Analysis of Supply in the State Water Resources Control Board, Division of Water Rights' 2015 Methodology for Water Availability Analyses for the Sacramento-San Joaquin-Delta Watershed

Prepared for

The West Side Irrigation District and
Byron-Bethany Irrigation District

January 18, 2016

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1.0 INTRODUCTION

This report discusses the methodology used by the State Water Resources Control Board, Division of Water Rights (SWRCB) to evaluate water availability within the watersheds of the Sacramento River, San Joaquin River, and Delta for purposes of issuing water right curtailments in 2015. This report focuses primarily on the Supply side of the SWRCB's water Supply/Demand analysis, although the two sides of the equation are interrelated. This report identifies deficiencies in the SWRCB's Supply quantitation methodology that resulted in overestimation of the Demand that could be satisfied by the available Supply. My analysis shows the reduced Demand that would result from applying appropriate corrective modifications to certain elements of the SWRCB's Supply methodology. This report also discusses sources of Supply that the SWRCB either did not consider or insufficiently considered in its reckoning of Supply.

1.1 Understanding of the SWRCB's Methodology

For purposes of evaluating water available for diverters within the Delta, the SWRCB's methodology is geographically based on the entire Sacramento-San Joaquin-Delta watershed as a whole, or on large subsets of that watershed (Sacramento River watershed plus Delta, or San Joaquin River watershed plus Delta), hereinafter referred to as "combined watersheds". In its analyses of the combined watersheds, the SWRCB's methodology quantifies Supply and Demand in the aggregate on a watershed-wide basis without regard to where a particular component of Supply accrues to the watershed and whether a particular diverter within the combined watershed has access to that Supply component.

The tool used by the SWRCB to quantify and analyze Supply and Demand for the combined watersheds is a complex Excel workbook structure. The Demand spreadsheet within the Excel workbook contains over 2.6 million cells that characterize some 167 data attributes for over 16,000 water rights. Other spreadsheets within the Excel workbook contain tools for filtering and sorting the vast amount of Demand data, and for quantifying Supply, all in support of preparing the Supply/Demand charts the SWRCB utilized in making decisions about Central Valley curtailments in 2015.

1.2 SWRCB's Quantification of Supply

The SWRCB's quantification of Supply is based primarily on "Full Natural Flow" (FNF). FNF is a term used by the Department of Water Resources (DWR) to represent the runoff from a particular basin that would have occurred had man not altered the flow of water within the basin. FNF at any given stream or river location is a computed value. It is typically based on a measured (gaged) flow rate that is subsequently adjusted to account for the effects of diversions from or imports into the upstream watershed, as well as the effects of upstream reservoir operations and consumptive use, so as to compute a natural flow that would exist at the point of reckoning absent these human-based actions. The "point of reckoning" is the FNF station location. Thus, FNF does not include any contributions to the river that occur downstream of the FNF station location.

In the Sacramento-San Joaquin Valley, FNF data is computed at 10 FNF stations located on tributary rivers, approximately at the perimeter of the valley floor. The locations of these stations are shown on **Figure 2A** herein and the watersheds tributary to each of the FNF stations are shown as solid orange lines thereon. At each of the 10 FNF stations, the SWRCB tabulates daily FNF data available from CDEC to quantify daily Supply, and relies on forecasts of monthly FNF prepared by DWR at these 10 stations as a predictor of potential future FNF Supply. All of the FNF stations are located far upstream from the boundary of the Legal Delta. The table on the right side of **Figure 2A** shows the river-mile distances from each FNF station downstream to the Legal Delta Boundary. For example, the sole FNF station on the Sacramento River (BND – Sacramento River At Bend Bridge) is located north of Red Bluff, some 199 river-miles north of the Legal Delta boundary and over 250 river-miles north of the WSID and BBID points of diversion.

For quantifying Supply available to the combined watersheds, the SWRCB's methodology sums the daily FNF values for some or all of the 10 FNF stations, depending upon which combined watershed it is evaluating. In the case of the entire Sacramento-San Joaquin-Delta combined watershed, daily flow data for all 10 stations is summed to quantify Supply for the combined watershed. The summation of daily FNF is then compared to the aggregated Demand for the entire combined watershed. This aggregated Demand includes diverters within the FNF watersheds above the FNF stations as well as diverters along the main stem rivers downstream of the FNF stations, and diverters on other smaller rivers, streams, and other waterways within the entire combined watershed. In short, the "FNF watersheds" that were used to assess Supply comprise a much smaller geographic area than the "combined watersheds" that were used to assess Demand. The "FNF watersheds" shown on **Figure 2A** collectively comprise a watershed area of approximately 22,000 square miles, while the watershed area of the "combined watersheds" reckoned at Collinsville near the westerly perimeter of the Delta is approximately 42,000 square miles.

1.3 Deficiencies in the SWRCB's Supply Methodology

Notwithstanding the SWRCB's voluminous Demand database, its reliance on DWR's calculated reckonings of FNF to characterize Supply, and its complex Excel workbook structure used to quantify and compare Supply and Demand, the fundamental methodology used by the SWRCB is inappropriate for evaluating water availability for Delta water users. Based on discussions I have had with other consultants that are experienced in the study of Delta hydrodynamics, it is my understanding that the Delta channels from which BBID, WSID, and many other Delta water users divert water are tidally influenced. Water flows into the Delta from the Sacramento River and the

San Joaquin River, and flows out of the Delta to Suisun Bay, but due to tidal effects and human influences, Delta channels do not flow in a typical "run-of-river" condition. In addition to water entering the Delta from the rivers, water moves into Delta channels from the west with the incoming tide and moves out of those channels with the outgoing tide, but there is always water in the channels and this back and forth movement results in residence times for the water in the Delta on the order of several months. Because the SWRCB's methodology does not consider this temporal aspect to the occurrence of water in the Delta, or recognize the continued presence of water in Delta channels, it is not the correct tool for evaluating Delta water availability.

In addition, the SWRCB's Excel workbook model assumes that water is simultaneously available (or not available) at the FNF stations, at the WSID and BBID diversion points, and at every other diversion point in the combined watersheds. This is not realistic. There is a travel time of a few days for water to flow from the FNF stations to the rim of the Delta. Then, once water has entered the Delta, it resides in the Delta channels for several months. The SWRCB methodology ignores the timing of water supply availability altogether, generating results that are more inaccurate and misleading the farther a particular diversion point is from the FNF station. The BBID and WSID diversion points are located at the very end of the combined watersheds and in the tidally influenced Delta where the temporal error is most pronounced.

Other consultants that are experts in Delta hydrodynamics will present information at the hearing pertaining to how the Delta functions. The remainder of my report points out shortcomings in the SWRCB's methodology for quantifying Supply. These inadequacies include:

- Lack of consideration of the spatial aspects of Supply - The SWRCB's methodology quantifies Supply (and Demand) in the aggregate on a combined watershed basis without regard to where a particular component of Supply accrues to the watershed and whether a particular diverter within the combined watershed has access to that Supply component. The lack of spatial considerations in the SWRCB's Supply/Demand analyses for the combined watersheds results in an overestimation of Demand and an inaccurate reckoning of water availability, particularly for diverters in the Delta.
- Inconsistency in how the SWRCB quantifies daily FNF Supply versus forecasted monthly FNF Supply;
- Omission of or inadequate consideration of agricultural return flows as sources of Supply;
- Omission of treated effluent discharges from municipal wastewater treatment plants to rivers and Delta channels as additional sources of Supply;
- Omission of releases from main stem tributary reservoirs for instream flow needs as possible additional sources of Supply.

It is noted that even if the above issues are remedied, the methodology would still not be appropriate for evaluating Delta water availability due to the unique hydrodynamic qualities of the

Delta mentioned above. Further, even if limited to the evaluation of rivers and waterways upstream of the Delta, the appropriateness of the methodology for purposes of pinpointing who is and who is not entitled to water at any one location within the combined watersheds is dubious. A fundamental problem with the SWRCB's methodology is that it primarily considers volume and priority, and but not when and where water actually occurs and how it moves through the system and is diverted from the system in real time.

In 1978, following the mid-1970's drought, both the SWRCB and DWR conducted evaluations of water Supply and Demand that considered where water originated in the Central Valley and how it was affected as it moved downstream in rivers and channels in response to diversions, accretions from natural and man-made sources, and depletions to due groundwater interactions.[1] Those spatial and temporal considerations, which were important to those trying to understand how the system functioned hydrologically in 1976-77, are largely absent in the SWRCB's 2015 methodology. While it is some 40 years after the mid-1970s drought and the watershed has changed in many ways, the fundamental element of when and where water occurs should not be ignored in the evaluation of water available to water users.

* * * * *

[1] These evaluations include the SWRCB's Drought '77 Dry Year Program Report and the accompanying 1978 Appendix, respectively dated January and March 1978, and DWR's Sacramento Valley Water Use Survey 1977, Bulletin 168, dated October 1978.

2.0 ANALYSIS OF SWRCB FNF AND UF SUPPLY CALCULATIONS

The Supply/Demand analyses the SWRCB prepared to support issuance of the April, May, and June curtailment notices were geographically based on the entire Sacramento-San Joaquin-Delta watershed as a whole, or the Sacramento plus Delta watershed, or the San Joaquin plus Delta watershed. For purposes of the following discussion these watersheds are collectively referred to as the "combined watersheds". In its analyses of the combined watersheds the SWRCB's methodology quantifies Supply and Demand in the aggregate on a watershed-wide basis without regard to where a particular component of Supply accrues to the watershed and whether a particular diverter within the combined watershed has access to that Supply component. The lack of spatial considerations in the SWRCB's Supply/Demand analyses for the combined watersheds results in an overestimation of Demand and an inaccurate reckoning of water availability, particularly for diverters in the Delta.

Based on the SWRCB's methodology the SWRCB's monthly reckoning of Demand attributable to all water rights in the Sacramento-San Joaquin-Delta results in an overestimation of Demand ranging from about 250,000 acre-feet to over 2 million acre-feet per month in the months of March through September. The following describes how the basis for this overestimation is rooted in the lack of spatial considerations in the SWRCB's methodology for computing Supply.

2.1 Analysis of SWRCB's Use of Full Natural Flow (FNF) Data to Quantify Supply

2.1.1 Basis of Full Natural Flow Data

Per the California Department of Water Resources (DWR), the terms "full natural flow" (FNF) and "unimpaired flow" (UF) are used interchangeably and described as follows:[2]

> *"Unimpaired flow is runoff that would have occurred had water flow remained unaltered in rivers and streams instead of stored in reservoirs, imported, exported, or diverted. The data is a measure of the total water supply available for all uses after removing the impacts of most upstream alterations as they occurred over the years. Alterations such as channel improvements, levees, and flood bypasses are assumed to exist."*

> *"Full natural flow, natural flow, natural runoff and unimpaired flow are all phrases that have been used by the Department of Water Resources (DWR) in various*

[2] California Central Valley Unimpaired Flow Data, Draft May 2007, California Department of Water Resources, Bay Delta Office.

publications to represent the runoff from a basin that would have occurred had man not altered the flow of water in the basin."

FNF at any given stream or river location is a computed value. It is typically based on a measured (gaged) flow rate that is subsequently adjusted to account for the effects of diversions from or imports into the upstream watershed, as well as the effects of upstream reservoir operations and consumptive use, so as to compute a natural flow that would exist at the point of reckoning absent these human-based actions.

2.1.2 SWRCB's Use of Daily FNF Data

The SWRCB's water availability analyses rely in part on daily FNF data reported on CDEC to quantify "Supply". Depending upon the watershed being analyzed the SWRCB's methodology for computing daily Supply is based on daily FNF data for some or all of 10 FNF stations located on tributary rivers at the perimeter of the Central Valley and Delta. These 10 stations are listed in the table below and their approximate locations and watershed boundaries are shown on **Figure 2A** as solid orange lines**.**

FNF Identifier per CDEC	Reckoning Location
BND	Sacramento River At Bend Bridge
ORO	Oroville Dam (Feather River)
YRS	Yuba River Near Smartville
FOL	Folsom Lake (American River)
MHB	Cosumnes River At Michigan Bar
MKM	Mokelumne-Mokelumne Hill (Mokelumne River)
GDW	Goodwin Dam (Stanislaus River)
TLG	Tuolumne River - La Grange Dam
MRC	Merced River Near Merced Falls
MIL	Friant Dam - Millerton (San Joaquin River)

The daily FNF for each of the above stations is obtainable from the CDEC web site.

