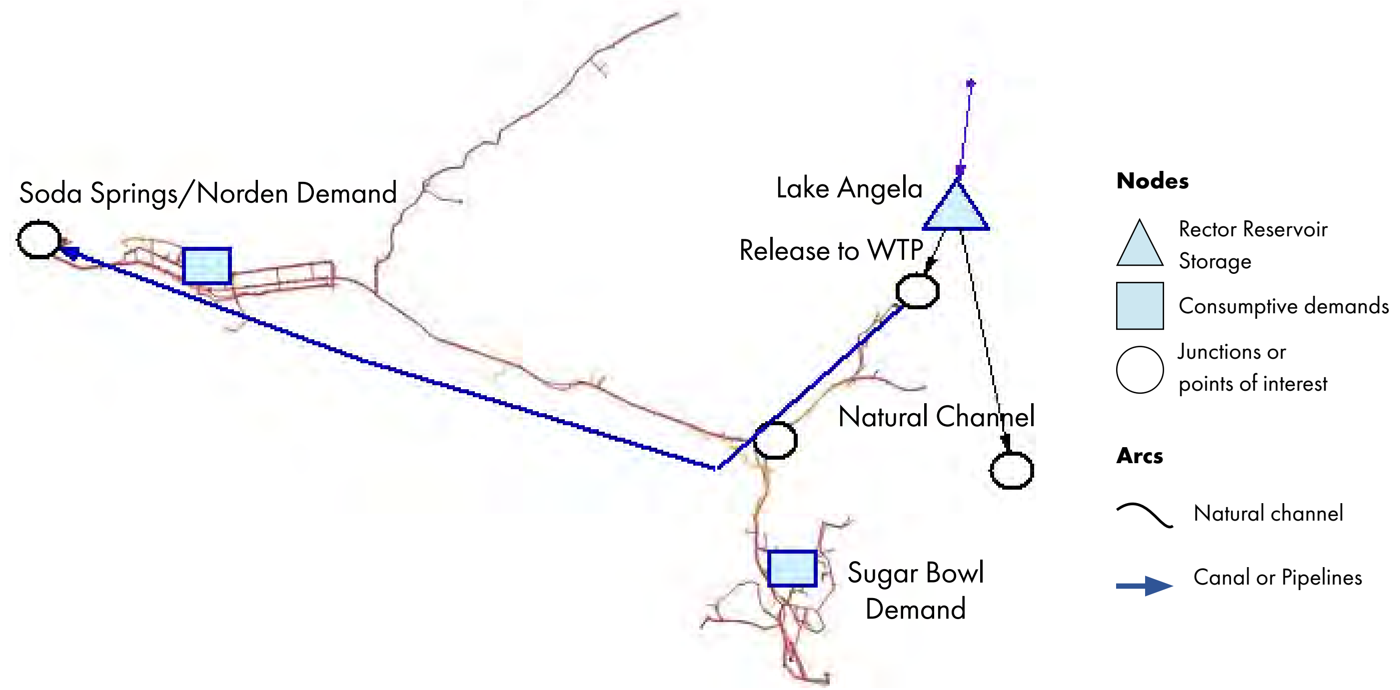

Figure 2-5. Lake Angela Reservoir System Schematic

These curtailments are for the April through the following February period only and impose a 25 percent reduction in delivery. These reductions in delivery exactly meet the reduction in demand meaning that these are following the curtailment logic and are not because storage has reached dead pool at Lake Angela.

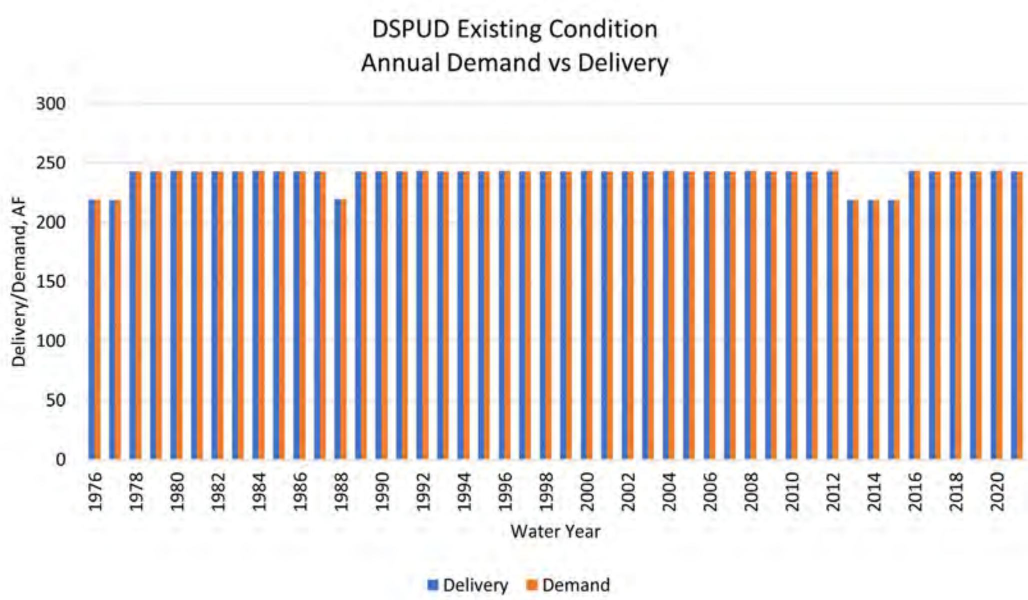

Figure 2-6. Scenario DR-1 Deliveries

Figure 2-7 illustrates the resulting storage at Lake Angela. The minimum storage at Lake Angela for the study period occurs in 1990 and is roughly 140 AF, leaving approximately 100 AF of additional storage above the dead pool. Under existing conditions, the water supply is more than sufficient to meet demand. Assuming the system is functioning well, the findings suggest a minimal risk of water supply shortage resulting from drought conditions under Scenario DR-1.

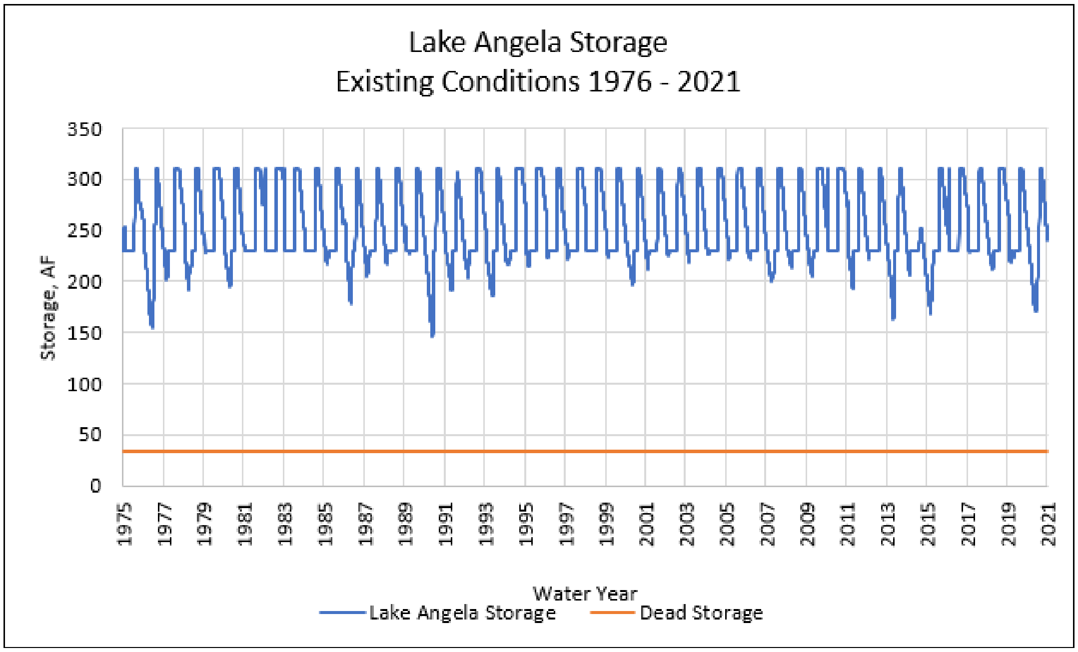

Figure 2-7. Scenario DR-1 Lake Angela Storage

2.2.2 SCENARIO DR-2 - FUTURE CONDITIONS

As discussed above, Scenario DR-2 includes full build out demands with climate change hydrology. The demands account for growth in the service area and, as discussed in Section 2.1.5.2, are expected to increase by 211 AFY. Figure 2-8 illustrates the deliveries made under Scenario DR-2. This scenario includes the same curtailment logic as Scenario DR-1. However, under Scenario DR-2, the deliveries do not exactly meet the demand. This is because the storage at Lake Angela has fallen to dead pool and no other supplies are available.

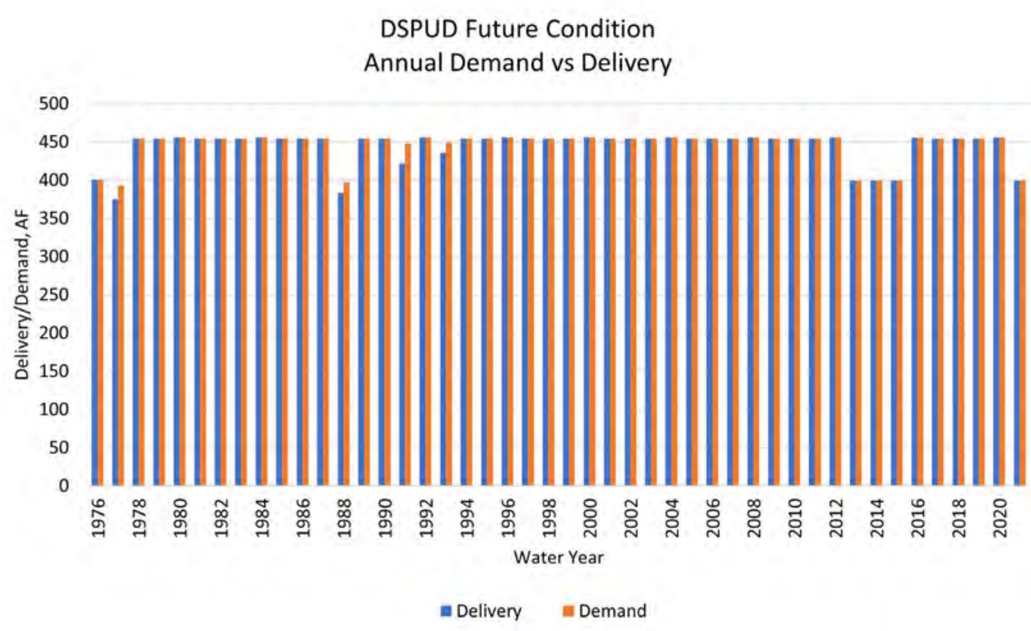

Figure 2-8. Scenario DR-2 Deliveries

Figure 2-9 illustrates the Lake Angela storage at the Future Level. Figure 2-9 shows that Lake Angela falls to dead pool eight times during the 1976 to 2021 simulation period. Figure 2-9 also shows that Lake Angela is constrained by the DSOD storage limitation. The DSOD limitation prevents storage of more than 230 AF during the November 1 through April 30 period. The shift in runoff patterns of the climate change hydrology results in a change in the ability to store water. This pattern shift combined with the DSOD requirement prevents Lake Angela from maximizing the water supply.

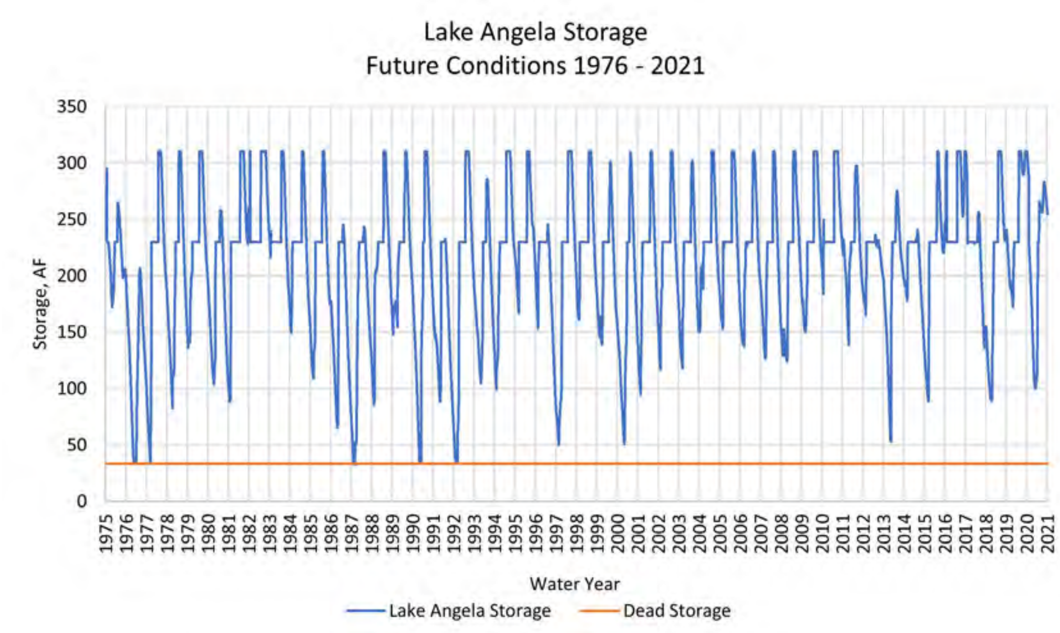

Figure 2-9. Scenario DR-2 Lake Angela Storage

Under future conditions, additional steps will be needed to meet anticipated demand. Changes to the DSOD requirements and the development of a water shortage contingency plan could be used to enhance water supply reliability. Under current operating criteria at future demand, study results indicate the reservoir will not always fill and in 5 years out of the 45-year study period, Lake Angela will be drawn down to dead pool.

2.2.3 CONCLUSIONS

Based on the results of the drought risk evaluation, it appears that Lake Angela can meet demands under existing conditions. Under future conditions assuming full build out demands and climate change hydrology, it appears that the increased demands coupled with the shift in runoff patterns due to climate change and the DSOD storage requirements limit Lake Angela from maximizing the available water supply.

The shift in the runoff pattern of the climate change hydrology is significant. Figure 2-10 illustrates the impact of climate change hydrology. The orange line shows the historic average annual runoff pattern. The blue line shows the climate change average annual runoff pattern. The red line shows the maximum allowable storage ordered by DSOD. Figure 2-10 illustrates how the climate change hydrology peak runoff pattern shifts earlier in the year to the December through March period as compared to the historic April through June period. Although both average annual runoff volumes are almost identical, use of climate shifted supply is hindered by the DSOD requirements that were developed for the historic runoff patterns.

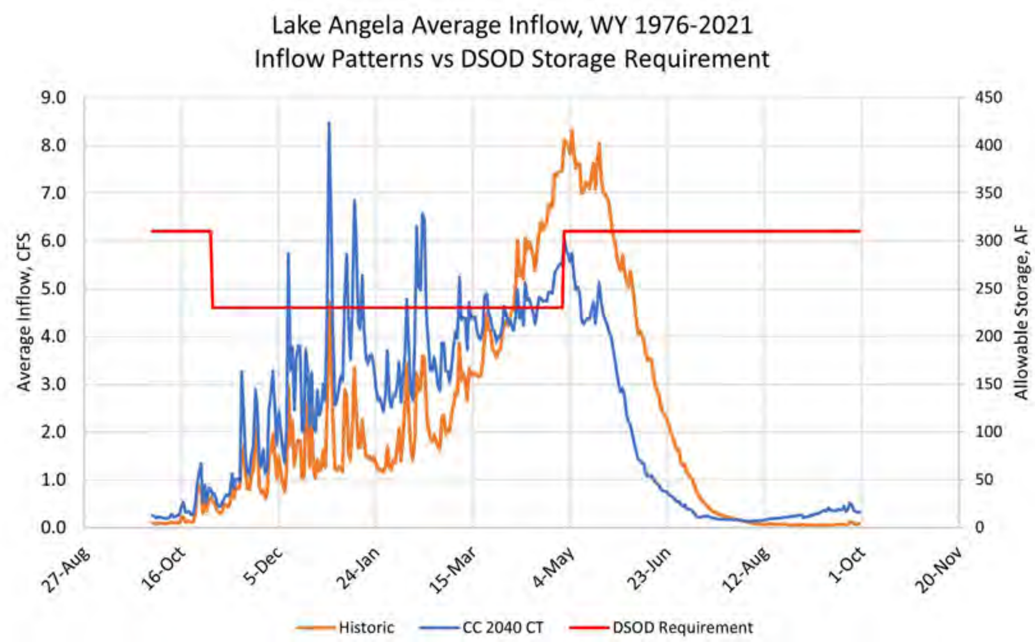

Figure 2-10. Lake Angela Inflow vs DSOD Storage Requirement

With the increase in demand, capturing the earlier runoff to fill Lake Angela is necessary. Figure 2-9 illustrates that the DSOD requirement causes spills, limiting the gain in storage to full pool in just 31 of the 45-year study period. Eliminating or revising the DSOD requirement will increase water supply and therefore reduce the delivery shortages.

2.3 DROUGHT RISKS AND RECOMMENDATIONS

The drought risk evaluation demonstrates the need for development of a water shortage contingency plan and the consideration of a revision to the DSOD storage requirements.

- **Development of a water shortage contingency plan:** Under existing conditions, study results indicate that there is little risk of water supply shortage due to drought. However, study results for Scenario DR-2 assuming full build out demands and climate change hydrology suggest that there will be a supply-demand imbalance during some future dry years. Without additional supplies, the District will need to impose reductions to deliveries during dry conditions to maintain storage levels above dead pool at Lake Angela. To help conserve water supplies during future droughts or emergency conditions where storage begins to approach dead pool, DSPUD should consider the development of a water shortage contingency plan. This plan would include a framework of specific water use restrictions that would be put into effect during a water shortage, and the triggers that would initiate these restrictions.

- **Consideration of a revision to the DSOD storage requirements:** The current DSOD storage requirements were developed for runoff patterns that generally peak in mid to late April through May. Climate change projections indicate future runoff patterns will result in peak runoff in the January through February period. Because of the shifting runoff patterns and the current DSOD requirements coupled with anticipated demands, filling Lake Angela in the future may become less frequent. Figure 2-10 illustrates the current DSOD requirements against the historic and future runoff patterns. By visual inspection, it appears that allowing storage up to full pool could be shifted to as early as March maximizing water supply while still protecting the dam. The District should request that DSOD review the current requirements and make adjustments as runoff patterns shift.

3 WATER QUALITY RISK EVALUATION

This chapter describes the ecological and limnological steady-state conditions for Lake Angela based on available information and describes the potential risks that may influence water quality and its treatability. In-lake management strategies and operational considerations regarding water treatment to adaptively mange changes in Lake Angela are also provided. Further details related to the water quality risk evaluation can be found in Appendix A.

3.1 LAKE ANGELA

As stated in Chapter 1, the District's only source of water supply comes from Lake Angela which is located at an elevation of about 7,200 feet, near Donner Summit and the crest of the Sierra Nevada Mountains. The water from Lake Angela is treated at the District's water treatment plant and distributed to approximately 360 domestic water customers in the Donner Summit area. This includes neighboring communities like Norden, Soda Springs, and Big Bend, as well as local ski resorts.

Lake Angela is supplied with source water from a relatively small watershed, spanning 144 acres, which forms a part of the headwaters in the South Fork Yuba River Watershed. The primary hydrological input to the lake is derived from snowpack and overland runoff, as there are no defined tributary inflows contributing to the waterbody. The lake also likely receives little to no ground water inflows given the surrounding geology and its headwaters location. The sole purpose of Lake Angela is for domestic water supply.

Lake Angela Dam was first constructed in 1945 and later expanded in 1971 to its current configuration, creating a surface area of approximately 19.6 acres with a storage capacity of approximately 310 AF – which is DSPUD's water right – at an elevation of 7,197 ft. The expansion of the dam created two basins separated by a ditch at an elevation of 7,177 feet. Even though the historical dam was partially removed to create a connectivity channel (i.e., ditch) between the basins, the natural geology along the historical dam remained in place, creating a natural sill between the basins (Figure 3-1). The existing concrete dam has a crest elevation of 7,197.2 feet and a spillway crest elevation of 7,192.8 feet (NAVD 88). A 10-inch diameter outlet structure for the water treatment facility is located at an elevation of 7,172 ft, at the southern end of the lake (i.e., southern basin), while the deepest portion of the lake is located approximately 1,000 ft north of the dam (i.e., northern basin). Other than the spillway, there is no defined reservoir outfall, releasing water downstream, thus, water supply releases and evaporation account for the hydrological outputs. During the period from November 1 to April 30, Lake Angela is required to reduce its storage capacity to 230 AF. From May 1 to October 31, the maximum capacity of the lake is allowed to reach its full 310 AF. The District will operate the spillway gates considering how wet the year is. For example, when the year is very wet the spillway gates may remain open beyond April 30 to bypass large inflows to Lake Angela.

3.2 ECOLOGICAL SETTING

Lake Angela is set in the granitic rock outcrops of the Cretaceous Period, characterized as Horneblende-biotite-granodiorite of Summit Lake with K-feldspar megacrystic facies and Tonalite of Lake Mary formations, with small pockets of Talus glacial deposits from the Holocene Period (Sylvester et al. 2012). The Natural Resource Conservation Service further refines the granitic soil characteristics as granitic-Tinker-Cryumbrepts derived from decomposed granite, with 2-30 percent slopes and Meiss weathered rock outcroppings with pockets of freely drained soils (Huntington and Akeson 1987). The mineral soils are poorly developed, and the organic matter content is low due to the exposed granitic outcrops and relatively open canopy of the coniferous forest consisting of Lodgepole Pine (Pinus contorta var. murrayana) and Jeffrey Pine (P. jeffreyi) with low lying shrubs, Sagebrush (Artemisia tridentata) and Bitterbrush (Purshia tridentata).

As reported in the Lake Angela Watershed Sanitary Survey Report (Sauers Engineering, 2021), wildlife in the watershed is relatively limited by availability of food, shelter, and places for rearing young. Land use, as defined by Nevada County General Plan, is Forest.

Because the lake is designed for storage, with no regular flow-through, water can become stagnant. There are two conditions that contribute to algae growth: 1) during years of low precipitation when there is no outflow; and 2) during summer months when the lake is experiencing thermal destratification. Excessive algal blooms were experienced in July-August 2009 and July-August 2015 (Sauers Engineering, 2021).

3.3 EXISTING MONITORING DATA FOR LAKE ANGELA

3.3.1 HYDROLOGY

Based on the limited lake level data, collected primarily from 2009 to 2015, Lake Angela is generally at full capacity (7,192.8 ft) from April to June, at which time the summer water demand decreases lake level by approximately 1.6 feet per month through September, and eventually decreases to minimum lake level (7,186 ft) in November. No lake level data are available for the winter months December through February when the lake is ice- and snow-covered. In terms of risk to Lake Angela's hydrological cycle and water storage, climate modeling scenarios indicate that the Yuba Watershed may experience considerable reductions in flow and water storage under warmer climate conditions (Null et al. 2010). The northern Sierra Nevada watersheds are highly developed for drinking water storage and reductions in flow are predicted to be the greatest during wet-year type conditions. Because Lake Angela is at the headwaters of the Yuba Watershed, these modeled conditions may be less pronounced; however,

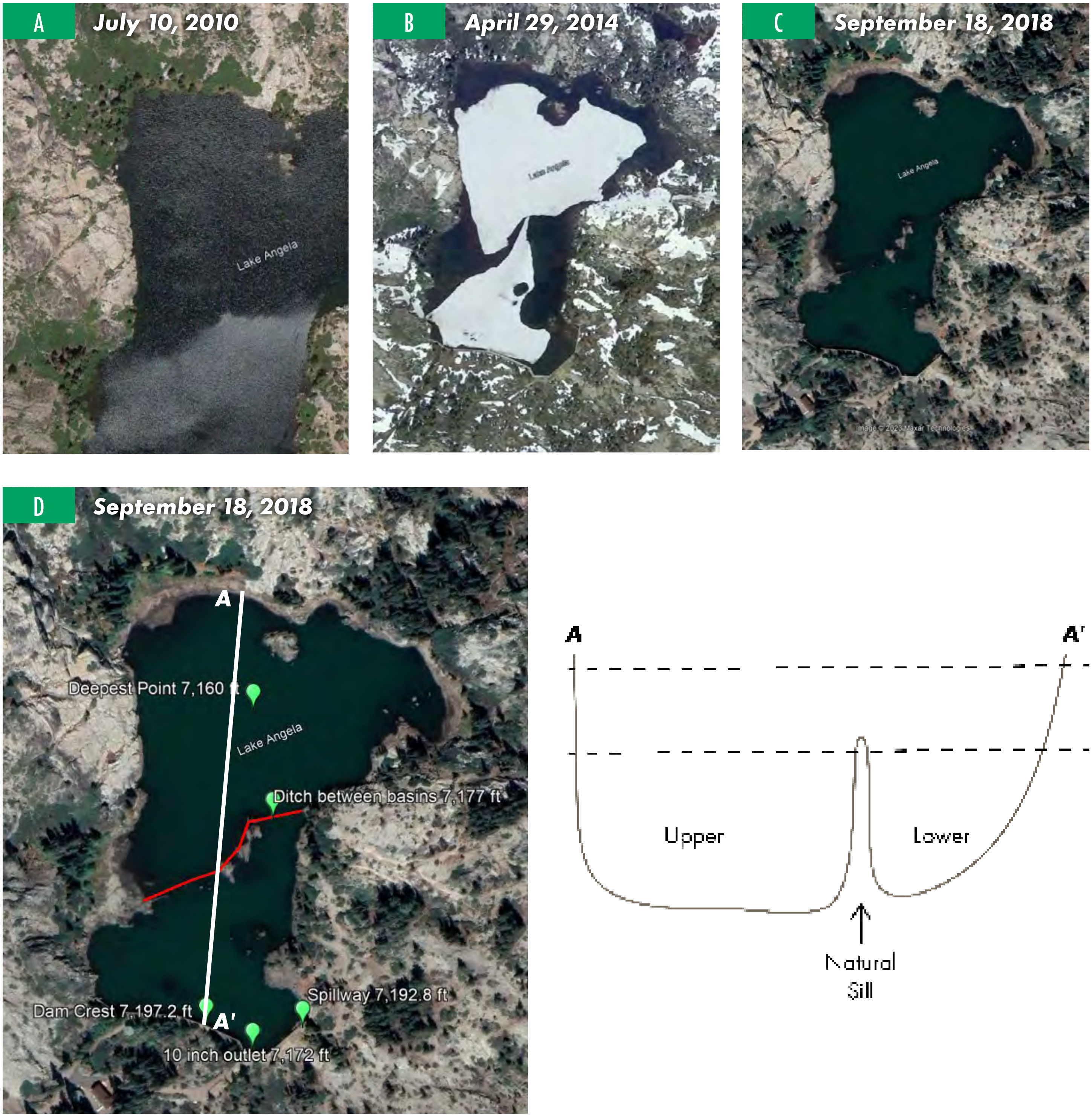

Figure 3-1. Satellite Images of Lake Angela

decreases in wet-year storage followed up by consecutive dry-year conditions may result in decreased lake levels that can also affect water quality. Per DSPUD's permit for diversion and use of water, water can only be collected and stored from November 1 to July 31, and collection outside of this period is not authorized to offset evaporative losses or low lake levels. If lake levels approach a condition where the two basins are largely isolated (Figure 3-1), except for the interconnective ditch portion, wind-induced mixing will be limited, creating more quiescent conditions in the southern basin. These conditions may be more prevalent during the late summer or fall period, when conditions are more favorable for algae production.

3.3.2 WATER QUALITY

The physicochemical properties of Lake Angela and its two distinct basins are poorly characterized; although DSPUD periodically collects raw water samples on the facility's intake from the southern basin (2008-2020, n = 8 samples). These few raw water intake samples are likely representative of water quality conditions in Lake Angela's southern basin. However, the hypolimnetic water withdrawal for treatment and movement of water from the northern basin into the southern basin can affect the water quality conditions observed in raw water intake samples. Nonetheless, the water quality results show a high quality drinking water source absent of organic contaminants, albeit with characteristics representative of its watershed and sediment conditions. The bicarbonate-carbonate-alkalinity concentrations show a weakly buffered lake that is low in ionic strength (i.e., conductivity) and hardness (i.e., calcium and magnesium). The metals that readily bind to phosphorus were typically present in detectable concentrations of raw water samples, but less than their maximum contaminant level for drinking water. Notably, the highest concentrations of iron and manganese, including total dissolved solids appeared to occur when the lake's elevation was relatively low and storing less water, and likely represented a mixed water column, post fall turnover (Sauers Engineering, 2021). The nutrient water chemistry data that are important for understanding the algae dynamics in Lake Angela are not available. Only nitrate-nitrite analyses were performed which represent only a fraction of the bioavailable total inorganic nitrogen component that that supports algae growth. No phosphorus analyses were performed on raw water samples.

3.3.3 ALGAE

Little to no information exists on the algae population dynamics in Lake Angela other than the lake has experienced infrequent nuisance algae blooms that resulted in raw water treatability issues (i.e., turbidity). In 2009, the nuisance alga was identified as Chlorella sp., a micro-green alga (2 10 µm spherical cell) that is common in high elevation lakes and is well adapted to low concentrations of inorganic nitrogen, soluble reactive phosphorus, and minerals. The lake also contained Oocystis sp., a green alga (10-20 µm ellipsoid cell), and three diatom genera–Navicula, Cocconeis, Cyclotella, that represent both pennate and centric cells (10-75 µm). In July 2016, Lake Angela experienced a similar nuisance algae bloom causing treatability issues, although the algal taxa were not identified.

3.4 LIMNOLOGY AND WATER QUALITY OF SIERRA NEVADA LAKES

External Nutrient Inputs

The soil nutrient contents and fluxes from the semiarid forest are relatively low compared to other northern temperate forest types (Johnson et al. 1997). However, the atmospheric deposition of nitrogen and phosphorus, from sources outside of the watershed, represents a relatively large fraction of the watershed nutrient budgets and inputs to high elevation lakes in the Sierra Nevada mountain range (Sickman et al. 2003). Sources for the atmospheric deposition include motor vehicle emissions, wind-blown dust,–pollen, and–organic matter, along with ash particulates from wildfires. In fact, the aeolian deposition of biologically available total inorganic nitrogen and soluble reactive phosphorus inputs to Sierra Nevada Lakes have been directly linked to regional forest fires (TREC 2022) which provides an external nutrient source to the lake's algae population. The atmospheric deposition within the watershed, along with the natural decomposition of organic matter, is "flushed" into Sierra Nevada lakes during spring snowmelt or rainfall runoff. These external nutrient sources have contributed to the general pattern of nutrient enrichment in lakes throughout the Sierra Nevada mountain range (Sickman et al. 2003), including Lake Angela. When this pattern of nutrient enrichment is placed into the context of a warmer climate, small changes in ice-cover duration, spring snowpack and timing of snow-melt runoff (Null et al. 2010), surface water temperature (Sadro et al. 2019), and light availability can have a large influence on algae production in the oligotrophic lakes of the Sierra Nevada mountain range (Goldman et al. 1993, Sickman et al. 2003, Goldman 2000). If dry-year type conditions continue to be more frequent, high elevation lakes in the Sierra Nevada (like Lake Angela) will continue to become more productive of algae (Sadro et al. 2019).

Internal Nutrient Inputs

Lake Angela may typify a small lake in the northern Sierra Nevada mountain range; however, little information exists describing the physicochemical characteristics of the lake or the hydrological processes that influence external nutrient inputs or possible internal nutrient loading from the lake sediments. Considering that the nutrient inputs from the watershed are likely small, the internal nutrient release may provide a substantive component of the nutrient mass balance that facilitates algal productivity during late summer or early fall. The long-term accumulation of organic matter at the bottom of the lake, supported by the annual cycle of algae growth–death–settling and nutrient recycling by aquatic life use (i.e., zooplankton and fish), has likely created a sediment layer that stores phosphorus bound to organic matter and mineral-oxides during oxygenated lake conditions. The sediment phosphorus content in high elevation, Sierra Nevada lakes, is sufficiently large enough (~1,450 mg/kg sediment) to provide a substantive internal nutrient loading component under redox conditions (Homyak et al. 2014). Approximately 30 percent of the sediment-bound phosphorus content is in the freely exchangeable and redox-sensitive iron-, manganese-oxides pool, while 70 percent is in the more recalcitrant aluminum- and calcium-oxides and non-reducible organic matter pool. Aluminum-bound phosphorus comprises the largest component of the recalcitrant pool in Sierra Nevada lakes (Homyak et al. 2014), effectively sequestering phosphorus that is not affected by redox conditions (Kopacek et al. 2005). The metals (e.g., iron, manganese, aluminum) along with calcium and silicates (important for diatom growth) are byproducts of natural weathering of the surrounding geology in the watershed.

Thermal Stability

Lake Angela is a small cold-water lake that exhibits a winter ice-covered period and two seasonal mixing periods (spring and fall). The two basins, separated by a sill, likely influence the thermal characteristics of Lake Angela and certainly influence the general spring warming and ice-off characteristics as evident in the satellite images (Figure 3-1). The lake is deep enough to exhibit thermal stratification during the summer months such that a density gradient separates the warmer upper water layer (epilimnion) from the colder bottom layer (hypolimnion). When the density gradient (thermocline) is resistant to mixing, the hypolimnetic dissolved oxygen content may be depleted by microbial respiration creating a low dissolved oxygen environment. When this condition persists, the microbial reduction of organic matter and metal oxides (e.g., freely exchangeable and redox-sensitive iron and manganese) as an electron source (i.e., energy) occurs in the sediment, releasing soluble reactive phosphorus, iron and manganese. These constituents diffuse across the sediment/water interface and into the overlying water column. When the hypolimnion remains stable and unmixed during the summer, the nutrient and metals concentrations can increase to levels that facilitate algae growth or influence water treatment, when the hypolimnion becomes mixed with the epilimnion in the fall. Other hydrological factors that can influence the water column stability, includes hypolimnetic withdrawal or stormwater inputs, causing temporary mixing of the water column or intrusion of water to deeper depths. These factors may be evident in Lake Angela when redox favorable conditions persist given the two distinct basins.

Algae

Despite the oligotrophic status of most Sierra Nevada lakes, there is evidence that algal productivity is increasing (Goldman et al. 1988, Goldman 2000, Derlet et al. 2009), concurrent with the increasing trends in nitrogen deposition (Sickman et al. 2003) and climate warming (OEHHA 2022). While reactive nitrogen deposition has be linked to changes in diatom assemblages of high elevation lakes (Winder et al. 2008, Olesky et al. 2020), the pronounced changes in other algae assemblages indicates additional drivers remain largely undocumented (Sadro et al. 2018). Algae populations in high elevation lakes are seasonally variable, with diatoms (single-celled, hard-bodied algae with silica based cell walls) typically the most abundant algae in the spring due to the mixing, nutrients, and light availability following seasonal ice-off conditions (Winder et al. 2009, Sommer 1989). Peak algae biomass typically occurs in late summer, and is usually associated with a shift from diatoms to small, soft-bodied unicellular chlorophytes (green algae) that are better adapted to the relatively stable water column and low nutrient and mineral concentrations (McKnight et al. 1990). The transition to the fall algae assemblage can contain a mix of chlorophytes, chrysophytes (golden algae) and cyanobacteria (Dory et al. 2022, McKnight et al. 1990), while the winter algae are often comprised of small motile cryptophytes and chrysophytes that are adapted to low light conditions, and can exhibit mixotrophy (i.e., consume bacteria to obtain carbon source rather than rely solely on photosynthesis). Oligotrophic conditions tend to provide a competitive advantage of small-bodied algae over the larger filamentous chlorophytes or cyanobacteria.

3.5 WATER QUALITY RISKS AND RECOMMENDATIONS

3.5.1 WATER QUALITY RISKS

Nuisance algae levels such as the ones observed in 2009 and 2016 can result in several water treatment problems such as taste and odor, formation of disinfection-by-products (e.g., trihalomethanes and chloroacetic acids), clogging of filter beds (Hung and Liu 2006), or biofouling and cake formation on filtration treatment systems (Shekhar et al. 2017). In addition to the size and shape of algal cells, algal organic matter [(i.e., metabolic byproducts and ruptured cells), dissolved organic carbon], and other particles affect the filtering efficiency and lifespan of microfiltration treatment systems (Novoa et al. 2021). As a result, a mix of physical and chemical biofouling control strategies are key to the long-term operation of water treatment systems. These approaches may include membrane cleaning (i.e., backwash, air scouring), chemical pretreatment (i.e., ozonation, oxidation, coagulation, in-lake algaecides), operational controls (i.e., cross flow velocity, induced shear stresses), or composite treatment systems [(i.e., coagulant + activated carbon pretreatment), Novoa et al. 2021]. In both instances, when raw water from Lake Angela created treatability issues, the nuisance algae levels were effectively controlled using chemical algaecides that reduced the water treatment issues. However, the algaecide control strategies are often reactionary in nature and occur after water treatment issues arise. Therefore, a mix of control strategies that include both proactive and reactive treatment options should be considered for risk planning purposes.

To summarize the potential risks to Lake Angela water supply and treatment for drinking water purposes, the risks include both external and internal mechanisms:

- **Mechanism:** Atmospheric deposition is increasing the nitrogen and phosphorus content in Sierra Nevada watersheds and lakes
  Risk: Promotes algae growth and biomass
- **Mechanism:** Ash deposition from regional wildfires is increasing the nitrogen and phosphorus content, including particulates in Sierra Nevada watersheds and lakes
  Risk: Promotes algae growth and biomass, increases particulates that affect treatability of water
- **Mechanism:** Climate warming is increasing the variability in dry- and wet-year type conditions, and influencing the timing of snow-melt runoff, stream flows, and water storage in Sierra Nevada watersheds and lakes
  Risk: Reduce water availability during consecutive dry-years, increase surface water temperature promoting algae growth and biomass
- **Mechanism:** Bathymetry of Lake Angela and its two distinct basins separated by an interconnective ditch influence water circulation
  Risk: Reduced capacity for mixing during low lake levels can affect water quality

- **Mechanism:** Basin morphology and water withdrawal from the southern basin may influence lake stratification during the summer. Southern basin may be mixed while the northern basin remains stratified
  Risk: Increase potential for internal nutrient loading that promotes late season algae growth, release of iron and manganese that affect treatability of raw water
- **Mechanism:** Deep water withdrawal from the southern basin can influence water circulation patterns and promote the movement of warmer epilimnetic water from the northern basin to the southern basin
  Risk: Warmer epilimnetic water is more suitable for nuisance algae growth
- **Mechanism:** Increasing trends in nutrient availability, increases the likelihood developing nuisance algae levels in July and August
  Risk: Increase the potential for taste and odor issues, affect the treatability of raw water

3.5.2 RECOMMENDATIONS

As the hydrology and water quality data for Lake Angela is limited, monitoring and a water quality assessment study are recommended to improve DSPUD's understanding of the dynamics that affect the ecology and steady-state conditions of the lake. In-lake and operational control strategies are also provided to help manage water quality risks.

3.5.2.1 MONITORING

A key component of a lake water protection plan is having a good understanding of the hydrological and water quality conditions that influence the summer algal growing season. This begins with documenting the volume of inflows (i.e., translation of lake level to storage volume) and outflows (i.e., withdrawal and spillway overflows) which better characterizes the water budget, hydraulic residence time, and the time that algae have to respond to favorable growing conditions.

The establishment of two in-lake monitoring sites, one in each basin over the deepest location, and performing one sampling event per month during the July-August-September algal growing season is also recommended. In addition to the lake monitoring, corresponding water samples should be collected from the facility's raw water intake and analyzed for the same constituents discussed below.

