# Appendix B

## Streamflow Depletion Effects on Downstream Water Supplies

# APPENDIX B - TECHNICAL MEMORANDUM, STREAMFLOW DEPLETION EFFECTS ON DOWNSTREAM WATER SUPPLIES

## Introduction

This technical memorandum describes the fundamental elements of streamflow depletion due to the pumping of groundwater to support a groundwater substitution transfer (GWS transfer) and describes the approach to determining a streamflow depletion factor (SDF) that would be applied to a GWS transfer to compensate the Central Valley Project (CVP) and State Water Project (SWP) for this effect on their water supplies). This technical memorandum also provides results of analysis that can be used in identifying the appropriate SDF for the accounting of Yuba Accord groundwater substitution transfers. Much of the analysis and results presented in this memorandum are specific to the Yuba Accord and Yuba Subbasins. In the description of technical analyses, some of the sections indicate that more analysis may be needed. Because the California Department of Water Resources (DWR) is the decision maker on a final approach to accounting for streamflow depletion effects from Yuba Accord GWS transfers (with Yuba Water Agency [Yuba Water] and Member Unit concurrence), DWR may wish to augment or revise portions of the analysis before a final accounting is agreed upon. Therefore, while this technical memorandum identifies a statistical representation of a range of SDF values that can be used in accounting, more work will likely be needed.

DWR's 2019 Draft Water Transfer White Paper (DWR and United States Bureau of Reclamation [Reclamation] 2019) Section 3 states:

*Flow reduction in a river, stream, canal, or drain could injure other legal users of water if it occurs when the Delta is in balanced conditions (see Section 1.1)*[1] *or there is limited streamflow in the channel from which the water is being transferred. However, if transfer-related streamflow losses occur when the Delta is in excess conditions and there is sufficient flow in the stream channel from which the water is being transferred, the streamflow depletions should not impact the water supply available to other legal users of water.*

In recent years DWR and Reclamation have intensified efforts to understand long-term streamflow depletion effects and concerns related to their water supplies. For the past several years throughout the Sacramento Valley, GWS transfers have included an SDF to offset (by leave-behind[2]) streamflow depletion impacts of the transfer. The SDF applied to a groundwater substitution transfer is a percentage of the transfer volume that would be left in the stream during balanced conditions and not transferred, resulting in this volume of water being available to the CVP and SWP. Because the SDF is applied to the transfer itself, the leave-behind occurs in the year of the transfer, though it is deemed to offset streamflow depletion that could occur many years in the future. For the past several years the SDF for most groundwater substitution transfers in the Sacramento Valley has been set at 13 percent.

Since the inception of the transfer program 15 years ago, the Yuba Accord did not have an SDF applied to Accord groundwater substitution transfers, relying instead on other components of the Accord to meet the needs of fisheries and downstream users during the driest years. Now, with the Sustainable Groundwater

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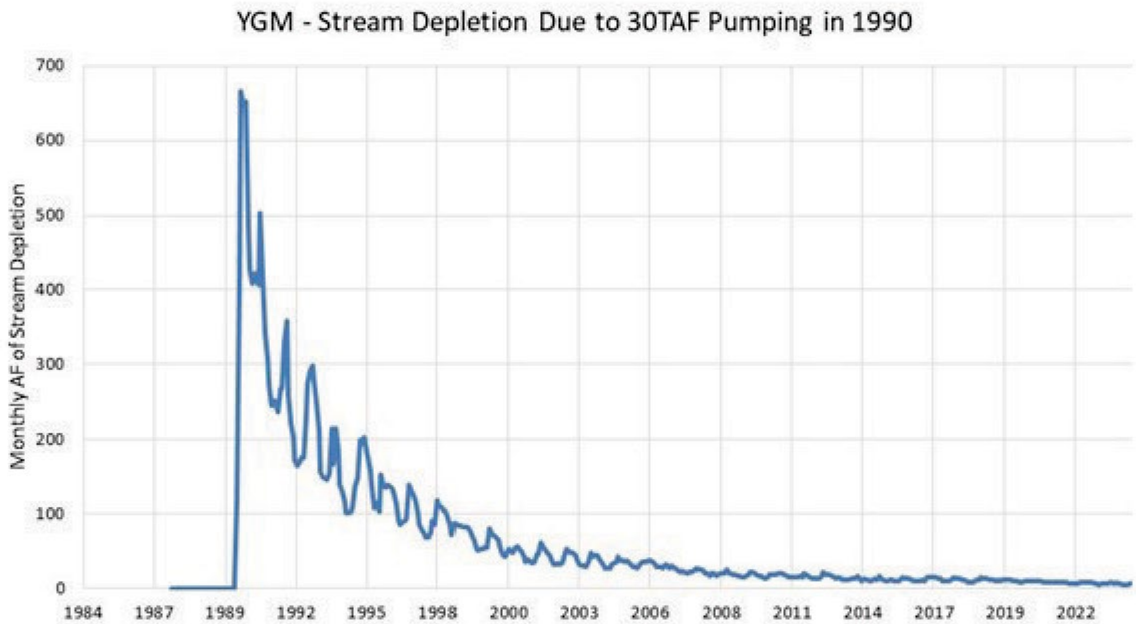
[1] Under the terms of the Coordinated Operation Agreement through which the federal and state water projects coordinate their operations, "Balanced Conditions" occur when DWR and the Reclamation agree that releases from upstream reservoirs plus unregulated flow into the Delta approximately equal the water supply needed to meet Sacramento Valley in-basin uses, plus exports. During Balanced Conditions, inflow is not sufficient to meet any applicable water quality requirements and releases must be made from storage.

[2] Application of an SDF, which is a percentage value, to a transfer volume results in the SDF percent volume of the transfer being made available to DWR and Reclamation and not transferred/delivered to the buyer. The SDF percent volume of the transfer is used by DWR and Reclamation to add to their water supplies in the current year and potentially future years if the SDF volume can be stored in CVP and SWP reservoirs.

Management Act (SGMA), streamflow depletion effects are under greater scrutiny, but when the Yuba Accord was being negotiated less was known about this issue. Regardless, Yuba Water GWS transfers under the Accord did incorporate special conditions that largely offset these effects. During the drier years when groundwater substitutions take place, the Accord's Fisheries Agreement requires minimum instream flow requirements be met at the Marysville Gage. Because most of the streamflow depletion that occurs on the Yuba River happens upstream of the Marysville Gage, streamflow depletion effects on the Yuba River are effectively supplied through releases from New Bullards Bar Reservoir as the amount of streamflow depletion in the Yuba River mostly results in an increased volume of releases Yuba Water must make from storage to comply with the instream flow requirements. With this combination of factors, Yuba Water effectively offsets much of the streamflow depletion that may have otherwise occurred on the Yuba River. Further offset was not required because, under the Accord, it was recognized that operations of the Yuba River Development Project (YRDP) in most years provide storage (also referred to as surface water) transfer water that cannot be transferred and delivered to a buyer, and this component of transfer water left instream was considered to offset any remaining streamflow depletion, such as any diminishment of Feather River and Bear River flows due to pumping in the adjacent Yuba Subbasin that could impact DWR and Reclamation water supplies.

DWR and Reclamation, being among the last downstream diverters in the Bay-Delta system, have required that surface water transfers include terms that protect their water supplies, generally in agreements with transferors that are relying upon DWR and Reclamation facilities to move transfer water to the buyer. Two examples of these terms are carriage water requirements and refill criteria. Both terms are intended to reduce or eliminate potential impacts to DWR and Reclamation water supplies and are negotiated terms between the transferor and DWR and Reclamation in conveyance agreements to use DWR and Reclamation facilities. These terms are also sometimes included in State Water Resources Control Board (SWRCB) transfer orders. Streamflow depletion effects due to GWS transfers on DWR and Reclamation water supplies are handled in much the same way. DWR and Reclamation must be satisfied that streamflow depletion effects are being sufficiently offset to alleviate their concerns of potential injury to their water rights, and this is typically accomplished with an agreement term applying an SDF to the GWS transfer.

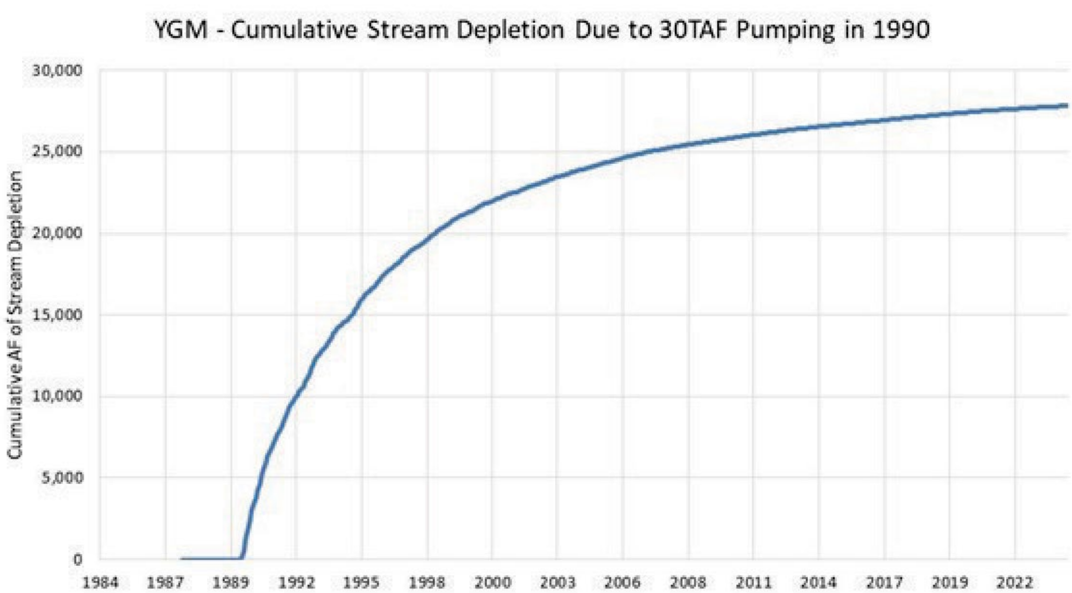
Unlike reservoir reoperation transfers that consist of releases from storage in one year and then refilling that evacuated storage the next winter or within a few years, streamflow depletion affecting downstream water supplies occurs over many years; only after decades does the accumulated volume of reduced streamflow typically approach the volume of groundwater pumped for transfer. Figure 1 shows the total streamflow depletion resulting from a GWS transfer as acre-feet of monthly streamflow depletion from all modeled streams interconnected to the Yuba Subbasins represented in the Yuba Groundwater Model (YGM). The model simulation is of a 30,000 acre-ft groundwater substitution transfer. The simulated GWS transfer pumping occurs in 1990 and the x-axis scale extends to 2024, 34 years after the pumping occurs.




Source: Prepared by S. Grinnell in 2023.

Figure 1 Monthly Volume of Total Streamflow Depletion for a YGM Simulated 30,000 acre-ft Groundwater Substitution Transfer in 1990

Figure 2 shows the cumulative monthly depletion volumes shown in Figure 1 for the simulation of the same 30,000 acre-ft pumping event in 1990. As seen in the figure, by 2024, 34 years after the pumping occurs, most of the streamflow depletion has occurred, 28,000 acre-ft of depletion compared to 30,000 acre-ft of pumping (93 percent). Further, as seen in the figure, most of the streamflow depletion – about 75 percent (22,000 acre-ft) – has recharged by 2000, the first ten years after pumping takes place.




Source: Prepared by S. Grinnell in 2023.

Figure 2. Cumulative Total Streamflow Depletion for a YGM Simulated 30,000 acre-ft Groundwater Substitution Transfer in 1990

Hydrogeologic properties of the pumped basin; timing, location, and depth of GWS transfer pumping; future hydrology of the affected streams that provide recharge to the pumped groundwater basin; and future hydrology of the Bay Delta system all contribute to a range of streamflow depletion volumes affecting Project water supplies. Assigning an SDF to a GWS transfer or transfer program requires making assumptions about future hydrology, determining a reasonable period into the future that should be used to compensate the CVP and SWP for these effects, accounting for the effects of projects that reduce or ameliorate streamflow depletion, and special conditions such as those described above regarding YRDP operations that offset streamflow depletion effects. In addition, models used to attempt to quantify streamflow depletion are invariably a simplification of the complex system of integrated surface water and groundwater, therefore, some approach to quantifying model limitations is also appropriate when determining an SDF. Finally, because the application of an SDF results in GWS transfer water being provided in the current transfer year to offset the effects of future years with unknown conditions, some assessment of the relative value of the leave behind volume versus the potential impact is warranted. Because each of the major factors has a range of assumptions that can be applied to determining streamflow depletion amounts, there is no single SDF that can be determined through analysis and policy decisions are needed to come to an agreement on the appropriate SDF for a project. For this assessment to support the Project Extension Supplemental Environmental Impact Report (SEIR), streamflow depletion is quantified within a general range of potential effects on downstream water supplies. Ultimately policy decisions, based on sound technical information for each of the factors to be considered, will be needed to determine a final SDF value or values.