For analysis of combined watersheds the SWRCB's methodology quantifies Supply and Demand in the aggregate on a watershed-wide basis. For example, in the case of the combined Sacramento-San Joaquin-Delta watershed, the SWRCB computes daily Supply for the combined watershed by summing the daily flows reckoned at all 10 FNF stations. **Table 2-1** shows monthly FNF (in units of acre-feet) for each of the 10 FNF basins, for the months of

March through September 2015, based on a summation of daily FNF data for each station.[3] The monthly FNF values for each of the 10 FNF stations are shown graphically as blue bars in **Figures 2B to 2H** for the months of March through September, respectively.

2.1.3 SWRCB's Representation of "Demand" in its Supply/Demand Analyses

Because FNF is a reckoning of the "runoff from a basin" it constitutes an estimate of the maximum amount of Demand that can be satisfied by natural flow within the FNF basin, i.e. Demand within the basin cannot exceed the amount of water physically available to satisfy it (Supply). It is important to understand that a "FNF basin" is a distinct geographical watershed area and is finite. The map shown in **Figure 2A** shows the watershed boundaries for each of the 10 distinct FNF basins associated with the aforementioned FNF reckoning locations using orange outlines. In conducting a calculation of water availability for a specific FNF basin, the FNF Supply for the basin should be compared to the Demand within that same FNF basin watershed area. If the Demand in the FNF basin area exceeds the FNF Supply, the excess Demand should not be included in any water availability analysis for a larger geographic area or system. This is because the excess Demand cannot physically be satisfied with supplies accruing to the system downstream or outside of the FNF reckoning location and therefore it is not a real Demand on the remainder of the system. With reference to **Figure 2A**, if a calculation of water availability for the BND FNF basin results in unmet Demand for that basin, it is a mistake to assume that the unmet Demand in the BND FNF basin could be satisfied by surplus FNF Supply in the ORO FNF basin.

Table 2-2 shows the amount of monthly Demand attributable to all water rights located within each FNF basin based on the SWRCB's Demand values for each water right as set forth in its WRUDS 2015-06-09.xlsx spreadsheet (June WRUDS spreadsheet). The SWRCB's use of the term "Demand" is the same as "diversion", i.e. it is the amount of water the SWRCB assumed would be diverted in 2015 under each right in each month within the entire Sacramento-San Joaquin-Delta watershed, and is the basis for the SWRCB's representation of Demand on its 2015 Supply/Demand charts.

The SWRCB's monthly Demand for each right is shown in Columns EW through FH in the June WRUDS spreadsheet. Column FI of the June WRUDS spreadsheet shows the total Demand for all 12 months in the calendar year, and Column FJ shows a seasonal subset of the Demand for the months of April through September. All of the SWRCB's Demand columns in the June WRUDS spreadsheet (Columns EW though FJ) are shaded in purple; an excerpt of the SWRCB's June WRUDS spreadsheet showing these Demand columns (with Columns B

[3] Because the SWRCB's Supply/Demand charts depict Demand as an average monthly value, it is useful for comparative purposes to similarly accumulate daily FNF into a monthly value. The monthly FNF values shown in **Table 6-1** are based on daily FNF data from the SWRCB's Excel workbook called "WY 2014-15 CDEC Supply Tables.xlsx", which was provided in the SWRCB's response to the PRA in folder 2015/Supply-Demand Charts, and which the SWRCB used for its depictions of Daily FNF in its Supply/Demand charts.

through EV hidden), is provided in **Attachment #1** hereto. For the remainder of the discussion herein, the term "SWRCB Demand" refers to the Demand values that the SWRCB used in its Supply/Demand analysis, as set forth in Columns EW through FJ in the SWRCB June WRUDS spreadsheet.

Table 2-2 shows the breakdown of monthly SWRCB Demand within each FNF basin on a priority basis (riparian, pre-1914, post-1914 up to and including WSID's Application 301, and post-1914 junior to Application 301). The SWRCB Demand data is shown graphically on **Figures 2B to 2H** in stacked bar chart format for the months of March through September, respectively.

The monthly SWRCB Demand values shown in **Table 2-2** are summations of SWRCB Demand values for individual rights within each FNF basin. These values were tabulated by sorting the "HUC 12" field in the SWRCB's June WRUDS spreadsheet. "HUC" is an acronym for Hydrologic Unit Code. "HUC 12" refers to a geographical area delineating the boundaries in a particular subwatershed within a larger basin/watershed, and each HUC 12 area has a unique 12-digit code.[4] For illustration, **Figure 2I** shows the HUC 12 subwatershed boundaries within the Yuba River Near Smartville (YRS) FNF watershed. The HUC 12 code(s) for each water right listed in the SWRCB's June WRUDS spreadsheet is provided in Columns J and K of that spreadsheet.[5] Using Excel filters and sorting tools, the HUC 12 data fields in the SWRCB's June WRUDS spreadsheet thus allowed us to select all rights within a specific FNF basin watershed to quantify SWRCB Demand within that FNF basin watershed.

With reference to **Figures 2B to 2H**, for each FNF basin in each month, wherever the accumulated SWRCB Demand within the basin is greater than the FNF for the basin, the amount of SWRCB Demand in excess of FNF could not have been satisfied, and hence there is no basis to assume that the excess SWRCB Demand could have occurred. If the excess SWRCB Demand within a particular FNF basin could not have been satisfied by the FNF basin Supply, then it should not have been included in the computation of *aggregated* SWRCB Demand for the Sacramento-San Joaquin-Delta *combined* watersheds. And yet the SWRCB's methodology does exactly that.

[4] The HUC coding system has been developed by the USGS and NRCS for purposes of standardizing how watershed boundaries of various extents are delineated and referenced nationwide. The methodology for delineating and coding watersheds is described in the USGS publication Federal Standards and Procedures for the National Watershed Boundary Dataset (WBD), Chapter 3 of Section A, Federal Standards Book 11, Collection and Delineation of Spatial Data, Techniques and Methods 11–A3 Fourth edition, 2013. HUCs are identified geographically, in order from largest to smallest, as regions, subregions, basins, subbasins, watersheds, and subwatersheds. HUC 12 refers to the smallest of these delineations (subwatershed); nationwide the average size of HUC 12 watersheds is about 40 square miles. HUC 12 subwatersheds along with HUC 4 (subregions) and HUC 8 (subbasins) can be viewed on the SWRCB's eWRIMS Web Mapping Application (GIS) web site.

[5] HUC 12 subwatersheds boundaries along with HUC 4 (subregions) and HUC 8 (subbasins) can also be viewed on the SWRCB's eWRIMS Web Mapping Application (GIS) web site.

Figures 2B to 2H show that total monthly SWRCB Demand exceeded monthly FNF for most of the basins in all months. In general the excess SWRCB Demand is attributable to post-1914 rights. SWRCB Demand attributable to senior rights is generally less than FNF in most of the basins for all months. Exceptions are the Stanislaus River (GDW) and Tuolumne River (TLG), where FNF is less than senior SWRCB Demand in almost all months.

2.2 Consideration of Unimpaired Flow (UF) Watersheds as Sources of Supply

In addition to the FNF watersheds, another possible source of unimpaired flow (i.e. additional Supply) is runoff from other streams and watersheds that are tributary to the Sacramento River, San Joaquin River, and Delta and for which DWR does not compute FNF. Estimates of historical monthly unimpaired flow values are presented in the report titled "California Central Valley Unimpaired Flow Data, Fourth Edition, Draft" dated May 2007, prepared by the Bay-Delta Office of DWR (2007 DWR UF report). The 2007 DWR UF report presents computed monthly unimpaired flows for 24 watersheds within the Sacramento-San Joaquin Valley watershed for Water Years 1921 through 2003. Figure 1 from the 2007 DWR UF report (provided in **Attachment #2**) shows the boundaries of the 24 UF subbasins, each of which has been given a designated UF number and name.

The 24 subbasins in the 2007 DWR UF report include the 10 FNF subbasins previously discussed herein. 13 of the remaining 14 UF subbasins constitute potential sources of Supply to either the Sacramento River, San Joaquin River, or Delta (UF 23 is identified as Tulare Basin Outflow which in most years does not contribute flow to the San Joaquin River). These 13 UF subbasins are listed in the table below. The approximate watershed boundaries of the UF subbasins are shown on **Figure 2J** as solid green lines.

Unimpaired Flow (UF) Subbasins within Central Valley

UF Subbasin	UF Name
UF 1	Sacramento Valley Floor
UF 2	Putah Creek Near Winters
UF 3	Cache Creek above Rumsey
UF 4	Stony Creek at Black Butte
UF 5	Sacramento Valley West Minor Side Streams
UF 7	Sacramento Valley East Side Minor Streams
UF 10	Bear River near Wheatland
UF 12	San Joaquin Valley East Side Minor Streams
UF 15	Calaveras River at Jenny Lind
UF 17	San Joaquin Valley Floor
UF 20	Chowchilla Reservoir at Buchanan Reservoir
UF 21	Fresno River near Daulton
UF 24	San Joaquin Valley West Side Minor Streams

As with the FNF data previously discussed, UF is a computed value. The 2007 DWR UF report includes a brief description for each UF subbasin describing how the historical monthly unimpaired flow values were derived.

For purpose of computing daily Supply, the SWRCB methodology relies solely on daily FNF data for the 10 FNF stations. It does not include in the calculation of daily Supply any unimpaired runoff from the 13 UF subbasins. The SWRCB did consider monthly flow contributions from 8 of 13 UF subbasins for purposes of making adjustments to DWR's Bulletin 120 forecasted monthly FNF values, but made no such adjustment to account for flows in these UF subbasins in its daily reckoning of FNF.

The discussion in **Section 2.1.3** above regarding the SWRCB's treatment of FNF data holds true for the UF subbasins. Demand within a UF subbasin cannot exceed the amount of water physically available to satisfy it. For each UF subbasin, the demand that the SWRCB attributed to that subbasin in its reckonings of daily Demand did not, based on the SWRCB's omission of UF subbasin Supply, have a source of Supply to satisfy it, and hence there is no basis to assume that the SWRCB Demand could have occurred. If the SWRCB Demand could not have occurred within a particular UF subbasin then it should not have been included in the computation of *aggregated* SWRCB Demand for the Sacramento-San Joaquin-Delta *combined* watersheds. And yet the SWRCB's methodology does exactly that.

Table 2-3 shows the amount of monthly SWRCB Demand attributable to all water rights located within each UF subbasin as set forth in the SWRCB's June WRUDS spreadsheet, broken down on a priority basis (riparian, pre-1914, and post-1914). The SWRCB Demand values shown in **Table 2-3** were obtained by sorting HUC 12 fields in the SWRCB's June WRUDS spreadsheet, as previously described herein for the FNF basins.

A complicating factor in reckoning SWRCB Demand in the UF subbasins was the fact that main stem rivers run through several of them and some of these main stem rivers have FNF stations on them. Because the DWRs 2007 FNF Report did not include main stem demand for main stem FNF rivers running though UF subbasins we excluded main stem SWRCB Demand from the quantifications of SWRCB Demand in the UF subbasins. For example, portions of the Sacramento River, Feather River, Yuba River, and American River run though UF 1 - Sacramento Valley Floor. Because UF 1 is supposed to consider only unimpaired flows accruing from "minor streams" within UF 1 (i.e. streams that are not included in FNF reckonings), SWRCB Demand associated with the aforementioned main stem rivers within UF 1 had to be excluded from the SWRCB Demand calculation for UF 1.

Demand for main stem rivers having FNF stations was excluded from the UF subbasins by accessing the SWRCB's online eWRIMS GIS database and using the "Find Water Right By

Stream" filter.[6] **Attachment #3** is a screen shot of the SWRCB's on-line GIS map showing how this filter was used to select all rights on the Sacramento River in Colusa County. By repeatedly selecting rivers and Counties using this filter for all FNF main stem rivers within the UF subbasins, we compiled a list of main stem water rights that were excluded from the calculation of SWRCB Demand for the UF subbasins. We subsequently manually checked the SWRCB's eWRIMS database and GIS map for any rights among the main stem rivers that may not have been captured by the automated GIS selection tool.

An additional adjustment was made to exclude SWRCB Demand for water rights within the Legal Delta from portions of UF subbasins that overlap the Delta. Identification and exclusion of Legal Delta water rights was facilitated using the "AREA" filter in the SWRCB's June WRUDS spreadsheet.