The collection of water quality data is recommended at each monitoring site to document water temperature, dissolved oxygen, specific conductivity, pH, and oxidation reduction potential on 1 foot increments from the surface to the near bottom water (i.e., within 2 feet of the sediment). These data will help characterize any thermal stratification or density gradients that may limit whole water column mixing, and if thermally stratified, whether the hypolimnion exhibits low dissolved oxygen and redox favorable conditions. Collection of a near-surface water sample (1 ft below the surface), and a near-bottom water sample (within 2 ft of the sediment) and analyzing the samples for nutrients (total and dissolved organic/inorganic nitrogen and phosphorus fractions, lowest detection limits possible), total recoverable and dissolved iron and manganese, turbidity, and chlorophyll-a content (only near-surface sample) is also recommended. These data will help determine whether conditions are favorable for internal nutrient loading that may facilitate late season algae growth or affect taste and odor due to algae or metals. If Lake Angela experiences a nuisance algae bloom or is impacted by ash deposition from wildfires, then the frequency of monitoring should be increased to better characterize the potential effect on Lake Angela and water treatment. Supplemental algae identification data collected during a nuisance bloom would also be helpful to characterize the potential effect on water treatment, especially considering if cyanobacteria are present in Lake Angela. Cyanobacteria may require special considerations for water treatment, such as the presence of cyanotoxins.

3.5.2.2 WATER QUALITY ASSESSMENT STUDY

Ideally, in-lake water quality monitoring should be a continuous part of a source water protection plan; however, there are economic and feasibility challenges associated with implementing and maintaining a source water monitoring program for small water districts. Therefore, a water quality assessment study is recommended to better characterize the limnological conditions of Lake Angela. This study may require at least two summers of water quantity and quality monitoring data to better characterize the potential risk of internal nutrient loading and potentially additional spring-time monitoring to characterize the nutrient and metals concentrations following spring snowmelt and runoff. The paired sampling routine (intake and lake water analyses) would help identify how the water quality characteristics in the northern basin influence the southern basin, or the lake as a whole, and whether the water quality in the southern basin is adequately represented by the raw water intake samples. A better understanding of how water quality conditions change and what influences them from a hydrological or water circulation standpoint will better inform the in-lake and water treatment process. Depending on the findings from the water quality assessment study, it may be practicable to modify the monitoring program and to only monitor the facility's raw water intake, if there are no significant differences between the intake chemistry and chemistry observed in the lake.

3.5.2.3 CONTROL STRATEGIES TO MANAGE RISK

Based on information gleaned from the water quality assessment study and considering that nuisance algae blooms and ash deposition present the greatest risk to a sole source water treatment facility, a mix of proactive and reactive control strategies should be considered for resiliency planning purposes. These strategies should include options for both in-lake and operational controls and are described in greater detail in Appendix A. Potential in-lake control strategies include the use of algaecides or ultrasonic soundwaves, an emerging technology to preemptively control the development of algae. Operational controls include closing the raw water intake in Lake Angela when treatability is poor, along with other operational changes associated with water treatment.

4 IDENTIFICATION OF POTENTIAL WATER SUPPLY SOLUTIONS

DSPUD identified a suite of potential water supply solutions to address the drought and water quality risks identified in Chapter 2 and 3. These potential solutions include permanent solutions, which may address the requirements of SB 552, and short-term solutions, which are not likely to address the requirements of SB 552 but could reduce the District's vulnerabilities related to climate change and drought.

4.1 POTENTIAL PERMANENT SOLUTIONS

4.1.1 GROUNDWATER

California's diverse natural environment is due in part to the complex geologic processes that have shaped the landforms of the State. California's geomorphic provinces are naturally defined geologic regions that display a distinct landscape or landform. There are eleven geomorphic provinces in California based on each regions defining features based on geology, faults, topographic relief, and climate.

DSPUD is in the Sierra Nevada Geomorphic Province in California which consists of a tilted fault block nearly 400 miles long. Its east face is high and rugged with multiple scarps, contrasting with the gentle western slope that disappears under sediments of the Great Valley Province. The granitic rocks of the Sierra Nevada batholith include older, deformed diorite and quartz in the western areas and younger undeformed granodiorite in the eastern areas.

A search for reports on the groundwater resources in the DSPUD service area did not identify any reports in the direct area. Limited reports are available regarding groundwater in hard rock environments such as those within the District. Information from those reports was used to complete this summary of the hard rock aquifer system.

There are some alluvial valleys located within the Sierra Nevada that are identified as groundwater basins by the California Department of Water Resources (DWR). These basins may be considered as potential sources of groundwater. The groundwater basin closest in proximity to the DSPUD service area is the Martis Valley Groundwater Basin. The groundwater potential from both the underlying hard rock geologic environment and the nearby Martis Valley Groundwater Basin are described in the following sections.

Martis Valley Groundwater Basin

The Martis Valley Groundwater Basin (Basin Number 6-067) is located about six miles east of DSPUD as shown on Figure 4-1. The District is about 7,200 feet above msl and is located west of the crest of the Sierra Nevada (at about 7,700 feet msl). The Martis Valley Groundwater Basin has an elevation around 5,700 feet msl and is located east of the crest of the Sierra Nevada crest. The description of the Martis Valley Groundwater Basin below is provided from the DWR California Water Plan – Groundwater Update 2013.

The Martis Valley Groundwater Basin (6-067) is located in Placer and Nevada counties covering approximately 36,381 acres. The groundwater basin is a fault-bounded basin located east of the Sierra Nevada crest. The elevation of Martis Valley is between 5,000 feet and 6,000 feet above msl. The mountains surrounding the Martis Valley are 1,000 feet above msl to more than 3,000 feet above msl. Average precipitation in the valley is 23 inches in the lower elevations of the eastern portion and nearly 40 inches in the western areas. Well-yield data from well completion reports indicate that groundwater production in the Martis Valley Groundwater Basin can be as much as 1,500 gallons per minute (gpm), with an average yield of 150 gpm.

The primary groundwater-bearing formations in the Martis Valley Groundwater Basin are the Miocene to Pliocene basin fill deposits interbedded with sediments of stream and lake deposits. There is also extensive Pleistocene glacial material and recent alluvial material that have embedded impermeable clay and silt layers.

Groundwater in the DSPUD Service Area

Surface Geology

The DSPUD area is generally underlain by granitic rocks composed of quartz diorite and granodiorite and some metamorphosed rocks. When exposed at the ground surface, both of these rock types have joints and fractures. The joints and fractures occur near the ground surface as a result of reduced pressure from the overburden being removed (compared to where they were formed at depth) resulting in the rocks expanding creating the joints and fractures. Various studies suggest that the joints and fractures occur to a depth of about 200 to 250 feet below the ground surface.

Occurrence and Movement of Groundwater

Granitic and metamorphic rocks do not have the alluvial deposits of aquifers in groundwater basins, and their porosity is limited to the secondary porosity created by the joints and fractures occurring within the rocks so they yield little, if any, water to wells unless the wells intersect the fractured or weathered joints and faults. As a result of the limited porosity, the more favorable well sites occur at the saturated intersections of the joints and fractures. Additionally, deeper wells do not significantly increase the yield of wells as there are fewer joints and fractures at depth.

Recharge and Discharge of Groundwater

Groundwater in the area moves primarily through the fractures in the hard rock and is recharged by rain and melting snowmelt. In general, the movement of ground water parallels the land surface as the groundwater flows from areas of higher elevation toward areas of lower elevation. DSPUD is located near the crest of the Sierra Nevada

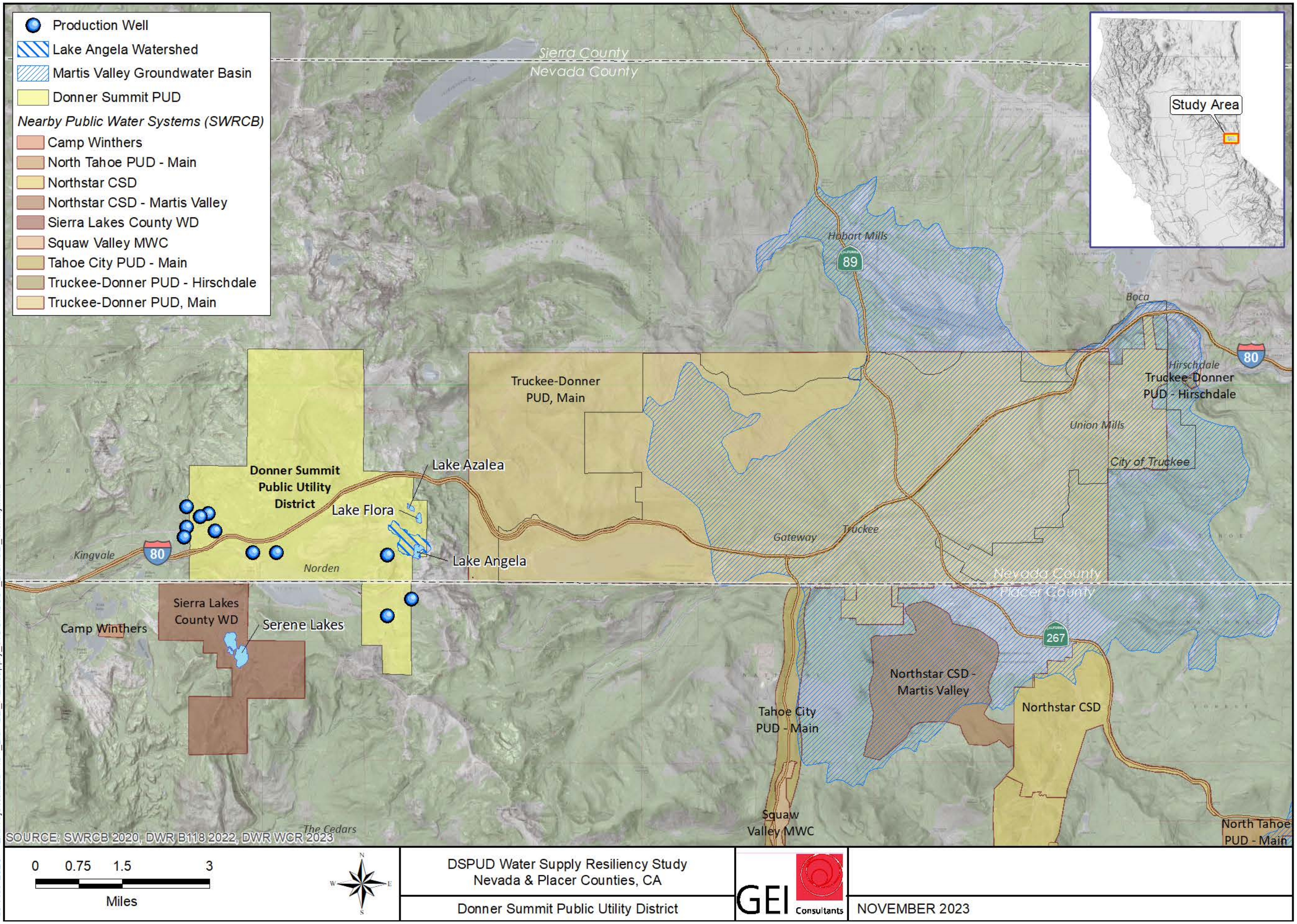

Figure 4-1. Groundwater Wells in DSPUD Service Area and nearby Public Water Systems

Notes: PUD = Public Utilities District, WD = Water District, MWC = Mutual Water Company, CSD = Community Services District, SWRCB = California State Water Resources Control Board and likely behaves as a groundwater divide with groundwater moving downslope away from the ridges towards discharge areas including wells, springs, or lakes.

Groundwater Wells in DSPUD Service Area

The DWR Sustainable Groundwater Management Act (SGMA) Data Viewer provides information related to the Well Completion Reports (WCRs) of wells drilled throughout the state. These include production wells in addition to monitoring wells and wells that have been destroyed.

A review of the of the SGMA Data Viewer identified the location of eleven WCRs of production wells in the District service area (see Figure 4-1). Numerous monitoring wells and destroyed wells are also present within the District. Information from the WCRs for the production wells is provided in Table 4-1. The Depth to Water, Depth to Static Water Level and Yield presented on the WCRs are recorded during the well drilling and development process. The depth to water and well yield vary annually and seasonally based on hydrologic conditions and the amount of groundwater pumping. There are no records of the current groundwater levels or well yields for wells in the District on the DWR SGMA Data Viewer.

Table 4-1. Summary of Well Completion Reports in the DSPUD Service Area

WCR Number	PLSS MTRS[1]	Purpose	Depth (feet)	Depth to Water (feet)	Depth to Static Water Level (feet)	Yield (gpm)
454564	17N14E16	Domestic	350	50		6
108066	17N14E15N	Domestic	305	36		5.5
e0322489	17N17E12	Domestic	275	60		15
924720	17N14E22	Domestic	480	130		10
e0363903	17N14E21	Domestic	345	18		40
789412	17N14E22	Domestic	585	434	200	60
2018-007198	17N14E23	Domestic	652	240	85	20
33914	17N14E23	Domestic	175	37		4
e0113690	17N15E17	Public	500	35	375	45
749305	17N15E21	Domestic	240	30	25	45
433360	17N15E20	Public	300	12		35
	Average		382	98	171	26
	Min		175	12	25	4
	Max		652	434	375	60

1 Public Land Survey System Meridian, Township, Range, Section

Dry Wells in DSPUD Service Area

The DWR Dry Well Reporting System is for Californians experiencing problems with their private (self-managed) wells (not for residents served by a public water system already regulated by the State). Dry wells can be caused by many drought and non-drought factors, including aging infrastructure like corroded wells, declining groundwater levels, changes to weather patterns and climate, or surface water and groundwater management.

4.1.2 ALTERNATIVE SURFACE WATER SUPPLIES

4.1.2.1 LAKE ANGELA EXPANSION

Lake Angela spills almost every year, presenting the opportunity to capture this additional supply by expanding the capacity of Lake Angela. The District currently operates using its senior Pre-1914 water right which appears to allow the District to directly divert up to 9.3 cubic feet per second (cfs) and divert to storage up to 310 AF per year. The additional water supply needed for the expansion of Lake Angela could already be authorized by its permitted water right (Application 30332, Permit 21118). The permitted right allows the District to directly divert up to 1.54 cfs between November 1 through June 1 and divert up to 310 AF to storage collected from November 1 through July 31.

4.1.2.2 DEVELOPMENT OF NEARBY NATURAL LAKES

There are two natural lakes in immediate proximity to Lake Angela. Flora Lake, located about 0.4 mi north of Lake Angela, and Azalea Lake, located about 0.1 mi northwest of Flora Lake (see Figure 4-1), could be used as a backup supply to the District. Azalea Lake spills into Flora Lake which then spills to a drainage that flows to Donner Lake and ultimately to the Truckee River. Because these lakes are within the Truckee River watershed, supplies from these lakes are not subject to Sacramento – San Joaquin Delta watershed curtailments nor would they be subject to agreements with Nevada Irrigation District and Pacific Gas and Electric. Water from these lakes could be pumped to Lake Angela or directly to the District's water treatment plant in an emergency. Currently, the potential water supply volume from these lakes is unknown. Any water supplies from these lakes would require new water rights.

4.1.3 INTERTIE WITH SIERRA LAKES COUNTY WATER DISTRICT

As shown in Figure 4-1, Sierra Lakes County Water District (SLCWD) is located adjacent to DSPUD. The water supply lines for DSPUD and SLCWD are approximately one mile apart, thus an intertie with the SLCWD is another potential source of backup water supply for the District. The primary source of SLCWD's water supply is Lake Serena, one of the two connected waterbodies that comprise Serene Lakes located in the North Fork American River watershed. Lake Serena sits on Donner Summit at an elevation of 6,881 feet and is located about 3.5 miles southwest of Lake Angela and 1.7 miles south of Interstate 80 (see Figure 4-1). SLCWD holds water rights (Application 20601, Permit 14248) to Lake Serena that include a direct diversion of up to 0.8 cfs capped at 394 AF per year and diversion to storage of up to 783 AF per year. The combined volume of the direct diversion limit and diversion to storage limit allows for the development of up to 1,177 AF per year. The season of diversion for these rights is October 1 through June 30.

According to SLCWD annual reports, annual average usage over the past five years is less than 100 AF, which provides the opportunity to support delivery to DSPUD in an emergency. Conversely, with water rights of up to 664 AF per year and a current demand of about 240 AF per year, DSPUD currently has an excess supply and could also support SLCWD deliveries in an emergency. To support an intertie between DSPUD and SLCWD, both districts would need to amend their water rights by filing a petition with the SWRCB to include the place of use of the partnering district in their respective place of use.

4.1.4 RECYCLED WATER

DSPUD owns and operates a wastewater treatment plant (WWTP) which is used to treat municipal wastewater generated within the District's service area. The WWTP is located at the District's office location on the north side of Interstate 80, northwest of the Soda Springs Mountain Resort (see Figure 4-2). DSPUD's WWTP was constructed in 1988 with an original design capacity of 1 million gallons per day (mgd); however, in the mid-2010's, regulatory updates with regards to filtration rates at the WWTP reduced the design capacity from 1 mgd to 0.6 mgd. This reduced capacity compounded with the District's water quality challenges and the lack of a pre-treatment process at the WWTP made it difficult at times to keep pace with demand. Consequently, in 2015 the WWTP was upgraded with two new treatment trains. The treatment trains utilize membrane filters and microfiltration followed by ultraviolet disinfection to produce tertiary treated recycled water that meets Title 22 standards. With these improvements, the District's WWTP can process up to 1.27 mgd during peak demand periods, with a design average dry weather flow capacity of 0.52 mgd.

Tertiary treated wastewater from the District's WWTP is either discharged to the South Yuba River or used to spray irrigate a portion of the Soda Springs Mountain Resort (see Figure 4-2). DSPUD has a 30-year lease agreement (signed in 2008) with the landowner, Boreal Ski Corporation. The lease encompasses 125 total acres, of which approximately 53 acres are used for irrigation. Additionally, when conditions allow, DSPUD reclaims the tertiary treated wastewater by sending it to the Soda Springs Mountain Resort for snowmaking. In lieu of discharging or reclaiming the water for snowmaking, the water could be reclaimed and introduced back into the District's system to meet consumptive demands. Options for reintroducing the water back into the District's system could include pumping the water back up to Lake Angela, or pumping the water to a new storage tank in the system. This option would require an amendment of the District's National Pollutant Discharge Elimination System permit with the Central Valley Regional Water Quality Control Board, which allows for the discharge of tertiary treated wastewater and using reclaimed water for snow making. An amendment of the District's Title 22 Engineering Report, which is required to be submitted to the Central Valley Regional Water Quality Control Board and other agencies prior to implementing recycled water projects, would also be required.

4.1.5 WATER SHORTAGE CONTINGENCY PLAN

In 1983, the State of California Legislature enacted the Urban Water Management Planning Act. The law requires urban water suppliers, providing water for municipal purposes to more than 3,000 customers or serving more than 3,000 acre-feet annually, to adopt an Urban Water Management Plan (UWMP) every five years demonstrating water supply reliability in normal, single dry, and multiple dry water years. As part of the UWMP, each urban water supplier must develop a Water Shortage Contingency Plan (WSCP) that outlines a framework for managing water supplies to minimize the adverse

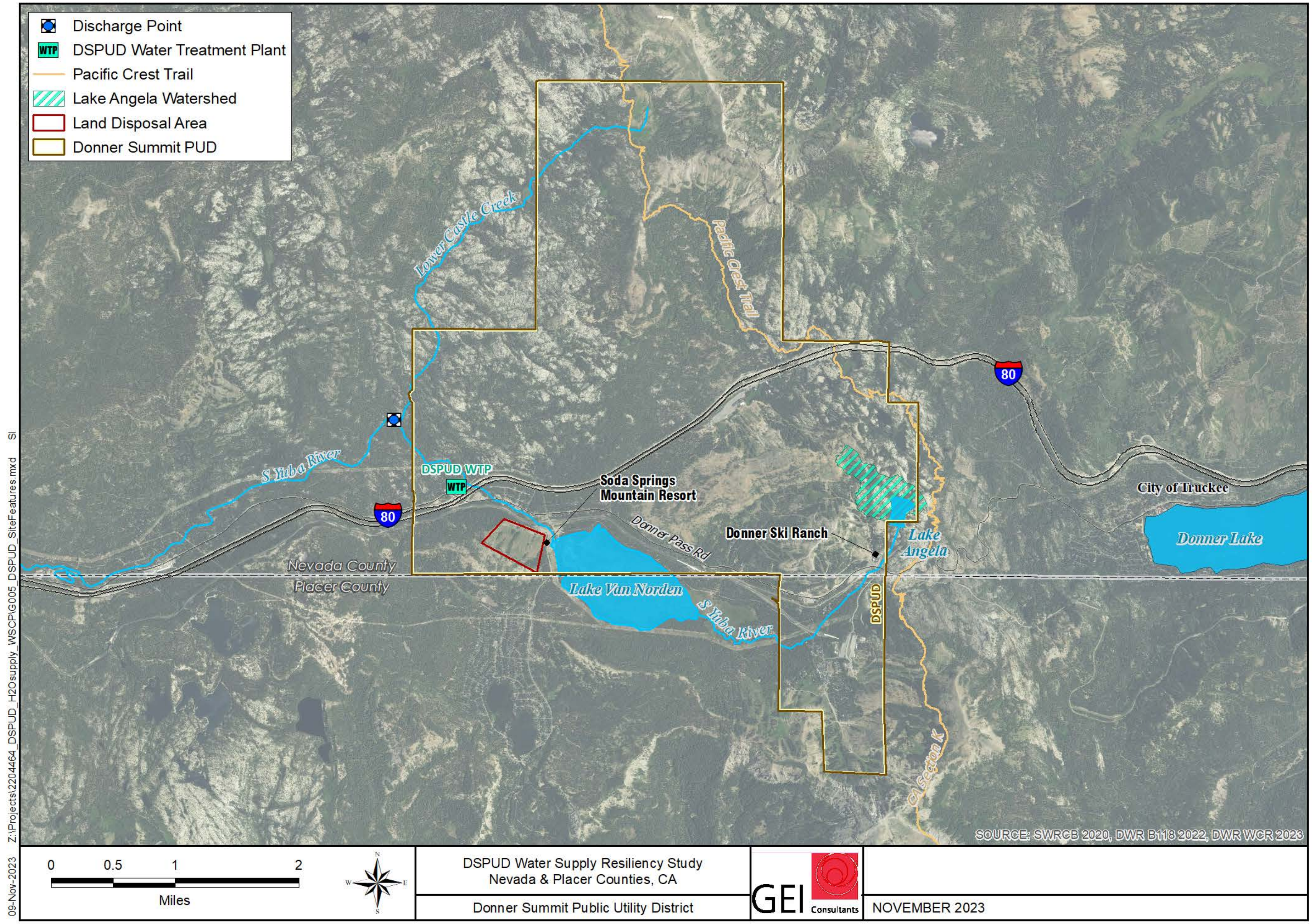

Figure 4-2. Wastewater Discharge Locations

impacts of water shortages. This framework includes the identification of drought response actions which are used to reduce demand under water shortage conditions, and the water shortage levels/triggers that are used to initiate these actions.

As previously stated in Chapter 2, results from the drought risk evaluation indicate that development of a WSCP could help reduce the District's vulnerability to drought. Unlike their larger counterparts, small water suppliers have not been required to maintain a WSCP. However, with the passage of SB 552 in 2021, small water suppliers which serve 1,000 to 2,999 connections are now required to prepare and update an abridged WSCP. The abridged WSCP covers a subset of drought-planning elements included in the WSCPs that urban water suppliers submit as part of their UWMP, including:

- **Drought planning contacts**
- **Triggering mechanisms and levels for action, including:**
    - Standard water shortage levels corresponding to progressive ranges based on the water supply conditions
    - Water shortage mitigation, response, customer communications, enforcement, and relief actions that align with the water shortage levels

While the District is not required to prepare an abridged WSCP under SB 552, serving only 360 domestic water customers, an abridged WSCP would serve as a long-term solution for reducing vulnerability during droughts or other catastrophic events that impact water supply.

4.2 POTENTIAL SHORT-TERM SOLUTIONS

Short-term solutions identified as part of this study include the provision of hauled/bottled water.

4.2.1 HAULED/BOTTLED WATER

According to the SWRCB's 2022 Drinking Water Needs Assessment, roughly 90 water providers across California had to resort to bottled or hauled in water to meet consumptive demands during the last drought. Similar to DSPUD, one of the most important vulnerabilities that the majority of these water providers share is that they have only one source of water.

Hauled and/or bottled water can help to augment, or replace, supplies under acute water shortage or emergency conditions. There are generally two options for water delivery: water hauled in via tanker truck, which is generally more suitable to meet household needs, or bottled water trucked on pallets.

Hauled and/or bottled water could serve as a short-term water supply solution in the event of a catastrophic water shortage or emergency; however, it would not serve as a long-term solution for DSPUD to enhance their water supply reliability, nor would it meet SB 552 requirements related to securing a backup water supply or water system intertie by January 1, 2027.

5 EVALUATION OF WATER SUPPLY SOLUTIONS

5.1 PRELIMINARY SCREENING OF WATER SUPPLY SOLUTIONS

The water supply solutions selected for further exploration were identified based on a preliminary evaluation. This evaluation eliminated solutions based on two key criteria:

1. Feasibility, i.e., does this option advance the goals of the study (does it respond to the impacts from drought and climate change while meeting the requirements of SB 552 to develop a backup water supply or intertie by 2027) and/or are there considerations that would make the option infeasible.
2. Redundancy, i.e., are there better options available to meet the same goals.

Below are the solutions that have been eliminated from further evaluation with a brief reason for their elimination:

- **Groundwater** (eliminated due to feasibility): the groundwater basin closest in proximity to the DSPUD service area is the Martis Valley Groundwater Basin (Basin Number 6-067). This basin is located about six miles east of DSPUD and about 2,000 feet below in elevation. The topographical change and distance from the District's treatment facility are limiting factors when it comes to cost. The pump station required to overcome the elevation change along with the six miles of piping over the terrain would increase costs such that this option would be economically infeasible.

- **Lake Angela Expansion** (eliminated due to feasibility): increasing the capacity of Lake Angela is anticipated to satisfy the additional water supply necessary to meet demand increases due to forecasted population growth, as well as allowing for climate change projection runoff pattern changes. However, the increase in storage may not satisfy all the requirements of SB 552 in relation to developing a backup water supply by January 1, 2027.

- **Development of nearby lakes** (eliminated due to redundancy): currently, the potential water supply volume from these lakes is unknown. Moreover, any water supplies from these lakes would require new water rights.

- **Recycled water** (eliminated due to feasibility): a preliminary evaluation of this option suggests that introducing the tertiary treated water back into Lake Angela would require a pump station, with around 560 feet of elevation gain, and around 4.0 miles of pipeline. The topographical change and distance from the District's treatment facility are limiting factors when it comes to cost. Moreover, the use of tertiary treated wastewater may not satisfy all the requirements of SB 552 in relation to developing a backup water supply by January 1, 2027.

- **Water Shortage Contingency Plan** (eliminated due to feasibility): development of a WSCP would provide the framework for future water conservation, but it would not serve as an additional water supply or meet the requirements of SB 552.
- **Hauled/Bottled Water** (eliminated due to feasibility): the provision of hauled/ bottled water would help to reduce vulnerability during a catastrophic water shortage, but would not serve as a viable long-term water source of supply for the District, nor would it meet the intent of SB 552.

While neither the development of a WSCP or the provision of hauled/bottled water would serve to meet the goals of this study, these solutions could result in reduced vulnerability during droughts or during other catastrophic events that impact water supply. Consequently, DSPUD has prepared an abridged WSCP as part of this study (see Appendix F). The abridged WSCP includes a framework of triggers, water reduction targets, and response actions to help DSPUD manage and mitigate an actual water shortage condition, should one occur because of drought or other impacts on water supplies. As part of the development of DSPUD's abridged WSCP, the District has also developed a catastrophic water allocation plan. The catastrophic water allocation plan will be used to allocate water in the event that water shortage conditions threaten public health and safety, which includes the provision of hauled/ bottled water as an interim alternative water supply to meet short-term public health needs. Consequently, the estimated costs associated with providing hauled/bottled water to meet public health and safety demands were developed as part of this study (see Appendix D).

5.2 EVALUATION OF WATER SUPPLY SOLUTIONS

The intertie with SLCWD was identified as the only option for evaluation following the preliminary screening. Evaluation of this potential water supply includes the identification of conceptual infrastructure requirements, development of reconnaissance level (Class 5) cost estimates, and an evaluation of the intertie using the model developed as part of this study as described in Section 2.1.

5.2.1 INTERTIE WITH SIERRA LAKES COUNTY WATER DISTRICT

5.2.1.1 INFRASTRUCTURE REQUIREMENTS

Conceptual infrastructure requirements for the intertie with SLCWD are summarized below.

- The location of the connection to the SLCWD water system would occur in the northeastern corner of their water system, at the intersection of Pahatsi Rd and Soda Springs Rd (see Figure 5-1). The existing elevation at this location is approximately 6,944. See Figure 5-1 for new pipeline and intertie locations.

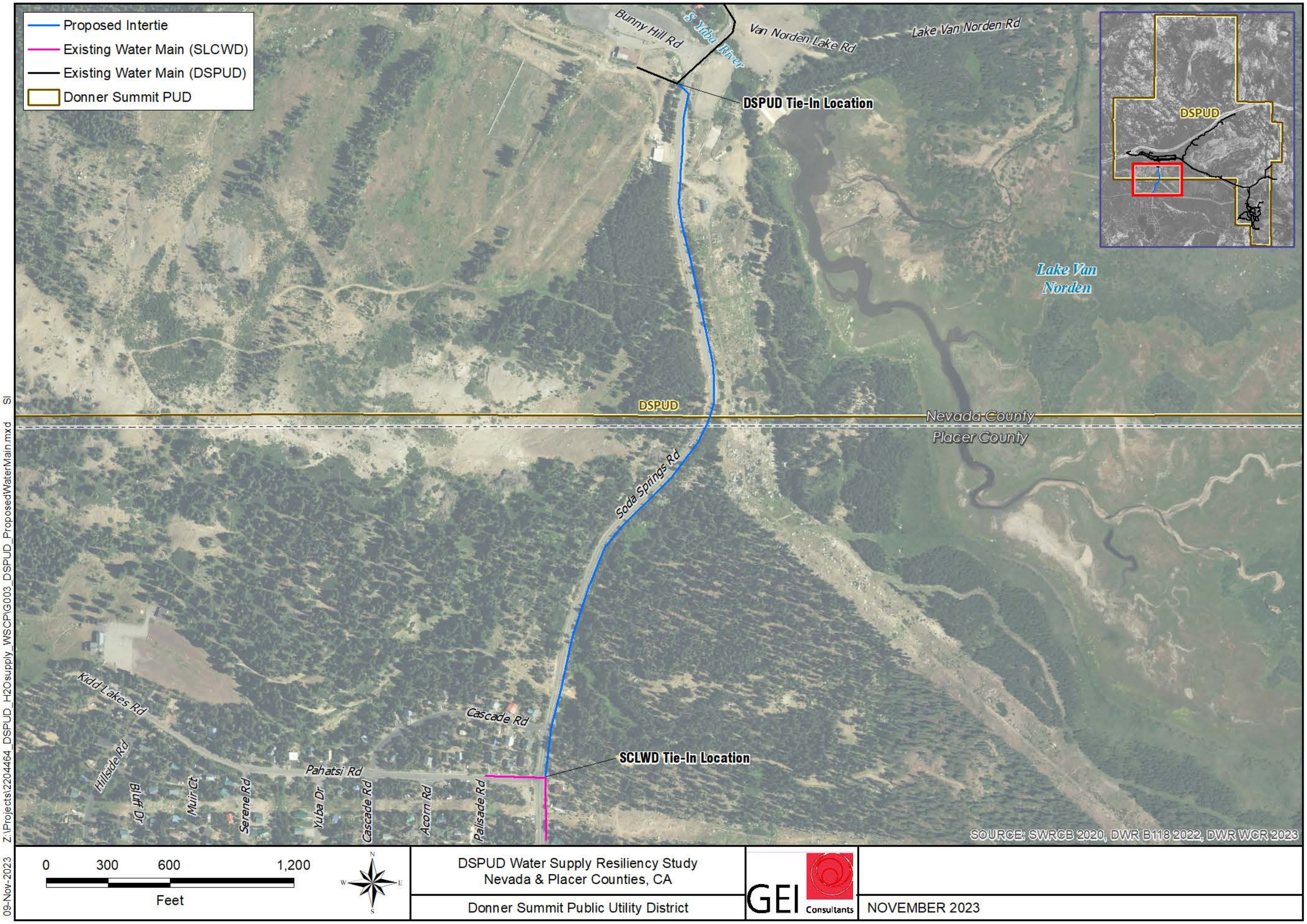

Figure 5-1: Sierra Lakes County Water District Intertie Conceptual Location and Alignment

- The new intertie would require a minimum of an 8-inch main built from high-density polyethylene that would be installed via open cut excavation and placed along Soda Springs Road, going north for approximately 0.8 miles. The connection to the DSPUD water supply system would occur south of the town of Soda Springs at the intersection of Bunny Hill Rd and Soda Springs Rd. The elevation at this intersection is 6,765.
- Since the system tie-in is below the existing system at SLCWD, a booster pump station would not be required to meet demands. For the DSPUD system to serve as a backup source for SLCWD, a booster pump station could be required to pump water back and forth from the two systems. This booster pump station is estimated to cost around $150,000 assuming a 100 foot raise in elevation with a capacity of 100 gpm.
- If the existing line at the intersection of Bunny Hill and Soda Springs is less than 6 inches, an additional 0.1-miles of pipeline would be required to tie into the system in Soda Springs. The additional pipe cost will not be significant, but the additional pipeline would require crossing the railroad line that traverses south of the town of Soda Springs (see Appendix D for more details). The costs associated with permitting and impacts on construction schedules could be significant. Cost estimates for an intertie with SLCWD assume directional drilling beneath the existing railroad will not be required.

5.2.1.2 ESTIMATED COST

The total estimated cost for an intertie with SLCWD is estimated at $835,000 (Table 5-1). This cost estimate includes costs for construction, mobilization/demobilization, design and engineering, legal, engineering during construction, and construction management. Assumptions used to develop these costs can be found in Appendix D. Note that cost estimates included as part of this study are classified as Class 5 (reconnaissance-level) according to the Association for the Advancement of Cost Engineering International standards. It is important to note that the Class 5 estimate is subject to change as the level of detail increases, and the expected accuracy of a Class 5 estimate ranges from -20 to -50 percent on the low side and +30 to +100 percent on the high side.

Table 5-1. Intertie Major Construction Cost Estimate

Item No.	Cost Component	Estimated Cost
1	Major Construction	$588,000
2	Mobilization and Demobilization (10% of Item No. 1)	$59,000
3	Subtotal	$647,000
4	Design and Engineering (15% of Item No. 3)	$97,000
5	Legal (2% of Item No. 3)	$13,000
6	Engineering During Construction (2% of Item No. 3)	$13,000
7	Construction Management (10% of Item No. 3)	$65,000
8	Subtotal	$188,000
Total (Item No. 3 + Item No. 8)		**$835,000**

5.2.1.3 MODEL EVALUATION

To evaluate the potential water supply from an intertie with SLCWD, the operations simulation model described in Section 2.1 was expanded to include SLCWD's Serene Lakes and associated consumptive demands. Consumptive demands were included for both existing conditions for model calibration purposes and anticipated 2040 future conditions to evaluate Serene Lakes operations with and without an intertie to DSPUD's system to determine if additional supplies could be delivered without impacting water supply reliability. These scenarios were tested over a study period containing water years 1976-2021 to include the hydrologic variability which occurs in the basin. Table 5-2 summarizes the three scenarios that were tested to evaluate the viability of an intertie with SLCWD. Further information related to the adjustments that were made to the model to evaluate the viability of an intertie and the assumptions used as part of this evaluation can be found in Appendix E.

Table 5-2. Intertie Evaluation Scenarios

Scenario No.	Scenario	Facilities	Hydrology	Study Period	Demand
IT-1	Existing Conditions	Existing	Historic	1976-2021	Historic (2017 – 2021 average)
IT-2	Future Conditions without Intertie	Existing	2040 Climate Change	1976-2021 modified by climate change factors	Future based upon planning documents[1]
IT-3	Future Conditions with Intertie	Existing with Intertie	2040 Climate Change	1976-2021 modified by climate change factors	Future based upon planning documents[1]

Notes:
IT = intertie
[1] This scenario incorporates water conservation measures to simulate operating under future drought conditions. These measures preserve Lake Angela storage while delivering 75% of the demand and are detailed in the abridged WSCP developed as part of this study (see Appendix F).

5.2.1.3.1 Scenario IT-1 – Existing Conditions

Scenario IT-1 represents current historic hydrology and existing demands. Development of the existing conditions hydrology dataset is described in Appendix E. Existing demands for this scenario were developed by averaging the deliveries for the 2017 to 2021 period on a monthly basis. As shown in Table 5-3, the total average demand for SLCWD over that period is 86.4 AF. Under Scenario IT-1, the average demand repeats for every year of the simulation.

Table 5-3. Sierra Lakes County Water District Existing Consumptive Demands

Month	SLCWD Existing Consumptive Demand, AF
Jan	7.0
Feb	6.2
Mar	6.5
Apr	6.6
May	5.7
Jun	7.3
Jul	11.3
Aug	9.3
Sep	7.1
Oct	5.2
Nov	4.8
Dec	6.2
Total Potable Water Demand	**83.1**

Figure 5-2 shows the annual delivery and demand for the period of record. In 1976, 1977, 1978, 1988, 1989, 1991, 2015, and 2016 there were shortages imposed. This was done in a manner that tries to mimic curtailments imposed by the SWRCB using the April through July runoff forecasts. The forecasts are made February 1, March 1, and April 1. The April 1 forecast is then used for the April 1 through February 1 period. When the April through July forecast is less than 30% of average, a 15% reduction in delivery is imposed, consistent with SLCWD conservation requirements (see Appendix E). These reductions in delivery exactly meet the reduction in demand meaning that these are following the curtailment logic and are not because storage has reached dead pool at Serene Lakes.

Results from the assessment of existing conditions show that the minimum storage at Serene Lakes for the study period occurs in the driest years and is roughly 580 AF (Figure 5-3). This leaves approximately 510 AF of additional storage above the dead pool. Under existing conditions, the water supply is more than sufficient to meet demand. Assuming the system is functioning well, the findings suggest a minimal risk of water supply shortage resulting from drought conditions under Scenario IT-1.

