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Water Availability Analysis for Sites Reservoir Water Right Application

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Executive Summary

This water availability analysis (WAA) was developed in support of the Sites Project Authority's (Authority) application to appropriate water (Application) for storage at Sites Reservoir and beneficial use within the Authority's requested place of use. The State Water Resources Control Board (State Water Board) can issue a permit to appropriate water when there is "unappropriated water available to supply the applicant" (Wat. Code, § 1375, subd. (d)). The analysis in this report is detailed, and results are presented with a high level of precision in order to demonstrate a reasonable likelihood of water available for appropriation.

The Authority's WAA presents three approaches to evaluating water availability. The WAA includes an estimate of unappropriated water based on historical stream gauge data minus downstream demands (equal to the face value of water rights or maximum historical diversion, as described below) and Project-specific instream flow requirements incorporated. The WAA also contains a calculation of unappropriated water based on CalSim II modeling. Additionally, to address the Division of Water Rights (Division) staff's request for a watershed-wide analysis, this WAA includes a comparison of unimpaired flow at three points of interest and the aggregated face value of water rights in the Sacramento River watershed. Based on the evidence and analyses presented in this WAA, the Authority's Application provides sufficient information for the State Water Board to find that unappropriated water is available for diversion, after consideration of Project-specific flow requirements that are intended to preserve and enhance fish and wildlife.

Background

The Authority seeks assignment of a portion of State Filed Application A025517 for the Sites Reservoir Project (Sites Reservoir or Project). A025517 identifies a September 30, 1977, priority date. The Project's Application requests diversion of up to 1.5 million acre-feet per year of unappropriated water to storage through Project components in Tehama, Glenn, and Colusa counties. Diversion to storage would include two points of diversion (POD) on the Sacramento River at the Tehama-Colusa Canal at Red Bluff (referred to herein as the "TCC POD") and the Glenn-Colusa Irrigation District's Hamilton City Pumping Plant (referred to herein as the "GCID POD"), at a maximum combined diversion rate of 4,200 cfs during September 1 – June 14 (i.e., outside of the fully-appropriated stream designation). In addition, Sites Reservoir would include construction of two main dams resulting in points of diversion on Funks Creek (Golden Gate Dam) and Stone Corral Creek (Sites Dam).

Historical Analysis

The Historical Analysis was developed as one approach to estimate the potential volumes of water available for appropriation at the Sites Reservoir POD. The Historical Analysis calculates water available for appropriation by comparing supply (historical stream gauge data) to demand (the calculated maximum diversion flow rate, based on the face value of downstream water rights [FV Demand] and/or current assumptions for minimum flow requirements at each location along the flow path) at several locations along a defined flow path. The Historical Analysis evaluates water availability at each of the four PODs identified in the Sites water right application.

The Sacramento River portion of the analysis follows a flow path, from U.S. Geological Survey (USGS) gauge 11377100 (Bend Bridge) through the Sacramento-San Joaquin River Delta (Delta), which is split into five discrete reaches. The analysis covers an approximate 22-year period from January 1, 2000, through September 30, 2021, and is completed on a daily timestep. After completing the supply and demand calculations for each reach, the final availability calculation is completed for each POD for each day over the period analyzed by limiting the total volume of water available for appropriation to the minimum volume among all reaches along the flow path from each POD downstream through the Delta. This ensures that the water shown available is above the volumes needed for senior water right holders and Project-specific flow requirements along the entire flow path.

Water available for appropriation at the TCC POD is the minimum volume of water available on each day among each of the five reaches (from the Red Bluff Reach downstream through the Delta Reach) after consideration of FV Demand, Project-specific flow requirements, and Delta conditions. Water is available in 21 out of the 22 years in the analysis, in volumes ranging from approximately 3,000 acre-feet to 3,945,000 acre-feet. The annual average volume of water available for appropriation at the TCC POD is approximately 862,000 acre-feet.

Water available for appropriation at the GCID POD is the minimum volume of water available on each day across each of the four lower reaches (from the Hamilton City Reach, downstream through the Delta Reach) after consideration of FV Demand, Project-specific flow requirements, and Delta conditions. Water is available in 21 out of the 22 years included in the analysis, in volumes ranging from approximately 3,000 acre-feet to 3,950,000 acre-feet. The annual average volume of water available for appropriation at the GCID POD is approximately 870,000 acre-feet. Volumes of water available for appropriation at the GCID POD are typically the same as those available at the TCC POD, and the two should not be added together to determine water available for Sites Reservoir.

The Funks and Stone Corral creeks analysis was developed to estimate water availability at the PODs located on each of the creeks. The POD on Funks Creek is located at Sites Reservoir's Golden Gate Dam, and the POD on Stone Corral Creek is located at Sites Reservoir's Sites Dam. The analysis used streamflow data for each creek as the available supply and obtained FV Demand for each creek to complete the water availability calculation. Historical streamflow data was unavailable for Funks Creek, and streamflow data for Stone Corral Creek was only available for the period of 1958 – 1985. Therefore, monthly supply data for Funks and Stone Corral creeks were developed through a streamflow correlation and watershed area proration.

The analysis first estimates water availability on Funks Creek by subtracting the FV Demand from the estimated Funks Creek streamflow. Since water right demands on Stone Corral Creek included in this analysis are located downstream of the confluence of Funks and Stone Corral creeks, any remaining supply from Funks Creek is added to the estimated Stone Corral Creek streamflow. The combined availability for Funks and Stone Corral creeks is then calculated by subtracting the FV Demand on Stone Corral Creek from this combined supply. Water is available in 7 out of the 22 years included in the analysis, in volumes ranging from approximately 700 acre-feet to 24,000 acre-feet. The combined annual average volume of water available for appropriation at the Funks and Stone Corral creeks PODs is approximately 2,900 acre-feet.

CalSim II Analysis

The CalSim II Analysis was developed for two purposes: first, to evaluate water availability from a system-wide perspective at a planning level of detail; second, to address the State Water Board's direction to analyze the effects of climate change and/or changes to regulatory requirements when considering water available for appropriation. The CalSim II model used for this analysis is the Alternative 3A model produced by the Authority in support of the Project's Final Environmental Impact Report/Environmental Impact Statement (EIR/EIS). The Authority incorporated Sites Reservoir into the CalSim II model to simulate Sites Reservoir operations, with respect to Central Valley Project (CVP) and State Water Project (SWP) operations and other system and regulatory requirements.

The diversion and operations logic currently implemented in the Sites CalSim II model only outputs the volume of water that is diverted into Sites Reservoir at each timestep. Since this diverted volume is limited by the physical capacity of the diversion infrastructure and the reservoir's storage capacity, the actual volume of water available for appropriation may be higher. To estimate the additional volumes of water that may be available for appropriation, MBK Engineers developed a CalSim WAA Tool to post-process the CalSim II results for each timestep.

Given the operational configuration of Sites diversions in CalSim II and the "system-wide" view of water available for appropriation by Sites within CalSim II, volumes of water available for appropriation are presented for a single "location". On average, approximately 1,174,000 acre-feet is annually available for appropriation. Water is available in 74 out of 82 years (~90%) in annual volumes ranging from approximately 15,000 acre-feet to approximately 4,622,000 acre-feet. More than 1,000,000 acre-feet is available in approximately 45% of years, and over 1,500,000 acre-feet is available in approximately 35% of years.

Face Value Analysis

The Face Value Analysis was developed to meet Division staff's request to estimate water availability from a watershed-wide perspective, using the maximum potential demands of all existing water rights within the Sacramento River watershed. The Face Value Analysis compares the monthly unimpaired flow data for each sub watershed in the Sacramento River watershed to the calculated maximum diversion and storage volumes based on the face value of water rights (FV Demand) throughout the Sacramento River watershed. The Face Value Analysis provides an evaluation of availability by considering potential availability in watersheds that are not directly downstream, but which are upstream and/or tributary to the flow path, while also assuming the full face value use – including storage – of all existing water rights and claims within the Sacramento River watershed. Assuming all water rights have a demand for their full face value every single year results is a conservative estimate of availability, as such an assumption overestimates the actual annual demands within the watershed.

The Face Value Analysis was developed to estimate water availability at three points of interest (POI) located within the Sacramento River watershed: the Sacramento River at Red Bluff, the Sacramento River at Wilkins Slough, and the Sacramento River at Freeport. The water availability results are summarized at each POI on a diversion year basis. The final availability calculation is completed by limiting the total volume of water available for appropriation to the minimum volume across the three POIs in each year. This ensures that water shown available is above the volumes needed for senior water right holders at each POI. Water available for appropriation is typically greatest at Freeport and lowest at Red Bluff. Under this conservative analysis, water is available in 39 out of 93 years (~42%), mostly during Wet and Above Normal year types, with an annual average volume of approximately 1,139,000 acre-feet. In years that water is available, availability ranges from approximately 10,000 acre-feet to approximately 8,309,000 acre-feet.

Water Availability Analysis Conclusions

As previously described, three approaches were developed to evaluate the volume of water available for appropriation. Each of these approaches relies upon different supply and demand datasets, with varying degrees of conservatism, with the final estimates of average annual water available ranging from 870,000 to 1,174,000 acre-feet. It is important to consider all three approaches together because each approach was developed to evaluate water availability with different assumptions. Each of the three approaches indicate a reasonable likelihood that water is available for appropriation.

Future Conditions

Sites Reservoir is intended to be a climate-resilient project that will provide supply by capturing storm-related runoff instead of relying on spring snowmelt. Therefore, it is important that the Project operate under future climate change scenarios and with diversions occurring during the appropriate months. In addition, there are future potential regulatory changes that have the potential to affect the availability of water for diversion in the Sacramento watershed.

A CalSim II model that includes Sites Reservoir and uses 2035 central tendency (CT) climate change hydrology was evaluated with the CalSim WAA Tool to determine the volumes of water for appropriation under this climate change scenario. On average, approximately 1,212,000 acre-feet is annually available for appropriation under 2035 CT climate change hydrology, which is approximately 40,000 acre-feet greater than the baseline CalSim II scenario presented in Section 3. Water is available in 73 out of 82 years (~89%) in annual volumes ranging from approximately 43,000 acre-feet to approximately 4,322,000 acre-feet. More than 1,000,000 acre-feet is available in nearly 50% of years, and over 1,500,000 acre-feet is available in approximately 40% of years. Water is available in all months of the proposed water right season (September – June). Water is available in the largest volumes in Wet and Above Normal years, but some volume of water can be available in all water year types.

The State Water Board is currently considering updates to the Water Quality Control Plan for the San Francisco Bay/Sacramento – San Joaquin Delta Estuary (Bay-Delta Plan), which establishes water quality objectives for the protection of beneficial uses in the Bay-Delta. Amendments to the Bay-Delta Plan could restrict diversions in the Sacramento River Watershed. The State Water Board staff's "July 2018 Framework for the Sacramento/Delta Update to the Bay-Delta Plan" (Framework), identifies a proposed inflow level of 45-65% of unimpaired flow, with a starting point of 55%. Currently, significant uncertainty remains regarding the State Water Board's adoption and implementation of the staff's unimpaired inflow approach, and its effect on individual water rights and tributaries. Both Governor Brown and Governor Newsom have called upon the California Natural Resources Agency (Resources Agency) to convene parties and help facilitate voluntary agreements among interested parties in order to implement flow and non-flow actions to meet regulatory standards and support all beneficial uses of water. The voluntary agreements are intended to provide an alternative to implementation of State Water Board staff's unimpaired flow approach. As a result of these collective efforts regarding voluntary agreements, various presentations and materials have been provided to the State Water Board. The State Water Board is developing the *Draft Staff Report*, which will evaluate the environmental and economic impacts of alternatives to updating the Bay-Delta Plan, including the Framework, and the alternative outlined in the recently executed, "*Memorandum of Understanding Advancing a Term Sheet for the Voluntary Agreements to Update and Implement the Bay-Delta Water Quality Control Plan and Other Related Actions*", dated March 29, 2022 (VA Framework). The State Water Board's Draft Staff Report for the Bay-Delta Plan Update, expected in fall 2022, is also expected to include the release of the Sacramento Water Allocation Model (SacWAM) files and results, which will analyze the updates outlined in the VA Framework.

Currently, there is no definitive proposed Sacramento/Delta Update of the Bay-Delta Plan. In addition, State Water Board staff have not yet released the SacWAM files which could be used to evaluate proposed Sacramento/Delta Update alternatives. The Authority recognizes and acknowledges that amendments to the Bay-Delta Plan could result in restrictions on diversions for Sites Reservoir. However, these potential regulations function as future operating conditions that are not necessary to evaluate in a WAA (State Water Board Decision 1651, p. 57). Recognizing that the Sacramento/Delta Update could restrict diversions in the future, as part of its water right application, the Authority has requested that the State Water Board include Standard Permit Term 96 in a permit issued pursuant to its application. Term 96 recognizes that the Bay-Delta Plan is being updated and provides that the amount authorized for diversion under any permit may be reduced due to implementation of future updates to the Bay-Delta Plan.

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1 Introduction

This water availability analysis (WAA) was developed in support of the Sites Project Authority's (Authority) Application for storage at Sites Reservoir and beneficial use within the Authority's requested place of use. The WAA is intended for the purpose of the Division of Water Rights' (Division) acceptance of the Application and future issuance of a water right permit. The analysis in this report is detailed, and results are presented with a high level of precision in order to demonstrate a reasonable likelihood of water available for appropriation.

This WAA includes three approaches to demonstrate a reasonable likelihood of water available for appropriation: the Historical Analysis, CalSim II Analysis, and the Face Value Analysis. Each of these approaches evaluates water available from the Sacramento River by relying upon different supply and demand datasets, with varying degrees of conservatism. Due to the size of Funks and Stone Corral creeks, the relatively small volume of water proposed to be appropriated from these streams, and their position in the Sacramento Watershed, water available from the creeks is only analyzed under the Historical Analysis.

The Historical Analysis is accompanied by a review of results from studies completed in CalSim II to evaluate project feasibility, and to address California Environmental Quality Act (CEQA) and National Environmental Protection Act (NEPA) requirements (CalSim II Analysis). The Historical and CalSim II Analyses analyze water availability under the following criteria:

- Diversions occur outside the Fully Appropriated Stream season, which is designated as June 15 through August 31 for the Delta watershed.
- The Permit includes Term 91; therefore, diversions do not occur when Term 91 curtailments are in effect.
- The Delta is in Excess.
- Specific Sites diversion/minimum flow requirements are met as described below.
- Senior downstream water rights and other more senior flow priorities have been satisfied.
- Flows are available above those needed to meet all applicable laws, regulations, Biological Opinions, and court orders in place at the time of diversion.

The Face Value Analysis is a theoretical approach to estimate the volumes of water available for appropriation by subtracting the face value of existing water rights from the unimpaired flow at three POIs along the flow path. Because of the theoretical nature of the Face Value Analysis, as further described in Section 4, this analysis does not include operational requirements such as minimum flows for the preservation and enhancement of fish and wildlife.

1.1 Water Availability Analysis Legal Requirements

The State Water Board can issue a permit to appropriate water when there is "unappropriated water available to supply the applicant" (Wat. Code, § 1375, subd. (d)). Unappropriated water is water that: has never been appropriated, has been appropriated and is no longer being appropriated, and water appropriated that returns to the watercourse. Unappropriated water does not include water that has been, is being applied to, or which is or may be reasonably needed for useful and beneficial purposes on lands riparian to a natural channel (Id., §§ 1201, 1202).

The State Water Resources Control Board (State Water Board) must also "take into account, when it is in the public interest, the amount of water required for recreation and the preservation and enhancement of fish and wildlife resources," in determining the amount of water available for appropriation for beneficial uses (Wat. Code, §§ 1243, 1243.5).

The State Water Board has recognized that "[t]he face value of permits and licenses … is not a good measure of amounts likely to be used or the availability of unappropriated water" (State Water Board Decision 1650, p. 6, para. 21). In addition, where a state-filed application is unassigned and there are not any pending requests for assignment or release from priority, the existence of a state-filed application does not affect the evaluation of water availability (State Water Board Decision 1651, p. 49). At the same time, the State Water Board has also determined that "it may be useful to evaluate the amounts needed to serve appropriations proposed by other applications to determine whether approval of the application would be in the public interest" (Id. at p. 48).

The State Water Board has also recognized that "a water availability analysis need not address future operating conditions of a proposed project as long as the analysis demonstrates that unappropriated water is available to meet the maximum potential diversion and use sought by the water right application" (State Water Board Decision 1651, p. 57).

1.1.1 Sites Compliance with the Water Availability Requirements

The Authority's WAA presents three approaches to evaluating water availability. The WAA includes an estimate of unappropriated water based on historical stream gauge data minus downstream demands (equal to the face value of water rights or maximum historical diversion, as described below) and with Project-specific flow requirements incorporated. The WAA also contains an evaluation of unappropriated water based on CalSim II modeling. Additionally, in response to Division staff's request for a watershed-wide analysis, this WAA includes a comparison of unimpaired flow at three points of interest (POI) to the aggregated face value of water rights in all watersheds upstream of each POI.

With respect to supplies, the Historical Analysis uses historical stream gauge data along specific flow paths on a daily timestep, and the CalSim II Analysis uses historical hydrology on a monthly timestep. For the Historical Analysis, the daily record of Delta conditions is used as a proxy to address water rights and hydrologic conditions in the Delta. The Historical and CalSim II analyses assume water is only available for appropriation during periods when the Delta is in an Excess condition, as an Excess condition indicates that all existing Delta water rights and claims are being satisfied. By also including minimum flow requirements that serve as conditions for Project diversions, Historical and CalSim II Analyses incorporate/account for criteria intended to protect fish and wildlife.

With respect to demands, while the State Water Board has previously recognized that the face value of permits and licenses is not a good measure of amounts likely to be used, the Historical Analysis in this WAA accounts for post-1914 appropriative water right demands based on the face value of these rights. Pre-1914 and riparian demands are based on reported data in statements of water diversion and use. The Historical Analysis includes the post-1914 face values and pre-1914/riparian reported demands, even though the historical gauge records reflect upstream diversions. The result is a conservative estimate of water availability. The CalSim II Analysis uses land-use based water use estimates, not water right face value, to estimate demands.

Division staff requested an analysis that compares unimpaired flow at a point(s) of interest to the face value of all water rights located upstream from that point within the watershed. An analysis based on this approach (referred to herein as the Face Value Analysis) is included to evaluate water availability at three locations on the Sacramento River: Red Bluff, Wilkins Slough, and Freeport. By providing the volumes of water available for appropriation at Freeport (relative to actual availability at Red Bluff), the Face Value Analysis provides a watershed-wide estimate of water available for appropriation. While not necessary to evaluate water availability (State Water Board Decision 1651, p. 49), the WAA also includes a separate analysis with state filings in its representation of demands as part of the Face Value Analysis.

Potential future unimpaired flow requirements associated with the State Water Board's Water Quality Control Plan for the San Francisco Bay/Sacramento – San Joaquin Delta Estuary (Bay-Delta Plan) Update, which have the potential to affect diversions by the Authority, function as future operating conditions and are not necessary in a water availability analysis. In this regard, the Authority need not evaluate the potential Phase 2 flow requirements to determine whether unappropriated water is available. Furthermore, because Phase 2 requirements are intended to protect fish and wildlife, these requirements are unnecessary to comply with Water Code sections 1243 and 1243.5 because the Authority's diversions include minimum flow requirements intended to protect fish and wildlife. Section 6.2 describes potential future Sacramento/Delta flow requirements and associated impacts on diversions.

1.1.2 Conclusion

Relying on the California Court of Appeals' conclusion that the State Water Board's determination of water availability is an estimate (United States v. State Water Resources Control Bd., 182, Cal.App. 3d at pp. 102-103), the State Water Board has recognized that: "determinations of the availability of unappropriated water are always subject to uncertainty" (State Water Board Decision 1651, p. 53). Thus, the State Water Board must have substantial evidence in the record to support its determination of water availability but need not have absolute certainty. With the evidence and analyses contained in this WAA, the Authority's application meets this standard and provides a basis for the State Water Board to find that unappropriated water is available for diversion, after consideration of Project-specific flow requirements that are intended to preserve and enhance fish and wildlife.

1.2 Background

The Authority seeks assignment of a portion of State Filed Application A025517 for the Sites Reservoir Project (Sites Reservoir or Project). A025517 identifies a September 30, 1977, priority date. The application provides for diversion for irrigation, domestic, municipal, industrial, recreation, incidental power, water quality control, and fish and wildlife enhancement purposes from Willow Creek, Funks Creek, Stone Corral Creek, and the Sacramento River. The application provides for a year-round diversion rate of 4,200 cubic feet per second (cfs) and a total combined diversion to storage of 3,164,000 acre-feet per year. The points of diversion are within Tehama, Glenn, and Colusa counties at Willow Dam, Funks Dam, Sites Dam, Tehama Colusa Canal, and Glenn Colusa Canal.

The Project's Application requests diversion of up to 1.5 million acre-feet per year of unappropriated water to storage through Project components in Tehama, Glenn, and Colusa counties. Diversion to storage would include two points of diversion on the Sacramento River at the Tehama-Colusa Canal at Red Bluff (referred to herein as the "TCC POD") and Glenn-Colusa Irrigation District's Hamilton City

Pumping Plant (referred to herein as the "GCID POD") at a maximum combined diversion rate of 4,200 cfs during September 1 – June 14 (i.e., outside of the Delta watershed's fully-appropriated stream designation). In addition, Sites Reservoir would include construction of two main dams resulting in points of diversion on Funks Creek (Golden Gate Dam[1]) and Stone Corral Creek (Sites Dam).

Figure 1 shows the locations of the four PODs along with other key locations in the Sacramento River watershed.

In addition to the Petition for Assignment of A025517, the Authority's Application also includes a Petition for Release from Priority of State Filed Applications A025513, A025514, A025517 (Remaining), A022235, A023780, and A023781 in favor of the portion of State Filed Application A025517 assigned to the Authority.

[1] Golden Gate Dam is the contemporary name of "Funks Dam", which was included in the State Filed Application A025517.

Figure 1. Map Showing Points of Diversion and Gauge Locations

2 Historical Analysis

The Historical Analysis was developed as one approach to estimate the potential volumes of water available for appropriation at each of the Sites Reservoir PODs. The Historical Analysis calculates water available for appropriation by comparing supply to demands, which are defined below.

- **Supply:** Historical stream gauge data at several locations along a defined flow path.
- **Demand:** The calculated maximum diversion flow rate based on the face value of downstream water rights (FV Demand) and/or current assumptions for minimum flow requirements in each reach along the flow path.

Any supply remaining after subtracting FV Demand (and considering minimum flow requirements) is assumed to be available for appropriation. The following sections describe this approach and the subsequent results in additional detail. Development of the FV Demand dataset is described in Attachment 1.

2.1 Analytical Approach and Assumptions

The Historical Analysis evaluates water availability at each of the four PODs identified in the Sites water right application. The PODs are:

1. Sacramento River: Tehama-Colusa Canal (TCC) at Red Bluff
2. Sacramento River: Glenn-Colusa Irrigation District (GCID) Canal at Hamilton City
3. Funks Creek: Golden Gate Dam
4. Stone Corral Creek: Sites Dam

As the water potentially available at each of these locations is from three discrete sources (Sacramento River, Funks Creek, and Stone Corral Creek), the Historical Analysis includes two components: the Sacramento River analysis and the combined Funks and Stone Corral creeks analysis.

Both analyses rely on basic datasets, Supply and FV Demand. The Supply dataset for each analysis consists of observed streamflow data from United States Geologic Survey (USGS) and California Department of Water Resources (DWR) stream gauges. The FV Demand dataset for each analysis consists of available face value water right demand data obtained from the Division's eWRIMS GIS mapping tool for each of the respective flow paths. For all water rights identified, the face value was assumed to represent the maximum diversion rate available under each water right. For all post-1914 appropriative permits or licenses, this involved identifying the maximum diversion rate and season identified in the permit/license. For all pre-1914 appropriative and riparian claims, the Initial Statement of Diversion and Use and/or available water right reporting data were used to estimate the maximum diversion rate and season of use for each claimed right. Although the Authority is petitioning for assignment of A025517, which has a priority date in 1977, the Historical Analysis does not consider this priority date and instead evaluates all water rights/demands along the flow path, including all water rights junior to A025517. This results in a more conservative calculation of water available for the Project.

2.1.1 Sacramento River Analysis

The Sacramento River analysis was developed to estimate water availability at each of the Sites Reservoir PODs located on the Sacramento River. The analysis follows a flow path from USGS gauge

11377100 (Bend Bridge) through the Sacramento-San Joaquin River Delta (Delta). The analysis covers an approximate 22-year period from January 1, 2000, through September 30, 2021[2], and is completed on a daily timestep.

The previously described flow path is split into five discrete reaches. The reaches were selected for several reasons: 1) to evaluate availability at a POD, 2) to evaluate availability relative to a minimum flow requirement, 3) there is a significant change in supply and demand along the reach relative to the next most upstream reach, and/or 4) the reach is the end of the flow path. The individual reaches and the respective stream gauge or data source used to indicate available supply along each reach are defined as:

1. Red Bluff Reach
    a. Source Gauge: USGS 11377100, Sacramento River above Bend Bridge near Red Bluff, CA
    b. Demands: FV Demand from Bend Bridge to above GCID Main Canal (including United States Bureau of Reclamation [Reclamation] water rights at the TCC)
    c. POD: TCC POD
2. Hamilton City Reach
    a. Source Gauge: California Data Exchange Center (CDEC) HMC, Sacramento River at Hamilton City-Main Channel
    b. Demands: FV Demand from Hamilton City (including GCID's existing water rights) to above Wilkins Slough Gauge
    c. POD: GCID POD
3. Wilkins Slough Reach
    a. Source Gauge: USGS 11390500, Sacramento River below Wilkins Slough near Grimes, CA
    b. Demands: FV Demand from below Wilkins Slough to above Verona or the Wilkins Slough Minimum Flow Requirement, whichever is greater
4. Verona Reach
    a. Source Gauge: USGS 11425500, Sacramento River at Verona, CA
    b. Demands: FV Demand from Verona to Freeport (upstream of the Delta)
5. the Delta Reach
    a. Source/Demands: Central Valley Operations (CVO) and State Water Project (SWP) reports

FV Demand is cumulative along the flow path which is further described below. For example, calculations of water availability at the Hamilton City Reach consider not only the FV Demand from Hamilton City to above Wilkins Slough Gauge, but also FV Demand calculated for the Red Bluff Reach. Figure 2 provides a visual representation of each reach, the associated stream gauges, and the PODs used for the Sacramento River Historical Analysis.

[2] Beginning date constrained by data availability of Delta conditions.

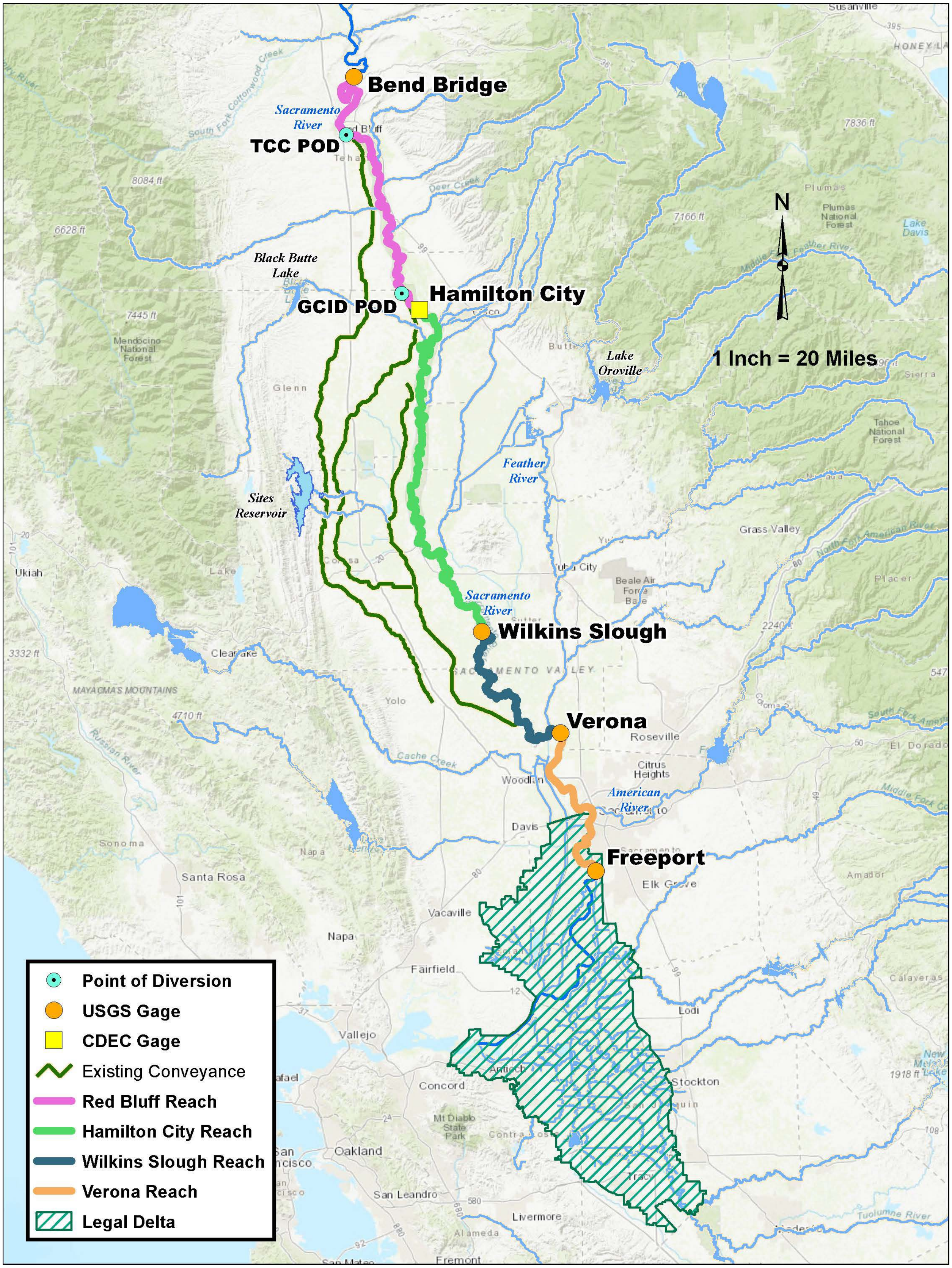

Figure 2. Map Detailing the Reaches, Stream Gauges, and the Sacramento River PODs

The analysis follows the flow path[3] approach by calculating availability along each reach of the flow path, with availability being determined by subtracting the FV Demand (or minimum flow requirements in the Wilkins Slough reach, described below) from the available supply on each reach. To account for the water that remains instream after assumed diversions in the upstream reaches, the FV Demand is accumulated as the analysis moves downstream. For example, at the Red Bluff POD, the FV Demand used in the availability calculation only includes the water rights on the Red Bluff reach. Conversely, at Wilkins Slough, the FV Demand used in the availability calculation includes all FV Demand on the Wilkins Slough reach plus the upstream FV Demand on the Hamilton City and Red Bluff reaches. FV Demand upstream from Red Bluff and other gauge locations are not included in this analysis as the gauge locations are downstream from major storage reservoirs and tributary flows to the Sacramento River. Estimating changes to available flow upstream of the flow path would involve more complex modeling that is beyond the scope of the Historical Analysis.

By subtracting the FV Demand along the flow path, the Sacramento River Analysis uses a very conservative approach to calculate potential water availability. Historical gage flow data reflects an existing level of diversion and use under the water rights included in this analysis. By including the FV Demand, the analysis is likely "double-counting" a significant portion of the water right demands along the flow path. Additionally, by accumulating the FV Demand as the analysis moves downstream and not assuming some level of return flow, the double-counting is potentially compounded. However, by following this conservative approach, the analysis ensures that the maximum potential diversion by senior water right holders is met before determining water is available for diversion by the Project.

After completing the supply and demand calculations for each reach, the final availability calculation is completed for each POD for each day over the period analyzed by limiting the total volume of water available for appropriation to the minimum volume among the reaches along the flow path from each POD downstream through the Delta. This ensures that the calculated water available for appropriation is above the volumes needed for senior water right holders and Project-specific flow requirements along the entire flow path.

The following sections provide a summary of the assumptions, FV Demand, and minimum flow requirements (as applicable) included in the supply and demand calculations for each reach.

2.1.1.1 Red Bluff Reach

The first (most upstream) reach extends from USGS gauge 11377100 (Bend Bridge) to just upstream of the Hamilton City POD. Water available for appropriation on the Red Bluff Reach is determined by comparing the daily record of flow at Bend Bridge to the FV Demand on this reach. The FV Demand for each month of the year on the Red Bluff Reach is summarized in Table 1. The volume of flow at Bend Bridge that exceeds the daily FV Demand is considered water available for appropriation on this reach. No water was considered available on a particular day if the FV Demand exceeded the daily flow at Bend Bridge.

[3] Described in a recent State Water Board document, "Water Availability Analysis for Streamline Recharge Permitting".
https://www.waterboards.ca.gov/waterrights/water_issues/programs/applications/groundwater_recharge/docs/streamlined_waa_guidance.pdf

Table 1. Red Bluff Reach FV Demand

Month	Reach FV Demand (cfs)
January	3,524
February	3,068
March	3,297
April	6,224
May	6,303
June	6,417
July	6,473
August	6,092
September	5,066
October	5,823
November	4,071
December	3,669

This analysis assumes that water available for appropriation on the Red Bluff Reach is also limited for the instream protection of fish and wildlife by the Bend Bridge Pulse Protection[4] criteria. On any day that the pulse protection criteria are initiated or in effect, no water is available for appropriation.

2.1.1.2 Hamilton City Reach

The second reach extends from the Hamilton City POD to USGS gauge 11390500 (Wilkins Slough). Water available for appropriation on the Hamilton City Reach is determined by comparing the daily record of flow from CDEC gauge HMC (Hamilton City) to the cumulative water right demands along the flow path (i.e., Red Bluff Reach plus Hamilton City Reach). The FV Demand for each month of the year on the Hamilton City Reach and the cumulative flow path FV Demand are summarized in Table 2. The volume of flow at Hamilton City that exceeds the cumulative FV Demand is considered water available for appropriation on this reach. No water was considered available on a particular day if the FV Demand exceeded the daily flow at Hamilton City.

[4] For the purposes of this WAA and to address comments provided by California Department of Fish and Wildlife (CDFW) to the Project's Revised Draft Environmental Impact Report/Supplement Draft Environmental Impact Statement, the Bend Bridge Pulse Protection is initiated when the 3-day forecasted average flow in the Sacramento River above Bend Bridge is greater than 8,000 cfs and the 3-day forecasted average tributary flow (as determined by summing the flow in Cow Creek near Millville, Cottonwood Creek near Cottonwood, and Battle Creek below Coleman Fish Hatchery) is greater than 2,500 cfs. The Bend Bridge Pulse Protection will remain in place for 7 consecutive days upon initiation. If the average daily Sacramento River flow at Bend Bridge exceeds 29,000 cfs, then diversions may resume, but are limited to the flow above 25,000 cfs for the remainder of the 7-day period. After completion of the Bend Bridge Pulse Protection period, resetting criteria must occur before another Bend Bridge Pulse Protection period may commence. The resetting criteria are met when the 3-day moving average flow in the Sacramento River above Bend Bridge is below 7,500 cfs for 7 consecutive days and the above-referenced 3-day moving average tributary flow is below 2,500 cfs for 7 consecutive days.

Table 2. Hamilton City Reach FV Demand

Month	Reach FV Demand (cfs)	Cumulative Flow Path FV Demand (cfs)
January	4,939	8,463
February	5,961	9,029
March	6,144	9,441
April	4,583	10,807
May	5,218	11,521
June	5,370	11,787
July	5,126	11,598
August	5,235	11,326
September	6,032	11,098
October	5,923	11,745
November	4,708	8,779
December	4,806	8,474

This analysis assumes that water available for appropriation on the Hamilton City Reach is also limited for the instream protection of fish and wildlife by the Bend Bridge Pulse Protection criteria discussed above. On any day that the Pulse Protection criteria are initiated or in effect, no water is available for appropriation.

2.1.1.3 Wilkins Slough Reach

The third reach extends from Wilkins Slough to USGS gauge 11425500 (Verona). Water available for appropriation on the Wilkins Slough Reach is determined by comparing the daily record of flow from the Wilkins Slough gauge to the maximum of the Wilkins Slough Minimum Flow Requirement[5] or the cumulative FV Demand along the flow path (i.e., Red Bluff and Hamilton City reaches plus Wilkins Slough Reach), whichever is greater. The Minimum Flow Requirement, the FV Demand on the Wilkins Slough Reach, and the cumulative flow path FV Demand for each month of the year are summarized in Table 3. The volume of flow at Wilkins Slough that exceeds the maximum of the bypass flow requirement or the cumulative FV Demand, whichever is greater, is considered water available for appropriation on this reach. No water was considered available on a particular day if the controlling requirement (i.e., the maximum of the Minimum Flow Requirement or the cumulative FV Demand) exceeded the daily flow at Wilkins Slough.