Another complicating factor was that the UF subbasins in the 2007 DWR UF Report are not identified by HUC. Our reckoning of UF boundaries shown on **Figure 2J** and our assignment of HUC 12 subwatersheds to those boundaries is based on our interpretation of Figure 1 and the accompanying UF watershed descriptions in the 2007 DWR UF Report to the extent that we could find the references cited therein.

The Demand values in **Table 2-3** show SWRCB Demand within the UF subbasins after the foregoing exclusions were made. These values are shown graphically on **Figures 2K through 2Q** in stacked bar chart format for the months of March through September, respectively.

2.3 SWRCB Demand in Excess of Available Supply

2.3.1 Demand in Excess of FNF Supply

Table 2-4 shows the derivation of SWRCB Demand in excess of FNF Supply on a station by station basis for the months of March through September 2015 for various water right priorities (riparian, pre-1914 and post-1914) for all 10 FNF stations in the Sacramento-San Joaquin-Delta watershed. In the tabulation for each FNF station the "Excess" value shown for each priority of right is the amount of SWRCB Demand for that priority that could not have been met by the available FNF watershed Supply for each month in 2015. For example, for the BND station in the month of May, of the 542,992 acre-feet of total SWRCB Demand, FNF was sufficient to meet SWRCB Riparian Demand and Pre-1914 Demand (as evidenced by the value of 0 "Excess Demand" for each of these priorities), but was insufficient to meet 262,991 acre-feet of the SWRCB Post-1914 Demand of 493,664 acre-feet. The 262,991 acre-feet of SWRCB Post-1914 Demand was "in excess" of the available FNF Supply for the BND station and hence there was no basis to assume that it occurred. If this excess SWRCB Post-1914 Demand could not have occurred at the BND station then the SWRCB should not have

[6] https://waterrightsmaps.waterboards.ca.gov/ewrims/gisapp.aspx

included it in the summation of total SWRCB Demand in the Supply/Demand analyses for combined watersheds considering all priorities of water rights.

At the end of **Table 2-4** subtotals of SWRCB Demand in excess of Supply are provided for the various water right priorities for the four Sacramento Valley FNF stations and for the 6 San Joaquin Valley stations, and a grand total is provided for all 10 FNF stations. These subtotals and grand total provide the amounts of SWRCB Demand for the various priorities that should have been deducted from the summation of total SWRCB Demand in the SWRCB's Supply/Demand analyses for combined watersheds.

2.3.2 Demand in Excess of UF Supply

Table 2-5 shows the derivation of SWRCB Demand in excess of Supply for the 13 UF subbasins for the months of March through September 2015 for various water right priorities (riparian, pre-1914 and post-1914). This table assumes no unimpaired flow Supply for any of the UF subbasins, commensurate with the SWRCB's omission of contributing flows from these UF subbasins in its reckoning of Daily FNF Supply. For example, in **Table 2-5** total SWRCB Demand for UF 1 in the month of May is 135,090 acre-feet. However, since the SWRCB did not account for any Supply in UF 1 there is no basis to assume that any of the total SWRCB Demand occurred, i.e. all of the SWRCB Demand was in excess of Supply regardless of priority. If the SWRCB Demand could not have occurred within the UF subbasin then it should not have been included in summations of SWRCB Demand in the Supply/Demand analyses for various combined watersheds.

At the end of **Table 2-5** subtotals are provided for the 5 of 7 Sacramento Valley UF subbasins and for the 6 San Joaquin Valley subbasins, and a grand total is provided for the 11 UF subbasins. Because the SWRCB omitted Demand from UF 2 (Putah Creek Near Winters and UF 3 (Cache Creek near Rumsey) from its Supply/Demand analyses for combined watersheds after the May 1, 2015 curtailment (apparently due to the SWRCB's perception of no UF Supply in these subbasins), the SWRCB Demand for UF 2 and UF 3 have not been included in the subtotal for the Sacramento or for the grand total for the combined watershed. These subtotals and grand total provide the amounts of SWRCB Demand for the various priorities that should have been deducted from the summation of total SWRCB Demand in the SWRCB's Supply/Demand analyses for combined watersheds.

2.4 Summary

The SWRCB's methodology for quantifying FNF and UF Supply has a systemic deficiency that results in overestimates of Demand when evaluating the combined watersheds. The method is therefore inappropriate for this purpose, but to the extent it would be used it is my recommendation that the excess SWRCB Demands shown in the respective subtotals and grand totals in **Tables 2-4 and 2-5** be deducted from the SWRCB's June WRUDS spreadsheet Demand for water availability analyses for the combined watersheds.

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3.0 INCONSISTENCIES AND INADEQUACIES IN SWRCB'S CONSIDERATION OF AGRICULTURAL RETURN FLOWS

Return flows from agricultural irrigation operations that are discharged to rivers, streams, and constructed drainage channels constitute a potential source of Supply to diverters located downstream of the points of discharge. The SWRCB's methodology for quantifying Supply includes consideration of certain return flows, but has several shortcomings:

- The SWRCB's methodology does not consider certain agricultural return flows that occurred in 2015 - The SWRCB's quantification of Supply does not include consideration of any return flows in the Sacramento River system, even though it is a well-established that many water users in the watershed rely on return flows from upstream water users for their Supply.

- The SWRCB's methodology does not accurately account for return flows it did consider - In the San Joaquin River system the SWRCB's methodology assumes that return flows occurred only in the months of April through June of 2015, however, based on information I have reviewed and analyzed return flows did accrue to the San Joaquin River system in the months of July through October 2015.

- The SWRCB's methodology considers certain return flows in an inconsistent manner - The SWRCB methodology considers contributions from certain return flows in its *forecast of monthly* Supply, but does not include these contributions in its *daily* reckoning of FNF Supply. It is unclear why the SWRCB includes return flows for forecasting monthly Supply but does not include them in its reckoning for daily Supply.

- The SWRCB's methodology does not consider spatial aspects of return flows – By ignoring spatial aspects of where return flows occur, the SWRCB's methodology incorrectly assumes that these flows are available to diverters that are located *upstream* of where the return flows are released. A fundamental problem with the SWRCB's methodology is that it only considers volume and priority, not when and where the water occurs. An appropriate water availability analysis would allocate Supply based on both location and time.

3.1 SWRCB's Methodology for Considering Agricultural Return Flows

The SWRCB's methodology "adjusts" DWR's *forecasted* 50, 90 and 99 percent monthly FNF (forecasted Supply) by adding the following agricultural return flows to the aggregated monthly FNF values:

- Return flows to the San Joaquin River are assumed to be 20 percent of riparian Demand for the months of March and April, and 10 percent of riparian Demand for the months of May and June. Return flows after June are assumed to be 0.
- Return flows to the Delta are assumed to be 40 percent of senior Demand (riparian plus pre-1914) for the months of March through September.
- Return flows to the Sacramento River are assumed to be 0 for the entire irrigation season.

The SWRCB's adjusted monthly forecasted FNF values are depicted on the SWRCB's Supply/Demand charts as points connected by dashed lines (see **Attachment #4** as an example). Because return flows are additive to waterways, the SWRCB's adjustment increases the forecasted monthly FNF Supply, i.e. the points depicting forecasted monthly Supply on the SWRCB's charts are plotted higher than they would be absent the adjustment.

3.1.1 Daily FNF not Adjusted for Return Flows

The SWRCB methodology does not adjust *Daily* FNF for agricultural return flows. Daily FNF, depicted as a continuous fluctuating solid blue line on the SWRCB's Supply/Demand charts (**Attachment #4**), is simply the sum of daily FNF data for whichever stations are within the watershed being analyzed. The methodology does not increase Daily FNF to account for the contribution of return flows to aggregate Supply. This appears to me to be an inconsistency in how the SWRCB's methodology accounts for Supply. If during the spring and summer of 2015 the SWRCB's was tracking Daily FNF for consistency with adjusted forecasted monthly FNF, it was comparing an unadjusted FNF-based parameter against an adjusted FNF-based parameter. I have not found anything in the information provided by the SWRCB that explains why adjustments were made to forecasted monthly FNF but not to Daily FNF.

3.2 Incorrect Basis for San Joaquin Return Flows

The basis for the SWRCB's assumptions for San Joaquin River return flows is listed on the FNF Adjustments tab as "1977 Drought Report". This refers to the SWRCB's Drought '77 Dry Year Program Report dated January 1978 and the accompanying Appendix to that report dated March 1978 (1978 Appendix). These documents summarize the SWRCB's actions during the drought year of 1977 and its analysis of water supplies available to various water right priorities in that year; both documents were provided in the SWRCB's response to the PRA. However, the SWRCB's 2015 methodology for accounting for San Joaquin return flows only partially reflects the methodology the SWRCB used in the 1978 Appendix. The 1978 Appendix accounted for return flows beyond those attributable to riparians in the months of March through June.

As part of the "available water supply", the analysis in the SWRCB's 1978 Appendix includes return flows in the San Joaquin River basin as follows:

> *"Return flow is assumed to be 20 percent for March and April, 10 percent for May and June, zero percent for July, August, and September, and 20 percent for October and November."* [7]

Tables 6 through 12 in the 1978 Appendix respectively apply the aforementioned percentages to riparian diversions for the Merced River, Tuolumne River, Stanislaus River, San Joaquin River (below Merced River confluence), Calaveras River, Mokelumne River and Consumes River. However, the 1978 Appendix recognized that return flows beyond the foregoing percentages also occurred in 1977:

> *"The water supply available to satisfy pre-1914 demands in the basin is equal to the total residual natural supply after riparian demands in the basin are satisfied <u>plus the return flow from the use of ground and project (stored or imported) water</u>."* [8] [Emphasis added]

The 1978 Appendix then goes on to describe how the availability of water for pre-1914 rights was estimated. Table 26 in the 1978 Appendix computes the amount of "return flow" for each of the aforementioned tributaries after accounting for riparian operations, and Table 27 includes these tributary amounts in the SWRCB's estimate of water available for pre-1914 and post-1914 water rights (both tables are provide as **Attachment #5** hereto). Tables 26 and 27 show that return flows were a source of supply in July and August.

Unlike the 1978 Appendix the SWRCB's 2015 methodology does not include a means of identifying when and where return flows occur. In addition, unlike the 1978 Appendix, the SWRCB's 2015 methodology does not consider return flows from the use of groundwater or project (stored or imported) water, thereby leaving out a source of Supply to appropriative rights.

While agricultural irrigation operations may have changed since 1977, with more water users and irrigation districts implementing tailwater capture and reuse systems, irrigation return flows still occur in the San Joaquin River system.

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[7] SWRCB Appendix to Drought '77 Dry Year Program Report, March 1978, at page 6.

[8] Ibid., page 18.

3.2.1 Modesto Irrigation District

Table 3-1 summarizes information obtained from Modesto Irrigation District's (MID) for monthly of return flows to rivers for the period of 2000 to 2015. Per MID the water returned to the rivers can be comprised of irrigation tailwater and/or pumped drainage of high groundwater.[9] **Table 3-1** shows that 12,160 acre-feet were discharged to rivers during the months of March through October 2015, and the releases were reasonably evenly distributed during May through October. Of this total, 7,924 acre-feet occurred after June 2015.

The 2015 total return flow was about 33 percent of the 2000-2015 average, and about 70 percent of 2014 total return flow.

3.2.2 Oakdale Irrigation District

Historical "Drainwater Outflow" from Oakdale Irrigation District (OID) to local waterways is quantified in OID's 2012 Agricultural Water Management Plan (AWMP) for the years 2005 through 2011. AWMP Table 5-16 titled "OID Overall Water District Water Balance Results 2005 to 2011" provided as **Attachment #6** hereto. For the period of 2005 to 2011, AWMP Table 5-16 shows that Drainwater Outflow averaged about 48,900 acre-feet per year. Table 5-16 also shows that average Drainwater Outflow in dry years was not significantly less than the overall average, about 48,500 acre-feet per year (Table 5-1 in the AWMP notes that the Drainwater Outflow values have an estimated uncertainty of 25 percent). Per Eric Thorburn, Water Operations Manager, OID is presently updating the AWMP and it is expected to be finalized and released to the public in February 2016. The updated AWMP will contain 2014 data, but not 2015 data. Even so, because 2014 was also a critical water year, the 2014 data will provide a basis for estimating Drainwater Outflow amounts 2015.

Per Mr. Thorburn the monthly breakdown of Drainwater Outflow amounts is not readily available for 2015 or for previous years. Mr. Thorburn indicated, however, that Drainwater Outflows did occur in 2015 after June.