## Relevant Factors for Estimating Streamflow Depletion

The degree to which streamflow depletion due to groundwater pumping results in reducing water supplies available to DWR and Reclamation depends on many factors. These factors must be assessed to determine the appropriate SDF for a GWS transfer. To reasonably quantify or assign ranges to these factors requires making assumptions, as much of the information is not known with certainty. Using a suite of reasonable assumptions results in a range rather than a specific numerical quantification of streamflow depletion. The major factors suggested for consideration in the determination of an SDF include the following.

- Hydrogeologic properties of the groundwater basin and the location and depth of pumping wells – These properties determine the timing and rate of streamflow depletion affecting surface water. This can also be expressed as cumulative streamflow depletion over time, which is a characteristic of the groundwater and pumping system and is a way to express streamflow depletion over time.
- Local hydrologic conditions – The amount of water flowing in a stream, if highly variable, will affect the rate of streamflow depletion. In wetter times when river stages are higher and wetted areas of the streams are greater, more discharge of surface water to the groundwater system may occur.
- Bay-Delta system hydrologic conditions – DWR and Reclamation have asserted that their water supplies are impacted by streamflow depletion due to GWS transfer pumping when the Delta is in Balanced Conditions. In drier times and droughts, the Delta can remain in Balanced Conditions all year, while in wetter times Balanced Conditions may not occur at all in a year. The assumed Delta conditions for future months and years are a major factor in determining an SDF. In addition to the determination of Balanced Conditions, there are times when DWR and Reclamation water supplies may not be impacted even with Balanced Conditions. If the Projects cannot move (export) any more water due to capacity constraints, a reduction in flow due to streamflow depletion would result in more water being released from Project reservoirs to maintain regulatory flows and water quality. The added releases, compared to conditions without streamflow depletion, mean lower reservoir storage going into the winter. If this lower storage were to persist into the following year, then the following year's water supplies could be impacted. Conversely, if the lower storage is negated because of wet conditions in the winter and there are reservoir spills or flood releases then the lower storage would not continue into the following year and no impact to DWR and Reclamation waters supplies would occur. Therefore, a careful review of DWR and Reclamation operations is needed to determine the impacts from streamflow depletion.

- Period of accumulation– Absent other changes in the system, streamflow depletion of interconnected surface water bodies to a groundwater basin due to groundwater pumping will eventually accumulate to nearly 100 percent of the pumped volume but, depending upon the hydrogeology of the basin and local hydrologic conditions, this typically takes several decades. Periods of 10, 20, or even 30 years are used in model simulations to analyze streamflow depletion. The period selected should be based on the potential for far future years to have a significant impact on Project water supplies. Because most of the streamflow depletion occurs in the first few years after a transfer and because DWR and Reclamation reservoirs do not accumulate the effects of many years of streamflow depletion due to periodically filling and spilling water for flood control, 10 years or less has been used in the past as the period of accumulation to compensate the CVP and SWP with an SDF.
- Local Conditions – For the Yuba River, as discussed above, the YRDP operations for instream flows at the Marysville Gage means that in drier times and drier years, Yuba Water is releasing water from storage to make up for streamflow depletion effects on the lower Yuba River. This river segment would not be included in the determination of an SDF to protect DWR and Reclamation water supplies as the effect is on YRDP storage and operations, not on DWR and Reclamation operations.
- Relative Value of the SDF portion of the GWS transfer volume – When an SDF is applied to a transfer, the SDF percentage of the transfer volume is provided for use by the CVP and SWP to offset for future streamflow depletion effects. As described above, a pattern (or patterns) of Balanced Conditions and Project operations in future years is assumed to formulate an SDF, but many of those years are wet or not very dry where water supplies are not constrained, and the relative value of water is much less than in the transfer year. This is because GWS transfers almost always occur in the driest years and during peak summer demand periods. Providing SDF compensation water in a very dry year for effects that occur in wetter years far in the future could be inequitable and the relative value of the offset water is a factor that should be considered.
- Model Limitations – DWR and Yuba Water use the same integrated surface water and groundwater modeling platform (the Integrated Water Flow Model [IWFM]) for their models, Sacramento Valley Groundwater-Surface Water Simulation Model (SVSim), and YGM respectively. These models, although computationally complex, are simplified representations of the physical system and do not include all elements or include only simplified elements that influence the interaction of surface and groundwater. This can affect the timing and relative contribution of basin recharge. Also, there are physical processes such as interconnected flooded rice fields and unlined irrigation supply delivery canals that are not explicitly included in these models, and these processes have implications for where, when, and to what extent streamflow depletion could impact downstream water supplies.
- Affirmative Offset Projects – Streamflow depletion occurs due to lower groundwater levels in a basin, which increases the flow gradient away from a stream or decreases the flow gradient towards a stream. Physically offsetting these effects can be accomplished by increasing basin storage. Two methods are to provide direct recharge of groundwater with surface water or in-lieu recharge where groundwater pumping is reduced at non-transfer times by providing farmers with surface water to promote higher groundwater levels.

Bracketing the range of hydrologic conditions that occur during and after groundwater substitution pumping takes place is a reasonable approach to identify the range of potential streamflow depletion impacting downstream water supplies. Besides the influence of the groundwater basin hydrogeology, hydrologic conditions have the largest influence on the magnitude of impact streamflow depletion has on DWR and Reclamation water supplies. Once a range of streamflow depletion effects is obtained from modeling, the additional factors listed above can be applied to this range to identify an SDF approach.

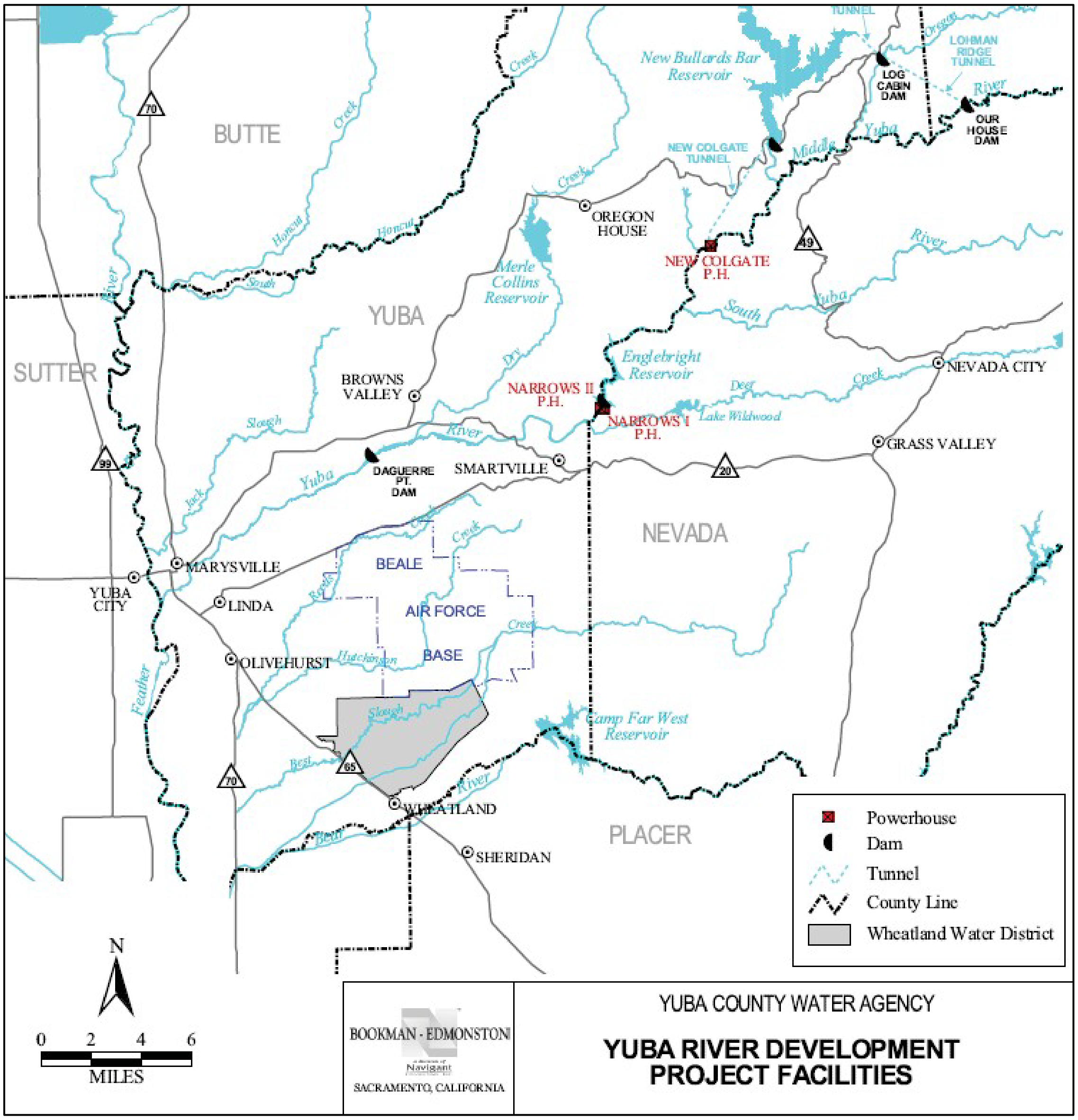
<u>Affirmative Projects to Offset Potential Losses to Downstream Water Supplies</u>

An SDF is the method of offsetting the effects of streamflow depletion on downstream water supplies by allocating a portion of the transfer water for use by the CVP and SWP. Other potential offsetting activities are projects that increase groundwater storage through direct or in-lieu recharge is another option to offset streamflow depletion from GWS transfer pumping. Projects that increase basin storage would reduce the amount of SDF applied to the transfer by offsetting the streamflow depletion effects from GWS pumping. Yuba Water implemented a recharge project that has been in operation since 2010: the Wheatland In-Lieu Recharge Project.

The Wheatland In-Lieu Recharge Project has been operating since 2010, reducing reliance on groundwater pumping in the South Yuba Subbasin and increasing groundwater storage as compared to the conditions that would exist if the project had not been built. Figure 3 shows the western portion of Yuba County, including the North Yuba and South Yuba Subbasins, and the location of Wheatland Water District.

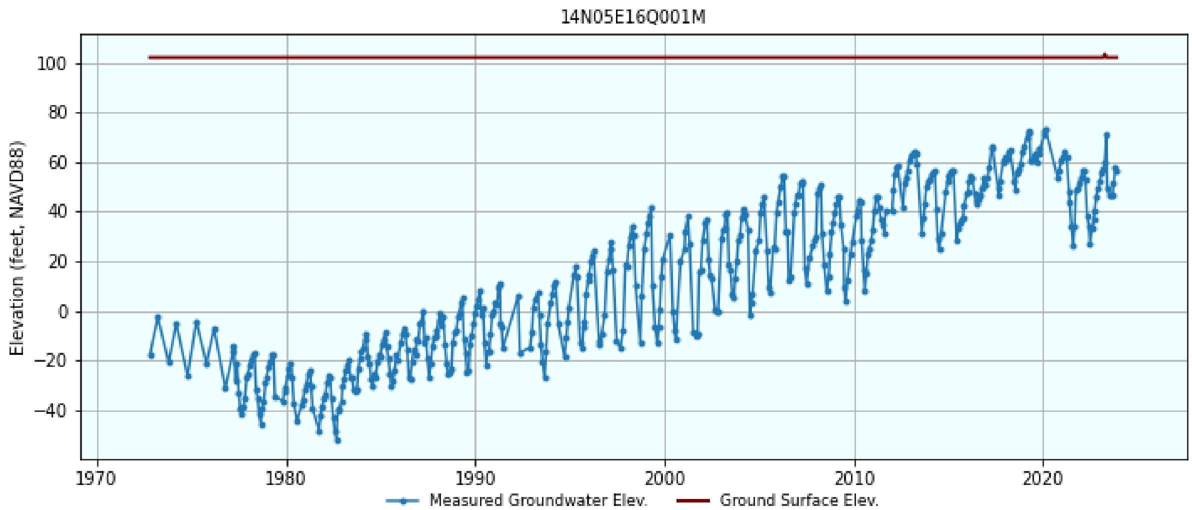
Figure 4 shows measured groundwater elevations in a well within Wheatland Water District that has been monitored since 1972. The figure shows that overall basin groundwater levels have been increasing since surface water deliveries began to much of the South Yuba Subbasin outside of Wheatland Water District in the early 1980s. Water levels then plateaued around 2007-2008. Since 2010 and the start of the Wheatland In-Lieu Recharge Project, higher groundwater levels have resulted, even with Wheatland Water District participating in Accord GWS transfers since that time. The Wheatland In-Lieu Recharge Project was constructed with funding made available through a Proposition 13 grant administered by DWR for conjunctive use and groundwater storage. The project received $3.15 million in grant funds, 50% of the total project cost. The project's ongoing benefits include increased streamflow over without-project conditions due to the higher groundwater levels and a more resilient basin, providing greater storage for conjunctive use operations.