[5] For the purposes of this WAA and based on comments from CDFW, the Wilkins Slough Minimum Flow Requirement prevents diversions if the flow in the Sacramento River below Wilkins Slough is less than, or diversions under this permit would cause the flow to be less than 10,700 cfs during October through June or 5,000 cfs at all other times.

Table 3. Wilkins Slough Reach Minimum Flow Requirement and FV Demand

Month	Minimum Flow Requirement (cfs)	FV Demand (cfs)	Cumulative Flow Path FV Demand (cfs)
January	10,700	522	8,985
February	10,700	498	9,527
March	10,700	907	10,348
April	10,700	1,131	11,938
May	10,700	1,217	12,738
June	10,700	1,216	13,002
July	5,000	1,143	12,741
August	5,000	1,141	12,467
September	5,000	1,216	12,315
October	10,700	1,080	12,826
November	10,700	900	9,679
December	10,700	485	8,959

In addition to the potential use of the Minimum Flow Requirement, water available for appropriation on the Wilkins Slough Reach is also limited for the instream protection of fish and wildlife by the Bend Bridge Pulse Protection criteria. On any day that the pulse protection criteria are initiated or in effect, no water is available for appropriation.

2.1.1.4 Verona Reach

The fourth reach extends from Verona to USGS gauge 11447650 (Freeport). Water available for appropriation on the Verona Reach is determined by comparing the daily record of flow at Verona to the cumulative FV Demand along the flow path (i.e., Red Bluff, Hamilton City, and Wilkins Slough reaches plus Verona Reach). The FV Demand on the Verona Reach and the cumulative flow path FV Demand for each month of the year are summarized in Table 4. The volume of flow at Verona that exceeds the cumulative FV Demand is considered water available for appropriation on this reach. No water was considered available on a particular day if the cumulative FV Demand exceeded the daily flow at Verona.

Table 4. Verona Reach FV Demand

Month	FV Demand (cfs)	Cumulative Flow Path FV Demand (cfs)
January	1,456	10,441
February	1,043	10,570
March	1,106	11,454
April	1,702	13,640
May	1,885	14,622
June	1,892	14,894
July	1,700	14,441
August	1,700	14,168
September	1,749	14,064
October	1,764	14,590
November	1,458	11,137
December	1,444	10,403

This analysis assumes that water available for appropriation on the Verona Reach is also limited for the instream protection of fish and wildlife by the Bend Bridge Pulse Protection criteria discussed above. On any day that the Pulse Protection criteria are initiated or in effect, no water is available for appropriation.

2.1.1.5 Sacramento-San Joaquin River Delta Reach

To account for existing water rights and claims in the Delta, this analysis uses a proxy to indicate hydrologic conditions during which all existing water rights and claims in the Delta (including the State and Federal projects) are assumed to be satisfied. This proxy condition relies on the historical record of Delta conditions as being in either a Balanced or Excess condition. Delta conditions are defined in the *1986 Coordinated Operations Agreement* (COA) between the United States and the State of California, regarding the coordinated operations of the Central Valley Project (CVP) and State Water Project (SWP). COA defines Balanced conditions as, "periods when it is agreed that releases from upstream reservoirs plus unregulated flow approximately equal the water supply needed to meet Sacramento Valley inbasin uses, plus exports". Similarly, COA defines Excess conditions as, "periods when it is agreed that releases from upstream reservoirs plus unregulated flow exceed Sacramento Valley inbasin uses, plus exports". Generally, Balanced conditions define periods when the CVP and SWP are controlling Delta outflow and the water currently in the system. This occurs whether water is attributable to releases from upstream reservoirs or unregulated flows; or whether it is used for a specified purpose, including meeting water quality and Delta outflow requirements.

CVP and SWP operators determine and agree on Delta conditions. The CVP Operations Office (CVO) posts a daily report[6] that accounts for water use and sharing between the two projects under COA and includes Delta conditions. For periods where the Delta condition was not available from the CVO report, a similar report[7] is available from the SWP. The daily record of Delta conditions was used as the proxy

[6] https://www.usbr.gov/mp/cvo/vungvari/coanew.pdf
[7] https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/State-Water-Project/Operations-And-Maintenance/Files/Operations-Control-Office/Delta-Status-And-Operations/Delta-Hydrologic-Conditions-Daily-Summary.pdf

condition in this analysis to address water rights and hydrologic conditions in the Delta. Water is only considered to be available for appropriation on days when the Delta is in an Excess condition, as Excess conditions imply that all existing Delta water rights and claims are being satisfied. An additional conservative assumption was included in the Historical Analysis to address potential concerns for periods when the Delta was in Excess conditions for short periods of time or was marginally in Excess. The analysis assumes that the Delta must be in an Excess condition for at least seven consecutive days for water to be considered available for appropriation on the Sacramento River by Sites.

2.1.2 Funks and Stone Corral Creeks Analysis

Funks Creek and Stone Corral Creek are both located in Colusa County and flow east towards the Sacramento River. The Funks and Stone Corral Creeks Analysis*,* was developed to estimate water availability at the PODs located on each of the creeks (see Figure 3). The POD on Funks Creek is located at Sites Reservoir's Golden Gate Dam, and the POD on Stone Corral Creek is located at Sites Reservoir's Sites Dam. The analysis provides an estimate of availability through a comparison of supply and demand. The analysis used streamflow data for each creek as the available supply and obtained FV Demand for each creek to complete the water availability calculation. Historical streamflow data was unavailable for Funks Creek, and streamflow data for Stone Corral Creek was only available for the period of 1958 – 1985[8]. Therefore, supply data for Funks and Stone Corral creeks were developed through a streamflow correlation and watershed area proration.

[8] Streamflow data available from USGS gauge 11390672 Stone Corral C Nr Sites CA.

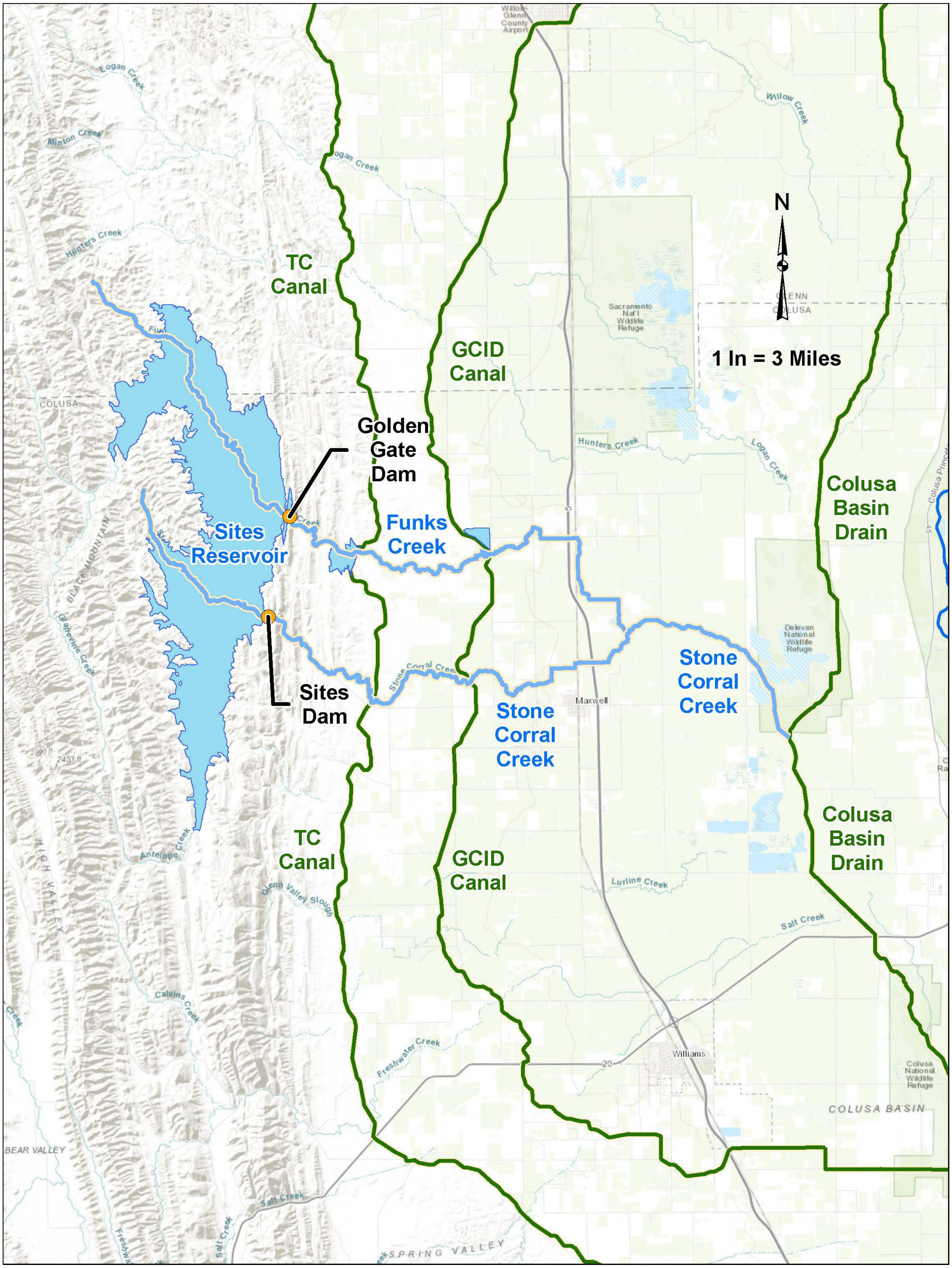

Figure 3. Map Showing Location of Funks Creek, Stone Corral Creek, and Associated PODs

Given the limited availability of streamflow data for Stone Corral Creek, historical stream gage data from Elder Creek was used to estimate an extended period of streamflow on Stone Corral Creek. The extended estimate of Stone Corral Creek streamflow was then used to produce an estimate of streamflow on Funks Creek. The Elder Creek gage[9] was chosen because it was the nearest gage on the valley floor with a long record of data available. A synthetic streamflow timeseries was developed for Stone Corral Creek by developing a correlation between the logarithmic transformation of available streamflow data for Stone Corral Creek and streamflow data for the same period from Elder Creek. As the Stone Corral Creek POD is upstream of the Stone Corral Creek gauge location, the streamflow at the gauge was prorated by the ratio of the watershed area at the POD to the watershed area at the gauge location. Given the similarities in watershed area, location, soil, vegetation, and elevation, the hydrologic characteristics of the Funks and Stone Corral watersheds were assumed to be similar. As such, the synthetic streamflow timeseries for the Stone Corral Creek POD was used to produce a streamflow timeseries for the Funks Creek POD by prorating the Stone Corral Creek streamflow by a ratio of the Funks and Stone Corral watershed areas at the respective PODs. The annual average streamflow is estimated to be approximately 6,600 acre-feet per year for Stone Corral Creek and 9,400 acre-feet per year for Funks Creek, at each respective POD. The development of the Stone Corral-Elder correlation and the subsequent streamflow timeseries produced for Funks and Stone Corral creeks are detailed in Attachment 2.

The development of the Stone Corral-Elder correlation proved to be more accurate on a monthly timestep, which led to the Funks and Stone Corral creeks streamflow timeseries being produced at a monthly timestep. Accordingly, the Funks and Stone Corral creeks analysis is performed on a monthly timestep.

Similar to the Sacramento River analysis, the existing water demands along each creek were reviewed through use of the Division's eWRIMS map (see Attachment 1). The FV Demand was determined for each water right using the same approach previously discussed. Table 5 shows the monthly FV Demand in each month for Funks and Stone Corral creeks. Note that the FV Demand values in Table 5 are in acre-feet, as compared to volumes presented in cfs for the Sacramento River portion of the analysis. This is due to the use of a monthly timestep for Funks and Stone Corral creeks.

[9] Streamflow data available from USGS gauge 11475560 Elder C Nr Branscomb CA.

Table 5. Funks and Stone Corral Creeks FV Demand

Month	Funks Creek Monthly FV Demand (acre-feet)	Stone Corral Creek Monthly FV Demand[10] (acre-feet)
January	0	4,612
February	350	4,165
March	275	4,612
April	1,315	838
May	1,809	1,506
June	2,380	1,458
July	2,460	1,506
August	2,460	1,506
September	846	1,240
October	1,036	4,638
November	126	4,463
December	0	4,612

The analysis for Funks and Stone Corral creeks does not extend through the flow path to the Sacramento River and the Delta. The current stream configuration for each creek results in the available flow on both creeks being routed into local irrigation canals or drains under most conditions. As such, downstream water rights on the Sacramento River and the Delta typically do not have access to flows on either creek. Given this, the analysis is limited to the combined Funks-Stone Corral watershed. However, to provide an additional conservative limitation on potential availability and to consider the potential that the creeks may be hydraulically connected to the Delta, the analysis assumes water is only available on either creek when the Delta is in an Excess condition. Since the Funks and Stone Corral creeks analysis was completed on a monthly timestep, it was assumed that the monthly Delta condition was "Excess" if more than half of the days in the month were in Excess; otherwise, the Delta was considered to be in a Balanced condition. Accordingly, the time period of the Funks and Stone Corral creeks analysis is limited to the period of January 2000 through September 2021 based on the availability of Delta conditions data.

To complete the availability calculations for Funks and Stone Corral creeks, the analysis first estimates water availability on Funks Creek by subtracting the FV Demand from the estimated Funks Creek streamflow. Since water right demands on Stone Corral Creek included in this analysis are located downstream of the confluence of Funks and Stone Corral creeks, any remaining supply from Funks Creek is added to the estimated Stone Corral Creek streamflow. The combined availability for Funks and Stone Corral creeks is then calculated by subtracting the FV Demand on Stone Corral Creek from this combined supply. It was assumed that no water is available in any month that these calculations result in a

[10] Water right A030445 is included in the total monthly FV Demand for Stone Corral Creek. This right includes four PODs on four different sources, one of which is the Sacramento River. As use of water under this right is for rice straw decomposition and fish and wildlife enhancement, it is likely that most or all of the potential diversion of water under this right would come from the Sacramento River. As such, a bookend analysis was completed that removed this demand from the Stone Corral Creek Monthly FV Demand. This bookend analysis in included in Appendix A.

negative value. Final availability on Funks and Stone Corral creeks is then limited to months when the above calculation indicates water is available and months when the Delta is in an Excess condition.

2.2 Results: Sacramento River Analysis

The following section presents a summary of the water available for appropriation calculated at each of the Sacramento River PODs: TCC POD and GCID POD. Water availability calculations are limited to the proposed Sites water right diversion season of September 1 through June 14 (i.e., the period outside of the fully appropriated stream designation for the Delta watershed).

2.2.1 Annual Results

Water available for appropriation at the TCC POD is the minimum volume of water available on each day among each of the five reaches (from the Red Bluff Reach downstream through the Delta Reach) after consideration of FV Demand, Project-specific flow requirements, and Delta conditions. Figure 4 shows the annual volumes of water available for appropriation at the TCC POD during each water year in the analysis. The Sacramento Valley Water Year Type is shown with each year for reference. Water is available in 21 out of the 22 years in the analysis, in volumes ranging from approximately 3,000 acre-feet to 3,945,000 acre-feet. The annual average volume of water available for appropriation at the TCC POD is approximately 862,000 acre-feet.

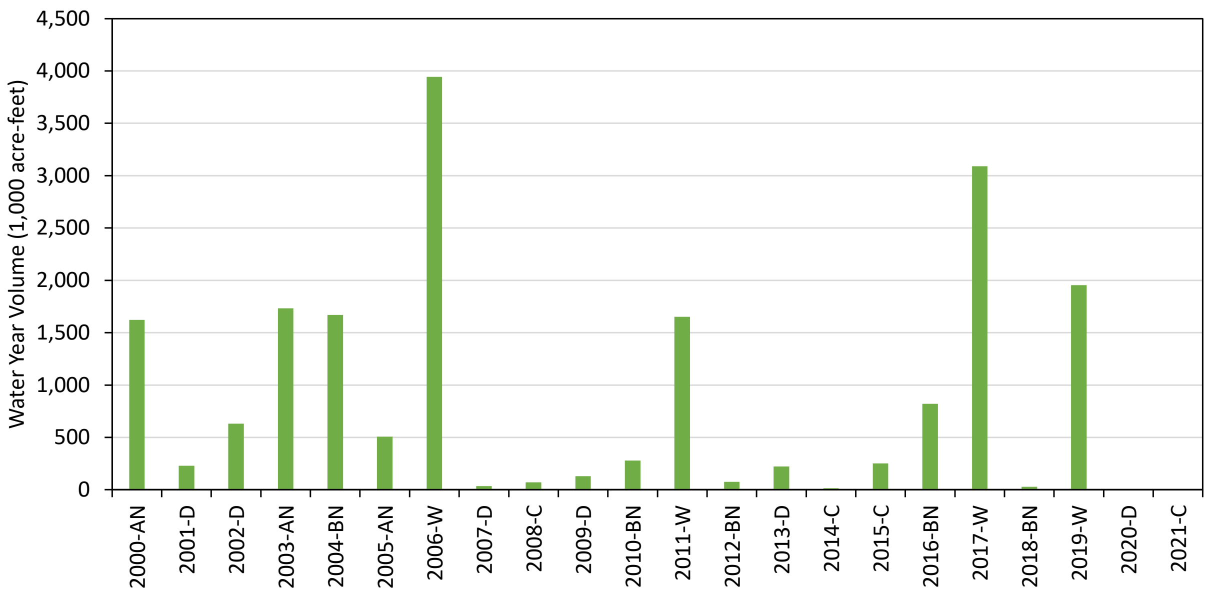

Figure 4. Annual Volumes of Water Available for Appropriation at the TCC POD under the Historical Analysis

Water available for appropriation at the GCID POD is the minimum volume of water available on each day among each of the four lower reaches (from the Hamilton City Reach downstream through the Delta Reach) after consideration of FV Demand, Project-specific flow requirements, and Delta conditions. Figure 5 shows the annual volumes of water available for appropriation at the GCID POD during each water year in the analysis. Water is available in 21 out of the 22 years included in the analysis, in volumes ranging from approximately 3,000 acre-feet to 3,950,000 acre-feet. The annual average volume of water available for appropriation at the GCID POD is approximately 870,000 acre-feet. Volumes of water available for appropriation at the GCID POD are typically the same as those available at the TCC POD, as daily availability is most often controlled by either the Hamilton City Reach or reaches further downstream on the flow path. Occasionally, additional water is available at Hamilton City due to accretions between the two PODs, hence why the annual maximum and annual average volumes are nominally higher than the volumes available at the TCC POD.

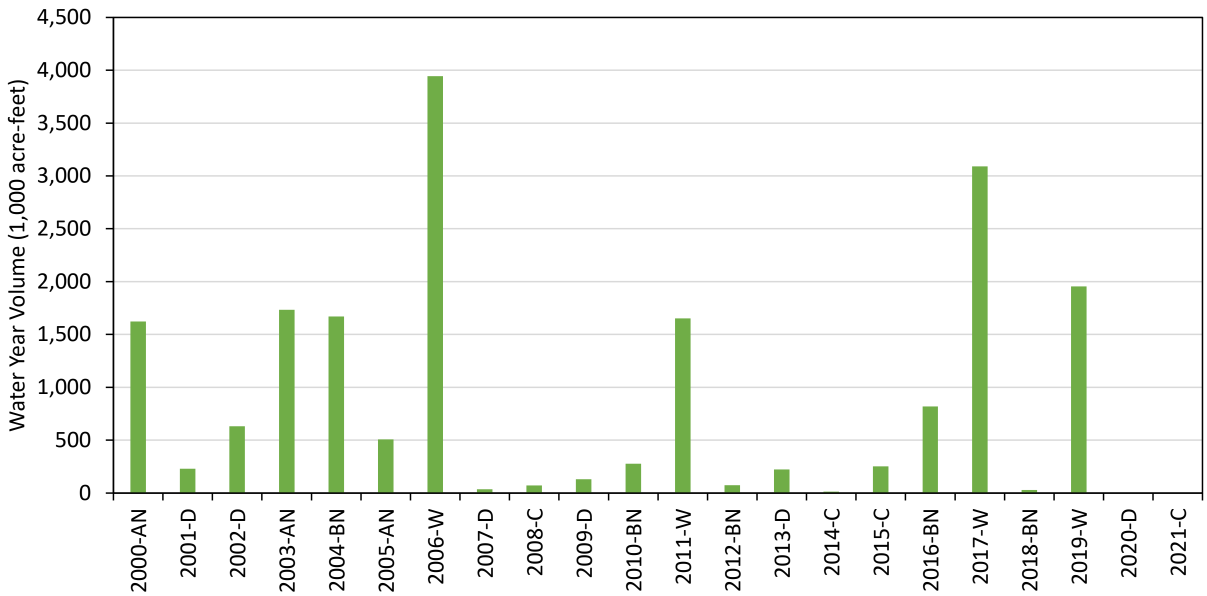

Figure 5. Annual Volumes of Water Available for Appropriation at the GCID POD under the Historical Analysis

The volumes of water shown as available for appropriation at the GCID POD in Figure 5 should not be added to the TCC POD volumes to determine total water available for Sites from the Sacramento River because availability at the GCID POD is calculated as a distinct location assuming no diversions at the TCC POD. When considering water potentially diverted at the TCC POD, less water becomes available for appropriation at the GCID POD. Figure 6 shows the annual volumes of water available at the GCID POD after assuming up to 2,200 cfs of water is diverted at the TCC POD, when available. This assumption results in water being available in 20 out of 22 years, ranging from 6,000 acre-feet to 3,263,000 acre-feet, at an annual average volume of approximately 682,000 acre-feet.

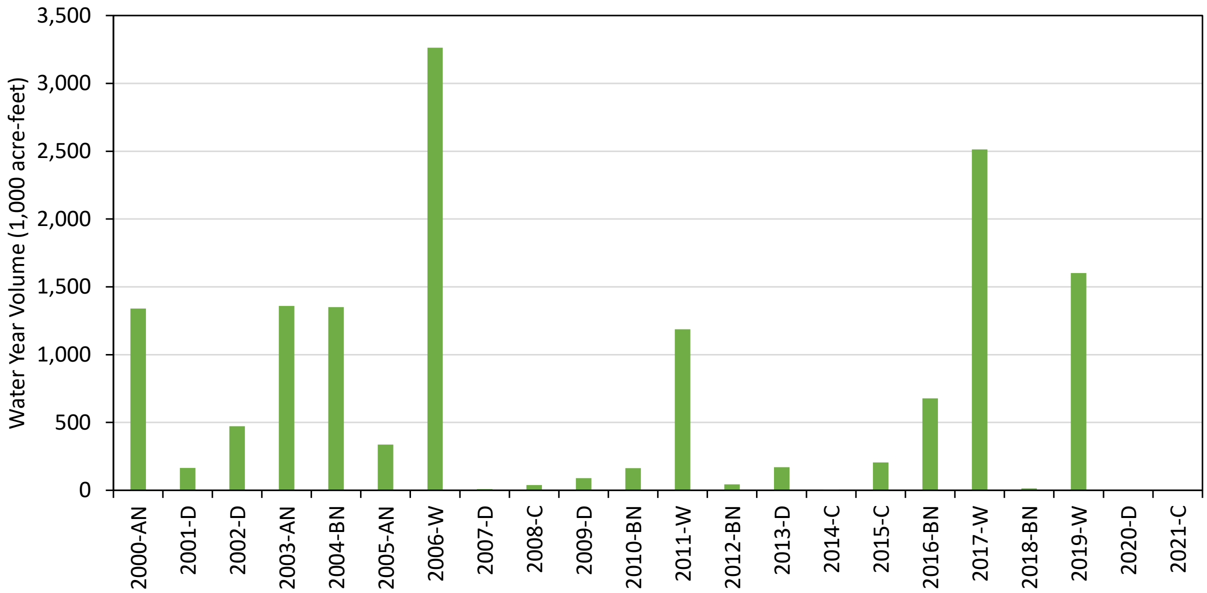

Figure 6. Annual Volumes of Water Available for Appropriation at the GCID POD after Potential Diversions at the TCC POD under the Historical Analysis

2.2.2 Monthly Results

Table 6 shows the monthly average availability by Sacramento Valley Water Year Type and over the full period of analysis at the TCC POD. The monthly volumes from the maximum water year (water year 2006) are included for additional reference. On average, water is available in all year types, with the largest volumes available in Wet and Above Normal years. Water is available for appropriation in all months from December through June. Availability in the September through November period is largely affected by the conservative assumptions for water right demands used in this analysis. In actual operations, water may be available during these months as irrigation demands are greatly reduced and maximum direct diversion rates are rarely used to meet rice straw decomposition demands for the full season[11]. Availability calculations were not completed for the period outside of the proposed Sites diversion season. Thus, no water is shown as available from June 15 through August 31.

[11] A sensitivity analysis was completed to assess water availability under current conditions (i.e., historical stream gauge data without FV Demand). The results of this sensitivity analysis are provided in Appendix A.

Table 6. Monthly Average Volumes of Water Available for Appropriation at the TCC POD under the Historical Analysis. Volumes in 1,000 acre-feet

Month / WY Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Wet	0	0	189	502	383	814	647	89	37	0	0	0	2,661
Above Normal	0	0	76	369	329	241	51	245	1	0	0	0	1,287
Below Normal	0	0	51	165	144	201	9	1	3	0	0	0	574
Dry	0	0	70	71	32	36	0	0	0	0	0	0	209
Critical	0	0	63	4	14	3	0	0	0	0	0	0	84
All Years	0	0	87	199	158	236	127	50	8	0	0	0	862
Max Year (2006)	0	0	204	949	468	1,062	961	286	16	0	0	0	3,945

Table 7 shows the monthly average volumes of water available for appropriation by Sacramento Valley Water Year Type and over the full period of analysis at the GCID POD. The monthly volumes from the maximum water year (water year 2006) are included for additional reference. Volumes and patterns of availability are very similar to the volumes of water available for appropriation shown at the TCC POD. As noted in the annual results discussion, volumes of water available for appropriation at the GCID POD are occasionally higher than at the TCC POD (Table 6) due to accretions downstream of the TCC POD. Additionally, the volumes of water shown as available for appropriation at the GCID POD assume no diversions at the TCC POD and should not be added to values in Table 6 .

Table 7. Monthly Average Volumes of Water Available for Appropriation at the GCID POD under the Historical Analysis. Volumes in 1,000 acre-feet

Month / WY Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Wet	0	0	194	506	384	814	647	90	37	0	0	0	2,672
Above Normal	0	0	76	371	329	240	51	224	1	0	0	0	1,289
Below Normal	0	0	51	173	146	204	9	1	3	0	0	0	587
Dry	0	0	74	72	33	38	0	0	0	0	0	0	217
Critical	0	0	66	4	14	3	0	0	0	0	0	0	87
All Years	0	0	90	202	160	238	127	50	8	0	0	0	870
Max Year (2006)	0	0	204	949	468	1,062	961	291	16	0	0	0	3,950

Table 8 shows the monthly average volumes of water available for appropriation by Sacramento Valley Water Year Type and over the full period of analysis at the GCID POD after assuming up to 2,200 cfs of diversion at the TCC POD, when available. The monthly volumes from the maximum water year (water year 2006) are included for additional reference.

Table 8. Monthly Average Volumes of Water Available for Appropriation at the GCID POD After Potential Diversions at the TCC POD under the Historical Analysis. Values in 1,000 acre-feet

Month / WY Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Wet	0	0	151	412	310	682	524	46	16	0	0	0	2,142
Above Normal	0	0	60	303	266	184	34	185	0	0	0	0	1,012
Below Normal	0	0	41	133	113	161	3	0	0	0	0	0	450
Dry	0	0	51	58	21	22	0	0	0	0	0	0	151
Critical	0	0	51	1	9	2	0	0	0	0	0	0	62
All Years	0	0	69	162	126	192	101	34	3	0	0	0	682
Max Year (2006)	0	0	178	813	358	926	831	158	0	0	0	0	3,263

Appendix A provides additional detail regarding the results of this analysis, including tables summarizing monthly volumes of water available for each year in the analysis; a summary of estimated diversions; and figures illustrating calculated flows, conditions, and diversions.

2.3 Results: Funks and Stone Corral Creeks

The following section presents a summary of the combined water available for appropriation calculated at the Funks and Stone Corral creeks PODs. Water available for appropriation is the volume of water remaining after subtracting the FV Demand on both creeks and accounting for Excess conditions in the Delta. Water availability calculations are limited to the proposed Sites water right diversion season of September through June[12].

2.3.1 Annual Results

Figure 7 shows the combined annual volumes of water available for appropriation at the Funks and Stone Corral PODs during each water year in the analysis. The Sacramento Valley Water Year Type is shown with each year for reference. Water is available in 7 out of the 22 years included in the analysis, in annual volumes ranging from approximately 700 acre-feet to 24,000 acre-feet. The combined annual average volume of water available for appropriation at the Funks and Stone Corral creeks PODs is approximately 2,900 acre-feet.

[12] As the supply data is available on a monthly timestep for Funks and Stone Corral creeks, the entire month of June is assumed to be part of the diversion season in the availability calculations.

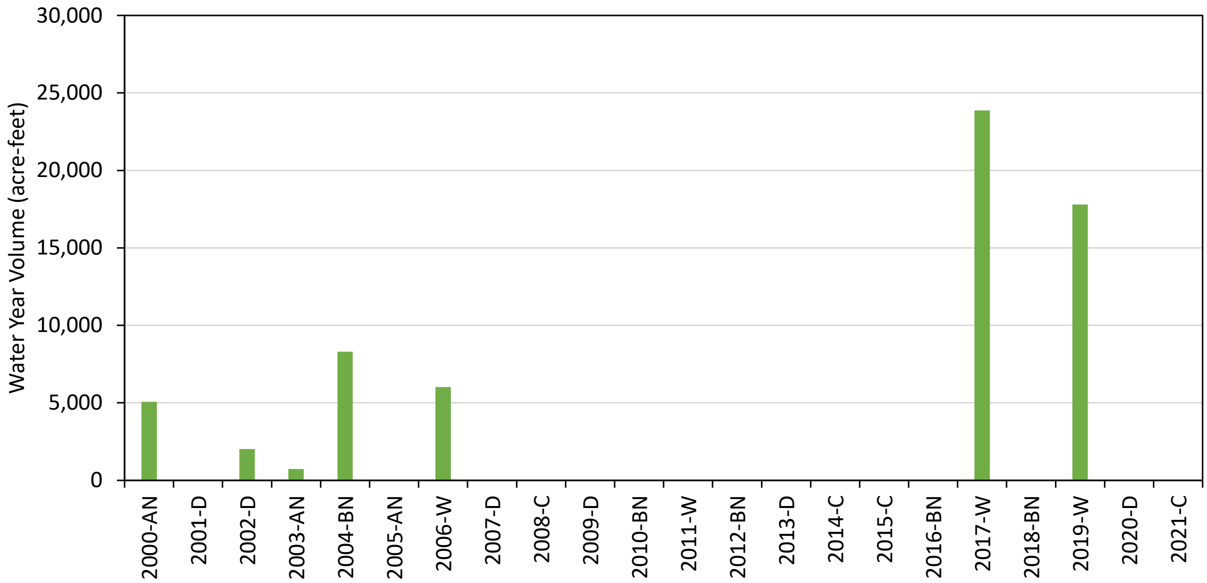

Figure 7. Combined Annual Volumes of Water Available for Appropriation at the Funks and Stone Corral Creeks PODs under the Historical Analysis

2.3.2 Monthly Results

Table 9 shows the combined monthly average availability by Sacramento Valley Water Year Type and over the full period of analysis at the Funks and Stone Corral creeks PODs. The monthly volumes from the maximum water year (water year 2017) are included for additional reference. On average, water is available in all year types except Critical years, with the largest volumes being available in Wet years. Water is shown as available for appropriation in all months from January through April. Streamflow on Funks and Stone Corral creeks is essentially non-existent from August through October and typically minimal in June and July except in exceptionally wet years. Streamflow does not exceed the FV Demand in May or June. Availability calculations were not completed for periods outside of the proposed Sites diversion season. Thus, no water is shown as available in July or August.

Table 9. Combined Monthly Average Volumes of Water Available for Appropriation at Funks and Stone Corral Creeks PODs under the Historical Analysis. Volumes in acre-feet

Month / WY Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Wet	0	0	0	1,071	8,675	675	1,505	0	0	0	0	0	11,927
Above Normal	0	0	0	241	1,687	0	0	0	0	0	0	0	1,928
Below Normal	0	0	0	0	1,659	0	0	0	0	0	0	0	1,659
Dry	0	0	0	337	0	0	0	0	0	0	0	0	337
Critical	0	0	0	0	0	0	0	0	0	0	0	0	0
All Years	0	0	0	320	2,184	123	274	0	0	0	0	0	2,900
Max Year (2017)	0	0	0	4,284	19,593	0	0	0	0	0	0	0	23,877

Funks and Stone Corral creeks are rain-fed, intermittent streams and are not intended to be a major source of supply for the Project; however, water from these creeks will be impounded during high flow events.

This analysis shows that water is available from Funks and Stone Corral creeks. However, due to the need to better understand the creeks, the Authority has committed to development of a Technical Studies Plan and an Operations Plan for Funks Creek and Stone Corral Creek, and has requested a Project-specific term be included in a permit issued pursuant to this application with these commitments. The Technical Studies Plan will include assessment of fish assemblage and available habitat, flow characteristics, water temperatures, losses, and methods for reporting data.

The Technical Studies will allow the Authority to better understand flows in the creeks and will be completed prior to impoundment of Funks Creek and Stone Corral Creek. It is expected that the Technical Studies will produce a Funks Creek and Stone Corral Creek Operations Plan. The Operations Plan shall include, but may not be limited to, the approach for reservoir releases into Funks Creek and Stone Corral Creek, including release schedules and volumes, and a monitoring plan. The Funks Creek and Stone Corral Creek Operations Plan shall be developed in consultation with CDFW, United States Fish and Wildlife Service, and Colusa County, and approved by the Deputy Director for Water Rights.

2.4 Historical Analysis Conclusions

The results of both the Sacramento River and Funks and Stone Corral creeks historical analyses demonstrate a reasonable likelihood of water available for appropriation at each POD.

Sacramento River: In regard to estimating water available at the Sacramento River PODs (TCC and GCID), the Historical Analysis has several advantages over other approaches. First, compared to a longer timestep, the daily timestep used in the Sacramento River Analysis is the most appropriate timestep to capture the variability of high flow events on the Sacramento River and flood control operations of Shasta Reservoir, while still being able to provide the necessary detail regarding the available flow, minimum required flows, and existing water rights. Second, the use of daily data for a recent period reflects actual conditions in the Sacramento River from Red Bluff to Freeport and in the Delta, including the diversion of water under many of the existing water rights in the watershed. The approach is conservative in that it relies on observed streamflows that reflect the use of water under existing water rights and claims, and then subtracts FV Demand. Third, the approach relies on observed data which is appropriate for the purpose of acceptance of the Application. The Historical Analysis estimates the annual average volume of water available for appropriation at the TCC POD and GCID POD. The calculated average availability between the two PODs is approximately 870,000 acre-feet annually.

Funks and Stone Corral Creeks: The available supply data for each creek provides a very conservative outlook on availability for two reasons. First, the calculated correlation produces a good estimate of streamflow in normal and dry years, but in wet years typically underestimates streamflow volumes compared to historical observations. The wetter periods are when water would typically be available for appropriation on the creeks, so the overall magnitude and potentially the frequency of water available for appropriation at the Funks and Stone Corral creek PODs shown in this analysis are likely underestimated. Second, the supply data included in the Funks and Stone Corral creeks analysis estimates flow at each POD. The water rights included in this analysis are located further downstream from the POD on each creek. Given that there is additional watershed area between the PODs and the downstream water rights, some additional accretions to the creeks could occur. As such, in actual operations, the downstream water demands may not always need to be met entirely from the available supply at each POD. The Historical Analysis estimates the combined annual average volume of water available for appropriation at the Funks and Stone Corral creeks PODs is approximately 2,900 acre-feet.

3 CalSim II Analysis

The CalSim II Analysis includes the review and post-processing of results from planning-level studies originally developed to evaluate the Sites' project feasibility. The CalSim II Analysis was developed for two purposes: first, to evaluate water availability from a system-wide perspective at a planning level of detail; second, to address the State Board's direction to analyze the effects of climate change[13] and/or changes to regulatory requirements when considering water available for appropriation. While the Historical Analysis provides the best estimate of water available for appropriation because it is based on the actual, observed operation of the system, it is not possible to predict or understand how the future effects of climate change or changes to regulatory requirements may affect the availability of water as estimated in the Historical Analysis. Through modeling the current water system – primarily the CVP/SWP system – with the addition of Sites Reservoir, multiple analyses can be completed and compared that evaluate different hydrologic inputs (historical or climate change) and assumptions regarding potential future regulatory requirements. Future conditions analyses are discussed in Section 6.