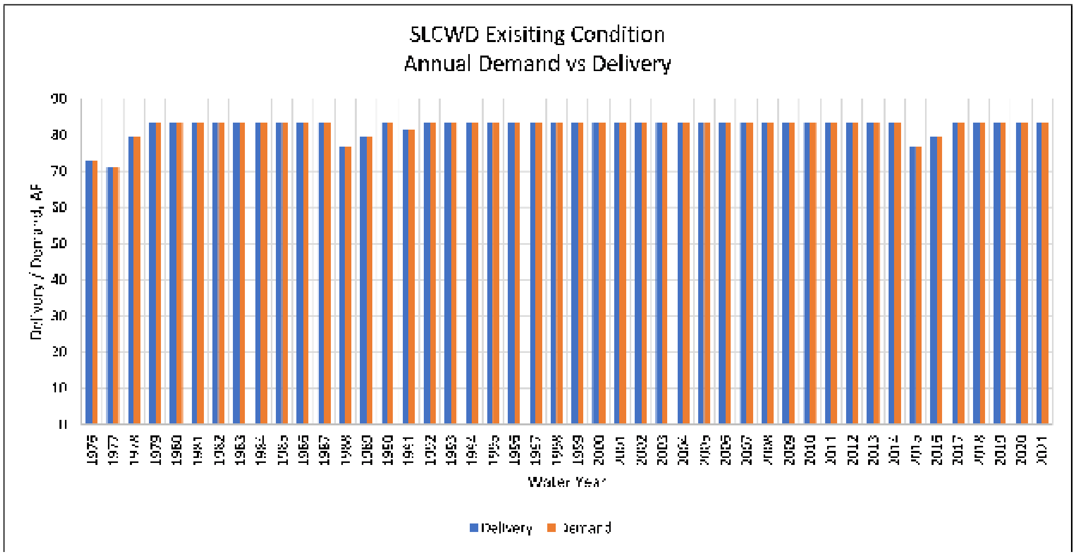

Figure 5-2: Scenario IT-1 - Existing Conditions Deliveries

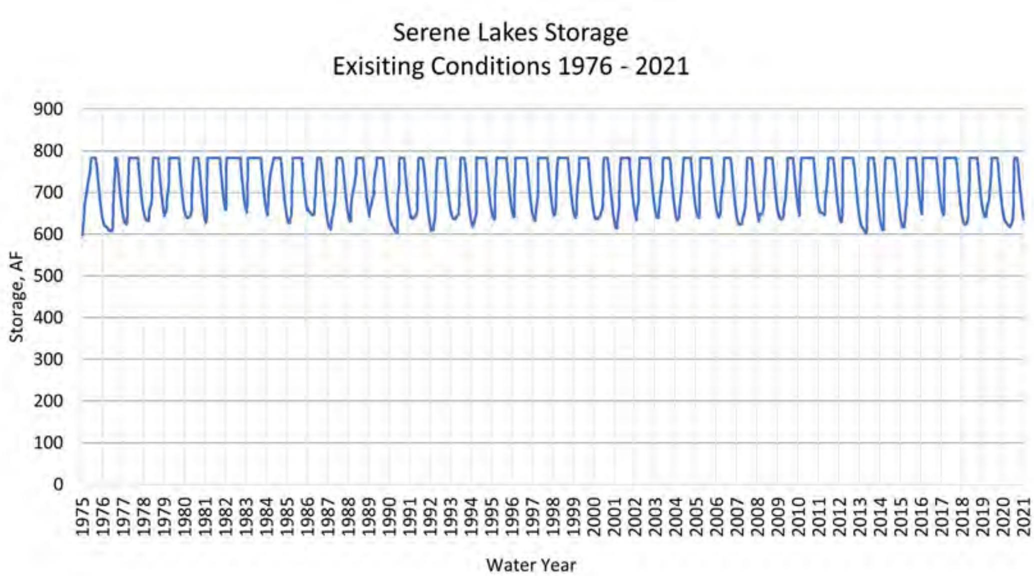

Figure 5-3: Scenario IT-1 - Existing Conditions Serene Lakes Storage

5.2.1.3.2 Scenario IT-2 – Future Conditions without Intertie

Scenario IT-2 builds on Scenario IT-1 by incorporating build out demands and climate change hydrology. Development of the climate change hydrology dataset is described in Appendix E. Build out demands for this scenario were developed using the historic demand patterns multiplied by the anticipated future water use of 365 AF (Table 5-4). Build out demands for SLCWD are expected to be around 279 AFY more than existing demands.

Table 5-4: Sierra Lakes County Water District Future Consumptive Demands

Month	SLCWD Build Out Consumptive Demand, AF
Jan	30.5
Feb	26.8
Mar	28.0
Apr	26.7
May	25.2
Jun	32.8
Jul	47.8
Aug	40.5
Sep	31.2
Oct	23.1
Nov	22.2
Dec	30.3
Total Potable Water Demand	**365.0**

Figure 5-4 illustrates the deliveries made under the future conditions without intertie scenario. Note that this scenario, along with Scenario IT-3, incorporates water conservation measures to simulate operating under drought conditions. These measures are detailed in the abridged WSCP developed as part of this study (see Appendix F) and aim to preserve storage in Lake Angela while delivering 75% of the demand. If not for the anticipated SWRCB curtailments, Serene Lakes is estimated to have enough supply under this scenario to meet SLCWD demands in all years.

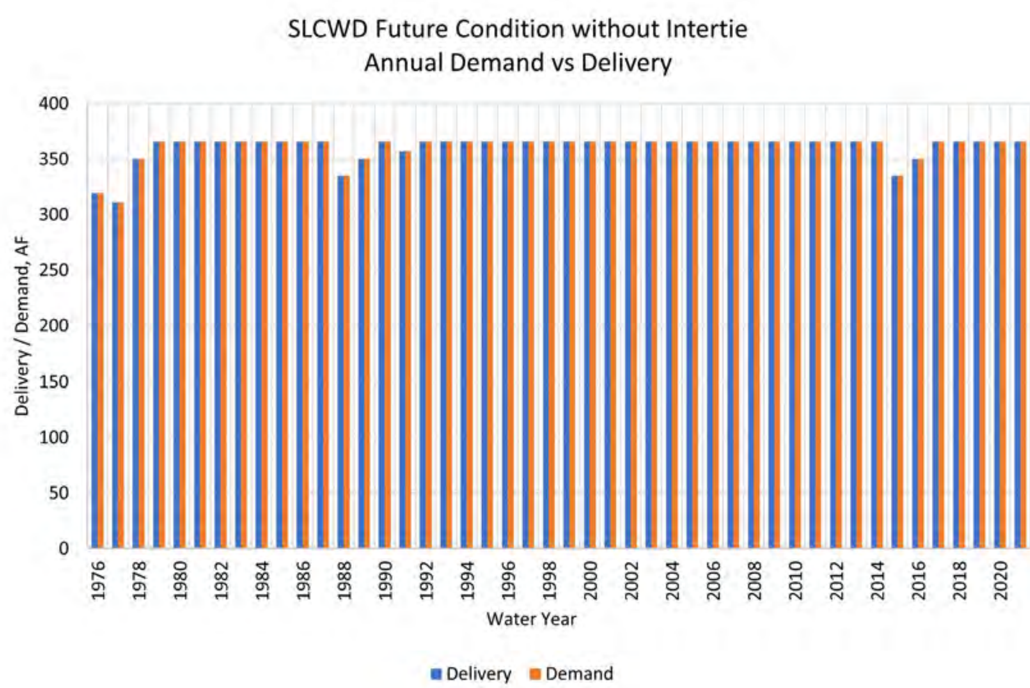

Figure 5-4: Scenario 2 - Future Conditions without Intertie Deliveries

Under Scenario IT-2, Serene Lakes generally remains above 400 AF except for 1977 when it dropped to 317 AF before winter precipitation began the refill (see Figure 5-5). Currently, SLCWD can pump water from an elevation of 6,864.5 ft msl or about 9 ft below the dam crest, allowing access to the remaining reservoir storage of about 300 AF. Under Scenario IT-2, Lake Angela experiences its lowest levels in the driest years, nearing dead storage and often dropping to approximately 50 AF (see Figure 5-6).

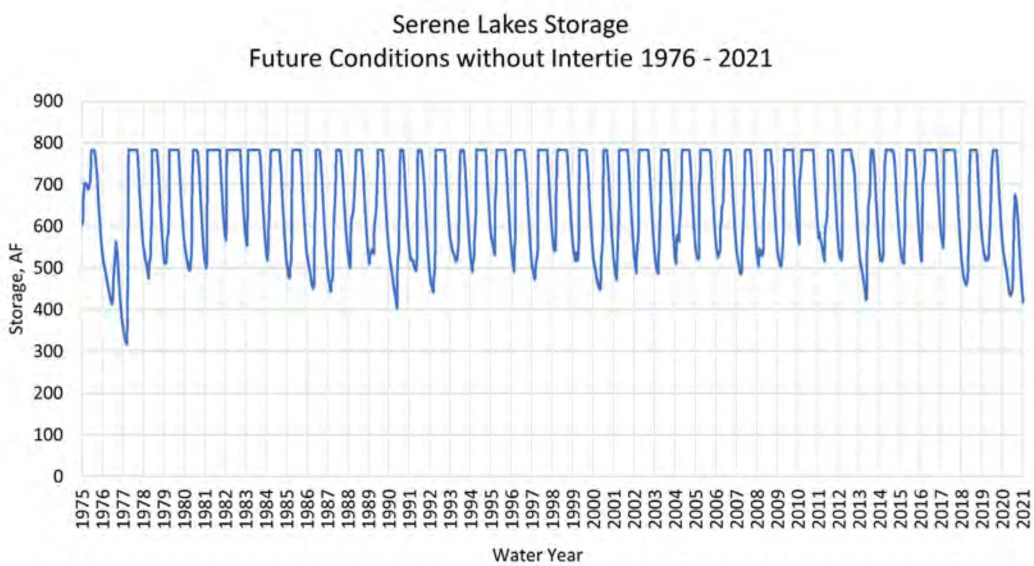

Figure 5-5. Future Condition without Intertie Serene Lakes Storage

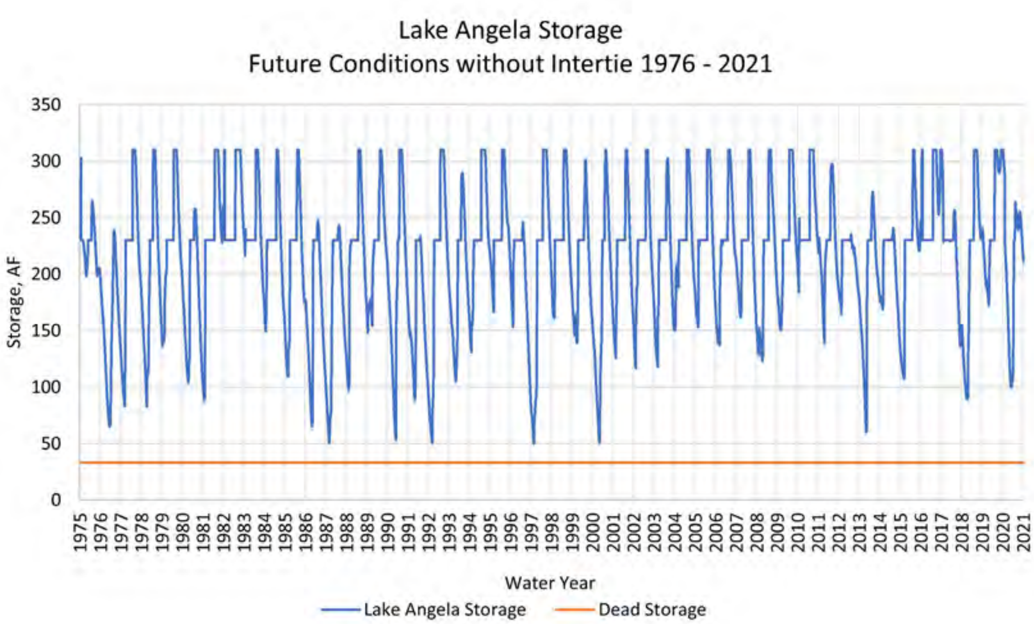

Figure 5-6. Lake Angela Storage without Intertie

5.2.1.3.3 Scenario IT-3 – Future Conditions with Intertie

Scenario IT-3 builds on Scenario IT-2 by incorporating an intertie between SLCWD and DSPUD. This scenario assumes the same buildout demands for SLCWD as Scenario IT-2 (*see* Table 5-4), and DSPUD build out demands of 454 AFY (*see* Table 2-4). Climate change hydrology for Scenario IT-3 is the same as Scenario IT-2 and is described further in Appendix E. As illustrated in Figure 5-7, the same deliveries are made as under Scenario IT-2, demonstrating no water supply impact to SLCWD customers.

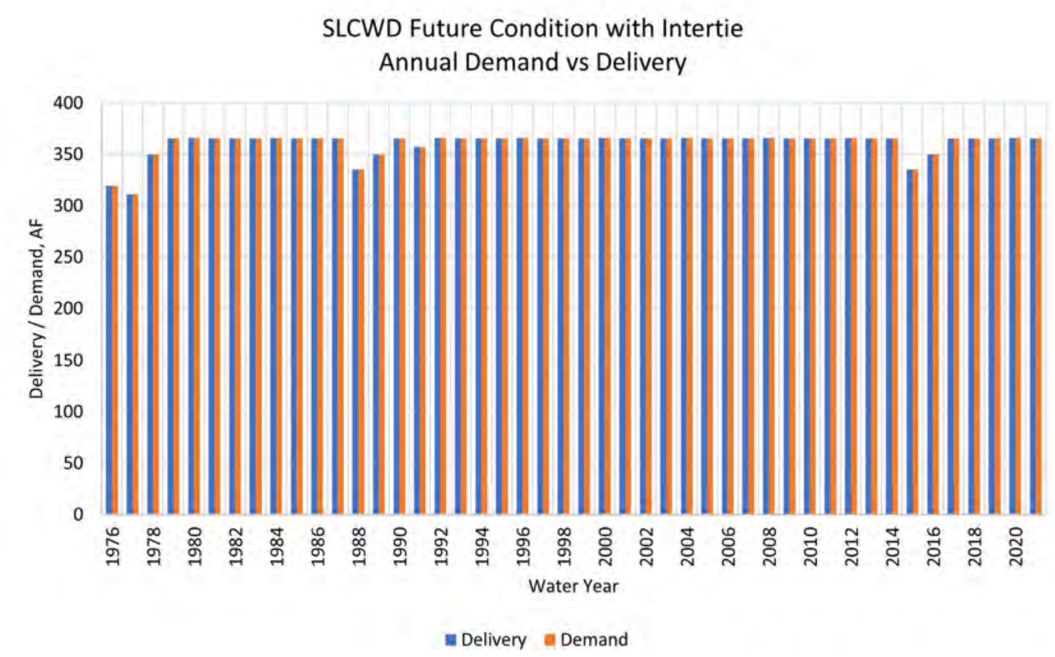

Figure 5-7: Scenario IT-3 - Future Conditions with Intertie Deliveries

Figure 5-8 illustrates the storage at Serene Lakes with and without intertie deliveries. Deliveries are made to DSPUD when Lake Angela Storage falls below 80 AF. The 80 AF threshold value results in a Serene Lakes low point of about 307 AF, allowing SLCWD to continue to pump water using existing facilities to serve their own customers. Deliveries to DSPUD are primarily made from direct diversions rather than storage withdrawals which minimizes impacts to Serene Lakes storage. The intake pipe could be extended deeper into the reservoir to allow for more operational flexibility.

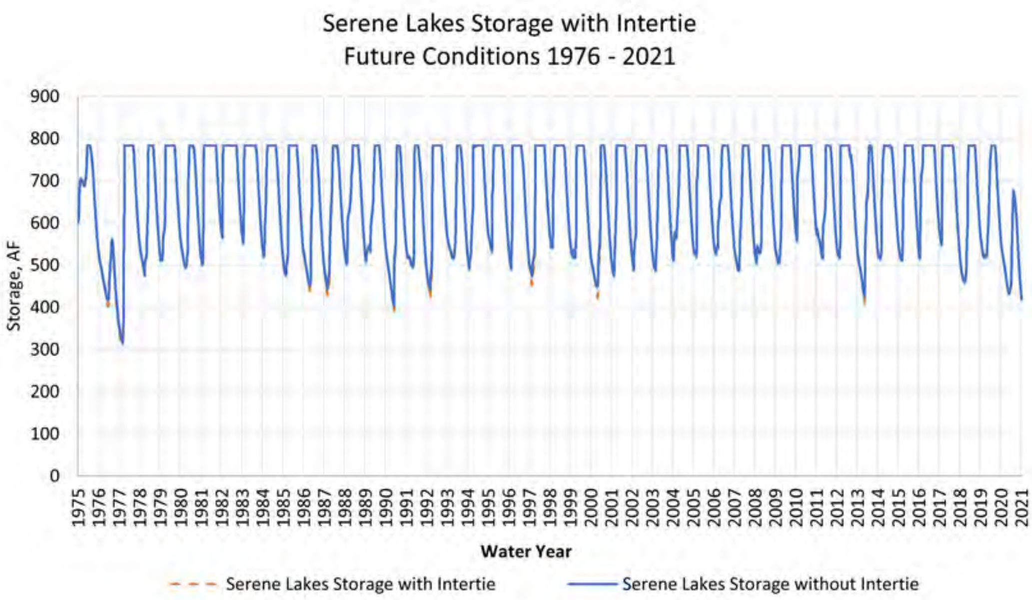

Figure 5-8: Serene Lakes Storage with Intertie Delivery to DSPUD

Utilizing the intertie can improve the dry year low point of Lake Angela storage from about 50 AF to 70 AF, as depicted in Figure 5-9, without significantly impacting SLCWD's water supply.

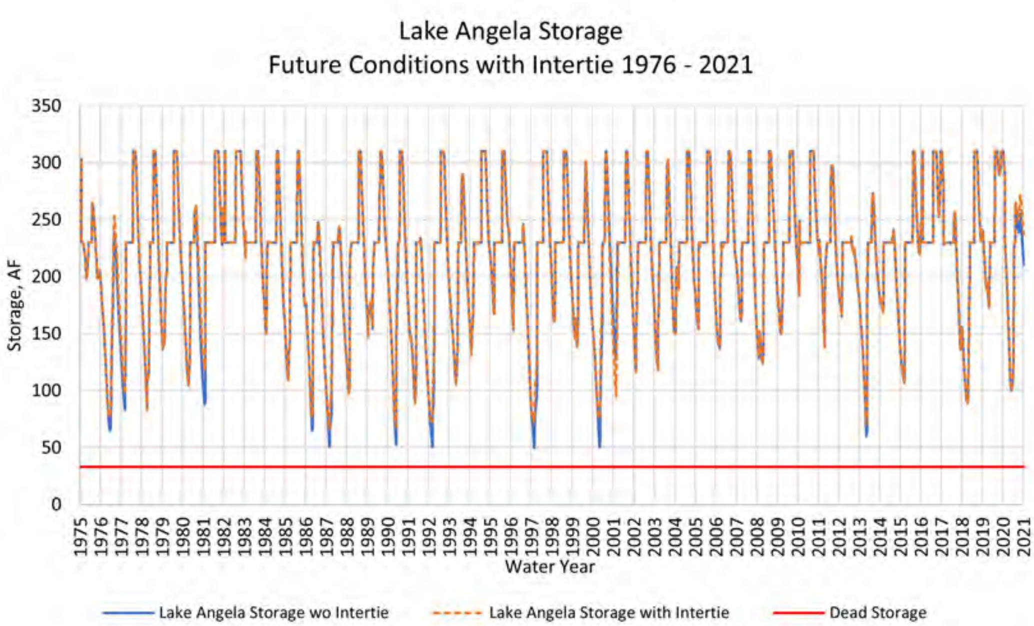

Figure 5-9. Lake Angela Storage with Intertie Delivery

Figure 5-10 provides an overview of the annual volumes of water delivered by the intertie in dry years. These deliveries range from approximately 2 AF to as much as 32 AF in each of the dry years. Deliveries from the intertie are made if Lake Angela storage falls below 80 AF, keeping Lake Angela storage from falling to dead storage while preserving water supply at Serene Lakes. Most intertie deliveries from Serene Lakes are sourced from direct diversions rather than storage withdrawals. This operation is advantageous because the intertie delivery has minimal impact on Serene Lakes storage while benefiting the storage capacity of Lake Angela.

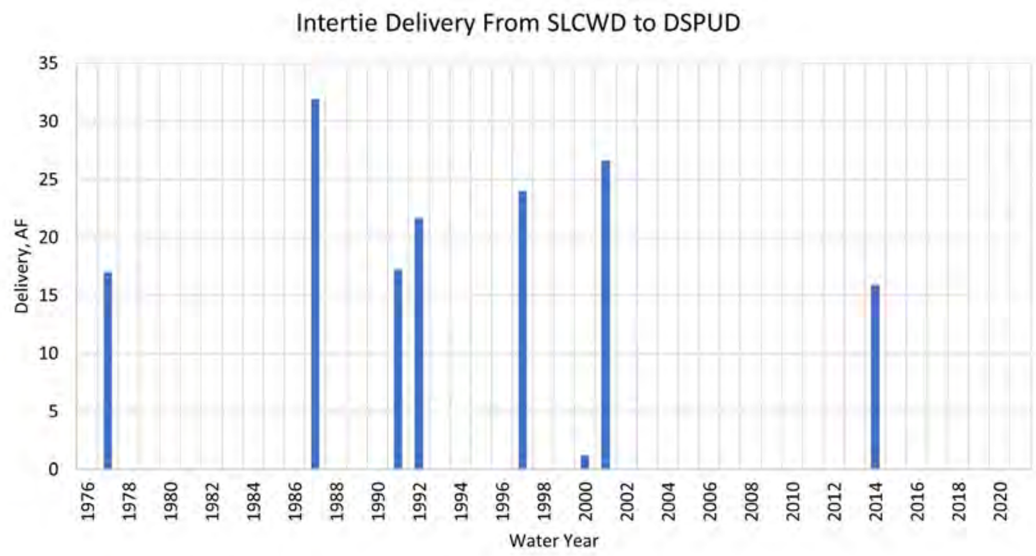

Figure 5-10. Intertie Delivery from SLCWD to DSPUD

5.2.1.3.4 Summary

In conclusion, under future climate conditions, both Lake Angela and Serene Lakes have the capacity to meet the anticipated future demand, provided that dry year reductions in deliveries are implemented during water-short years. The results suggest that by adding an intertie, early spring runoff during drier years can be diverted to Lake Angela without significantly affecting Serene Lakes' storage. This operational improvement enhances overall water supply and may lead to a revision of the triggers included in DSPUD's abridged WSCP (see Appendix F), potentially allowing for increased deliveries by DSPUD.

For water supply purposes, both DSPUD and SLCWD would only need an intertie when consumptive demands approach build out levels. However, an intertie could serve as a valuable resource for emergency water supply needs, enabling the two Districts to offer temporary support in the event of equipment failures or water quality emergencies.

6 SUMMARY AND CONCLUSIONS

6.1 SUMMARY AND CONCLUSIONS

As a result of vulnerabilities related to water quality and a changing climate, which is expected to increase the severity and duration of future droughts, DSPUD has a need to identify potential sources of additional water which respond to these risks. This study is supportive of the requirements of SB 552 which mandates that by January 1, 2027, the District have at least one backup water supply or a water system intertie meeting current water quality requirements and sufficient to meet average daily demand.

The goal of this study was to evaluate the vulnerability of the District's water supply to risks associated with water quality, drought, and climate change, and to identify potential sources of water to address these impacts and the requirements of SB 552. To evaluate the risks associated with drought, as described in Chapter 2, an operations simulation model was developed to evaluate scenarios representing existing and future conditions. Model runs under existing conditions suggest little risk of water supply shortage due to drought assuming current historic hydrology and existing demands. However, results from this evaluation suggest that there is potential for a supply-demand imbalance in the future, particularly during dry years, due to the impacts from climate change and population growth. To help conserve water supplies during future water shortage conditions, including drought, the development of a WSCP that would serve as a framework for implementing water use restrictions was recommended. The periodic review and adjustment of DSOD's storage requirements was also recommended to address the impacts from shifting runoff patterns as a result of climate change. The water quality risk evaluation, described in Chapter 3, identified the potential for continued water quality challenges as a result of impacts from climate change and other internal and external mechanisms. In-lake and operational control strategies, along with the development of a monitoring plan and water quality assessment study, were identified to address and manage these risks.

Several potential permanent and short-term water supply solutions were identified based on the drought risk and water quality evaluations:

Potential Permanent Solutions:

- Groundwater
- Alternative Surface Water Supplies
  - Lake Angela Expansion
  - Development of Nearby Natural Lakes
- Intertie with SLCWD
- Recycled Water
- Water Shortage Contingency Plan

Potential Short-Term Solutions:

- Hauled/Bottled Water

As the only solution that meets the goal of this study, the intertie with SLCWD was carried forward for further evaluation with the development of conceptual infrastructure requirements, feasibility level cost estimates, and evaluation of the intertie using the operations simulation model.

As described in Chapter 5, an intertie with SLCWD would require a 0.8-mile-long 8-inch pipeline extending from the tie-in to the SLCWD water supply system at the intersection of Pahatsi Rd and Soda Springs Rd to the connection to the DSPUD water supply system at the intersection of Bunny Hill Rd and Soda Springs Rd. The total estimated cost for an intertie with SLCWD is estimated at $835,000, including costs for construction, mobilization/demobilization, design and engineering, legal, engineering during construction, and construction management. The results of this study suggest that, under future climate conditions, both Lake Angela and Serene Lakes have the capacity to meet the anticipated future demand, provided that dry year reductions in deliveries are implemented during water-short years. For water supply purposes, both DSPUD and SLCWD would only need an intertie when consumptive demands approach build out levels. However, an intertie could serve as a valuable resource for emergency water supply needs, enabling the two Districts to offer temporary support in the event of equipment failures or water quality emergencies. Construction of an intertie with SLCWD would require changes to both District's water rights to include the other's service area in their place of use.

6.2 NEXT STEPS

Climate change projections from this study indicate future runoff patterns will result in peak runoff in the January through February period. Because of the shifting runoff patterns and the current Lake Angela DSOD requirements coupled with anticipated demands, maximizing storage in Lake Angela and Serene Lakes in the future may become critical once consumptive demands reach build out levels. An economic analysis for the construction of the intertie should be considered. The analysis should not only consider the increase in water supply, but also the value of an emergency water supply at any point in the future. This economic analysis could be performed as part of a feasibility study for the intertie, which is also recommended to include:

- A pipeline alternatives analysis to identify the most optimal pipeline configuration.
- An evaluation of the Class 5 cost estimate prepared as part of this study, along with the development of cost estimates for other identified alternatives as needed.
- Identification and analysis of project implementation considerations including but not limited to funding/financing, needed permits, water rights issues, and legal and institutional requirements.

As discussed in Chapter 2, revision of the DSOD storage requirements was recommended to help maximum storage in Lake Angela given the projected shift in runoff patterns as a result of climate change. Revising the DSOD storage requirements would likely require the District to prepare a monthly design storm study to demonstrate that the dam would not overtop or fail if the November 1 through April 30 timing was relaxed. DSOD may permit some amount of overtopping since Lake Angela is a concrete gravity dam. Regardless, the District would need to brief DSOD on the intent of the study and verify the recommended approach prior to embarking on such an effort.

As described in Chapter 5, the District has prepared an abridged WSCP as part of this study. The abridged WSCP was adopted by the District's Board of Directors on October 17, 2023. The abridged WSCP serves as a framework to manage and mitigate future water shortage conditions as a result of drought or other factors. This framework includes water shortage levels corresponding to progressive ranges of shortages, along with accompanying response actions to help conserve available supplies. These water shortage levels are based on projected surface water storage in Lake Angela and Bulletin 120 forecasts for the American River below Folsom Lake. DSPUD will continue to monitor water supply and demand conditions on a monthly basis and initiate monitoring of the Bulletin 120 forecasts for the American River below Folsom Lake to evaluate when the abridged WSCP should be activated. A summary of the triggers, water reduction targets, and response actions associated with each of the water shortage levels is provided in Appendix F.

As part of the development of DSPUD's abridged WSCP, the District has also developed a catastrophic water allocation plan. The catastrophic water allocation plan will be used to allocate water in the event that water shortage conditions threaten public health and safety, which includes the provision of hauled/bottled water as an interim alternative water supply to meet short-term public health needs. Water will be hauled to DSPUD by a California Department of Public Health certified potable water hauler, and the District is in the process of identifying procurement needs for distributing this alternative water supply. Additionally, the District is in the process of joining the California Water/Wastewater Agency Response Network (CalWARN), a mutual assistance program which could help provide greater access to water supplies during a catastrophic water shortage.

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APPENDIX A: LAKE ANGELA WATER QUALITY RISK EVALUATION TECHNICAL MEMORANDUM

Consulting
Engineers and
Scientists

Technical Memorandum

Lake Angela Water Quality Risk Evaluation

Source water protection planning is an integral component of drinking water providers in the arid-west, especially when drought conditions greatly influence water quantity and quality conditions. The decadal trends in climate warming and its impact on spring snowpack and runoff conditions followed by warmer summers highlighted by wildfires have prompted water providers to evaluate the resiliency in their water supply system. This includes source water quantity and quality, raw water storage, water treatment, finished water storage, and ultimately, the distribution system to the consumer. For the water treatment to distribution component of drinking water supply, resiliency is more commonly defined as the ability to anticipate, absorb, adaptively manage, and recover from a disturbance that upsets water supply. As a result, the Donner Summit Public Utility District (DSPUD) needs to have a good understanding of the ecology and steady-state conditions of their source water supply and Lake Angela to anticipate and respond to a changed condition. In addition, DSPUD needs to understand what tools are available to adaptively manage a changed condition in Lake Angela or to incorporate flexibility into their water treatment system to absorb a water quality upset and return to typical operating conditions.

Purpose

The purpose of this technical memorandum is to describe the ecological and limnological steady-state conditions for Lake Angela based on the available information and to describe the potential risks that may influence water quality and its treatability. We provide an overview of limnological conditions in Sierra Nevada lakes and how this information supplements our current understanding of Lake Angela, and make recommendations on how to improve our understanding of limnological conditions that influence water quality in the lake. Lastly, we describe in-lake management strategies to adaptively manage changes in Lake Angela water quality and operational considerations regarding water treatment.

Background

Lake Angela is the sole source of water supply for DSPUD which serves the nearby communities of Norden, Soda Springs and Big Bend, including local ski resorts, with drinking water. Lake Angela is located at an elevation of 7,200 feet, near Donner Summit and the crest of the Sierra Nevada Mountains, and receives source water from a relatively

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small watershed (144 acres) that comprises a portion of the headwaters in the South Fork Yuba River Watershed. DSPUD owns most of the watershed contributing to the Lake and restricts usage to protect water quality.

The Lake Angela Watershed receives approximately 79 inches of liquid precipitation per year in the form of snowfall (20 inches liquid equivalent) and rainfall (50 inches). Snowpack and overland runoff provide the primary hydrological input to the lake, as there are no defined tributary inflows to the waterbody. The lake also likely receives little to no ground water inflows given the surrounding geology and its headwaters location. The sole purpose of Lake Angela is for domestic water supply.

Lake Angela Dam was first constructed in 1945 and later expanded in 1971 to its current configuration, creating a surface area of approximately 19.6 acres with a storage capacity of approximately 310 acre-feet – which is DSPUD's water right – at an elevation of 7,197 ft (Domenichelli & Associates 2019). The expansion of the dam created two basins separated by a ditch at an elevation of 7,177 feet. Even though the historical dam was partially removed to create a connectivity channel (i.e., ditch) between the basins, the natural geology along the historical dam remained in place, creating a natural sill between the basins (Figure 1). The existing concrete dam has a crest elevation of 7,197.2 feet and a spillway crest elevation of 7,192.8 feet (NAVD88). A 10-inch diameter outlet structure for the water treatment facility is located at an elevation of 7,172 ft, at the southern end of the lake (i.e., southern basin), while the deepest portion of the lake is located approximately 1,000 ft north of the dam (i.e., northern basin). Other than the spillway, there is no defined reservoir outfall, releasing water downstream, thus, water supply releases and evaporation account for the hydrological outputs.

Ecological Setting

Lake Angela is set in the granitic rock outcrops of the Cretaceous Period, characterized as Horneblende-biotite-granodiorite of Summit Lake with K-feldspar megacrystic facies and Tonalite of Lake Mary formations, with small pockets of Talus glacial deposits from the Holocene Period (Sylvester et al. 2012). The Natural Resource Conservation Service (NRCS) further refines the granitic soil characteristics as granitic-Tinker-Cryumbrepts derived from decomposed granite, with 2-30 percent slopes and Meiss weathered rock outcroppings with pockets of freely drained soils (Huntington and Akeson 1987). The mineral soils are poorly developed, and the organic matter content is low due to the exposed granitic outcrops and relatively open canopy of the coniferous forest consisting of Lodgepole Pine (*Pinus contorta var. murrayana*) and Jeffrey Pine (*P. jeffreyi*) with low lying shrubs, Sagebrush (*Artemisia tridentata*) and Bitterbrush (*Purshia tridentata*).

As reported in the Lake Angela Watershed Sanitary Survey Report (Sauers Engineering, 2021), wildlife in the watershed is relatively limited by availability of food, shelter, and places for rearing young. Land use, as defined by Nevada County General Plan, is Forest. The community served by DSPUD is located 2 miles east and downhill from the Lake at an elevation of 6,850 feet.

Because the lake is designed for storage, with no regular flow-through, water can become stagnant. There are two conditions that contribute to algae growth: 1) during years of low precipitation when there is no outflow; and 2) during summer months when the lake is experiencing thermal destratification. Excessive algal blooms were experienced in July-August 2009 and July-August 2015 (Sauers Engineering, 2021).

Limnology and Water Quality of Sierra Nevada Lakes

External Nutrient Inputs

The soil nutrient contents and fluxes from the semiarid forest are relatively low compared to other northern temperate forest types (Johnson et al. 1997). However, the atmospheric deposition of nitrogen and phosphorus, from sources outside of the watershed, represents a relatively large fraction of the watershed nutrient budgets and inputs to high elevation lakes in the Sierra Nevada mountain range (Sickman et al. 2003). Sources for the atmospheric deposition include motor vehicle emissions, wind-blown dust,–pollen, and–organic matter, along with ash particulates from wildfires. In fact, the aeolian deposition of biologically available total inorganic nitrogen (TIN) and soluble reactive phosphorus (SRP) inputs to Sierra Nevada Lakes have been directly linked to regional forest fires (TREC 2022) which provides an external nutrient source to the lake's algae population. The atmospheric deposition within the watershed, along with the natural decomposition of organic matter, is "flushed" into Sierra Nevada lakes during spring snowmelt or rainfall runoff. These external nutrient sources have contributed to the general pattern of nutrient enrichment in lakes throughout the Sierra Nevada mountain range (Sickman et al. 2003), including Lake Angela. When this pattern of nutrient enrichment is placed into the context of a warmer climate, small changes in ice-cover duration, spring snowpack and timing of snow-melt runoff (Null et al. 2010), surface water temperature (Sadro et al. 2019), and light availability can have a large influence on algae production in the oligotrophic lakes of the Sierra Nevada mountain range (Goldman et al. 1993, Sickman et al. 2003, Goldman 2000). If dry-year type conditions continue to be more frequent, high elevation lakes in the Sierra Nevada (like Lake Angela) will continue to become more productive of algae (Sadro et al. 2019).

Internal Nutrient Inputs

Lake Angela may typify a small lake in the northern Sierra Nevada mountain range; however, little information exists describing the physicochemical characteristics of the lake or the hydrological processes that influence external nutrient inputs or possible internal nutrient loading from the lake sediments. Considering that the nutrient inputs from the watershed are likely small, the internal nutrient release may provide a substantive component of the nutrient mass balance that facilitates algal productivity during late summer or early fall. The long-term accumulation of organic matter at the bottom of the lake, supported by the annual cycle of algae growth–death–settling and nutrient recycling by aquatic life use (i.e., zooplankton and fish), has likely created a sediment layer that stores phosphorus bound to organic matter and mineral-oxides during oxygenated lake conditions. The sediment phosphorus content in high elevation, Sierra Nevada lakes (n = 50), is sufficiently large enough (~1,450 mg/kg sediment) to provide a substantive internal nutrient loading component under redox conditions (Homyak et al. 2014). Approximately 30 percent of the sediment-bound phosphorus content is in the freely exchangeable and redox-sensitive iron-, manganese-oxides pool, while 70 percent is in the more recalcitrant aluminum- and calcium-oxides and non-reducible organic matter pool. Aluminum-bound phosphorus comprises the largest component of the recalcitrant pool in Sierra Nevada lakes (Homyak et al. 2014), effectively sequestering phosphorus that is not affected by redox conditions (Kopacek et al. 2005). The metals (e.g., iron, manganese, aluminum) along with calcium and silicates (important for diatom growth) are byproducts of natural weathering of the surrounding geology in the watershed.

Thermal Stability

Lake Angela is a small cold-water dimictic lake that exhibits a winter ice-covered period and two seasonal mixing periods (spring and fall). The two basins, separated by a sill, likely influence the thermal characteristics of the Lake Angela and certainly influence the general spring warming and ice-off characteristics as evident in the satellite images (Figure 1). The lake is deep enough to exhibit thermal stratification during the summer months such that a density gradient separates the warmer upper water layer (epilimnion) from the colder bottom layer (hypolimnion). When the density gradient (thermocline) is resistant to mixing, the hypolimnetic dissolved oxygen content may be depleted by microbial respiration creating a low dissolved oxygen environment. When this condition persists, the microbial reduction of organic matter and metal oxides (e.g., freely exchangeable and redox-sensitive iron and manganese) as an electron source (i.e., energy) occurs in the sediment, releasing soluble reactive phosphorus, iron and manganese. These constituents diffuse across the sediment/water interface and into the overlying water column. When the hypolimnion remains stable and unmixed during the summer, the nutrient and metals concentrations can increase to levels that facilitate algae growth or influence water treatment, when the hypolimnion becomes mixed with the epilimnion in the fall. Other hydrological factors that can influence the water column stability, includes hypolimnetic withdrawal or stormwater inputs, causing temporary mixing of the water column or intrusion of water to deeper depths. These factors may be evident in Lake Angela when redox favorable conditions persist given the two distinct basins.

Algae

Despite the oligotrophic status of most Sierra Nevada lakes, there is evidence that algal productivity is increasing (Goldman et al. 1988, Goldman 2000, Derlet et al. 2009), concurrent with the increasing trends in nitrogen deposition (Sickman et al. 2003) and climate warming (OEHHA 2022). While reactive nitrogen deposition has be linked to changes in diatom assemblages of high elevation lakes (Winder et al. 2008, Olesky et al. 2020), the pronounced changes in other algae assemblages indicates additional drivers remain largely undocumented (Sadro et al. 2018). Algae populations in high elevation lakes are seasonally variable, with diatoms (single-celled, hard-bodied algae with silica based cell walls) typically the most abundant algae in the spring due to the mixing, nutrients, and light availability following seasonal ice-off conditions (Winder et al. 2009, Sommer 1989). Peak algae biomass typically occurs in late summer, and is usually associated with a shift from diatoms to small, soft-bodied unicellular chlorophytes (green algae) that are better adapted to the relatively stable water column and low nutrient and mineral concentrations (McKnight et al. 1990). The transition to the fall algae assemblage can contain a mix of chlorophytes, chrysophytes (golden algae) and cyanobacteria (Dory et al. 2022, McKnight et al. 1990), while the winter algae are often comprised of small motile cryptophytes and chrysophytes that are adapted to low light conditions, and can exhibit mixotrophy (i.e., consume bacteria to obtain carbon source rather than rely solely on photosynthesis). Oligotrophic conditions tend to provide a competitive advantage of small-bodied algae over the larger filamentous chlorophytes or cyanobacteria.

Existing Monitoring Data for Lake Angela

Hydrology

Based on the limited lake level data, collected primarily from 2009 to 2015, Lake Angela is generally at full capacity (7,192.8 ft) from April to June, at which time the summer water demand decreases lake level by approximately 1.6 feet per month through September, and eventually decreases to minimum lake level (7,186 ft) in November. No lake level data are available for the winter months December through February when the lake is ice- and snow-covered. In terms of risk to Lake Angela's hydrological cycle and water storage, climate modeling scenarios indicate that the Yuba Watershed may experience considerable reductions in flow and water storage under warmer climate conditions (Null et al. 2010). The northern Sierra Nevada watersheds are highly developed for drinking water storage and reductions in flow are predicted to be the greatest during wet-year type conditions. Because Lake Angela is at the headwaters of the Yuba Watershed, these modeled conditions may be less pronounced; however, decreases in wet-year storage followed up by consecutive dry-year conditions may result in decreased lake levels that can also affect water quality. Per DSPUD's permit for diversion and use of water (#21118), water can only be collected and stored from November 1 to July 31, and collection outside of this period is not authorized to offset evaporative losses or low lake levels. If lake levels approach a condition where the two basins are largely isolated (Figure 1), except for the interconnective ditch portion, wind-induced mixing will be limited, creating more quiescent conditions in the southern basin. These conditions may be more prevalent during the late summer or fall period, when conditions are more favorable for algae production.