The streamflow increase, or lower streamflow depletion, reduces GWS transfer-related streamflow depletion, is a factor to be considered when determining the amount of SDF needed to offset potential impacts to downstream water supplies.




Source: Prepared by Bookman-Edmonston Engineering in 2002

Figure 3 Western Portion of Yuba County including Yuba River Development Project Facilities and the Location of the Wheatland Water District




Source: Prepared by S. Grinnell in 2023.

Figure 4. Measured Groundwater Levels in a Well within Wheatland Water District (state well number 14N05E16Q001M).

# DEVELOPING A STREAMFLOW DEPLETION FACTOR

## 1. Streamflow changes in response to groundwater pumping

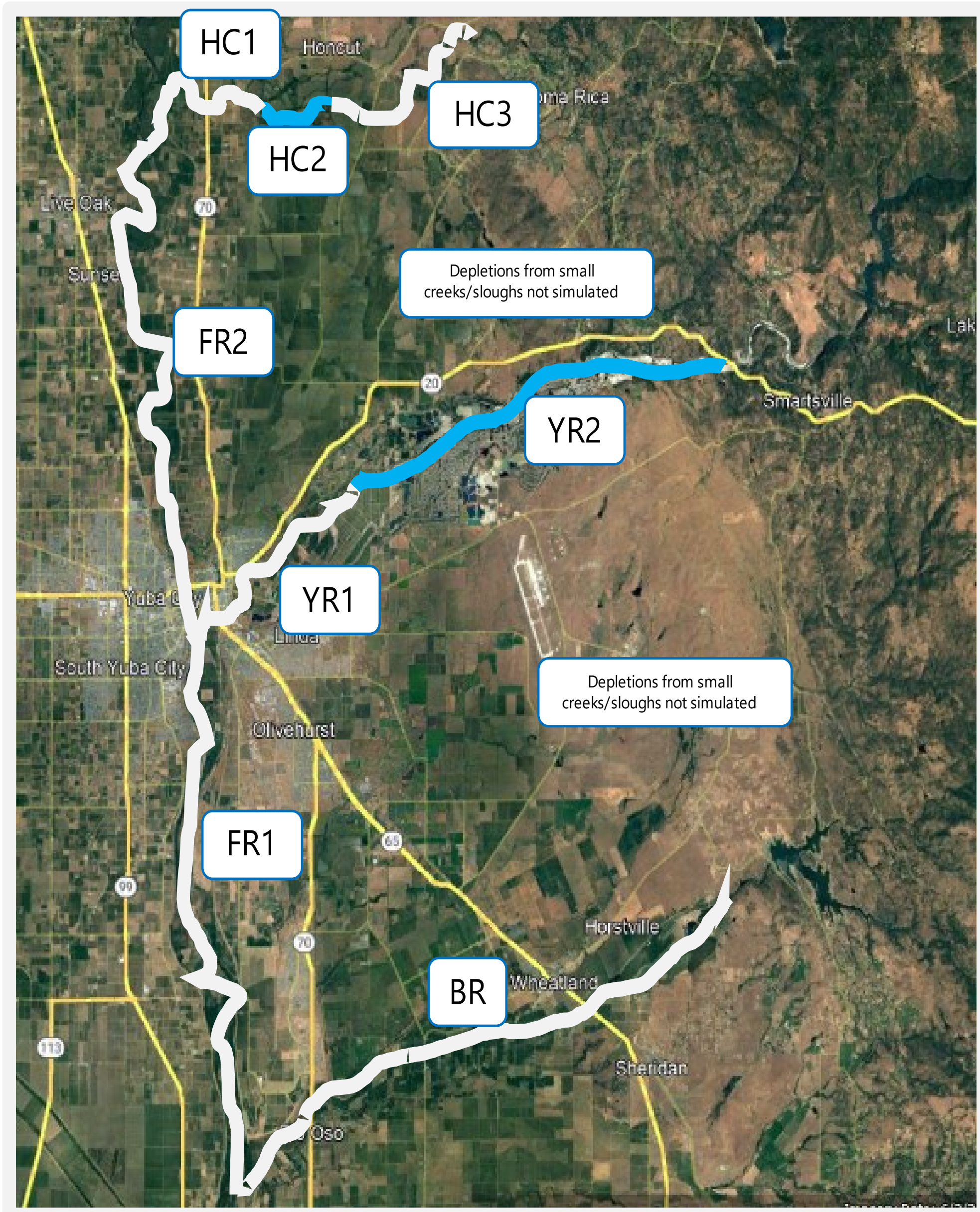
The starting point for developing an SDF is modeling of surface water-groundwater interaction in the basin. The YGM was used to simulate a GWS transfer in typical years when groundwater substitution transfers occur. Historically, Accord GWS transfers have occurred in Below Normal, Dry, and Critical years. Initially, GWS pumping was modeled as individual events and then examined through the effects of future hydrology. The first simulations were done for 1990, which was selected to represent the dry future year series, and 1994, which was selected as the wetter future year series. The resulting range of accumulated streamflow depletion volume during balanced conditions was the starting point for examining the effect of other factors leading to an applicable SDF for Yuba Accord GWS transfers.

The simulations used 30,000 acre-ft transfers with pumping distributed across the eight Yuba Water Member Unit areas consistent with the historical pattern of pumping and the GWS transfer program framework. Pumping occurs in May through November with most of the pumping occurring in July and August and only a very small amount of pumping in November. Each year's GWS transfer volume depends on several factors, including basin condition and basin management objectives and limitations, willing buyers and sellers agreeing on pricing and volume, and reservoir and river conditions for delivery of surface water that would have been used by the Yuba Water Member Units in the absence of the GWS transfer.

The YGM scenario used for this analysis is derived from the scenario used in the GSP analysis. It covers the historical water years from 1988 to 2017, followed by existing conditions (represented by repeating the 21-year hydrology between the water years 1997 and 2017 three times, covering the 63-year period between 2018 and 2080). The analysis used for this document mostly utilizes the historical part of the scenario, while the existing condition extension was used to quantify the longer-term impacts such as shown in Figures 1 and 2. This scenario also assumes that there is no change in the subsurface flows across YGM boundaries as a result of the GWS transfer pumping. This assumption results in all depletions occurring within the model domain, which includes the rivers shown in Figure 5, rather than considering a smaller portion of the depletions occurring at a greater distance. This assumption likely accelerates the depletions and may result in higher SDF than if considering a larger geographic area.

A CalSim 3 simulation of existing conditions is used to determine the months when the Delta is in Balanced Conditions from 1922 to 2015 and historical conditions are used for 2016 to 2022; from which only 2016 and 2017 are used for some of the analysis to be consistent with the YGM period of historical simulation approach.

YGM simulations are used to assess depletions in the groundwater system due to GWS transfer pumping. Streamflow depletion due to GWS transfer pumping is not a direct output of the model. Streamflow is calculated in the model and includes the calculation of stream inflow and outflow from the groundwater basin. The GWS transfer pumping simulation is compared to a baseline, non-transfer simulation to determine the change in streamflow. As the only difference between the GWS transfer pumping simulation and the baseline simulation is the GWS transfer pumping, any changes in streamflow simulated in the model are depletions. Figure 5 shows the major streams in and around the Yuba Subbasins where streamflow is modeled, and streamflow changes are calculated to determine streamflow depletion volumes. Two stream segments, YR2 and HC2, are treated differently than all other stream segments modeled as they are not included in the summation of streamflow depletion affecting downstream conditions. YR2 is the portion of the Yuba River within the basin upstream from the Marysville Gage where Yuba Water makes releases to satisfy the instream flow requirements of the Yuba Accord. Streamflow depletion in this stream segment affects YRDP operations and has a very limited effect on downstream water supplies. The section below describes the analysis of this reach of the Yuba River to determine the impact on downstream water supplies due to streamflow depletion occurring on this section of the river with Yuba Water operations of the YRDP. Stream segment HC2, a reach of Honcut Creek, is used to convey irrigation water deliveries in the irrigation season and therefore streamflow depletion in this segment mainly affects irrigation water deliveries, meaning depletion on this reach is also abated with YRDP operations.

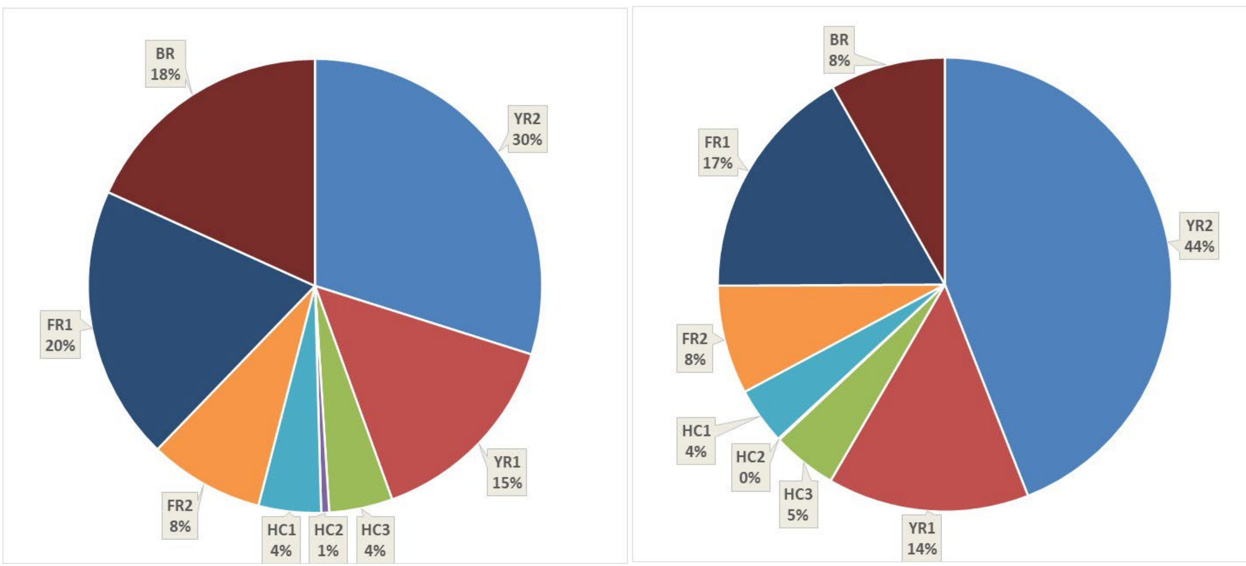



Source: Prepared by Woodard & Curran in 2023.

Figure 5 River Systems Modeled in the Yuba Groundwater Model with Model-Designated Reach Labels

2. Assessment of streamflow depletion on the Yuba River above the Marysville Gage

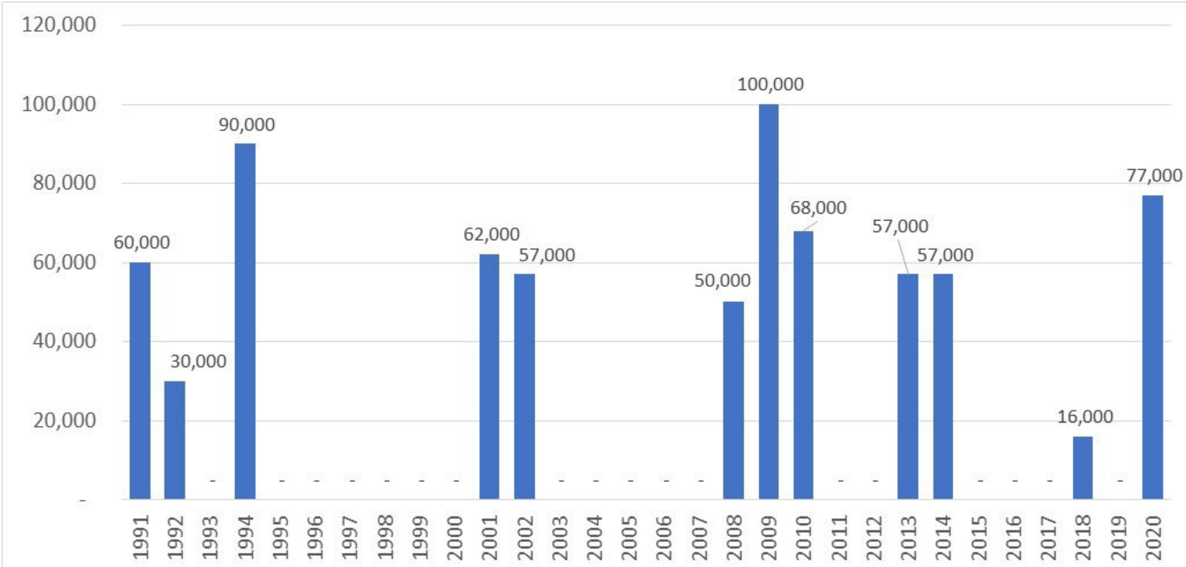
A significant portion of the total streamflow depletion due to GWS transfer pumping occurs on the Yuba River above the Marysville Gage. The reason for the large influence of the Yuba River recharging the North and South Yuba Subbasins is the proximity to many wells used in the transfers, the location in the middle of the combined Yuba Subbasins, and, most importantly, the highly transmissive sediments underlying and adjacent to the river, including the Yuba Goldfields. The left pie chart in Figure 6 shows the relative percentage of total streamflow depletion occurring on the modeled major streams in the YGM for the 1992 GWS transfer simulation over the first ten years after the start of the transfer and the right pie chart shows the same information but only for months when the Delta is in Balanced Conditions. The Yuba River above the Marysville Gage accounts for 30% of the total streamflow depletion volume overall but when examined for total streamflow depletion during Balanced Conditions the Yuba River above the Marysville Gage accounts for 44% of the total streamflow depletion volume. The 1992 simulation is used for Figure 6 as this simulation is used for most of the analysis.