The CalSim II Analysis calculates water available for appropriation by post-processing the results of a Sites' CalSim II study. CalSim II[14] is a planning model designed to simulate operations of the CVP and SWP reservoirs and water delivery systems. CalSim II is a simulation by optimization model, which simulates operations by solving a mixed-integer linear program to maximize an objective function for each month of the simulation. CalSim II was developed by Reclamation and DWR to simulate operation of the CVP and SWP for defined physical conditions and a set of regulatory requirements. The model simulates these conditions on a monthly timestep using 82 years of hydrology from water year 1922 through 2003.

The CalSim II model used for this analysis is the Alternative 3A model produced by the Authority in support of the Final Environmental Impact Report/ Environmental Impact Statement[15] currently in preparation. The relevant supply and demand inputs used in this copy of the CalSim II model include[16]:

- **Supply:** Historical Hydrology
- **Demand:** Sacramento Valley 2020 level of demand; San Joaquin Valley 2030 level of demand; CVP and SWP operations that comply with 2019 Biological Opinions and the 2020 State Water Project Incidental Take Permit (ITP)

[13] https://www.waterboards.ca.gov/waterrights/water_issues/programs/climate_change/docs/climate_change_considerations_appropriative_water_rights_applications_factsheet.pdf

[14] CalSim II was used for this analysis rather than CalSim 3 for two reasons. First, although public copies of CalSim 3 have been released in recent years, the model is in the developmental stage. CalSim II continues to be the primary tool used by agencies and technical experts for the purpose of modeling the CVP/SWP system and the most appropriate tool for a planning-level water availability analysis. Second, CalSim II was used to provide the modeling and analysis used in the documentation prepared for the Sites' CEQA analysis that began several years ago. The same analysis was relied upon here to provide consistency with the CEQA analysis and avoid potential confusion.

[15] https://sitesproject.org/environmental-review/

[16] Additional model assumptions can be found in *Appendix 5A* of the Revised Draft EIR/Supplemental Draft EIS. https://sitesproject.org/wp-content/uploads/2021/11/RDEIR-SDEIS-App05A1-Surface-Water-Resources-Modeling-Assumptions.pdf

The CalSim II Analysis also incorporates the site-specific Bend Bridge Pulse Protection and Wilkins Slough Minimum Flow Requirement. The following section discusses the approach taken to analyze the results from the CalSim II model to estimate the volumes of water available for appropriation.

3.1 Analytical Approach and Assumptions

The Authority's consultants incorporated Sites Reservoir into CalSim II as part of the modeling and analysis completed for the Sites Reservoir project feasibility studies. A brief summary of the assumptions included in the modeling relative to the availability of water and subsequent diversions to Sites Reservoir are discussed below. The diversion logic and output results for Sites Reservoir operations in CalSim II considers availability in the context of hydrologic, regulatory, and physical constraints. As the volumes of water potentially available for appropriation need not be limited by physical constraints, MBK Engineers developed a post-processor to estimate the volumes of water available for appropriation indicated by the CalSim II modeling.

3.1.1 Sites Reservoir in CalSim II

As noted above, Sites Reservoir was incorporated into the CalSim II model to simulate Sites Reservoir operations with respect to CVP/SWP operations and other system and regulatory requirements. The volumes of water available for appropriation and any subsequent diversions to Sites Reservoir simulated in CalSim II are constrained by multiple physical limitations and regulatory requirements. Table 10 summarizes the constraints that limit the volume of water which is available for appropriation and that can physically be diverted. Note that many of the same protections and requirements used in the Historical Analysis are also included in the CalSim II study (e.g., Bend Bridge Pulse Protection, Wilkins Slough Minimum Flows Requirement, Excess Conditions in the Delta, etc.).

Table 10. Constraints on Availability and Diversion for Sites Reservoir in CalSim II

Constraint	Description
Delta / System Availability	- Delta must be in an Excess condition - Diversions in January – March must not cause the Delta to go into a Balanced condition[17] - No diversions can occur from April through September in Shasta Critical years and/or in Dry and Critical years[18]
Shasta Operations	Shasta is not releasing for the Upper Sacramento River Spring Pulse Flow
ITP Delta Outflow	Limit diversions when the SWP is releasing water as part of an ITP Delta Outflow action[19]
Bend Bridge Pulse Protection	- **Initiation:** 3-day forecasted average Sacramento River flow is projected to exceed 8,000 cfs and 3-day forecasted average combined tributary flow must exceed 2,500 cfs - **Duration:** 7 days upon initiation; if flows exceed 29,000 cfs at Sacramento River at Bend Bridge, diversions are limited to the flow in excess of 25,000 cfs for the remainder of the 7-day period - **Reset:** After completion of the pulse protection period, resetting criteria must be met for another pulse protection period to commence: 3-day trailing average Sacramento River flow at Bend Bridge is less than 7,500 cfs for 7 consecutive days; 3-day trailing average tributary flow must go below 2,500 cfs for 7 consecutive days - **Period:** October – May
Wilkins Slough Minimum Flow Requirement	- 10,700 cfs in October – June - 5,000 cfs all other times
Fully Appropriated Streams	No diversions allowed June 15 – August 31 to comply with the fully appropriated stream status of the Sacramento River
Sites Reservoir Capacity	1.5 million acre-feet, including 60,000 acre-feet of deadpool storage
Diversion Capacity[20]	- 2,100 cfs plus losses at Red Bluff (limited by hydraulic diversion capability at lower flows) - 1,800 cfs plus losses at Hamilton City (occasionally limited by annual maintenance periods)

3.1.2 CalSim II Water Available for Appropriation Tool

The diversion and operations logic currently implemented in the Sites CalSim II model does not explicitly output a calculated "water available for appropriation" volume at each timestep. The logic only outputs the final diversions to Sites Reservoir. Since this diverted volume is limited by the physical capacity of the diversion infrastructure and the reservoir's storage capacity, the actual volume of water available for

[17] The CalSim II model includes a diversion constraint during the January – March period that flow is only available when the Delta Excess surrogate is at least 3,000 cfs. This constraint is designed to prevent a potential effect on the CVP and SWP's ability to meet the Spring X2 requirement. This constraint is purely a modeling nuance and not intended to be part of any operational criteria.
[18] This constraint is purely a modeling nuance and not intended to be part of any operational criteria.
[19] Ibid.
[20] The diversion capacity noted is the facility capacity for conveyance of water from the TCC and GCID Main Canal into Sites Reservoir. The diversion from the Sacramento River is therefore that flow rate plus assumed flows for losses between each POD and the pipeline from the canal into Sites Reservoir. The total rate diverted from the Sacramento River (diversion to Sites plus losses) does not exceed the 4,200 cfs diversion capacity identified in the Application.

appropriation may be higher. To estimate the additional volumes of water that may be available for appropriation, a CalSim WAA Tool (tool) was developed to post-process the CalSim II results for each timestep. The post-processing tool estimates the volumes of water available for appropriation in CalSim II that are not constrained by the capacity of the diversion infrastructure at each POD or the total storage capacity of Sites Reservoir.

The tool was developed in an Excel spreadsheet and uses the output from each of the physical and regulatory constraints applied to the diversions to Sites Reservoir in CalSim II to calculate the maximum volume of water available for appropriation at each timestep. Put simply, the tool re-creates the availability and diversion calculations used in the CalSim II model but uses the actual volumes of water present at each location without constraining availability to any physical infrastructure limitations. The primary CalSim II variables used for the water availability calculation are summarized in Table 11.

Table 11. CalSim II Variables Used in the CalSim II WAA Tool

CalSim II Variable	Description
C112	Flow at Red Bluff Diversion Dam
FLOWABVL1_C112	Flow at C112 above the minimum instream flow requirement in CalSim II
D175TC_DIVRTABLE*	Potential divertible flow volume at Red Bluff
TS_ADJ_RB	Pre-defined maximum flow “adjustment” allowed at Red Bluff
C114	Flow at Hamilton City
FLOWABVL1_C114	Flow at C114 above the minimum instream flow requirement in CalSim II
D14401_DIVRTABLE*	Potential divertible flow volume at Hamilton City
TS_ADJ_HC	Pre-defined maximum flow “adjustment” allowed at Hamilton City
D17501_DIVRTABLE*	Overall potential divertible flow volume
C129	Flow at Wilkins Slough
FLOWABVL1_C129	Flow at C129 above the Wilkins Slough Minimum Flow Requirement
TS_ADJ_WLK	Pre-defined maximum flow “adjustment” allowed at Wilkins Slough
C17601_DIVRTBLE_WLKBYP*	Potential total diversion constraint based on Wilkins Slough Minimum Flow Requirement
C17601_PPZLTD*	Diversion constraint based on Bend Bridge Pulse Protection
C17601_FILL_EST_DV	Diversion estimate used in earlier cycles as part of Delta water quality calculations
C407	Delta Excess Surrogate
INT_BALANCED	Binary condition of Delta in an Excess or Balanced condition
SWPITP_INCOUT_FLAG_DV	Binary condition that limits diversions when the SWP is making a release for an ITP Delta Outflow action
C17601_FILL	Total diversion from the Sacramento River to Sites Reservoir

**Variable is re-calculated using available flow not limited by diversion infrastructure capacities*[21].

The tool completes each of the re-calculations and determines the revised availability at each POD, as limited by each of the diversion criteria. Upon completion of these calculations, the tool then calculates the volume of water available for appropriation at each timestep. The volume of water available for

[21] The divertible flow volumes are re-calculated at each location using the same formula in the CalSim II model (NODOS_diversions.wresl) to determine the value relative to total available flow not considering physical infrastructure capacity limitations.

appropriation at each timestep is the minimum of five groups of CalSim II variables. These five groups include:

1. Combined POD Availability – The minimum of available and divertible flows at Red Bluff and Hamilton City, respectively, or the combined divertible flow. The combined POD availability is used as the CalSim results are typically presented as a single diversion volume and diversion decisions in the model may be influenced by operational requirements/objectives, not simply availability at each POD
2. Wilkins Slough – The minimum of flow above the Wilkins Slough minimum (bypass) flow requirement and calculated divertible flow
3. Bend Bridge Pulse Protection – Divertible flow available as limited by the Bend Bridge Pulse Protection criteria
4. The Delta – Available flow as controlled by the Delta being in an Excess condition and flow above the January – March limitation (when applicable)
5. Additional Binary Conditions Checks – Constraints that limit availability during certain hydrologic conditions and operational actions (as noted in Table 10)

To provide a conservative estimate of availability, each step of the post-processor calculations that are noted above use the minimum value available. Additionally, the diversion logic in CalSim II currently limits Sites diversions in June to half of what is calculated as available so as to comply with the Fully Appropriated Stream status of the Delta watershed. To be consistent with the CalSim II assumption for June availability, the CalSim WAA Tool applies the same logic to the water availability calculations in June.

3.2 Results

The following section presents a summary of the volumes of water available for appropriation calculated by the CalSim WAA Tool for the period of analysis in the CalSim II model, October 1921 through September 2003. As noted above, given the operational configuration of diversions to Sites Reservoir in CalSim II along with the "system-wide" view of water available for appropriation by Sites within CalSim II, volumes of water available for appropriation are presented for a single "location". In actual operations, the amount available would be equal to the maximum combined volume that would be available for appropriation at the two Sites PODs on the Sacramento River.

Figure 8 shows the annual volumes of water available for appropriation over the 82-year simulation period of the CalSim II simulation. On average, approximately 1,174,000 acre-feet is annually available for appropriation. Water is available in 74 out of 82 years (~90%) in annual volumes ranging from approximately 15,000 acre-feet to approximately 4,622,000 acre-feet. Figure 9 shows the probability of exceedance of the annual volumes of water available for appropriation. More than 1,000,000 acre-feet is available in approximately 45% of years, and over 1,500,000 acre-feet is available in approximately 35% of years.

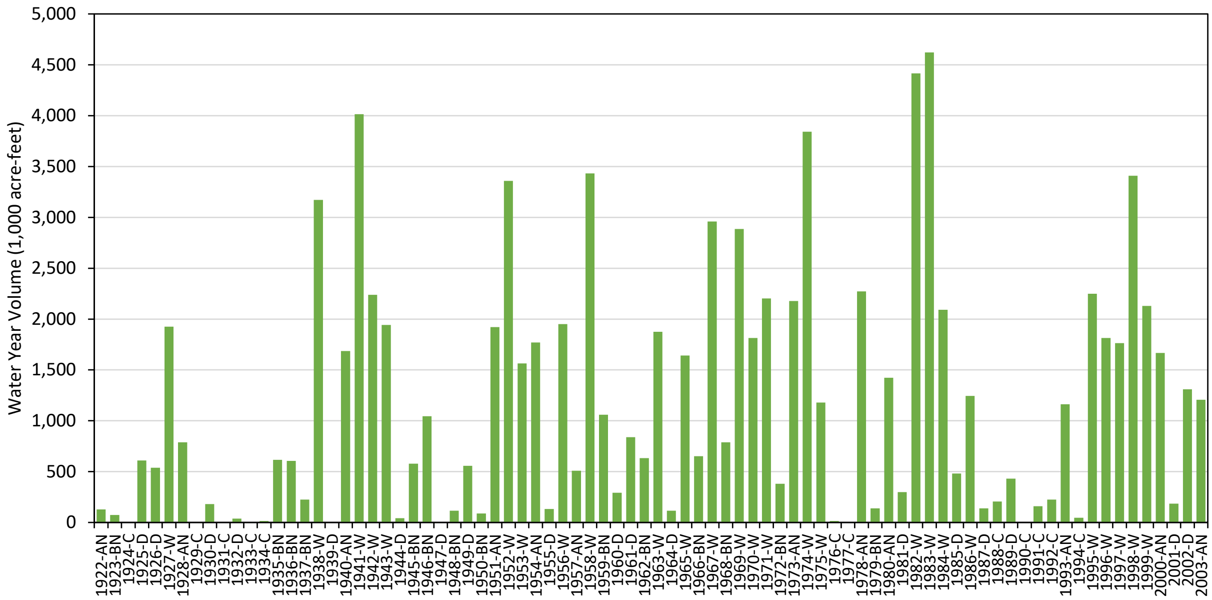

Figure 8. Annual Volumes of Water Available for Appropriation under the CalSim II Analysis

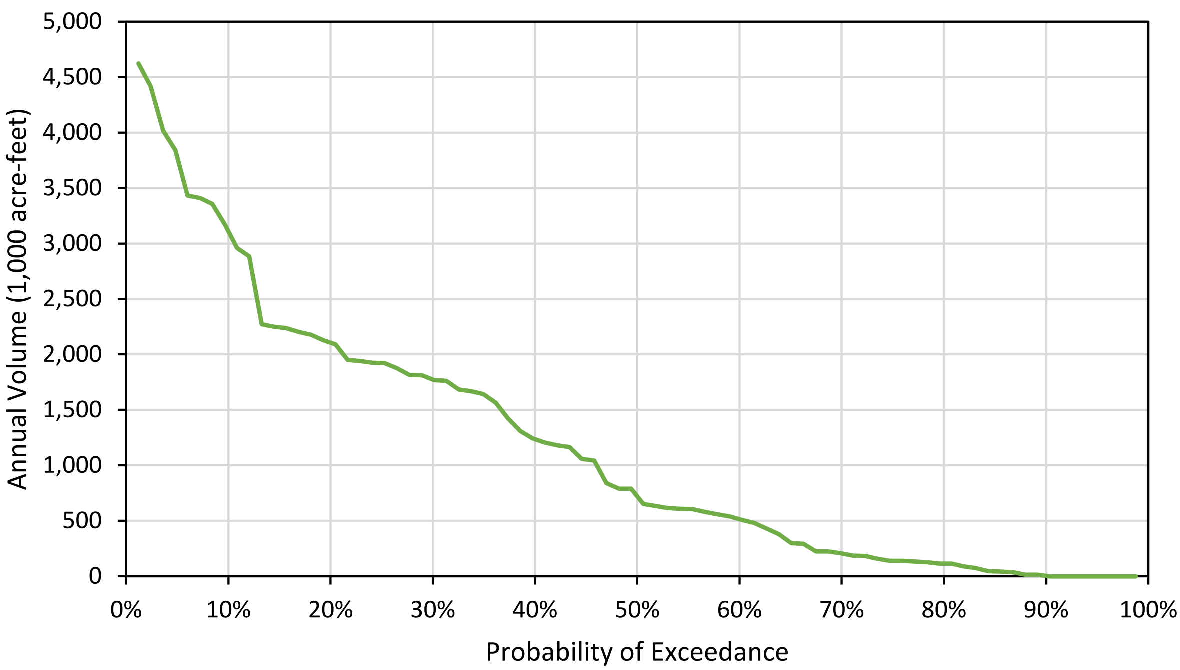

Figure 9. Probability of Exceedance of the Annual Volumes of Water Available for Appropriation under the CalSim II Analysis

Table 12 shows the average monthly volumes of water available for appropriation by Sacramento Valley Water Year Type and for all years. The monthly volumes for the maximum water year (1983) are shown for additional reference. Water is available in all months of the proposed water right season (September

– June). Water is available in the largest volumes in Wet and Above Normal years, but some volume of water can be available in all water year types.

Table 12. Average Monthly Volumes of Water Available for Appropriation under the CalSim II Analysis. Values in 1,000 acre-feet

Month / WY Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Wet	10	75	393	516	565	478	338	106	20	0	0	28	2,528
Above Normal	0	14	90	341	473	407	67	0	2	0	0	0	1,392
Below Normal	0	7	50	86	232	82	31	0	0	0	0	12	500
Dry	0	28	57	40	116	104	0	0	0	0	0	0	344
Critical	1	1	3	14	18	18	0	0	0	0	0	0	56
All Years	3	33	159	239	316	250	122	34	7	0	0	11	1,174
Max Year (1983)	38	36	971	547	883	794	681	495	177	0	0	0	4,622

Appendix B provides a summary of estimated diversions from the CalSim II model results.

3.3 CalSim II Analysis Conclusions

The CalSim II Analysis was developed to provide a planning level estimate of water available for appropriation for Sites Reservoir, while also providing the capability to evaluate potential changes to availability under changed hydrologic conditions (climate change) and future regulatory requirements. The results presented in this section of the report detail the estimated volumes of water available for appropriation based on results from a CalSim II model that includes Sites Reservoir and is simulated using historical hydrology and current regulatory requirements, including site-specific flow requirements for the preservation and enhancement of fish and wildlife resources. As CalSim II does not explicitly output potential volumes of water available for appropriation, MBK developed a post-processor tool that calculates the volumes of water available for appropriation using the same logic and calculations included in CalSim II, but absent any diversion infrastructure capacity constraints. At each step of the post-processing calculation, the analysis maintains a conservative approach by assuming the final volume of water available for appropriation is the minimum volume available at each location, as limited by each diversion criteria, for all timesteps.

The results of the CalSim II Analysis showed water available in approximately 90% of years, in volumes ranging from approximately 15,000 acre-feet to approximately 4,622,000 acre-feet. In approximately 35% of years, more than 1.5 million acre-feet – the design capacity of Sites Reservoir – was estimated to be available for appropriation.

To address potential changes in hydrologic conditions, a CalSim II model with 2035 Central Tendency (CT) climate change hydrology was used to produce an additional water availability analysis. This analysis presented in Section 6.1.

4 Face Value Analysis

A third approach was proposed by Division staff that seeks to estimate water availability from a watershed-wide perspective using the maximum potential demands of all existing water rights within the Sacramento River watershed. The "Face Value Analysis" was developed to meet this proposal. The Face Value Analysis compares supply and demand in each of the sub watersheds (or "subbasins") in the Sacramento River watershed upstream of Freeport, and then calculates the volumes of water potentially available for appropriation at three discrete locations (Points of Interest) in the Sacramento River watershed. The datasets used to complete these calculations are defined as:

- **Supply:** monthly unimpaired flow data for each sub watershed in the Sacramento River watershed
- **Demand:** calculated maximum diversion and storage volumes based on the face value of water rights (FV Demand) throughout the Sacramento River watershed

Any supply remaining at the three POIs after subtracting the FV Demand is assumed to be available for appropriation. The available volumes at each POI are then compared to each other to arrive at a final, watershed-wide volume of water available for appropriation.

The Face Value Analysis is a theoretical approach to evaluating water availability for Sites Reservoir for several reasons. First, the State Water Board has determined that the face value of water rights is not a good measure of the amount of water to be used (State Water Board Decision 1650, p. 6, para. 12); however, it does define the amount of currently appropriated water. Second, the Face Value Analysis uses the unimpaired flow to represent the available water supply. While the unimpaired flow is a reasonable proxy for the water available to supply the existing rights, it is not representative of the flows that are available with the operation of the current system of reservoirs, diversions, and minimum flow requirements. Additionally, unimpaired flow does not include a representation of return flows that can be available to meet downstream water rights and may be available for appropriation. Third, the Face Value Analysis compares the unimpaired flow to the face value of existing rights each year, but independently, not in a sequence of hydrology[22]. Because of the theoretical nature of the Face Value Analysis, it does not include operational requirements such as minimum flows for the preservation and enhancement of fish and wildlife. The following sections describe this approach and the subsequent results in additional detail.

4.1 Analytical Approach and Assumptions

The Face Value Analysis was developed to estimate water availability at three POIs located within the Sacramento River watershed: the Sacramento River at Red Bluff, the Sacramento River at Wilkins Slough, and the Sacramento River at Freeport. Similar to the Historical Analysis, the Face Value Analysis calculates availability along a flow path from the Sites POD at Red Bluff to Freeport. However, the Face Value Analysis provides an even more conservative evaluation of availability by considering potential availability in watersheds that are not only directly downstream, but are upstream and/or tributary to

[22] As noted in more detail later in this section, the Face Value Analysis assumes that every water right in the Sacramento Valley can take the full volume of the water right, both direct diversion and storage, in every year. This assumption results in the analysis not accounting for how exceptionally wet or dry periods may influence demands, particularly as it relates to the use of previously stored water and potential storage space available in a reservoir after multiple wet years in a row.

the flow path, while also assuming the full face value use – including storage – of all existing water rights and claims within the Sacramento River watershed.

The Face Value Analysis calculates availability by comparing available supply to FV Demand within the entire Sacramento River watershed. The supply dataset used for this analysis is the unimpaired flow data available from DWR's *Estimates of Natural and Unimpaired Flows for the Central Valley of California: Water Years 1922-2014*[23] (Unimpaired Flow Report). Data is available at a monthly timestep for water years 1922 through 2014, for each of the eleven "Unimpaired Flow Subbasins" within the Sacramento River watershed identified in the Unimpaired Flow Report. The eleven unimpaired flow (UF) subbasins included in this analysis are summarized in Table 13 and shown in Figure 10.

Table 13. Sacramento River Watershed Unimpaired Flow Subbasins as Defined in the Unimpaired Flow Report

Subbasin Number	Unimpaired Flow Subbasin
1	Sacramento Valley Floor
2	Putah Creek near Winters
3	Cache Creek above Rumsey
4	Stony Creek at Black Butte
5	Sacramento Valley West Side Minor Streams
6	Sacramento River near Red Bluff
7	Sacramento Valley East Side Minor Streams
8	Feather River near Oroville
9	Yuba River at Smartville
10	Bear River near Wheatland
11	American River at Fair Oaks

The demand dataset used for this analysis includes all post-1914 appropriative water rights[24], pre-1914 appropriative and riparian claims, stockpond certificates, domestic registrations, federal claims and stockponds, cannabis registrations, and livestock registrations located within the Sacramento River watershed[25]. The demand dataset (FV Demand) was obtained from Division's eWRIMS GIS mapping tool for all areas within the Sacramento River watershed upstream of Freeport. For all water rights identified, this analysis assumes that the face value reflects the maximum diversion rate available under each water right. For all post-1914 appropriative permits or licenses, as well as all certificated rights, registrations, and federal claims, this involved identifying the maximum diversion rate, season, and storage volume (if applicable) identified in the water right. For all pre-1914 appropriative and riparian claims, the available water use reporting data from Division's Report Management System (RMS) for each claim was provided by Division staff. This data was used to estimate the maximum diversion rate, season, and storage volume (if applicable) for each claim. Demands for each water right were then organized into monthly FV "direct diversion" demands and annual FV "storage" demands. This analysis

[23] https://cawaterlibrary.net/document/estimates-of-natural-and-unimpaired-flows-for-the-central-valley-of-california-water-years-1922-2014-draft/

[24] Only post-1914 appropriative rights that are senior to Sites' requested priority date of September 30, 1977, are included in this analysis.

[25] The analysis presented in Section 4 does not include State Filings in the FV Demand dataset. A separate analysis that includes all State Filings in the Sacramento River watershed that are senior in priority to the Sites water right is presented in Appendix C.

conservatively assumes that the FV Demand for each water right is equal to the maximum rate that may be diverted every day throughout the water rights' entire season, which allows for some post-1914 appropriative rights to divert above the face value defined in their permit/license. Additionally, the FV storage demand is especially conservative because it assumes each right holder may divert/store the full volume of their right in each year (thereby assuming each reservoir is empty to start the year) and is not limited by season or diversion rate[26]. The analysis does not include assumptions related to deadpool storage, carryover storage, or storage space requirements for flood control associated with existing storage reservoirs. Additional detail on the development of the FV Demand dataset is included in Attachment 1.

Lastly, the analysis makes no assumptions regarding return flows or abandoned flows, nor does it include any minimum flow requirements, water quality requirements, or bypass flow requirements associated with existing water rights. This is because the Face Value Analysis relies on a theoretical flow scenario based on unimpaired flows and does not factor in system operations. Operations throughout the Sacramento watershed are extremely complex and are considered in the Historical Analysis and CalSim II Analysis. In line with this alternative approach, the Face Value Analysis compares unimpaired flow (supply) to FV Demand (demand) without including existing flow requirements. Therefore, Sites Reservoir's Wilkins Slough Minimum Flow Requirement and Bend Bridge Pulse Protection Criteria are not included in this theoretical scenario because it cannot be evaluated as part of overall system operations.

For this analysis, all FV Demand is grouped according to the USGS HUC-8 that the water right is located within, as identified in eWRMIS. Grouping in this manner allows for a simple and consistent approach to assign each water right to a geographic region that correlates to the source used by each water right. The HUC-8 boundaries are also generally consistent with the boundaries of the eleven unimpaired flow subbasins, which allows for a consistent and technically appropriate approach to compare supply and demand data throughout the watershed. The HUC-8 subbasins included in this analysis are summarized in Table 14 and shown in Figure 10.

[26] Including seasonal limits and diversion rates on storage rights would have greatly increased the complexity of the analysis. Given that the storage season for many of the major reservoirs is approximately November through June and most major reservoirs do not have a diversion rate limit, these refinements would likely result in comparable volumes of water available for appropriation as presented in this analysis. It must be noted that although including these two refinements would likely result in small changes, any change would show additional water available for appropriation as compared to the results presented in this analysis.

Table 14. Sacramento River Watershed HUC-8s

HUC-8 Code	HUC-8 Subbasin
18020001	Goose Lake
18020002	Upper Pit
18020003	Lower Pit
18020004	McCloud
18020005	Sacramento Headwaters
18020104	Sacramento-Stone Corral
18020111	Lower American
18020115	Upper Stony
18020116	Upper Cache
18020121	North Fork Feather
18020122	East Branch North Fork Feather
18020123	Middle Fork Feather
18020125	Upper Yuba
18020126	Upper Bear
18020128	North Fork American
18020129	South Fork American
18020151	Cow Creek
18020152	Cottonwood Creek
18020153	Battle Creek
18020154	Clear Creek-Sacramento River
18020155	Paynes Creek-Sacramento River
18020156	Thomes Creek-Sacramento River
18020157	Big Chico Creek-Sacramento River
18020158	Butte Creek
18020159	Honcut Headwaters-Lower Feather
18020161	Upper Coon-Upper Auburn
18020162	Upper Putah
18020163	Lower Sacramento

Figure 10. Sacramento River Watershed showing the Points of Interest, Unimpaired Flow Subbasins, and HUC-8 Aggregation

As noted above, the Face Value Analysis calculates volumes of water available for appropriation at three discrete POIs along the Sacramento River: Red Bluff, Wilkins Slough, and Freeport. The general approach to calculating availability using the Face Value Analysis is a two-step process. The first step subtracts the monthly FV direct diversion demands for a geographic area from the monthly supply data for the corresponding geographic area. This is done for each month of a single water year (October through September); any month that the calculation results in a negative value is assumed to have no availability. The second step takes the FV storage demands and subtracts any remaining supply from the first step on a month-by-month basis, until the end of the water year or until the full storage demand is met on a cumulative basis (whichever occurs first). Any month with supply still remaining after subtracting the storage demands is assumed to have water available for appropriation. Table 15 provides an example calculation of the two-step calculation. Although the FV direct diversion and FV storage demand calculations are completed on a monthly timestep, the assumptions used to structure the FV storage demand portion of the analysis make it appropriate to only consider the results on a seasonal or water year basis. For example, results of the analysis after the FV storage demands have been calculated would generally only show availability in the later months of the diversion season. Such a result is a function of the assumptions and structure of the analysis, not necessarily because water is more likely to be available late in the diversion season. As such, the water availability results are summarized at each POI on a diversion year basis (September through June). The minimum volume of water available across the three POIs is assumed to be the overall volume of water available for appropriation in that diversion year.

Table 15. Two-Step Water Availability Calculation Example[27]. Values in acre-feet

	Year	Month 1	Month 2	Month 3	Month 4
Supply	1	1,000	2,000	5,000	1,500
	2	100	400	2,000	700
	3	2,000	4,000	400	800
Direct Diversion Demands		**800**	**500**	**400**	**600**
Remaining Supply	**1**	200	1,500	4,600	900
	2	0	0	1,600	100
	3	1,200	3,500	0	200
Storage Demand		**3,000**			
Remaining Storage Demand	1	2,800	1,300	0	0
	2	3,000	3,000	1,400	1,300
	3	1,800	0	0	0
Final Availability	1	0	0	3,300	900
	2	0	0	0	0
	3	0	1,700	0	200

Although the general analytical approach for calculating availability is the same at each of the three POIs, the data aggregation and subsequent supply and demand calculations differ based on the geographic disaggregation and data availability of the sub watersheds upstream of each POI. As such, the following sections describe the geographic details and assumptions included in the availability calculations at each POI.

4.1.1 Red Bluff Point of Interest

The Sacramento River at Red Bluff was chosen as a POI as it corresponds to the first and primary Sites POD. Availability calculations at Red Bluff also provide insight to availability on the Upper Sacramento River and upper tributaries. Supply and demand datasets used for the availability calculations at Red Bluff are summarized in Table 16.

Availability calculations at Red Bluff were made by summing the FV demand for the 10 HUC-8s identified in Table 16 (as shown in Figure 10 as the Red Bluff Watershed) as the combined geographic area of these HUC-8s align well with the geographic area of the Sacramento River near Red Bluff unimpaired flow subbasin. The two-step availability calculation was then performed for the Red Bluff POI. Any year with supply remaining after the availability calculations was assumed to indicate water potentially available for appropriation at Red Bluff.

[27] The example shows a four-month period of three individual years. In Year 1, there is a total ***Supply*** available of 1,000 acre-feet in Month 1. Subtracting the 800 acre-feet of ***Direct Diversion Demand***, leaves 200 acre-feet of ***Remaining Supply***. There is 3,000 acre-feet of total ***Storage Demand*** in the watershed. Storage demands are met on a cumulative basis for the season (and reset each year), so after storage of the remaining 200 acre-feet, there is 2,800 acre-feet of ***Remaining Storage Demand.*** The remaining storage demand consumes all available supply for this month, leaving 0 acre-feet of ***Final Availability*** supply in Month 1 of Year 1. The calculations are then completed through the rest of year. In Month 3 of Year 1, the storage demand has been met on a cumulative basis, so water becomes available for appropriation. The final volumes available for appropriation in each year of the example are: Year 1 = 4,200 acre-feet; Year 2 = 0 acre-feet; Year 3 = 1,900 acre-feet.

Table 16. UF Subbasins, HUC-8s, and Corresponding Sub Watershed Aggregation Included in the Red Bluff POI Availability Calculation

UF Subbasin Supply	HUC-8 Code	HUC-8 Subbasin	Availability Calculation
UF 6 Sacramento River near Red Bluff	18020001	Goose Lake	Red Bluff
	18020002	Upper Pit	
	18020003	Lower Pit	
	18020004	McCloud	
	18020005	Sacramento Headwaters	
	18020151	Cow Creek	
	18020152	Cottonwood Creek	
	18020153	Battle Creek	
	18020154	Clear Creek-Sacramento River	
	18020155	Paynes Creek-Sacramento River	

4.1.2 Wilkins Slough Point of Interest

The Sacramento River at Wilkins Slough was chosen as a POI as it corresponds to the location for the Wilkins Slough Minimum Flow Requirement. Supply and demand datasets used for the availability calculations at Wilkins Slough are summarized in Table 17. The "Availability Calculation" column indicates which supply and demand calculation the identified UF subbasin(s) and FV Demand from the HUC-8(s) were included in.

Based on the geographic alignment of the unimpaired flow subbasins and HUC-8s for the Wilkins Slough region (as shown in Figure 10 as the Wilkins Slough Watershed), two availability calculations were completed for this region. The two-step availability calculations were first performed individually for the Stony Creek sub watershed as a "local availability" calculation. This sub watershed was conducive to a local availability calculation as the unimpaired flow subbasin and the HUC-8 aligned, and the calculation resulted in an estimated remaining supply from the Stony Creek sub watershed available for the Wilkins Slough POI availability calculation.

The total available supply at Wilkins Slough thus includes any remaining supply from the Stony Creek local availability calculation, the remaining supply from the Red Bluff availability calculation, and the supply from unimpaired flow subbasins 5 and 7. The two-step availability calculation was then performed using the total available supply and the remaining FV demand. Any year with supply remaining after the availability calculations was assumed to indicate water potentially available for appropriation at Wilkins Slough.

Table 17. UF Subbasins, HUC-8s, and Corresponding Sub Watershed Aggregation Included in the Wilkins Slough POI Availability Calculation

UF Subbasin Supply	HUC-8 Code	HUC-8 Subbasin	Availability Calculation
UF 4 Stony Creek at Black Butte	18020115	Upper Stony	Stony
UF 5 Sacramento Valley West Side Minor Streams & UF 7 Sacramento Valley East Side Minor Streams	18020104	Sacramento-Stone Corral	Wilkins Slough
	18020156	Thomes Creek-Sacramento River	
	18020157	Big Chico Creek-Sacramento River	
	18020158	Butte Creek	

4.1.3 Freeport Point of Interest

The Sacramento River at Freeport was chosen as a POI as it corresponds to the Sacramento River watershed outlet. All available supply and demands within the Sacramento River watershed occur upstream of Freeport, and thus any water available for appropriation at Freeport indicates water that may be available for appropriation on a watershed-wide scale. Supply and demand datasets used for the availability calculations at Freeport are summarized in Table 18 and discussed in more detail below. The “Availability Calculation” column indicates which supply and demand calculation the identified UF subbasin(s) and FV Demand from the HUC-8(s) were included in.

Similar to Wilkins Slough, local availability calculations were completed for several sub watersheds included in the Freeport POI availability calculations. These include Putah Creek, Cache Creek, the American River, and the Feather “watershed” (as shown in Figure 10 as the Freeport Watershed). The Feather watershed[28] included several steps of local availability calculations to arrive at a final local availability calculation for the entire Feather watershed:

- Local availability calculations were first completed individually for the “Oroville” sub watershed, the Yuba sub watershed, and the Bear sub watershed
- Any remaining supply from each of these three sub watersheds was then added to the supply from Sacramento Valley Floor unimpaired flow subbasin[29] and the two-step availability calculations were completed with this total supply and the FV demand from the Honcut-Headwaters-Lower Feather and the Upper Coon-Upper Auburn HUC-8s
- This final calculation results in a local availability calculation for the Feather watershed

[28] Assumed to be from the Feather-Sacramento River confluence upstream on the Feather River.
[29] Unimpaired flow subbasin 1 is the Sacramento Valley Floor region. This subbasin includes all local flows and minor creeks in the Sacramento Valley that are not included in any of the other Sacramento watershed unimpaired flow subbasins. This analysis makes a simplifying assumption that all flow in this subbasin is available for use in the “valley floor” region of the Feather watershed (HUC-8s 18020159 and 18020161) as typically most of the flow from this subbasin occurs in the minor streams that drain the foothills and valley floor from the Oroville-area south to the American watershed. Although this is a simplistic assumption, it is consistent with the level of detail included in this analysis.