3.3 Omission of Sacramento River Return Flows

The SWRCB's water availability methodology for quantifying Supply did not include any return flows for the Sacramento River basin. The basis for the omission of Sacramento River return flows is not well documented in the information the SWRCB produced. A comment in the "Prorated Demand" tab in the SWRCB's Excel workbook "Sacramento Basin Charts With WRUDS 2015-05-01.xlsx" (provided in the PRA response in folder 2015/20150501_Notice) states "1977

[9] Telecon with Carrie Loschtke of MID, December 28, 2015.

Drought Report", presumably as the basis for assuming no return flows for the Sacramento River.[10] A comment in the "FNF Adjustments" tab in the SWRCB's workbook "20150610_sacprorated.xls" (provided in the PRA response in folder 2015/20150612_Notice) states "(Assumed 0 - return flow consumed by conveyance losses)" but there is no other information provided to support this assertion.

3.3.1 Colusa Basin Drain and Ridge Cut Slough

Contrary to the first SWRCB notation cited above, the SWRCB's Drought '77 Report and accompanying 1978 Appendix did consider and quantify certain return flows to the Sacramento River during the 1976-77 drought. Table 19 of the 1978 Appendix (**Attachment #7**) shows estimated monthly flows out of the Colusa Basin Drain (CBD) into the Sacramento River ranging from about 16,000 to 32,000 acre-feet per month. Additionally, in October 1978 DWR prepared a report called "Sacramento Valley Water Use Survey 1977, Bulletin 168, October 1978 (Bulletin 168)". Table 15 of Bulletin 168 (**Attachment #8**) provides reach-by-reach reckonings of Sacramento River flows in 1977 that include measured return flows to the Sacramento River as a component of the analysis, including the CBD. DWR's Table 15 shows significant flows from the CBD in May (about 28,000 acre-feet), August (about 18,500 acre-feet), and September (27,990 acre-feet). DWR's Table 15 shows virtually no discharge from the CBD in June and July (83 and 149 acre-feet respectively).

Agricultural irrigation operations have changed since 1977, with more water users and irrigation districts implementing tailwater capture and reuse systems. Due to funding issues DWR no longer compiles flow data for CBD discharges to the Sacramento River, but stage and gate opening data for the CBD control structure near Knights Landing are posted on CDEC (Station KLG).[11] The CDEC data for 2015 indicates that one or more of the 10 control gates were open from April 2 to April 19, May 19 to May 22, June 5 to June 9, August 8 to August 20, and August 24 to September 9 (see graph of 2015 percent gate openings in **Figure 3A**). To the extent that the gates were open in 2015 CBD flows would have accrued to the Sacramento River, but the SWRCB methodology does not account for this source of Supply.

Also, it appears that there were periods in 2015 when CBD flows were being directed into Ridge Cut Slough from upstream of the control structure; Ridge Cut Slough accrues to the Yolo Bypass. The data as posted (which I understand is unofficial) indicates that flows were in the range of about 200 cfs in March, 0 to about 100 cfs in April, 0 to about 150 cfs in portions of May, and generally in excesses of 100 cfs starting around the first of August and continuing thereafter (**Attachment**

[10] Per my previous reference herein, I assume this refers to the SWRCB's Drought '77 Dry Year Program Report dated January 1978 and the accompanying Appendix to that report dated March 1978 (1978 Appendix).

[11] Telecon with Michael Beckley, DWR Sutter Yard, January 5, 2016. DWR could compute CBD flows based on the stage and gate opening data if funding were to be provided.

#9 is a CDEC graph showing 2015 Ridge Cut Slough flows). Based on my conversation with DWR staff, gaps in the record in early May and from mid-June to early August are likely attributable to low flows in Ridge Cut Slough that are below DWR's instrumentation.[12] In any case, to the extent that CBD flows were diverted into Ridge Cut Slough in 2015 they would have been available to diverters located on the Slough and possibly downstream in the Yolo Bypass, however, the SWRCB's methodology does not account for this source of Supply.

3.3.2 Omission of Irrigation Tailwater as Source of Supply

It is a well-established that many diverters in the Sacramento River system rely on tailwater from upstream water users a source of Supply for irrigation. Figure 2-59 from the 2010/2011 Sacramento Valley Regional Water Management Plan Annual Update (**Attachment #10**) shows estimated diversions, recycled water, and return flows schematically for nine USBR Sacramento River Settlement Contractors for the year 2011. Tailwater from upstream water users accrues in natural channels and constructed drain channels and is available for diversion by downstream water users. There are a number of diverters in the Sacramento River basin that hold appropriative rights or have filed claims of right naming "drains" and/or "canals" as sources of water diverted and used under those rights. The SWRCB's methodology counts Demand under these rights in its water availability analysis. However, by omitting return flows from the analysis the methodology does not account for the Supply needed to support these Demands. This means that Supply is underestimated (or Demand is overestimated) in the SWRCB's aggregated analyses of water availability for the Delta.

Provided below are several examples of water rights for which the SWRCB assigned a Demand but, by excluding return flows, did not assign a Supply. Each example provides the Demand amount as set forth in the WRUDS 2015-09-06 tab in SWRCB's Excel workbook 20150610_sacsjcombined.xlsx (hereinafter referred to as the SWRCB June workbook). Two amounts are provided, one for the entire season of Demand and the other for the months of April through June, relevant to the SWRCB's curtailment and enforcement actions in this matter.[13]

3.3.2.1 Statement 7368 of Glenn-Colusa Irrigation District

Statement 7368 of Glenn-Colusa Irrigation District claims diversions from Colusa Basin Drain during the months of April to October. The SWRCB June workbook assigned a

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[12] Telecon with Dave Huston, DWR NCRO Flow Monitoring and Special Studies Section, on January 5, 2016.

[13] Several of the rights discussed are for post-1914 rights, which the SWRCB curtailed in the Sacramento River on May 1, 2015. Consequently, the SWRCB omitted post-1914 Demand in its analysis for the June curtailment. Post-curtailment Demands are nonetheless presented herein for these rights as they demonstrate the magnitude of the unsupported assumption that there was no Supply from return flows.

Demand of 9,391 acre-feet to this right, of which 2,771 acre-feet are for the months of April to June.

It is noteworthy that monthly reports of actual diversion submitted by GCID to the SWRCB in response to the SWRCB's Informational Order indicate a total diversion of 8,760 acre-feet during the period of April to August 2015.[14]

3.3.2.2 Campbell Water Rights

Arch J. Campbell holds Statements 14982 and 14983, both of which name Reclamation District 2047 Main Drain as the source of water and assert a year of first use of 1863. The SWRCB's eWRIMS GIS map shows a common point of diversion for these rights (and other rights held by other diverters). For the period of April to September the SWRCB June workbook assigned a combined Demand of 9,270 acre-feet to the two Campbell Statements, of which 5,408 acre-feet are for the months of April through June. Only Statement 14982 was subject to the SWRCB's Informational Order, but apparently Campbell did not submit monthly reports to the SWRCB in 2015.[15]

Campbell also holds License 4367 (Application 11900) for post-1914 appropriative diversions from the RD 2047 Main Drain at the same point of diversion as the Statements (per SWRCB's eWRIMS GIS). For the months of April through September the SWRCB June workbook assigned a Demand of 5,986 acre-feet to this right. For the months of April to June the SWRCB Demand amount for this right is 3,492 acre-feet.

3.3.2.3 Application 9737 of Maxwell Irrigation District

Maxwell ID holds License 4644 (Application 11957) for diversions from the RD 2047 Main Drain and named creeks tributary thereto. License 4644 allows for direct diversion at a combined rate of 65.5 cfs from April 15 to October 1. For the months of April through September the SWRCB June workbook assigned a Demand of 16,402 acre-feet to this right. For the months of April to June the SWRCB Demand amount for this right is 8,037 acre-feet.

Maxwell ID holds other rights for diversions from the Sacramento River, as well as a USBR Settlement Contract based on those rights, but based on the description of the source for License 4644 and other information I have reviewed, it is my understanding that the License 4644 stands apart from the Sacramento River supply.[16]

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[14] SWRCB Excel workbook 2015 IO Actual Demands.xlsx modified 9/16/2015, provided in SWRCB PRA folder 2015/Information Order WR 2015-0002-DWR

[15] Ibid.

[16] Declaration of Marc E. Van Camp dated March 13, 2009, United States District Court, Eastern District of California, Fresno Division, Case No. 1:05-CV-01207 OWW-GSA. At pages 27-28: *"Maxwell held and continues to hold water rights to divert from the Colusa Drain, and other creeks and drains in addition to the Sacramento River"*.

3.3.2.4 Application 9737 of Meridian Farms

Meridian Farms holds License 7160 (Application 9737) which identifies Reclamation District 70 Main Drain, Lateral Drain No. 4, and Long Lake as the sources of water. The License allows for direct diversion of 100 cfs during the period of about April 1 to about October 1. Meridian Farms also holds a license for diversion from the Sacramento River, as well as a USBR Settlement Contract based on the license, but based on the source description for License 7160 and other information I have reviewed, it is my understanding that License 7160 stands apart from the Sacramento River supply.[17]

In its 2014 Report of Licensee Meridian Farms reported diverting 4,937 acre-feet under this right only in the months of April and May. No diversions were reported after May due to the SWRCB's 2014 curtailment of post-1914 rights in the Sacramento River. However, for the months of April through September the SWRCB June workbook assigned a Demand of 21,881 acre-feet to this right. For the months of April to June the SWRCB Demand amount for this right is 9,773 acre-feet. Meridian Farms' diversion in 2015 were likely more akin to 2014 than the SWRCB's value. This is an instance where in addition to not considering Supply, the SWRCB methodology likely over-counted Demand by double.

Based on the few examples discussed above the SWRCB methodology assigned a seasonal Demand of about 63,000 acre-feet to these rights, of which the April to June amount was about 32,000 acre-feet. Again, by including these demands in its analysis, the SWRCB overstated the Demand applicable to the Supply in the Sacramento River system. Alternatively, to properly include these Demands, the SWRCB should have also included the drain waters as additional sources of Supply.

3.4 Lack of Spatial Considerations for Delta Return Flow Supply

The SWRCB's methodology assumes that, for purposes of adjusting DWR's forecasted monthly FNF, return flows in the Delta are assumed to be 40 percent of senior Delta Demand in the months of March through September. This source of Supply occurs in the Delta and thus it is available only to Delta diverters. It is not available to diverters on tributaries to the Delta that are upstream of tidal influences. However, the SWRCB's methodology does not distinguish Supply and Demand spatially.

The SWRCB's methodology aggregates Supply and Demand on a "global" basis. For the particular watershed being analyzed, whether it be the Sacramento-San Joaquin-Delta

[17] Ibid. at page 23: *"Meridian also held, and continues to hold, water rights to various canals within RD 70 and Long Lake, which is located within Meridian Farms and serves as a regulatory reservoir."*

combined watershed or a subset thereof, the SWRCB simply tallies Supply for the watershed as a whole. Watershed-wide Demand is then counted against the global Supply based only on order of water right priority (riparian, pre-1914, and post-1914). If a particular tributary Demand would not be met but for the inclusion of Delta-only Supply in the accounting of aggregate Supply, the assumption that the tributary Demand is met errantly depletes aggregate Supply, potentially resulting in an underestimation of aggregate Supply available to Delta diverters and an inaccurate reckoning of water availability.

This error has a large magnitude with respect to Delta Supply. The assumption of 40 percent return flow for Delta senior Demand in the SWRCB's June workbook (FNF Adjustments tab) resulted in 66,000 acre-feet of additional Supply in the month of May 2015 and 97,000 acre-feet in the month of June 2015. These quantities of water would only have been available to satisfy diverters in the Delta channels. Yet, the SWRCB analysis applies Demands from the entire Sacramento-San Joaquin watershed to this Supply, even though it would be physically impossible for diverters upstream of the Delta to divert it.

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4.0 OMISSION OF TREATED WATER DISCHARGES AS SOURCES OF SUPPLY

There are a number of municipal wastewater treatment plants within the Central Valley that discharge treated effluent to the Sacramento River, San Joaquin River, and Delta channels during the irrigation season. These treated effluent discharges contribute to flows in the receiving streams and contribute to the water Supply available to downstream diverters. These discharges can be locally or regionally substantial. For example, the largest discharger of treated effluent is the Sacramento Regional Wastewater Treatment Plant (SRWTP), which during the period of March through October 2015 discharged about 82,500 acre-feet to the Sacramento River at Freeport.