Source: Prepared by S. Grinnell 2024

Figure 6: Charts of the Relative Percentage of Total Streamflow Depletion by Reach for the Ten Years after a Simulated 1992 GWS Transfer, with the Left Chart Totaling All Months and the Right Chart Totaling Only Months with Delta Balanced Conditions.

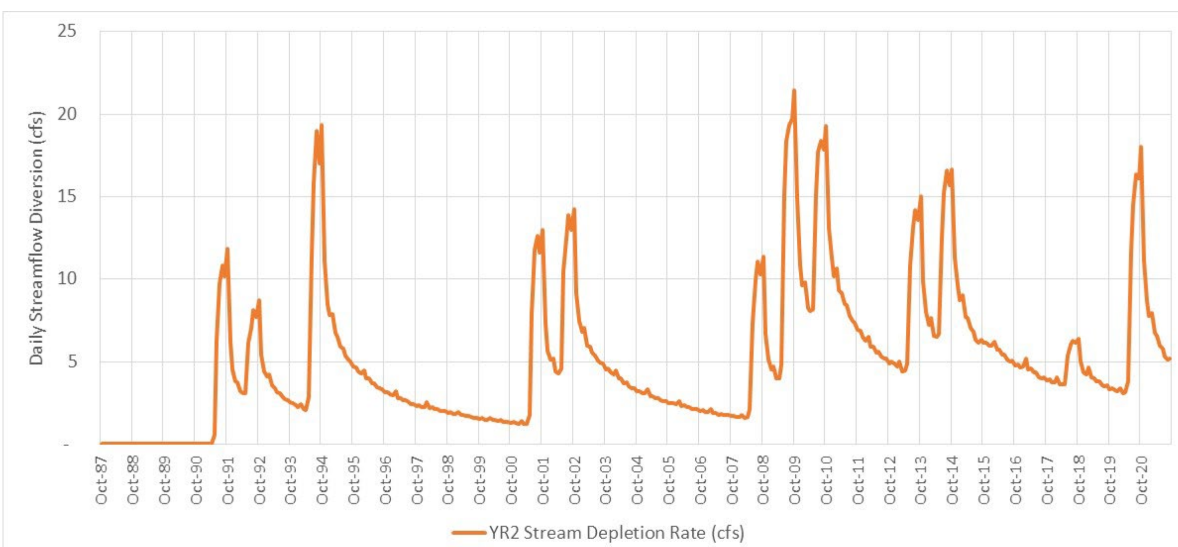
To determine to what extent operations of the YRDP nullify streamflow depletion effects on downstream water supplies, the analysis used both the YGM model and the daily time-step YRDP Water Balance and Operations model developed for Yuba Water's FERC license application and used in day-to-day operational planning for the YRDP. First, the historical GWS transfers conducted in the Yuba Subbasins from 1991 to 2020 were modeled in the YGM. Figure 7 is a plot of the annual GWS transfer volumes used in the modeling for this analysis.




Source: Prepared by S. Grinnell in 2024

Figure 7: Simulated Historical GWS Transfers in the Yuba Subbasins Used in the Analysis of Streamflow Depletion from the Yuba River above the Marysville Gage

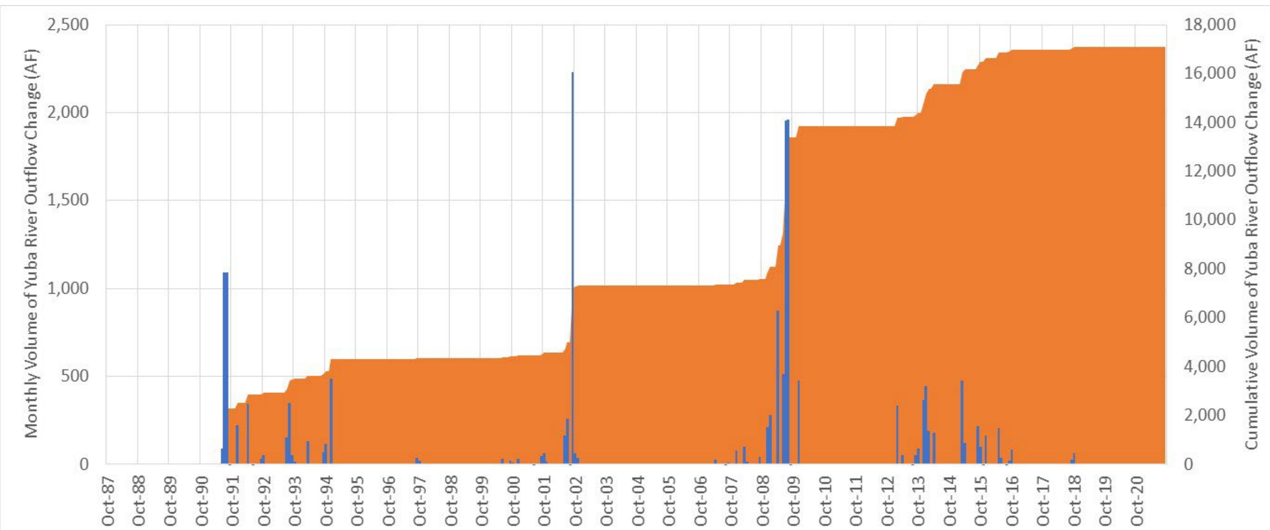
The resulting time series of monthly streamflow depletion volumes from the YC2 reach in the YGM simulation was converted into a daily time series of diversions from the Yuba River at Daguerre Point Dam and included as an added diversion from the river in the YRDP model. Figure 8 is a plot of the streamflow depletion time series converted to a daily time step diversion from the Yuba River at Daguerre Point Dam. The model was then run for the period of the water year 1970 to 2021 with and without the added diversion. The model results for the with and without added diversion time series for Yuba River outflow were compared and the time series of daily flow changes in Yuba River outflow were filtered through the monthly time series of Calsim 3 historical Balanced Conditions described above, along with an additional filter that excludes years when CVP and SWP Project water supplies would not be impacted, due to export capacity limits and following winter flood releases as described more fully below.




Source: Prepared by S. Grinnell in 2024

Figure 8: Simulated Daily Time Series of Streamflow Depletion-based Diversions from the Yuba River at Daguerre Point Dam

Unlike the analysis of streamflow depletion that uses an accumulation period of ten years, this analysis uses a streamflow depletion that accumulates throughout the entire simulation period and therefore the average volume weighted accumulation period for the modeled GWS transfer is about sixteen years. Figure 9 shows the results from the YRDP model for the Yuba River outflow difference between a baseline model run with no added depletion-based diversion and the model run with the depletion-based diversion. The figure shows monthly flow difference volumes in blue bars and a cumulative volume for the entire 31-year simulation in orange. The total cumulative volume of flow difference with the added depletion-based diversion is 17,073 acre-ft. With a total GWS transfer pumping volume of 724,000 acre-ft, the reduction in streamflow from the Yuba River above the Marysville Gage (the YR2 stream segment in the YGM model) for the entire period is 2.4% of the total pumping. The results of the analysis of the YR2 section, the Yuba River above the Marysville Gage, demonstrate that while up to 44% of the total streamflow depletion during Balanced Conditions occurs on this reach of the Yuba River, YRDP operations eliminate all but about 2% of any impact on downstream water supplies, and if a ten-year accumulation period is used the effect would be even less. Additional analysis may be warranted to further refine the understanding of the effects of YRDP operations to reduce any impact of streamflow depletion on downstream water supplies.



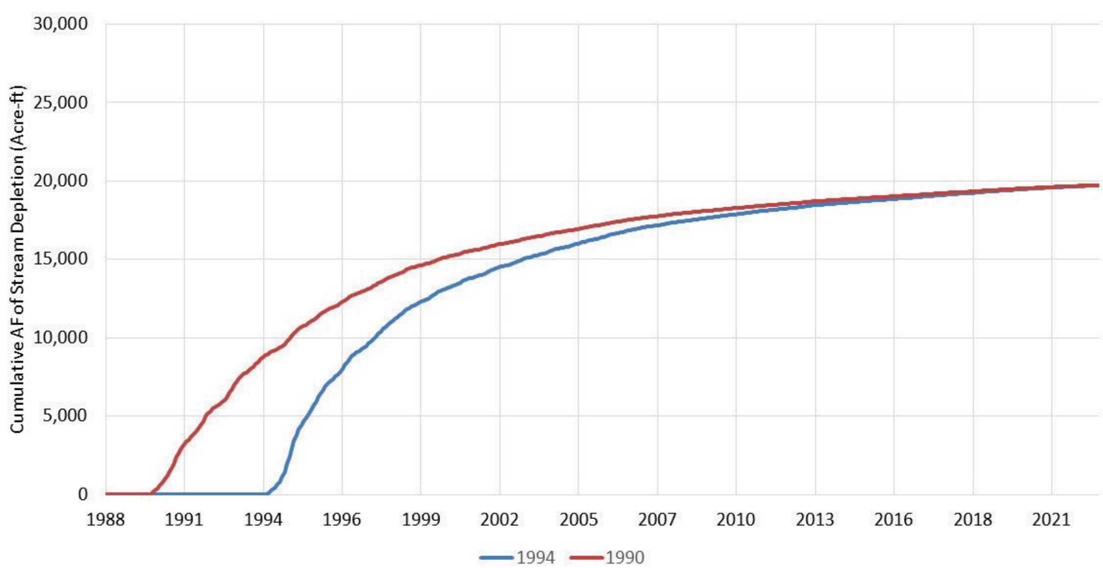

Source: Prepared by S. Grinnell in 2024

Figure 9: Yuba River Outflow Monthly Flow Reduction Volume (as a positive value) due to the Added Depletion Based Diversion from GWS Pumping (blue bars) and a Cumulative Outflow Reduction Volume for the 31 Year Simulation (orange)

## 3. Determination of a Characteristic Streamflow Depletion Curve Resulting from Yuba Accord GWS Transfer Pumping

An approach was developed to identify a characteristic depletion curve attributable to Yuba Accord GWS transfers to resolve differences between the YGM simulation period and the Calsim 3 modeling period from which information on downstream hydrologic conditions is derived. As previously described, the YGM historical period covers the water years 1988 to 2017 period (with 1988 used to initialize the model). However, the downstream hydrologic conditions data covers 1922 to 2022, including Calsim 3 modeling from 1922 to 2015 and historical conditions from 2016 to 2022. Further, the YGM modeling period is significantly drier than the 1922 to 2022 period. The characteristic streamflow depletion curve, described below, relates the streamflow depletion curve from the YGM to the significantly longer period of 1922 to 2017. As described in more detail below, the final approach used to relate a YGM derived characteristic streamflow depletion curve to future hydrologic conditions was to first use the historical Sacramento Valley Index water year types within the 1922 to 2017 period to select the Below Normal, Dry and Critical years from that period to apply the representative 1992 GWS transfer simulated YGM streamflow depletion curve. Then, the Calsim 3 1922 to 2015 future hydrologic conditions, plus historical conditions of 2016 and 2017, repeating the 1997 to 2017 conditions three times are used to complete the time series of future hydrologic conditions, from which the resulting streamflow depletion affecting downstream water supplies is calculated.

The selection of a characteristic streamflow depletion curve for the analysis started with examining the volume of streamflow depletion for all stream segments (excluding the YR2 and HC2 segments, for the reasons discussed above) summed for each month to calculate the total cumulative reduction in streamflow downstream over time. Figure 10 shows the accumulated streamflow depletion volume for all modeled stream segments, excluding YR2 and HC2, for the 1990 and 1994 30,000-acre-ft transfer simulations. As seen in the figure, the slope of the 1994 line is greater in the early years after the transfer compared to the 1990 transfer, showing that, with wetter conditions, recharge, and streamflow depletion are more rapid, but the long-term accumulated volume of streamflow depletion is the same at just under 20,000 acre-ft by the end of the simulation, without considering Delta Balanced Conditions. Comparing this figure for the 1990 simulation that shows about 20,000 acre-ft of depletion by 2021 to Figure 2 which shows about 28,000 acre-ft by this date demonstrates the significance of the YR2 stream segment and the reduction in downstream water supply impacts due to Yuba Water's operations on the Yuba River.