Table 18. UF Subbasins, HUC-8s, and Corresponding Sub Watershed Aggregation Included in the Freeport POI Availability Calculation

UF Subbasin Supply	HUC-8 Code	HUC-8 Subbasin	Availability Calculation
UF 2 Putah Creek near Winters[30]	18020162	Upper Putah	Putah
UF 3 Cache Creek above Rumsey	18020116	Upper Cache	Cache
UF 11 American River at Fair Oaks	18020128	North Fork American	American
	18020129	South Fork American	
	18020111	Lower American	
UF 8 Feather River near Oroville	18020121	North Fork Feather	Oroville
	18020122	East Branch North Fork Feather	
	18020123	Middle Fork Feather	
UF 9 Yuba River at Smartville	18020125	Upper Yuba	Yuba
UF 10 Bear River near Wheatland	18020126	Upper Bear	Bear
UF 1 Sacramento Valley Floor	18020159	Honcut Headwaters-Lower Feather	Feather
	18020161	Upper Coon-Upper Auburn	
-	18020163	Lower Sacramento	Freeport

The final availability calculation for Freeport takes the remaining supply from Wilkins Slough, plus the Putah, Cache, American, and Feather watersheds, and then completes the two-step availability calculation using the FV Demand from the Lower Sacramento HUC-8. After completing the availability calculations at each POI, the final, overall availability calculation is completed by limiting the total volume of water available for appropriation to the minimum volume across the three POIs in each diversion year. This ensures that water shown available is above the volumes needed for senior water right holders at each POI.

4.2 Results

The following section presents a summary of the water available for appropriation calculated at each of the POIs and overall, for the period of available supply data, October 1921 through September 2014. Water available for appropriation is the minimum volume of water available in each diversion year across the three POIs. Water availability calculations are presented as an annual water year volume, with October of the diversion year corresponding to the water year indicated in the following tables and figures. As previously described, although the calculations in the spreadsheet used for the Face Value

[30] Although Putah Creek does not drain into the Sacramento River above Freeport, the sub watershed is located in the Sacramento River watershed and is upstream of the Legal Delta. The inclusion or exclusion of the Putah Creek sub watershed in this analysis does not affect the overall availability results as the local availability calculations for Putah Creek do not result in any flow available for appropriation from the Putah Creek sub watershed.

Analysis are completed on a monthly timestep, the assumptions used to structure the analysis make it appropriate to only consider the final results on a seasonal or water year basis.

Figure 11 shows the overall volumes of water available for appropriation in each diversion year of the 93-year period of analysis. Water is available in 39 out of 93 years (~42%), with an annual average volume of approximately 1,139,000 acre-feet. In years that water is available, availability ranges from approximately 10,000 acre-feet to approximately 8,309,000 acre-feet. Table 19 shows the average annual volumes of water available for appropriation, at each POI and overall, by Sacramento Valley water year type and for the period of analysis. Water is mostly available in Wet and Above Normal years, but the Face Value Analysis also indicates some availability in Below Normal and Dry years. Water available for appropriation is typically greatest at Freeport and lowest at Red Bluff. This is further demonstrated by Figure 12, which shows the probability of exceedance of annual volumes of water available for appropriation at each POI and for the watershed overall. Overall availability is typically controlled by availability at Red Bluff, with water typically available in much greater volumes and at a greater frequency at Wilkins Slough and Freeport. Water is available in over 85% of years at both of those POIs.

Table 19. Average Volumes of Water Available for Appropriation under the Face Value Analysis. Values in 1,000 acre-feet

WY Type / Location	Red Bluff	Wilkins Slough	Freeport	Overall
W	3,328	4,214	5,273	3,289
AN	1,029	1,436	1,630	1,029
BN	29	263	283	29
D	0.5	159	149	0.5
C	0	38	28	0
All	1,151	1,559	1,905	1,139
Max Year (Year)	8,309 (1983)	10,391 (1983)	14,059 (1983)	8,309 (1983)

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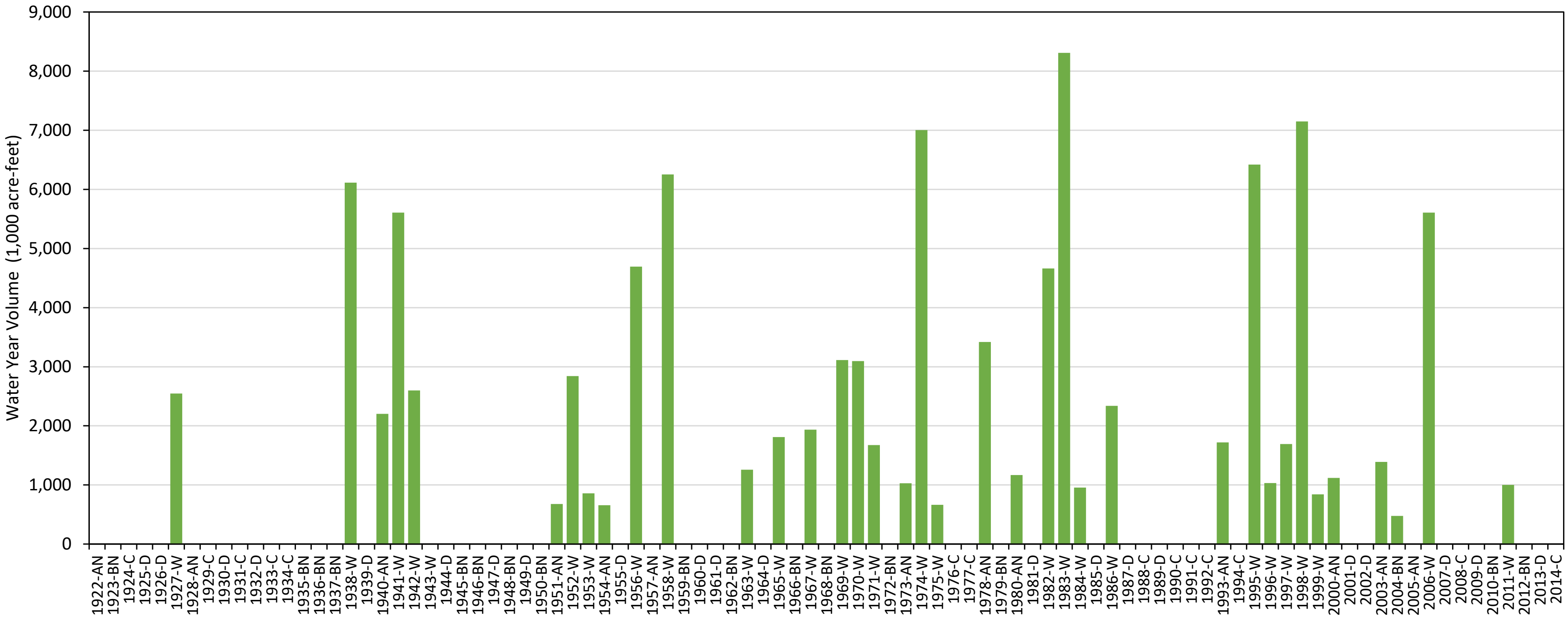

Figure 11. Overall Annual Volumes of Water Available for Appropriation under the Face Value Analysis

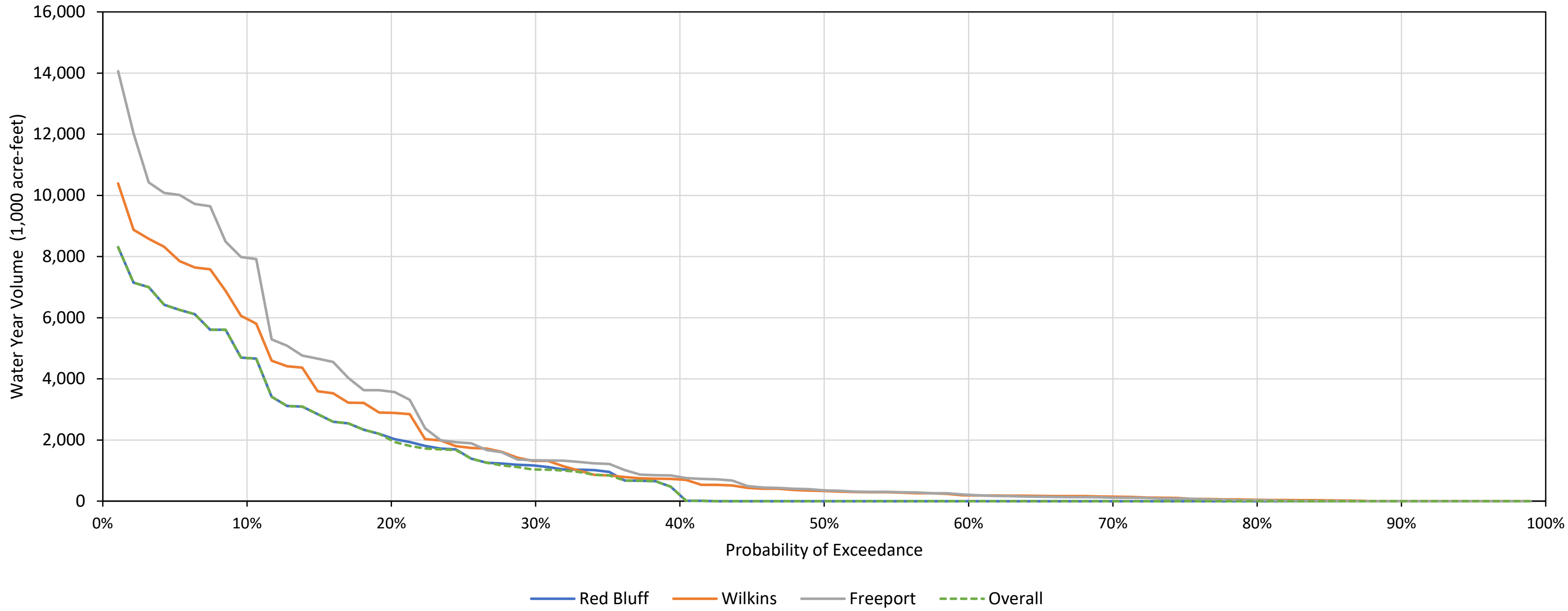

Figure 12. Probability of Exceedance of the Annual Volumes of Water Available for Appropriation under the Face Value Analysis at Each POI and Overall

4.3 Face Value Analysis Conclusions

The Face Value Analysis was developed at the request of Division staff to provide a conservative, watershed-wide estimate of the volumes of unappropriated water available for appropriation under the Application. The analysis was structured to use the face value of all water right demands in the Sacramento River watershed, including the face value storage demand for all reservoirs. The availability calculations were designed to calculate availability from upstream to downstream and to allow for the use of all FV Demand in each year (i.e., reservoirs can store the face value storage demand every year). This structure provides a technically sound and straightforward way of estimating availability, while also providing an exceptionally conservative view of existing water right demands in the system.

The results of the Face Value Analysis showed water available at each of the three POIs in at least 42% of years. Availability was mostly in Wet and Above Normal years, but some availability also occurred in Below Normal and Dry years. In the years that water was available, more than half indicated volumes of water available that were greater than 1.5 million acre-feet – the design capacity of Sites Reservoir. As such, if the same assumption made for other storage demands in this analysis was made for the Sites water right, Sites Reservoir would be able to completely fill from empty in 23 out of 93 years (~25%).

As noted above, the results presented for the Face Value Analysis include all water rights in the Sacramento River watershed senior to the priority date requested in the Sites water right application, except for all State Filings in the Sacramento River watershed. A separate Face Value Analysis was completed which includes all State Filings in the Sacramento watershed that are senior to Sites' requested priority date. The results of this separate analysis also show water being available for appropriation, although at lesser volumes and frequencies than shown under the Face Value Analysis presented here. The results and a brief discussion of this separate analysis can be found in Appendix C.

5 Water Availability Analysis Conclusions

Three approaches were developed to evaluate the potential volumes of water available for appropriation by Sites Reservoir. Each of these approaches relies upon different supply and demand assumptions with varying degrees of conservatism. Overall, the approaches provide a range of average annual volumes of water available between 870,000 and 1,174,000 acre-feet.

The Historical Analysis relies upon recent gage data that allows the approach to consider system operations when calculating water availability. This is important because the proposed PODs are located downstream from Shasta Reservoir which regulates flows on the Sacramento River. To ensure that senior downstream water rights and flow requirements for fish and wildlife protection and enhancement are met, FV Demand and site-specific flow criteria are included in this analysis. During the period of analysis from 2000 through 2021, the Historical Analysis estimates that an annual average of approximately 870,000 acre-feet of water is available per year; ranging from a minimum of 0 acre-feet in 2021 to almost 4,000,000 acre-feet in 2006.

The Historical Analysis was also relied upon to evaluate water available for appropriation from Funks and Stone Corral creeks. The Historical Analysis indicates that water was available from the creeks in seven years out of the 22-year period of analysis; ranging in a combined availability from the creeks of approximately 2,000 acre-feet to 32,000 acre-feet. The combined annual average volume of water available for appropriation at the Funks and Stone Corral creeks PODs is approximately 2,900 acre-feet. Although the analysis indicates that water is available above what is needed for senior FV Demand on the creeks, the Authority has committed to studies which will include assessments of fish assemblage and available habitat, flow characteristics, water temperatures, losses, and methods for reporting data. The Technical Studies will allow the Authority to better understand flows in the creeks and will be completed prior to impoundment of Funks Creek and Stone Corral Creek.

As compared to the Historical Analysis, the CalSim II Analysis provides an estimate of water available for appropriation across a wider variety of hydrology under current regulatory requirements and demands. Similar to the Face Value Analysis, the CalSim II Analysis provides a watershed- and system-wide outlook on availability. In contrast to both the Historical and Face Value Analyses, the CalSim II Analysis provides a more operationally realistic outlook on availability given the operational requirements and demands simulated in the model. The CalSim II Analysis estimates the largest average annual volume of water available for appropriation (1,174,000 acre-feet) as compared to the other two approaches. The historical conditions evaluated in the CalSim II Analysis described in Section 3 are an important baseline for evaluating the potential effects of climate change on the volumes of water available for appropriation described in Section 6.1.

The Face Value Analysis is a more theoretical analysis that removes system operations from the supply side of the calculation and instead develops a scenario where senior water rights divert the maximum allowed under their rights at all times. The Face Value Analysis provides a watershed-wide estimate of the volumes of unappropriated water available for appropriation under the Sites Reservoir water right. Due to the theoretical nature of the analysis and the complex water operations which occur in the Sacramento watershed, the Face Value Analysis evaluates water availability on a seasonal timestep. The Face Value Analysis calculates that water is available in 39 out of 93 years (~42%), with an annual average volume of approximately 1,139,000 acre-feet. In years that water is available, availability ranges from approximately 10,000 acre-feet in 2001 to approximately 8,309,000 acre-feet in 1983.

Together, all three approaches provide sufficient information for the State Water Board to determine unappropriated water is available because each approach used different assumptions to evaluate water availability. Because each of the three approaches indicate a reasonable likelihood that water is available for appropriation, this report constitutes sufficient information supporting a decision by the State Water Board to accept the Application.

6 Future Conditions

Sites Reservoir is a long-term project that is anticipated to be constructed and operable by 2030. Sites Reservoir is intended to be a climate-resilient project that will provide supply by capturing storm-related runoff instead of relying on spring snowmelt. Therefore, it is important that the Authority demonstrates the ability to operate under future climate change scenarios and with diversions occurring during the appropriate months. In addition, there are proposed regulatory changes that have the potential to affect the availability of water for appropriation in the Sacramento watershed. This section describes some of these potential future conditions and discusses their potential effects to water available for appropriation by Sites Reservoir.

6.1 Climate Change

At the time of the writing of this report, the Sites project team had prepared a CalSim II model which uses 2035 CT climate change hydrology[31]. This CalSim II model is essentially identical to the model used for the CalSim II Analysis (Section 3), except for the use of the 2035 CT climate change hydrology. The diversion and operations logic included for Sites Reservoir is identical. As such, the results from this CalSim II model can be input to the CalSim WAA Tool to determine the volumes of water available for appropriation under 2035 CT climate change hydrology.

6.1.1 Water Available for Appropriation

The following section presents a summary of the water available for appropriation calculated by the CalSim WAA Tool for the period of analysis in the CalSim II model, October 1921 through September 2003. As previously noted, given the operational configuration of Sites' diversions in CalSim II and the "system-wide" view of water available for appropriation by Sites within CalSim II, volumes of water available for appropriation are presented for a single "location". In actual operations, this would be equal to the maximum combined volume that would be available for appropriation between the two Sacramento River Sites PODs. Results presented below first show the results from this simulation, while the following section presents the results in a comparative sense to the CalSim II model results under historical hydrology.

Figure 13 shows the annual volumes of water available for appropriation over the 82-year simulation period of the CalSim II study. On average, approximately 1,212,000 acre-feet is annually available for appropriation under 2035 CT climate change hydrology. Water is available in 73 out of 82 years (~89%) in annual volumes ranging from approximately 43,000 acre-feet to approximately 4,322,000 acre-feet. Figure 14 shows the probability of exceedance of the annual volumes of water available for

[31] 2035 Central Tendency Climate Change provides a near-term outlook on climate change effects to hydrology. The Central Tendency projection values were calculated based on averaging around the 30-year period of 2020–2049 projections from CalSim II model output to represent "with climate change". Additional model assumptions can be found in *Chapter 28* and *Appendix 28A* of the Revised Draft EIR/Supplemental Draft EIS.
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appropriation. More than 1,000,000 acre-feet is available in nearly 50% of years, and over 1,500,000 acre-feet is available in approximately 40% of years.

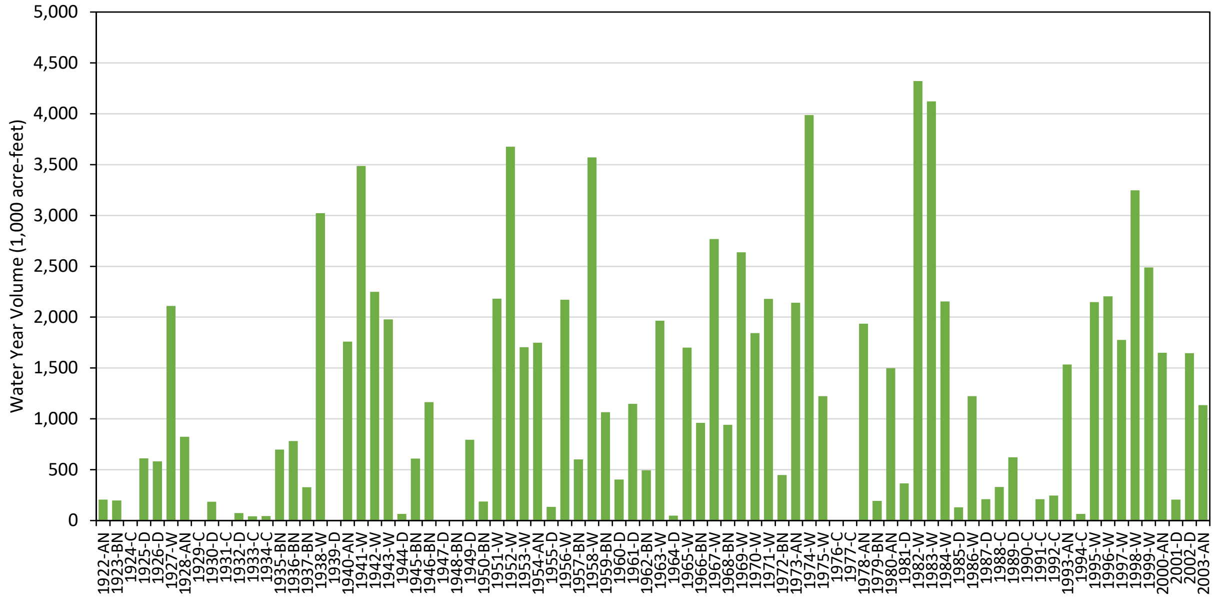

Figure 13. Annual Volumes of Water Available under 2035 CT Climate Change

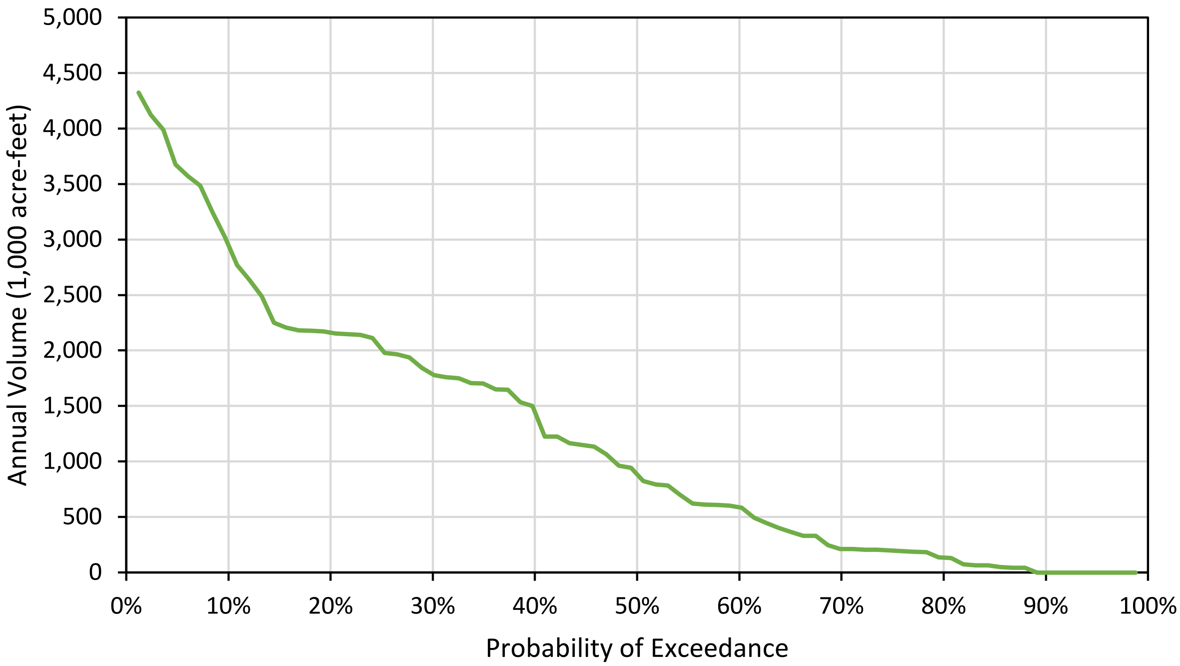

Figure 14. Probability of Exceedance of Annual Water Available for Appropriation under 2035 CT Climate Change

Table 20 shows the average monthly volumes of water available for appropriation by Sacramento Valley Water Year Type and for all years. The monthly volumes for the maximum water year (1982) are shown for additional reference. Water is available in all months of the proposed water right season (September through June). Water is available in the largest volumes in Wet and Above Normal years, but some volume of water is available in all water year types.

Table 20. Average Monthly Volumes of Water Available for Appropriation under 2035 CT Climate Change. Values in 1,000 acre-feet

Month / WY Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Wet	5	69	429	571	585	474	331	52	9	0	0	0	2,537
Above Normal	0	9	45	362	546	427	53	0	0	0	0	7	1,435
Below Normal	0	0	56	120	243	122	27	0	0	0	0	5	577
Dry	0	5	78	49	131	138	0	0	0	0	0	0	401
Critical	0	0	5	24	24	26	0	0	0	0	0	0	78
All Years	2	25	175	268	336	265	121	17	3	0	0	2	1,212
Max Year (1982)	0	539	806	756	567	748	906	0	0	0	0	0	4,322

6.1.2 Change to Water Available for Appropriation from Historical Hydrology

Most differences to the volumes of water available for appropriation between the 2035 CT climate change and historical hydrology results are relatively minor, with the biggest changes occurring in the timing and seasonal volumes of water available.

Figure 15 shows the probability of exceedance of annual water available for appropriation for the CalSim II model runs under historical hydrology and under 2035 CT climate change hydrology. Availability is slightly higher under historical hydrology in the lower probability range (0 – 15%), somewhat higher under the 2035 CT climate change hydrology in the middle probability range (20 – 60%), and similar at all other exceedance probability levels. Overall, annual average availability is nearly 40,000 acre-feet higher under 2035 CT climate change hydrology.

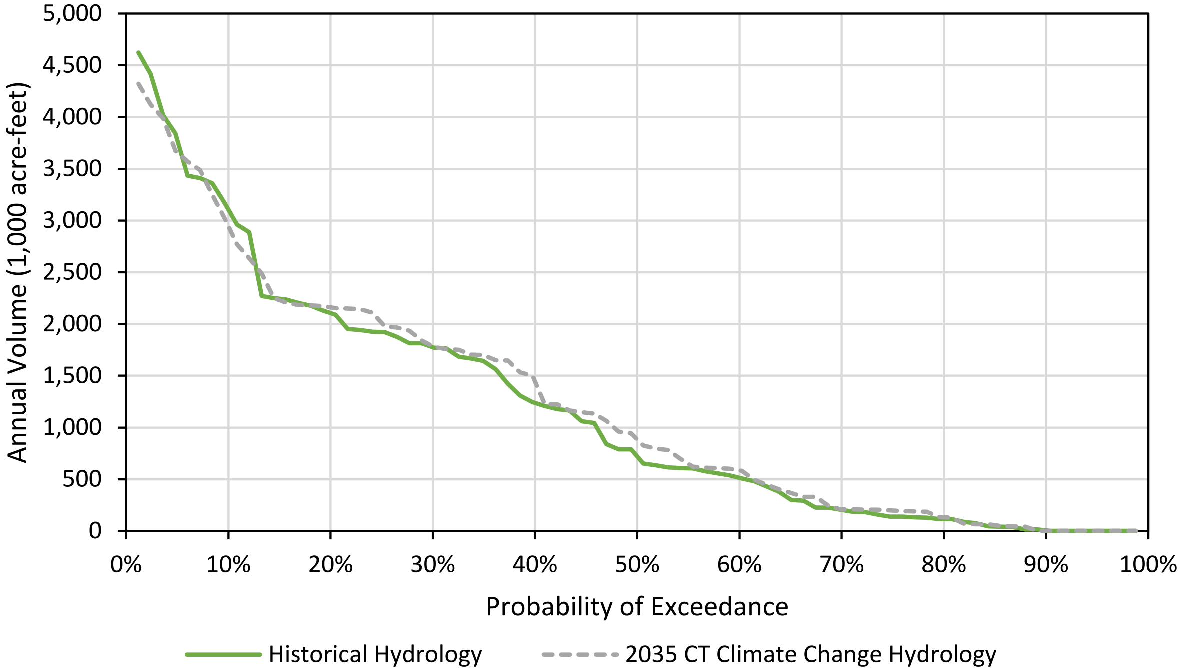

Figure 15. Probability of Exceedance of Annual Volumes of Water Available for Appropriation under Historical Hydrology and 2035 CT Climate Change Hydrology

Table 21 shows the difference in monthly average volumes of water available for appropriation by Sacramento Valley Water Year Type and over the entire simulation. Values show the results under 2035 CT climate change hydrology minus the results under historical hydrology. In the December through March period of most water year types, availability is lower under historical hydrology. Conversely, availability is greater in the October through November and April through June period under historical hydrology. This shift in availability – drier fall and spring months, wetter winter months – is consistent with recent observed shifts in hydrology, shifts that are further expected to occur under climate driven changes to Central Valley hydrology[32]. Despite these differences, water is still shown to potentially be available for appropriation in all months of the Sites diversion season, September through June, and in all year types. As noted above, the annual average volume of water available for appropriation is nearly 40,000 acre-feet higher under 2035 CT climate change hydrology.

[32] Swain, D. L. (2021). A shorter, sharper rainy season amplifies California wildfire risk. Geophysical Research Letters, 48, e2021GL092843. https://doi. org/10.1029/2021GL092843

Table 21. Difference in Monthly Average Volumes of Water Available for Appropriation (2035 CT Climate Change Hydrology minus Historical Hydrology). Values in 1,000 acre-feet

Month / WY Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Wet	-5	-6	35	55	19	-4	-7	-53	-11	0	0	-28	-4
Above Normal	0	-5	-44	22	73	21	-14	0	-2	0	0	0	51
Below Normal	0	-7	6	34	11	40	-4	0	0	0	0	-1	79
Dry	0	-22	21	9	16	34	0	0	0	0	0	0	57
Critical	-1	-1	1	9	6	8	0	0	0	0	0	0	22
All Years	-2	-8	15	29	20	14	-2	-16	-4	0	0	-9	38

6.2 Updates to Bay-Delta Plan

The State Water Board is responsible for updating the Water Quality Control Plan for the San Francisco Bay/Sacramento – San Joaquin Delta Estuary, which establishes water quality objectives for the protection of beneficial uses in the Bay-Delta. The State Water Board is considering amendments to the Bay-Delta Plan focused on the Sacramento River, its tributaries, Delta eastside tributaries, and the Delta. These areas are generally referred to as the "Sacramento/Delta." Amendments to the Sacramento/Delta flow requirements of the Bay-Delta Plan would affect water availability in the Sacramento River Watershed.

6.2.1 2018 Framework and Voluntary Agreements

In October 2017, State Water Board staff issued its Scientific Basis Report in support of updates to the Bay-Delta Plan which included an unimpaired flow approach. Specifically, the Scientific Basis Report recommends that unimpaired flows be used to dedicate a portion of the watershed inflow to protect instream fish and wildlife. State Water Board staff then prepared and released its "July 2018 Framework for the Sacramento/Delta Update to the Bay-Delta Plan" (Framework). The Framework identifies a proposed inflow level of 45-65% of unimpaired flow, with a starting point of 55%. In December 2018, the State Water Board adopted Resolution No. 2018-0059 to update the 2006 Bay-Delta Plan, including the addition of specific flow objectives for the Lower San Joaquin River. Resolution No. 2018-0059 does not include specific inflow objectives for the Sacramento/Delta. At this time, significant uncertainty remains in regard to the State Water Board's adoption and implementation of staff's unimpaired inflow approach and its effect on individual water rights and tributaries in the Sacramento River watershed.

Governor Brown and Governor Newsom both called upon the California Natural Resources Agency to convene parties and help facilitate voluntary agreements among interested parties to implement flow and non-flow actions to meet regulatory standards and support all beneficial uses of water. The voluntary agreements are intended to provide an alternative to implementation of the State Water Board staff's proposed unimpaired flow approach. As a result of these collective efforts on the voluntary agreements, various presentations and materials have been provided to the State Water Board. Most recently and under Governor Newsom's leadership, a memorandum of understanding (MOU) was signed on March 29, 2022, by state, federal, and local water leaders entitled, "Memorandum of Understanding Advancing a Term Sheet for the Voluntary Agreements to Update and Implement the Bay-Delta Water Quality Control Plan, and Other Related Actions" (VA Framework), with broad agreement on measures to provide additional flows and new habitat to improve conditions in the

Sacramento/Delta through the voluntary agreement process. The VA Framework describes an alternative for the State Water Board's Bay-Delta Plan Update to meet the objectives through an integrated program that includes habitat creation; new flows for the environment above existing regulatory requirements; funding for environmental improvements and water purchases; and a new, collaborative, science program for monitoring and adaptive management. The VA Framework outlines the terms, governance framework, and a habitat monitoring framework to implement the Bay-Delta Plan objectives.

The State Water Board is developing a Scientific Basis Report, which will include an evaluation of the VA Framework. The draft of the Scientific Basis Report is expected to be released for public review and comment in the summer of 2022. Additionally, State Water Board staff is developing the Draft Staff Report, which evaluates environmental and economic impacts of the alternatives, including the VA Framework. The Draft Staff Report for the Bay-Delta Plan Update, expected fall 2022, is expected to include release of the Sacramento Water Allocation Model (SacWAM) files and results which will analyze the alternatives for the Sacramento/Delta Plan Update outlined in the Framework and the voluntary agreement. The public review and engagement process will include a public workshop planned for early 2023, response to comments, and development of proposed final changes to the Bay-Delta Plan for the Sacramento/Delta.

6.2.2 Change to Water Available for Appropriation

At this time, there is no definitive proposed Sacramento/Delta Update of the Bay-Delta Plan. In addition, State Water Board staff has not yet released the SacWAM results and files for all alternatives. Although the Framework provides initial estimates of water supply costs, the estimates presented are annual averages for the entire Sacramento/Delta. There is not enough information provided to disaggregate the estimated water supply cost to evaluate the potential change to water available for Sites Reservoir at its proposed PODs on the Sacramento River, Funks Creek, and Stone Corral Creek, nor is there enough information to evaluate the water supply cost during the Project's proposed diversion season. The Framework also does not provide or describe operational objectives or compliance locations for how the regulations would be met. As such, it is unclear exactly how the system would be operated to meet these objectives and how and when they would specifically affect Sites ability to divert.

Recognizing that the Sacramento/Delta Update could restrict diversions in the future, as part of its water right application, the Authority has requested that the State Water Board include Standard Permit Term 96 in a permit issued pursuant to its application[33]. Term 96 recognizes that the Bay-Delta Plan is being updated and provides that the amount authorized for diversion under any permit may be reduced due to implementation of the Bay-Delta Plan Update.

As described in Section 2.1.1, updates to the Bay-Delta Plan are intended to protect fish and wildlife and, therefore, evaluation of the potential amendments are unnecessary to comply with Water Code sections 1243 and 1243.5. The Authority has included Pulse Protection Criteria at Bend Bridge and Minimum Flow Requirements at Wilkins Slough for fish and wildlife purposes in the Historical Analysis and CalSim II Analysis. Potential future unimpaired flow requirements being considered for the

[33] https://www.waterboards.ca.gov/waterrights/water_issues/programs/permits/terms_80thru99.html

Sacramento/Delta Bay-Delta Plan Update represent possible future operating conditions that have not yet been established and are speculative at this time.

Without additional information (e.g., SacWAM results) to calculate water availability under this potential new regulatory condition, it is not possible for the Authority to evaluate the impacts of such changes to the Project. Although regulatory conditions in CalSim II can be modified to analyze future conditions, the granularity of supply and demands in CalSim II limits the utility of the model to evaluate the various regulatory conditions proposed for the Bay-Delta Plan Update.

Appendices

Appendix A: Historical Analysis

Water Available for Appropriation and Diversion Estimates

Table A - 1 shows the monthly volumes of water available for appropriation at the TCC POD for the entire period of analysis. The results show some volume of water available in all years, except 2021, and in all months from December through June. Volumes summarized by water year type are shown in Section 2.2.2.

Table A - 1. Monthly Volume of Water Available for Appropriation at TCC POD under the Historical Analysis. Volumes in 1,000 acre-feet

Month / WY	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
2000	-	-	-	126	839	635	22	0	0	0	0	0	1,622
2001	0	0	0	0	118	111	0	0	0	0	0	0	229
2002	0	0	186	423	0	22	0	0	0	0	0	0	632
2003	0	0	152	906	139	31	124	381	0	0	0	0	1,733
2004	0	0	253	414	541	463	0	0	0	0	0	0	1,671
2005	0	0	0	76	8	57	6	355	4	0	0	0	506
2006	0	0	204	949	468	1,062	961	286	16	0	0	0	3,945
2007	0	0	14	0	19	2	0	0	0	0	0	0	35
2008	0	0	0	15	57	0	0	0	0	0	0	0	72
2009	0	0	0	0	52	78	0	0	0	0	0	0	130
2010	0	0	0	75	140	29	13	3	17	0	0	0	278
2011	0	0	364	188	7	565	404	17	108	0	0	0	1,653
2012	0	0	0	0	0	43	32	0	0	0	0	0	74
2013	0	0	217	5	0	0	0	0	0	0	0	0	222
2014	0	0	0	0	0	14	0	0	0	0	0	0	14
2015	0	0	251	0	0	0	0	0	0	0	0	0	251
2016	0	0	0	336	39	445	0	0	0	0	0	0	819
2017	0	0	189	714	832	700	611	45	0	0	0	0	3,091
2018	0	0	0	1	0	27	0	0	0	0	0	0	29
2019	0	0	0	159	223	929	611	7	26	0	0	0	1,954
2020	0	0	3	0	0	0	0	0	0	0	0	0	3
2021	0	0	0	0	0	0	0	0	0	0	0	0	0
Average	0	0	87	199	158	237	127	50	8	0	0	0	862

Table A - 2 shows the monthly volumes of water available for appropriation at the GCID POD for the entire period of analysis. The results show some volume of water available in all years, except 2021, and in all months from December through June. Results presented in this table show potential volumes available at the GCID POD with no assumption for diversions occurring at the TCC POD. Volumes summarized by water year type are shown in Section 2.2.2.