Water Quality

The physicochemical properties of Lake Angela and its two distinct basins are poorly characterized; although DSPUD periodically collects raw water samples on the facility's intake from the southern basin (2008-2020, n = 8 samples). These few raw water intake samples are likely representative of water quality conditions in Lake Angela's southern basin. However, the hypolimnetic water withdrawal for treatment and movement of water from the northern basin into the southern basin can affect the water quality conditions observed in raw water intake samples. Nonetheless, the water quality results show a high quality drinking water source absent of organic contaminants, albeit with characteristics representative of its watershed and sediment conditions. The bicarbonate-carbonate-alkalinity concentrations show a weakly buffered lake that is low in ionic strength (i.e., conductivity) and hardness (i.e., calcium and magnesium). The metals that readily bind to phosphorus were typically present in detectable concentrations of raw water samples, but less than their maximum contaminant level for drinking water. Notably, the highest concentrations of iron and manganese, including total dissolved solids (October 18, 2018, Sauers Engineering, Inc. 2021, Table B.1) appeared to occur when the lake's elevation was relatively low and storing less water (Figure 2), and likely represented a mixed water column, post fall turnover. The nutrient water chemistry data that are important for understanding the algae dynamics in Lake Angela are not available. Only nitrate-nitrite analyses were performed which represent only a fraction of the bioavailable total inorganic nitrogen component that that supports algae growth. No phosphorus analyses were performed on raw water samples.

Algae

Little to no information exists on the algae population dynamics in Lake Angela other than the lake has experienced infrequent nuisance[1] algae blooms that resulted in raw water treatability issues (i.e., turbidity). In 2009, the nuisance alga was identified as *Chlorella* sp., a micro-green alga (2-10 µm spherical cell) that is common in high elevation lakes and is well adapted to low concentrations of inorganic nitrogen, soluble reactive phosphorus, and minerals. The lake also contained *Oocystis* sp., a green alga (10-20 µm ellipsoid cell), and three diatom genera–*Navicula*, *Cocconeis*, *Cyclotella*, that represent both pennate and centric cells (10-75 µm). In July 2016, Lake Angela experienced a similar nuisance algae bloom causing treatability issues, although the algal taxa were not identified.

[1] a rapid increase of one or only a few species of algae, resulting in densities high enough to cause discoloration of the surface water

Water Quality Risks

Nuisance algae levels such as the ones observed in 2009 and 2016 can result in several water treatment problems such as taste and odor, formation of disinfection-by-products (e.g., trihalomethanes and chloroacetic acids), clogging of filter beds (Hung and Liu 2006), or biofouling and cake formation on filtration treatment systems (Shekhar et al. 2017). In addition to the size and shape of algal cells, algal organic matter [(i.e., metabolic byproducts and ruptured cells), dissolved organic carbon, DOC], and other particles affect the filtering efficiency and life-span of microfiltration treatment systems (Novoa et al. 2021). As a result, a mix of physical and chemical biofouling control strategies are key to the long-term operation of water treatment systems. These approaches may include membrane cleaning (i.e., backwash, air scouring), chemical pretreatment (i.e., ozonation, oxidation, coagulation, in-lake algaecides), operational controls (i.e., cross flow velocity, induced shear stresses), or composite treatment systems [(i.e., coagulant + activated carbon pretreatment), Novoa et al. 2021]. In both instances, when raw water from Lake Angela created treatability issues, the nuisance algae levels were effectively controlled using chemical algaecides that reduced the water treatment issues. However, the algaecide control strategies are often reactionary in nature and occur after water treatment issues arise. Therefore, a mix of control strategies that include both proactive and reactive treatment options should be considered for risk planning purposes.

To summarize the potential risks to Lake Angela water supply and treatment for drinking water purposes, the risks include both external and internal mechanisms:

Mechanism: *Atmospheric deposition is increasing the nitrogen and phosphorus content in Sierra Nevada watersheds and lakes*
Risk: *Promotes algae growth and biomass*

Mechanism: *Ash deposition from regional wildfires is increasing the nitrogen and phosphorus content, including particulates in Sierra Nevada watersheds and lakes*
Risk: *Promotes algae growth and biomass, increases particulates that affect treatability of water*

Mechanism: *Climate warming is increasing the variability in dry- and wet-year type conditions, and influencing the timing of snow-melt runoff, stream flows, and water storage in Sierra Nevada watersheds and lakes*
Risk: *Reduce water availability during consecutive dry-years, increase surface water temperature promoting algae growth and biomass*

Mechanism: *Bathymetry of Lake Angela and its two distinct basins separated by an interconnective ditch influence water circulation*
Risk: *Reduced capacity for mixing during low lake levels can affect water quality*

Mechanism: *Basin morphology and water withdrawal from the southern basin may influence lake stratification during the summer. Southern basin may be mixed while the northern basin remains stratified*
Risk: *Increase potential for internal nutrient loading that promotes late season algae growth, release of iron and manganese that affect treatability of raw water*

Mechanism: *Deep water withdrawal from the southern basin can influence water circulation patterns and promote the movement of warmer epilimnetic water from the northern basin to the southern basin*
Risk: *Warmer epilimnetic water is more suitable for nuisance algae growth*

Mechanism: *Increasing trends in nutrient availability, increases the likelihood developing nuisance algae levels in July and August*
Risk: *Increase the potential for taste and odor issues, affect the treatability of raw water*

Monitoring Recommendations to Improve Understanding of Lake Angela

A key component of a lake water protection plan is having a good understanding of the hydrological and water quality conditions that influence the summer algal growing season. This begins with documenting the volume of inflows (i.e., translation of lake level to storage volume) and outflows (i.e., withdrawal and spillway overflows) which better characterizes the water budget, hydraulic residence time, and the time that algae have to respond to favorable growing conditions.

We also recommend establishing two in-lake monitoring sites, one in each basin over the deepest location, and performing one sampling event per month during the July-August-September growing season. In addition to the lake monitoring, corresponding water samples should be collected from the facility's raw water intake and analyzed for the same constituents discussed below.

At each lake site, we recommend collecting water quality sonde profile data to document water temperature, dissolved oxygen, specific conductivity, pH, and oxidation reduction potential on 1 feet increments from the surface to the near bottom water (i.e., within 2 feet of the sediment). These data will help characterize any thermal stratification or density gradients that may limit whole water column mixing, and if thermally stratified, whether the hypolimnion exhibits low dissolved oxygen (e.g., < 2 mg/L) and redox favorable conditions. We also recommend collecting a near-surface water sample (1 ft below the surface), and a near-bottom water sample (within 2 ft of the sediment) and analyzing the samples for nutrients (total and dissolved organic/inorganic nitrogen and phosphorus fractions, lowest detection limits possible[2]), total recoverable and dissolved iron and manganese, turbidity, and chlorophyll-a content (only near-surface sample). These data will help determine whether conditions are favorable for internal nutrient loading that may facilitate late season algae growth or affect taste and odor due to algae or metals. If Lake Angela experiences a nuisance algae bloom or is impacted by ash deposition from wildfires, then the frequency of monitoring should be increased to better characterize the potential effect on Lake Angela and water treatment. Supplemental algae identification data collected during a nuisance bloom would also be helpful to characterize the potential effect on water treatment, especially considering if cyanobacteria are present in Lake Angela. Cyanobacteria may require special considerations for water treatment, such as the presence of cyanotoxins.

Lake Angela Water Quality Assessment

Ideally, in-lake water quality monitoring should be a continuous part of a source water protection plan; however, we also recognize the economic and feasibility challenges of implementing and maintaining a source water monitoring program for small water districts. Therefore, we recommend performing a water quality assessment study to better characterize the limnological conditions of Lake Angela. This study may require at least two summers of water quantity and quality monitoring data to better characterize the potential risk of internal nutrient loading and potentially additional spring-time monitoring to characterize the nutrient and metals concentrations following spring snowmelt and runoff. The paired sampling routine (intake and lake water analyses) would help identify how the water quality characteristics in the northern basin influence the southern basin, or the lake as a whole, and whether the water quality in the southern basin is adequately represented by the raw water intake samples. A better understanding of how water quality conditions change and what influences them from a hydrological or water circulation standpoint will better inform the in-lake and water treatment process. Depending on the findings from the water quality assessment study, it may be practicable to modify the monitoring program and to only monitor the facility's raw water intake, if there are no significant differences between the intake chemistry and chemistry observed in the lake.

Control Strategies to Manage Risk

Based on information gleaned from the water quality assessment study and considering that nuisance algae blooms and ash deposition present the greatest risk to a sole source water treatment facility, a mix of proactive and reactive control strategies should be considered for

[2] Many laboratories analyze nitrogen components using relatively high detection limits that generally correspond to their respective MCLs for drinking water or even wastewater (i.e., milligram per liter, mg/L). However, for limnological and algae assessment purposes, low level detection limits (i.e., microgram per liter, µg/L) need to be requested for nutrient analyses.

resiliency planning purposes. These strategies should include options for both in-lake and water treatment controls.

In-Lake Control Strategies

Algaecides

In-lake control strategies have primarily centered around the use of chemical herbicides as a response to treat problematic algae and cyanobacteria. Copper-based algaecides have been widely used because the efficacy, fate of copper, and potential effects on non-target aquatic life use have been well-documented (Moore and Kellerman 1905, Calomeni et al. 2017, Murray-Gulde et al. 2002). However, there are limitations that should be considered before its use in Lake Angela, because copper is a priority pollutant under the California Lead and Copper Rule (CCR Title 22, Div.4, Ch 17.5). In addition, when treating soft waters, such as in Lake Angela, with copper-based algaecides, there is an increased risk to non-target aquatic life use. As a result, copper-based algaecides are not recommended, especially when other USEPA and California approved oxidizers are available as algaecide treatment in raw water storage reservoirs.

The use of stabilized peroxide pellets (sodium carbonate peroxyhydrate) is an equally effective approach for controlling algae blooms, compared to copper-based algaecides, and has a substantial amount of field evidence supporting its effectiveness in the United States and Europe (Mattheiss et al. 2017, Matthijs et al 2012, Zhou et al. 2018, Lusty and Gobler 2021). There are two versions – one that sinks to the bottom and effectively treats benthic algae or one that floats and slowly dissolves and is designed for planktonic algae. Relatively low concentrations of peroxide-based algaecides are very effective in controlling cyanobacteria via oxidative stress. Although, there is evidence that green algae, including *Chlorella* sp., exhibit antioxidant defense mechanisms that help degrade oxidants and lessen their effectiveness at relatively low concentrations that are effective on cyanobacteria (Weenink et al. 2021, Lusty and Gobler 2020, Foyer and Shigeoka 2011). As a result, larger treatment doses may be necessary to effectively control a nuisance green algal population. The application of peroxide-based algaecides certainly has an advantage over other forms of algaecides in that the product breaks down to water and oxygen within a few days of treatment, leaving no long-term chemical signature in the environment (Matthijs et al. 2012). This characteristic is particularly desirable in a drinking water storage reservoir, and even more in a pristine Sierra Nevada lake.

Ultrasonic Sound Waves

An emerging technology to preemptively control the development of algae relies on high frequency, low power, sound waves to disrupt algal cell structure. These ultrasonic systems are typically mounted on a buoy platform with a solar panel/battery system that is deployed in the spring and retrieved late fall. The frequency, power intensity, and duration of output are adjusted to target specific algal groups (i.e., cyanobacteria or green algae) and operate over the summer growing season. For cyanobacteria, the objective is to rupture the gas vacuoles to eliminate their ability to move up/down in the water column to maximize photosynthesis, whereas the objective for green algae is to compromise the cell wall bond and effect the chloroplast causing internal cell disruption. The ultrasound devices have been used on eutrophic raw water storage reservoirs with limited success in controlling nuisance cyanobacteria blooms (Schneider et al. 2015). In turbid, eutrophic systems, attenuation of the ultrasonic sound waves is more rapid and less effective, whereas in oligotrophic systems there should be much less signal attenuation, resulting in greater effectiveness. The technology has proven effective on most singled cell cyanobacteria and green algae in smaller waterbodies and does not affect fish, birds, or domestic animals in the water. However, this technology has not been effective on filamentous or colonial types of algae that include–*Pithophora*, *Chara*, *Nitella*, *Hydrodictyon*, *Cylindrospermopsis*, *Scendesmus*, *Oscillatoria* or *Euglena* (Sonic Solutions LLC). The advantage of ultrasonic technology is its preemptive treatment to reduce algae growth over the growing season and to eliminate the occurrence of nuisance algae blooms, as well as to reduce or eliminate the use of algaecides.

Operational Control Strategies

Operational controls for the raw water intake in Lake Angela are limited given the single deep water intake, but when the treatability is extremely poor, the intake may need to be closed for a period of time to allow conditions to improve. This operational approach has obvious implication on water treatment; thus, the duration may be limited given the finished storage capacity. The recent upgrade to the DSPUD treatment system and the redundant 0.5 MGD clarification/filtration basins provides system backup during high turbidity events and presents an opportunity to optimize one system to treat source waters severely impacted by wildfires. Operational changes within the water treatment should be prepared for if/when ash deposition results in a high suspended solids load to Lake Angela. High turbidity conditions will require operating at lower flows, shorter filter runs, increased backwashing, and having to adjust treatment for the composition of the ash such as clay particles versus total organic carbon [(TOC), OHA 2021]. Organic carbon from wildfires contains more humics and aromatics than typical TOC, and is more likely to form disinfection by products [(DBPs), Hohner et al. 2016]. Therefore, higher coagulant doses and additional oxidation may be required to address the TOC and taste and odor issues, along with more chlorine to address the oxidants. Powdered activated carbon may even be considered with the coagulant. Small single source water treatment systems such as DSPUD are at risk when wildfires impact source waters. Therefore, additional finish water storage capacity should also be evaluated as an operation control if wildfires impact Lake Angela or its watershed.

Summary

Lake Angela is a high-elevation, oligotrophic lake in the headwaters of the South Yuba Watershed that serves as the sole raw water storage supply for DSPUD. The high-elevation lakes of the Sierra Nevada have experienced decades of atmospheric nitrogen deposition that has gradually increased the algal productivity of these lakes, and more recently, ash deposition from regional wildfires have added to the nitrogen and phosphorus content of many lakes. These factors combined with the warming of the Sierra Nevada lakes, due to climate change, have resulted in more frequent algal blooms that are slowly eroding their oligotrophic status. Because Lake Angela serves as a sole source water supply, these environmental factors place it at greater risk of increased nutrient-algae impacts, given the treatability issues associated with nuisance algae levels and turbidity.

Other factors that may influence the development of nuisance algae growth and contribute to other water quality issues lie within Lake Angela and its two distinct basins interconnected by a ditch. The basin morphology influences the thermal and water circulation patterns in the lake which create conditions favorable for internal nutrient loading when stratified during the summer. The location of the raw water intake in the southern basin also influences the water circulation and thermal stratification patterns in the lake, such that the northern basin may experience the release of phosphorus, iron and manganese from the sediment. This internal release of nutrients and metals can affect algal production and treatability issues once the lake becomes fully mixed in the fall.

Because the hydrology and water quality data for Lake Angela is limited, we have recommended a monitoring plan and water quality assessment study that will improve DSPUD’s understanding of the dynamics that affect the ecology and steady-state conditions of the lake. This information will also help inform DSPUD how to best prepare for and to manage an upset in water quality conditions in their drinking water supply and treatment process. Lastly, we have provided guidance on in-lake control strategies that are the most appropriate for managing algae production in a pristine source water lake, as well as, incorporating flexibility and optimizing the water treatment process to adaptively manage an extreme turbidity event.

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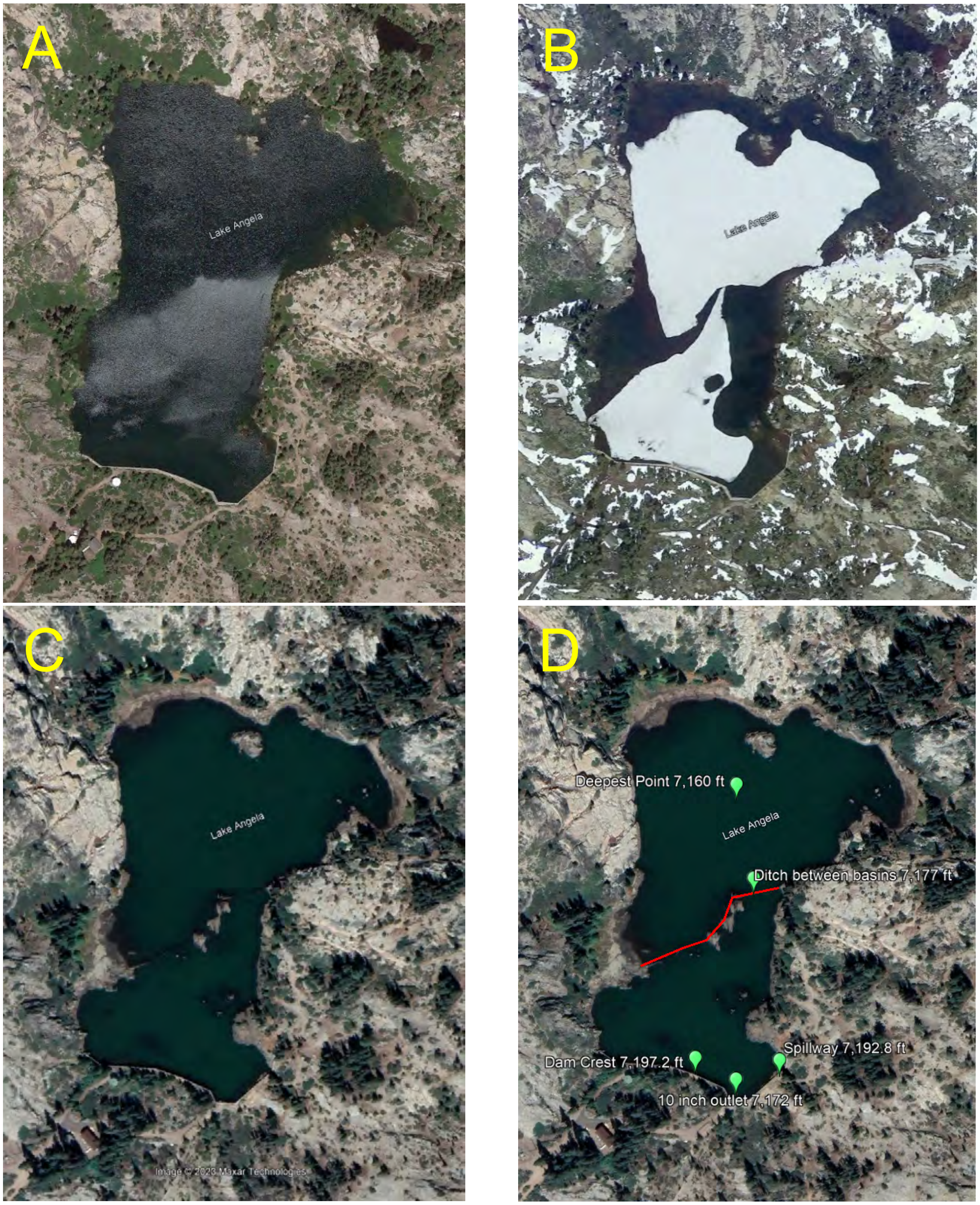


Figure 1: Satellite images of Lake Angela and relevant elevation datum [(NAVD88), Google Earth]. A = July 10, 2010, B = April 29, 2014, C = September 18, 2018, D = September 18, 2018, red line indicates historical dam location and natural sill.

Figure 2: **Monthly average lake elevations with sample size standard deviations, 2008-2015 and 2022 data overlay. 1 = Jan to 12 = Dec.**

APPENDIX B: DROUGHT RISK EVALUATION TECHNICAL MEMORANDUM

TECHNICAL MEMORANDUM

TO: Steve Palmer/ Jim King, Donner Summit Public Utility District

FROM: Jeff Meyer, Western Hydrologics

DATE: September 2023

RE: ***Revised Task 2: Evaluate Risk of Drought Impacts***

Donner Summit Public Utility District (DSPUD, or District) has contracted with GEI Consultants, Inc., and Western Hydrologics to develop a water supply resiliency study to address DSPUD's present challenges related to water supply reliability. This study includes an evaluation of the risk of drought and climate change impacts to Lake Angela and the identification of shortage criteria which will ultimately be incorporated into DSPUD's abridged Water Shortage Contingency Plan (WSCP) to be developed as part of this study.

To evaluate the risk of drought and climate change impacts, Western Hydrologics developed an operations simulation model which incorporated current and future demands under historic and climate change hydrologic scenarios. These scenarios were tested over a period containing water years 1976-2021 to include the hydrologic variability which occurs in the basin. Table 1 provides a summary of the assumptions used for the studies performed for this effort. The purpose of this Technical Memorandum is to describe the development of the model, evaluate model results, and to document the risk of potential drought impacts under both existing conditions and anticipated 2040 future conditions.

Table 1 - Model Scenario Summary Table

Scenario	Facilities	Hydrology	Study Period	Demand
Existing	Existing	Historic	1976-2021	Historic (2017 – 2021 Avg)
Future	Existing	2040 Climate Change	1976 - 2021 modified by climate change factors	Future based upon planning documents

Hydrology

As part of the model development, two hydrology datasets were developed. The first data set is a representation of historic inflow to Lake Angela derived from the Kidd Lake inflow data created as part of the inflow dataset for Nevada Irrigation District's Federal Energy Regulatory Commission Relicensing effort of the Yuba-Bear Project, updated for their current *Plan for*

Water effort. This dataset was developed by using the methods described in the Hydrologic Analysis Technical Memorandum – Final Report for Nevada Irrigation District dated November 12, 2020. The dataset extends through 2021 and includes an inflow time series to Kidd Lake. Kidd Lake is about 5 miles west of Lake Angela with similar watershed characteristics and watershed areas. Lake Angela has a watershed area of 0.225 square miles and an elevation of 7,210 ft mean sea level (msl). Kidd Lake has a watershed area of 1.9 square miles and an elevation of about 6,640 ft msl. One significant difference is the elevation of the watersheds of the two lakes. Lake Angela's watershed reaches over 7,600 ft msl, while Kidd Lake's watershed highest point is 6,750 ft msl.

Initially, the Kidd Lake inflow dataset was scaled by watershed area to develop a daily inflow dataset for Lake Angela from 1976 through 2021. Eq. 1

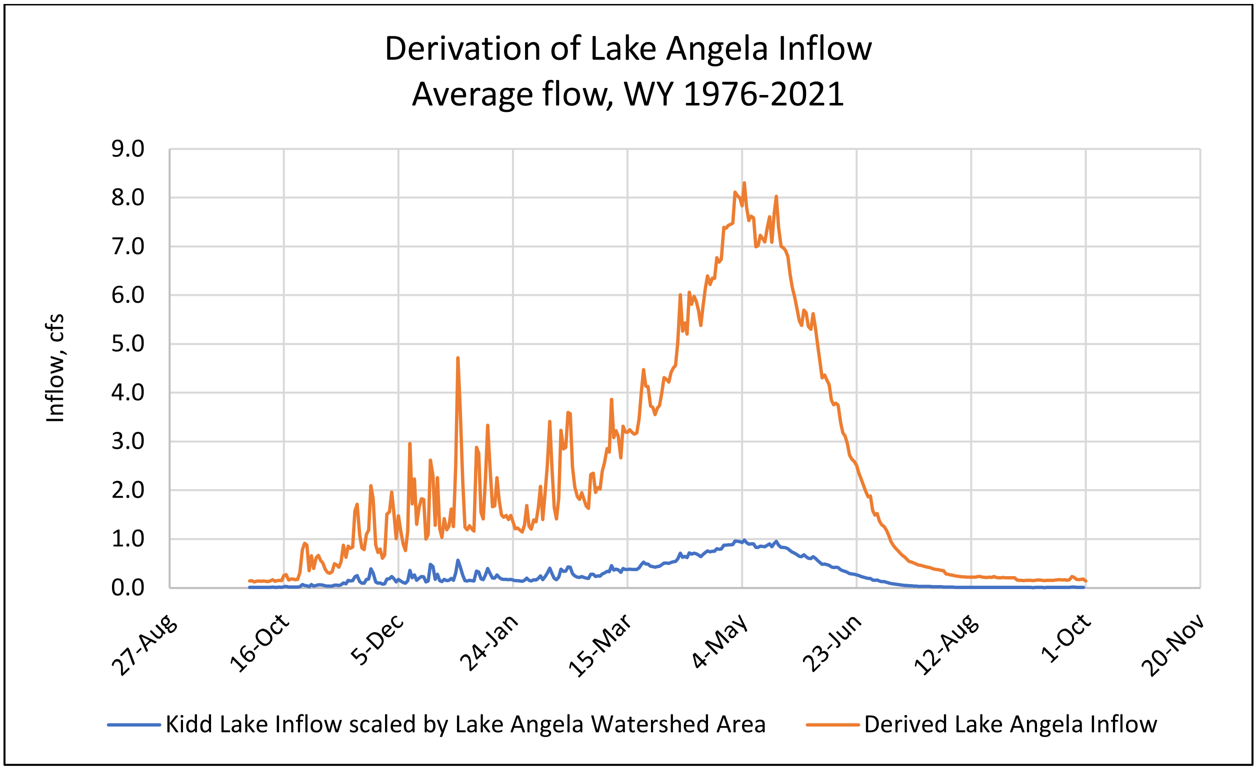
Eq 1. $\text{Inflow}_{KL} \times (\text{Watershed Area}_{LA} / \text{Watershed Area}_{KL})$

Where:

Inflow_{KL}	equals the time series inflow to Kidd Lake
$\text{Watershed Area}_{LA}$	equals the watershed area of Lake Angela (0.225 sq mi)
$\text{Watershed Area}_{KL}$	equals the watershed area of Kidd Lake (1.9 sq mi)

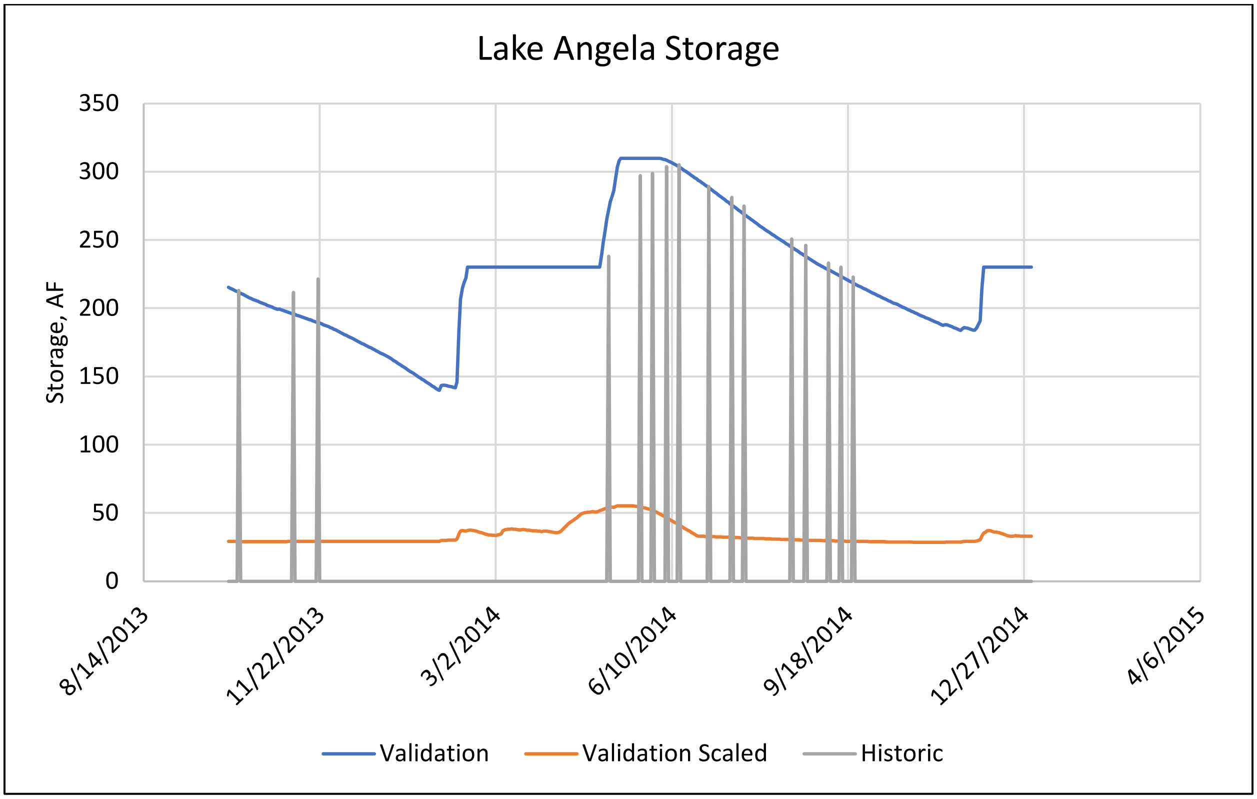
The resulting inflow, shown in blue in Figure 1, was used in the model simulation with historic demand.

Figure 1 - Lake Angela Inflow



The simulation model was used to test the Lake Angela Inflow hydrology dataset by comparing model operations to the historic storage data using historic deliveries. Figure 2 illustrates the simulated storage compared to the historic storage. The gray lines show the intermittent historic Lake Angela storage. The orange line represents the simulated storage using the scaled Kidd Lake inflow and the historic consumptive deliveries. Using the scaled hydrology data results in storage volumes that are much lower than historic. The results indicate that the scaled approach produces inflows that are much lower than actual inflows. A second validation study was performed using the full Kidd Lake inflow dataset. The blue line illustrates the resulting storage which very closely matches the historic storage. Although Figure 2 only shows 2014, these trends are similar for the 2009 – 2015 period where both historic storage and historic delivery data are available. The full derived Lake Angela inflow dataset demonstrates a better fit for the Lake Angela inflow than the scaled Kidd Lake inflow. The derived inflow dataset was chosen as a suitable dataset for the Lake Angela inflow for this analysis.

Figure 2 - Simulated Lake Angela Storage vs Historic Storage



Climate Change Hydrology

Climate change adjusted hydrology was developed using CalSim 3 2040 Central Tendency[1] for the U.S. Geological Survey Gage at South Yuba River at Cisco Grove. This dataset was developed for the 2021 California Department of Water Resources (DWR) Delivery Capability Report. The 2040 Central Tendency (or 2040 CT) data at Cisco Grove was disaggregated into daily timestep data and adjusted for the historic Lake Angela inflow dataset. The study period for this climate change dataset is October 1, 1975 – September 30, 2015. Because the CalSim dataset only has data through 2015, years similar to 2016 through 2021 were identified to extend the record through 2021.

[1] Technical Addendum to the State Water Project Final Delivery Capability Report 2021 - https://water.ca.gov/Library/Modeling-and-Analysis/Central-Valley-models-and-tools/CalSim-3/DCR2021

Figure 3 - Climate Change 2040 CT vs Historic

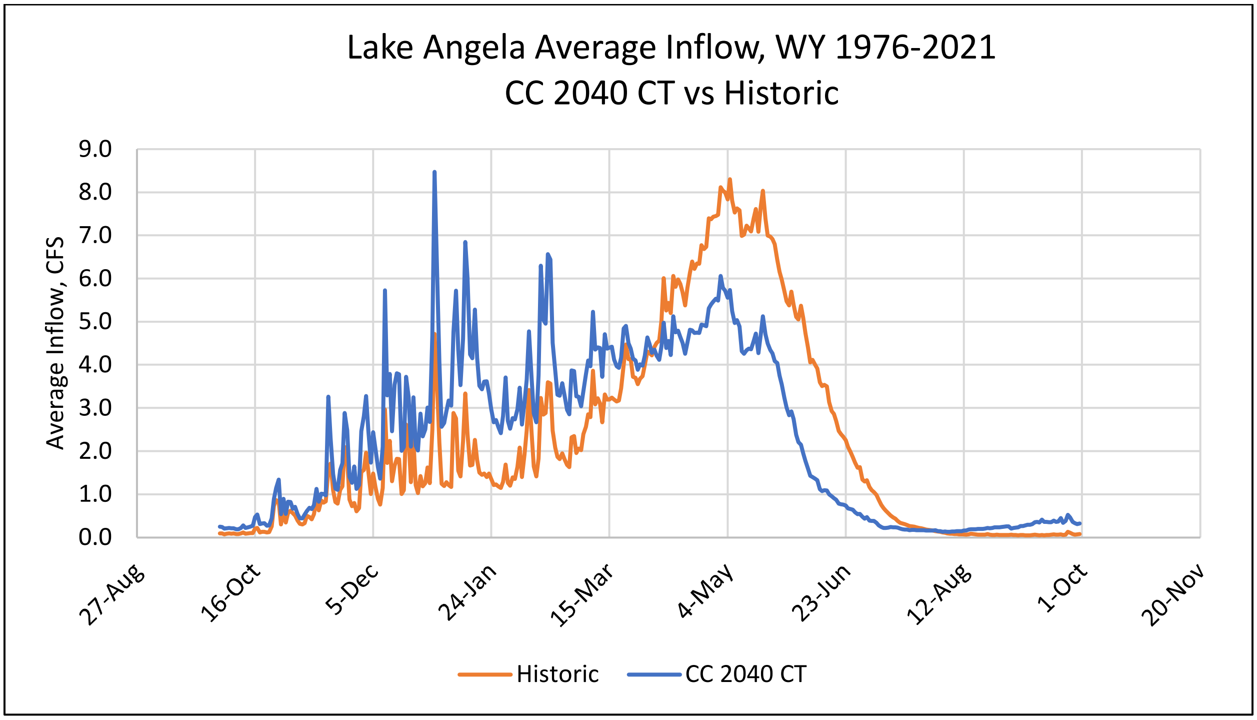


Figure 3 illustrates the historic unimpaired inflow to Lake Angela compared to the 2040 level of climate change hydrology. The total volume of the climate change hydrology is 0.2 percent less than the historic hydrology. The most significant change is the shift in runoff pattern. This shift reflects the diminished snowpack expected in the future, resulting in a potential need for changes in operations or a replacement of the snowpack storage.

These inflow datasets contain watershed runoff modeling results for two climate conditions as shown in Table 2.

Table 2 - Climate Conditions

Condition	**Description**
Historical	Historical representation of Lake Angela inflow from Kidd Lake Inflow
2040 Future Conditions	Future conditions projected climate for a thirty-year period centered on 2040 (2025-2055)

Figure 4 – Historical versus 2040 Future Conditions

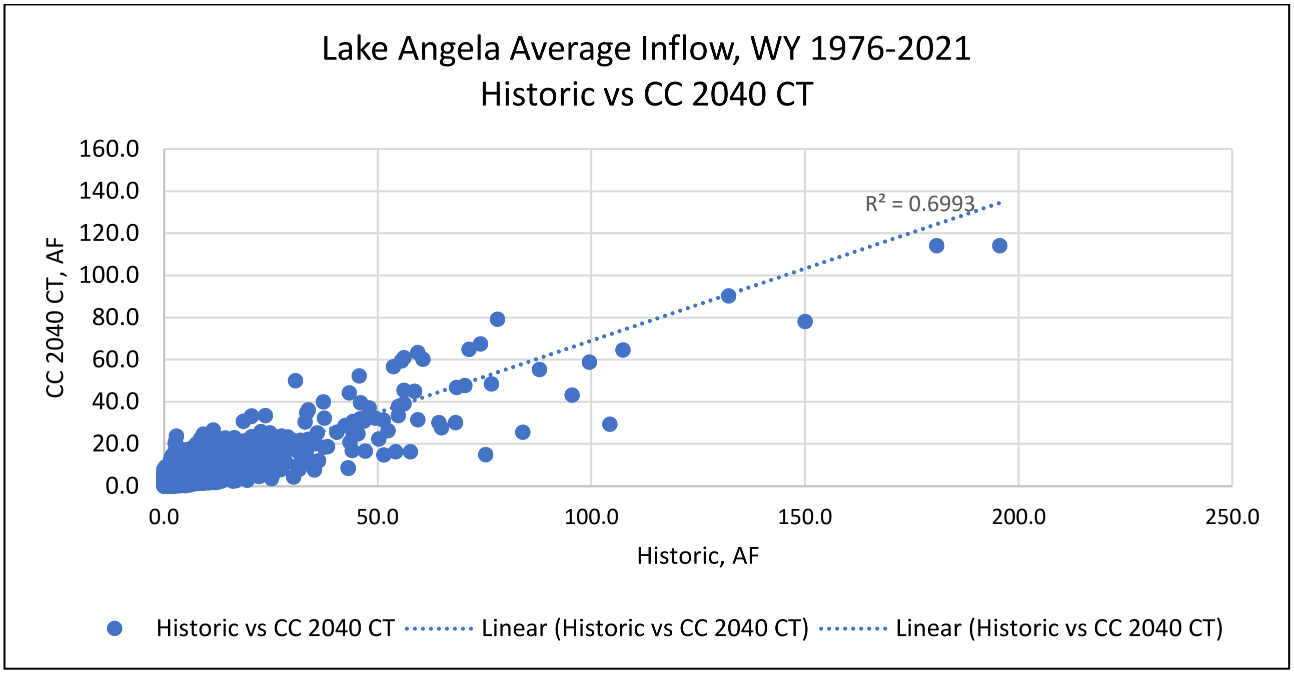


Figure 4 shows how the two datasets compare. The climate change scenario volume is almost identical to the historic hydrology.

<u>Evaporation</u>

No evaporation rate data was available specifically for Lake Angela. As an estimate of evaporation, the DWR Bulletin 73, *"Evaporation from Water Surfaces in California"*, dated November 1979 combined with the Lake Valley Reservoir evaporation pattern from CalSim 3 was used. There is a fairly strong relationship between elevation and evaporation. Table 3 illustrates the estimated evaporation rates used for Lake Angela. According to Google Earth Lake Angela is located at about 7,200 ft msl. We estimated the annual evaporation to be about 32.01 inches for the Historic study and 32.98 inches for the 2040 CT climate change study. Neither the annual total nor the monthly rates are significantly different between the Historic and 2040 CT climate change datasets.

Table 3 - Evaporation Rates, inches

Month	Historic	2040 CT
Oct	2.53	2.62
Nov	0.94	0.98
Dec	0.49	0.51
Jan	0.37	0.38
Feb	0.74	0.76
Mar	1.33	1.36
Apr	2.47	2.52
May	3.58	3.69
Jun	4.57	4.73
Jul	5.89	6.04
Aug	5.26	5.41
Sep	3.86	3.97
Total	**32.01**	**32.98**

Division of Safety of Dams Storage Requirements

Lake Angela operations are subject to the California Division of Safety of Dams (DSOD) Jurisdiction. Lake Angela must reduce storage capacity to 230 acre-feet (AF) from November 1 through April 30. Maximum capacity is 310 AF from May 1 to October 31. In addition, the District will operate the spillway gates considering how wet the year is. For example, when the year is very wet the spillway gates may remain open beyond April 30 to bypass large inflows to Lake Angela.

Consumptive Demands

Another stressor on the Lake Angela water supply are the consumptive demands summarized in the following sections and shown in Table 4.

Existing Demands

The Existing demands were developed by averaging the deliveries reported as beneficial use to the State Water Resources Control Board[2]. Averaging the deliveries for the 2017 – 2021 period on a monthly basis results in the *Existing Consumptive Demand, AF* column in Table 3. The District estimates that an additional 20 percent of the raw water supply is needed for backwashing the water treatment plant in addition to the consumptive demand. Total existing demand is 243 AF/YR.