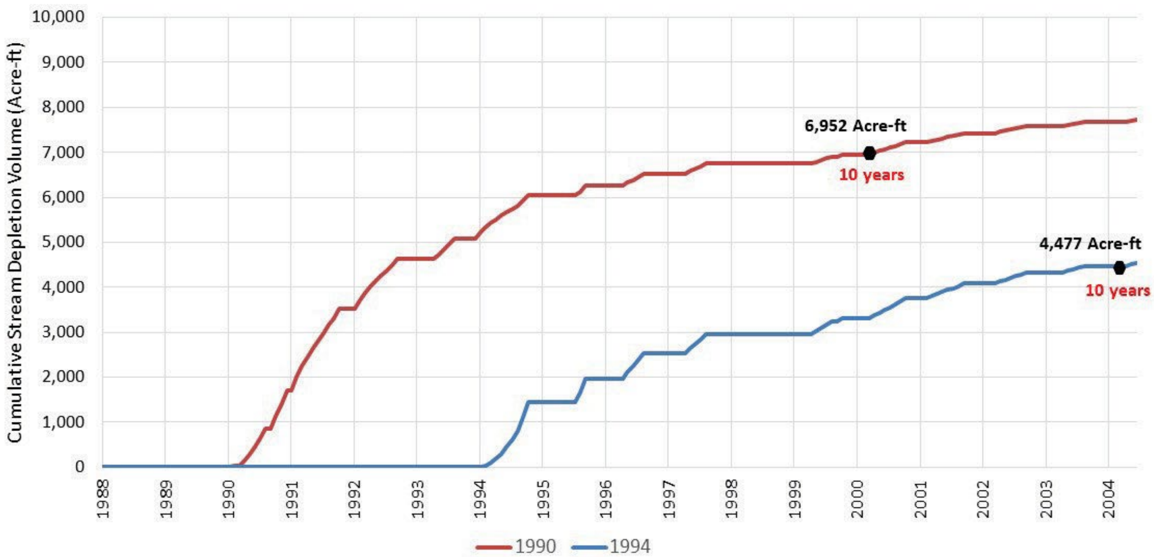



Source: Prepared by S. Grinnell in 2023.

Figure 10: YGM Simulated Results for Accumulated Streamflow Depletion Volume, Excluding YR2 and HC2, for the 1990 and 1994 GWS Transfers of 30,000 acre-ft Each.

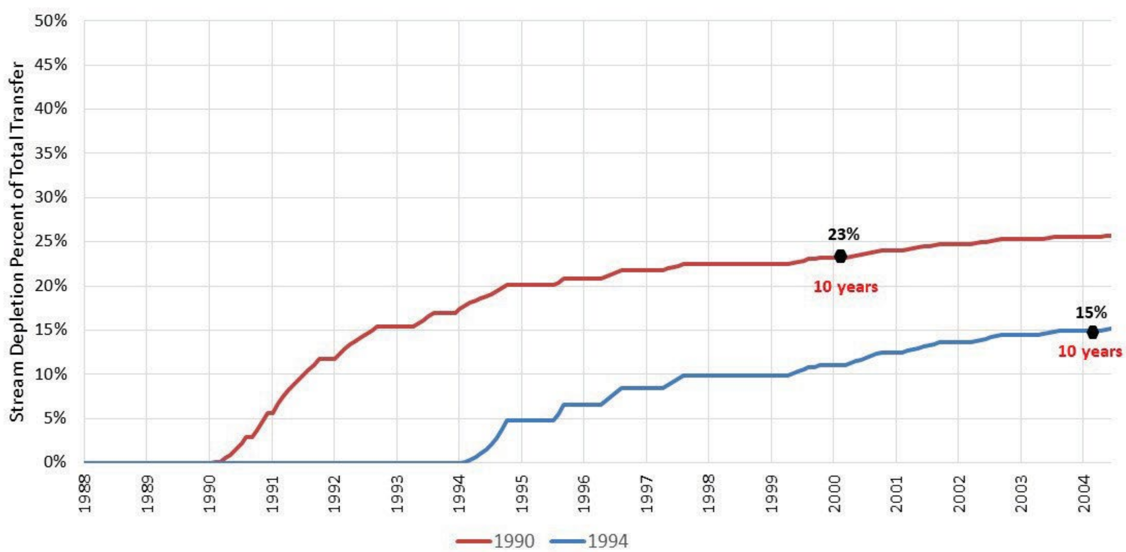
Because the accumulation of streamflow depletion is more rapid in wetter years and in wetter years Delta Balanced Conditions occurs less often, the impacts to DWR and Reclamation water supplies from a transfer with future wetter year conditions is much less than from a transfer with future dry years. Figure 11 shows the accumulated streamflow depletion volume occurring during Balanced Conditions for all modeled stream segments, excluding YR2 and HC2, for the 1990 and 1994 transfer simulations. The ten-year accumulated volume is used to illustrate the reduced flow volume to downstream over a ten-year period, the time that Reclamation has used in its analysis of GWS transfer for the Central Valley Project Long Term Water Transfers Program (2015 to 2024) (Reclamation and SLDMWA 2019). Figure 12 shows accumulated streamflow depletion as a percentage of the total pumping of 30,000 acre-ft for the same two 1990 and 1994 transfers during

Balanced Conditions. As seen in Figure 12, the ten-year accumulation of streamflow depletion affecting downstream water supplies is 23 and 15 percent, respectively, of the total pumped volume.




Source: Prepared by S. Grinnell in 2023

Figure 11: Accumulated Streamflow Depletion Volume for Simulated GWS Transfers of 30,000 acre-ft in 1990 and 1994 during Balanced Conditions

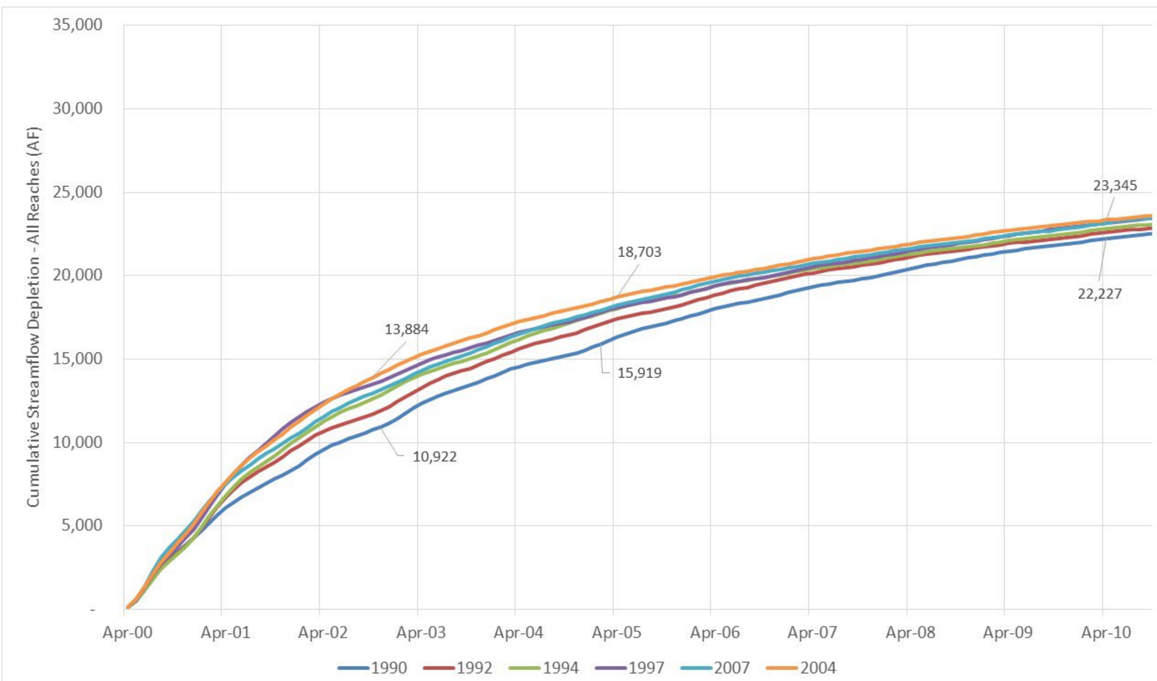



Source: Prepared by S. Grinnell in 2023.

Figure 12: Accumulated Streamflow Depletion as a Percentage of the Total Pumped Volume of 30,000 acre-ft for the 1990 and 1994 Simulated GWS Transfers during Balanced Conditions

Because of the wide range of hydrologic conditions that can occur and because simple bracketing of conditions at upper and lower levels does not provide information on the frequency of these conditions, a more extensive analysis of streamflow reduction was completed. Analyzing an extended range of historical hydrology not only identifies the range of potential effects but also determines the frequency of occurrence across this range.

Simulation of 30,000 acre-ft GWS transfers in several years provides an indication of the variability of stream depletion rates. If the variation of stream depletion rates from year to year is not too large, a characteristic year and rate can be used to calculate the effects on downstream water supplies of future hydrologic conditions for an array of potential transfer years. Figure 13 shows the cumulative streamflow depletion of a 30,000 acre-ft groundwater substitution transfer modeled in the YGM for a ten-year period with the transfer occurring in six separate years (1990, 1992, 1994, 1997, 2004, and 2007). The figure shows the variation of streamflow depletion rates recharging the basin under differing hydrologic conditions. The 1990 curve shows the slowest streamflow depletion rate for the first three and first five years compared to the fastest rate of 2004. However, by year ten there is little difference in cumulative streamflow depletion across all the years shown. Since most of the streamflow depletion occurs in the first several years and the rate does vary within this period, a central streamflow depletion curve from the 1992 transfer simulation was selected as representative of the basin characteristics for streamflow depletion. Using a single characteristic streamflow depletion curve is a simplifying approach that may need to be assessed in future work.

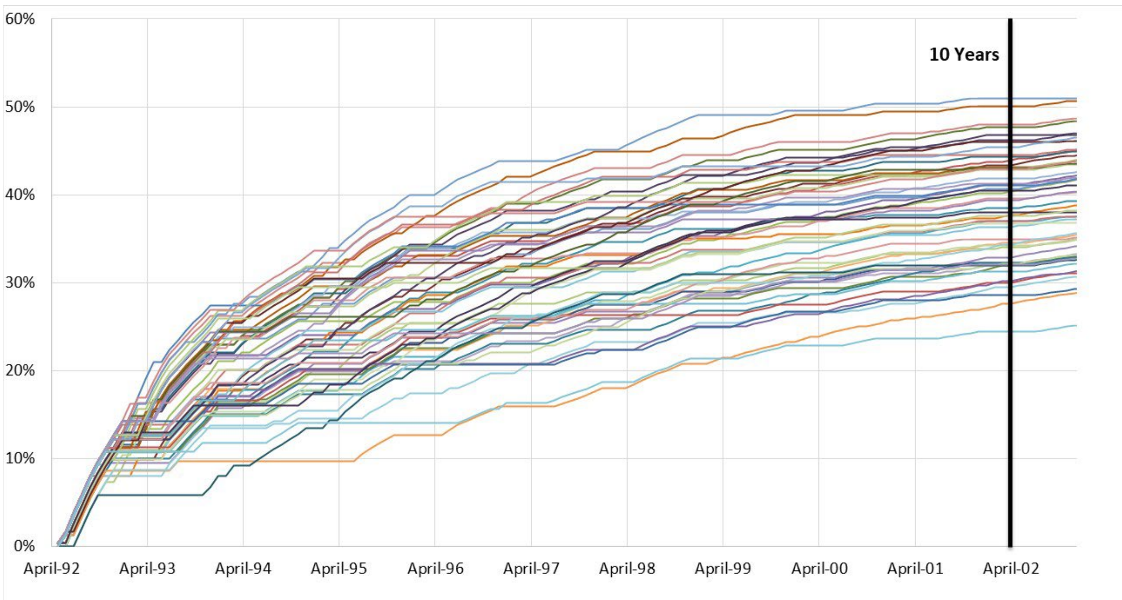



Source: Prepared by S. Grinnell in 2024

Figure 13: Cumulative streamflow depletion from a 30,000 acre-ft groundwater substitution transfer for starting in six different years (1990, 1992, 1994, 1997, 2004, and 2007)