Table A - 2. Monthly Volume of Water Available for Appropriation at GCID POD under the Historical Analysis. Volumes in 1,000 acre-feet

Month / WY	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
2000	-	-	-	126	839	635	22	0	0	0	0	0	1,622
2001	0	0	0	0	127	122	0	0	0	0	0	0	250
2002	0	0	189	428	0	22	0	0	0	0	0	0	639
2003	0	0	152	906	139	31	124	381	0	0	0	0	1,733
2004	0	0	253	416	548	463	0	0	0	0	0	0	1,680
2005	0	0	0	81	8	57	6	355	4	0	0	0	512
2006	0	0	204	949	468	1,062	961	291	16	0	0	0	3,950
2007	0	0	14	0	19	2	0	0	0	0	0	0	35
2008	0	0	0	15	57	0	0	0	0	0	0	0	72
2009	0	0	0	0	52	81	0	0	0	0	0	0	134
2010	0	0	0	85	144	29	13	3	17	0	0	0	291
2011	0	0	364	188	7	565	404	17	108	0	0	0	1,653
2012	0	0	0	0	0	46	32	0	0	0	0	0	78
2013	0	0	237	5	0	0	0	0	0	0	0	0	242
2014	0	0	0	0	0	14	0	0	0	0	0	0	14
2015	0	0	264	0	0	0	0	0	0	0	0	0	264
2016	0	0	0	364	40	454	0	0	0	0	0	0	858
2017	0	0	208	715	832	700	611	45	0	0	0	0	3,110
2018	0	0	0	1	0	28	0	0	0	0	0	0	29
2019	0	0	0	172	229	929	611	7	26	0	0	0	1,974
2020	0	0	3	0	0	0	0	0	0	0	0	0	3
2021	0	0	0	0	0	0	0	0	0	0	0	0	0
Average	0	0	90	202	160	238	127	50	8	0	0	0	870

Table A - 3 shows the monthly volumes of water available for appropriation on Funks and Stone Corral creeks for the entire period of analysis. The results show some volume of water available in all months from January through April. Volumes summarized by water year type are shown in Section 2.2.2.

Table A - 3. Combined Monthly Volumes of Water Available for Appropriation at Funks and Stone Corral Creeks PODs under the Historical Analysis. Volumes in acre-feet

Month / WY	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
2000	-	-	-	0	5,061	0	0	0	0	0	0	0	5,061
2001	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	0	0	0	2,024	0	0	0	0	0	0	0	0	2,024
2003	0	0	0	723	0	0	0	0	0	0	0	0	723
2004	0	0	0	0	8,294	0	0	0	0	0	0	0	8,294
2005	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	0	0	0	0	0	0	6,021	0	0	0	0	0	6,021
2007	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	0	0	0	0	0	0	0	0	0	0	0	0	0
2010	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	0	0	0	0	0	0	0	0	0	0	0	0	0
2012	0	0	0	0	0	0	0	0	0	0	0	0	0
2013	0	0	0	0	0	0	0	0	0	0	0	0	0
2014	0	0	0	0	0	0	0	0	0	0	0	0	0
2015	0	0	0	0	0	0	0	0	0	0	0	0	0
2016	0	0	0	0	0	0	0	0	0	0	0	0	0
2017	0	0	0	4,284	19,593	0	0	0	0	0	0	0	23,877
2018	0	0	0	0	0	0	0	0	0	0	0	0	0
2019	0	0	0	0	15,108	2,702	0	0	0	0	0	0	17,809
2020	0	0	0	0	0	0	0	0	0	0	0	0	0
2021	0	0	0	0	0	0	0	0	0	0	0	0	0
Average	0	0	0	320	2,184	123	274	0	0	0	0	0	2,900

Table A - 4 shows the monthly volumes of water potentially diverted at the TCC POD for the entire period of analysis. This assumes a diversion capacity of 2,200 cfs at the TCC POD, with no assumption for hydraulic limitations at lower flows. Results show what could have been diverted, not what would have been diverted, as there is no accounting of available storage space in Sites Reservoir. The results show some volume of water potentially diverted in all years, except 2021, and in all months from December through June. Table A - 5 shows results from the first table averaged by Sacramento Valley Water Year Type.

Table A - 4. Estimated Monthly Volume of Water Diverted at TCC POD under the Historical Analysis. Volumes in 1,000 acre-feet

Month / WY	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
2000	-	-	-	26	127	109	19	0	0	0	0	0	281
2001	0	0	0	0	36	48	0	0	0	0	0	0	84
2002	0	0	63	83	0	21	0	0	0	0	0	0	166
2003	0	0	31	135	55	28	26	98	0	0	0	0	374
2004	0	0	48	101	93	87	0	0	0	0	0	0	329
2005	0	0	0	42	6	34	6	82	4	0	0	0	174
2006	0	0	26	135	110	135	131	133	16	0	0	0	687
2007	0	0	7	0	18	2	0	0	0	0	0	0	27
2008	0	0	0	12	22	0	0	0	0	0	0	0	34
2009	0	0	0	0	18	26	0	0	0	0	0	0	44
2010	0	0	0	24	54	18	10	3	17	0	0	0	128
2011	0	0	78	82	7	120	115	17	45	0	0	0	464
2012	0	0	0	0	0	13	21	0	0	0	0	0	34
2013	0	0	66	5	0	0	0	0	0	0	0	0	72
2014	0	0	0	0	0	7	0	0	0	0	0	0	7
2015	0	0	58	0	0	0	0	0	0	0	0	0	59
2016	0	0	0	75	20	85	0	0	0	0	0	0	180
2017	0	0	65	123	122	135	131	20	0	0	0	0	597
2018	0	0	0	1	0	13	0	0	0	0	0	0	15
2019	0	0	0	38	55	135	113	6	25	0	0	0	371
2020	0	0	3	0	0	0	0	0	0	0	0	0	3
2021	0	0	0	0	0	0	0	0	0	0	0	0	0
Average	0	0	21	40	34	46	26	16	5	0	0	0	188

Table A - 5. Monthly Average Volumes of Water Diverted at TCC POD under the Historical Analysis. Volumes in 1,000 acre-feet

Month / WY Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Wet	0	0	42	94	74	131	123	44	21	0	0	0	530
Above Normal	0	0	16	68	62	66	17	64	1	0	0	0	289
Below Normal	0	0	10	40	33	43	9	1	3	0	0	0	139
Dry	0	0	23	15	18	16	0	0	0	0	0	0	71
Critical	0	0	15	7	7	2	0	0	0	0	0	0	31
All Years	0	0	21	41	36	47	27	17	5	0	0	0	193

Table A - 6 shows the monthly volumes of water potentially diverted at the GCID POD for the entire period of analysis. This assumes a diversion capacity of 2,000 cfs at the GCID POD, with no assumption for canal maintenance periods. Results show what could have been diverted, not what would have been diverted, as there is no accounting of available storage space in Sites Reservoir. Results also show what would have been available to be diverted after the potential diversions at the TCC POD shown in the previous table. The results show some volume of water potentially diverted in all years, except 2020 and 2021, and in all months from December through June. Table A - 7 shows results from the first table averaged by Sacramento Valley Water Year Type.

Table A - 6. Potential Volume of Water Diverted at GCID POD under the Historical Analysis. Volumes in 1,000 acre-feet

Month / WY	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
2000	-	-	-	24	115	88	3	0	0	0	0	0	229
2001	0	0	0	0	28	27	0	0	0	0	0	0	55
2002	0	0	44	65	0	1	0	0	0	0	0	0	111
2003	0	0	20	123	31	3	22	68	0	0	0	0	267
2004	0	0	44	72	74	66	0	0	0	0	0	0	255
2005	0	0	0	21	3	18	0	66	0	0	0	0	108
2006	0	0	24	123	71	123	119	89	0	0	0	0	549
2007	0	0	4	0	1	0	0	0	0	0	0	0	5
2008	0	0	0	3	12	0	0	0	0	0	0	0	15
2009	0	0	0	0	10	17	0	0	0	0	0	0	26
2010	0	0	0	14	35	6	2	0	0	0	0	0	57
2011	0	0	63	44	0	78	72	0	24	0	0	0	283
2012	0	0	0	0	0	12	8	0	0	0	0	0	20
2013	0	0	41	0	0	0	0	0	0	0	0	0	41
2014	0	0	0	0	0	4	0	0	0	0	0	0	4
2015	0	0	45	0	0	0	0	0	0	0	0	0	45
2016	0	0	0	67	10	69	0	0	0	0	0	0	145
2017	0	0	55	107	111	123	119	12	0	0	0	0	527
2018	0	0	0	0	0	8	0	0	0	0	0	0	8
2019	0	0	0	29	41	123	95	1	1	0	0	0	290
2020	0	0	0	0	0	0	0	0	0	0	0	0	0
2021	0	0	0	0	0	0	0	0	0	0	0	0	0
Average	0	0	16	31	25	35	20	11	1	0	0	0	138

Table A - 7. Monthly Average Volumes of Water Diverted at GCID POD under the Historical Analysis. Volumes in 1,000 acre-feet

Month / WY Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Wet	0	0	35	76	56	112	101	26	6	0	0	0	412
Above Normal	0	0	10	56	50	36	8	45	0	0	0	0	202
Below Normal	0	0	9	30	24	32	2	0	0	0	0	0	97
Dry	0	0	15	11	6	8	0	0	0	0	0	0	40
Critical	0	0	11	1	3	1	0	0	0	0	0	0	16
All Years	0	0	16	31	25	35	20	11	1	0	0	0	138

Given the assumptions previously noted for the potential diversions at the TCC and GCID PODs, the total potential diversion volume is the sum of the values in the previous tables. Table A - 8 presents these values for each month of the period of analysis, while Table A - 9 provides results from the first table averaged by Sacramento Valley Water Year Type. Overall, water can potentially be diverted in all years except 2021, in volumes ranging from 3,000 acre-feet to 1,236,000 acre-feet. The annual average diversion is approximately 326,000 acre-feet.

Table A - 8. Combined Potential Monthly Volume of Water Diverted at TCC POD and GCID POD under the Historical Analysis. Volumes in 1,000 acre-feet

Month / WY	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
2000	-	-	-	50	242	197	22	0	0	0	0	0	511
2001	0	0	0	0	63	75	0	0	0	0	0	0	138
2002	0	0	107	148	0	22	0	0	0	0	0	0	277
2003	0	0	51	258	86	31	48	166	0	0	0	0	641
2004	0	0	92	173	168	152	0	0	0	0	0	0	585
2005	0	0	0	63	8	52	6	148	4	0	0	0	282
2006	0	0	50	258	182	258	250	222	16	0	0	0	1,236
2007	0	0	11	0	19	2	0	0	0	0	0	0	32
2008	0	0	0	15	34	0	0	0	0	0	0	0	49
2009	0	0	0	0	27	43	0	0	0	0	0	0	70
2010	0	0	0	38	89	25	13	3	17	0	0	0	185
2011	0	0	142	126	7	198	188	17	69	0	0	0	747
2012	0	0	0	0	0	25	29	0	0	0	0	0	54
2013	0	0	107	5	0	0	0	0	0	0	0	0	113
2014	0	0	0	0	0	11	0	0	0	0	0	0	11
2015	0	0	104	0	0	0	0	0	0	0	0	0	104
2016	0	0	0	142	30	154	0	0	0	0	0	0	325
2017	0	0	120	230	233	258	250	32	0	0	0	0	1,124
2018	0	0	0	1	0	21	0	0	0	0	0	0	23
2019	0	0	0	66	96	258	208	7	26	0	0	0	662
2020	0	0	3	0	0	0	0	0	0	0	0	0	3
2021	0	0	0	0	0	0	0	0	0	0	0	0	0
Average	0	0	37	72	58	81	46	27	6	0	0	0	326

Table A - 9. Combined Monthly Average Volumes of Water Diverted at TCC GCID and GCID POD under the Historical Analysis. Volumes in 1,000 acre-feet

Month / WY Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Wet	0	0	78	170	130	243	224	69	28	0	0	0	942
Above Normal	0	0	25	124	112	93	26	105	1	0	0	0	478
Below Normal	0	0	18	71	57	75	8	1	3	0	0	0	234
Dry	0	0	38	26	18	24	0	0	0	0	0	0	105
Critical	0	0	26	4	9	3	0	0	0	0	0	0	41
All Years	0	0	37	72	58	81	46	27	6	0	0	0	326

Diversion Season Flow, Availability, and Potential Diversion Volumes

The following figures show the daily flow at Bend Bridge and Wilkins Slough, the daily flow available for appropriation, the daily flows potentially diverted at the TCC and GCID PODs (shown as stacked areas), and periods when the Delta Excess Buffer[34] was met. Each figure shows the individual "diversion season" (September 1 through June 14) for each year from the analysis presented in Section 2 and in the previous section of this appendix. Although not explicitly indicated on the figures, periods when the Bend Bridge Pulse Protection and/or the Wilkins Slough Minimum Flow Requirement may be controlling diversions can be inferred by a review of the flow at Bend Bridge and/or Wilkins Slough.

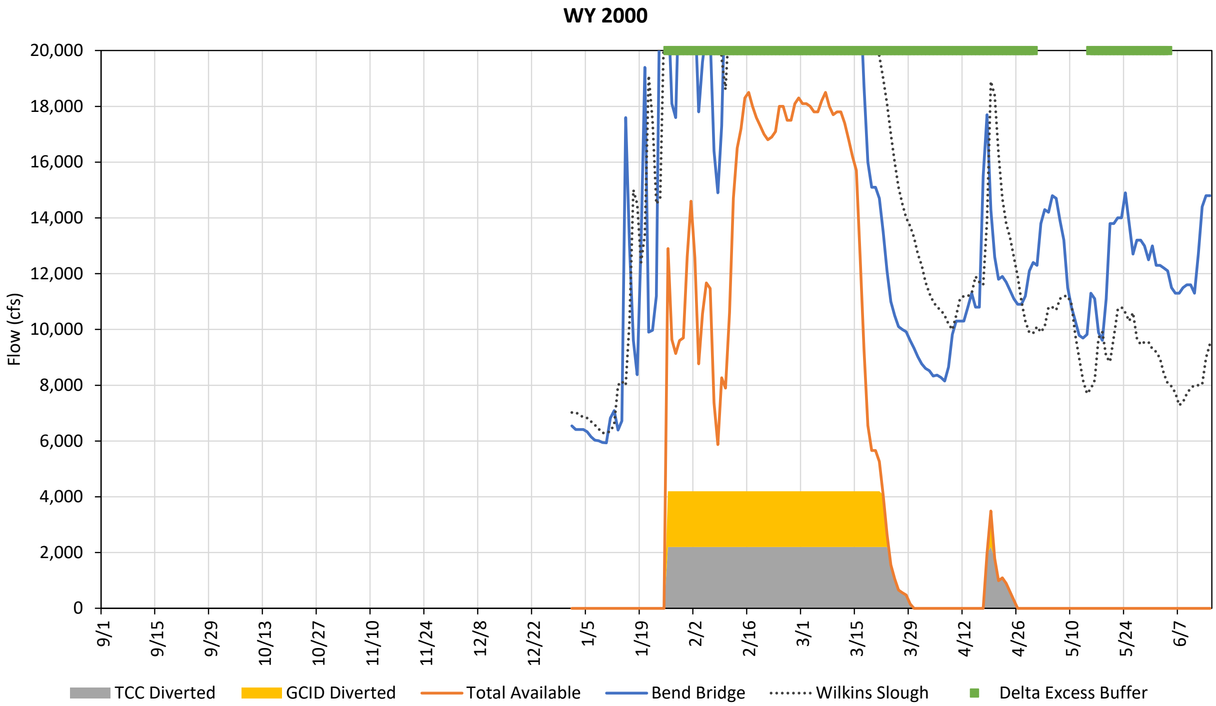

Figure A - 1. Water Year 2000 Historical Analysis

[34] The Delta Excess Buffer was a conservative assumption included in this analysis which limits availability to periods when the Delta has been in an Excess condition for at least 7 consecutive days. Additional detail and description can be found in Section 2.1.1.5.