Future Demands

The future demand data set was developed using the Soda Springs Area Plan, dated October 25, 2016[3] for the portion of the District that exists in Nevada County. The Land Use designations from the Placer County General Plan were used for the portion of the District that exists in

[2] https://ciwqs.waterboards.ca.gov/ciwqs/ewrims/listReportsForWaterRight.do?waterRightId=37062
[3] https://www.nevadacountyca.gov/995/Soda-Springs-Area-Plan

Placer County. The Nevada Irrigation District 2020 Urban Water Management Plan dated July 2021[4] was used as a reference to identify unit demands for the various Service Area types identified in both the Soda Springs Area Plan and the Placer County area. Total treated water demand within the Nevada County service area is 218 AF/YR. The Service Area within Placer County lies completely within the Sugar Bowl Ski Resort. Most of the parcels within the resort area with a treated water demand are residential. The Placer County GIS Department provided the land use designations within the Ski Resort[5]. The same demand factors within the Nevada Irrigation District 2020 Urban Water Management Plan were applied to the residential parcels within the Sugar Bowl Ski Resort to develop the Future level demands. Total Placer County demand is anticipated to be 160.6 AF/YR. Total District (Nevada County + Placer County) demand is anticipated to be approximately 378.6 AF/YR. After adding water needed for backwashing the treatment plant, total demand is 454.3 AF/YR

Build out demands are expected to be about 176 AF/YR more than the existing demand. With an anticipated increase in backwash water, that increase rises to 211 AF/YR more than existing demand. Table 4 summarizes the demands used for both the existing and future conditions.

Table 4 - Existing and Future Consumptive Demands

Month	Existing Consumptive Demand, AF	Baskwash (20% of Demand), AF	Total Existing Demand, AF	Build out Consumptive Demand, AF	Baskwash (20% of Demand), AF	Total Future Demand, AF
Jan	23.7	4.7	28.4	44.2	8.8	53.1
Feb	16.2	3.2	19.4	30.2	6.0	36.3
Mar	17.5	3.5	21.0	32.7	6.5	39.3
Apr	15.2	3.0	18.2	28.4	5.7	34.1
May	14.4	2.9	17.3	26.9	5.4	32.3
Jun	18.3	3.7	22.0	34.3	6.9	41.1
Jul	18.3	3.7	21.9	34.2	6.8	41.0
Aug	16.9	3.4	20.3	31.7	6.3	38.0
Sep	14.1	2.8	16.9	26.4	5.3	31.6
Oct	14.8	3.0	17.8	27.7	5.5	33.3
Nov	14.6	2.9	17.5	27.3	5.5	32.8
Dec	18.5	3.7	22.2	34.6	6.9	41.5
Total Potable Water Demand	**202.5**	**40.5**	**243.0**	**378.6**	**75.7**	**454.3**

Model Schematic

The model schematic shown in Figure 5 illustrates the modeled facilities and linkage. The modeled facilities are overlayed on the watershed features to approximate the geographic

[4] https://www.nidwater.com/ag-urban-water-management-plans

[5] http://maps.placer.ca.gov/Html5viewer/Index.html?configBase=http://arcgis/Geocortex/Essentials/REST/sites/LIS_Public/viewers/LIS_Base-Public/virtualdirectory/Resources/Config/Default

location of the facilities. The schematic is made up of three node types and two link types, described below.

Nodes

Rector Reservoir Storage

Consumptive demands

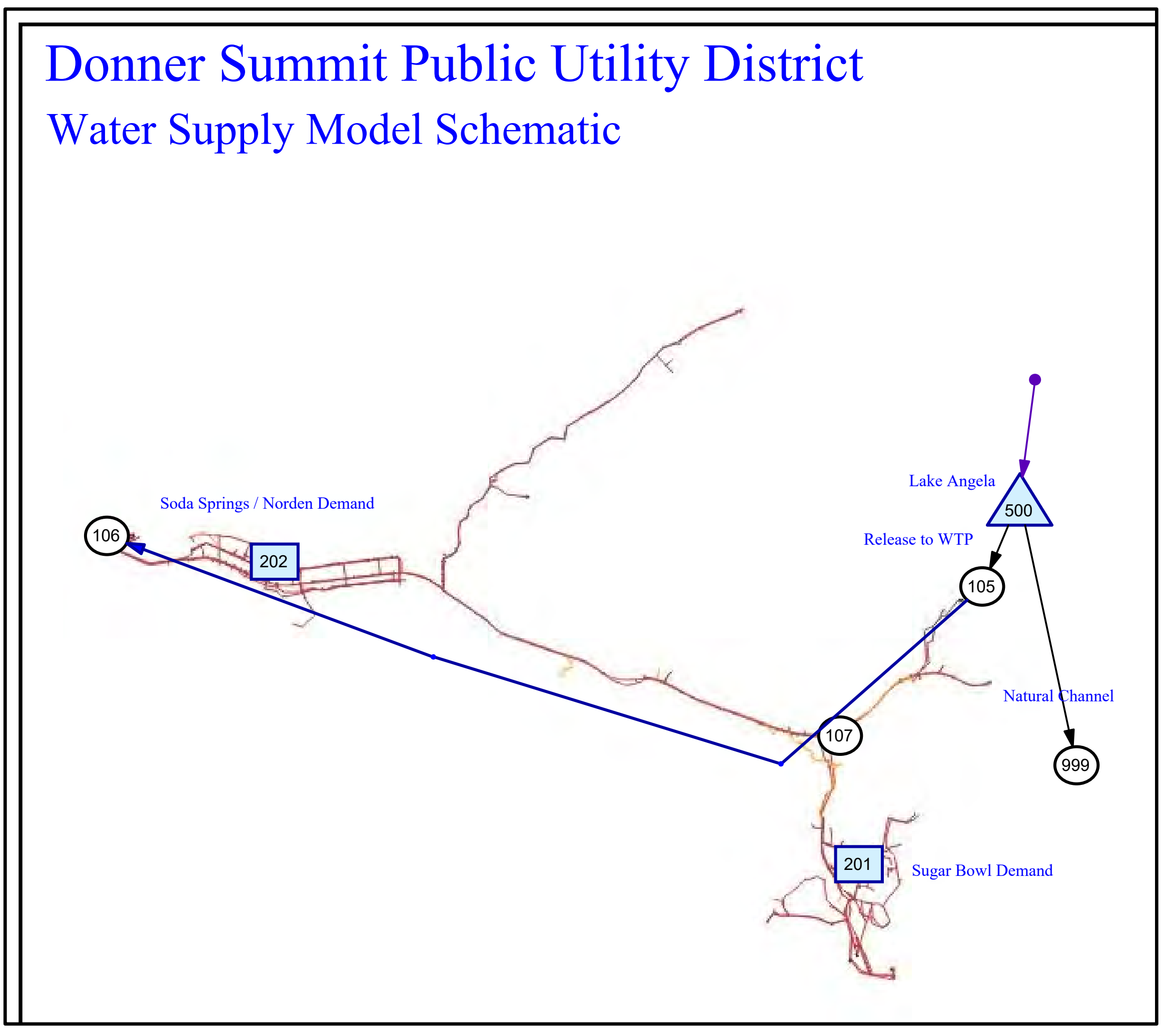
Junctions or points of interest

Arcs

Natural channel

Canal or Pipelines

Figure 5 – Lake Angela Reservoir System Schematic



Results

The results of these studies are discussed as Existing Conditions and Future Conditions.

Existing Conditions

The Existing conditions study represents current historic hydrology and existing demands. Table 5 summarizes the assumptions for this study.

Table 5 - Current Level Study Assumptions

Scenario	Facilities	Hydrology	Study Period	Demand
Existing	Current	Historic	1976-2021	Historic (2017 – 2021 Avg)

As discussed above, this scenario uses a demand that was developed by averaging the actual historic demands for the 2017 – 2021 period. The average demand repeats for every year of the simulation. Figure 6 shows the Annual Delivery and Demand for the period of record. In 1976, 1977, 1988, 2013, 2014 and 2015 there are shortages imposed. This was done in a manner that tries to mimic curtailments imposed by the State Water Resources Control Board by looking at the April through July runoff. These curtailments are for the April through the following February period only and impose a 25 percent reduction in delivery. These reductions in delivery exactly meet the reduction in demand meaning that these are following the curtailment logic and are not because storage has reached dead pool at Lake Angela.

Figure 6 - Existing Condition Deliveries

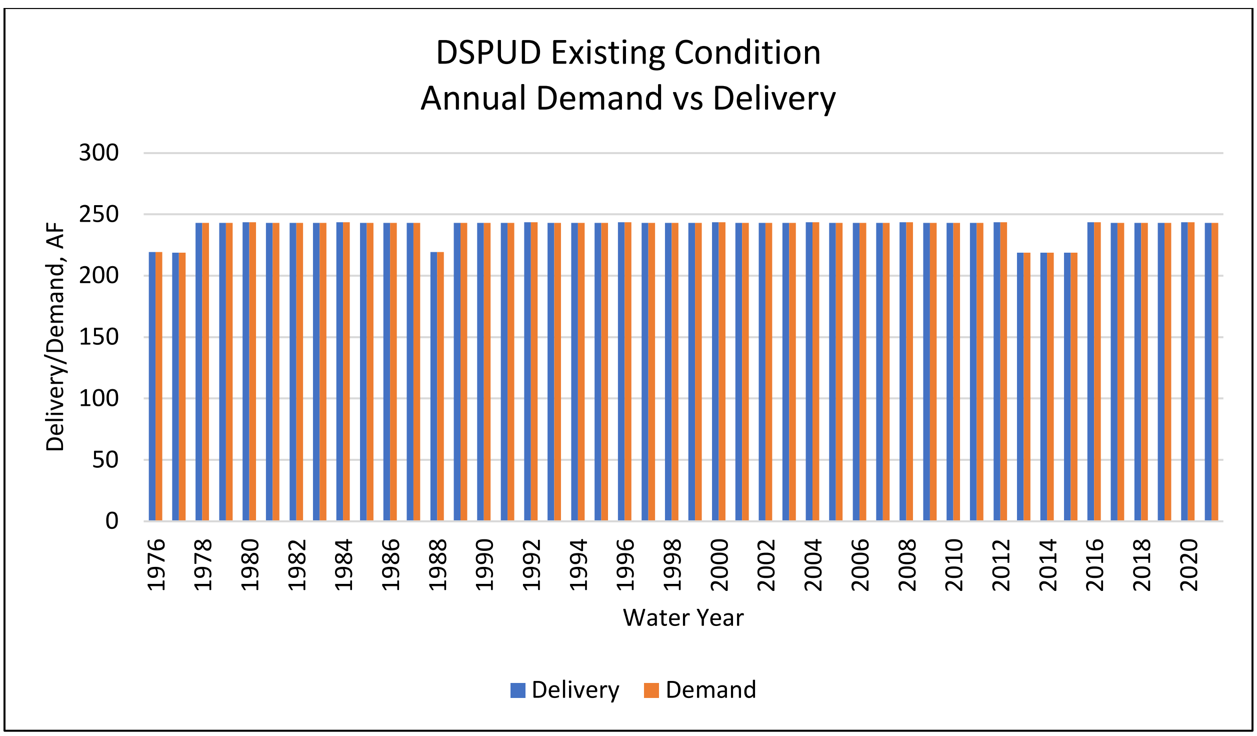
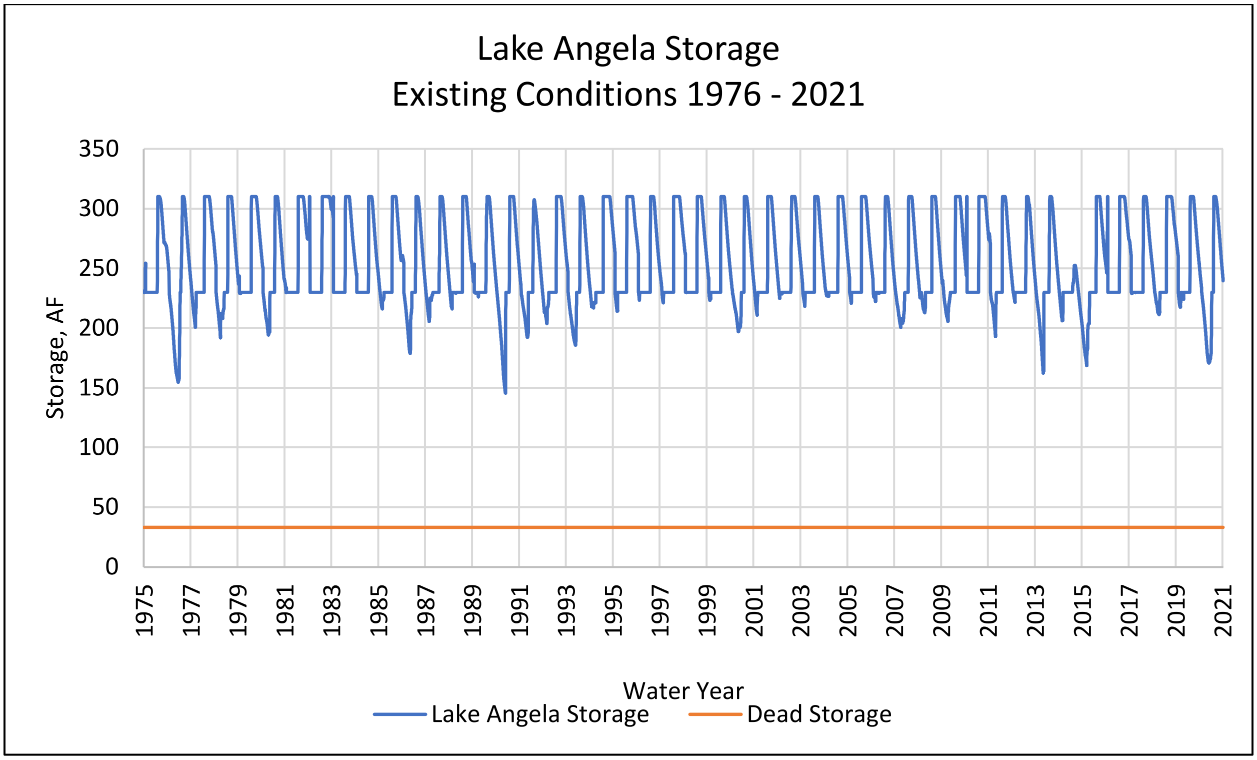


Figure 7 illustrates the resulting storage at Lake Angela. The minimum storage at Lake Angela for the study period occurs in 1990 and is roughly 140 AF, leaving approximately 100 AF of additional storage above the dead pool. At Existing Condition, there is plenty of water supply to meet existing demand. Assuming the system is in good working order, study results indicate there is very little risk of water supply shortage due to drought.

Figure 7 - Existing Conditions Lake Angela Storage



<u>Future Condition</u>

The Future Condition study evaluates the impacts of the climate change hydrology coupled with an anticipated future level demand. Table 6 summarizes the assumptions.

Table 6 - Future Level Study Assumptions

Scenario	Facilities	Hydrology	Study Period	Demand
Future	Existing	2040 Climate Change	1976 - 2021 modified by climate change factors	Future based upon planning documents

The Future Condition study includes full build out demands with climate change hydrology. The demands account for growth in the service area, and as discussed in the consumptive demands section are expected to increase by 211 AF/Yr. Figure 8 illustrates the deliveries made in the Future Condition simulation. This study includes the same curtailment logic as the baseline study. However, in this study the deliveries do not exactly meet the demand. This is because the storage at Lake Angela has fallen to dead pool and no other supplies are available.

Figure 8 - Future Condition Deliveries

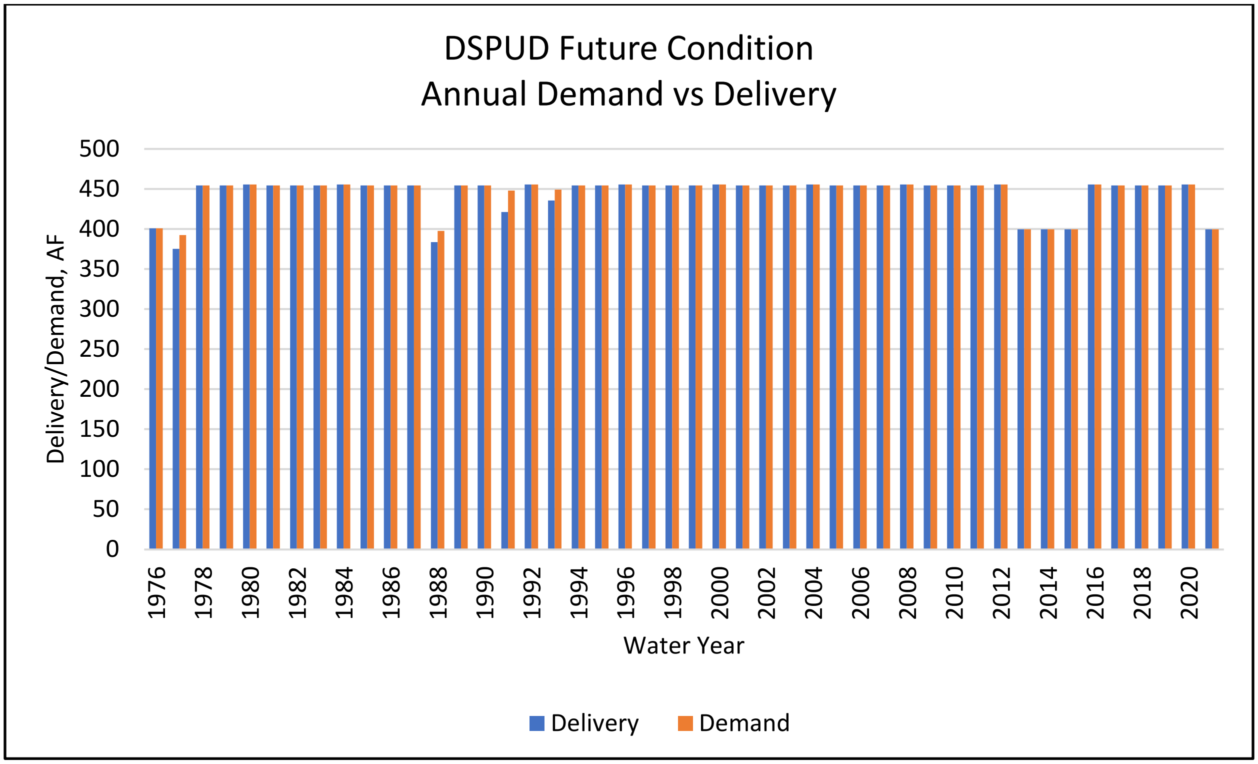
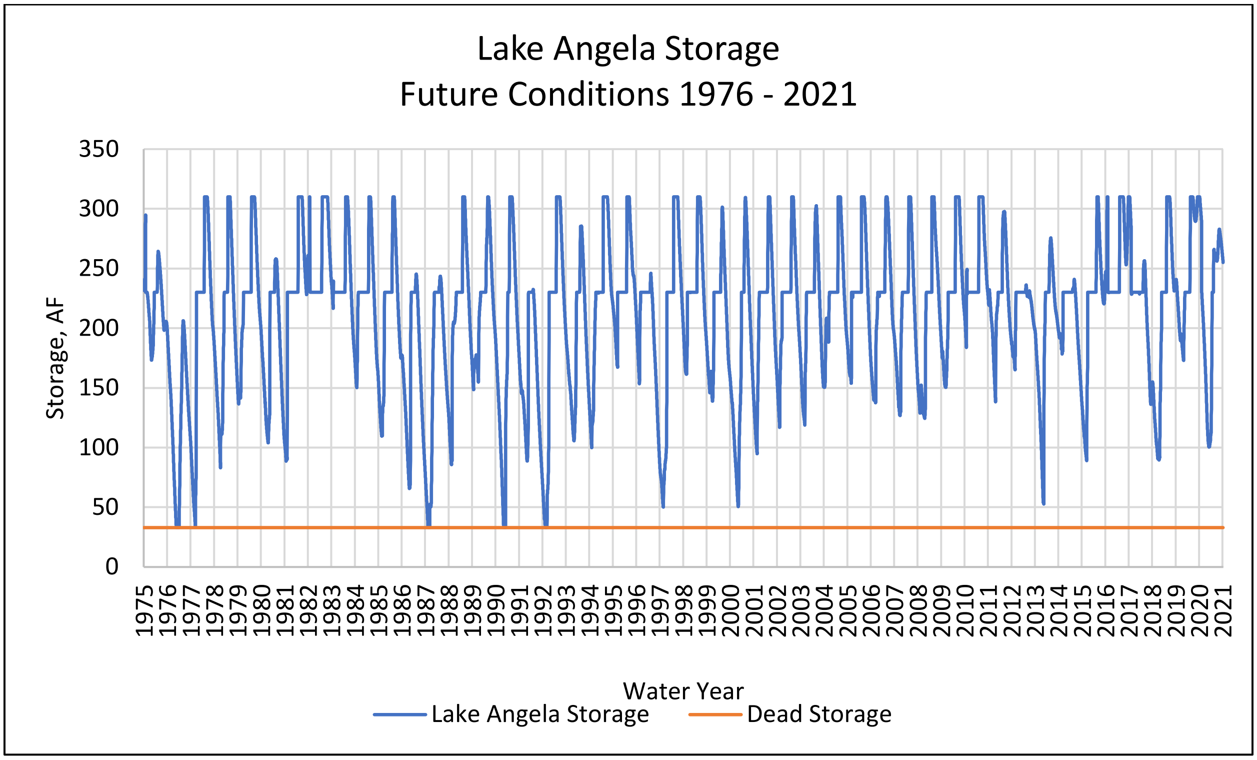


Figure 9 illustrates the Lake Angela storage at the Future Level. Figure 9 shows that Lake Angela falls to dead pool eight times during the 1976 – 2021 simulation period. Figure 9 also shows that Lake Angela is constrained by the DSOD storage limitation. The DSOD limitation prevents storage of more than 230 AF during the November 1 through April 30 period. The shift in runoff patterns of climate change hydrology results in a change in the ability to store water. This pattern shift combined with the DSOD requirement prevents Lake Angela from maximizing the water supply.

Figure 9 - Future Condition Lake Angela Storage



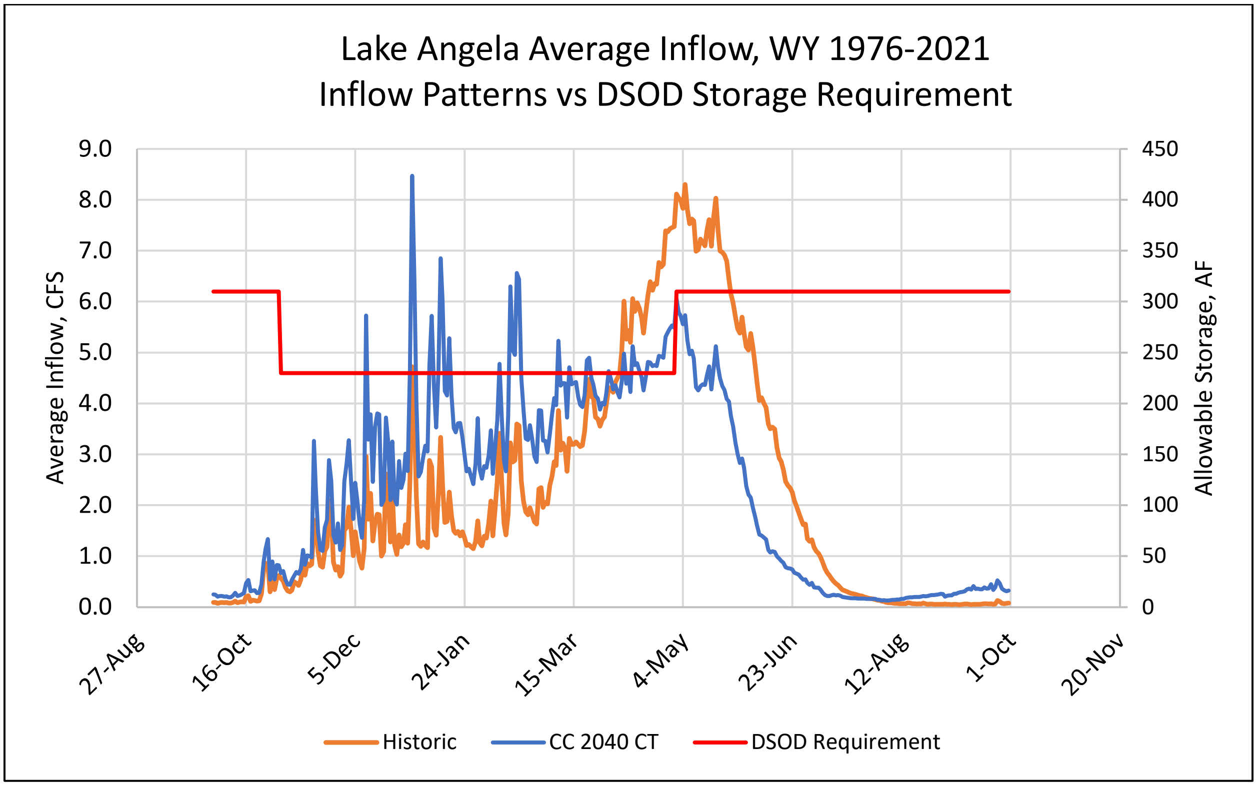
At the Future Condition, additional steps will be needed to meet anticipated demand. Changes to the DSOD requirements and drought contingency plans could be used to improve the reliability of the supply. Under current operating criteria at future demand, study results indicate the reservoir will not always fill and in 5 years out of the 45-year study period, Lake Angela will be drawn down to dead pool.

Conclusions

Based on the results of these studies, it appears under the existing condition, Lake Angela can meet the existing demand. At the future condition, it appears that the increased demands coupled with the shift in runoff patterns due to climate change and the DSOD storage requirements limit Lake Angela from maximizing the available water supply.

The shift in the runoff pattern of the climate change hydrology is significant. Figure 10 illustrates the impact of climate change hydrology. The orange line shows the historic average annual runoff pattern. The blue line shows the climate change average annual runoff pattern. The red line shows the maximum allowable storage ordered by DSOD. Figure 10 illustrates how the climate change hydrology peak runoff pattern shifts earlier in the year to the December through March period as compared to the historic April through June period. Although both average annual runoff volumes are almost identical, use of climate shifted supply is hindered by the DSOD requirements that were developed for the historic runoff patterns.

Figure 10 - Lake Angela Inflow vs DSOD Storage Requirment



With the increase in demand, capturing the earlier runoff to fill Lake Angela is necessary. Figure 9 illustrates that the DSOD requirement causes spills, limiting the gain in storage to full pool in just 31 of the 45-year study period. Eliminating or revising the DSOD requirement will increase water supply and therefore reduce the delivery shortages.

Recommendations

The studies performed for this task have illustrated a need for the development of a water supply index and consideration of a revision to the DSOD storage requirements.

Demands in the Future Condition scenario have increased by 211 AF/YR. In water short years, delivery reduction policy could be developed to impose deficiencies in those years where storage begins to approach dead pool. Developing a water supply index based on storage in Lake Angela Reservoir plus snowpack storage could be developed to determine when deficiencies should be imposed. This index and associated deficiency schedule will then inform the District's abridged WSCP.

The current DSOD storage requirements were developed for runoff patterns that generally peak in mid to late April thru May. Climate change projections indicate future runoff patterns will result in peak runoff in the January thru February period. Because of the shifting runoff patterns and the current DSOD requirements coupled with anticipated demands, filling Lake Angela in the future may become less frequent. Figure 10 illustrates the current DSOD requirements against the historic and future runoff patterns. By visual inspection, it appears that allowing storage up to full pool could be shifted to as early as March maximizing water supply while still protecting the dam. The District should periodically request that DSOD review the current requirements and make adjustments as runoff patterns shift.

APPENDIX C: IDENTIFICATION OF POTENTIAL SOURCES OF ADDITIONAL WATER TECHNICAL MEMORANDUM

Technical Memorandum

Identification of Potential Sources of Additional Water

Donner Summit Public Utility District (DSPUD, or District) has contracted with GEI Consultants, Inc., and Western Hydrologics (GEI Team) to develop a water supply resiliency study to address DSPUD's present challenges related to water supply reliability. This study includes an investigation of the potential sources of additional water that may be available to supplement the District's existing supply, considering the requirements of Senate Bill (SB) 552 which requires that small water suppliers have at least one backup source of water supply, or a water system intertie, that meets current water quality requirements and is sufficient to meet average daily demand by January 1, 2027. In response to the requirements of SB 552, the GEI Team has explored backup supplies such as groundwater, alternative surface water supplies, and an intertie with a neighboring water district. Supplemental surface water supplies explored include expansion of the existing Lake Angela or development of supplies in the vicinity. This investigation includes identification of potential new supplies including requirements or amendments for water rights filings. The potential sources of water identified herein will be assessed by the GEI Team at the beginning of Fiscal Year 2023-2024 consistent with the GEI Team's contract with DSPUD and their proposal to the District dated October 6, 2022.

Groundwater

California's diverse natural environment is due in part to the complex geologic processes that have shaped the landforms of the State. California's geomorphic provinces are naturally defined geologic regions that display a distinct landscape or landform. There are eleven geomorphic provinces in California based on each regions defining features based on geology, faults, topographic relief, and climate.

DSPUD is in the Sierra Nevada Geomorphic Province in California which consists of a tilted fault block nearly 400 miles long. Its east face is high and rugged with multiple scarps, contrasting with the gentle western slope that disappears under sediments of the Great Valley Province. The granitic rocks of the Sierra Nevada batholith include older, deformed diorite and quartz in the western areas and younger undeformed granodiorite in the eastern areas.

A search for reports on the groundwater resources in the DSPUD service area did not identify any reports in the direct area. Limited reports are available regarding groundwater in hard rock environments such as those within the District. Information from those reports was used to complete this summary of the hard rock aquifer system.

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There are some alluvial valleys located within the Sierra Nevada that are identified as groundwater basins by the California Department of Water Resources (DWR). These basins may be considered as potential sources of groundwater. The groundwater basin closest in proximity to the DSPUD service area is the Martis Valley Groundwater Basin. The groundwater potential from both the underlying hard rock geologic environment and the nearby Martis Valley Groundwater Basin are described in the following sections.

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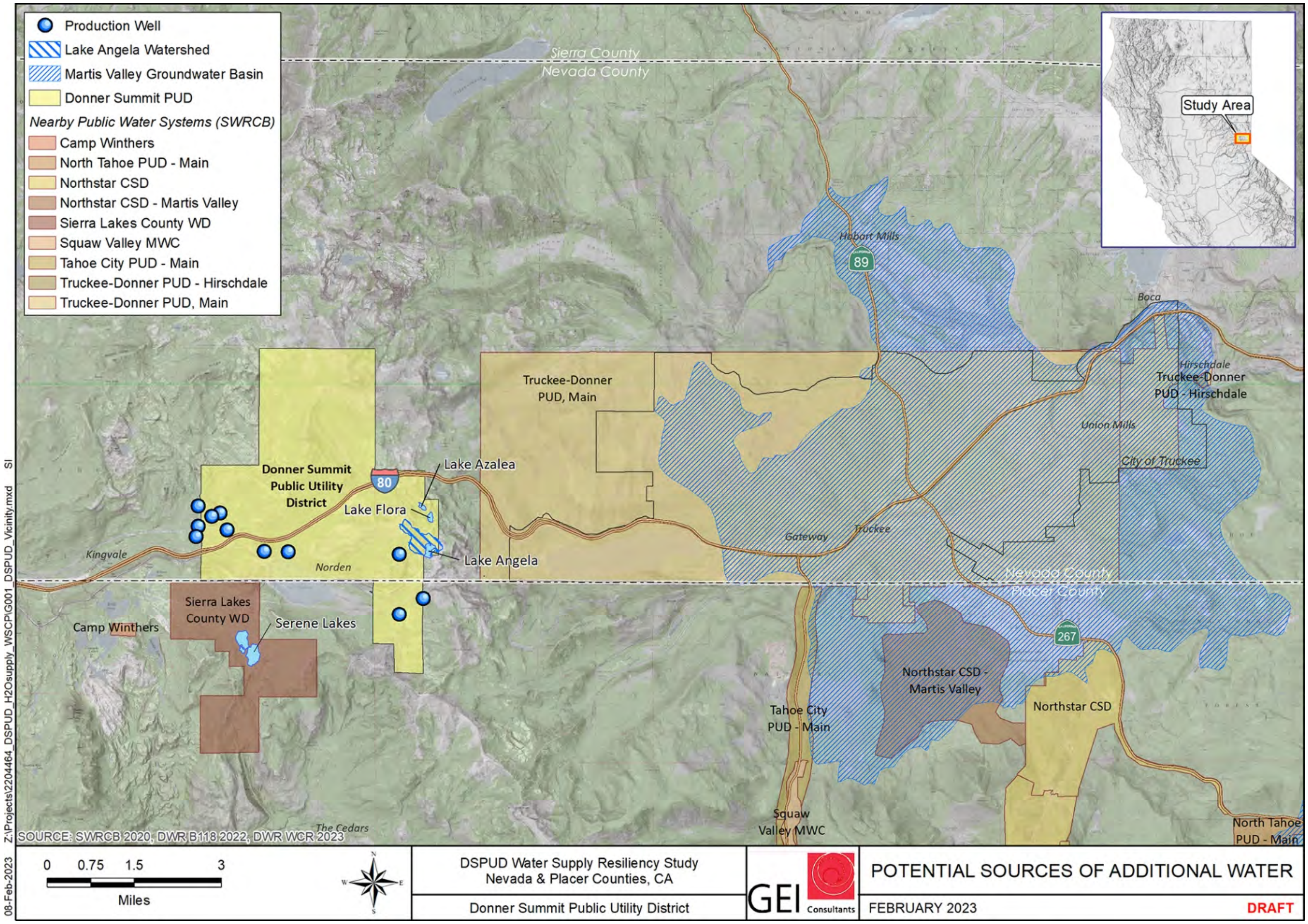

Figure 1: Site Vicinity Map

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Martis Valley Groundwater Basin

The Martis Valley Groundwater Basin (Basin Number 6-067) is located about six miles east of DSPUD as shown on Figure 1. The District is about 7,200 feet above mean sea level (msl) and is located west of the crest of the Sierra Nevada (at about 7,700 feet msl). The Martis Valley Groundwater Basin has an elevation around 5,700 feet msl and is located east of the crest of the Sierra Nevada crest. The description of the Martis Valley Groundwater Basin below is provided from the DWR California Water Plan – Groundwater Update 2013.

The Martis Valley Groundwater Basin (6-067) is located in Placer and Nevada counties covering approximately 36,381 acres. The groundwater basin is a fault-bounded basin located east of the Sierra Nevada crest. The elevation of Martis Valley is between 5,000 feet and 6,000 feet above msl. The mountains surrounding the Martis Valley are 1,000 feet above msl to more than 3,000 feet above msl. Average precipitation in the valley is 23 inches in the lower elevations of the eastern portion and nearly 40 inches in the western areas. Well-yield data from well completion reports indicate that groundwater production in the Martis Valley Groundwater Basin can be as much as 1,500 gallons per minute (gpm), with an average yield of 150 gpm.

The primary groundwater-bearing formations in the Martis Valley Groundwater Basin are the Miocene to Pliocene basin fill deposits interbedded with sediments of stream and lake deposits. There is also extensive Pleistocene glacial material and recent alluvial material that have embedded impermeable clay and silt layers.

Groundwater in the DSPUD Service Area

Surface Geology

The DSPUD area is generally underlain by granitic rocks composed of quartz diorite and granodiorite and some metamorphosed rocks. When exposed at the ground surface, both of these rock types have joints and fractures. The joints and fractures occur near the ground surface as a result of reduced pressure from the overburden being removed (compared to where they were formed at depth) resulting in the rocks expanding creating the joints and fractures. Various studies suggest that the joints and fractures occur to a depth of about 200 to 250 feet below the ground surface.

Occurrence and Movement of Groundwater

Granitic and metamorphic rocks do not have a the alluvial deposits of aquifers in groundwater basins, and their porosity is limited to the secondary porosity created by the joints and fractures occurring within the rocks so they yield little, if any, water to wells unless the wells intersect the fractured or weathered joints and faults. As a result of the limited porosity, the more favorable well sites occur at the saturated intersections of the joints and fractures. Additionally, deeper wells do not significantly increase the yield of wells as there are fewer joints and fractures at depth.

Recharge and Discharge of Groundwater

Groundwater in the area moves primarily through the fractures in the hard rock and is recharged by rain and melting snowmelt. In general, the movement of ground water parallels the land surface as the groundwater flows from areas of higher elevation toward areas of lower elevation. DSPUD is located near the crest of the Sierra Nevada and likely behaves as a groundwater divide with groundwater moving downslope away from the ridges towards discharge areas including wells, springs, or lakes.

Groundwater Wells in DSPUD Service Area

The DWR Sustainable Groundwater Management Act (SGMA) Data Viewer provides information related to the Well Completion Reports (WCRs) of wells drilled throughout the state. These include production wells in addition to monitoring wells and wells that have been destroyed.

A review of the of the SGMA Data Viewer identified the location of eleven WCRs of production wells in the District service area (*see* Figure 1). Numerous monitoring wells and destroyed wells are also present within the District. Information from the WCRs for the production wells is provided in Table 1. The Depth to Water, Depth to Static Water Level and Yield presented on the WCRs are recorded during the well drilling and development process. The depth to water and well yield vary annually and seasonally based on hydrologic conditions and the amount of groundwater pumping. There are no records of the current groundwater levels or well yields for wells in the District on the DWR SGMA Data Viewer.

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Table 1: Summary of Well Completion Reports in the DSPUD Service Area

WCR Number	PLSS MTRS	Purpose	Depth (feet)	Depth to Water (Feet)	Depth to Static Water Level (Feet)	Yield (GPM)
454564	17N14E16	Domestic	350	50		6
108066	17N14E15N	Domestic	305	36		5.5
e0322489	17N17E12	Domestic	275	60		15
924720	17N14E22	Domestic	480	130		10
e0363903	17N14E21	Domestic	345	18		40
789412	17N14E22	Domestic	585	434	200	60
2018-007198	17N14E23	Domestic	652	240	85	20
33914	17N14E23	Domestic	175	37		4
e0113690	17N15E17	Public	500	35	375	45
749305	17N15E21	Domestic	240	30	25	45
433360	17N15E20	Public	300	12		35
		Average	**382**	**98**	**171**	**26**
		Min	**175**	**12**	**25**	**4**
		Max	**652**	**434**	**375**	**60**

Dry Wells in DSPUD Service Area

The DWR Dry Well Reporting System is for Californians experiencing problems with their private (self-managed) wells (not for residents served by a public water system already regulated by the State). Dry wells can be caused by many drought and non-drought factors, including aging infrastructure like corroded wells, declining groundwater levels, changes to weather patterns and climate, or surface water and groundwater management.

Potential Surface Water Supplies

Lake Angela Expansion

Lake Angela is located in the southern portion of Nevada County just north of the Placer County line. The lake sits on Donner Summit at an elevation of 7,195 feet, located between Donner Pass Road to the south, Donner Ski Ranch to the west, the Pacific Crest Trail to the east, and Interstate 80 to the north (*see* Figure 1). The lake is located at the crest of the South

Yuba River watershed and has a drainage area of about 0.225 square miles. The watershed receives approximately 52 inches per year of liquid precipitation in the form of rain and snow. In wet years that annual total can be as high as 112 inches and in dry years the annual total can be as low as 20 inches.

The GEI Team understands that Lake Angela spills almost every year. There is the potential to capture this additional supply by expanding the capacity of Lake Angela. The District currently operates using its senior Pre-1914 water right which appears to allow the District to directly divert up to 9.3 cubic feet per second (cfs) and divert to storage up to 310 acre-feet (AF) per year. The additional water supply needed for the expansion of Lake Angela could already be authorized by its permitted water right (Application 30332, Permit 21118). The permitted right allows the District to directly divert up to 1.54 cfs between November 1 through June 1 and divert up to 310 AF to storage collected from November 1 through July 31.