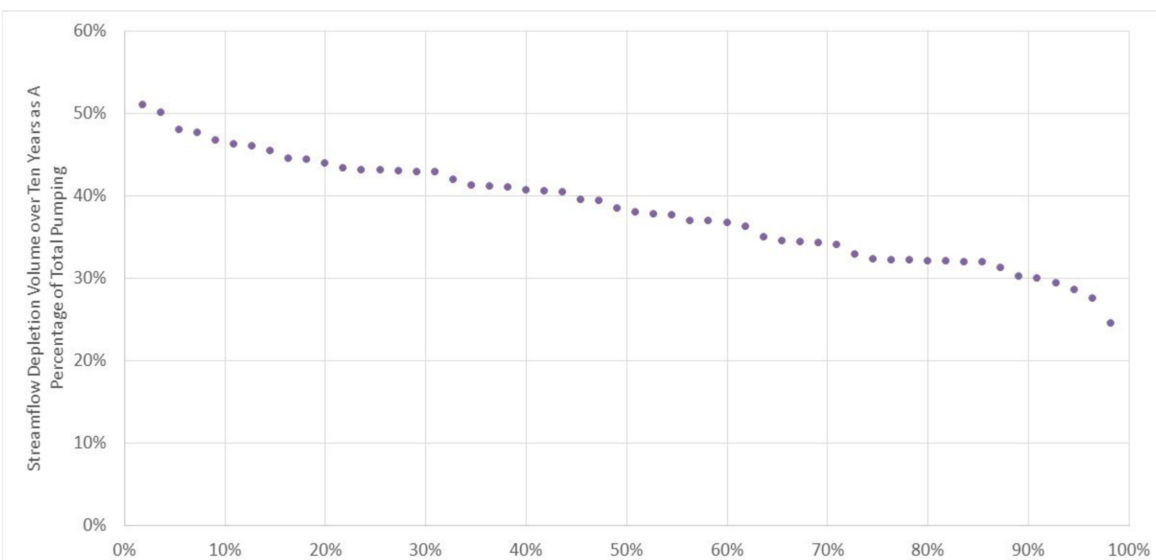
## 4. Future Hydrologic Conditions

Once a representative streamflow depletion curve is selected, the associated monthly time series of depletion volumes can be applied to Delta Balanced Conditions defined by a range of different future hydrologic conditions. A review of historical Accord GWS transfers shows these transfers occur in Below Normal, Dry, and Critical year types. The time series of Balanced Conditions discussed previously in Section 3 is applied to the time series of stream depletion for all streams in the model domain for a YGM simulated 1992 GWS transfer of 30,000 acre-ft to obtain 54 separate time series There are 54 years that are either Below Normal, Dry or Critical year types in the 1922 to 2017 period. For each year, the 1992-based monthly depletions are applied to the monthly Balanced Conditions time series starting with that year of streamflow depletion during Balanced Conditions. Figure 14 is a plot of the 54 separate time series of streamflow depletion during Balanced Conditions for all reaches (including the YR2 and HC2 reaches). Figure 15 is an exceedance probability plot of the cumulative volume of streamflow depletion after ten years for a YGM simulated 1992 GWS transfer of 30,000 acre-ft for all reaches in the YGM model for Below Normal, Dry and Critical years of the 1922 to 2017 period.




Source: Prepared by S. Grinnell in 2024

Figure 14: Streamflow Depletion Time Series of all reaches in the YGM Model as Percent of Total 1992 GWS Transfer Pumping for Below Normal, Dry and Critical Years of 1922 to 2017 During Balanced Conditions

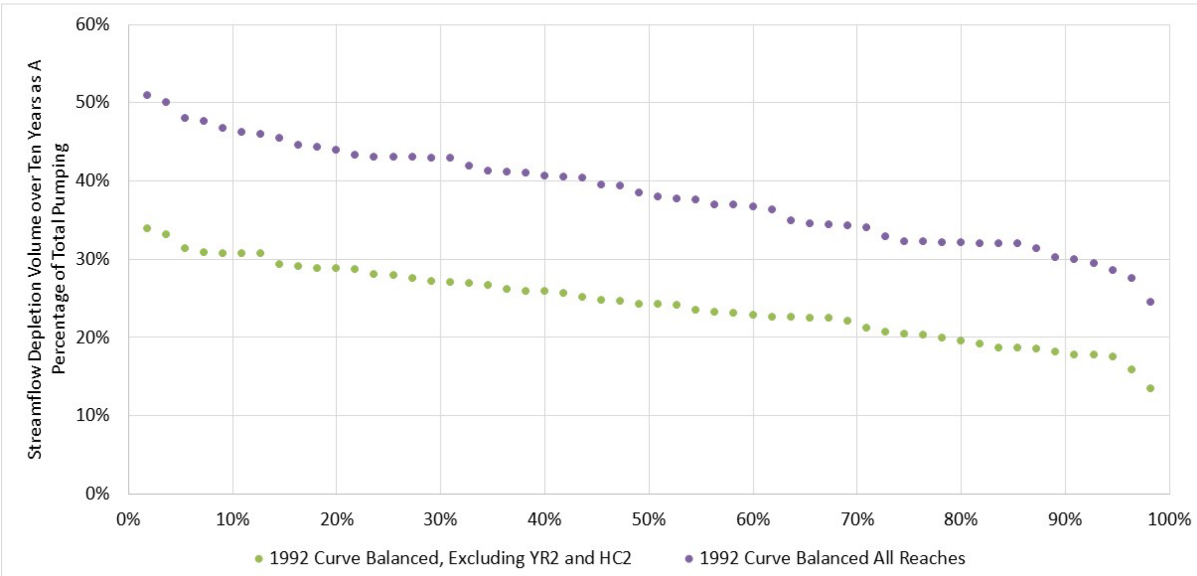



Source: Prepared by S. Grinnell in 2024

Figure 15: Exceedance probability plot of the cumulative volume of streamflow depletion after ten years for a

YGM simulated 1992 GWS Transfer of 30,000 acre-ft for all reaches in the YGM model for Below Normal, Dry, and Critical years of the 1922 to 2017 period.

As described above in the section on the effects of streamflow depletion on the Yuba River above the Marysville Gage (YR2) and the conditions on the middle Honcut Creek reach (HC2), these reaches can be excluded from the total cumulative streamflow depletion volume during Balanced Conditions as it relates to impacts to DWR and Reclamation; the resulting exceedance probability plot for depletions after ten years is shown in Figure 16. The results for cumulative streamflow depletion volume for all reaches shown in Figure 15 are included for reference.




Source: Prepared by S. Grinnell in 2024

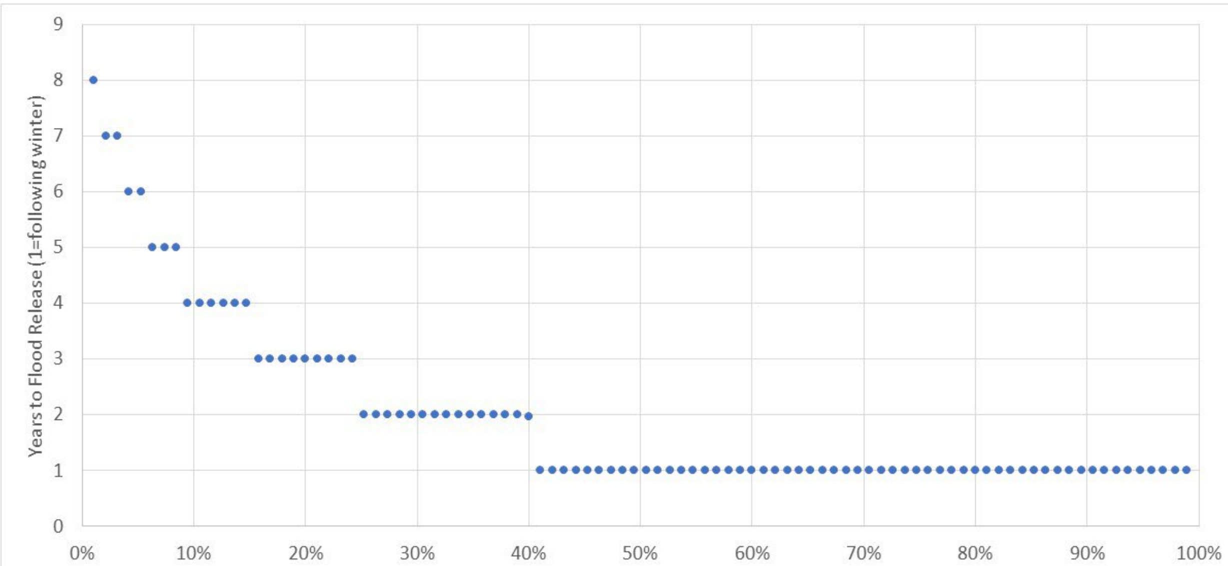
Figure 16: Exceedance probability plot of the cumulative volume of streamflow depletion after ten years for a YGM simulated 1992 GWS Transfer of 30,000 acre-ft for all reaches in the YGM model, excluding YR2 and HC2 for Below Normal, Dry and Critical years of the 1922 to 2017 period.

## 5. Refinement of the Conditions Used to Determine Impacts on Downstream Water Supplies

Up to this point in the analysis, Balanced Conditions have been used as the future conditions filter to determine when streamflow depletion could impact downstream water supplies. A closer examination of CVP and SWP operations suggests there are times when these projects' water supplies may not be impacted during Balanced Conditions. In some years the CVP and SWP are fully utilizing their export facilities capacity to move water south of the Delta. This occurs mostly in wetter years and Balanced Conditions generally occur only in the summer and early fall. If the CVP and SWP export facilities are operating at maximum capacity during Balanced Conditions, a relatively small reduction in Delta inflow would not affect these projects' exports but would result in an increase in reservoir releases to compensate for the reduced Delta inflow. The increased reservoir releases would mean lower storage levels going into the winter months. If the reservoir with lower storage levels must make releases to keep storage levels within the conservation space and avoid encroaching into its flood space (i.e., a flood release) the reduced storage due to streamflow depletion would be nullified. Since the export facilities generally only operate at full capacity in the summer when DWR and Reclamation reservoirs have above average storage, the likelihood of a flood release in the following winter is high.

A preliminary analysis was done to determine the years when streamflow depletion would not impact Project water supplies even when Balanced Conditions were to occur. This analysis used Calsim 3 data for the SWP to identify these years. CVP export capacity was examined for this more limited analysis, but further analysis of CVP reservoir operations would need to be completed to confirm whether this analysis of the condition of no impact years is also valid for the CVP, or if some years should not be excluded.

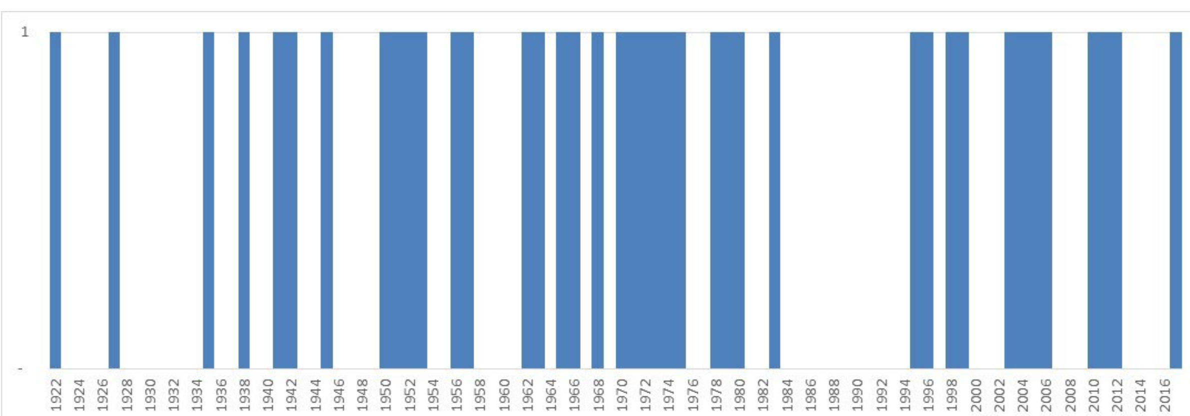
For the analysis of SWP conditions, CVP export capacity, and Oroville Reservoir storage conditions and releases, Calsim 3 output for Banks Pumping Plant operations and SACWAM WEAP model (SWRCB 2023) output for Oroville storage and flood space requirements were used. Figure 17 shows the number of years to a flood release from Oroville Reservoir from 1922 to 2015 from the WEAP model as an exceedance probability plot. 1 year means a flood release is made in the following winter, 2 is the second winter, and so on. The determination of a flood release was a simplified assumption that if storage approached the flood reservation space a flood release would be made. As shown in the plot, 60% of years result in a flood release in the following winter.