The SWRCB Methodology failed to include any treated effluent discharges in its calculation of available Supply. The omission of treated effluent discharges in the SWRCB's methodology results in an underestimate of Supply, particularly in the Delta. Also, the omission of treated effluent discharges ignores a source of Supply to which downstream appropriators potentially have priority over riparians. For example, to the extent that the treated effluent was the product of water originally obtained from percolating groundwater or from stored water, its release into a receiving stream would not be considered water subject to downstream riparian claims. However, in general, the SWRCB's methodology defaults to riparians having the highest priority, and does not include a means of identifying and distinguishing instances where appropriators have priority over riparians.

The following Section 4.1 presents actual 2015 monthly treated effluent discharge amounts for the SRWTP and estimated 2015 amounts for the cities of Stockton, Tracy and Turlock that can be reasonably derived from other data. The combined actual and estimated amounts for these four discharges during the months of April through June (the period relevant to the SWRCB's curtailment and enforcement actions in this matter) totaled about 41,500 acre-feet. These four dischargers are by no means a comprehensive list of dischargers that the SWRCB omitted from its quantification of Supply. Section 4.2 identifies and provides qualitative information regarding other treated effluent dischargers within the watershed Sacramento-San Joaquin-Delta watershed.

4.1 Actual and Estimated 2015 Treated Effluent Discharges

4.1.1 Sacramento Regional Wastewater Treatment Plant (SRWTP)

Table 4-1 shows monthly treated effluent discharges to the Sacramento River at Freeport for CDEC station SPE (Sac Regional Wastewater Treatment Plant) in calendar year 2015. For the period of March through October 2015 about 82,500 acre-feet of treated effluent was discharged to the Sacramento River. Monthly average discharge during the months of April to June of 2015 (relevant to the SWRCB's curtailment and enforcement actions in this matter) ranged from 160 to 190 cfs during this period, equivalent to a monthly volume ranging from about 9,500 acre-feet to about 11,300 acre-feet per month. Treated effluent released near Freeport contributes to flows in the Sacramento River and the Delta.

The monthly average treated effluent discharge in June was 160 cfs. While the allocation of this Supply to any one downstream right-holder would require a detailed analysis of the occurrence of water and water right priorities along the Sacramento River and within the Delta, it is noteworthy that this average discharge flow is about double the average rate of BBID's diversion during the 13-day alleged violation period of June 13 to June 25, 2015 (about 80 cfs).

4.1.2 Stockton Regional Wastewater Treatment Plant

The Stockton Regional Wastewater Treatment Plant is located in the southwest area of the City of Stockton (City). Treated effluent is pumped into the San Joaquin River.[18] **Table 4-2** shows monthly treated effluent discharges for the period of January 2012 through June 2015 as set forth in Monthly Operations and Maintenance Reports prepared by the City's Municipal Utilities Department. For the period of January through June 2015, the City discharged almost 12,000 acre-feet to the San Joaquin River.

The City is authorized to divert water from the San Joaquin River under Permit 21176 (Application 30531A) issued by the SWRCB on December 20, 2005. Diverted water is treated for municipal use at the City's Delta Water Treatment Plant located north of Stockton. **Table 4-2** shows monthly amounts of water diverted by the City under Permit 21176 for calendar years 2012-14, based on annual Progress Reports By Permittee on file with the SWRCB. To the extent that diversions under Permit 21176 occurred concurrent with treated effluent releases **Table 4-2** computes monthly "Effluent Net of Diversion" for 2012-14 by deducting monthly diversions under Permit 21176 from monthly treated effluent discharge.

The City has not yet filed its annual Progress Report By Permittee for 2015. Accordingly, I computed estimated Effluent Net of Diversion amounts for January through June 2015 by prorating 2015 effluent discharges by the average monthly ratio of net-to-total effluent discharges for 2012-14, to the extent data was available. Based on this adjustment the estimated amount of treated effluent discharged from the Stockton Regional Wastewater Treatment Plan totaled about 10,600 acre-feet for the period of January to June 2015. The average monthly discharge for the months of April through June was about 1,857 acre-feet, equivalent to an average 30-day flow rate of about 31 cfs.

[18] http://www.stocktongov.com/government/departments/municipalUtilities/utilPlantTreat.html

4.1.3 City of Tracy

The City of Tracy's (City) wastewater treatment plant is located north of the Interstate 205 freeway between MacArthur Drive and Holly Drive. The plant discharges treated effluent through two outfalls to Old River.[19] I estimate that in 2015 the City discharged about 8,600 acre-feet of treated effluent. This estimate is based on adjustment of daily treated effluent flow data for the City of Tracy for calendar year 2014 provided by the SWRCB in response to a PRA request.[20] During the months of April through June, the estimated monthly discharge averaged 793 acre-feet, equivalent to a 30-day rate of about 13 cfs.

My derivation of estimated 2015 treated effluent discharge is provided in **Table 4-3**. As shown, monthly values for 2015 were assumed to be the same as 2014 values through the month of May. For the month of June and later, I applied a reduction factor to 2014 monthly values based on the assumption that reductions in effluent discharge in 2015 likely tracked with reductions in municipal water use attributable to implementation of the SWRCB's 2015 emergency urban water conservation regulations (this is likely a conservative assumption as a significant amount of reduced urban use in 2015 was likely attributable to outdoor use, while treated effluent discharge is a function indoor use). The reduction factor of 29.6 percent shown in **Table 4-3** is the City's cumulative water use reduction percentage for the period of June through October 2015, based on the SWRCB's October 2015 Water Conservation Report by Supplier posted on its website.

While the implementation of SWRCB's 2015 emergency regulations for urban water use conservation were to be based on 2013 base year values, I used 2014 data as that was the data that was made available to me.[21] Because 2014 was a critical drought year, water use was likely less in 2014 than in 2013. If this is true then the application of the urban water conservation reduction factor to 2014 data results in a lower estimate of effluent discharge than if 2013 data had been used. Accordingly, I believe that my estimate of 2015 treated effluent discharge likely underestimates actual effluent discharge and hence is conservative for purposes of quantifying additional Supply from this source in 2015.

4.1.4 City of Turlock

I estimate that in 2015 the City of Turlock discharged about 8,300 acre-feet to the San Joaquin River. The estimated average monthly discharge for the months of April through June was about 761 acre-feet, equivalent to a 30-day flow rate of 12.8 cfs. The basis for my estimated values, which is similar to the approach discussed in Section 7.1.3 for the City of Tracy, is discussed below.

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[19] City of Tracy 2010 Urban Water Management Plan, Section 4.9.2.2.

[20] Email from SWRCB's Andrew Tauriainen to Jeanne Zolezzi of Herum\Crabtree\Sontag dated November 3, 2015.

[21] 2014 daily data from SWRCB in response to a PRA request, email from SWRCB's Andrew Tauriainen to Jeanne Zolezzi of Herum\Crabtree\Sontag dated November 3, 2015.

In 2015 the City of Turlock (City) filed Wastewater Change Petition WW0088 (Petition) with the SWRCB. The SWRCB publicly noticed the Petition in October 2015. The map accompanying the Petition shows the existing point of discharge to the San Joaquin River to be within Section 36, T5S, R8E, MDB&M. Treated effluent released at this location contributes to flows in the San Joaquin River downstream from this location.

Attachment 4 to the petition is a table showing the City's historical monthly treated effluent discharges to the San Joaquin River for the years 2000 through 2014. **Table 4-4** herein shows 2013 and 2014 treated effluent discharges per the City's Petition Attachment 4. As shown, monthly values for 2015 were assumed to be the same as 2014 values through May 2015. For the month of June and later, I applied a reduction factor to 2013 monthly treated effluent values based on the assumption that reductions in effluent discharge in 2015 likely tracked with reductions in municipal water use attributable to implementation of the SWRCB's 2015 emergency urban water conservation regulations (this is likely a conservative assumption as a significant amount of reduced urban use in 2015 was likely attributable to outdoor use, while treated effluent discharge is a function indoor use). The reduction factor of 26 percent shown in **Table 4-4** is the City's cumulative water use reduction percentage for the period of June through October 2015, based on the SWRCB's October 2015 Water Conservation Report by Supplier posted on its website.

4.2 Other Sources of Treated Effluent Supply

Provided below is a list of other municipal wastewater treatment facilities that are known to discharge treated effluent to the Central Valley waterways and which have been omitted from the SWRCB's quantification of Supply in its 2015 water availability analyses:

- City of Redding – Redding operates two wastewater treatment plants having a combined Average Dry Weather Flow (ADWF) capacity of about 13.4 million gallons per day (MGD), equivalent to an average flow rate of about 20.7 cfs and about 1,200 acre-feet per month. Both treatment plants are located at the south end of the city and release treated effluent to the Sacramento River[22]. Treated effluent releases would constitute an additional Supply to the Sacramento River downstream from the points of discharge.
- City of Woodland – Woodland operates a wastewater treatment plant on the east side of the city. The plant is permitted for an ADWF capacity of 10.4 MGD, equivalent to an average flow of about 16.1 cfs and about 957 AF/month.[23] Treated effluent is released into Tule Canal within the Yolo Bypass just north of the Interstate 5 freeway.

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[22] City of Redding Wastewater Utility Master Plan, 2012

[23] California Regional Water Quality Control Board, Central Valley Region, Order No. R5-2009-0010 NPDES NO. CA0077950.

- City of Davis – Davis operates a wastewater treatment plant located along Willow Slough Bypass north of Davis. The plant has an ADWF capacity 7.5 MGD, equivalent to an average flow rate of 11.6 cfs and about 690 AF/month. Effluent is discharged either to Willow Slough Bypass near the treatment plant or to the Yolo Bypass near Exit 32A on Interstate 80, after passing through a constructed wetlands area.[24]

- Mountain House Community Services District – Mountain House is located about 7 miles northwest of Tracy. The District operates a wastewater treatment plan having an ADWF capacity of 3.0 MGD, equivalent to an average flow rate of about 4.6 cfs and about 276 acre-feet/month. Treated effluent is discharged to Old River in the Delta.[25]

- Town of Discovery Bay – Discovery Bay is located in the Delta on Byron Tract near the intersection of Highway 4 and Bixler Road. Treated effluent is discharged to Old River and thus contributes to Delta Supply. ADWF capacity is 1.75 MGD, equivalent to an average flow rate of 2.7 cfs and about 161 AF/month.[26]

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[24] http://cityofdavis.org/city-hall/public-works/wastewater/water-pollution-control-plant

[25] California Regional Water Quality Control Board, Central Valley Region Order R5-2013-0004, NPDES No. CA0084271, Waste Discharge Requirements for the Mountain House Community Services District Mountain House Wastewater Treatment Plant.

[26] The Town of Discovery Bay Community Services District Wastewater Treatment Plant Master Plan, February 2012.

5.0 CONSIDERATION OF REQUIRED MINIMUM INSTREAM FLOWS

The operators of various large dams on the Stanislaus, Tuolumne, and Merced Rivers are required to maintain certain minimum instream flows in the river channels downstream of their projects based on various regulatory requirements. The following discussion presents information and analysis showing that in 2015 some of these operations contributed flows to the downstream river channels that the SWRCB did not consider in its 2015 water availability analyses.

5.1 Required Minimum Instream Flows

Stanislaus River – Based on information provided to me by Karna Harrigfeld of Herum\Crabtree\Sontag in 2015 the United States Bureau of Reclamation (USBR) ordered certain minimum instream flows be maintained below Goodwin Dam. From time to time in 2015 the USBR ordered changes in flows based on downstream instream flow needs; Ms. Harrigfeld provided me with a summary of the USBR-ordered minimum flows for 2015. The ordered release data closely matches flow data posted on CDEC for the GDW (Goodwin Dam) station for sensor description "Spillway Discharge".

Tuolumne River –Minimum instream flows to be maintained in the Tuolumne River at LaGrange Dam are set forth in Appendix A to a 1995 Settlement Agreement among the Federal Energy Regulatory Commission, Turlock Irrigation District, Modesto Irrigation District and others (FERC Agreement).[27] A copy of the Flow Schedule is provided in **Attachment #11**. In referencing the Flow Schedule for analysis I assumed that the schedule for "Critical & Below" was applicable to 2015 conditions. This schedule requires a flow of 50 cfs from June 1 to September 30, 100 cfs from October 1 to October 15, and 150 cfs from October 16 to May 31.