Development of Nearby Natural Lakes

There are two natural lakes in immediate proximity to Lake Angela. Flora Lake, located about 0.4 mi north of Lake Angela, and Azalea Lake, located about 0.1 mi northwest of Flora Lake (*see* Figure 1), could be used as a backup supply to the District. Azalea Lake spills into Flora Lake which then spills to a drainage that flows to Donner Lake and ultimately to the Truckee River. Because these lakes are within the Truckee River watershed, supplies from these lakes are not subject to Sacramento – San Joaquin Delta watershed curtailments nor would they be subject to agreements with Nevada Irrigation District and Pacific Gas and Electric. Water from these lakes could be pumped to Lake Angela or directly to the District's water treatment plant in an emergency. Currently, the potential water supply volume from these lakes is unknown. Any water supplies from these lakes would require new water rights.

Intertie with Sierra Lakes County Water District

As shown in Figure 1, Sierra Lakes County Water District (SLCWD) is located adjacent to DSPUD. The water supply lines for DSPUD and SLCWD are approximately one mile apart, thus an intertie with the SLCWD is another potential source of backup water supply for the District. The primary source of SLCWD's water supply is Lake Serena, one of the two connected waterbodies that comprise Serene Lakes located in the North Fork American River watershed. Lake Serena sits on Donner Summit at an elevation of 6,881 feet and is located about 3.5 miles southwest of Lake Angela and 1.7 miles south of Interstate 80 (*see* Figure 1). SLCWD holds water rights (Application 20601, Permit 14248) to Lake Serena that include a direct diversion of up to 0.8 cfs capped at 394 AF per year and diversion to storage of up to 783 AF per year. The combined volume of the direct diversion limit and diversion to storage limit allows for the development of up to 1,177 AF per year. The season of diversion for these rights is October 1 through June 30.

According to SLCWD annual reports, annual average usage over the past five years is less than 100 AF, which provides the opportunity to support delivery to DSPUD in an emergency. Conversely, with water rights of up to 664 AF per year and a current demand of about 240 AF per year, DSPUD currently has an excess supply and could also support SLCWD deliveries in an emergency. To support an intertie between DSPUD and SLCWD, both districts would need to amend their water rights by filing a petition with the State Water Resources Control Board to include the place of use of the partnering district in their respective place of use.

APPENDIX D: EVALUATION OF POTENTIAL SOURCES OF ADDITIONAL WATER COST ESTIMATE TECHNICAL MEMORANDUM

Technical Memorandum

Prepared For:	Donner Summit Public Utility District
Prepared By:	Stephen Oldemeyer
Reviewed By:	Mark Martin
Date:	September 14, 2023
Subject:	Donner Summit Public Utility District Evaluation of Potential Sources of Additional Water Cost Estimate Technical Memorandum
GEI Project No.	2204464

Donner Summit Public Utility District (DSPUD, or District) has contracted with GEI Consultants, Inc., and Western Hydrologics (GEI Team) to develop a water supply resiliency study (Study) to address DSPUD's present challenges related to water supply reliability. This study includes an investigation of the potential sources of additional water that may be available to supplement the District's existing supply, considering the requirements of Senate Bill (SB) 552 which requires that small water suppliers have at least one backup source of water supply, or a water system intertie, that meets current water quality requirements and is sufficient to meet average daily demand by January 1, 2027. In response to the requirements of SB 552, the GEI Team has identified the following options for backup supplies:

- Groundwater
- Alternative surface water supplies, including:
    - Lake Angela Expansion
    - Development of nearby lakes
- Sierra Lakes County Water District (SLCWD) intertie

These potential sources of additional water are described in the GEI Team's *Identification of Potential Sources of Additional Water Technical Memorandum* (TM). Subsequent to the development of this TM, the District also identified hauled/bottled water as a potential supply source to be considered as part of this Study.

The purpose of this TM is to document the infrastructure requirements and reconnaissance-level (Class 5) cost estimates associated with the backup supply options. As detailed in the *Task 2: Evaluate Risk of Drought Impacts* TM developed by Western Hydrologics, the development of cost estimates for each of the supply options assumes a future demand of approximately 454.3 acre-feet per year (AFY).

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Preliminary Screening

Based on a preliminary evaluation, some of the options identified were eliminated based on two key criteria:

1. Feasibility, i.e., does this option advance the goals of the study
2. Redundancy, i.e., are there better options available to meet the same goals

Below are the options that have been eliminated from further evaluation with a brief reason for their elimination:

- **Groundwater** (eliminated due to feasibility): the groundwater basin closest in proximity to the DSPUD service area is the Martis Valley Groundwater Basin (Basin Number 6-067). This basin is located about six miles east of DSPUD and about 2,000 feet below in elevation. The topographical change and distance from the District's treatment facility are limiting factors when it comes to cost. The pump station required to overcome the elevation change along with the six miles of piping over the terrain would increase costs such that this option would be economically infeasible.
- **Development of nearby lakes** (eliminated due to redundancy): currently, the potential water supply volume from these lakes is unknown. Moreover, any water supplies from these lakes would require new water rights.

The options that remain following the preliminary screening are as follows:

- **Option 1:** Lake Angela Expansion
- **Option 2:** Sierra Lakes County Water District intertie
- **Option 3:** Hauled/bottled water

Cost Estimates

Option 1: Lake Angela Expansion

Lake Angela sits on Donner Summit at an elevation of 7,195 feet, located between Donner Pass Road to the south, Donner Ski Ranch to the west, the Pacific Coast Trail to the east, and Interstate 80 to the north. The lake is located at the crest of the South Yuba River watershed and has a drainage area of about 0.225 square miles. The watershed receives approximately 52 inches per year of liquid precipitation in the form of rain and snow. Lake Angela operations are subject to the California Division of Safety of Dams (DSOD) Jurisdiction. Lake Angela must reduce storage capacity to 230 acre-feet (AF) from November 1 through April 30. Maximum capacity is 310 AF from May 1 to October 31.

The GEI Team understands that Lake Angela spills almost every year. There is potential to capture this additional supply by expanding the capacity of Lake Angela. The District currently operates using its senior Pre-1914 water right which appears to allow the District to directly divert up to 9.3 cubic feet per second (cfs) and divert to storage up to 310 AFY. Increasing the capacity of Lake Angela will satisfy the additional water supply necessary to meet demand increases due to forecasted population growth, as well as allowing for climate change projection runoff pattern changes. The increase in storage may not however satisfy all the requirements of SB 552, which requires that the District have at least one backup water supply by January 1, 2027. If it is determined that an expansion of Lake Angela is not sufficient to meet SB 552 requirements, requiring the District to have a backup water supply in addition to increasing the capacity of Lake Angela, this option will not be economically feasible.

Note that the cost estimates for Option 1 are considered reconnaissance level (Class 5) cost estimates. If DSPUD decides that increasing the reservoir capacity is the option that satisfies all the agencies requirements and provides the biggest benefit to the District, a more precise design of the structure will be required, and quantities/costs could be impacted.

Construction Cost Estimate

To increase the capacity of Lake Angela to meet future demands (~454 AFY), the crest would need to be raised by 10 feet along the entire length of the dam (815 feet) from the low crest elevation of 7192.8 to a low crest of 7202.8. A 10-foot dam raise was identified based on an extrapolation of the Lake Angela area capacity curve (see Figure 1), as there is minimal data available on the existing topography and bathymetry near the dam. Google Earth imagery at the dam suggests that minimal increases to the dam length would be required to raise the crest. Costs associated with increasing the dam length are assumed for the purposes of this Study to be nominal and captured in the overall reinforced concrete costs. To increase the height of the dam by 10 feet, the section of concrete will need to be extended downstream and four separate cross sections will be utilized to accomplish the increased height (shown in Figure 2). The larger concrete section is required to ensure stability and prevent overturning. Note that increasing the reservoir's storage will require the Water Control Manual to be adjusted to allow larger volumes throughout the year.

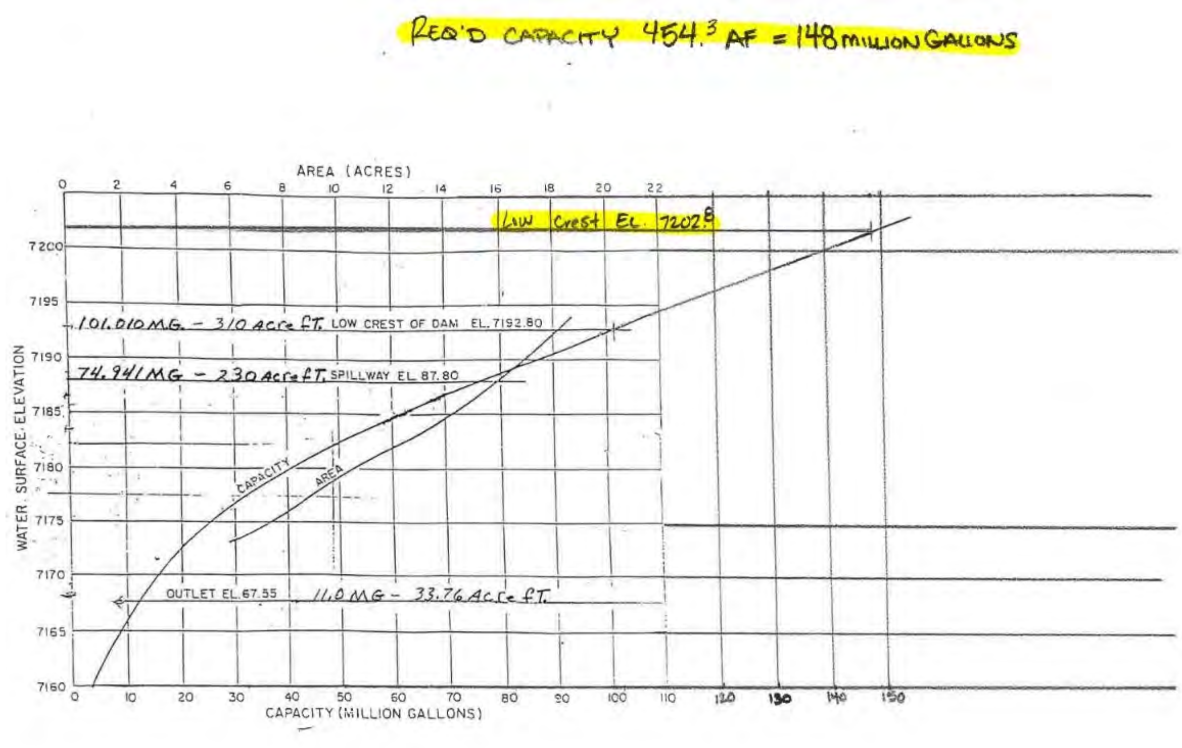

Figure 1: Area Capacity Curve

The development of Class 5 cost estimates for Option 1 assumed the following:

- Minimal earthwork would be required before concrete placement. No additional excavation would be required in the reservoir.
- Concrete of the existing structure is satisfactory to build upon.
- Minimal additional length would be required.
- Quantities were based off of similar sections that were used during the retrofit of Lake Angela Dam in the 1970s.

The cross section shown in Figure 2 was used to develop a reinforced concrete quantity for Option 1.

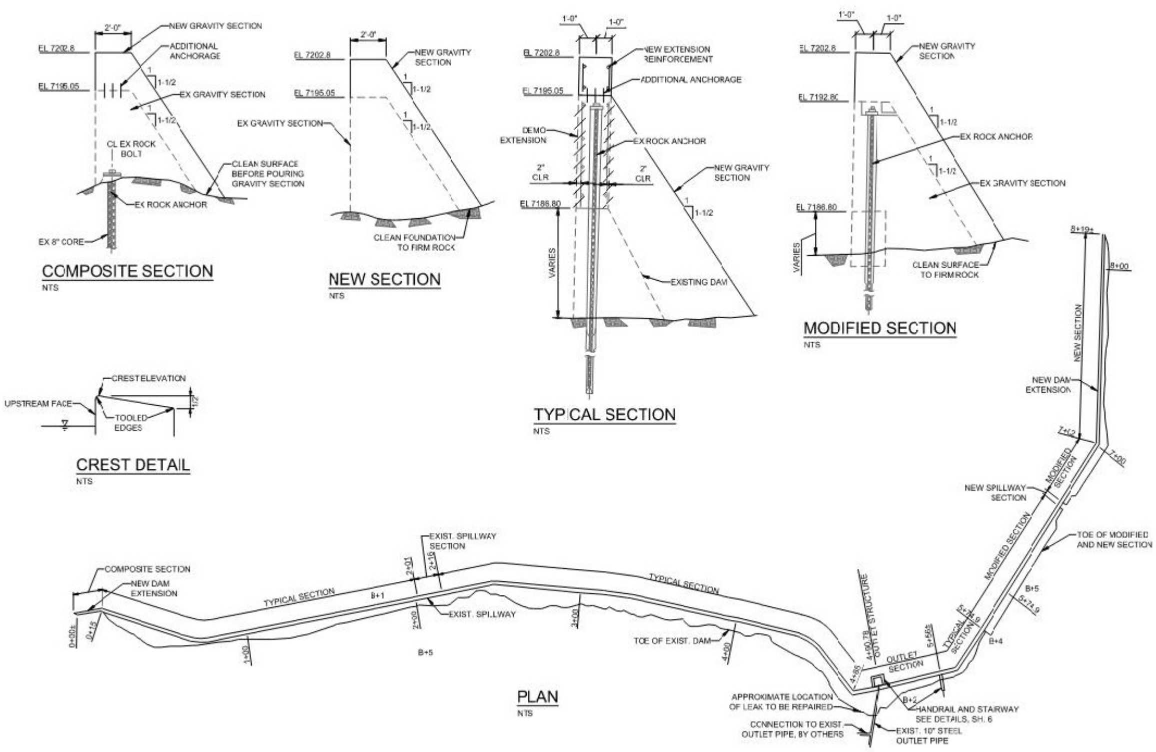

Figure 2: Dam Cross Section

The quantity of reinforced concrete per foot of dam is an average of 6.0 cubic yards per foot. Thus, the total quantity of reinforced concrete assumed for Option 1 is:

6.0 cubic yards/foot x 815 feet = 4,890 cubic yards

Typical costs to construct a gravity structure of this height average around $4,800 per cubic yard, thus the total cost for reinforced concrete under Option 1 is:

$4,800/cubic yard x 4,890 cubic yards = $23,500,000

Additional anchors or piles beneath the structure would be required and are assumed to be captured in the reinforced concrete cost. Anchors would be driven into the hard rock and are assumed to be shallow in overall depth due to the surrounding rock formation in the area. In addition to the costs for reinforced concrete, additional costs will be incurred to increase the height of the existing spillway. To replace the stoplog closure spillway would require removal of the existing structure and replacement of the 144 ft^2 opening. A unit cost of $4,750/$ft^2$ is assumed for replacement of the stoplog closure spillway, which equates to a total cost of:

$$\$4,750/ft^2 \times 144\ ft^2 = \$684,000$$

Thus, the total major construction cost for Option 1 is approximately:

$$\$23,500,000 + \$684,000 = \$24,200,000$$

Mobilization and demobilization costs are added to the total major construction cost to arrive at a total construction cost. Mobilization and demobilization costs are based on a percentage of the total major construction cost and are usually between 5-10%, dependent upon location and proximity to supply centers. Since this is an area considered rural and mountainous, 10% is assumed for mobilization and demobilization, with a total cost assumed cost of $2,420,000.

Thus, the total construction cost for Option 1 is:

$$\$24,200,000 + \$2,420,000 = \$26,620,000$$

Other owner costs are also presented as percentage-based costs during planning, engineering, and construction. Other owner costs include design and engineering, legal, engineering during construction, and construction management. These costs are identified below, assuming 15% of the total construction cost for design and engineering, 2% for legal and engineering during construction, and 10% for construction management.

Design and Engineering Costs (15%) = $4,000,000

Legal Costs (2%) = $532,000

Engineering During Construction (2%) = $532,000

Construction Management (10%) = $2,662,000

The total cost for Option 1 is thus:

$$\$26,620,000 + \$4,000,000 + \$532,000 + \$532,000 + \$2,662,000 = \$34,346,000$$

Environmental Cost Estimate

When faced with a discretionary project which is not exempt from the California Environmental Quality Act (CEQA), a Lead Agency must prepare an initial study (IS) to determine whether the project may have a significant adverse effect on the environment. Although CEQA categorically exempts existing facilities, it is assumed that the California Department of Fish and Wildlife (CDFW), as a Responsible Agency, will not issue a Lake or Streambed Alteration (LSA) Agreement with such a determination. Because it is assumed that potential effects can be reduced to a level that is less than significant with the incorporation of mitigation measures, a mitigated negative declaration (MND) can be adopted (Public Resources Code Section 21080).

It is assumed that Option 1 would require development of an IS/MND, which would include a reconnaissance-level onsite survey. Option 1 would also likely require a lake or streambed alteration (LSA) notification to CDFW, along with a supporting Biological Technical Report (BTR). The BTR would also require a reconnaissance-level onsite survey.

A total cost of $100,000 is assumed for development of the IS/MND, LSA notification to CDFW, and the BTR under Option 1.

Additional Costs Associated with Increased Diversions from Lake Angela

Expanding Lake Angela will incur additional costs due to the *"Agreement Between Nevada Irrigation District (NID), Pacific Gas and Electric Company (PG&E), and Donner Summit Public Utility District".* The agreement states that PG&E and NID agree to allow DSPUD to use up to 260.7 AF of water from Lake Angela per year without compensation. Diversions in excess of 260.7 AF would require DSPUD to compensate NID for the loss of water, and PG&E for the loss of power, per the agreement. Assuming DSPUD would utilize the full forecasted future demand of 454.3 AFY under Option 1, the total owed to each party would be as follows.

Compensation to NID

NID would be compensated annually per the NID Rate Schedule 5-K for Raw Intermittent Flow Irrigation Water. These rates are released bi-annually, however for the purposes of this Study, the 2022 rate of $80.04 per acre foot is assumed to evaluate compensation to NID.[1] Assuming a total volume of 193.6 AF of water is diverted (454.3 AF – 260.7 AF), the annual compensation to NID would be:

193.6 AF x $80.04/AF = $15,000/year

Compensation to PG&E

PG&E would be reimbursed for the additional water supplied (193.6 AF) assuming an average marginal unit cost of energy ($/KWH) and using the maximum duty through all downstream powerhouses as identified in the agreement (3,403 killowatt-hour [kWh]/AF). An average marginal unit cost of energy of $0.31/kWh was assumed to estimate compensation to PG&E. With these assumptions, the annual compensation to PG&E would be:

193.6 AF x 3,403 kWh/AF x $0.31/kWh = $204,000/year

Total Estimated Cost

The total estimated cost for Option 1 including the cost for construction ($34,350,000) along with environmental documentation and permitting ($100,000) is estimated at $34,450,000. Option 1, absent an amendment to the agreement between the District, NID, and PG&E, would also require

[1] Note that these rates are increased up to $99.88 per acre foot in the event of a drought declaration.

annual payment to these entities totaling $219,000. The annual payment to these entities would likely increase over time as the unit rates identified above escalate as a result of inflation or other factors.

Option 2: Sierra Lakes County Water District Intertie

As previously shown in the *Identification of Potential Sources of Additional Water TM*, SLCWD is located adjacent to DSPUD. The water supply lines for DSPUD and SLCWD are approximately 0.8 miles apart. The primary source of SLCWD's water supply is Lake Serena. SLCWD holds water rights (Application 20601, Permit 14248) to Lake Serena that include a direct diversion of up to 0.8 cfs capped at 394 AF per year and diversion to storage of up to 783 AF per year. The combined volume of the direct diversion limit and diversion to storage limit allows for the development of up to 1,177 AF per year. The season for this diversion of water is October 1 through June 30. This coincides with the restricted level of Lake Angela.

According to SLCWD annual reports, annual average usage over the past five years is less than 100 AF, which provides the opportunity to support delivery to DSPUD in an emergency. Conversely, with water rights of up to 664 AF per year and a current demand of about 240 AF per year, DSPUD currently has an excess supply and could also support SLCWD deliveries in an emergency. The geographic location and topography of the two systems allow for an easy connection between the two.

Construction Cost Estimate

The development of Class 5 construction cost estimates for Option 2 assumed the following:

- The location of the connection to the SLCWD water system would occur in the northeastern corner of their water system, at the intersection of Pahatsi Rd and Soda Springs Rd. The existing elevation at this location is approximately 6,944. See Figure 3 for new pipeline and intertie locations.

- The new intertie would require a minimum of an 8-inch main built from high-density polyethylene (HDPE) that would be installed via open cut excavation and placed along Soda Springs Road, going north. The connection to the DSPUD water supply system would occur south of the town of Soda Springs at the intersection of Bunny Hill Rd and Soda Springs Rd. The elevation at this intersection is 6,765.

- Since the system tie-in is below the existing system at SLCWD, a booster pump station would not be required to meet demands. For the DSPUD system to serve as a backup source for SLCWD, a booster pump station could be required to pump water back and forth from the two systems. This booster pump station is estimated to cost around $150,000 assuming a 100 foot raise in elevation with a capacity of 100 gpm.

- If the existing line at the intersection of Bunny Hill and Soda Springs is less than 6 inches, an additional 0.1-miles of pipeline would be required to tie into the system in Soda Springs. The additional pipe cost will not be significant, but the additional pipeline would require crossing the railroad line that traverses south of the town of Soda Springs (see Figure 4). The costs associated with permitting and impacts on construction schedules could be significant. Cost estimates for Option 2 assume directional drilling beneath the existing railroad will not be required.

- Minimal impacts to other buried utilities.

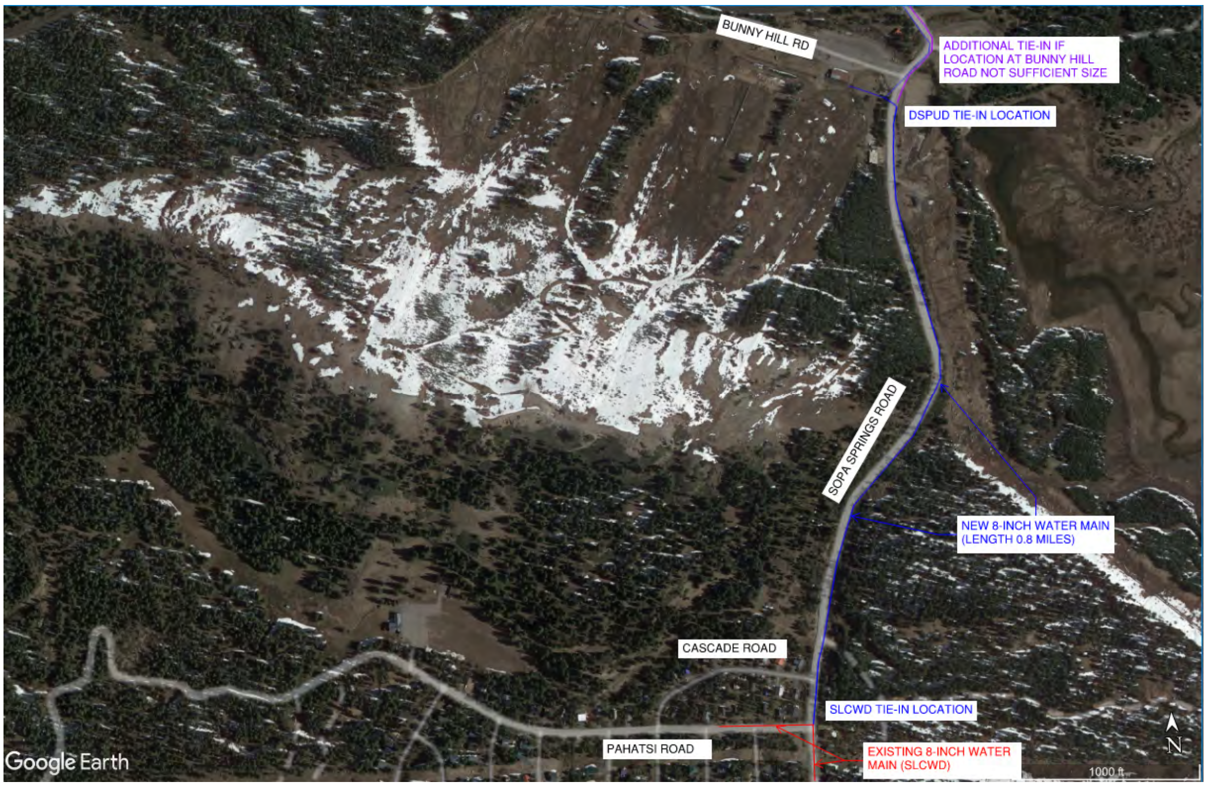

Figure 3: Intertie Location and Alignment

Figure 4: Railroad Crossing and Intertie Location

The total major construction cost for Option 2 is shown in Table 1 below.

Table 1: Option 1 Major Construction Cost Estimate

	Quantity	Unit Cost	Total Cost
Potholing Utility Coordination	Lump Sum	-	$15,000
HDPE Hauling, Purchasing, and Install	4,250 LF	$102.21/LF	$434,000
Blowoff Assemblies	3 EA	$3,000/EA	$9,000
Water System Tie-In Connections	2 EA	$10,000/EA	$20,000
Gate Valves	4 EA	$4,300/EA	$17,000
Fire Hydrant Assembly	2 EA	$16,300/EA	$32,000
Asphalt Replacement	1,420 SY	$21.22/SY	$30,000
Hydrostatic Testing & Disinfection of Pipeline	Lump Sum	-	$30,000
		Total	**$588,000**

Note:
Estimates are rounded to the nearest $1,000 which may result in rounding differences in the total

Mobilization and demobilization costs are added to the total major construction cost to arrive at a total construction cost. Since this is an area considered rural and mountainous, 10% is assumed for mobilization and demobilization, with a total cost assumed cost of $59,000.

Thus, the total construction cost for Option 2 is:

$588,000 + $59,000 = $647,000

Similar to Option 1, 15% of the total construction cost is assumed for design and engineering, with 2% assumed for legal and engineering during construction, and 10% for construction management.

Design and Engineering costs (15%) = $97,000

Legal Costs (2%) = $13,000

Engineering During Construction (2%) = $13,000

Construction Management (10%) = $65,000

The total cost for Option 1 is thus:

$647,000 + $97,000 + $13,000 + $13,000 + $65,000 = $835,000

Environmental Cost Estimate

Any environmental documentation or permitting for work done within the roadway for the pipeline will be handled during the construction and part of the contractor's bid items.

Total Estimated Cost

The total estimated cost for Option 2 is estimated at $835,000.

Option 3: Hauled/Bottled Water

As previously discussed, the District identified hauled water as a potential supply source to be considered as part of this Study. While this option would not serve as a viable option for meeting SB 552 requirements, hauled and/or bottled water could support the District in the event of a catastrophic water shortage or emergency. As part of this TM, the GEI Team has developed an estimated daily cost for hauled/bottled water. The development of this cost is summarized below. There are no anticipated construction or environmental documentation/permitting costs associated with Option 3.

- There are a total of 75 households within the District's service area where said household is their permanent/primary residence; the remaining households include seasonal occupants who would be directed to stay at their permanent residence during a catastrophic water shortage or emergency.

- One household contains 2.92 persons/household (thus, the District should expect to serve approximately a population of 219 during an emergency).

- Each person requires 47 gallons per day to meet human health and safety needs[2], which eqautes to 6,000 ounces per person per day, or 10,293 gallons per day.

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[2] Based on Water Code Section 10609.4 for standard indoor residential water use starting in 2025.

- There are two options for water delivery: water hauled in via tanker truck, or bottled water trucked on pallets. This Study assumes delivery would be a mix of both options.
  - **Hauled water:** household needs are better suited using tanker trucked water. This water would be stored in tanks placed physically onsite at the DSPUD office. Assuming two thirds of the required water needed per day would be delivered via water trucks (~32 gallons/person/day, or ~7,000 gallons/day), and that each truck can hold 2,500 gallons, a total of 3 trucks per day would be required. The cost of trucking is dependent on where the water would be shipped from. Assuming DSPUD is able to contract with nearby Truckee to get their trucked-in water, each truck of water is assumed to cost $650, resulting in a total cost of approximately $2,000 per day.
  - **Bottled water:** bottled water would serve the remaining one third of the required water needed per day (~15 gallons/person/day, or ~3,285 gallons/day). Assuming that bottled water would be trucked on pallets, with 18-20 pallets per truck, 72 cases per pallet, 24 bottles of water per case, and 16.9 ounces per bottle, approximately 1 truck of bottled water would be needed per day. With these assumptions, the cost of trucked bottled water is approximately $12,000 per day.

The total estimated daily cost for Option 3, including the cost of hauled water ($2,000 per day) and bottled water ($12,000 per day) is $14,000 per day.

APPENDIX E: EVALUATION OF POTENTIAL SOURCES OF ADDITIONAL SUPPLY TECHNICAL MEMORANDUM

TECHNICAL MEMORANDUM

TO: Steve Palmer/Jim King, Donner Summit Public Utility District

FROM: Jeff Meyer, Western Hydrologics

DATE: September 14, 2023

RE: ***Task 4: Evaluation of Potential Sources of Additional Supply***

Donner Summit Public Utility District (DSPUD) has contracted with GEI Consultants, Inc., and Western Hydrologics to develop a water supply resiliency study to address DSPUD's present challenges related to water supply reliability. This study includes the development of an operations simulation model to evaluate the risk of drought and climate change impacts, and the identification and evaluation of potential sources of additional supply for DSPUD. The purpose of this Technical Memorandum is to evaluate potential water supply from an intertie with Sierra Lakes County Water District (SLCWD, or District). To perform the evaluation, the operations simulation model was expanded to include SLCWD's Serene Lakes and associated consumptive demands under both the existing conditions for model calibration purposes and anticipated 2040 future conditions to evaluate whether an intertie would improve water supply. The model was used to test the ability of Serene Lakes to meet current and future demands under historic and climate change hydrologic sequences. An Existing scenario was used to verify that the Serene Lakes operations closely matched historic records. Future scenarios were used to evaluate the Serene Lakes operations with and without an intertie to DSPUD's system to determine if additional supplies could be delivered without impacting water supply reliability. These scenarios were tested over a study period containing water years 1976-2021 to include the hydrologic variability which occurs in the basin. The table below provides a summary of the assumptions used for the studies performed for this effort.

Table 1 - Model Scenario Summary Table

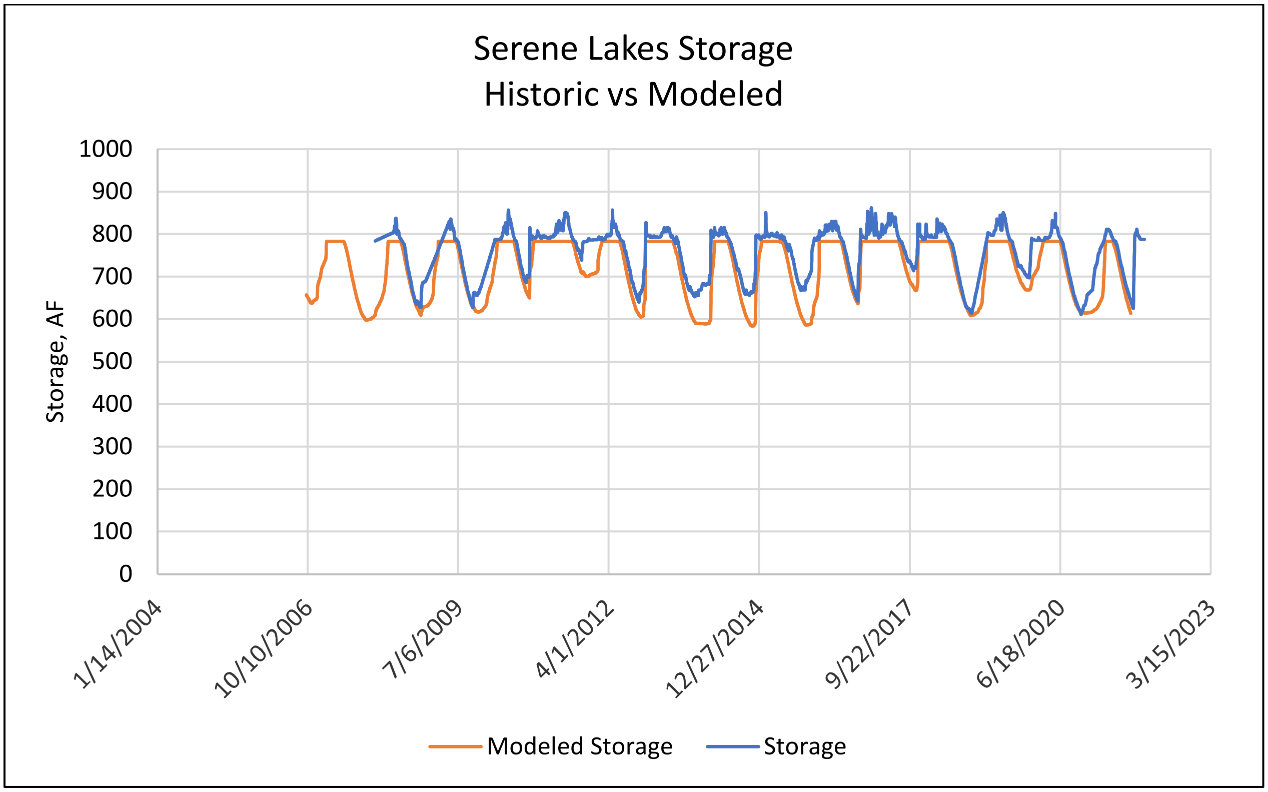
Scenario	Facilities	Hydrology	Study Period	Demand
Existing	Existing	Historic	1976-2021	Historic (2017 – 2021 Avg)
Future	Existing without Intertie	2040 Climate Change	1976 - 2021 modified by climate change factors	Future based upon planning documents. DSPUD Triggers for Enacting Water Shortage Response.
Future	Existing with Intertie	2040 Climate Change	1976 - 2021 modified by climate change factors	Future based upon planning documents. DSPUD Triggers for Enacting Water Shortage Response.

Hydrology

As part of the model development, two hydrology datasets were developed. The first data set is a representation of historic inflow to Serene Lakes using the Kidd Lake inflow data created as part of the inflow dataset for Nevada Irrigation District's Federal Emergency Regulatory Commission relicensing effort of the Yuba-Bear Project, updated for the current Plan for Water effort. This dataset was developed by using the methods described in the *Hydrologic Analysis Technical Memorandum – Final Report* for Nevada Irrigation District dated November 12, 2020. The dataset extends through 2021 and includes an inflow time series to Kidd Lake. Kidd Lake is the adjacent watershed west of Serene Lakes with similar watershed characteristics and watershed areas. According to a U.S. Geological Survey (USGS) watershed analysis product called StreamStats (https://streamstats.usgs.gov/ss/), Kidd Lake and Serene Lakes both have a watershed area of 1.9 sq mi. Kidd Lake has an annual average precipitation of 66.6 inches and an elevation of about 6,806 ft mean sea level (msl). Serene Lakes has an annual average precipitation of 66.7 inches and an elevation of 7,062 feet.

Because the characteristics of Kidd Lake and Serene Lakes are so similar, the Kidd Lake inflow dataset was used as the inflow to Serene Lakes. The simulation model was used to test the Serene Lakes Inflow hydrology dataset by comparing model operations using historic deliveries to the historic storage data. Figure 1 illustrates the simulated storage compared to the historic storage. The red line represents the simulated storage using the Kidd Lake inflow and the average 2017 – 2021 historic consumptive deliveries. During the 2017 – 2021 period, the simulated and historic storage traces match very well. The inflow dataset demonstrates a good fit for the Serene Lakes inflow and was chosen as a suitable dataset for this analysis.

Figure 1 - Simulated Serene Lakes Storage vs Historic Storage



<u>Climate Change Hydrology</u>

Climate change adjusted hydrology was developed using CalSim 3 2040 Central Tendency[1] for the USGS Gage at South Yuba River at Cisco Grove. This dataset was developed for the 2021 California Department of Water Resources (DWR) Delivery Capability Report. The 2040 Central Tendency data at Cisco Grove was disaggregated into Daily timestep data and adjusted for the historic Serene Lakes inflow dataset. The study period for this Climate Change dataset is October 1, 1975 – September 30, 2015. Because the CalSim dataset only has data through 2015, years similar to 2016 through 2021 were identified to extend the record through 2021.

[1] Technical Addendum to the State Water Project Final Delivery Capability Report 2021 - https://water.ca.gov/Library/Modeling-and-Analysis/Central-Valley-models-and-tools/CalSim-3/DCR2021

Figure 2 – Climate Change 2040 CT vs Historic

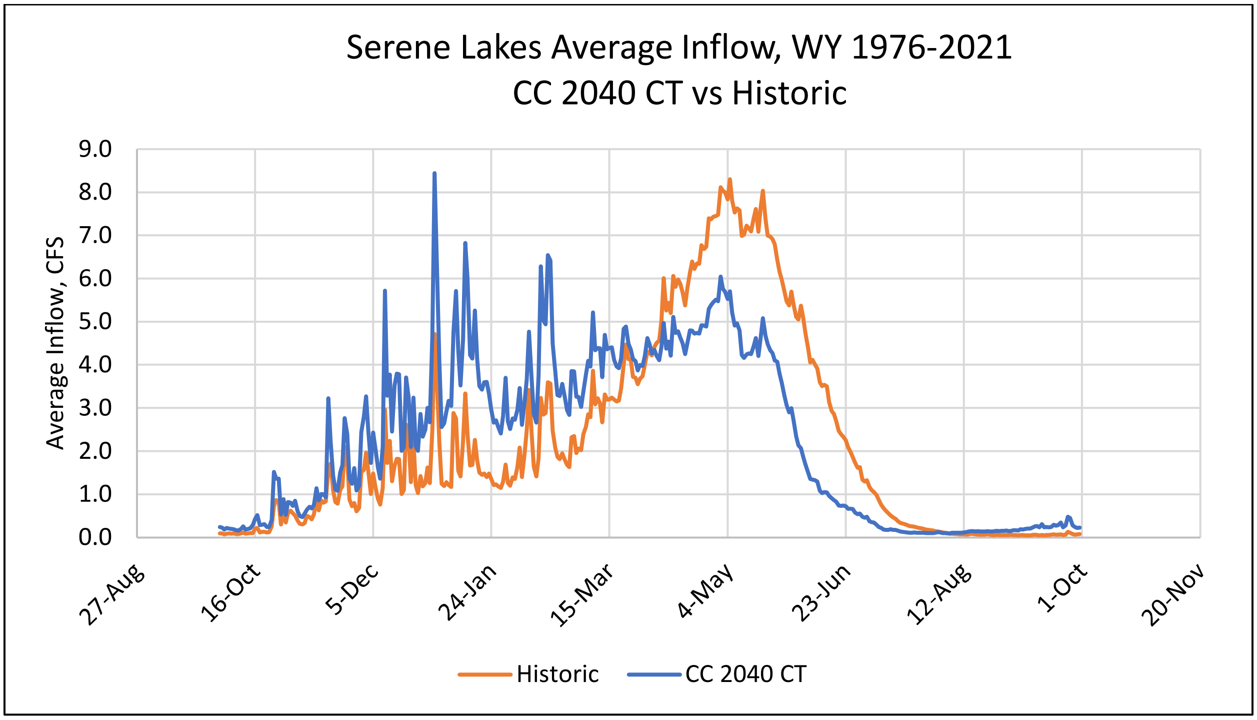


Figure 2 illustrates the Historic unimpaired inflow to Serene Lakes compared to the 2040 level of climate change hydrology. The total volume of the climate change hydrology is 0.15% more than the Historic Hydrology. The most significant change is the shift in runoff pattern. This shift reflects the diminished snowpack expected in the future, resulting in a potential need for changes in operations or a replacement of the snowpack storage.