Source: Prepared by S. Grinnell in 2024

Figure 17: Exceedance Probability plot of Years to Flood Release from Oroville Reservoir (SACWAM 11/06/2023)

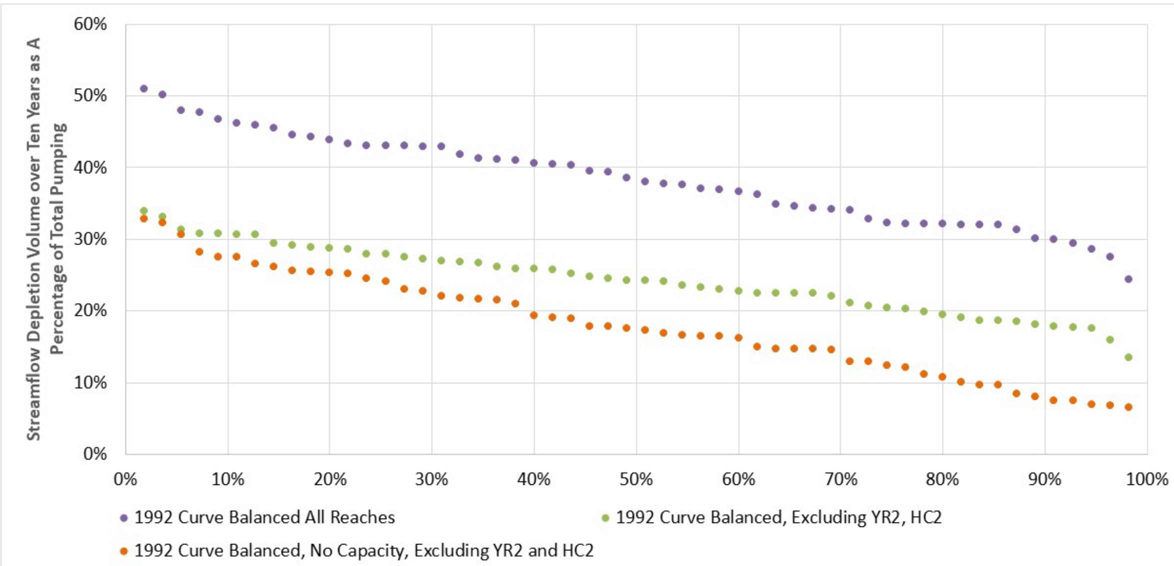
The flood release time series was combined with an examination of Banks Pumping Plant pumping and maximum allowed pumping from a Calsim 3 simulation. The result is the identification of years when these two conditions occur, and it is assumed that DWR and Reclamation water supplies would not be impacted by streamflow depletion under such conditions. As stated above, this is a simplified analysis and additional analysis is warranted.




Source: Prepared by S. Grinnell in 2024

Figure 18: Years when DWR and Reclamation Water Supplies may not be Impacted by Streamflow Depletion

Using the added time series filter of years when DWR and Reclamation water supplies may not be impacted by streamflow depletion and adding this information to the analysis of GWS transfers in Below Normal, Dry, and Critical years of the 1922 to 2017 period as shown in Figure 16 results in an exceedance probability of the cumulative volume of streamflow depletion after ten years for a YGM simulated 1992 GWS Transfer of 30,000 acre-ft for all reaches in the YGM model excluding YR2 and HC2, for Balanced Conditions in years when either export capacity exists at the Banks Pumping Plant or the following winter does not include a flood release from Oroville Reservoir, which is shown as the orange data series in Figure 19.




Source: Prepared by S. Grinnell in 2024

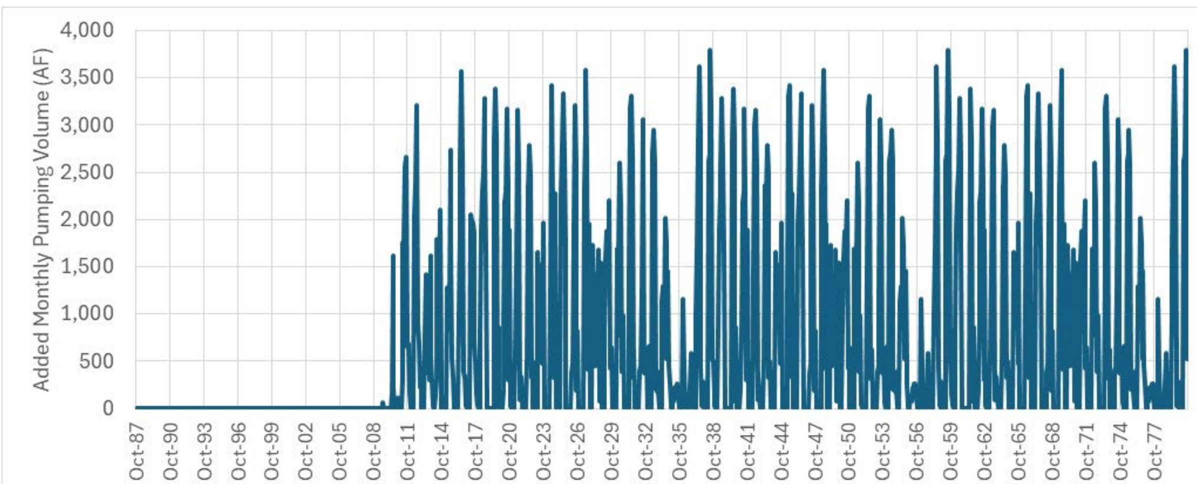
Figure 19: Exceedance probability plot of the cumulative volume of streamflow depletion after ten years for a YGM simulated 1992 GWS Transfer of 30,000 acre-ft for all reaches in the YGM model Excluding YR2 and HC2 for Below Normal, Dry, and Critical years of the 1922 to 2017 period, During Balanced Condition and Excluding Years when Banks Capacity is Full and there is a Flood Release from Oroville Reservoir the following Winter

## 6. Offset Projects – Wheatland Water District In-Lieu Recharge Project

As summarized above, the Wheatland Water District In-lieu Recharge Project (WWD Project) was implemented in 2011 with the construction of canals and pumping stations to deliver surface water to WWD. The project was a Proposition 13 Conjunctive Use Storage Project. As described in the DWR grant summary "*On March 7, 2000, California voters approved Proposition 13, the Safe Drinking Water, Clean Water, Watershed Protection and Flood Protection Act, which authorized a total of $1.97 billion in bonds and included funding for groundwater storage and recharge projects. The Proposition 13 Groundwater Storage Program authorized the California Department of Water Resources (DWR) to provide grants for feasibility studies and construction projects to facilitate conjunctive management of surface water and groundwater to improve water supply reliability*." The WWD Project was one of 27 groundwater storage construction grants and received $3.15 million to fund 50% of the $6.3 million project to bring surface water to an area that relied solely on groundwater for irrigation supply. As a result of the project, WWD uses an average of 14,400 acre-ft of Yuba River water annually, delivered through the newly constructed project since 2011. This project was funded to improve basin storage in the area, providing greater conjunctive use opportunities and increasing the volume of GWS transfers from the Yuba Subbasins, and as stated in the YWA grant application at Section C-3 "*Additional benefits not quantified in this analysis are the potential for conjunctive use management that provides for out-of-county groundwater substitution transfers in future years*" and "*As a secondary benefit to the Wheatland*

*Project, instream flows in the Bear River, Dry Creek, Best Slough, and Hutchinson Creek would be enhanced, and pumping lifts throughout the Sub-Basin would be reduced, thus reducing the cost of conjunctive use operations basin-wide*" (WWD 2001).

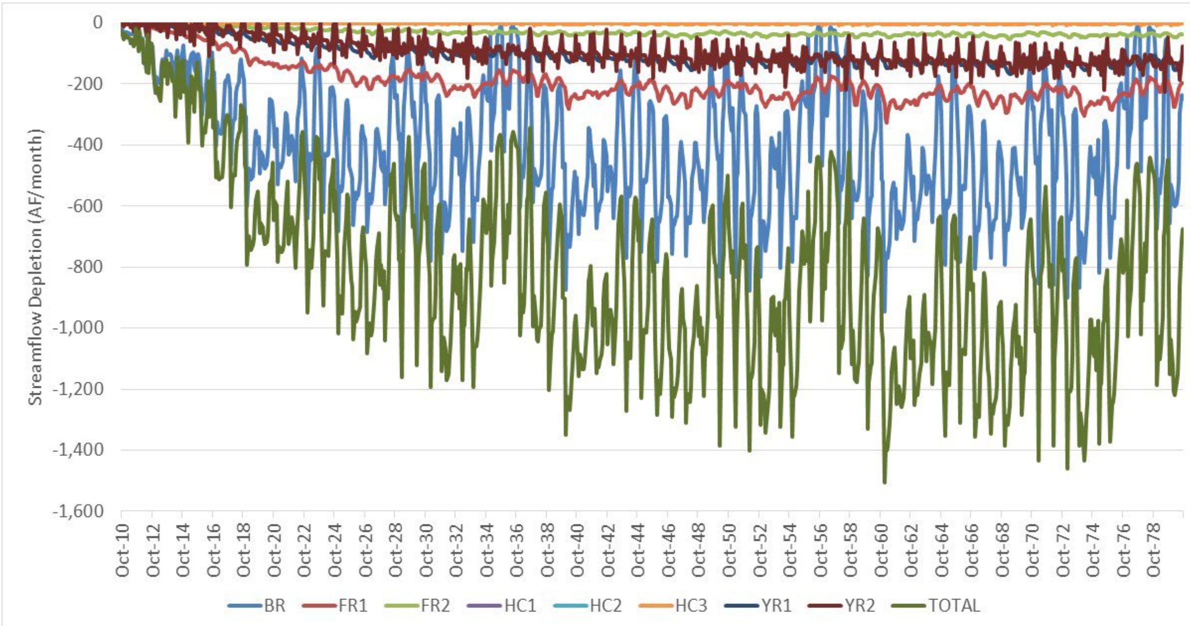
By reducing groundwater pumping by WWD for local irrigation supply, basin storage increases, and streamflow depletion decreases. Because there is less pumping each year, the basin "resets" to a new, higher level of storage equilibrium with the change from groundwater supply to surface water supply. The changes that occur are the reduction of extracted groundwater, deep percolation of applied surface water rather than groundwater, and canal losses of surface water to the groundwater basin (WWD canals are unlined). Two types of analysis were conducted to determine the streamflow depletion reduction benefit from this project. First, because the historical surface water delivery to WWD from 2011 to 2017 is included in the baseline YGM model, a simulation was constructed to replace the historical surface water use and delivery to WWD with groundwater pumping. The simulation uses the historical surface water delivery converted to groundwater pumping from 2011 to 2017 and then repeats 1997-2017 hydrology under existing conditions assumptions 3 times to complete the 2018 to 2080 time series for the full period of simulation of 1987 to 2080. Figure 20 shows the time series of groundwater pumping that is a replacement of the surface water delivery in the baseline model.




Source: Prepared by S. Grinnell in 2024

Figure 20: Simulated Groundwater Pumping in WWD as a Substitute for Surface Water Delivery to the District in the Baseline YGM Model, (AF)/month

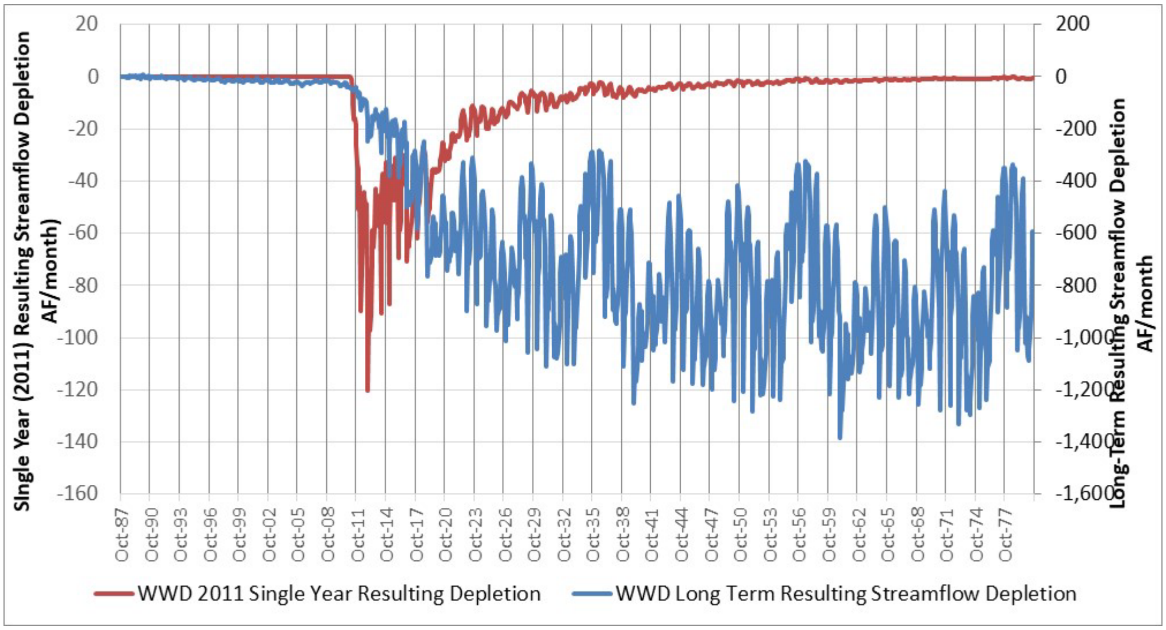
Comparison of streamflow depletion in the baseline model to the simulation of continued groundwater pumping in WWD instead of the surface water delivery results in decreasing streamflow depletion over time, with steadily reducing streamflow depletion until a new equilibrium of groundwater-surface water interaction is established. Figure 21 is a plot of the change in streamflow depletion, with a reduction in depletion shown as a negative value, for each stream segment in the model and a total. Examination of the total reduction in streamflow depletion over time shows the increasing reduction rate for the first ten to fifteen years. The plot also shows most of the reduction in streamflow depletion occurs on the Bear River (BR) followed by the portion of the Feather River from the confluence with the Yuba River to the Bear River (FR1). The time series is varied because the historical surface water deliveries to WWD were reduced in some years to support Yuba Accord GWS transfers and in 2015 and 2021 significant irrigation delivery shortages were applied to WWD contract deliveries due to extremely dry years and low storage in New Bullards Bar Reservoir. The reduction in surface water deliveries in these GWS transfer years and drought years results in a historical average annual surface water delivery to WWD of about 11,000 acre-ft, lower than the average of 14,400 acre-ft in years other than transfer and drought shortage years.