Merced River – Merced Irrigation District filed a Temporary Urgency Change Petition (TUCP) with the SWRCB for its Licenses 11395 and 11396 (Applications 16186 and 16187, respectively) on April 22, 2015. The SWRCB issued an Order approving the TUCP on May 12, 2015. The TUCP allowed for the reduction in minimum flows in the Merced River, as measured at Schaffer Bridge, from 60 cfs to 40 cfs in the months of April and May. The TUCP did not modify the minimum instream flows for the remainder of the year, which under a dry year condition require

[27] Turlock and Modesto Irrigation Districts. 1996. New Don Pedro proceeding P-2299024 settlement agreement between California Department of Fish and Game, California Sportfishing Protection Alliance, City and County of San Francisco, Federal Energy Regulatory Commission, Friends of the Tuolumne, Modesto Irrigation District, Turlock Irrigation District, and U.S. Fish and Wildlife Service. Turlock California.

60 cfs for January 1 through May 31, 15 cfs for June 1 to October 15, 60 cfs for October 15 to October 31, and 75 cfs for November 1 through December 31.

5.2 Analysis

The attached **Figures 5A, 5B, and 5C** are hydrographs showing daily Full Natural Flow (FNF, blue line), the required minimum instream flow as discussed above (gray line), and the actual daily flow that occurred during calendar year 2015 (orange line) for the Stanislaus, Tuolumne, and Merced Rivers, respectively. The data used to plot daily FNF and actual daily flows was obtained from CDEC as follows: CDEC station GDW (Goodwin Dam) for the Stanislaus River[28], CDEC station LGN (Tuolumne River below La Grange Dam) for the Tuolumne River, and CDEC station MBN (Merced River at Shaffer Bridge) for the Merced River. On **Figures 5A, 5B, and 5C**, whenever the orange line (actual flow) is above the blue line (FNF) this is an indication that releases from the upstream projects are providing a supply of water in excess of what would have occurred under natural conditions unaltered by human actions (such as dams, diversions, out-of-watershed imports) upstream of the FNF reckoning points.

The hydrographs in **Figures 5A and 5C** show that actual flows for the Stanislaus and Merced Rivers were generally greater than FNF starting in late July/early August of 2015 and continuing into the fall months. **Figure 5A** shows the effect of two spring pulse flows made on the Stanislaus River in March and April. **Figure 5B** shows that actual flows on the Tuolumne River were greater than FNF only during short sporadic periods from about late August to about mid-October.

Table 5-1 provides a monthly quantification of actual flow in excess of FNF in units of acre-feet. The monthly amounts were computed by summing the difference between daily actual flow and daily FNF for all days in the month when daily actual flow exceeded daily FNF. During the period of March through October 2015, actual flow in excess of FNF was about 80,000 acre-feet collectively for the three rivers. Of this amount about 16,600 acre-feet occurred in the months of March and April, most of it attributable to the pulse flows on the Stanislaus River. About 60,000 acre-feet occurred in the months of August through October with the Stanislaus being the biggest contributor in all three months. The largest collective monthly amount, totaling about 39,000 acre-feet, occurred in October.

[28] Because the CDEC actual flow data for the Stanislaus River closely matched the USBR-ordered release flow information provided by Ms. Harrigfeld and was in a more user-friendly format, we relied on the CDEC data for plotting the actual flow hydrograph.

5.3 SWRCB Methodology’s Omission of Released Flows

The SWRCB’s methodology for evaluating daily water availability for the combined watersheds (Sacramento-San Joaquin-Delta watershed, Sacramento plus Delta watershed, or San Joaquin plus Delta watershed) considers daily FNF as the sole source of Supply. Flows released by the upstream projects that resulted in actual flows exceeding daily FNF, such as those discussed herein, were not considered in the SWRCB’s 2015 water availability analyses for the combined watersheds.

* * * * *

6.0 CONCLUSION

The foregoing discussion highlights a number of inadequacies in the SWRCB's methodology for quantifying Supply and the effects of some of these inadequacies on Demand:

- The discussion in Section 2.0 demonstrates how the methodology's failure to consider spatial elements when quantifying FNF and UF Supply resulted in an overestimation of Demand when analyzing the Sacramento-San Joaquin-Delta combined watershed in 2015. Per **Tables 2-4 and 2-5** this overestimation is on the order of millions of acre-feet in some months when all water rights are considered in the combined watershed.

- The discussion in Section 3.0 reveals omissions and inaccuracies in the SWRCB's consideration of agricultural return flows. Section 3.0 provides examples of how the methodology mishandles return flows for the San Joaquin watershed and the Delta, as well as examples of return flows in the Sacramento River that the methodology omits altogether. Time and resources did not allow us to research each and every instance where the consideration of return flows might have provided an additional source of Supply to the combined watershed, and thus the extent of these issues is unknown. In my view the SWRCB should have evaluated return flows with greater attention to where these flows occur, their amounts, and their availability as sources of Supply to downstream water users with due regard to water right priorities.

- The discussion in Section 4.0 identifies sources of treated effluent from municipal wastewater treatment plants that accrue to the Sacramento River, San Joaquin River, and Delta that constitute additional sources of Supply that the SWRCB's methodology did not consider. While the allocation of this Supply to any one downstream water user would require a detailed analysis of the occurrence of water and water right priorities along the rivers and within the Delta, it is noteworthy that the average discharge flow for the largest discharger within the combined watershed (the Sacramento Regional Wastewater Treatment Plant) was about double the average rate of BBID's diversion during the 13-day alleged violation period of June 13 to June 25, 2015.

- The discussion in Section 5.0 identifies flows released from large dams and reservoirs on the Stanislaus, Tuolumne, and Merced Rivers in 2015, in accordance with regulatory minimum instream flow requirements, that were in excess of the FNF values that the SWRCB used in its quantification of Supply. While the availability of these excess released flows, after they have served their intended regulatory purposes, to any one downstream water user would require a detailed analysis of legal and regulatory considerations, these releases represent a potential source of Supply to downstream water users that was not considered in the SWRCB's methodology. On a broader scale, the SWRCB's methodology in general does not consider water released from storage as a possible source of Supply that in 2015 may have been available to meet downstream Demand that the SWRCB's methodology assumes could only have been met by FNF.

In addition to the foregoing, for the reasons stated in Section 1.0 pertaining to the unique hydrodynamic characteristics of the tidally-influenced Delta channels that I understand will be described in great detail at the SWRCB hearing by other experts, the SWRCB's methodology is not the appropriate tool for evaluating the availably of water to various right-holders in the Delta.

* * * * *

TABLES

TABLE 2-1

2015 Monthly Full Natural Flow for 10 Stations Within the Sacramento - San Joaquin River Watershed

(all values in acre-feet)

FNF Station	Reckoning Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
BND	Sacramento River at Bend Bridge	437,943	1,067,789	347,122	306,719	280,001	248,178	215,507	194,083	210,668
ORO	Oroville Dam (Feather River)	170,381	437,380	150,014	107,539	84,924	66,360	46,549	45,432	40,840
YRS	Yuba River near Smartville	76,617	215,128	71,307	58,999	47,620	23,312	12,803	5,367	8,807
FOL	Folsom Lake (American River)	66,364	236,879	84,025	80,857	84,586	25,734	774	785	2,783
MHB	Cosumnes River at Michigan Bar	3,537	34,291	5,437	4,149	3,279	1,188	143	0	0
MKM	Mokelumne - Mokelumne Hill (Mokelumne River)	12,016	65,416	30,030	29,074	34,128	8,997	2,981	1,063	871
GDW	Goodwin Dam (Stanislaus River)	16,199	91,283	37,482	37,205	59,580	29,745	9,160	1,519	664
TLG	Tuolumne River - La Grange Dam	24,724	113,657	57,402	85,233	144,508	62,181	16,146	10,358	6,819
MRC	Merced River near Merced Falls	6,702	32,101	17,373	25,264	39,402	18,369	7,206	1,135	143
MIL	Friant Dam - Millerton (San Joaquin River)	14,311	42,326	33,781	38,202	75,936	55,867	23,748	7,815	3,017
	Total	828,794	2,336,250	833,974	773,242	853,964	539,931	335,017	267,558	274,612

Notes:

(1) Monthly Full Natural Flow (FNF) is based on the summation of daily FNF data for each month. Daily FNF data copied and pasted from SWRCB spreadsheet WY 2014-2015 CDEC Supply Tables.xlsx i PRA folder 2015/Supply-Demand Charts.

TABLE 2-2

SWRCB Demand Within FNF Basins[1]

(all values in acre-feet)

FNF Station	Reckoning Location	Water Right Type	SWRCB Demand Within FNF Basin Mar	Apr	May	Jun	July	Aug	Sep
BND	**Sacramento River**	Riparian	5,012	12,715	12,814	14,167	9,848	8,829	8,560
	at Bend Bridge	Pre-1914	14,767	25,079	36,514	36,295	35,854	35,239	32,451
		Subtotal Senior Demand	19,780	37,794	49,328	50,463	45,701	44,069	41,011
		Post-1914 up to and Including A000301	375	11	20	30	30	30	30
		Post-1914 Junior to A000301	1,193,324	1,064,934	493,644	380,354	232,147	205,118	204,656
		Subtotal Post-1914 Demand	1,193,699	1,064,945	493,664	380,384	232,177	205,148	204,686
		Total FNF Basin Demand	1,213,479	1,102,739	542,992	430,846	277,878	249,217	245,697
ORO	**Oroville Dam**	Riparian	2,847	3,264	4,782	5,438	5,317	4,756	4,339
	(Feather River)	Pre-1914	25,757	19,762	17,621	5,038	7,794	4,572	4,320
		Subtotal Senior Demand	28,604	23,026	22,403	10,476	13,110	9,328	8,659
		Post-1914 up to and Including A000301	0	0	0	0	0	0	0
		Post-1914 Junior to A000301	700,204	919,780	384,177	313,564	160,883	143,961	136,305
		Subtotal Post-1914 Demand	700,204	919,780	384,177	313,564	160,883	143,961	136,305
		Total FNF Basin Demand	728,809	942,806	406,580	324,040	173,994	153,289	144,964
YRS	**Yuba River**	Riparian	186	196	206	187	184	171	167
	near Smartville	Pre-1914	13,250	26,395	22,037	18,483	11,123	8,015	7,306
		Subtotal Senior Demand	13,436	26,591	22,243	18,670	11,306	8,185	7,474
		Post-1914 up to and Including A000301	0	0	0	0	0	0	0
		Post-1914 Junior to A000301	148,795	167,048	106,074	40,721	5,596	2,122	5,269
		Subtotal Post-1914 Demand	148,795	167,048	106,074	40,721	5,596	2,122	5,269
		Total FNF Basin Demand	162,231	193,639	128,317	59,391	16,902	10,308	12,743
FOL	**Folsom Lake**	Riparian	508	513	538	557	570	568	556
	(American River)	Pre-1914	8,254	11,843	18,364	12,717	8,357	7,467	6,290
		Subtotal Senior Demand	8,762	12,356	18,902	13,275	8,928	8,034	6,847
		Post-1914 up to and Including A000301	0	0	0	0	0	0	0
		Post-1914 Junior to A000301	152,970	222,623	82,330	38,271	45,605	14,176	6,106
		Subtotal Post-1914 Demand	152,970	222,623	82,330	38,271	45,605	14,176	6,106
		Total FNF Basin Demand	161,733	234,979	101,232	51,545	54,533	22,210	12,953

Notes:

(1) “Demand” values shown above are computed by selecting all of the water rights located upstream of the particular FNF station as set forth in SWRCB’s WRUDS 2015-06-09.xlsx spreadsheet, and then sorting and summing monthly Demand amounts for each water right type.