These inflow datasets contain watershed runoff modeling results for two climate conditions as shown in Table 2.

Table 2 – Climate Conditions

Condition	**Description**
Historical	Historical representation of Lake Angela inflow from Kidd Lake Inflow
2040 Future Conditions	Future conditions projected climate for a thirty-year period centered on 2040 (2025-2055)

Evaporation

No evaporation rate data was available specifically for Lake Angela. The DWR Bulletin 73, *"Evaporation from Water Surfaces in California"*, dated November 1979 combined with the Lake Valley Reservoir evaporation pattern from CalSim 3 was used as an estimate of evaporation. There is a fairly strong relationship between elevation and evaporation. Table 3 illustrates the estimated evaporation rates used for Lake Angela. According to Google Earth, Lake Angela is located at about 7,200 ft msl and Serene Lakes is located at about 6,881 ft msl. We estimated the annual evaporation to be about 32.01 inches for the Historic study and 32.98 inches for the 2040 CT climate change study for both lakes. Neither the annual total nor the monthly rates are significantly different between the Historic and 2040 CT climate change datasets.

Table 3 - Evaporation Rates, inches

Month	Historic	2040 CT
Oct	2.53	2.62
Nov	0.94	0.98
Dec	0.49	0.51
Jan	0.37	0.38
Feb	0.74	0.76
Mar	1.33	1.36
Apr	2.47	2.52
May	3.58	3.69
Jun	4.57	4.73
Jul	5.89	6.04
Aug	5.26	5.41
Sep	3.86	3.97
Total	**32.01**	**32.98**

Consumptive Demands

Another stressor on the Serene Lakes water supply are the consumptive demands summarized in the following sections and shown in Table 4.

Existing Demands

The Existing demands were developed by averaging the deliveries provided by SLCWD. Averaging the deliveries for the 2017 – 2021 period on a monthly basis results in the *Existing Consumptive Demand, AF* column in Table 4. Total average demand over that period is 86.4 acre-feet (AF).

Future Demands
The Future demand data set was developed using the historic demand patterns multiplied by the anticipated Future Water use of 365 AF (SLWCD 2011)[2] as authorized by the amended water right permit.

Build out demands are expected to be about 278.6 AF/year (AFY) more than the existing demand. Table 4 summarizes the demands used for both the existing and future conditions.

Table 4 - Existing and Future Consumptive Demands

Month	Existing Consumptive Demand, AF	Build out Consumptive Demand, AF
Jan	7.0	30.5
Feb	6.2	26.8
Mar	6.5	28.0
Apr	6.6	26.7
May	5.7	25.2
Jun	7.3	32.8
Jul	11.3	47.8
Aug	9.3	40.5
Sep	7.1	31.2
Oct	5.2	23.1
Nov	4.8	22.2
Dec	6.2	30.3
Total Potable Water Demand	**83.1**	**365.0**

Drought Contingency Implementation

Sierra Lakes County Water District has developed and implemented two water conservation requirement documents. In May of 2015, SLCWD adopted Resolution 2015-825, implementing Mandatory Water Conservation Measures to help the District manage the effects of a prolonged drought. In February 2018, the District adopted Division XI to the District's code of Ordinances pertaining specifically to Water Conservation. Both documents remain in effect and in addition to the water conservation measures, all SLCWD customers were asked to further reduce their water consumption by an additional 15% as compared to 2020. To implement these requirements in the modeling, a 15% delivery reduction was imposed whenever the April through July runoff forecast fell below 30% of average. This resulted in delivery reductions in

[2] SWALE, Inc (2018), Draft Municipal Service Review North Tahoe and Martis Valley MSR prepared for Placer LAFCo. Pg 11-14 https://www.placer.ca.gov/DocumentCenter/View/7734/Final-Tahoe-Martis-Vallely-Municipal-Service-Review-PDF

1976, 1977, 1988, 1991, and 2015. This approach was used to simulate similar drought delivery reductions as what occurred historically.

As part of this project, Triggers for Enacting Water Shortage Response were developed for the DSPUD system. Table 5 summarizes those triggers and associated actions. These were assumed in the Future level studies. A more complete description can be found in the *Task 5: Triggers for Enacting Water Shortage Response* Technical Memorandum.

Table 5 - Triggers for Enacting Water Shortage Response

Period	Index	Trigger	Delivery reduction
January	Lake Angela Storage **OR** Previous April Bulletin 120 Apr – Jul Runoff Forecast For American River below Folsom Lake	Storage below 50 AF **OR** Greater than 50% of Avg 30% - 50% of Avg Less than 30% of Avg	**Lesser of:** 25% **OR** 0% 15% 25%
February	February 1 Bulletin 120 Apr – Jul Runoff Forecast[3] For American River below Folsom Lake	Greater than 50% of Avg 30% - 50% of Avg Less than 30% of Avg	0% 15% 25%
March	March 1 Bulletin 120 Apr – Jul Runoff Forecast For American River below Folsom Lake	Greater than 50% of Avg 30% - 50% of Avg Less than 30% of Avg	0% 15% 25%
April - December	April 1 Bulletin 120 Apr – Jul Runoff Forecast For American River below Folsom Lake	Greater than 50% of Avg 30% - 50% of Avg Less than 30% of Avg	0% 15% 25%

Model Schematic

The model schematic shown in Figure 3 illustrates the modeled facilities and linkage. The modeled facilities are overlayed on the watershed features to approximate the geographic location of the facilities. The schematic is made up of three node types and two link types, described below.

Nodes

Rector Reservoir Storage

Consumptive demands

Junctions or points of interest

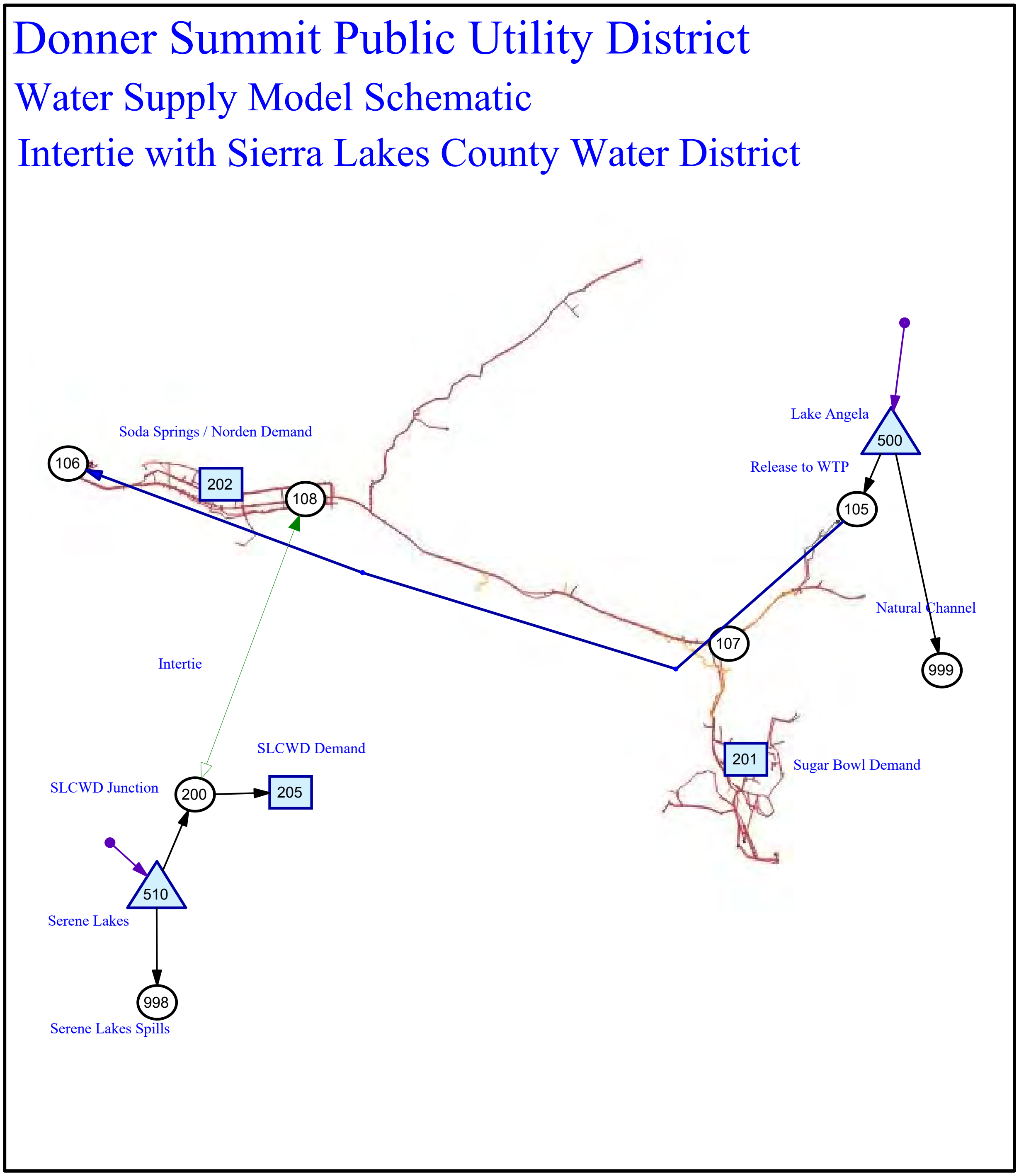
Arcs

Natural channel

Canal or Pipelines

[3] The B-120 Water Supply Forecast Summary April-July Forecast Percent of Average was used to determine when delivery reductions should be applied. The Summaries can be found at the following link: https://cdec.water.ca.gov/reportapp/javareports?name=B120

Figure 3 –DSPUD Intertie with SLCWD Schematic



Results

The results of these studies are discussed in the Existing Conditions and Future Conditions sections.

Existing Conditions

The existing conditions study represents current historic hydrology and existing demands. Table 6 summarizes the assumptions for this study.

Table 6 - Current Level Study

Scenario	Facilities	Hydrology	Study Period	Demand
Existing	Current	Historic	1976-2021	Historic (2017 – 2021 Avg)

As discussed above, this scenario uses a demand that was developed by averaging the actual historic demands for the 2017 – 2021 period. The average demand repeats for every year of the simulation. Figure 4 shows the Annual Delivery and Demand for the period of record. In 1976, 1977, 1978, 1988, 1989, 1991, 2015, and 2016 there are shortages imposed. This was done in a manner that tries to mimic curtailments imposed by the State Water Resources Control Board using the April through July runoff forecasts. The forecasts are made February 1, March 1, and April 1. The April 1 forecast is then used for the April 1 through February 1 period. When the April through July forecast is less than 30% of average, a 15% reduction in delivery is imposed. These reductions in delivery exactly meet the reduction in demand meaning that these are following the curtailment logic and are not because storage has reached dead pool at Serene Lakes.

Figure 4 - Existing Condition Deliveries

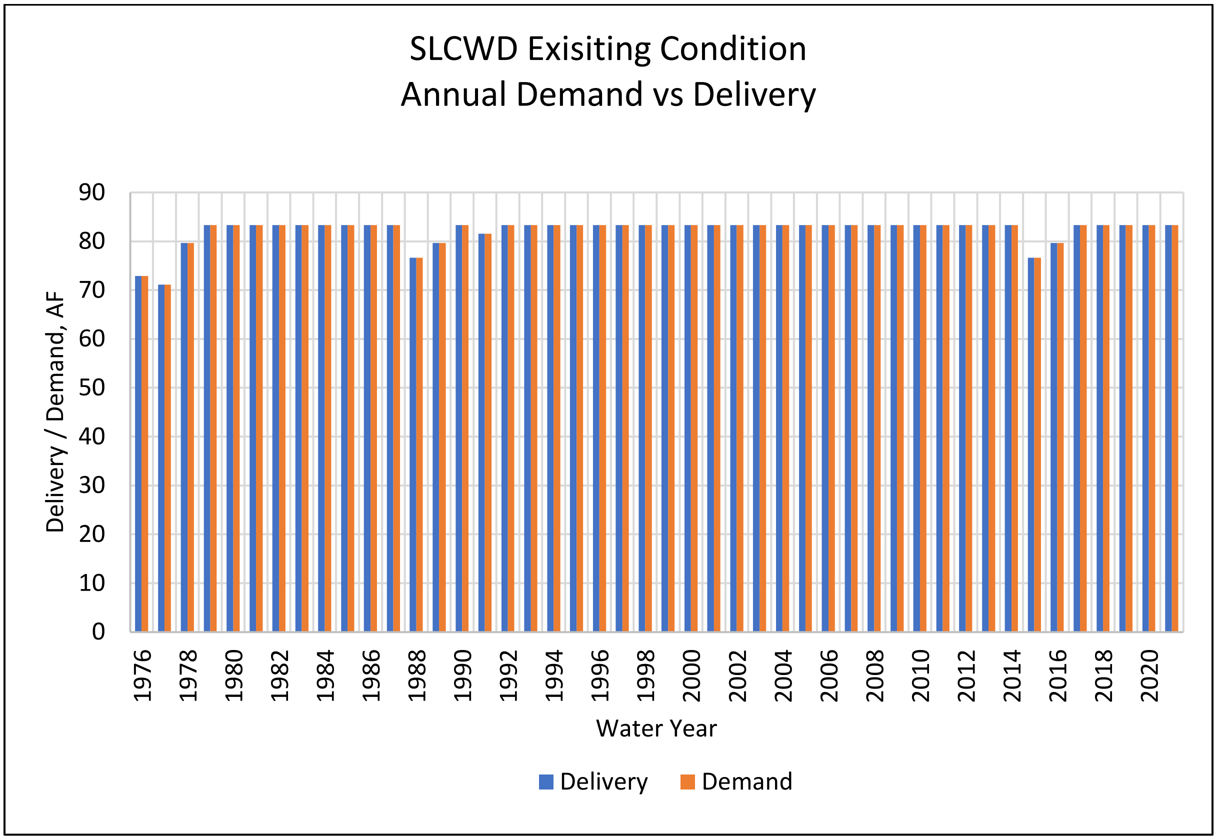
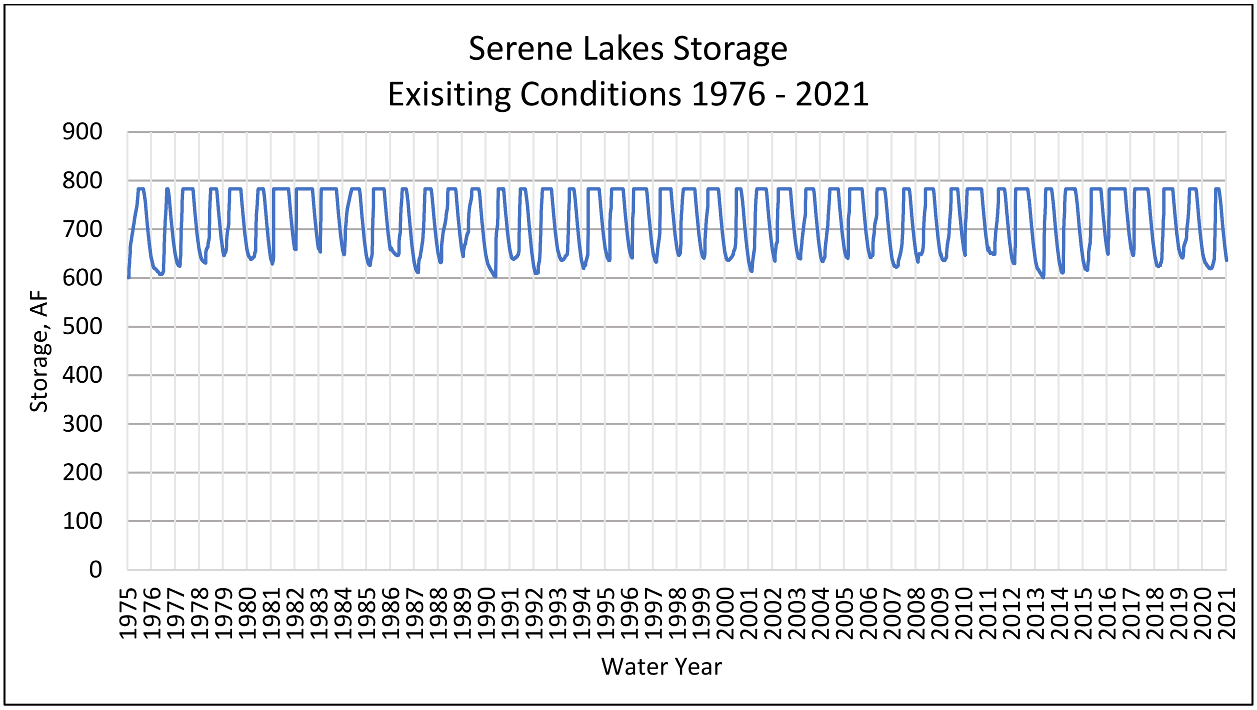


Figure 5 illustrates the resulting storage at Serene Lakes. The minimum storage at Serene Lakes for the study period occurs in the driest years and is roughly 580 AF, leaving approximately 510 AF of additional storage above the dead pool. At Existing Condition, there is plenty of water supply to meet existing demand. Assuming the system is in good working order, study results indicate there is very little risk of water supply shortage due to drought.

Figure 5 - Existing Conditions Serene Lakes Storage



<u>Future Condition without Intertie</u>

The Future Condition without intertie study evaluates the impacts of climate change hydrology coupled with an anticipated future level demand. Table 7 summarizes the assumptions.

Table 7 - Future Level Studies

Scenario	Facilities	Hydrology	Study Period	Demand
Future	Existing without Intertie	2040 Climate Change	1976 - 2021 modified by climate change factors	Future based upon planning documents. DSPUD Triggers for Enacting Water Shortage Response.

The Future condition study includes full build out demands with climate change hydrology. The demands account for growth in the service area and are expected to increase by 211 AFY. Figure 6 illustrates the deliveries made in the Future Condition simulation. This study includes the DSPUD Triggers for Enacting Water Shortage Response. These were developed to prepare a plan for operating through drought conditions by curtailing deliveries. These measures preserve Lake Angela Storage while delivering 75% of the demand. Please see the *Task 5: Triggers for Enacting Water Shortage Response* Technical Memorandum for details. If not for the anticipated State Water Resources Control Board curtailments, Serene Lakes has enough supply to meet SLCWD demands in all years.

Figure 6 – Future Condition Deliveries

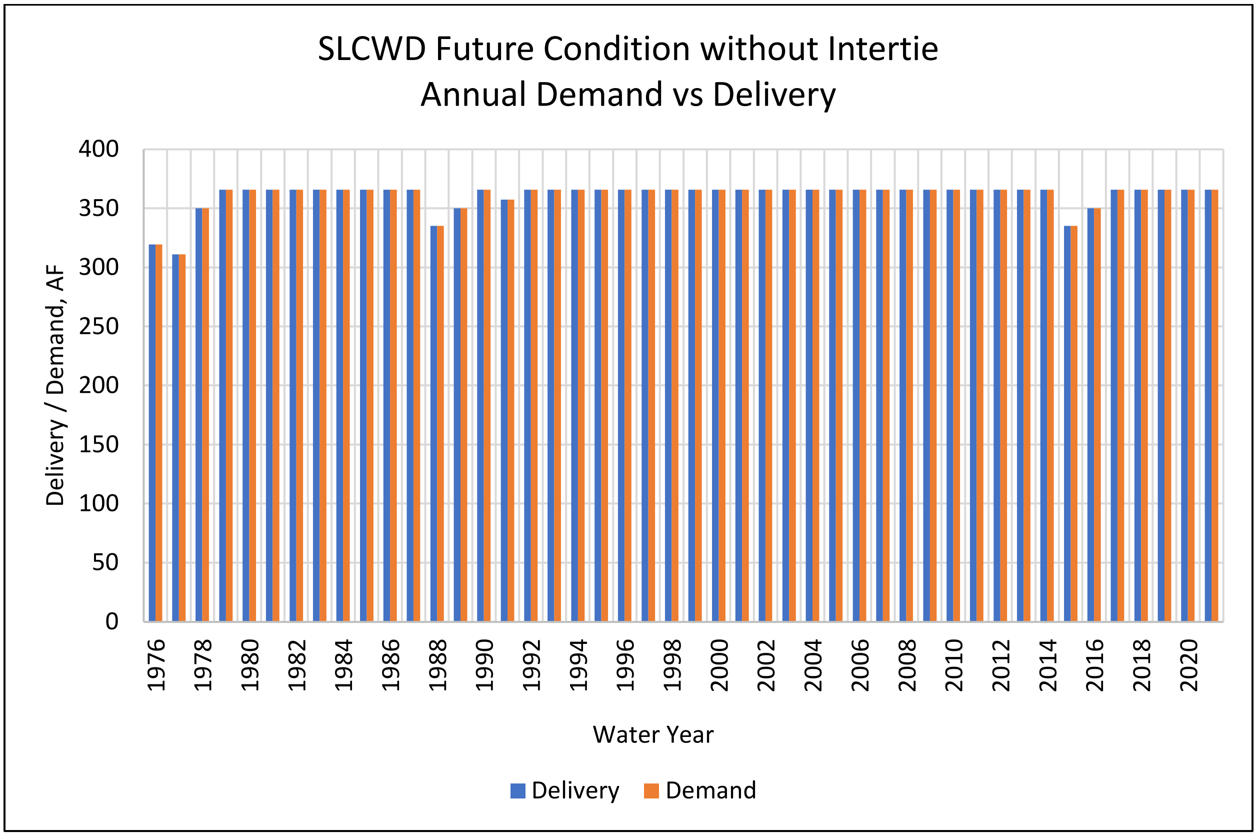


Figure 7 illustrates the resulting Serene Lakes storage at the Future Level. Figure 7 shows that Serene Lakes generally remains above 400 AF in most years and is above 300 AF in all years except 1977. In 1977, Serene Lakes storage fell to 317 AF before the winter precipitation began the refill. Currently, SLCWD can pump water from an elevation of 6,864.5 ft msl or about 9 ft below the dam crest. At this elevation, the remaining storage in the reservoir is about 300 AF.

Figure 7 - Future Condition without Intertie Serene Lakes Storage

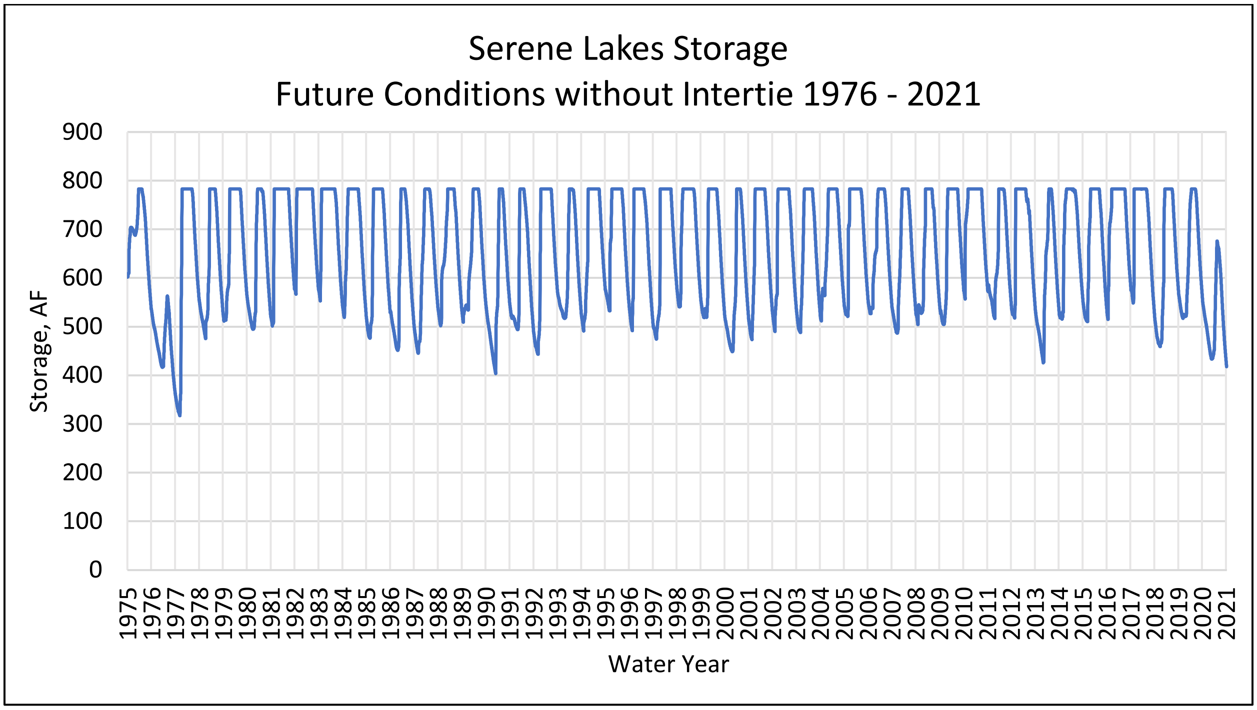
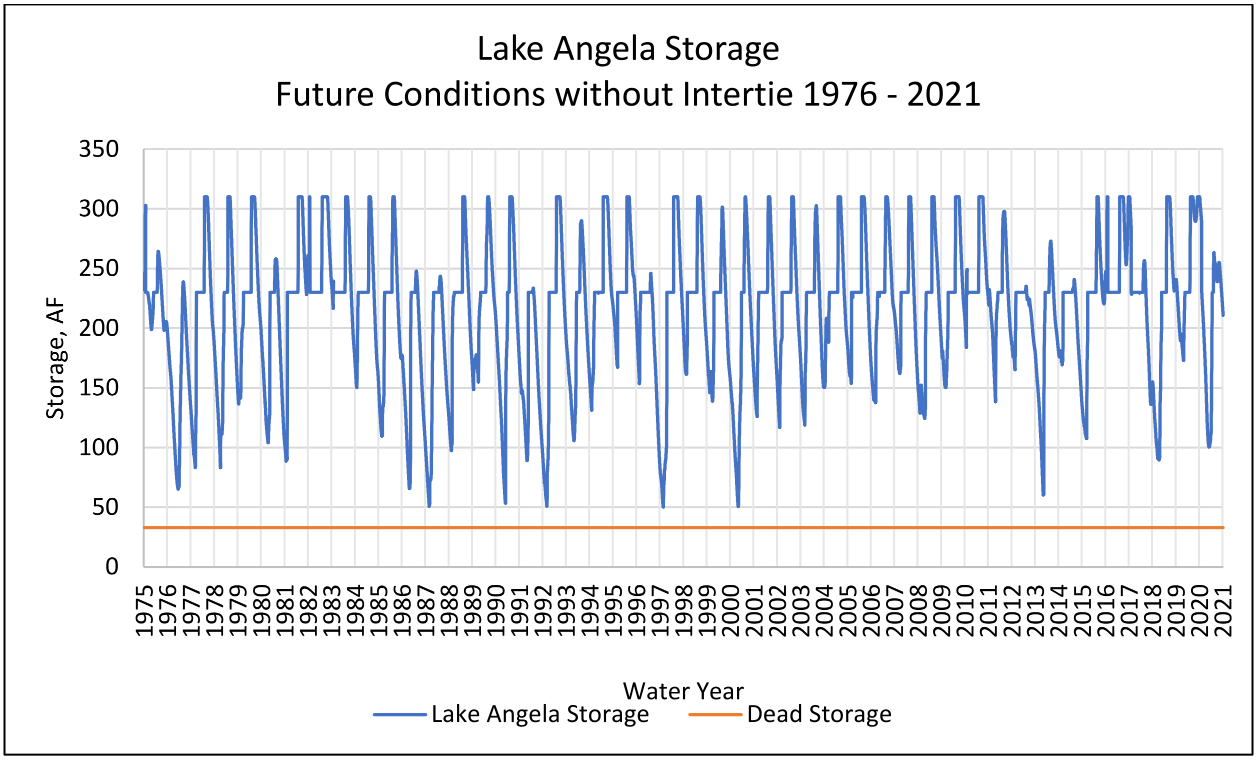


Figure 8 illustrates Lake Angela storage at the future condition. In the driest years, storage approaches dead storage, often being drawn down to about 50 AF.

Figure 8 - Lake Angela Storage without Intertie



<u>Future Conditions with Intertie</u>

This scenario is investigated as DSPUD has been experiencing water quality issues and future level demands could drive storage to near dead pool. This scenario assumes DSPUD buildout demands of 454 AFY and SLCWD buildout demands of 365 AFY.

Table 8 – Future conditions with Intertie

Scenario	Facilities	Hydrology	Study Period	Demand
Future	Existing with Intertie	2040 Climate Change	1976 - 2021 modified by climate change factors	Future based upon planning documents. DSPUD Triggers for Enacting Water Shortage Response.

Figure 9 illustrates that in the Future Condition with Intertie, the same deliveries are made as without the Intertie, demonstrating no water supply impact to the SLCWD customers.

Figure 9 - SLCWD Annual Demand vs Delivery with Intertie

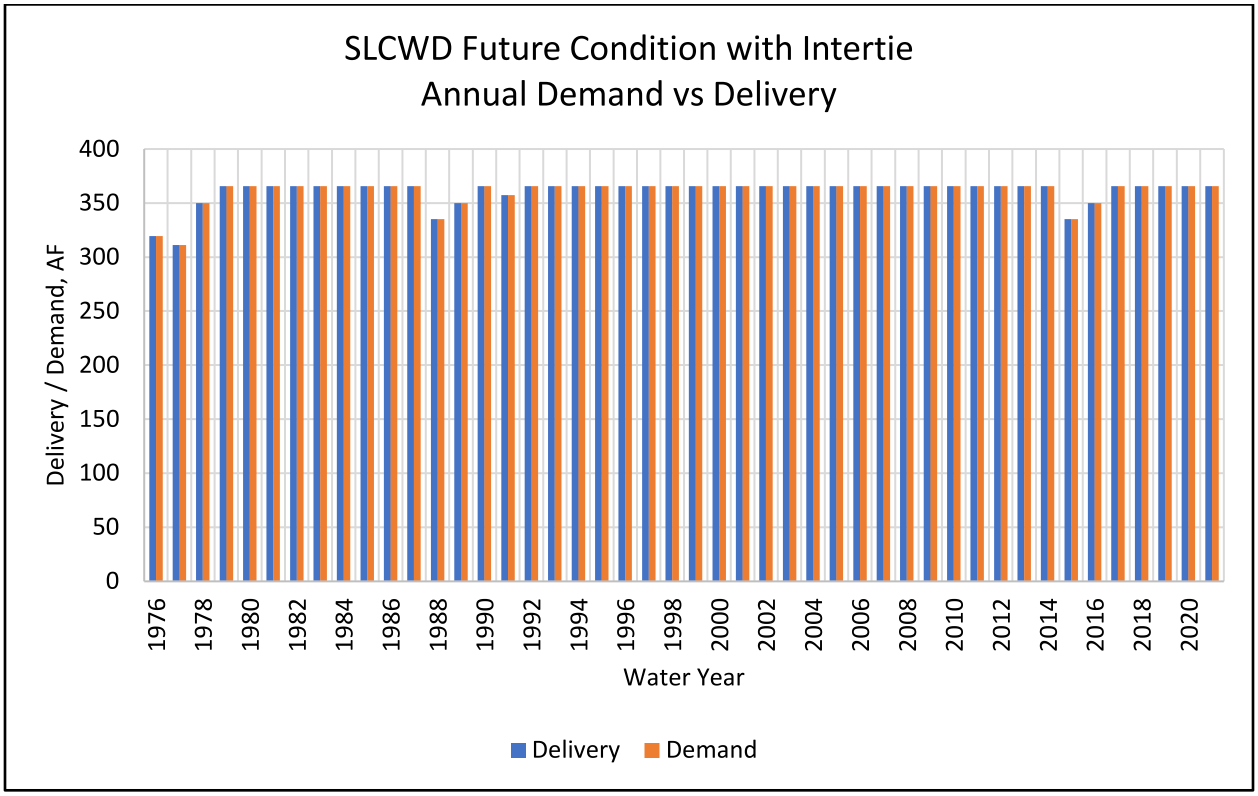
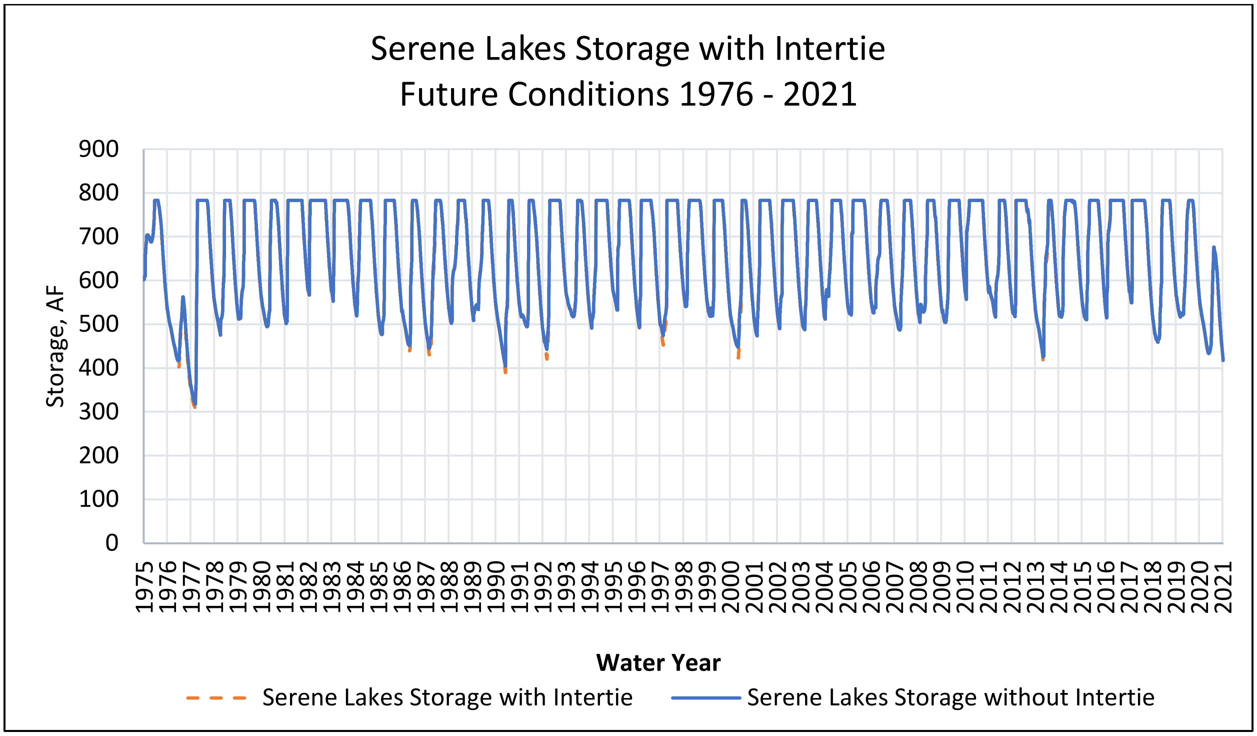


Figure 10 illustrates the storage at Serene Lakes with and without Intertie deliveries. Deliveries are made to DSPUD when Lake Angela Storage falls below 80 AF. The 80 AF threshold value results in a Serene Lakes low point of about 307 AF, allowing SLCWD to continue to pump water using existing facilities to serve their own customers. Deliveries to DSPUD are primarily made from direct diversions rather than storage withdrawals which minimizes impacts to Serene Lakes storage. The intake pipe could be extended deeper into the reservoir to allow for more operational flexibility.

Figure 10 - Serene Lakes Storage with Intertie Delivery to DSPUD



Using an Intertie can improve the dry year low point Lake Angela storage from about 50 AF to 70 AF, as shown in Figure 11, without significantly impacting SLCWD's water supply.

Figure 11 - Lake Angela Storage with Intertie Delivery

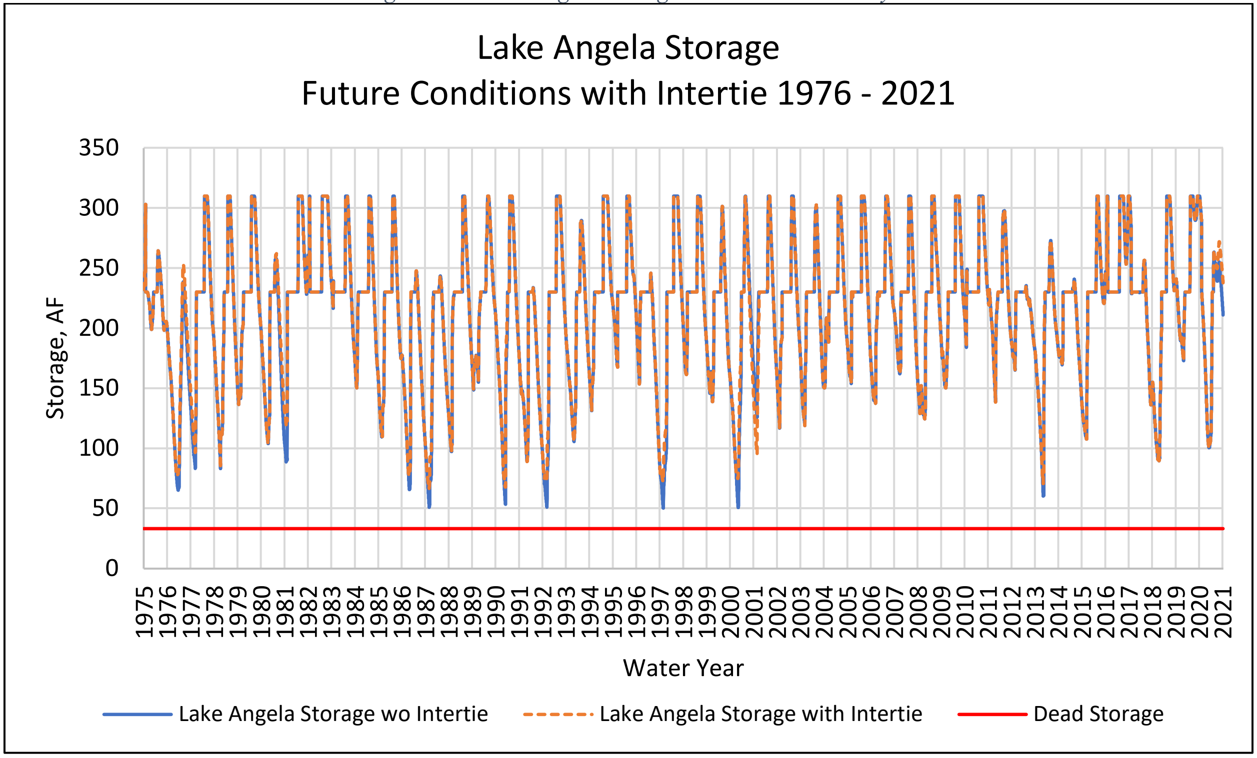
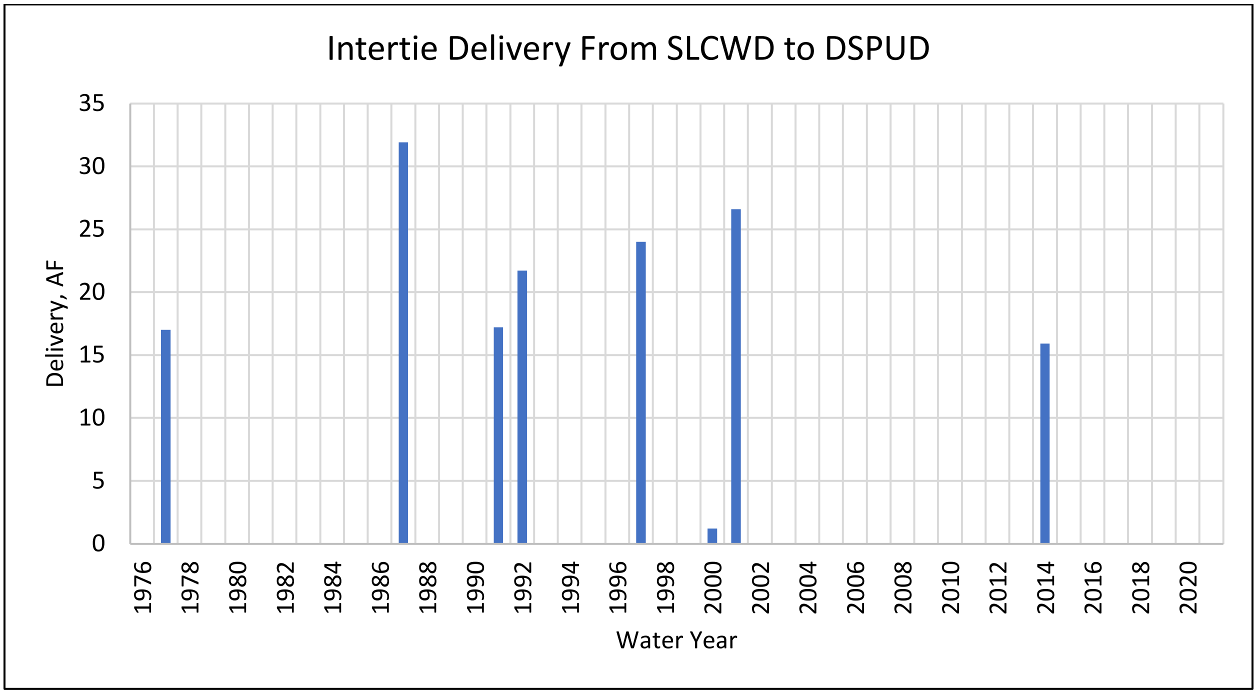


Figure 12 illustrates the annual volumes of water delivered by the Intertie in dry years. The annual delivery ranges from about 2 AF to as much as 32 AF. Deliveries from the intertie are made if Lake Angela storage falls below 80 AF to keep Lake Angela storage from falling to dead storage while preserving water supply at Serene Lakes. The Intertie deliveries from Serene Lakes mostly occur from direct diversions and not storage withdrawals. This operation is advantageous because the intertie delivery has a very minor effect on Serene Lakes storage but provides a benefit to Lake Angela storage as shown in Figure 11.