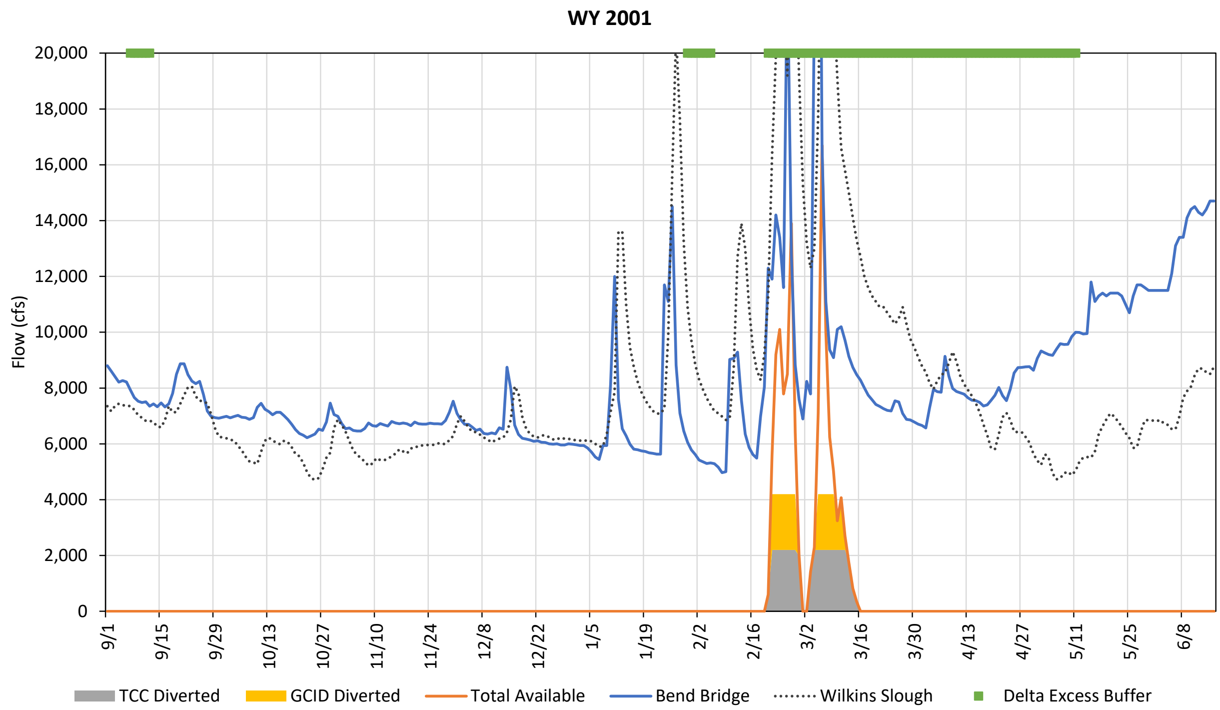

Figure A - 2. Water Year 2001 Historical Analysis

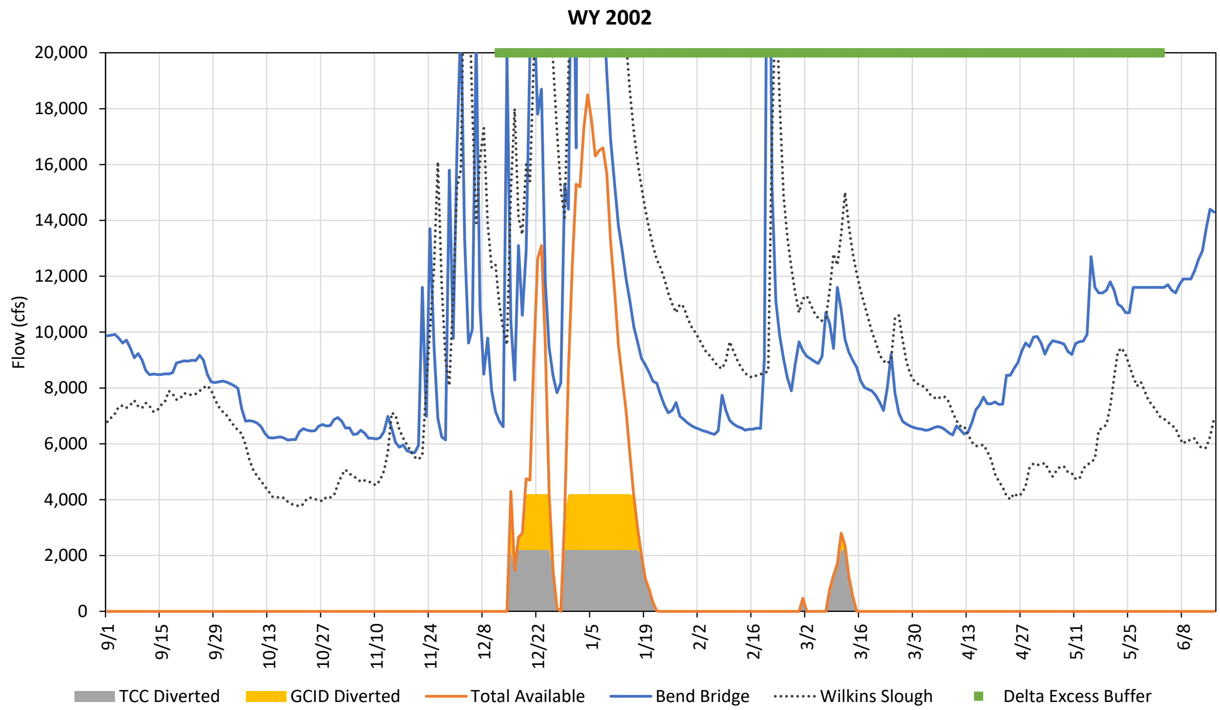

Figure A - 3. Water Year 2002 Historical Analysis

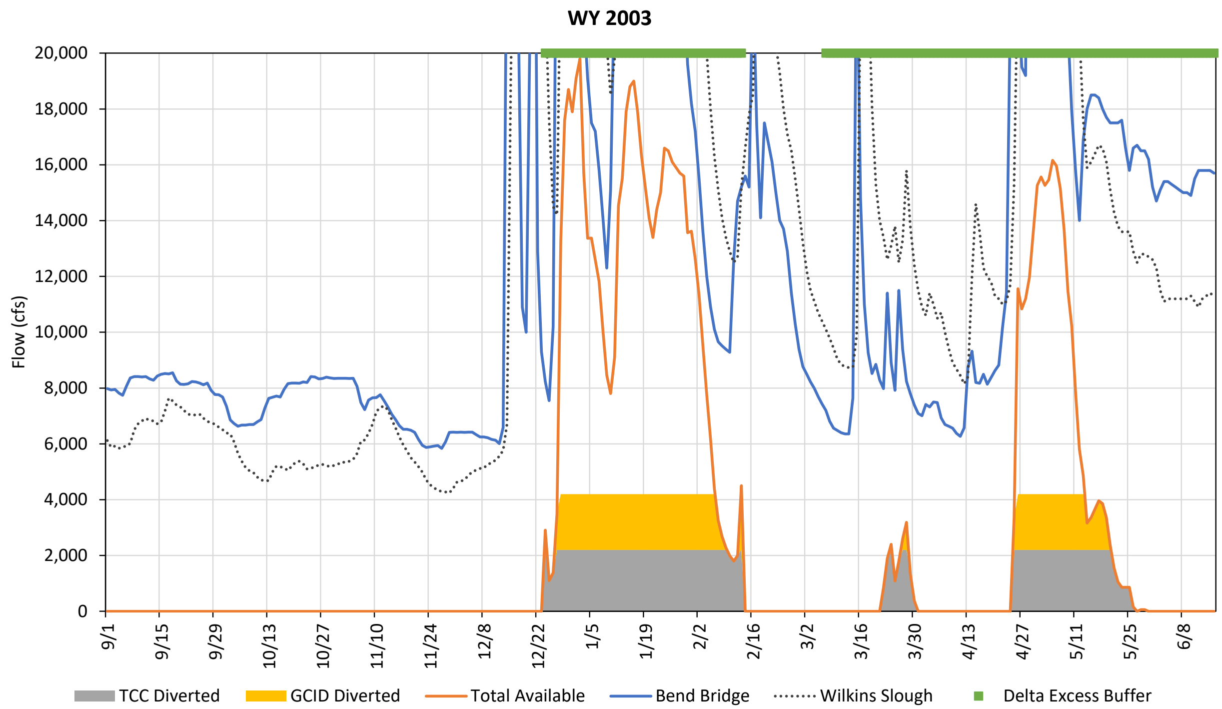

Figure A - 4. Water Year 2003 Historical Analysis

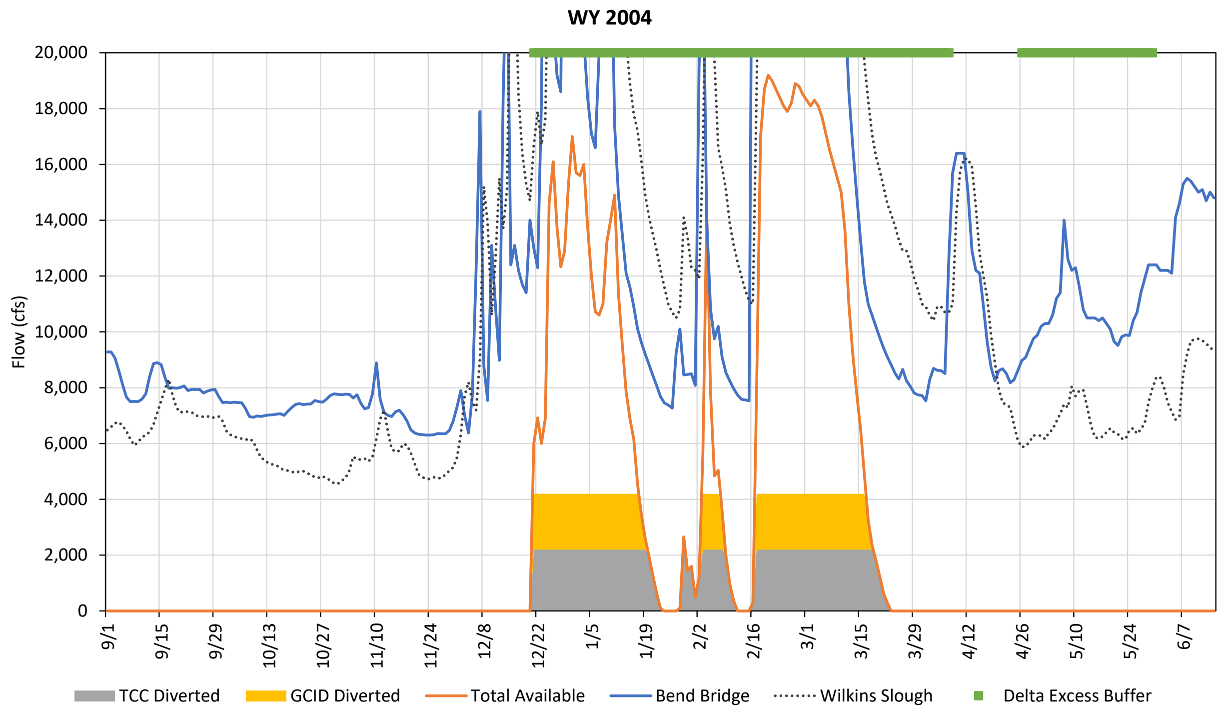

Figure A - 5. Water Year 2004 Historical Analysis

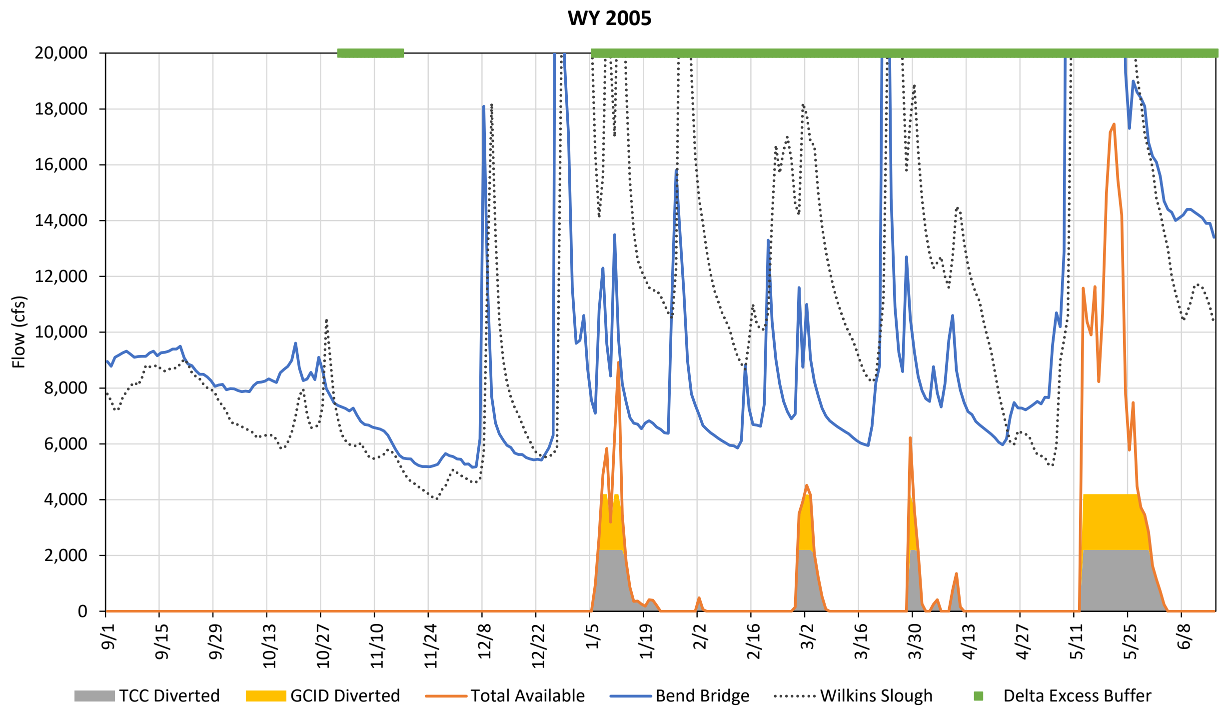

Figure A - 6. Water Year 2005 Historical Analysis

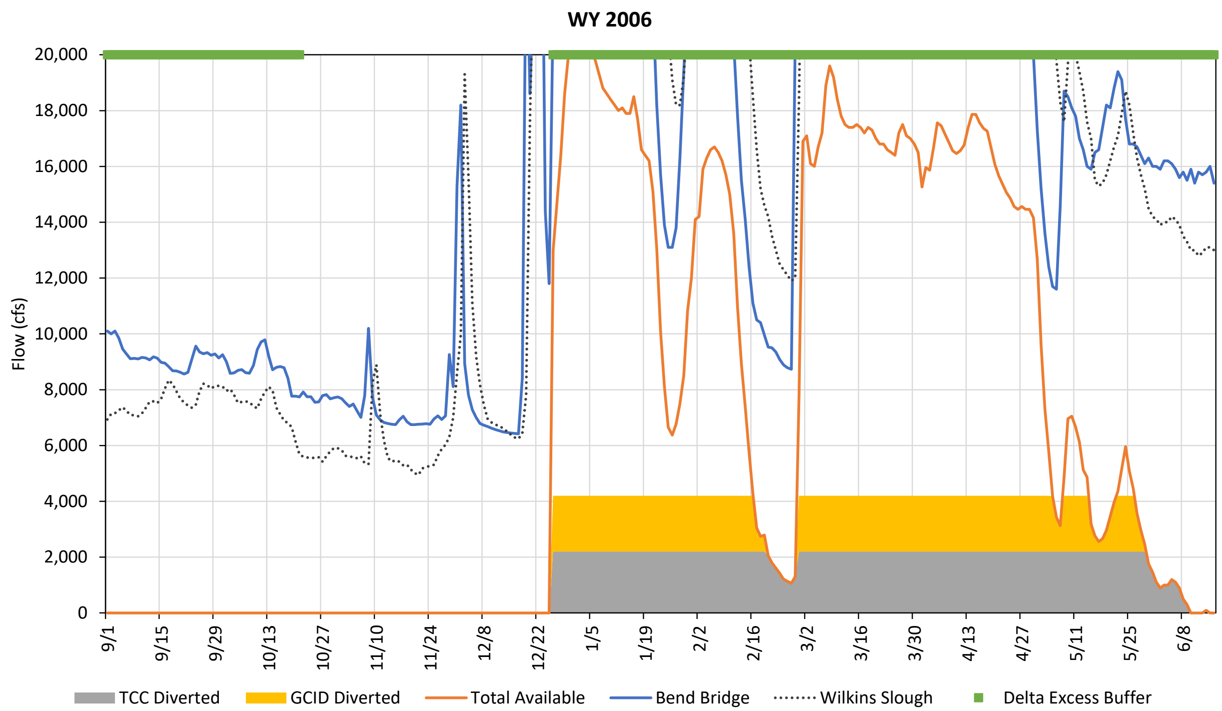

Figure A - 7. Water Year 2006 Historical Analysis

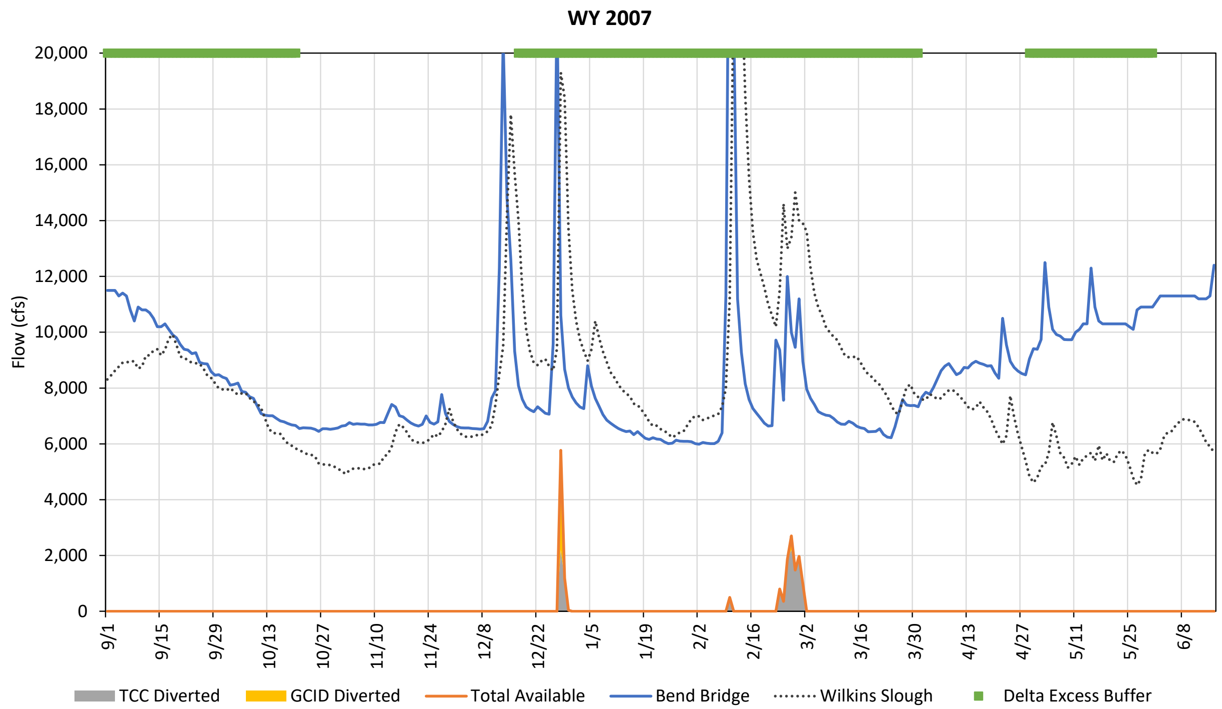

Figure A - 8. Water Year 2007 Historical Analysis

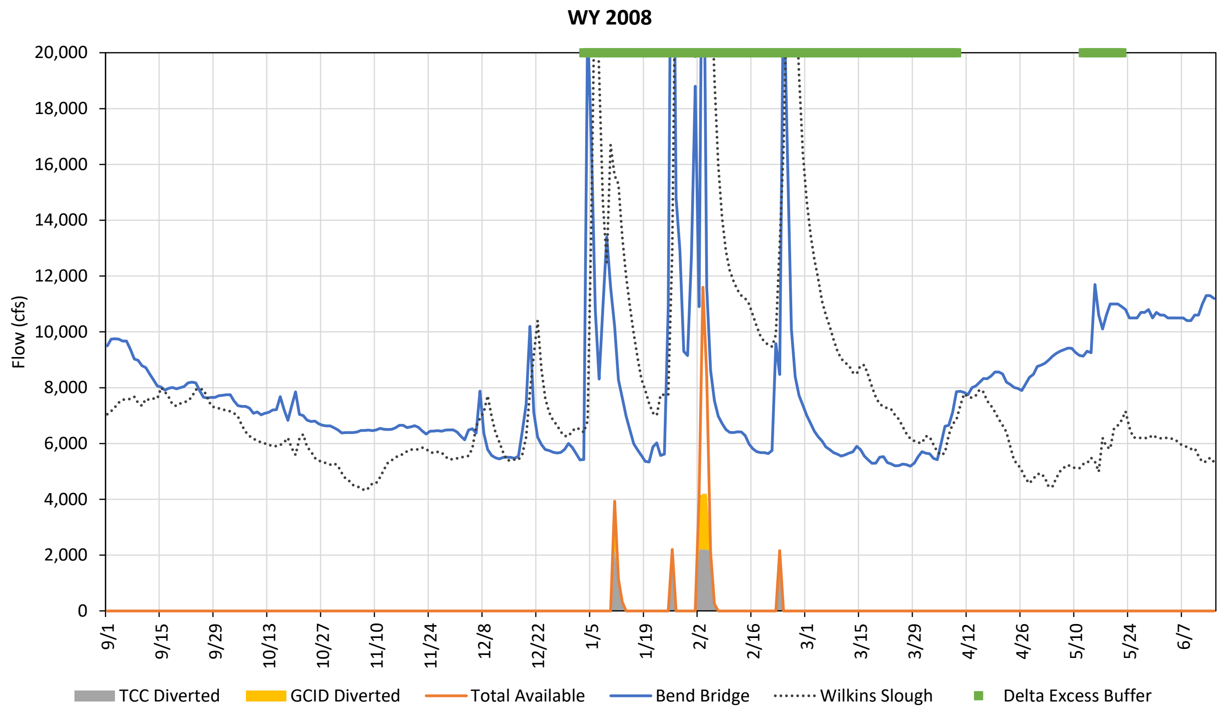

Figure A - 9. Water Year 2008 Historical Analysis

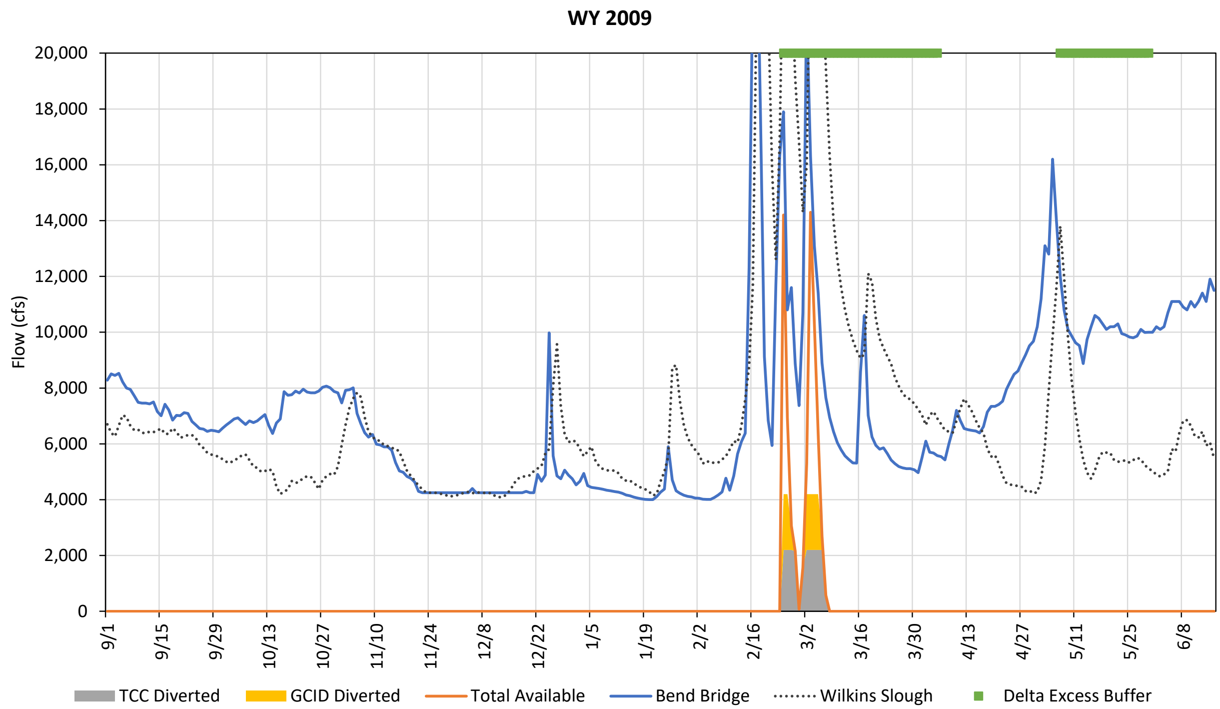

Figure A - 10. Water Year 2009 Historical Analysis

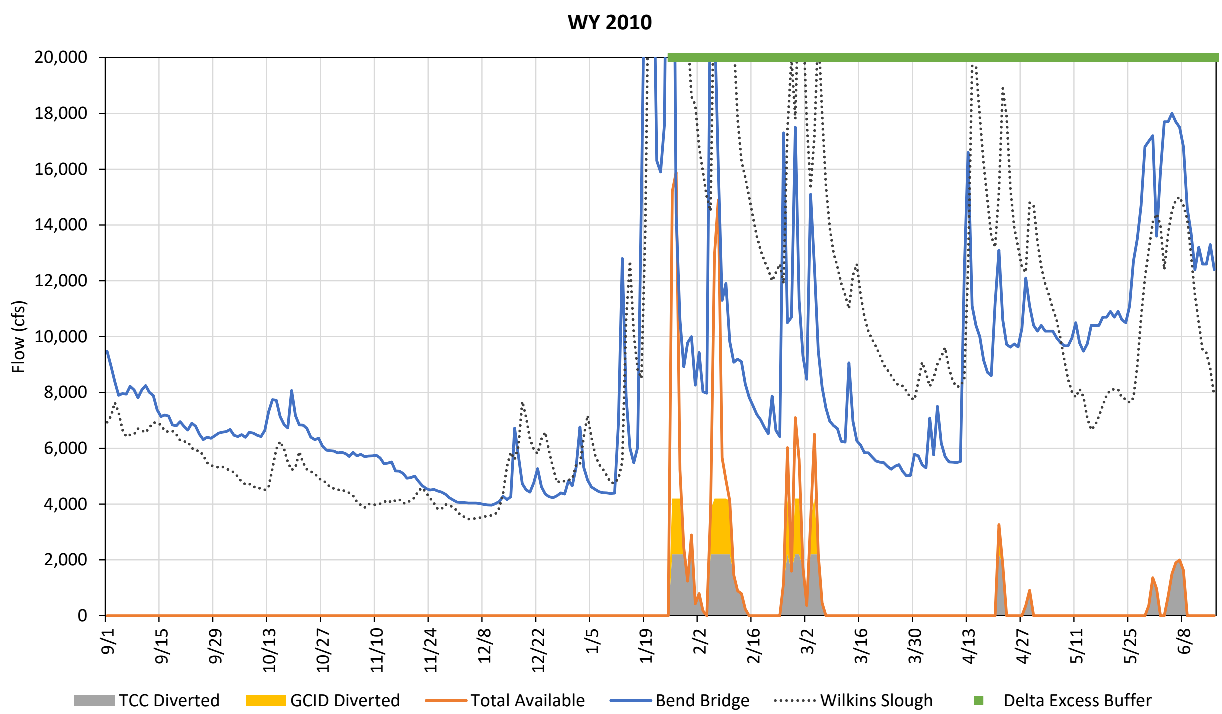

Figure A - 11. Water Year 2010 Historical Analysis

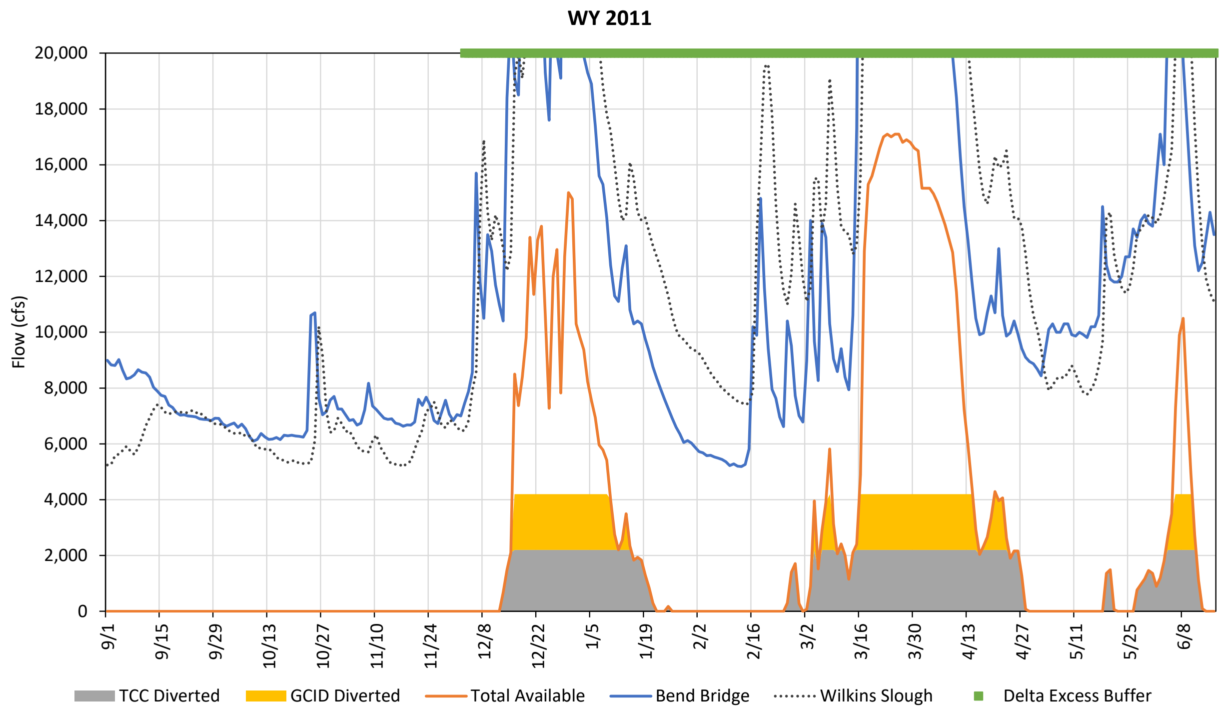

Figure A - 12. Water Year 2011 Historical Analysis

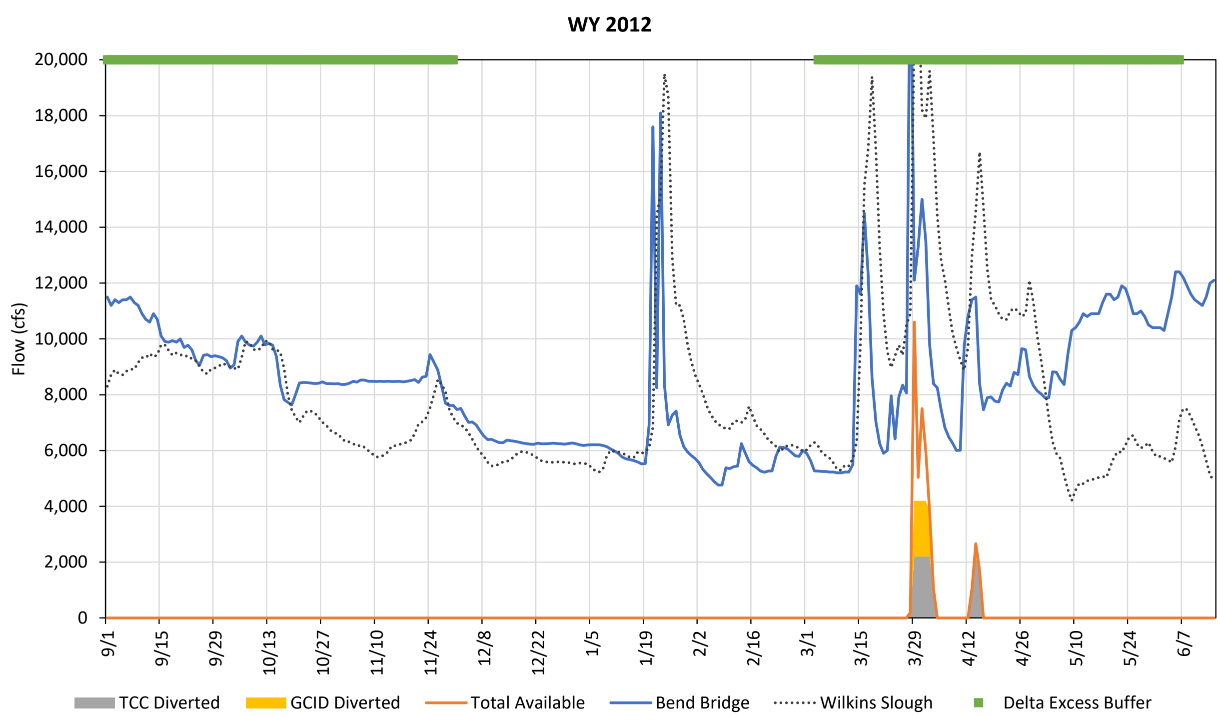

Figure A - 13. Water Year 2012 Historical Analysis

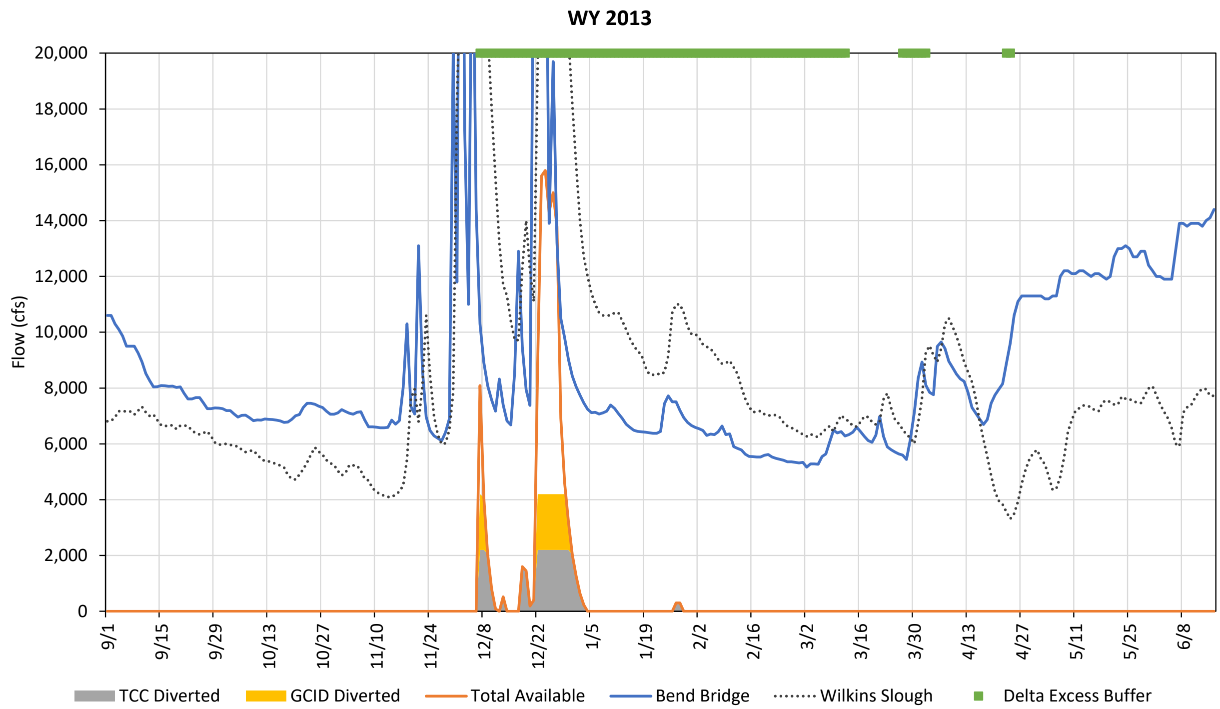

Figure A - 14. Water Year 2013 Historical Analysis

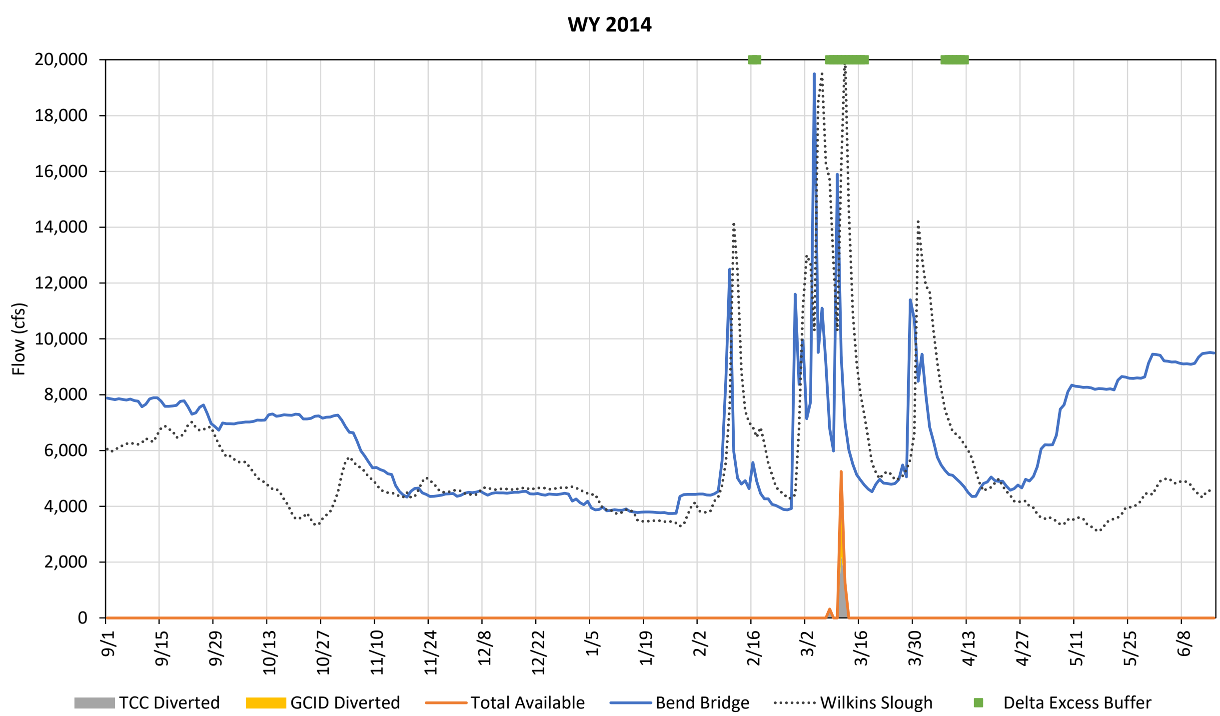

Figure A - 15. Water Year 2014 Historical Analysis

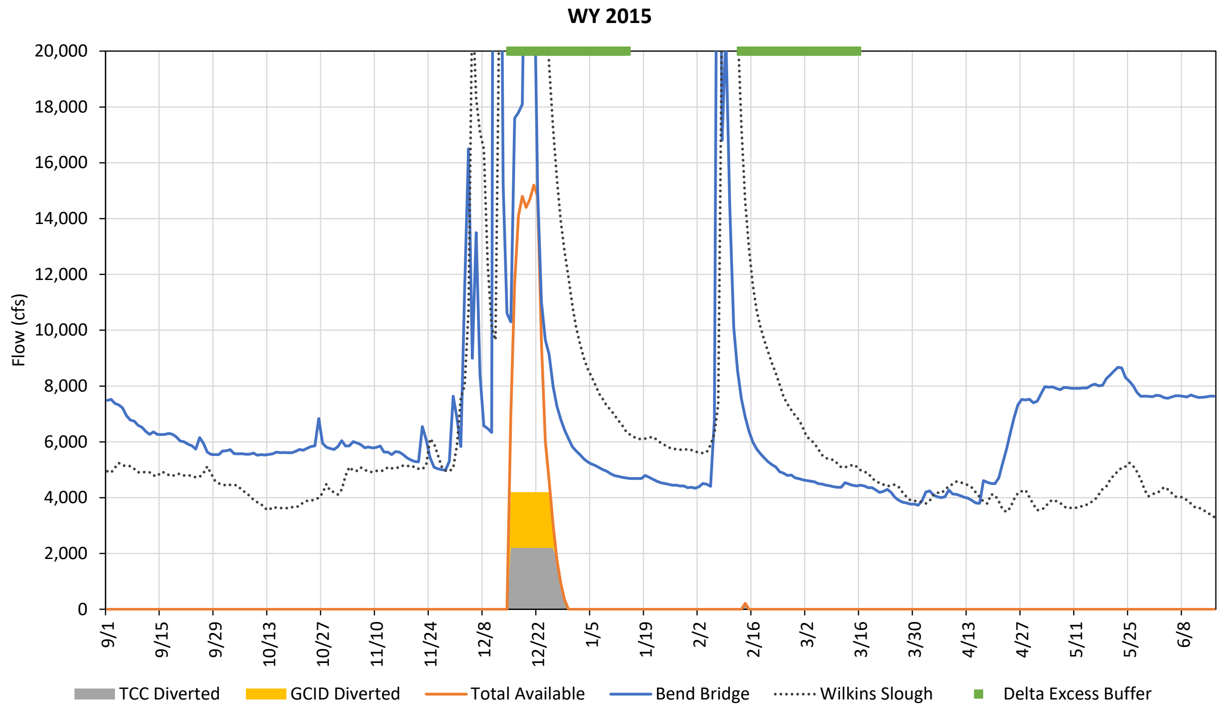

Figure A - 16. Water Year 2015 Historical Analysis

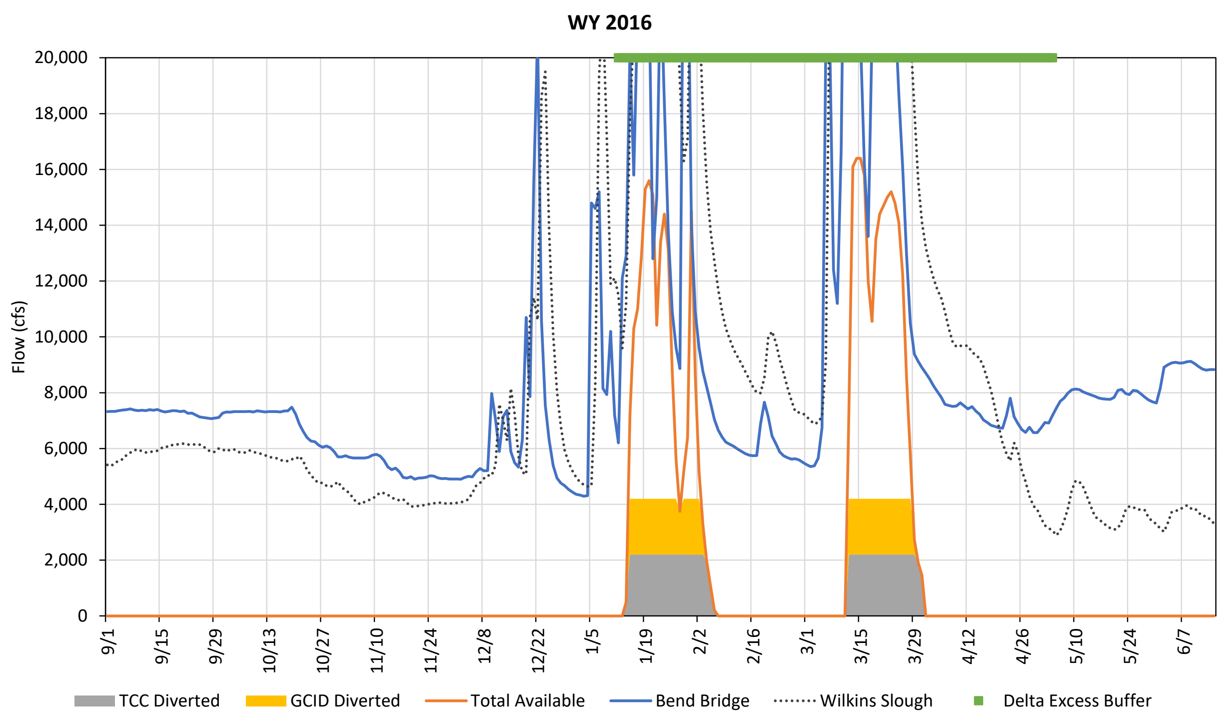

Figure A - 17. Water Year 2016 Historical Analysis

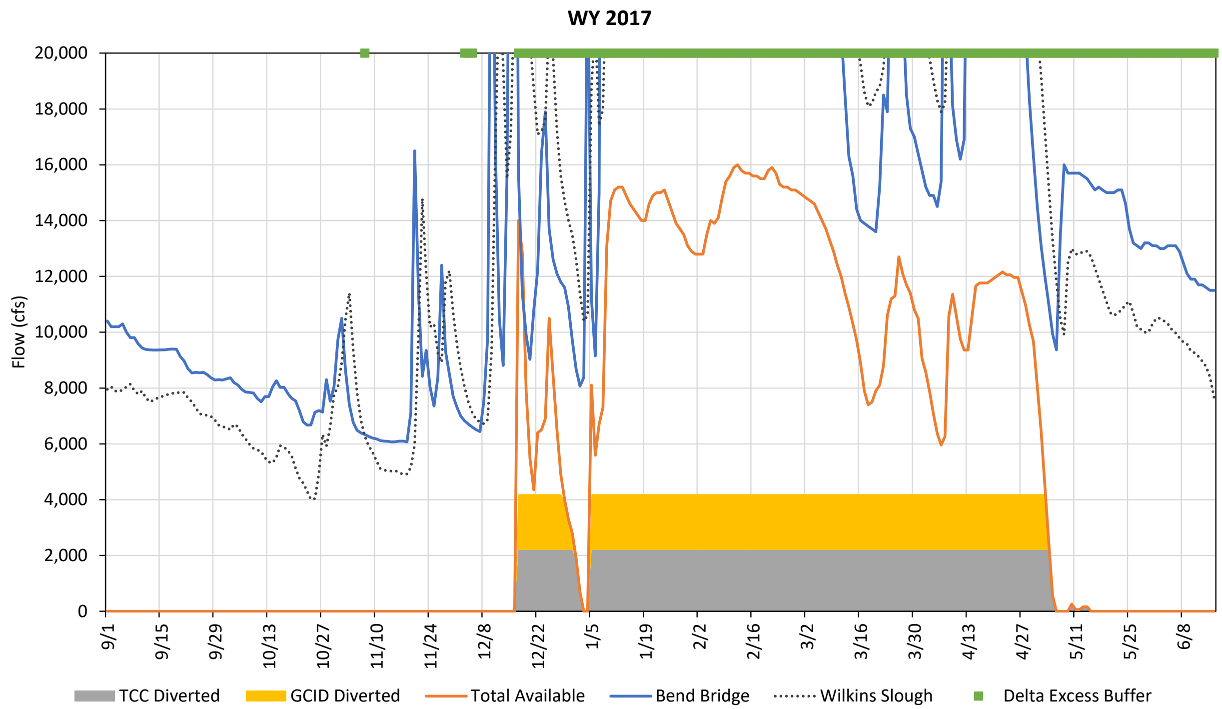

Figure A - 18. Water Year 2017 Historical Analysis

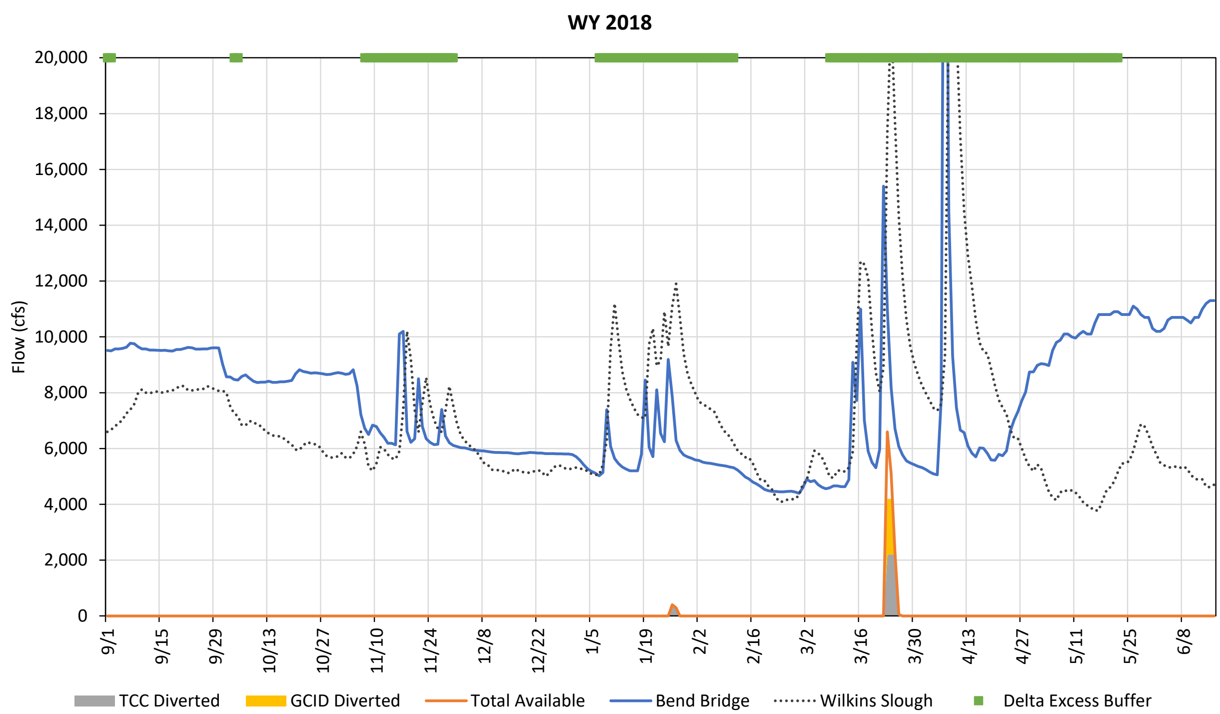

Figure A - 19. Water Year 2018 Historical Analysis

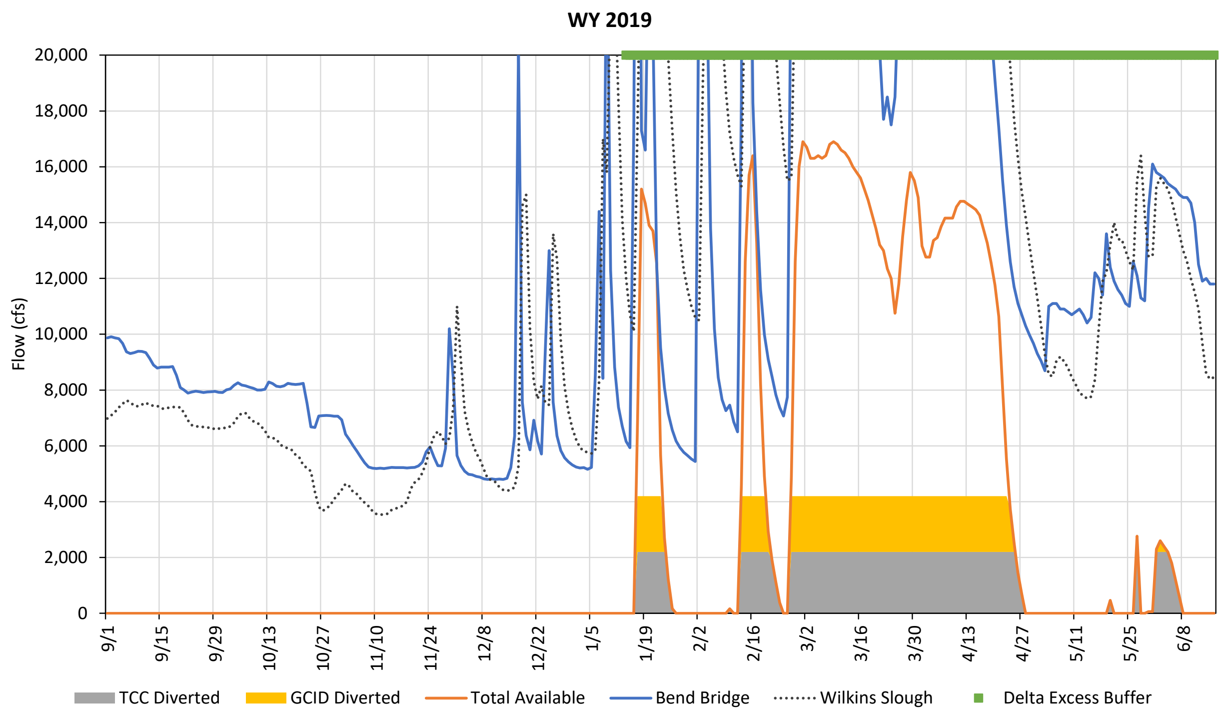

Figure A - 20. Water Year 2019 Historical Analysis

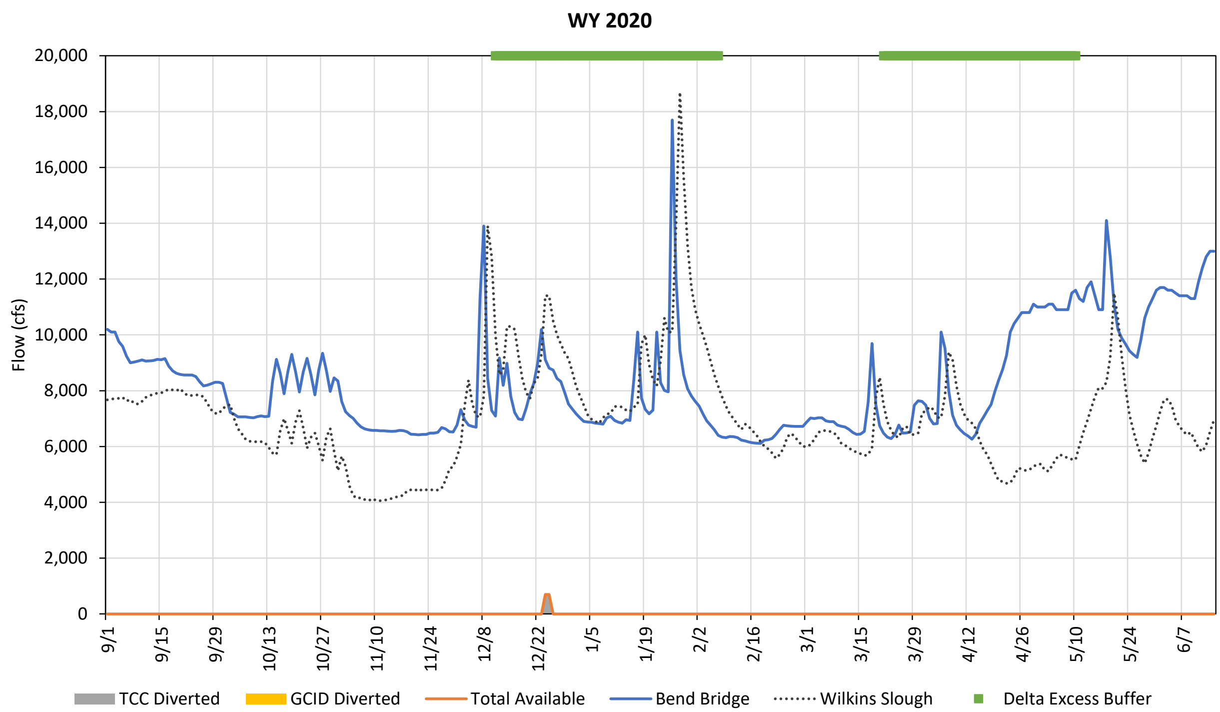

Figure A - 21. Water Year 2020 Historical Analysis

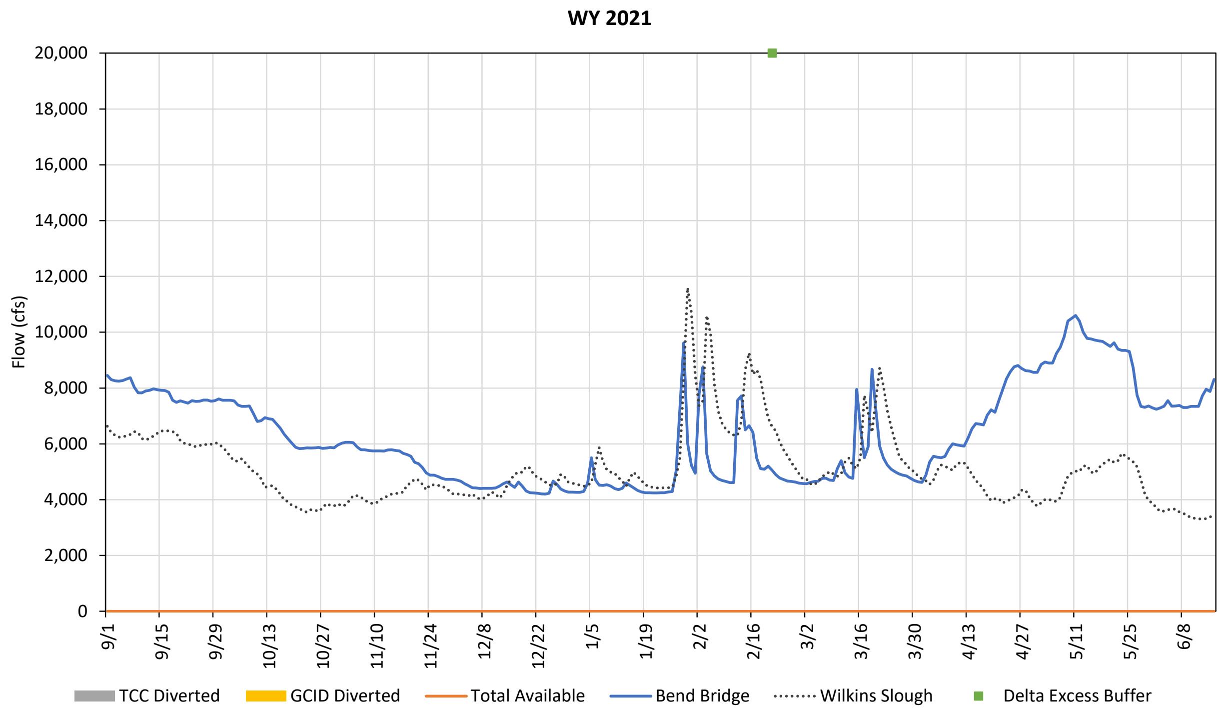

Figure A - 22. Water Year 2021 Historical Analysis

Historical Analysis with No Assumption for Face Value Demands

This section provides a much less conservative "bookend" set of results using the Historical Analysis. This bookend analysis does not include any water right demands (i.e., the FV Demand) on top of the historical streamflow gauge data. As such, the bookend analysis assumes that the historical gauge data represents the volumes of water potentially available, which may only be controlled or reduced by the Bend Bridge Pulse Protection, the Wilkins Slough Minimum Flow Requirement, and the Delta being in Excess condition. The following results present the volumes of water available for appropriation and potentially diverted under the Historical Analysis without subtracting FV Demand.