TABLE 2-2
SWRCB Demand Within FNF Basins[1]
(all values in acre-feet)

FNF Station	Reckoning Location	Water Right Type	SWRCB Demand Within FNF Basin Mar	Apr	May	Jun	July	Aug	Sep
MHB	**Cosumnes River at Michigan Bar**	Riparian	198	300	326	354	226	210	185
		Pre-1914	544	422	1,655	2,015	1,844	1,027	450
		Subtotal Senior Demand	743	722	1,981	2,370	2,070	1,237	634
		Post-1914 up to and Including A000301	0	0	0	0	0	0	0
		Post-1914 Junior to A000301	6,197	6,380	4,032	4,995	1,075	837	550
		Subtotal Post-1914 Demand	6,197	6,380	4,032	4,995	1,075	837	550
		Total FNF Basin Demand	6,939	7,102	6,014	7,365	3,145	2,075	1,184
MKM	**Mokelumne - Mokelumne Hill (Mokelumne River)**	Riparian	10	12	13	17	16	12	10
		Pre-1914	7,241	6,018	3,542	2,156	657	538	470
		Subtotal Senior Demand	7,251	6,030	3,555	2,174	673	550	480
		Post-1914 up to and Including A000301	0	0	0	0	0	0	0
		Post-1914 Junior to A000301	3,428	22,198	22,224	31,536	974	188	144
		Subtotal Post-1914 Demand	3,428	22,198	22,224	31,536	974	188	144
		Total FNF Basin Demand	10,679	28,229	25,778	33,709	1,647	738	624
GDW	**Goodwin Dam (Stanislaus River)**	Riparian	16	86	223	231	234	105	24
		Pre-1914	40,766	52,239	65,990	32,167	16,654	11,728	8,863
		Subtotal Senior Demand	40,783	52,325	66,213	32,398	16,888	11,834	8,888
		Post-1914 up to and Including A000301	278	1,592	2,193	0	0	0	0
		Post-1914 Junior to A000301	163,134	130,424	122,195	195,457	62,184	7,793	4,550
		Subtotal Post-1914 Demand	163,412	132,016	124,387	195,457	62,184	7,793	4,550
		Total FNF Basin Demand	204,195	184,341	190,601	227,855	79,072	19,627	13,438
TLG	**Tuolumne River - La Grange Dam**	Riparian	60	53	41	18	2	2	3
		Pre-1914	76,766	202,990	238,103	73,941	17,886	7,890	11,104
		Subtotal Senior Demand	76,826	203,043	238,144	73,959	17,889	7,893	11,107
		Post-1914 up to and Including A000301	0	0	0	0	0	0	0
		Post-1914 Junior to A000301	52,128	73,341	80,150	76,359	28,389	10,819	7,273
		Subtotal Post-1914 Demand	52,128	73,341	80,150	76,359	28,389	10,819	7,273
		Total FNF Basin Demand	128,954	276,384	318,294	150,318	46,278	18,711	18,380

Notes:

(1) "Demand" values shown above are computed by selecting all of the water rights located upstream of the particular FNF station as set forth in SWRCB's WRUDS 2015-06-09.xlsx spreadsheet, and then sorting and summing monthly Demand amounts for each water right type.

TABLE 2-2

SWRCB Demand Within FNF Basins[1]

(all values in acre-feet)

FNF Station	Reckoning Location	Water Right Type	SWRCB Demand Within FNF Basin						
			Mar	Apr	May	Jun	July	Aug	Sep
MRC	Merced River near Merced Falls	Riparian	4	5	6	7	7	7	6
		Pre-1914	1,798	2,348	1,417	561	400	542	504
		Subtotal Senior Demand	1,802	2,353	1,424	568	406	549	510
		Post-1914 up to and Including A000301	0	0	0	0	0	0	0
		Post-1914 Junior to A000301	70,567	140,663	112,883	208,378	941	14	14
		Subtotal Post-1914 Demand	70,567	140,663	112,883	208,378	941	14	14
		Total FNF Basin Demand	72,369	143,016	114,307	208,945	1,347	563	524
MIL	Friant Dam - Millerton (San Joaquin River)	Riparian	135	148	176	209	211	183	178
		Pre-1914	1,866	2,261	2,091	590	70	0	0
		Subtotal Senior Demand	2,001	2,409	2,267	799	281	183	178
		Post-1914 up to and Including A000301	73,142	46,106	139,578	257,784	144,902	108,425	81,951
		Post-1914 Junior to A000301	224	17,508	32,619	37,085	32,539	5,800	145
		Subtotal Post-1914 Demand	73,366	63,614	172,197	294,869	177,442	114,224	82,096
		Total FNF Basin Demand	75,367	66,022	174,464	295,668	177,722	114,407	82,274

Notes:
(1) "Demand" values shown above are computed by selecting all of the water rights located upstream of the particular FNF station as set forth in SWRCB's WRUDS 2015-06-09.xlsx spreadsheet, and then sorting and summing monthly Demand amounts for each water right type.

TABLE 2-2

SWRCB Demand Within FNF Basins[1]

(all values in acre-feet)

FNF Station / Reckoning Location	Water Right Type	SWRCB Demand Within FNF Basin						
		Mar	Apr	May	Jun	July	Aug	Sep
Subtotal Sacramento	Riparian	8,554	16,688	18,340	20,349	15,919	14,324	13,624
(BND, ORO, YRS, FOL)	Pre-1914	62,028	83,079	94,535	72,534	63,127	55,293	50,367
	Subtotal Senior Demand	70,582	99,767	112,876	92,883	79,046	69,617	63,990
	Post-1914 up to and Including A000301	375	11	20	30	30	30	30
	Post-1914 Junior to A000301	2,195,294	2,374,385	1,066,225	772,909	444,231	365,377	352,335
	Subtotal Post-1914 Demand	2,195,669	2,374,396	1,066,245	772,939	444,261	365,407	352,365
	Total FNF Basin Demand	2,266,251	2,474,162	1,179,121	865,823	523,307	435,024	416,356
Subtotal San Joaquin	Riparian	424	604	785	836	696	520	406
(MHB, MKM, GDW,	Pre-1914	128,981	266,277	312,799	111,430	37,511	21,726	21,391
TLG, MRC, MIL)	Subtotal Senior Demand	129,404	266,881	313,584	112,266	38,207	22,246	21,797
	Post-1914 up to and Including A000301	73,420	47,698	141,770	257,784	144,902	108,425	81,951
	Post-1914 Junior to A000301	295,679	390,515	374,103	553,809	126,103	25,452	12,677
	Subtotal Post-1914 Demand	369,099	438,213	515,874	811,594	271,005	133,876	94,627
	Total FNF Basin Demand	498,503	705,094	829,458	923,860	309,212	156,122	116,424
Total	Riparian	8,978	17,291	19,125	21,185	16,615	14,844	14,030
Sacramento - San Joaquin	Pre-1914	191,009	349,357	407,335	183,965	100,639	77,019	71,757
Combined	Subtotal Senior Demand	199,986	366,648	426,460	205,150	117,253	91,863	85,787
	Post-1914 up to and Including A000301	73,795	47,709	141,790	257,814	144,932	108,455	81,981
	Post-1914 Junior to A000301	2,490,973	2,764,899	1,440,329	1,326,719	570,334	390,829	365,012
	Subtotal Post-1914 Demand	2,564,768	2,812,608	1,582,119	1,584,533	715,266	499,284	446,993
	Total FNF Basin Demand	2,764,754	3,179,256	2,008,579	1,789,683	832,520	591,146	532,780

Notes:

(1) "Demand" values shown above are computed by selecting all of the water rights located upstream of the particular FNF station as set forth in SWRCB's WRUDS 2015-06-09.xlsx spreadsheet, and then sorting and summing monthly Demand amounts for each water right type.

TABLE 2-3

SWRCB Demand Within UF Subbasins[1]

(all values in acre-feet)

UF Subbasin	UF Name	Water Right Type	SWRCB Demand Within UF Subbasin: Mar	Apr	May	Jun	July	Aug	Sep
UF 1	**Sacramento Valley Floor**	Riparian	3,096	3,640	9,910	10,995	11,154	10,873	5,944
		Pre-1914	9,679	12,845	17,738	12,940	15,824	21,758	18,234
		Subtotal Senior Demand	12,775	16,485	27,648	23,936	26,978	32,631	24,178
		Post-1914 up to and Including A000301	0	0	0	0	0	0	0
		Post-1914 Junior to A000301	17,747	54,822	107,442	112,997	85,374	76,261	66,937
		Subtotal Post-1914 Demand	17,747	54,822	107,442	112,997	85,374	76,261	66,937
		Total UF Subbasin Demand	30,521	71,307	135,090	136,932	112,352	108,892	91,115
UF 2	**Putah Creek near Winters**	Riparian	131	199	282	135	125	103	91
		Pre-1914	11	11	10	7	5	3	3
		Subtotal Senior Demand	142	210	292	142	130	106	94
		Post-1914 up to and Including A000301	0	0	0	0	0	0	0
		Post-1914 Junior to A000301	90,086	26,702	4,990	12,424	3,315	2,779	1,760
		Subtotal Post-1914 Demand	90,086	26,702	4,990	12,424	3,315	2,779	1,760
		Total UF Subbasin Demand	90,228	26,912	5,283	12,565	3,445	2,885	1,854
UF 3	**Cache Creek above Rumsey**	Riparian	346	300	535	794	824	706	287
		Pre-1914	28,677	16,653	1,333	958	1,418	817	975
		Subtotal Senior Demand	29,023	16,954	1,868	1,752	2,242	1,524	1,262
		Post-1914 up to and Including A000301	0	0	0	0	0	0	0
		Post-1914 Junior to A000301	59,493	32,779	7,640	3,387	752	2,354	4,481
		Subtotal Post-1914 Demand	59,493	32,779	7,640	3,387	752	2,354	4,481
		Total UF Subbasin Demand	88,516	49,733	9,508	5,140	2,994	3,877	5,742
UF 4	**Stony Creek at Black Butte**	Riparian	2	17	22	22	22	17	7
		Pre-1914	0	0	0	0	0	0	0
		Subtotal Senior Demand	2	17	22	22	22	17	7
		Post-1914 up to and Including A000301	0	0	0	0	0	0	0
		Post-1914 Junior to A000301	36,180	38,258	9,877	279	647	172	207
		Subtotal Post-1914 Demand	36,180	38,258	9,877	279	647	172	207
		Total UF Subbasin Demand	36,181	38,274	9,898	301	669	189	214

Notes:

(1) “Demand” values shown above are computed by selecting all of the water rights located within the particular UF subbasin as set forth in SWRCB’s WRUDS 2015-06-09.xlsx spreadsheet, and then sorting and summing monthly Demand amounts for each water right type.

TABLE 2-3

SWRCB Demand Within UF Subbasins[(1)]

(all values in acre-feet)

UF Subbasin	UF Name	Water Right Type	SWRCB Demand Within UF Subbasin Mar	Apr	May	Jun	July	Aug	Sep
UF 5	**Sacramento Valley**	Riparian	3	5	16	15	14	12	11
	West Side	Pre-1914	0	0	0	0	0	0	0
	Minor Streams	Subtotal Senior Demand	3	5	16	15	14	12	11
		Post-1914 up to and Including A000301	0	0	0	0	0	0	0
		Post-1914 Junior to A000301	72	11	11	5	0	0	1
		Subtotal Post-1914 Demand	72	11	11	5	0	0	1
		Total UF Subbasin Demand	75	16	28	21	14	12	13
UF 7	**Sacreamento Valley**	Riparian	2,993	4,360	4,633	4,593	5,625	4,677	4,765
	East Side	Pre-1914	1,887	5,380	8,216	8,726	7,778	7,454	7,278
	Minor Streams	Subtotal Senior Demand	4,880	9,740	12,849	13,319	13,403	12,131	12,043
		Post-1914 up to and Including A000301	0	0	0	0	0	0	0
		Post-1914 Junior to A000301	2,831	2,340	3,491	2,925	1,986	1,227	1,099
		Subtotal Post-1914 Demand	2,831	2,340	3,491	2,925	1,986	1,227	1,099
		Total UF Subbasin Demand	7,711	12,080	16,341	16,244	15,389	13,358	13,142
UF 10	**Bear River**	Riparian	2	15	16	16	17	17	16
	near Wheatland	Pre-1914	1,450	3,883	1,351	949	2,558	864	748
		Subtotal Senior Demand	1,452	3,898	1,366	965	2,574	880	764
		Post-1914 up to and Including A000301	0	0	0	0	0	0	0
		Post-1914 Junior to A000301	18,802	4,391	15,238	9,359	8,272	3,340	1,364
		Subtotal Post-1914 Demand	18,802	4,391	15,238	9,359	8,272	3,340	1,364
		Total UF Subbasin Demand	20,254	8,289	16,604	10,324	10,846	4,221	2,128
UF 12	**San Joaquin Valley**	Riparian	1,117	2,561	4,149	4,695	4,686	4,344	3,034
	East Side	Pre-1914	748	435	192	188	286	257	62
	Minor Streams	Subtotal Senior Demand	1,865	2,996	4,341	4,883	4,973	4,601	3,095
		Post-1914 up to and Including A000301	0	0	0	0	0	0	0
		Post-1914 Junior to A000301	7,476	6,777	5,890	4,203	3,571	3,447	2,441
		Subtotal Post-1914 Demand	7,476	6,777	5,890	4,203	3,571	3,447	2,441
		Total UF Subbasin Demand	9,341	9,773	10,231	9,086	8,544	8,049	5,537

Notes:

(1) “Demand” values shown above are computed by selecting all of the water rights located within the particular UF subbasin as set forth in SWRCB’s WRUDS 2015-06-09.xlsx spreadsheet, and then sorting and summing monthly Demand amounts for each water right type.