Figure 12 - Intertie Delivery from SLCWD to DSPUD



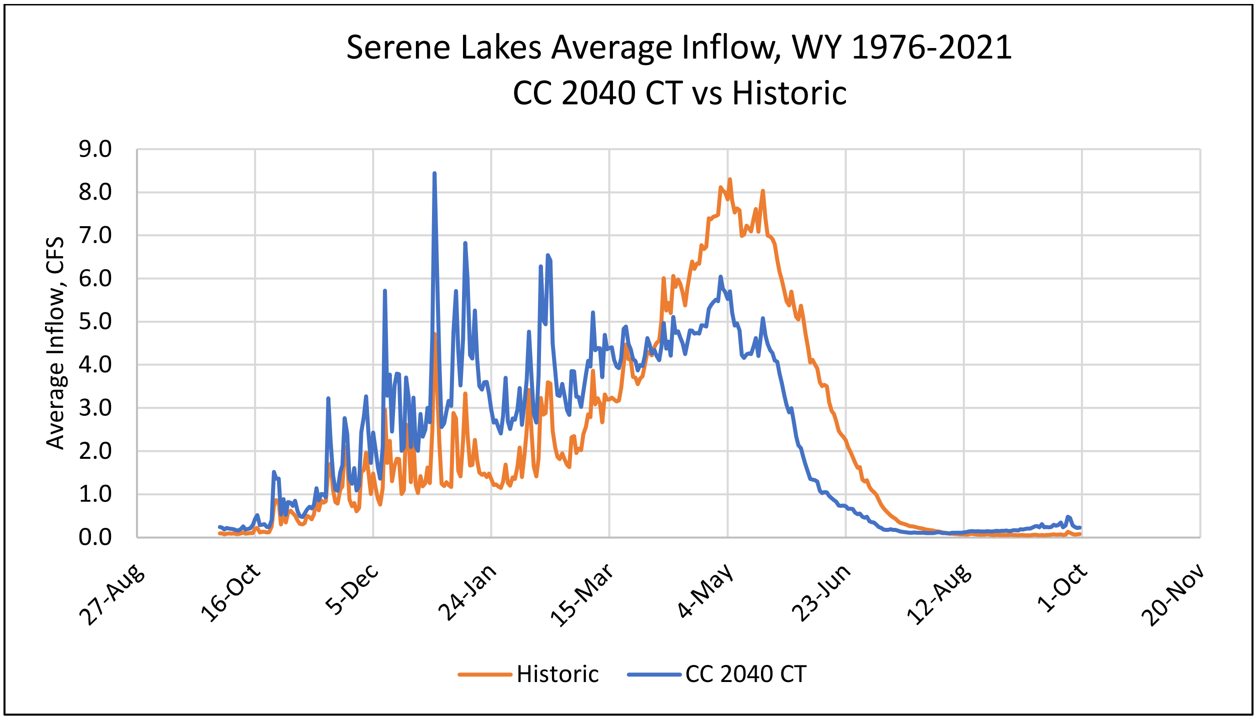
<u>Conclusions</u>

Based on the results of these studies, it appears under the future climate condition, both Lake Angela and Serene Lakes can meet the anticipated future demand as long as the dry year reductions in deliveries are implemented in water short years.

The shift in the runoff pattern of climate change hydrology is significant. Figure 13 illustrates the impact of climate change hydrology. The orange line shows the historic average annual runoff pattern. The blue lines show the climate change average annual runoff pattern. Figure 13 illustrates how the climate change hydrology peak runoff pattern shifts earlier in the year to the December through March period as compared to the historic April through June period. Although both average annual runoff volumes are almost identical, use of climate shifted supply can be accomplished.

Results indicate that with the addition of an Intertie, early spring runoff during drier years can be diverted to Lake Angela without significantly impacting Serene Lakes storage. This operation improves overall water supply and could result in a modification to the Triggers for Enacting a Water Shortage Response, allowing for increased deliveries by DSPUD.

Figure 13 – Seren Lakes Climate Change 2040 CT Inflow



For water supply purposes, both DSPUD and SLCWD would only need an Intertie when consumptive demands approach the buildout levels. An Intertie could also be useful for emergency water supply needs. The two Districts could temporarily support each other during equipment failures or water quality emergencies. Emergency actions are beyond the scope of this analysis but should be studied if an Intertie is considered.

<u>Recommendations</u>

The studies performed for this task have illustrated that for water supply purposes, an Intertie between DSPUD and SLCWD could be beneficial. Until consumptive demands reach buildout levels, the additional supply is not necessarily needed. However, in an emergency both Districts could benefit from an Intertie.

Demands in the Future Condition scenario have a combined increase of 493 AFY. In water short year,s delivery reduction policy could be developed to impose deficiencies in those years where storage withdrawals begin to approach dead pool. With the Triggers for Enacting Water Shortage Response for DSPUD and the Drought Contingency Implementation for SLCWD, both projects could manage their respective water supplies through anticipated droughts. Study results indicate that with an Intertie, the total delivery capability could be increased.

Climate Change projections indicate future runoff patterns will result in peak runoff in the January thru February period. Because of the shifting runoff patterns and the current Lake Angela DSOD requirements coupled with anticipated demands, maximizing storage at Lake Angela and Serene Lakes in the future may become critical once consumptive demands reach build out levels. A cost benefit analysis for the construction of the Intertie should be considered. The analysis should not only consider the increase in water supply, but also the value of an emergency water supply at any point in the future.

Finally, construction and use of an Intertie would require changes to both District's water rights to include the other's service area in their place of use. This is a relatively simple procedure and can be accomplished by filing a petition for change in place of use and the necessary environmental documentation with the State Water Resources Control Board.

APPENDIX F: DONNER SUMMIT PUBLIC UTILITY DISTRICT ABRIDGED WATER SHORTAGE CONTINGENCY PLAN

SAVE WATER. SAVE CALIFORNIA.

Water Shortage Contingency Plan

for

Donner Summit Public Utility District (DSPUD)

53823 Sherritt Lane, Soda Springs, CA 95728

Public Water System CA #2910016

Effective: October 17, 2023

Table of Contents

Section I: Declaration of Policy, Purpose, and Intent

In order to conserve the available water supply and protect the integrity of public water system (PWS) supply facilities, with particular regard for domestic water use, sanitation, and fire protection, to protect and preserve public health, welfare, and safety and minimize the adverse impacts of water supply shortage or other water supply emergency conditions, Donner Summit Public Utility District (DSPUD, or District) hereby adopts the following regulations and restrictions on the delivery and consumption of water through this abridged Water Shortage Contingency Plan (WSCP, or Plan).

In relation to the ongoing drought, in September 2021, Governor Gavin Newsom signed Senate Bill 552 (SB 552) requiring small water suppliers serving 1,000 to 2,999 connections and providing less than 3,000 acre-feet per year of water to develop an abridged WSCP, along with other prescriptive drought resiliency measures between 2023 and 2032. DSPUD serves approximately 360 domestic water customers in the Donner Summit area and is exempt from the requirements to develop, adopt, and maintain an abridged WSCP; however, the District is not immune to the challenges associated with climate change and drought. Due to these challenges, the District may see water supply–demand imbalances, especially at future levels of development. This abridged WSCP will address the water supply–demand imbalances by identifying standard water shortage levels corresponding to progressive ranges based on the water supply conditions, including catastrophic interruptions of water supply including regional power outage, earthquake, fire, and other potential emergency events.

Water uses regulated or prohibited under this Plan are considered to be non-essential and continuation of such uses during times of water shortage or other emergency water supply condition are deemed to constitute a waste of water subjecting the offender(s) to penalties as defined in Section XI of the Plan.

Section II: Public Involvement

While DSPUD is not required to prepare an abridged WSCP under SB 552, the District provided the opportunity for the public to provide input into the preparation of the Plan by posting the Plan on their website and through their regular Board meeting held on September 19, 2023. Hard copy mailers were distributed ahead of this meeting to notify the public of the opportunity for input into the Plan. Final adoption of the Plan occurred at a properly noticed Board meeting on October 17, 2023.

Section III: Public Education

DSPUD will regularly provide the public with information about the Plan, including information about the conditions under which each stage of the Plan is to be initiated or terminated and the drought response measures to be implemented in each stage, including but not limited to the value of water, sources of water being used, methods and opportunities for conservation. Detailed information on public education is provided in Section X of the Plan.

Section IV: Coordination with Regional Water Planning Groups

The service area of DSPUD is located within the Lake Angela watershed and the District has provided a copy of this Plan to the State Water Resources Control Board, Division of Drinking Water. The final plan was also posted on the DSPUD website on October 20, 2023.

Section V: Authorization

The General Manager, or designee, is hereby authorized and directed to implement the applicable provisions of this Plan upon determination that such implementation is necessary to protect public health, safety, and welfare. The General Manager, or designee, shall have the authority to initiate or terminate drought or other water supply emergency response measures as described in this Plan. The contact information for the General Manager is: 530-426-3456 and via email at SPalmer@dspud.com.

Section VI: Application

The provisions of this Plan shall apply to all persons, customers, and properties utilizing water provided by DSPUD. The terms “person” and “customer” as used in the Plan may include individuals, corporations, partnerships, associations, and all other legal entities.

Section VII: Definitions

For the purposes of this Plan**,** the following definitions shall apply:

Aesthetic water use: water use for ornamental or decorative purposes such as fountains, reflecting pools, and water gardens.

Commercial and Institutional water use: water use which is integral to the operations of commercial and non-profit establishments and governmental entities such as schools, hospitals, clinics, retail establishments, hotels and motels, restaurants, and office buildings.

Conservation: those practices, techniques, and technologies that reduce the consumption of water, reduce the loss or waste of water, improve the efficiency in the use of water or increase the recycling and reuse of water so that a supply is conserved and made available for future or alternative uses.

Customer: any person, company, or organization using water supplied by DSPUD.

Domestic water use: water use for personal needs or for household or sanitary purposes such as drinking, bathing, heating, cooking, sanitation, or for cleaning a residence, business, industry, or institution.

Even number address: street addresses, box numbers, or rural postal route numbers ending in 0, 2, 4, 6, or 8 and locations without addresses.

Industrial water use: the use of water in processes designed to convert materials of lower value into forms having greater usability and value.

Landscape irrigation use: water used for the irrigation and maintenance of landscaped areas, whether publicly or privately owned, including residential and commercial lawns, gardens, golf courses, parks, rights-of-way and medians.

Non-essential water use: water uses that are not essential nor required for the protection of public, health, safety, and welfare, including:

(a) irrigation of landscape areas, including parks, athletic fields, and golf courses, except otherwise provided under this Plan;
(b) use of water to wash any motor vehicle, motorbike, boat, trailer, airplane or other vehicle;
(c) use of water to wash down any sidewalks, walkways, driveways, parking lots, tennis courts, or other hard-surfaced areas;
(d) use of water to wash down buildings or structures for purposes other than immediate fire protection;
(e) flushing gutters or permitting water to run or accumulate in any gutter or street;
(f) use of water to fill, refill, or add to any indoor or outdoor swimming pools or Jacuzzi-type pools;
(g) use of water in a fountain or pond for aesthetic or scenic purposes except where necessary to support aquatic life;
(h) failure to repair a controllable leak(s) within a reasonable period after having been given notice directing the repair of such leak(s); and
(i) use of water from hydrants for construction purposes or any other purposes other than firefighting or hauling water for a domestic water use.

Odd numbered address: street addresses, box numbers, or rural postal route numbers ending in 1, 3, 5, 7, or 9.

Section VIII: Summary of Drought Response Stages and Response Actions

The General Manager, or designee, shall monitor a) water supply and/or demand conditions on a monthly basis and b) Bulletin 120 forecasts as they are released in the months of February, March, April, and May. The General Manager, or designee, shall determine when conditions warrant initiation or termination of each stage of the Plan, that is, when the specified "triggers" are reached.

The triggering and termination criteria described in subsequent sections of this document are based on:

- Projected surface water storage;
- Bulletin 120 runoff forecasts for the American River below Folsom Lake (https://cdec.water.ca.gov/reportapp/javareports?name=B120)
- Emergencies such as fire, earthquake, etc. resulting in potential water outages

The response actions described in subsequent sections of this document are based on the following general precepts:

- Source capacity augmentation is proposed through the provision of hauled or bottled water since DSPUD does not have an emergency intertie.
- Conservation techniques employed include progressively implementing more strict water use policies, primarily focused on outdoor irrigation and increasingly restrictive water use in business functions. In natural disaster type scenarios, water supplies are limited based on a per capita per day scenario.
- Notification of the public is performed in a variety of ways to ensure drought messaging is received by the residents. Depending on the severity of the drought stage, this may include messages on DSPUD's website to county emergency messaging text alerts.
- DSPUD will coordinate with a variety of agencies, including but not limited to County Office of Emergency Services, County Environmental Health, and the State Water Resources Control Board, Division of Drinking Water, depending upon the severity of drought or water shortage.

A summary of the triggers and water reduction targets associated with each of the stages presented in this section is provided in table format below.

Summary of Drought Response Stages

Month	Index	Trigger	Shortage Level	Target	Stage
January	Lake Angela Storage **OR** Previous April Bulletin 120 Apr-Jul runoff forecast for American River below Folsom Lake			**Lesser of:**	
		Lake Angela Storage < 50 AF	15-25%	25%	2
		OR		**OR**	
		Greater than 50% of average	0%	0%	-
		30-50% of average	0-15%	15%	1
		< 30% of average	15-25%	25%	2
	-	DSPUD discretion	25-35%	35%	3
			35-45%	45%	4
			45-55%	55%	5
		Emergencies such as fire, earthquake, etc.	> 55%	≥ 55%	6
February/March/ April-December	February 1/March 1/April 1 Bulletin 120 Apr – Jul Runoff Forecast For American River below Folsom Lake	Greater than 50% of average	0%	0%	-
		30-50% of average	0-15%	15%	1
		< 30% of average	15-25%	25%	2
	-	DSPUD discretion	25-35%	35%	3
			35-45%	45%	4
			45-55%	55%	5
		Emergencies such as fire, earthquake, etc.	> 55%	≥ 55%	6

Section IX: Drought Response Triggers

The drought response triggers and terminations discussed below provides details on when varying levels of drought responses, further discussed in Section X, will be implemented and then subsequently terminated. The DSPUD Board of Directors may choose to make modifications to the triggers and terminations depending on real-time scenarios, however these response triggers stand in the absence of other Board decisions.

Stage 1 Triggers – Water Shortage WATCH Conditions

Requirements for initiation

Customers shall be required to comply with the restrictions on certain non-essential water uses provided in Section X of this Plan when the Bulletin 120 April to July runoff forecast for the American River below Folsom Lake is 30 to 50% of average.

Requirements for termination

Stage 1 of the Plan may be rescinded when the Bulletin 120 April to July runoff forecast for the American River below Folsom Lake is updated to be greater than 50% of average.

Stage 2 Triggers – WARNING Water Shortage Conditions

Requirements for initiation

Customers shall be required to comply with the restrictions on certain non-essential water uses provided in Section X of this Plan when the Bulletin 120 April to July runoff forecast for the American River below Folsom Lake is less than 30% of average **OR** if Lake Angela storage falls below 50 acre-feet in the month of January.

Requirements for termination

Stage 2 of the Plan may be rescinded when the Bulletin 120 April to July runoff forecast for the American River below Folsom Lake is updated to be greater than 30% of average. Upon termination of Stage 2, Stage 1 becomes operative unless the runoff forecast is updated to be greater than 50% of average, in which case there would be no restrictions on non-essential water uses.

Stage 3 Triggers – ACUTE Water Shortage Conditions

Requirements for initiation

Customers shall be required to comply with the restrictions on certain non-essential water uses provided in Section X of this Plan when DSPUD recommends

Stage 3 drought response measures.

Requirements for termination

Stage 3 of the Plan may be rescinded when triggering events have ceased to exist for a period of 10 consecutive days. Upon termination of Stage 3, Stage 2 becomes operative unless otherwise specified.

Stage 4 Triggers – CRITICAL Water Shortage Conditions

Requirements for initiation

Customers shall be required to comply with the restrictions on certain non-essential water uses provided in Section X of this Plan when DSPUD recommends Stage 4 drought response measures.

Requirements for termination

Stage 4 of the Plan may be rescinded when triggering events have ceased to exist for a period of 10 consecutive days. Upon termination of Stage 4, Stage 3 becomes operative unless otherwise specified.

Stage 5 Triggers – EMERGENCY Water Shortage Conditions

Requirements for initiation

Customers shall be required to comply with the restrictions on certain non-essential water uses provided in Section X of this Plan when DSPUD recommends Stage 5 drought response measures.

Requirements for termination

Stage 5 of the Plan may be rescinded when triggering events have ceased to exist for a period of 10 consecutive days. Upon termination of Stage 5, Stage 4 becomes operative unless otherwise specified.

Stage 6 Triggers – CATASTROPHIC Water Shortage Conditions

Requirements for initiation

Customers shall be required to comply with the restrictions on certain non-essential water uses provided in Section X of this Plan when DSPUD recommends Stage 3 drought response measures. Triggers may also include earthquakes resulting in significant infrastructure damage, emergency conservation needed for fire protection, or other actual or threatened catastrophic water infrastructure failure as determined by the General Manager, or designee.

Requirements for termination

Stage 6 of the Plan may be rescinded when all the conditions listed as triggering events have ceased to exist and coordination with the health and safety authorities have indicated that the water source and distribution system is safe. Upon termination of Stage 6, Stage 5 becomes operative unless otherwise specified.

Section X: Drought Response Stages and Actions

The General Manager, or designee, shall monitor a) water supply and/or demand conditions on a monthly basis and b) Bulletin 120 forecasts as they are released in the months of February, March, April, and May. Based on this monitoring and in accordance with the triggering criteria set forth in Section IX of this Plan, the General Manager or his designee shall determine if a water shortage condition exists and the severity of any such water shortage conditions (*e.g., 1-Watch, 2-Warning, 3-Acute, 4-Critical, 5-Emergency, 6-Catastrophic Water Loss*), and shall implement the following notification procedures accordingly:

Notification

Description of Customer Notification Methods:

The General Manager, or designee, shall notify the public by means of one of the following Methods:

- Method 1: Notice on DSPUD website
- Method 2: Notice to local radio stations
- Method 3: Email to customer list
- Method 4: Direct Mail to each customer, in bill or flyer format
- Method 5: Door to door outreach in parts of the distribution system impacted by emergency
- Method 6: Nevada County and Placer County Emergency Messaging text alert through CodeRED (Nevada County) and Placer Alert (Placer County)

Prepared materials from the Department of Water Resources, “Save Our Water Toolkit”, may be used as drought communication tools with the DSPUD logo added. The link for these materials is provided below:

https://saveourwater.com/en/Partner-Toolkit

Public Safety Contacts:

The General Manager, or designee, shall notify directly the following individuals and entities of restrictions and water shortages, as defined in the subsections below, as appropriate for each response stage.

Organization or Department	Name & Position	Telephone	Email
Truckee Fire Protection District	Kevin McKechnie Fire Chief	911 or (530) 536-6142 (non-emergency)	kevinmckechnie@truckeefire.org
Sugar Bowl Ski Resort	Andy Chapko, Resort Maintenance Manager	(760) 694-6984	AChapko@sugarbowl.com
Boreal Ski	Mike Spain, Director of Soda Operations	(530) 426-3901 ext. 44130	mspain@skisodasprings.com
Donner Summit Association	Beth Tanhoff		
Nevada County Office of Emergency Services	Craig Griesbach, OES Director	(530) 265-1515	oes@nevadacountyca.gov
Placer County Office of Emergency Services	Stephen Fletcher, Emergency Coordinator	911 or (530) 886-5300 (non-emergency	placeroes@placer.ca.gov
Nevada County Env. Health	Amy Irani, Director	911 or (530) 265-1222 Option 3 (non-emergency)	Env.health@nevadacountyca.gov
Placer County Env. Health	Jason Phillippe	911 or (530) 745-2300 (non-emergency)	environmentalheatlh@placer.ca.gov
CalWARN Contact	Lisa Deklinski or Karla Tejada	(916) 808-1309 or (916) 804-2481	LDeklinski@cityofsacramento.org or Karla.Tejada@gswater.com
Division of Drinking Water Engineer	Ali Rezvani, District Engineer	(916) 445-5285	Ali.Rezvani@ waterboards.ca.gov

Support Services Contacts:

The following is a listing of support services that may be appropriate for a water shortage emergency.

Organization or Department	Company & Name	Phone	Email
Water Hauler	H2O To Go	(530) 432-8440	pinktruck@grassvalleywater.com
Water Hauler	Christensen & Son LLC	(530) 710-4827	
Emergency Showers and Portable Toilets	Outlaw Foods LLC	(530) 913-3418	
Bottled Water Vendor	Baxter Canyon Water Company	(530) 906-5288	baxtercanyonwater@gmail.com
Storage Tank Vendor	Service Pump Co.	(530) 268-3850	dsparks@sparks.com
Community Service Partners: Red Cross	Sierra-Delta Chapter	(916) 993-7070	

<u>Drought Responses Actions</u>:

Stage 1 Response – Water Shortage WATCH Conditions

<u>Target</u>: Achieve a 15% reduction in total monthly water usage.

<u>Best Management Practices for Supply Management:</u>

(a) Organize and ensure joint messaging and actions between DSPUD and communities/ski resorts served by the District.

(b) Verify CalWARN membership is active and in good standing.

<u>Voluntary Water Use Restrictions for Reducing Demand</u>:

(a) Water customers are requested to voluntarily limit the irrigation of landscaped areas to Sundays and Thursdays for customers with a street address ending in an even number (0, 2, 4, 6 or 8), and Saturdays and Wednesdays for water customers with a street address ending in an odd number (1, 3, 5, 7 or 9), and to irrigate landscapes only between the hours of 5:00 a.m. and 6:00 a.m. and 8:00 p.m. to midnight on designated watering days.

(b) Water customers are requested to practice water conservation and to minimize or discontinue water use for non-essential purposes such as ornamental fountains, washing down of sidewalks or hard surface areas.

(c) All restaurants are requested to serve water to patrons only upon request.

(d) Water customers are requested to not irrigate during rain or within 48 hours after measurable rainfall.

(e) Hotels/Motels are requested to provide guests the option of not having towels and linens laundered daily.

<u>Notification Method(s) and Frequency:</u>

Methods: 1 and 4 (via monthly bills) – Permanent website, monthly outreach

<u>Agencies Contacted:</u>

Contact communities and ski resorts to align potential future actions.

Stage 2 Response – WARNING Water Shortage Conditions

Target: Achieve a 25% reduction in total monthly water usage.

Best Management Practices for Supply Management:

(a) Continue to organize and ensure joint messaging and aligned actions between communities/ski resorts served by the District.

(b) Verify CalWARN membership is active and in good standing.

(c) Identify potential long-term mitigation strategies.

Mandatory Water Use Restrictions for Reducing Demand:

(a) Irrigation of landscaped areas with hose-end sprinklers or automatic irrigation systems shall be limited to Sundays and Thursdays for customers with a street address ending in an even number (0, 2, 4, 6 or 8), and Saturdays and Wednesdays for water customers with a street address ending in an odd number (1, 3, 5, 7 or 9), and irrigation of landscaped areas is further limited to the hours of 5:00 a.m. and 6:00 a.m. and 8:00 p.m. to midnight on designated watering days. However, irrigation of landscaped areas is permitted at any time if it is by means of a filled bucket or watering can of five (5) gallons or less.

(b) Use of water to wash any motor vehicle, motorbike, boat, trailer, airplane or other vehicle is prohibited except on designated watering days between the hours of 5:00 a.m. and 6:00 a.m. and 6:00 p.m. to midnight. Such washing, when allowed, shall be done with a hand-held bucket or a hand-held hose equipped with a positive shutoff nozzle for quick rinses. Vehicle washing may be done at any time on the immediate premises of a commercial car wash or commercial service station that utilizes internally recycled water. Further, such washing may be exempted from these regulations if the health, safety, and welfare of the public is contingent upon frequent vehicle cleansing, such as garbage trucks and vehicles used to transport food and perishables.

(c) Use of water to fill, refill, or add to any indoor or outdoor swimming pools, wading pools, or Jacuzzi-type pools is prohibited except on designated watering days between the hours of 5:00 a.m. and 6:00 a.m. and 6:00 p.m. to midnight.

(d) Operation of any ornamental fountain or pond for aesthetic or scenic purposes is prohibited except where necessary to support aquatic life.

(e) The following uses of water are defined as non-essential and are prohibited:

i. washdown of any sidewalks, walkways, unless being performed by a County or emergency response employee addressing a public health issue such as fecal waste removal, etc.;
ii. washdown of driveways, parking lots, tennis courts, or other hard-surfaced areas;
iii. use of water to wash down buildings or structures for purposes other than immediate fire protection;
iv. use of water for dust control;
v. flushing gutters or permitting water to run or accumulate in any gutter or street; and
vi. failure to repair a controllable leak(s) within a reasonable period after having been given notice directing the repair of such leak(s).

Notification Method(s):

Methods: 1, 2, 3, and 4 (via bill and separate conservation flyer). At least monthly outreach.

Agencies Contacted:

Work with communities and ski resorts to align potential future actions. If Stage 2 is initiated within one month of Stage 1 between January and April of any given year, inform County Environmental Health and/or State Water Resources Control Board District Engineer of decreasing production and initiate feasibility evaluation for long-term mitigation strategies.

Stage 3 Response – ACUTE Water Shortage Conditions

Target: Achieve a 35% reduction in total weekly water usage.

Best Management Practices for Supply Management:

(a) Continue to organize and ensure joint messaging and aligned actions between communities/ski resorts served by the District. Joint public workshops may be appropriate for messaging.

(b) Execute agreements to prepare engineering designs, cost estimates and estimated schedule for long-term mitigation strategy. Seek to evaluate if drought construction funding is available.

Mandatory Water Use Restrictions for Reducing Demand:

All requirements of Stage 2 shall remain in effect during Stage 3 with the following modifications:

(a) Use of water from hydrants shall be limited to firefighting, related activities, or other activities necessary to maintain public health, safety, and welfare such as hauling water to domestic well residents. The use of water for construction purposes from fire hydrants is to be discontinued.

(b) Use of water to wash any motor vehicle, motorbike, boat, trailer, airplane or other vehicle not occurring on the premises of a commercial car wash and commercial service stations, that utilizes internally recycled water, or not in the immediate interest of public health, safety, and welfare is prohibited.

(c) All restaurants are prohibited from serving water to patrons except upon request of the patron.

Notification Method(s) and Frequency:

Methods: 1, 2, 3 and 4 (via bill and separate conservation flyer). At least monthly outreach.

Agencies Contacted:

Continue to work with communities and ski resorts to align potential future actions. Continue to collaborate with County Environmental Health and/or State Water Resources Control Board District Engineer. Initiate planning for short-term alternative water scenarios and long-term mitigation strategies. Coordinate with County Public Health to consider needs of vulnerable persons registered with the County in the event drought conditions worsen.

Stage 4 Response – CRITICAL Water Shortage Conditions

Target: Achieve a 45% percent reduction in total daily water usage.

Best Management Practices for Supply Management:

(a) Seek Board approval for long-term mitigation strategy and secure funding. Prepare necessary CEQA documentation.

(b) Evaluate the feasibility of water transfers.

Mandatory Water Use Restrictions for Reducing Demand:

All requirements of Stage 2 and 3 shall remain in effect during Stage 4 with the following modifications:

(a) Use of water to fill, refill, or add to any indoor or outdoor swimming pools, wading pools, or Jacuzzi-type pools is prohibited. The only exception is for the County public swimming pool during the months of June, July and August.

(b) Irrigation of landscaped areas with hose-end sprinklers or automatic irrigation systems shall be limited to Thursdays for customers with a street address ending in an even number (0, 2, 4, 6 or 8) and Wednesdays for water customers with a street address ending in an odd number (1, 3, 5, 7 or 9), and irrigation of landscaped areas is further limited to the hours of 5:00 a.m. and 6:00 a.m. and 8:00 p.m. to midnight on designated watering days. However, irrigation of landscaped areas is permitted at any time if it is by means of a filled bucket or watering can of five (5) gallons or less.

Notification Method(s) and Frequency:

Methods: 1, 2, 3, 4 (via bill and separate conservation flyer), 5. At least weekly outreach through 2 or more methods.

Agencies Contacted:

Continue to work with communities and ski resorts to align potential future actions. Continue to collaborate with County Environmental Health and/or State Water Resources Control Board District Engineer. Continue coordinating with County Public Health to consider needs of vulnerable persons registered with the County should drought conditions worsen.

Stage 5 Response – EMERGENCY Water Shortage Conditions

Target: Achieve a 55% percent reduction in total daily water usage.

Best Management Practices for Supply Management:

(a) Evaluate the feasibility of water transfers.

(b) Identify other long-term mitigation strategies as needed.

Mandatory Water Use Restrictions for Reducing Demand:

All requirements of Stage 2, 3 and 4 shall remain in effect during Stage 5 except with the following modifications:

(a) All outdoor irrigation is prohibited.

(b) Swamp coolers are only permitted for use when temperatures exceed 85ºF.

Notification Method(s) and Frequency:

Methods: 1, 2, 3, 4 (via bill and separate conservation flyer), 5. At least weekly outreach via three or more methods.

Agencies Contacted:

Weekly coordination and status updates to all agencies.

Stage 6 Response – CATASTROPHIC Water Shortage Conditions

<u>Target</u>: Achieve >55% reduction in total daily water usage or implement allocation plan requirements depending on situation.

<u>Best Management Practices for Supply Management:</u>

(a) Initiate CATASTROPHIC Water Allocation Plan

<u>Mandatory Water Use Restrictions for Reducing Demand</u>:

All requirements of Stage 5 shall remain in effect during Stage 6 and indoor conservation such as utilizing showers instead of baths, decreasing frequency of clothes washing and decreasing toilet flushing are further promoted.

<u>Notification Method(s) and Frequency:</u>

Methods: 1, 2, 3, and 4 (via bill and separate conservation flyer). Daily communication. Methods 5 and 6 as appropriate.

<u>Agencies Contacted:</u>

Daily or weekly coordination and status updates to all agencies, depending on the severity of the issue.

CATASTROPHIC Water Allocation Plan

In the event that water shortage conditions threaten public health, safety, and welfare, the General Manager, or designee, is hereby authorized to allocate water according to the following water allocation plan:

Single and MultiFamily Residential Customers

In the event of a catastrophic water shortage, DSPUD will allocate to single- and multi-family residential customers sufficient water to meet minimum human health and safety demands. This allocation will be communicated to customers through the appropriate outreach and communication methods identified above.

Additional decreases for short-term emergency response to earthquakes, fires, etc. Any short-term decrease (defined as less than 72 hours) to the allocation to single- and multi-family customers will be determined by the General Manager along with provision for alternative water supplies for any period of water outage greater than 10 hours. Any conservation decreases, for greater than 72 hours, requires a properly noticed board meeting (regular or special) for public input and Board adoption.

Commercial Customers

A monthly water allocation shall be established by the General Manager, or designee, for each nonresidential, non-industrial commercial water customer who uses water for processing purposes. The allocation to nonresidential, non-industrial commercial water customers shall be as follows: 40% of monthly water usage and no irrigation. All restaurants shall only provide water upon request, hotels must only wash linens upon exist of customers, and all commercial customers must post drought conservation messaging.

Industrial Customers

DSPUD does not have industrial customers.

CATASTROPHIC Interim Replacement Water Supply for Water Outages

In the event that water outages occur, the following is the plan to provide interim alternative water supply for customers to meet short-term public health needs. Longer-term hauling of water directly to the distribution storage tanks would be coordinated with the Office of Emergency Services and CalWARN as soon as possible if the wells and intertie continue to be inaccessible.

Source of Alternative Water Supply:

Water will be hauled to DSPUD by one of the California Department of Public Health certified potable water haulers identified in this plan. Coordination will also be done with the State Water Resource Control Board's Division of Drinking Water and County Environmental Health on any chlorination and special water quality testing or noticing prior to serving hauled water.

Distribution of Alternative Water Supply:

There will be up to two portable plastic 10,000-gallon storage tanks and pumps brought in to the DSPUD office located at 53823 Sherritt Lane in Soda Springs, California. Residents may come and fill up to 10 gallons of water per person per day[1]. Water will be provided free of charge and may not be sold by the person receiving the water to others, or used for any purposes other than human consumption, cooking or sanitation.

If water outages occur only in part of the distribution system, a similar but abridged version of the alternative water supply plan will be initiated to focus only

1 The World Health Organization (WHO) information on minimum water needs during humanitarian emergencies states that "15 liters per person per day should be provided as soon as possible, though in the immediate post-impact period, it may be necessary to limit treated water to a minimum of 7.5 liters per day per person."

WHO website: https://www.who.int/teams/environment-climate-change-and-health/water-sanitation-and-health/environmental-health-in-emergencies/humanitarian-emergencies on those parts of the distribution that are impacted.

If bringing in water must occur and continue for a longer period of time, water will be shipped to the area on rail cars from a CalWARN mutual aid water supplier, and then hauled directly to the storage tanks and pumped into them. If necessary, boil water orders will be in place until the water quality is stabilized and the distribution system has been determined to be bacteriologically safe. While the boil water orders are in place, bottled water will continue to be provided to residents needing special assistance.

Public Notification Regarding Access to Alternative Water Supplies:

Methods: All methods (Methods 1-5) will be utilized to inform residents of the location of alternative water and sanitation access and availability of additional services for the elderly/disabled or those without transportation. American Red Cross may also be utilized to provide flyers to homes.

CATASTROPHIC Notification of Emergency Service Providers

If adequate water supply will potentially become unavailable for fire response, public services, etc., then the following emergency providers will be notified as soon as possible to ensure that adequate planning, response and assistance may be provided:

Local Fire Agency: Shall be contacted immediately when any water outages are believed to be potentially imminent or is occurring in any part of the distribution system.

State Water Resources Control Board and/or County Environmental Health: The State Water Resources Control Board's Division of Drinking Water and the Nevada and/or Placer County Environmental Health shall be contacted when any water outage is believed to be potentially imminent or is occurring in the distribution system.

County Office of Emergency Services: The Nevada and/or Placer County Office of Emergency Services may be contacted when any water outage is believed to be potentially imminent or is occurring in the distribution system as the result of a natural disaster and/or additional County or State support is needed.

Section XI: Enforcement

(a) No person shall knowingly or intentionally allow the use of water from this water system for residential, commercial, industrial, agricultural, governmental, or any other purpose in a manner contrary to any provision of this Plan, or in an amount in excess of that permitted by the drought response stage in effect at the time pursuant to action taken by General Manager, or designee, in accordance with provisions of this Plan.

(b) Any person, including a person classified as a water customer of the water system, in apparent control of the property where a violation occurs or originates shall be presumed to be the violator, and proof that the violation occurred on the person's property shall constitute a presumption that the person in apparent control of the property committed the violation, but any such person shall have the right to show that he/she did not commit the violation.

(c) If a person or persons is in violation of this Plan, DSPUD shall notify the person in writing, specifying the violation. Upon failure of the person or persons to cease or prevent further violation within five days, DSPUD shall provide a financial penalty of up to $300 per day. Each day that one or more of the provisions in this Plan is violated shall constitute a separate offense.

Section XII: Variances

The General Manager, or designee, may grant, in writing, a temporary variance for existing water uses otherwise prohibited under this Plan if it is determined that failure to grant such variance would cause an emergency condition adversely affecting the health, sanitation, or fire protection for the public or the person requesting such variance and if one or more of the following conditions are met:

(a) Compliance with this Plan cannot be technically accomplished during the duration of the water supply shortage or other condition for which the Plan is in effect.

(b) Alternative methods can be implemented which will achieve the same level of reduction in water use.

Persons requesting an exemption from the provisions of this Ordinance shall file a petition for variance with the water system within 5 days after the Plan or a particular drought response stage has been invoked. All petitions for variances shall be reviewed by the General Manager, or designee, and shall include the following:

(a) Name and address of the petitioner(s).

(b) Purpose of water use.

(c) Specific provision(s) of the Plan from which the petitioner is requesting relief.

(d) Detailed statement as to how the specific provision of the Plan adversely affects the petitioner or what damage or harm will occur to the petitioner or others if petitioner complies with this Ordinance.

(e) Description of the relief requested.

(f) Period of time for which the variance is sought.

(g) Alternative water use restrictions or other measures the petitioner is taking or proposes to take to meet the intent of this Plan and the compliance date.

(h) Other pertinent information.

A decision on the variance request will be returned to the customer within no more than 5 business days.

While submittal of a variance is required, the following exemptions are pre-approved:

1. Use of a residential swamp cooler on days where the ambient temperature is greater than 80º F for residents that can demonstrate a medical need.

2. Use of water for the operation of a medical support device needed by a resident.

Appendix A: Water System Information

DSPUD provides water to approximately 360 domestic water customers in the area of Donner Summit. DSPUD has a single source of supply for domestic water purposes, Lake Angela.

Annual consumptive demand for the District is approximately 203 acre-feet per year. The District also utilizes an additional 20 percent of raw water supply to backwash their water treatment plant in addition to the consumptive demand. Thus, the total existing demand is approximately 243 acre-feet per year. DSPUD has water rights to Lake Angela which allows the District to directly divert up to 1.54 cubic feet per second between November 1 through June 1 and divert up to 310 acre-feet to storage collected from November 1 through July 31.

DSPUD does not currently have an emergency intertie to assist with supply augmentation during drought or a natural disaster. However, the District is exploring the potential for an intertie with Sierra Lakes County Water District as of the writing of this Plan.