Figure A - 23 shows the annual volumes of water available for appropriation at the TCC POD during each water year in the analysis. Water is available in 21 out of the 22 years in the analysis, in volumes ranging from approximately 3,000 acre-feet to 4,581,000 acre-feet. The annual average volume of water available for appropriation at the TCC POD is approximately 1,086,000 acre-feet.

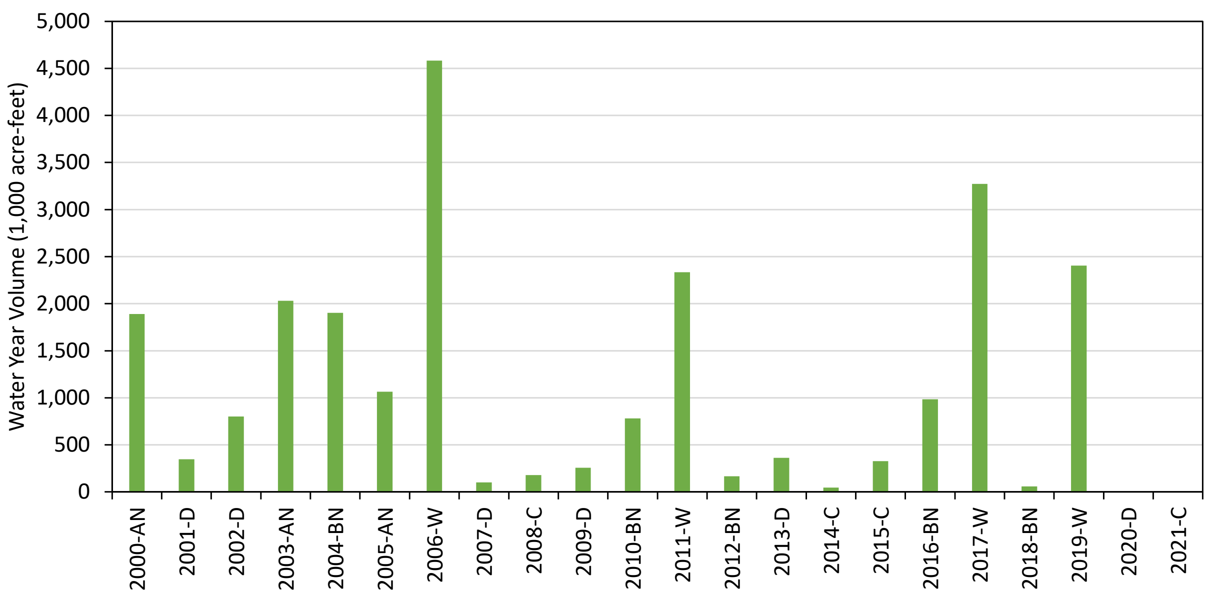

Figure A - 23. Annual Volumes of Water Available for Appropriation at TCC POD under the Historical Analysis with no FV Demand

Table A - 10 shows the monthly average availability by Sacramento Valley Water Year Type and over the full period of analysis at the TCC POD. The monthly volumes from the maximum water year (water year 2006) are included for additional reference. On average, water is available in all year types, with the largest volumes being available in Wet and Above Normal years. Water is shown as available for appropriation in all months from December through June and September.

Table A - 10. Monthly Average Volumes of Water Available for Appropriation at the TCC POD under the Historical Analysis with no FV Demand. Volumes in 1,000 acre-feet

Month / WY Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Wet	0	0	209	561	432	823	741	177	84	0	0	122	3,148
Above Normal	0	0	89	415	359	310	102	339	18	0	0	59	1,661
Below Normal	0	0	52	199	202	264	42	6	14	0	0	0	778
Dry	0	0	106	88	49	69	0	0	0	0	0	0	312
Critical	0	0	78	8	37	15	0	0	0	0	0	0	138
All Years	0	0	106	229	194	273	158	80	21	0	0	30	1,086
Max Year (2006)	0	0	204	977	524	1,062	1,035	466	79	0	0	234	4,581

Table A - 11 shows the monthly average potential diversions by Sacramento Valley Water Year Type and over the full period of analysis at the TCC POD. The annual volumes range from 3,000 acre-feet to 870,000 acre-feet. Water can be diverted in all year types and in all months from December through June and September.

Table A - 11. Monthly Average Potential Diversions at the TCC POD under Historical Analysis with no FV Demand. Volumes in 1,000 acre-feet

Month / WY Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Wet	0	0	43	105	84	133	129	75	41	0	0	67	677
Above Normal	0	0	17	75	70	74	47	72	15	0	0	51	416
Below Normal	0	0	10	44	51	61	24	5	9	0	0	0	202
Dry	0	0	29	20	15	29	0	0	0	0	0	0	94
Critical	0	0	17	5	15	8	0	0	0	0	0	0	45
All Years	0	0	24	46	43	57	35	25	12	0	0	19	260
Max Year (2006)	0	0	26	135	115	135	131	135	61	0	0	131	870

Figure A - 24 shows the annual volumes of water available for appropriation at the GCID POD during each water year in the analysis. Water is available in 21 out of the 22 years included in the analysis, in volumes ranging from approximately 3,000 acre-feet to 4,581,000 acre-feet. The annual average volume of water available for appropriation at the GCID POD is approximately 1,100,000 acre-feet. Volumes of water available for appropriation at the GCID POD are typically the same as those available at the TCC POD, as daily availability is most often controlled by either the Hamilton City Reach or reaches further downstream on the flow path. Occasionally, additional water is available at Hamilton City due to accretions between the two PODs, hence why the annual average volume is nominally higher than the volumes available at the TCC POD.

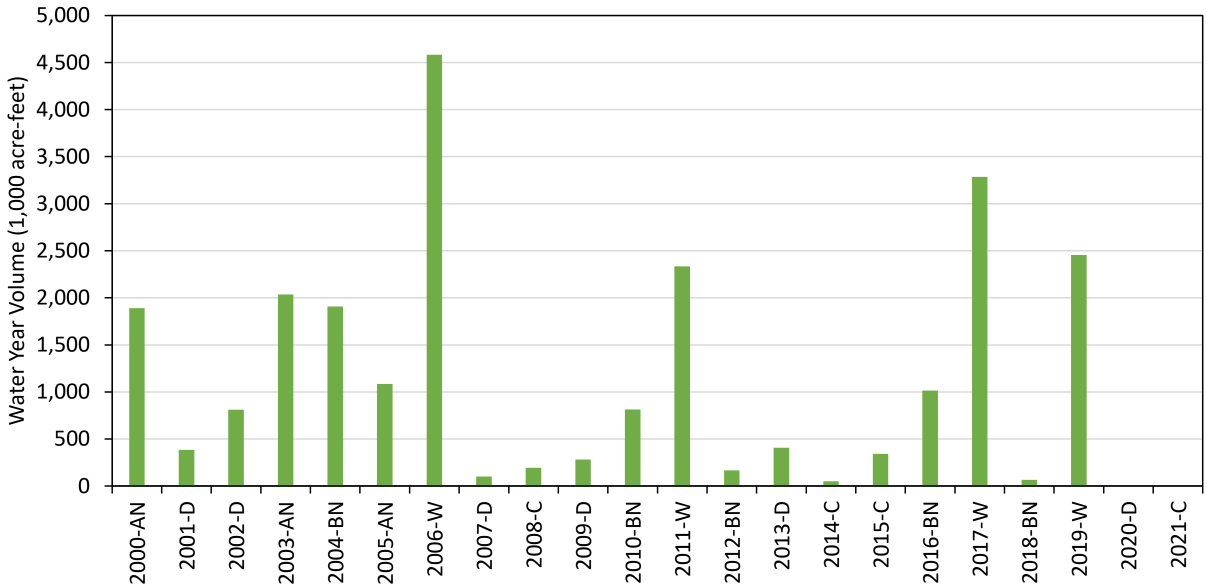

Figure A - 24. Annual Volumes of Water Available for Appropriation at GCID POD under Historical Analysis with no FV Demand

Please note the volumes of water shown as available for appropriation at the GCID POD are not in addition to the TCC POD volumes, as availability at the GCID POD is calculated as a distinct location with no assumptions included for potential diversions at the TCC POD. When considering water potentially diverted at the TCC POD, less water becomes available for appropriation at the GCID POD.

Table A - 12 shows the monthly average volumes of water available for appropriation by Sacramento Valley Water Year Type and over the full period of analysis at the GCID POD. The monthly volumes from the maximum water year (water year 2006) are included for additional reference. Volumes and patterns of availability are very similar to the volumes of water available for appropriation shown at the TCC POD. As previously noted, volumes of water available for appropriation at the GCID POD are occasionally higher than at the TCC POD due to accretions downstream of the TCC POD. Additionally, the volumes of water shown as available for appropriation at the GCID POD do not consider potential diversions at the TCC POD and are not additive.

Table A - 12. Monthly Average Volumes of Water Available for Appropriation at the GCID POD under Historical Analysis with no FV Demand. Volumes in 1,000 acre-feet

Month / WY Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Wet	0	0	212	567	440	823	741	177	84	0	0	122	3,164
Above Normal	0	0	92	422	359	310	102	339	18	0	0	59	1,670
Below Normal	0	0	52	206	207	267	42	6	14	0	0	0	793
Dry	0	0	115	88	53	75	0	0	0	0	0	0	331
Critical	0	0	82	8	41	16	0	0	0	0	0	0	147
All Years	0	0	110	233	198	276	158	80	21	0	0	30	1,100
Max Year (2006)	0	0	204	977	524	1,062	1,035	466	79	0	0	234	4,581

Table A - 13 shows the monthly average volumes of water available for appropriation by Sacramento Valley Water Year Type and over the full period of analysis at the GCID POD after assuming up to 2,200 cfs of diversion at the TCC POD, when available. The monthly volumes from the maximum water year (water year 2006) are included for additional reference.

Table A - 13. Monthly Average Potential Volumes of Water Available for Appropriation at the GCID POD under the Historical Analysis with no FV Demand After Potential Diversions at the TCC POD. Volumes in 1,000 acre-feet

Month / WY Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Wet	0	0	168	462	356	690	612	102	43	0	0	55	2,487
Above Normal	0	0	75	346	289	235	56	267	3	0	0	8	1,254
Below Normal	0	0	42	162	156	206	18	1	5	0	0	0	591
Dry	0	0	86	68	37	47	0	0	0	0	0	0	237
Critical	0	0	65	3	26	8	0	0	0	0	0	0	102
All Years	0	0	86	187	155	219	123	55	9	0	0	11	841
Max Year (2006)	0	0	178	842	410	926	904	331	18	0	0	103	3,712

Table A - 14 shows the monthly average potential diversions by Sacramento Valley Water Year Type and over the full period of analysis at the GCID POD. The annual volumes range from 15,000 acre-feet to 709,000 acre-feet. Water can be diverted in all year types and in all months from December through June and September.

Table A - 14. Monthly Average Potential Diversions at the GCID POD under the Historical Analysis with no FV Demand. Volumes in 1,000 acre-feet

Month / WY Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Wet	0	0	36	86	68	115	112	42	22	0	0	52	533
Above Normal	0	0	15	62	54	51	19	54	3	0	0	8	261
Below Normal	0	0	9	35	36	45	11	1	5	0	0	0	144
Dry	0	0	22	14	10	14	0	0	0	0	0	0	61
Critical	0	0	13	2	7	4	0	0	0	0	0	0	27
All Years	0	0	19	36	32	43	25	15	5	0	0	11	186
Max Year (2006)	0	0	24	123	83	123	119	121	18	0	0	98	709

Table A - 15 shows the combined monthly average potential diversions at the TCC POD and GCID POD under the Historical Analysis. Annual diversion volumes range from 3,000 acre-feet to 1,579,000 acre-feet, the greater of which would be greater the design storage capacity of Sites Reservoir.

Table A - 15. Combined Monthly Average Potential Diversions at the TCC POD and GCID POD under the Historical Analysis. Volumes in 1,000 acre-feet

Month / WY Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Wet	0	0	79	191	152	249	241	117	62	0	0	119	1,210
Above Normal	0	0	32	137	124	126	65	127	18	0	0	59	677
Below Normal	0	0	18	79	86	106	35	6	14	0	0	0	343
Dry	0	0	52	34	26	43	0	0	0	0	0	0	155
Critical	0	0	30	7	22	12	0	0	0	0	0	0	72
All Years	0	0	43	82	75	100	61	40	17	0	0	30	446
Max Year (2006)	0	0	50	258	198	258	250	256	79	0	0	229	1,579

The results presented in this appendix and the results presented in Section 2 provide two bookends on availability under the Historical Analysis. The results presented in Section 2 provide a more conservative outlook on availability, while the results presented in this appendix estimate availability based solely on the observed flows, the results of which assume that the recent historical period provides a representative outlook of hydrologic conditions and system-wide operations. A noteworthy result from the analysis presented in this appendix is the annual average availability at the TCC POD – 1,114,000 acre-feet. This volume is within 5% of each of the annual average availability volumes presented in Section 3 (the CalSim II Analysis) and Section 4 (the Face Value Analysis).

Funks and Stone Corral FV Demand Bookend Analysis

An additional analysis was completed for the Funks and Stone Corral Creek Historical Analysis that removes FV Demand associated with A030445 from the Stone Corral Creek FV Demand, assuming all diversions under this water right are made from the Sacramento River and/or other available sources. This analysis provides a bookend assumption for availability on the creeks, as diversions under A030445 are more likely to occur from the Sacramento River and/or occur at lower volumes than the maximum rate for the POD on Stone Corral Creek (75 cfs) identified in the water right. Table A - 16 shows the monthly FV Demand for A030445 and the Stone Corral Creek FV Demand used in this analysis (i.e., with A030445 removed).

Table A - 16. A030445 Monthly FV Demand and Adjusted Stone Corral Creek Monthly FV Demand

Month	A030445 Monthly FV Demand (acre-feet)	Adjusted Stone Corral Creek Monthly FV Demand (acre-feet)
January	4,612	0
February	4,165	0
March	4,612	0
April	1,315	838
May	1,809	1,506
June	2,380	1,458
July	2,460	1,506
August	2,460	1,506
September	846	1,240
October	4,612	27
November	4,463	0
December	4,612	0

Figure A - 25 shows the combined annual volumes of water available for appropriation at the Funks and Stone Corral PODs during each water year in the analysis. The Sacramento Valley Water Year Type is shown with each year for reference. Water is available in 21 out of the 22 years included in the analysis, in annual volumes ranging from approximately 20 acre-feet to 34,000 acre-feet. The combined annual average volume of water available for appropriation at the Funks and Stone Corral creeks PODs is approximately 6,800 acre-feet.

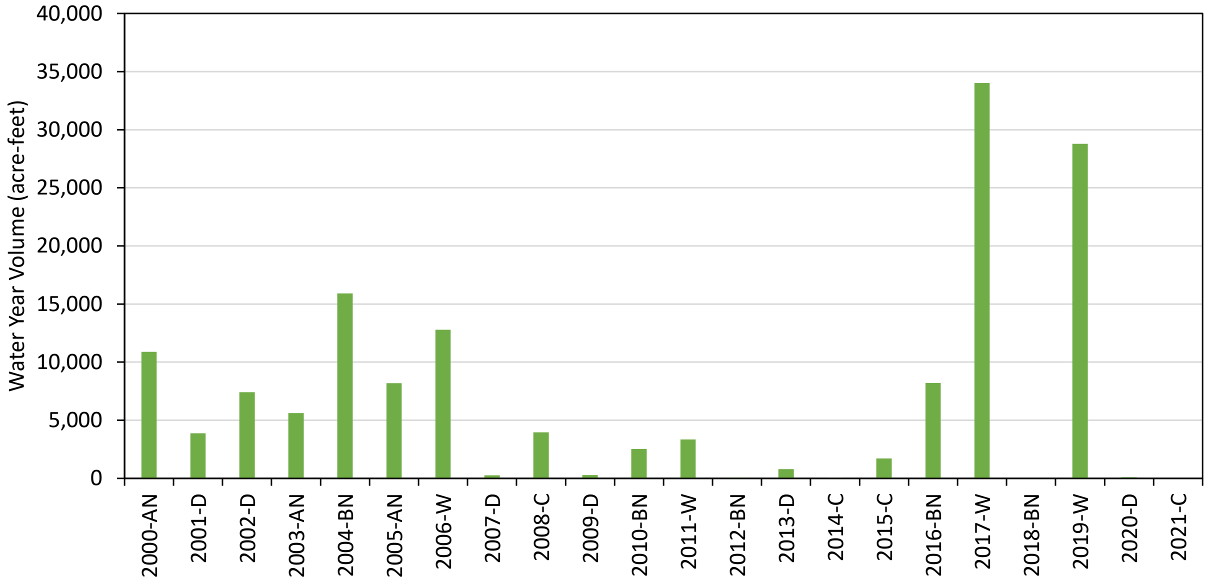

Figure A - 25. Combined Annual Volumes of Water Available for Appropriation at the Funks and Stone Corral Creeks PODs

Table A - 17 shows the combined monthly average availability by Sacramento Valley Water Year Type and over the full period of analysis at the Funks and Stone Corral creeks PODs. The monthly volumes from the maximum water year (water year 2017) are included for additional reference. On average, water is available in all water year types, with the largest volumes being available in Wet years. Water is shown as available for appropriation in all months from November through April.

Table A - 17. Combined Monthly Average Volumes of Water Available for Appropriation at Funks and Stone Corral Creeks PODs. Volumes in acre-feet

Month / WY Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Wet	0	0	112	3,817	10,959	3,339	1,505	0	0	0	0	0	19,732
Above Normal	0	1	0	2,572	4,031	1,628	0	0	0	0	0	0	8,231
Below Normal	0	1	100	1,250	2,972	1,026	0	0	0	0	0	0	5,349
Dry	0	0	198	1,162	141	613	0	0	0	0	0	0	2,114
Critical	0	0	236	538	616	42	0	0	0	0	0	0	1,431
All Years	0	0	147	1,743	3,368	1,237	274	0	0	0	0	0	6,769
Max Year (2006)	0	0	255.	8,896	23,758	1,100	0	0	0	0	0	0	34,009

Appendix B: CalSim II Analysis

Diversion data from the Sites CalSim II model under both sets of input hydrology are included in this appendix. Please note diversion results come directly from CalSim II results and have not been post-processed.

Diversions to Sites in CalSim II with Historical Hydrology

Diversions to Sites, as simulated in CalSim II under historical hydrology, occur in 73 out of 82 years (~89%) in volumes ranging from approximately 7,000 acre-feet to approximately 1,055,000 acre-feet. Figure B - 1 shows the annual volumes of water diverted into Sites Reservoir. The annual average diversion to Sites Reservoir is approximately 276,000 acre-feet.

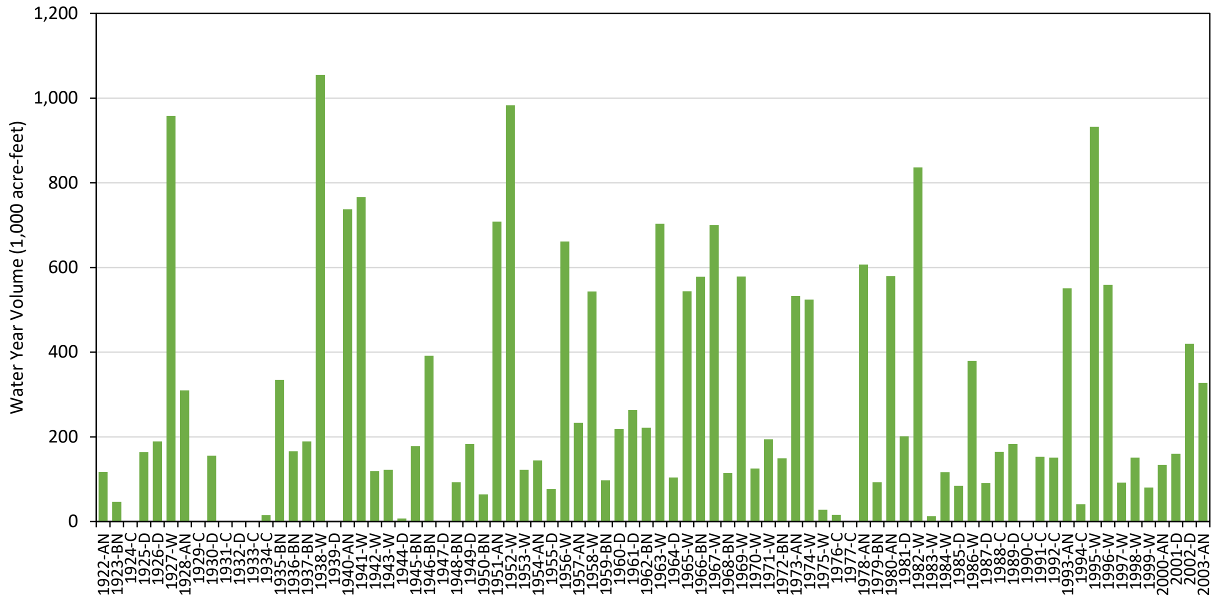

Figure B - 1. Annual Volumes of Water Diverted under the CalSim II Analysis with Historical Hydrology

Figure B - 2 shows the probability of exceedance of the annual diversions to Sites Reservoir. As noted above, some level of diversion occurs in nearly 90% of years.

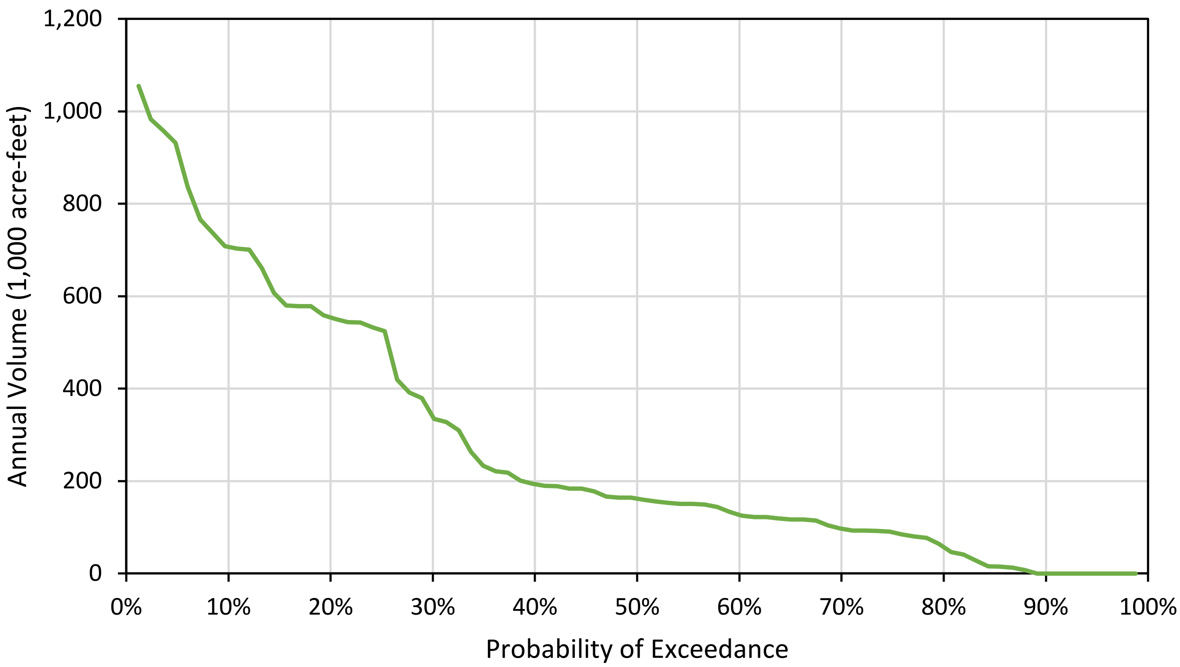

Figure B - 2. Probability of Exceedance of Annual Water Diverted under the CalSim II Analysis with Historical Hydrology

Table B - 1 shows the average monthly diversions to Sites Reservoir by water year type and over the full simulation. Diversion patterns generally align with the patterns of availability; however, diversions are influenced by infrastructure capacity at the PODs and available storage in Sites Reservoir. Noticeably, the average diversions in Wet years are similar to Above Normal years due to limited capacity at the PODs and available storage space in Sites Reservoir. The year with the maximum diversion volume (1938) is also included for reference. The year with the maximum diversion volume differs from the year with max availability largely due to available storage space in the reservoir. For example, in the CalSim II simulation, Sites Reservoir was nearly empty at the beginning of water year 1938. As such, available storage capacity was not a limiting factor on the volumes of water diverted during 1938. Conversely, storage in Sites Reservoir at the beginning of water year 1983 – the year with the greatest availability – was essentially full, hence the small volume of water (13,000 acre-feet) ultimately diverted into Sites Reservoir in water year 1983.

Table B - 1. Monthly Average Volumes of Water Diverted under the CalSim II Analysis with Historical Hydrology. Volumes in 1,000 acre-feet

Month / WY Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Wet	8	25	110	91	93	66	44	13	0	0	0	5	457
Above Normal	0	10	32	126	119	109	18	0	2	0	0	0	415
Below Normal	0	5	17	41	62	48	14	0	0	0	0	7	194
Dry	0	10	21	11	39	57	0	0	0	0	0	0	139
Critical	1	1	0	14	14	15	0	0	0	0	0	0	45
All Years	3	13	47	59	68	60	19	4	0	0	0	3	276
Max Year (1938)	0	180	109	6	189	214	218	138	0	0	0	0	1,055

Diversions to Sites in CalSim II with Climate Change Hydrology

Diversions to Sites Reservoir as simulated in CalSim II under 2035 CT climate change hydrology occur in 73 out of 82 years (~89%) in volumes ranging from approximately 2,000 acre-feet to 967,000 acre-feet. Figure B - 3 shows the annual volumes of water diverted into Sites Reservoir. The annual average diversion to Sites Reservoir is approximately 303,000 acre-feet.

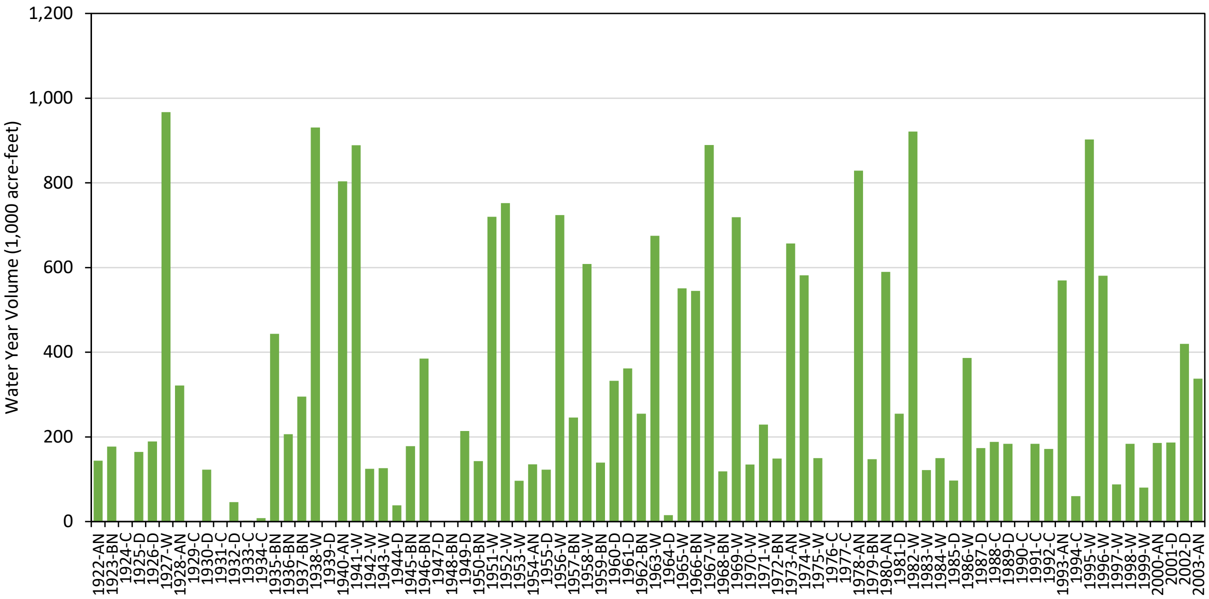

Figure B - 3. Annual Volumes of Water Diverted under the CalSim II Analysis with 2035 CT Hydrology

Figure B - 4 shows the probability of exceedance of the annual diversions to Sites Reservoir under 2035 CT climate change hydrology. As noted above, some level of diversion occurs in nearly 90% of years.

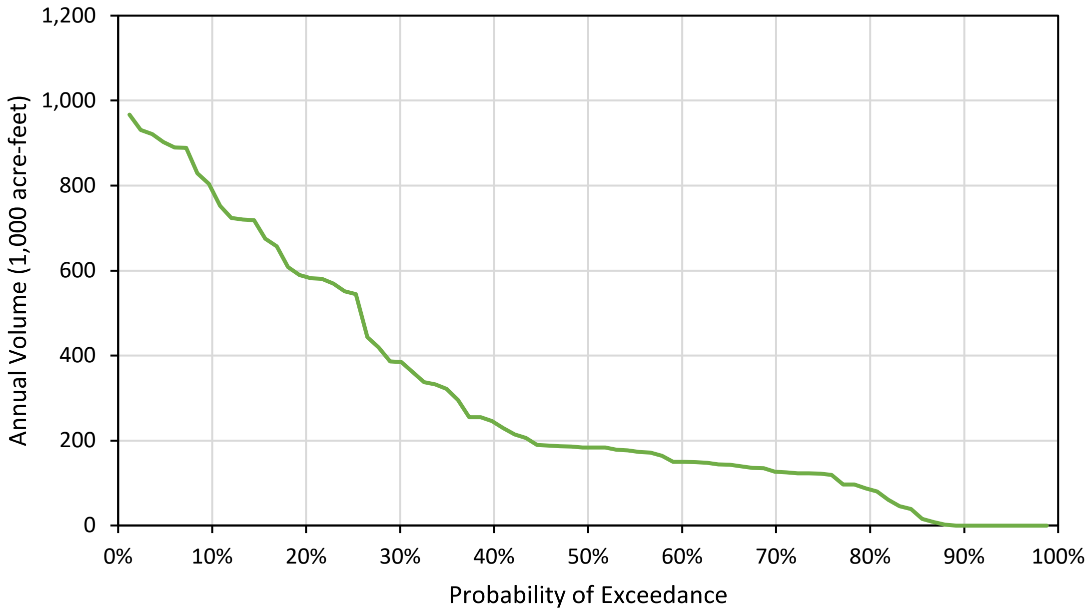

Figure B - 4. Probability of Exceedance of Annual Water Diverted under the CalSim II Analysis with 2035 CT Hydrology

Table B - 2 shows the average monthly diversions to Sites Reservoir by Sacramento Valley Water Year Type and over the full simulation under 2035 CT climate change hydrology. Diversion patterns generally align with the patterns of availability; however, diversions are influenced by infrastructure capacity at the PODs and available storage in Sites Reservoir. Noticeably, the average diversions in Wet years are similar to Above Normal years due to limited capacity at the PODs and limited available storage space in Sites Reservoir. The year with the maximum diversion volume (1927) is also included for reference. Similar to the results under historical hydrology, the year with the maximum diversion volume differs from the year with maximum availability due to available storage space in the reservoir. For example, in the CalSim II simulation, Sites Reservoir was nearly empty at the beginning of water year 1927. As such, available storage capacity was not a limiting factor on the volumes of water diverted during 1927. Conversely, storage in Sites Reservoir at the beginning of water year 1982 – the year with the greatest availability under 2035 CT climate change hydrology – was approximately one-third full. This allowed for approximately 921,000 acre-feet to be diverted in 1982, a volume which could have been even bigger had the reservoir started the year at a lower storage level.

Table B - 2. Monthly Average Volumes of Water Diverted under the CalSim II Analysis with 2035 CT Hydrology. Volumes in 1,000 acre-feet

Month / WY Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Wet	3	29	122	105	103	76	46	7	0	0	0	0	492
Above Normal	0	7	23	131	141	112	43	0	0	0	0	0	457
Below Normal	0	0	21	56	70	67	13	0	0	0	0	0	228
Dry	0	2	36	13	46	66	0	0	0	0	0	0	162
Critical	0	0	2	15	17	17	0	0	0	0	0	0	51
All Years	1	11	55	66	77	68	23	2	0	0	0	0	303
Max Year (1927)	0	0	208	204	189	167	199	0	0	0	0	0	967

Differences in Diversions to Sites Reservoir Between Historical and 2035 CT Climate Change Hydrology

Differences to the timing and volume of diversions to Sites Reservoir between the two sets of hydrology are similar to those previously reported for differences in water available for appropriation. Beyond the hydrologic differences in availability discussed in Section 6.1, the climate change hydrology results in a more active reservoir operation (i.e., more frequent diversions and use) as the more frequent see-saw between wetter and drier conditions experienced under the 2035 CT climate change hydrology results in a greater demand for water from Sites Reservoir. As such, annual diversions are often greater, as evidenced by the increase in the annual average diversion volume from 276,000 acre-feet to 303,000 acre-feet. Figure B - 5 demonstrates that in nearly all years that water is available, diversions to Sites Reservoir are greater under 2035 CT climate change hydrology.