Source: Prepared by S. Grinnell in 2024

Figure 21: Simulated Change in Monthly Streamflow Depletion with WWD conversion from Groundwater Supply to Surface Water Supply, (Reduction in Depletion Shown as a Negative Value) for each Stream Segment in the YGM Model and a Total

The analysis of streamflow depletion to support the determination of an SDF utilizes a single GWS transfer of 30,000 acre-ft applied to simulated conditions representing future hydrologic conditions for Below Normal, Dry, and Critical years, the years when Yuba Accord GWS transfers take place. The long-term simulation of streamflow depletion reduction with the WWD Project cannot be readily applied to the SDF analysis. Therefore, a second simulation of the WWD Project reduction in streamflow depletion was run. This second simulation used only a single year of surface water delivery, calendar year 2011, to simulate the WWD Project effects on streamflow depletion. The year 2011 was chosen because of its similarity to the median of all years that WWD received surface water. The 2011 simulation included changing surface water deliveries to groundwater pumping, similar to the long-term simulation. The resulting streamflow reduction of the 2011 simulation and the long-term simulation (reduction shown as negative values) are shown in Figure 22. The 2011 single year pumping simulation results for total depletion from all streams in the YGM model excluding the YR2 and HC2 reaches use the left vertical axis and the long-term simulation results use the right vertical axis, which is a factor of 10 greater than the left axis. The YGM model reaches YR2 and HC2 are excluded in the total streamflow depletion for the same reasons these reaches are excluded in the 30,000 acre-ft GWS transfer analysis, which is because these reaches do not affect downstream water supplies and, in this case, do not benefit downstream water supplies.




Source: Prepared by Woodard & Curran in 2024

Figure 22: Simulated Change in Monthly Streamflow Depletion, total model segment minus YR2 and HC2 with WWD conversion from Groundwater Supply to Surface Water Supply for a single year (2011) and Long Term simulation (Reduction in Depletion Shown as a Negative Value) in AF per Month

To analyze the effect of the WWD Project on an SDF, the results of the WWD Project 2011 streamflow depletion reduction are applied to the 1992 30,000 acre-ft GWS transfer streamflow depletion time series and then filtered through the time series of future conditions that include Balanced Conditions and the preliminary results of years that do not include full export capacity and flood releases in the following winter. The same approach is used for this analysis, which applies the 1992 GWS transfer streamflow depletion time series to each Below Normal, Dry, and Critical year of the 1922 to 2017 period to develop a statistical representation of the 10-year cumulative streamflow depletion volume expressed as a percent of the total GWS transfer volume. Figure 23 shows the exceedance probability plot of the results as the black data series. The plot shows the range of depletions as a percentage of a 30,000 acre-ft GWS transfer that impacts downstream water supplies over a ten-year period after accounting for the reduction in streamflow depletion of a single year of the WWD Project.

The WWD Project provides benefits to streamflow depletion each year as groundwater pumping for local supply is not occurring because of the Proposition 13 grant and construction of the surface water delivery system even accounting for GWS transfers, which do not occur each year. For the sixteen years of Yuba Accord operations from 2008 to 2023, GWS transfers have occurred in nine years with an average annual GWS transfer volume of 32,000 acre-ft. Application of one year of WWD Project to one year of 30,000 acre-ft GWS transfer and using the cumulative ten-year streamflow depletion volume affecting downstream water supplies is expected to result in reduction in streamflow depletion of a long term simulation of these projects.

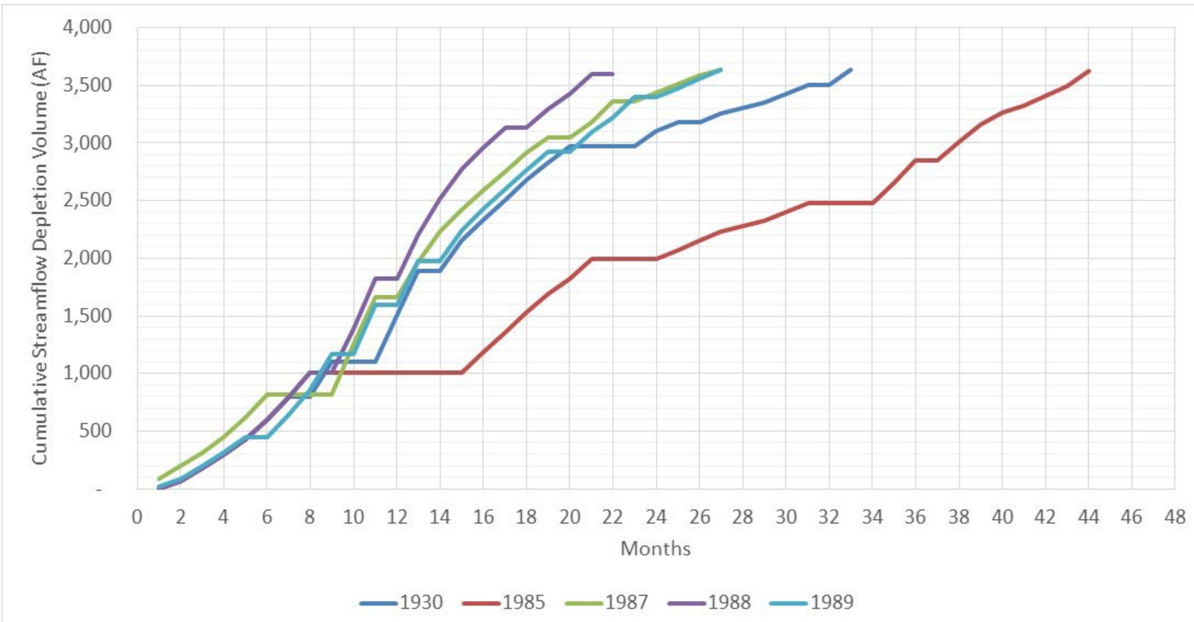

Source: Prepared by S. Grinnell in 2024

Figure 23: Exceedance probability plot of the cumulative volume of streamflow depletion after ten years for a YGM simulated 1992 GWS Transfer of 30,000 acre-ft for all reaches in the YGM model Excluding YR2 and HC2 for Below Normal, Dry and Critical years of the 1922 to 2017 period, During Balanced Condition and Excluding Years when Banks Capacity is Full and there is a Flood Release from Oroville Reservoir the following Winter and Including the Streamflow Depletion Reduction of a single year of WWD Project surface Water Deliveries

## 7. SDF Adequacy in Drought Conditions

Various strategies can be used to implement an SDF for a GWS transfer. In past years for GWS transfers throughout the Sacramento Valley, DWR and Reclamation have required a single SDF value to be applied to the transfer unless an alternative value can be supported by technical analysis. The SDF used has generally been developed by examining streamflow depletion affecting downstream water supplies over a ten-year period. The information presented in this technical memorandum shows a range of SDF depending upon future conditions, which cannot be known at the time of the transfer when the SDF is applied, and transfer water is provided to DWR and Reclamation to offset future streamflow depletion effects. The SDF median value would protect DWR and Reclamation for the future ten-year conditions in 50% of years, but in the 50% of years when future conditions are dry, such as in extended drought periods, the median value would not fully offset the impact of streamflow depletion. However, even in the most severe multi-year droughts, a median SDF would account for some of the drought year impacts.

Additional analysis was done to determine how much of the streamflow depletion impact from a GWS transfer would be offset by using a median value SDF. For demonstration purposes, an example median value SDF of 12 percent is used for the following analysis. 12 percent of a 30,000 acre-ft GWS transfer equals 3,600 acre-ft. Examining the driest 10 percent exceedance conditions (GWS transfer years that result in percent SDF values at or above the SDF value at the 10 percent exceedance of Figure 22) includes analysis of the 5 GWS transfer year hydrology's of 1930, 1985, 1987, 1988, and 1989 with SDF percentage values of 19.6, 19.3, 22.2, 23.3 and 19.3, respectively. The analysis consists of determining when the median SDF of the GWS transfer volume, in this case 12 percent of 30,000 acre-ft or 3,600 acre-ft, is reached as a streamflow depletion affecting downstream water supplies. The assumption is that the SDF applied volume of a GWS transfer, which is provided to the Projects in the year of the GWS transfer, would fully offset the future drought year streamflow depletion for a certain time following the start of the GWS transfer. For the five highest SDF percentage years from Figure 23, examining the cumulative volume time series of streamflow depletion affecting downstream supplies until the SDF volume is met determines the number of months from the start of the transfer that is offset by the SDF volume. Figure 24 shows the cumulative volume of streamflow depletion from the start of the GWS transfer until the SDF volume of 12 percent of the 30,000 acre-ft transfer (3,600 acre-ft) is met. The number of months to reach this volume ranges from 22 months for 1988 to 42 months for 1985. Three of the five years used in the analysis, which have the highest SDF percentages in the exceedance probability plot of Figure 23, include years of the six year drought of 1987 to 1992.




Source: Prepared by S. Grinnell in 2024

Figure 24: Cumulative Volume of Streamflow Depletion from the start of the GWS Transfer until the SDF Volume of 12 Percent of the 30,000 acre-ft Transfer (3,600 acre-ft) is met for the Five largest SDF Values from Figure 23

The analysis results suggest that a possible approach for implementing an SDF to the Yuba Accord transfer program could take advantage of the multi-year aspect of the program while protecting the Projects' water supplies in multi-year droughts. For example, selecting a median SDF value would result in providing more of the GWS transfer volume than would be expected to occur over 10 years for half of all GWS transfers, and less than would be expected to occur in half of all GWS transfers. However, with a multi-year transfer program a lower SDF value could be used, and then in future years the SDF value could be adjusted higher or lower and as long as the period of time to adjust the SDF is not too long, the initial SDF value would protect the CVP's and SWP's water supplies for the interim period between the initial transfer at the beginning of a drought until a revision to the SDF is made to ensure following year SDF volumes account for past year transfer effects that may not have fully compensated the CVP and SWP with the initial SDF.

## 8. Final SDF Formulation

Figure 23 illustrates the current understanding of the range of SDF values that could be used for Yuba Accord GWS transfers. As described above, there are many factors that must be considered in determining the SDF value to be applied to a GWS transfer.

The uncertainty of the modeling in representing streamflow depletion, further refinement of the analysis, and any ongoing or future offset projects that reduce the effects of GWS transfer pumping streamflow depletion are factors that also should be considered in formulating an SDF. These additional factors would affect the determination of a final SDF to be applied to the transfer. These additional factors can be informed to some degree with technical information but because all the factors used in the analysis are not precisely calculated and can vary depending on assumptions used, ultimately policy decisions will be needed to guide the determination of a final SDF. Additionally, DWR will need to review any analysis of an SDF and may want to augment, revise, or reconstruct some of the technical work, which may result in changes to the results described in this technical memorandum.

## Summary

As described above, for more than fifteen years, impacts to CVP and SWP downstream water supplies due to streamflow depletion caused by GWS transfer pumping throughout most of the Sacramento Valley have been compensated for by using an SDF applied to the GWS transfer. However, an SDF has never been explicitly applied to Yuba Accord groundwater substitution transfers, although the Accord incorporates other protections for surface water flows. With a greater understanding of these effects and concern for impacts on DWR and Reclamation water supplies, an SDF will be implemented in the amended Water Purchase Agreement Accounting Principles and appropriately applied to Accord transfers under the Proposed Extension, and this additional accounting element is consistent with the adaptive management actions described in the Yuba Accord 2007 EIR. Like carriage water and refill accounting, the appropriate SDF would be determined through an informed process between Yuba Water, its Member Units, and DWR, with DWR coordinating with Reclamation.

New information since the 2007 Yuba Accord EIR and considered in the Proposed Extension SEIR consists of new groundwater modeling analysis, information from the Groundwater Sustainability Plan developed under Sustainable Groundwater Management Act guidelines, a better understanding of stream-aquifer interactions, and heightened concern for impacts to downstream water supplies. This new information has led to a re-examination of streamflow depletion effects from Yuba Accord groundwater substitution transfer pumping.

Streamflow depletion effects have been examined in the context of impacts to the aquatic environment and impacts to downstream water supplies of DWR and Reclamation and are discussed in Section 3.2 of the SEIR.