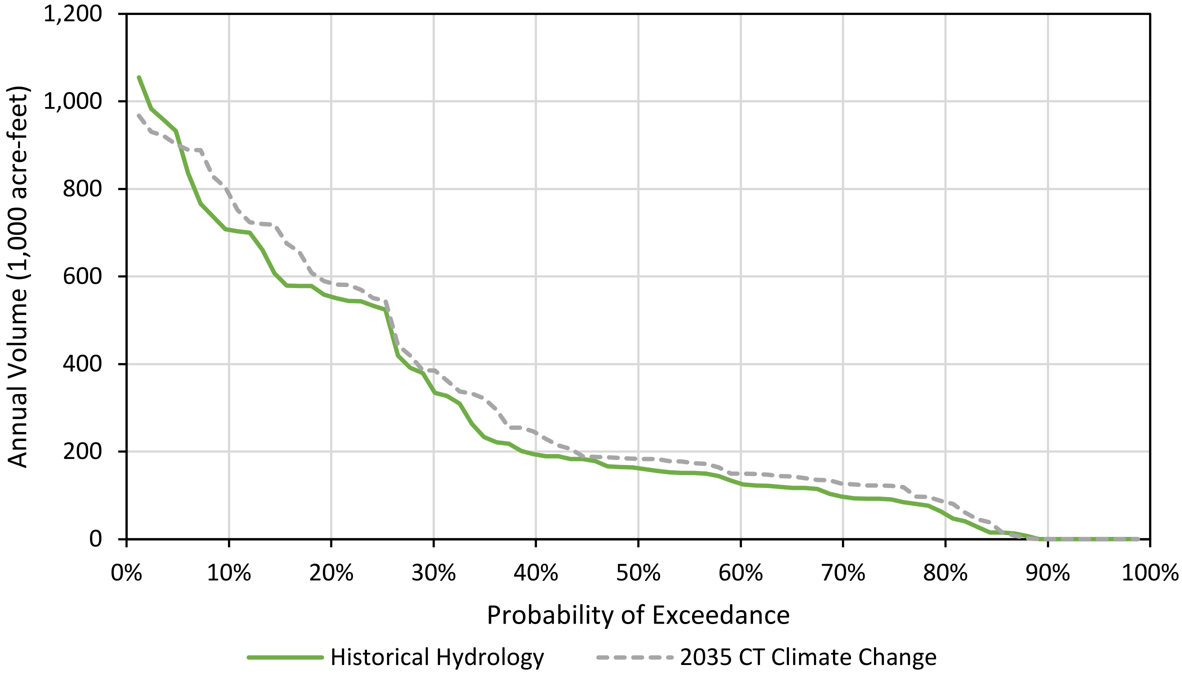

Figure B - 5. Probability of Exceedance of Annual Volumes of Water Diverted under Historical Hydrology and 2035 CT Climate Change Hydrology

Table B - 3 shows the difference in monthly average diversion volumes by Sacramento Valley Water Year Type and over the entire simulation. Values show the results under 2035 CT climate change hydrology minus the results under historical hydrology. In the December through June period of most year types, diversions are typically lower under historical hydrology. Conversely, diversions are typically greater in the October through November and April through June periods under historical hydrology. This shift in diversions – drier fall and spring months, wetter winter months – is consistent with the change in hydrology expected under climate change (as previously noted). Despite these differences, water is still diverted in all water year types. As noted above, the annual average volume of water available is approximately 27,000 acre-feet higher under the 2035 CT climate change hydrology.

Table B - 3. Difference in Monthly Average Volumes of Water Diverted (2035 CT Climate Change Hydrology minus Historical Hydrology). Values in 1,000 acre-feet

Month / WY Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Wet	-5	4	12	14	10	10	2	-7	0	0	0	-5	35
Above Normal	0	-3	-9	4	22	3	26	0	-2	0	0	0	42
Below Normal	0	-5	5	15	9	19	-1	0	0	0	0	-7	34
Dry	0	-9	15	1	7	10	0	0	0	0	0	0	23
Critical	-1	-1	2	1	3	3	0	0	0	0	0	0	6
All Years	-2	-2	8	7	8	8	4	-2	0	0	0	-3	27

Appendix C: Face Value Analysis including State Filings

The following figures and table summarize the results from the Face Value Analysis with the inclusion of all State Filings in the Sacramento River watershed with a priority date senior to September 30, 1977 (the priority date of A025517, the State Filing which the Authority is requesting assignment). In total, there are 45 State Filings included in this analysis[35].

Inclusion of these State Filings into the FV Demand dataset used for this analysis results in a reduction to both the frequency and volume of water available for appropriation. Figure C - 1 shows the overall volumes of water available over the 93-year period of analysis. Water is available in 35 out of 93 years (~37%), with an annual average volume of approximately 885,000 acre-feet. In years where water is available, availability ranges from approximately 27,000 acre-feet to approximately 7,655,000 acre-feet.

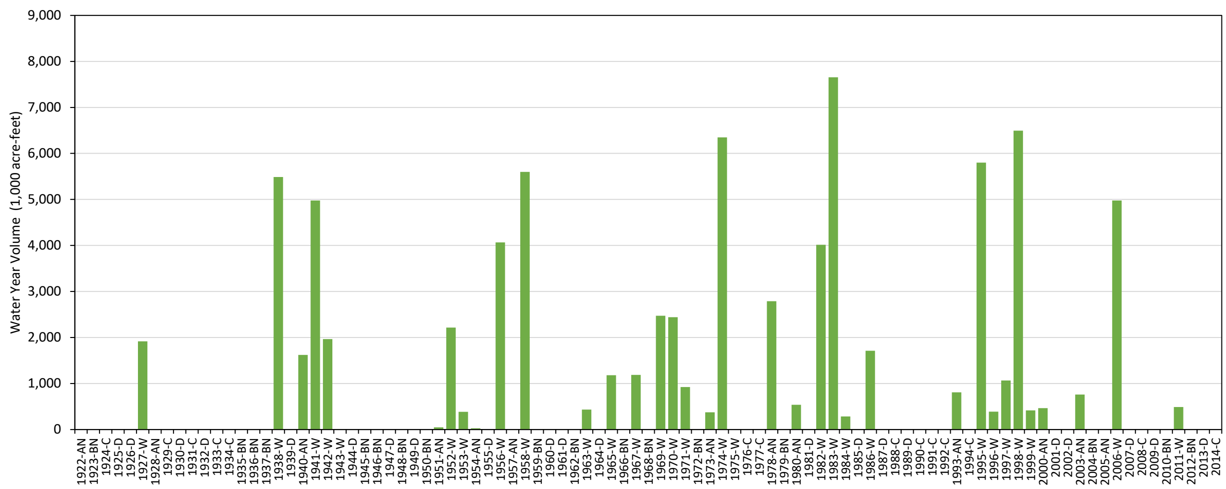

Figure C - 1. Overall Annual Volumes of Water Available for Appropriation under the Face Value Analysis including State Filing FV Demand

Table C - 1 shows the average annual volumes of water available for appropriation at each POI and overall, by Sacramento Valley water year type and for the period of analysis. Overall, water is mostly available in Wet years, but water is also available at all locations in Above Normal years, and in all other year types at Wilkins Slough and Red Bluff. Water available for appropriation is typically greatest at Freeport and lowest at Red Bluff.

[35] There are two State Filings, A017514SF and A017515SF, located in Solano County on Lindsay Slough that were not included as they are outside of the watershed area used in this analysis.

Table C - 1. Average Volumes of Water Available for Appropriation under the Face Value Analysis including State Filing FV Demand. Values in 1,000 acre-feet

WY Type / Location	Red Bluff	Wilkins Slough	Freeport	Overall
W	2,709	3,376	3,525	2,675
AN	595	1,004	932	572
BN	0	255	217	0
D	0	159	128	0
C	0	38	28	0
All	899	1,245	1,264	885

Figure C - 2 further demonstrates this point by showing the probability of exceedance of annual volumes of water available for appropriation for each POI and for the watershed overall. Overall availability is nearly always controlled by availability at Red Bluff, with water typically available in much greater volumes and at a greater frequency at Wilkins Slough and Freeport. Water is available in approximately 85% of years at both of those POIs.

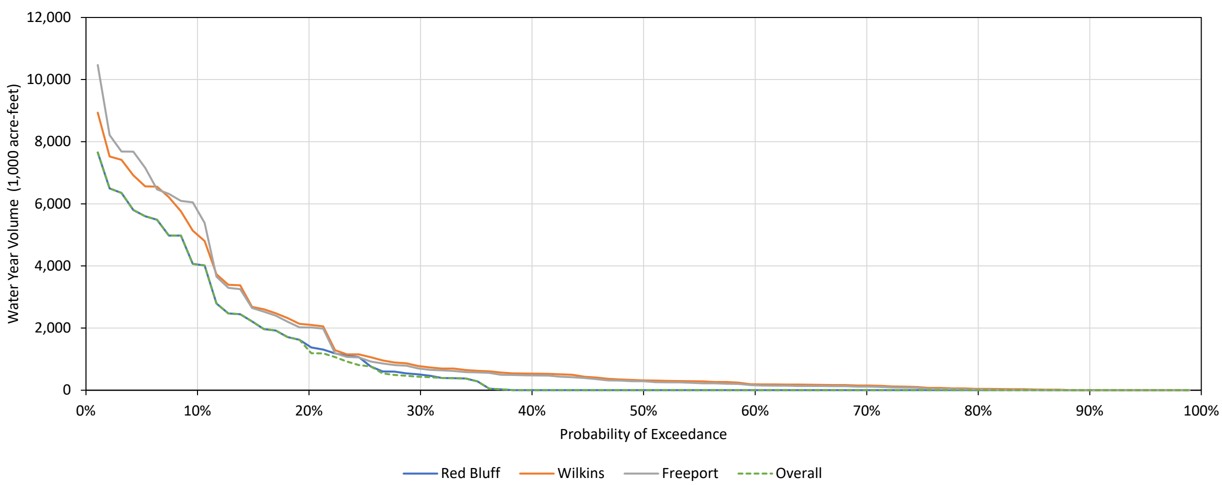

Figure C - 2. Probability of Exceedance of the Annual Volumes of Water Available for Appropriation under the Face Value Analysis including State Filing FV Demand at Each POI and Overall

The magnitude and frequency of overall availability is reduced by approximately 20% as compared to the results presented in Section 4. Nonetheless, water is available for appropriation in at least 37% years, and in volumes greater than 1.5 million acre-feet – the design capacity of Sites Reservoir – in approximately 19% of years.

Attachment 1.
Development of Water Right Demand Datasets Technical Memorandum

MBK ENGINEERS
Water Resources ◆ Flood Control ◆ Water Rights

TECHNICAL MEMORANDUM

DATE: May 7, 2022

PREPARED BY: Angela Bezzone, PE and Wesley Walker, PE

SUBJECT: Development of Water Right Demand Datasets

The purpose of this memorandum is to document the process used to quantity demands from existing water rights to be used in the water availability analysis (WAA) for the Sites Reservoir Project (Sites). This memo describes the methodology used to develop the calculated maximum diversion flow rate or maximum volumetric diversion based on the face value of water rights (FV Demand) for two of the methods reviewed in the WAA Report, the Historical Analysis and the Face Value Analysis. The resulting FV Demand datasets are limited by the accuracy of the information available from the State Water Resources Control Board's online Electronic Water Rights Information Management System (eWRIMS).

Use of eWRIMS

The Stream Trace Tool (STT) available in the eWRIMS mapping application was used to create lists of water rights within the areas specific to the Historical Analysis and the Face Value Analysis. For the Historical Analysis, the STT was used to identify water rights on the Sacramento River between Bend Bridge and Freeport, and on Funks Creek and Stone Corral Creek. For the Face Value Analysis, the STT was used to identify all water rights in the Sacramento watershed upstream of Freeport. Due to limitations of the STT, an additional search by Hydrologic Unit Codes (HUCs) was performed for the Face Value Analysis. The lists of water rights to be evaluated for the two analyses were limited to those that are currently active. The eWRIMS Water Rights Records Search was used to compile water right details needed for each water right including point of diversion location, rate of diversion and/or storage volume, and season of use.

Historical Analysis FV Demand Dataset

The FV Demand was calculated for the defined reaches used in the Historical Analysis. For post-1914 appropriative water rights, the authorized rate of diversion and season of use were used to determine the maximum daily flow rate. For riparian and pre-1914 appropriative claims documented by Statements of Water Diversion and Use (Statements), information from the Initial Statements and the annual Supplemental Statements filed by each claimant were reviewed. The final FV Demand dataset also includes State Filings A025513SF, A025514SF, and A025517SF on the Sacramento River for reference.

Minor adjustments were made to the direct diversion demands of rights along the Sacramento River held by U.S. Bureau of Reclamation (Reclamation). These adjustments were made to limit USBR demands to the currently available diversion capacity less any water rights that can divert at a point of diversion. For the Sacramento River, this includes PODs at the Tehama-Colusa Canal, Chico Canal, the City of Sacramento Intake, and the Freeport Regional Water Project Intake. Reclamation water rights typically include maximum direct diversion rates that include full diversion capacities at each listed POD. Although the capability to divert in such a manner exists, in actual operations the maximum diversion rate would be limited to remaining capacity at a particular POD. For example, Reclamation's rights include the Sacramento River Freeport Regional Water Project Intake ("Freeport") as a POD, which has a diversion capacity of approximately 286 cfs. Sacramento County Water Agency and the City of Sacramento's water rights also include Freeport as a POD. Since each of the three entities cannot physically divert more than the available capacity, the Reclamation rights at the Freeport POD (and others with a similar condition) were manually capped at the remaining diversion capacity after subtracting Sacramento County Water Agency and City of Sacramento water right face values.

Face Value Analysis FV Demand Dataset

The FV Demand was calculated for the areas upstream of each Point of Interest. Approximately 8,500 water rights were identified for the Face Value Analysis which included non-consumptive rights (which were not included in FV Demand) and storage rights. Division of Water Rights staff provided a dataset of Statement reporting information submitted by water right holders through the Report Management System. This dataset included reported data for Statements within the 1802 HUC (Sacramento Watershed) and was used to determine maximum diversion volumes under Statements. All State Filings located in the Sacramento River watershed upstream of Freeport are included in the FV Demand dataset.

After compiling the FV Demand dataset, an extensive quality control process was completed. The following components of the FV Demand dataset were reviewed and corrections were made where necessary:

- The demands of all rights were screened by volume to determine if a rate or reported value was using units other than CFS or acre-feet. Any flagged rights were reviewed and corrected as needed.
- Some rights indicated locations in multiple HUC 8s. Each of these was reviewed, with most rights being assigned to the most upstream HUC-8. Central Valley Project (CVP) and State Water Project (SWP) water rights were assigned to the HUC-8 that all or a majority of the demand would be expected to occur in.
- Major storage rights were reviewed, with some being adjusted to the actual maximum volume of the reservoir or to limits identified as a term in the water right(s).
- Direct diversion volumes for CVP and SWP rights were adjusted as follows:
    - CVP: Direct diversion rights along the Sacramento River and American River were adjusted to allow for diversion up to the currently available diversion capacity less any rights that can divert at the same point of diversion. For the Sacramento River, this includes the Tehama-Colusa Canal, Chico Canal, the City

of Sacramento Intake (less City of Sacramento water rights, and the Freeport Regional Water Project Intake (less Sacramento County water rights). For the American River this included Folsom Lake diversions and the Folsom South Canal.

- SWP: It was assumed that all Feather River Settlement Contactor demands were accounted for by each Contractor's underlying water right(s) and/or claim(s). The only other SWP demands in the Sacramento River watershed upstream of Freeport would be accounted for under Table A contracts, which the analysis assumed would be met from previously stored water. Given these assumptions, and the fact that all water diverted to storage by the SWP was accounted for at Oroville and other Feather River storage facilities, it was assumed that all direct diversion demands under SWP water rights at Oroville and in the Sacramento Valley upstream of Freeport were zero.
- Export demands: As CVP and SWP export demands occur downstream of Freeport, no direct diversion demand for CVP or SWP exports were included in the FV Demand dataset.

Attachment 2.
Development of Funks Creek and Stone Corral Creek Streamflow Estimate

MBK ENGINEERS

Water Resources ◆ Flood Control ◆ Water Rights

TECHNICAL MEMORANDUM

DATE:	May 3, 2022
TO:	Wesley Walker and Angela Bezzone (MBK Engineers)
PREPARED BY:	Carissa Abraham, EIT (MBK Engineers)
SUBJECT:	Development of Funks Creek and Stone Corral Creek Streamflow Estimate

MBK Engineers was tasked with developing a streamflow estimate for Funks Creek and Stone Corral Creek to assist with determining the water available for appropriation from these creeks for Sites Reservoir. Sites Reservoir is a reservoir proposed near Maxwell, California, which would store water diverted off the Sacramento River to increase water supply in dry years. Sites Reservoir would include two dams that would impound the creeks flow: Sites Dam on Stone Corral Creek and Golden Gate Dam on Funks Creek.

Background

Stone Corral Creek and Funks Creek are both located in Colusa County and flow east towards the Sacramento River. The total drainage area of the historical gauge on Stone Corral Creek is approximately 38.3 square miles, with approximately 35.4 square miles located upstream of the proposed Sites Dam location. The total drainage area of Funks Creek upstream of the proposed Golden Gate Dam location is approximately 50.3 square miles as shown in Figure 1. Streamflow data for Stone Corral Creek is available from United States Geological Survey (USGS) Gage No. 11390672, which includes recorded discharge for the period April 1, 1958, through September 29, 1985. There is some missing and erroneous data in 1964-1965. There is no historical streamflow data available for Funks Creek.

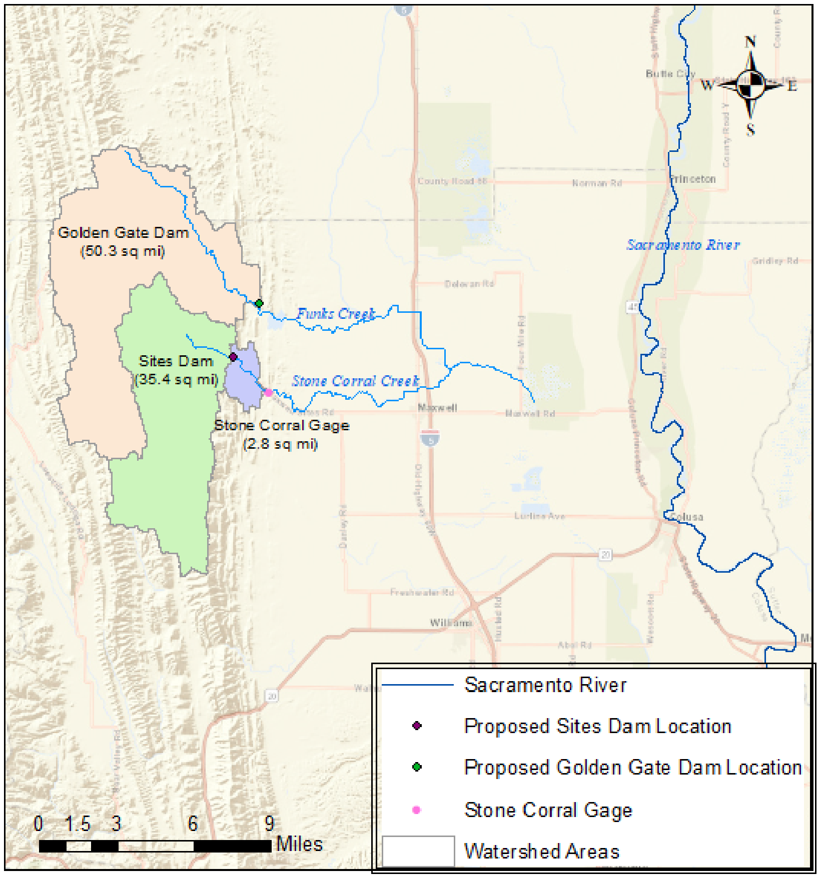

Figure 1 - Stone Corral Creek and Funks Creek Watersheds Upstream of Proposed Sites Dam and Golden Gate Dam Locations and Stone Corral Gauge

Analytical Approach

Because the historical gauge record for Stone Corral Creek is limited and Funks Creek is ungauged, historical stream gauge data from Elder Creek was used to produce an estimate of streamflow on Stone Corral and Funks creeks. The Elder Creek gauge was chosen because it was the nearest gauge on the valley floor with a long record of data available. It was assumed that Elder Creek has relatively similar precipitation and runoff patterns to Stone Corral and Funks creeks. The streamflow of Elder Creek, located in Tehama County, has been measured since 1948 (USGS Gage No. 11379500). The Elder Creek gauge is approximately 49 miles northwest of the proposed Sites Reservoir location as shown in Figure 2. The drainage area above the Elder Creek gauge is approximately 92.4 square miles.

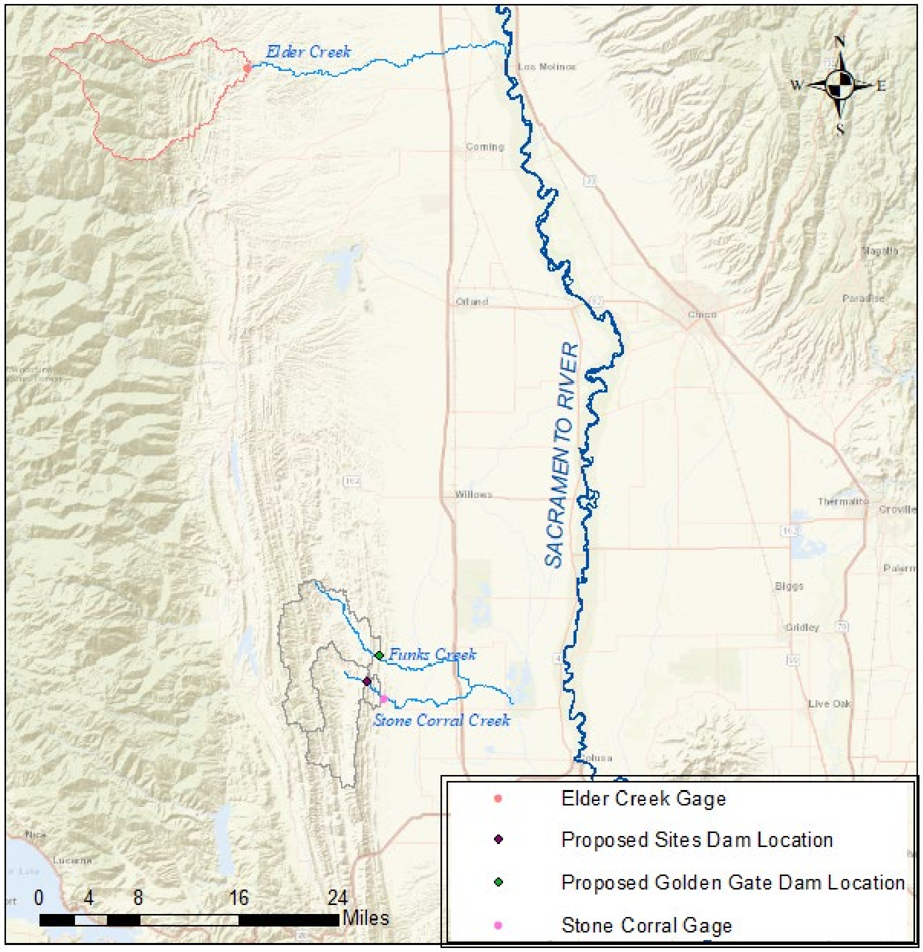

Figure 2 - Elder Creek Proximity to Proposed Sites Reservoir Location

The overlapping period of gauge records for Stone Corral Creek and Elder Creek (1958-1985) was used to determine a logarithmic correlation between the two gauges for each month of the year. A monthly correlation was chosen as the daily variability in flow between Elder Creek and Stone Corral Creek limited the utility of developing a reasonable and acceptable daily correlation. The monthly correlation was then used to estimate the monthly Stone Corral Creek flow for the period of September 1985 (end of gauge record) through September 2021. An example of the logarithmic correlation for the monthly flow at each gauge for January is shown in Figure 3 below. Based on a review of the available data, Stone Corral Creek can be described as a stream with an intermittent flow regime. Available data suggested that essentially no measured surface flow occurred at the gauge location during the months of August-October and only three years with marginal flow in July. Based on this data and for the purposes of the water availability analysis, it was assumed that no measurable surface flow would occur at the gauge location on Stone Corral Creek during July-October or at any time there was no flow measured at the Elder Creek gauge.

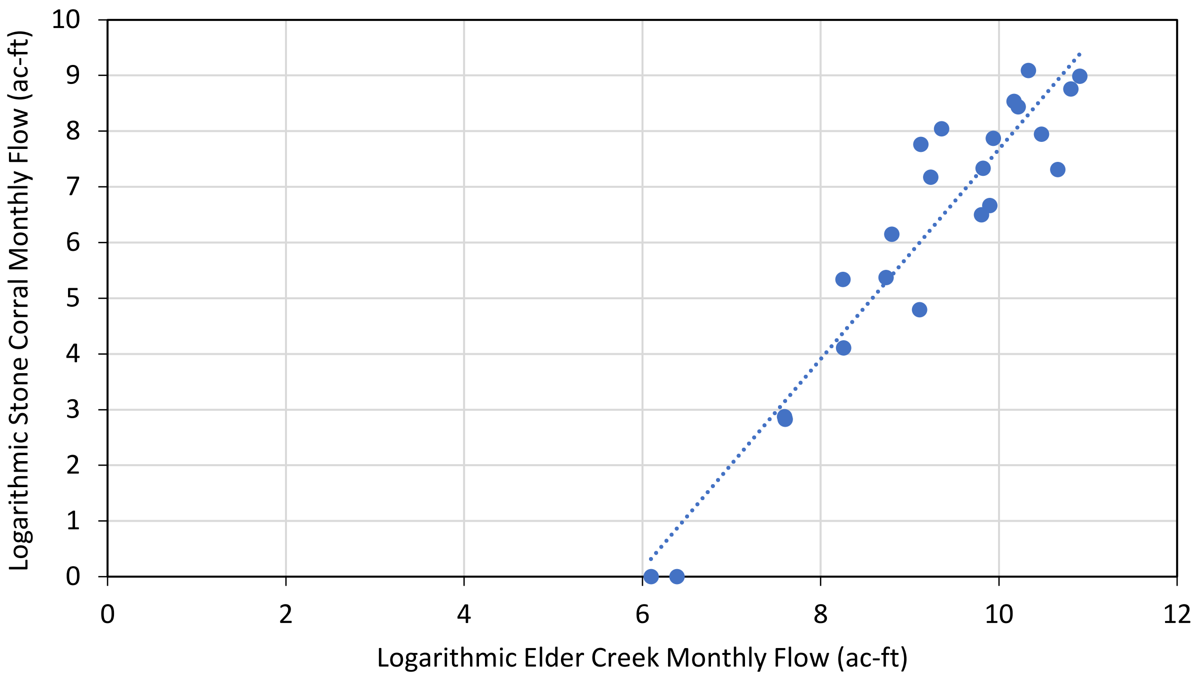

Figure 3 - Logarithmic Correlation between Elder Creek and Stone Corral Creek for January (1958-1985)

The monthly flow at the Stone Corral gauge was estimated using the following equation for each month in Table 1. The R^2 correlation between Stone Corral Creek and Elder Creek for each month over the period of available data is also included for reference.

Table 1 - Monthly Logarithmic Correlation Equations for Flow at Stone Corral Gauge

Month	Stone Corral Gage Flow Equation	R^2 Correlation
Nov	exp (1.216* ln(Elder Creek Flow) - 7.595	0.837
Dec	exp (1.523* ln(Elder Creek Flow) - 9.314	0.694
Jan	exp (1.886* ln(Elder Creek Flow) - 11.184	0.946
Feb	exp (2.178* ln(Elder Creek Flow) - 14.056	0.912
Mar	exp (2.188* ln(Elder Creek Flow) - 14.678	0.858
Apr	exp (2.041* ln(Elder Creek Flow) - 13.465	0.826
May	exp (1.560* ln(Elder Creek Flow) - 9.770	0.761
Jun	exp (1.125* ln(Elder Creek Flow) - 6.950	0.666

The calculated Stone Corral Creek flow at the proposed Sites Dam location was then determined by prorating the estimated flow at the Stone Corral gauge by the ratio of the watershed areas upstream of the gauge and the proposed dam location. The monthly streamflow in Stone Corral Creek at the proposed Sites Dam location is estimated using the following equation (Equation 1):

$$Stone\ Corral\ Flow\ at\ Sites\ Dam = \frac{35.4\ sq\ mi}{38.3\ sq\ mi} * (Stone\ Corral\ Gage\ Flow)$$

Since there is no streamflow data available for Funks Creek, the same correlation approach cannot be followed to estimate Funks Creek streamflow. Given that the Funks Creek and Stone Corral Creek watersheds have similar watershed areas, soils, vegetation, and elevation, the hydrologic characteristics of the two creeks were assumed to be similar. As such, the flow in Funks Creek was estimated by prorating the monthly Stone Corral Creek streamflow data by the ratio of Funks and Stone Corral Creek's watershed areas upstream of the proposed dam locations. The monthly streamflow in Funks Creek is estimated using the following equation (Equation 2):

$$Funks\ Creek\ Flow = \frac{50.3\ sq\ mi}{35.4\ sq\ mi} * (Stone\ Corral\ Flow\ at\ Sites\ Dam)$$

Results of Analysis

The average monthly flow volume in Stone Corral Creek at the proposed Sites Dam location for Sacramento Valley Water Year Types is shown in Figure 4 and Table 2. The average monthly flow volumes are calculated using the gauge record for October 1958 through August 1985 and using the logarithmic monthly correlations for September 1985 through September 2021. Results are summarized by Sacramento Valley Water Year Type: wet (W), above normal (AN), below normal (BN), dry (D), and critical (C).

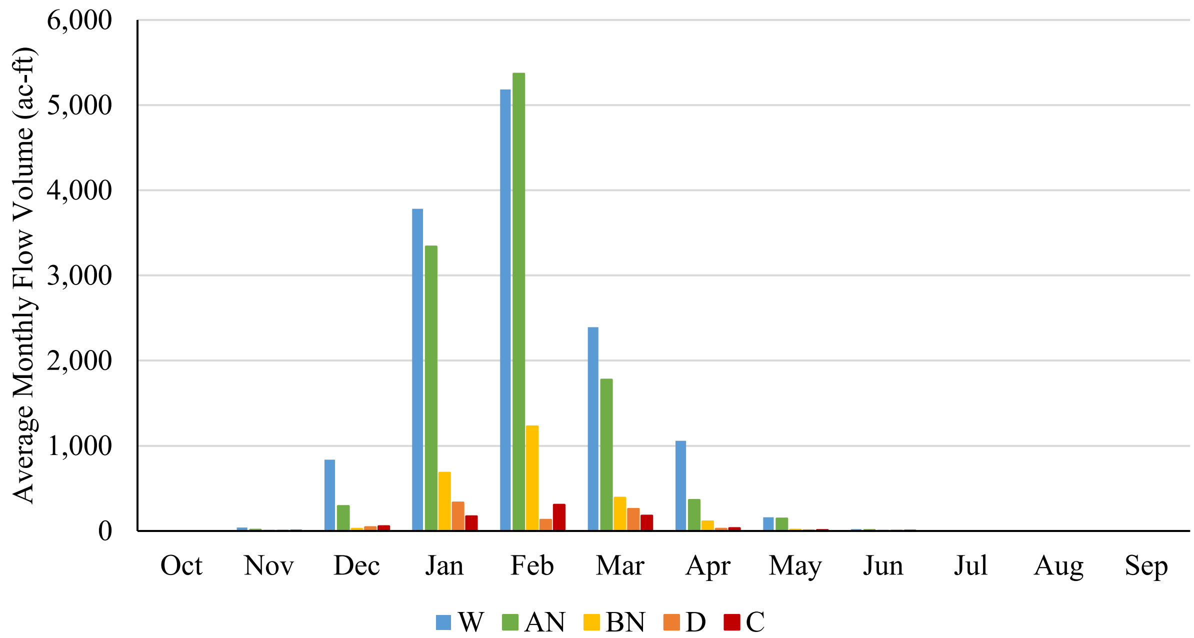

Figure 4 – Estimated Average Monthly Flow Volume Based on WY Type for Stone Corral Creek at Proposed Sites Dam (1958-2021)

Table 2 - Stone Corral Creek at Proposed Sites Dam Average Monthly Flow Volume (ac-ft) by Water Year Type (1958-2021)

	Water Year Type					
Month	**Wet**	**Above Normal**	**Below Normal**	**Dry**	**Critical**	**Average of All Years**
Oct	0	**0**	0	0	0	0
Nov	41	13	2	4	0	17
Dec	836	292	27	46	54	342
Jan	3,783	3,340	685	335	171	1,883
Feb	5,185	5,366	1,229	131	307	2,657
Mar	2,394	1,777	389	258	179	1,169
Apr	1,058	364	112	25	35	433
May	159	145	14	6	9	76
Jun	23	9	2	1	1	9
Jul	1	0	0	0	0	1
Aug	0	0	0	0	0	0
Sep	0	0	0	0	0	0
WY Total	13,479	11,308	2,459	805	757	6,587

Table 3 shows a comparison of the flow estimated using monthly logarithmic regressions and the gauged record for Stone Corral Creek. Overall, the regression produces estimated streamflow volumes that are comparable in most months of all water year types, with larger differences in the winter months of Wet and Above Normal[1] years. The error in Wet, Above Normal, and Below Normal years is a negative value indicating the estimated flow was less than the observed gauge flow. This indicates the estimated flow may be conservative and underestimating the flow in these year types.

Table 3 - Average Difference between Estimated Stone Corral Monthly Flow at the Gage from Logarithmic Regression and the Monthly Flow from Gauge Period of Record, 1958-1985 (ac-ft)

	Water Year Type					
Month	**Wet**	**Above Normal**	**Below Normal**	**Dry**	**Critical**	**Average of All Years**
Nov	-82	-23	-2	-7	1	-36
Dec	-1,548	-208	14	4	1	-615
Jan	-1,670	-4,286	-534	-276	2	-1,313
Feb	1,974	-2,125	-890	164	1	340
Mar	-1,129	188	38	156	2	-374
Apr	1,216	551	129	73	5	576
May	20	56	27	14	8	24
Jun	-3	10	4	4	2	2
Jul	-1	2	1	1	1	1
WY Avg	-1,109	-5,837	-1,214	133	22	-1,401

The average monthly flow volume in Funks Creek for different water year types using the monthly flow volumes calculated using Equation 2 is shown in Figure 5 and Table 4.

[1] As only three Above Normal years occur over the 1958-1985 period, the average is overly biased by the limited data points available. As noted above, the large negative value indicates the correlation provides a conservative estimate of potential water available by underestimating flow in these wetter years.

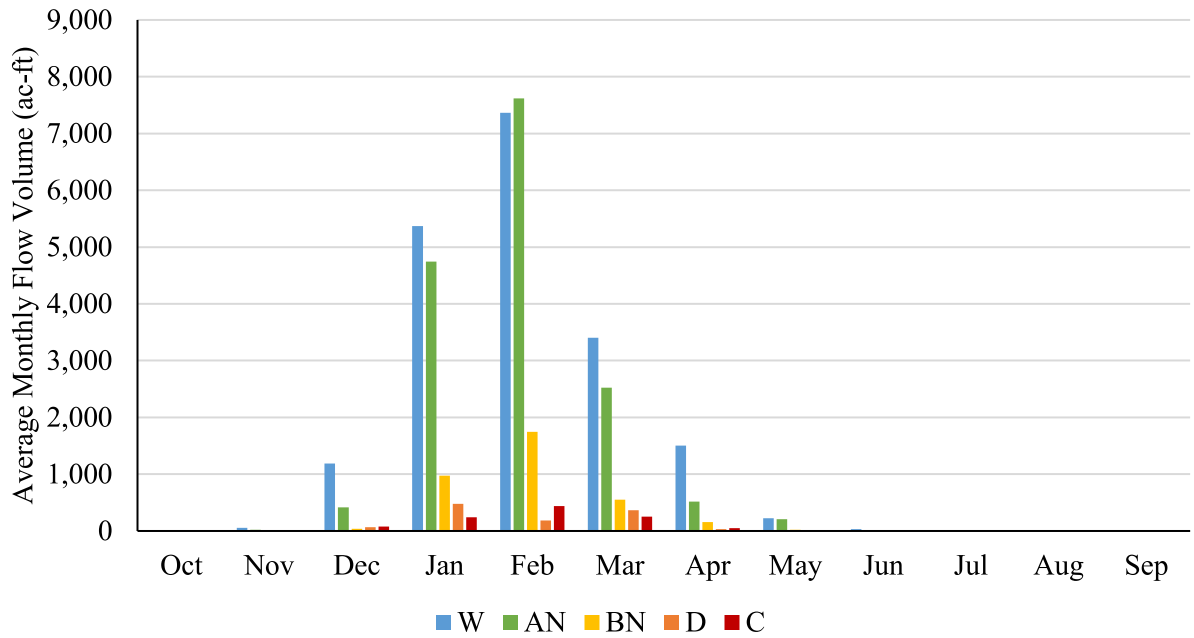

Figure 5 - Estimated Average Monthly Flow Volume Based on WY Type for Funks Creek (1958-2021)

Table 4 - Funks Creek Average Monthly Flow Volume (ac-ft) by Water Year Type (1958-2021)

	Water Year Type					
Month	**Wet**	**Above Normal**	**Below Normal**	**Dry**	**Critical**	**Average of All Years**
Oct	0	0	0	0	0	0
Nov	58	19	3	6	1	24
Dec	1,187	415	39	65	77	486
Jan	5,372	4,743	972	476	243	2,674
Feb	7,363	7,621	1,745	185	436	3,773
Mar	3,400	2,523	552	367	255	1,660
Apr	1,502	517	158	35	49	616
May	226	207	20	9	13	108
Jun	32	13	2	1	2	13
Jul	2	0	0	0	0	1
Aug	0	0	0	0	0	0
Sep	0	0	0	0	0	0
WY Total	19,142	16,059	3,492	1,144	1,075	9,355