TABLE 2-3

SWRCB Demand Within UF Subbasins[1]

(all values in acre-feet)

UF Subbasin	UF Name	Water Right Type	SWRCB Demand Within UF Subbasin Mar	Apr	May	Jun	July	Aug	Sep
UF 15	**Calaveras River at Jenny Lind**	Riparian	314	310	320	220	156	124	111
		Pre-1914	702	291	36	1	62	79	1
		Subtotal Senior Demand	1,016	601	356	221	218	203	112
		Post-1914 up to and Including A000301	0	0	0	0	0	0	0
		Post-1914 Junior to A000301	19,388	33,954	30,450	15,946	148	102	125
		Subtotal Post-1914 Demand	19,388	33,954	30,450	15,946	148	102	125
		Total UF Subbasin Demand	20,404	34,555	30,806	16,167	366	305	236
UF 17	**San Joaquin Valley Floor**	Riparian	3,548	5,135	6,339	7,443	6,747	4,801	2,561
		Pre-1914	3,332	2,141	1,178	330	170	100	100
		Subtotal Senior Demand	6,880	7,276	7,517	7,773	6,917	4,901	2,661
		Post-1914 up to and Including A000301	0	0	0	0	0	0	0
		Post-1914 Junior to A000301	9,395	14,702	12,042	17,924	19,880	13,336	11,948
		Subtotal Post-1914 Demand	9,395	14,702	12,042	17,924	19,880	13,336	11,948
		Total UF Subbasin Demand	16,275	21,978	19,559	25,697	26,797	18,237	14,609
UF 20	**Chowchilla River at Buchanan Reservoir**	Riparian	14	11	13	10	6	2	3
		Pre-1914	0	0	0	0	0	0	0
		Subtotal Senior Demand	14	11	13	10	6	2	3
		Post-1914 up to and Including A000301	0	0	0	0	0	0	0
		Post-1914 Junior to A000301	6,115	6,394	3,108	676	10	9	12
		Subtotal Post-1914 Demand	6,115	6,394	3,108	676	10	9	12
		Total UF Subbasin Demand	6,129	6,405	3,120	686	17	11	14
UF 21	**Fresno River near Daulton**	Riparian	29	19	38	56	53	30	7
		Pre-1914	0	0	0	0	0	0	0
		Subtotal Senior Demand	29	19	38	56	53	30	7
		Post-1914 up to and Including A000301	0	0	0	0	0	0	0
		Post-1914 Junior to A000301	6,393	6,211	29	7	6	5	5
		Subtotal Post-1914 Demand	6,393	6,211	29	7	6	5	5
		Total UF Subbasin Demand	6,423	6,230	67	63	59	36	12

Notes:

(1) "Demand" values shown above are computed by selecting all of the water rights located within the particular UF subbasin as set forth in SWRCB's WRUDS 2015-06-09.xlsx spreadsheet, and then sorting and summing monthly Demand amounts for each water right type.

TABLE 2-3
SWRCB Demand Within UF Subbasins(1)

(all values in acre-feet)

UF Subbasin	UF Name	Water Right Type	SWRCB Demand Within UF Subbasin: Mar	Apr	May	Jun	July	Aug	Sep
UF 24	San Joaquin Valley West Side Minor Streams	Riparian	3	0	0	0	0	0	0
		Pre-1914	0	0	0	0	0	0	0
		Subtotal Senior Demand	3	0	0	0	0	0	0
		Post-1914 up to and Including A000301	0	0	0	0	0	0	0
		Post-1914 Junior to A000301	23	25	20	11	5	4	4
		Subtotal Post-1914 Demand	23	25	20	11	5	4	4
		Total UF Subbasin Demand	26	25	20	11	5	4	4
Subtotal Sacramento(2) (UF 1, 4, 5, 7, 10)		Riparian	6,095	8,036	14,598	15,641	16,831	15,596	10,744
		Pre-1914	13,016	22,109	27,304	22,615	26,159	30,075	26,259
		Subtotal Senior Demand	19,111	30,145	41,902	38,256	42,990	45,671	37,003
		Post-1914 up to and Including A000301	0	0	0	0	0	0	0
		Post-1914 Junior to A000301	75,632	99,821	136,059	125,566	96,280	81,001	69,608
		Subtotal Post-1914 Demand	75,632	99,821	136,059	125,566	96,280	81,001	69,608
		Total UF Subbasin Demand	94,743	129,966	177,961	163,821	139,270	126,672	106,611
Subtotal San Joaquin (UF 12, 15, 17, 20, 21, 24)		Riparian	5,025	8,035	10,858	12,423	11,648	9,301	5,715
		Pre-1914	4,782	2,867	1,406	519	518	436	163
		Subtotal Senior Demand	9,806	10,902	12,264	12,942	12,166	9,737	5,877
		Post-1914 up to and Including A000301	0	0	0	0	0	0	0
		Post-1914 Junior to A000301	48,791	68,064	51,540	38,768	23,621	16,905	14,535
		Subtotal Post-1914 Demand	48,791	68,064	51,540	38,768	23,621	16,905	14,535
		Total UF Subbasin Demand	58,597	78,966	63,804	51,710	35,788	26,642	20,412
Total Sacramento - San Joaquin Combined(2)		Riparian	11,120	16,071	25,456	28,064	28,479	24,896	16,459
		Pre-1914	17,798	24,976	28,710	23,134	26,678	30,511	26,422
		Subtotal Senior Demand	28,918	41,047	54,166	51,198	55,157	55,408	42,881
		Post-1914 up to and Including A000301	0	0	0	0	0	0	0
		Post-1914 Junior to A000301	124,423	167,885	187,599	164,334	119,901	97,906	84,143
		Subtotal Post-1914 Demand	124,423	167,885	187,599	164,334	119,901	97,906	84,143
		Total UF Subbasin Demand	153,340	208,932	241,765	215,532	175,058	153,313	127,023

Notes:

(1) "Demand" values shown above are computed by selecting all of the water rights located within the particular UF subbasin as set forth in SWRCB's WRUDS 2015-06-09.xlsx spreadsheet, and then sorting and summing monthly Demand amounts for each water right type.

(2) Excludes UF 2 (Putah Creek) and UF 3 (Cache Creek).

TABLE 2-4

SWRCB Demand in Excess of Supply for FNF Basins Within the Sacramento River and San Joaquin River Watersheds[1]

(all values in acre-feet)

FNF Station	Reckoning Location	Supply/Demand Component	SWRCB Demand Within FNF Basin						
			Mar	Apr	May	Jun	July	Aug	Sep
BND	Sacramento River at Bend Bridge	Full Natural Flow (FNF)[2]	347,122	306,719	280,001	248,178	215,507	194,083	210,668
		Riparian Demand	5,012	12,715	12,814	14,167	9,848	8,829	8,560
		Pre-1914 Demand	14,767	25,079	36,514	36,295	35,854	35,239	32,451
		Post-1914 Demand	1,193,699	1,064,945	493,664	380,384	232,177	205,148	204,686
		Total Demand	1,213,479	1,102,739	542,992	430,846	277,878	249,217	245,697
		Excess Riparian Demand	0	0	0	0	0	0	0
		Excess Pre-1914 Demand	0	0	0	0	0	0	0
		Excess Post-1914 Demand	866,356	796,020	262,991	182,669	62,371	55,133	35,029
		Excess Total Demand	866,356	796,020	262,991	182,669	62,371	55,133	35,029
ORO	Oroville Dam (Feather River)	Full Natural Flow (FNF)[2]	150,014	107,539	84,924	66,360	46,549	45,432	40,840
		Riparian Demand	2,847	3,264	4,782	5,438	5,317	4,756	4,339
		Pre-1914 Demand	25,757	19,762	17,621	5,038	7,794	4,572	4,320
		Post-1914 Demand	700,204	919,780	384,177	313,564	160,883	143,961	136,305
		Total Demand	728,809	942,806	406,580	324,040	173,994	153,289	144,964
		Excess Riparian Demand	0	0	0	0	0	0	0
		Excess Pre-1914 Demand	0	0	0	0	0	0	0
		Excess Post-1914 Demand	578,795	835,266	321,656	257,680	127,445	107,857	104,123
		Excess Total Demand	578,795	835,266	321,656	257,680	127,445	107,857	104,123
YRS	Yuba River near Smartville	Full Natural Flow (FNF)[2]	71,307	58,999	47,620	23,312	12,803	5,367	8,807
		Riparian Demand	186	196	206	187	184	171	167
		Pre-1914 Demand	13,250	26,395	22,037	18,483	11,123	8,015	7,306
		Post-1914 Demand	148,795	167,048	106,074	40,721	5,596	2,122	5,269
		Total Demand	162,231	193,639	128,317	59,391	16,902	10,308	12,743
		Excess Riparian Demand	0	0	0	0	0	0	0
		Excess Pre-1914 Demand	0	0	0	0	0	2,818	0
		Excess Post-1914 Demand	90,924	134,640	80,697	36,079	4,099	2,122	3,936
		Excess Total Demand	90,924	134,640	80,697	36,079	4,099	4,941	3,936
FOL	Folsom Lake (American River)	Full Natural Flow (FNF)[2]	84,025	80,857	84,586	25,734	774	785	2,783
		Riparian Demand	508	513	538	557	570	568	556
		Pre-1914 Demand	8,254	11,843	18,364	12,717	8,357	7,467	6,290
		Post-1914 Demand	152,970	222,623	82,330	38,271	45,605	14,176	6,106
		Total Demand	161,733	234,979	101,232	51,545	54,533	22,210	12,953
		Excess Riparian Demand	0	0	0	0	0	0	0
		Excess Pre-1914 Demand	0	0	0	0	8,154	7,249	4,064
		Excess Post-1914 Demand	77,708	154,122	16,646	25,811	45,605	14,176	6,106
		Excess Total Demand	77,708	154,122	16,646	25,811	53,759	21,425	10,170

Notes:

(1) “Demand” values shown above are computed by selecting all of the water rights located upstream of the particular FNF station as set forth in SWRCB’s WRUDS 2015-06-09.xlsx spreadsheet, and then sorting and summing monthly Demand amounts for each water right type.

(2) Monthly Full Natural Flow (FNF) is based on the summation of daily FNF data for each month. Daily FNF data copied and pasted from SWRCB spreadsheet WY 2014-2015 CDEC Supply Tables.xlsx in PRA folder 2015/Supply-Demand Charts.

TABLE 2-4

SWRCB Demand in Excess of Supply for FNF Basins Within the Sacramento River and San Joaquin River Watersheds[(1)]

(all values in acre-feet)

			SWRCB Demand Within FNF Basin						
FNF Station	Reckoning Location	Supply/Demand Component	Mar	Apr	May	Jun	July	Aug	Sep
MHB	**Cosumnes River at Michigan Bar**	Full Natural Flow (FNF)[(2)]	5,437	4,149	3,279	1,188	143	0	0
		Riparian Demand	198	300	326	354	226	210	185
		Pre-1914 Demand	544	422	1,655	2,015	1,844	1,027	450
		Post-1914 Demand	6,197	6,380	4,032	4,995	1,075	837	550
		Total Demand	6,939	7,102	6,014	7,365	3,145	2,075	1,184
		Excess Riparian Demand	0	0	0	0	83	210	185
		Excess Pre-1914 Demand	0	0	0	1,181	1,844	1,027	450
		Excess Post-1914 Demand	1,502	2,952	2,735	4,995	1,075	837	550
		Excess Total Demand	1,502	2,952	2,735	6,177	3,002	2,075	1,184
MKM	**Mokelumne - Mokelumne Hill (Mokelumne River)**	Full Natural Flow (FNF)[(2)]	30,030	29,074	34,128	8,997	2,981	1,063	871
		Riparian Demand	10	12	13	17	16	12	10
		Pre-1914 Demand	7,241	6,018	3,542	2,156	657	538	470
		Post-1914 Demand	3,428	22,198	22,224	31,536	974	188	144
		Total Demand	10,679	28,229	25,778	33,709	1,647	738	624
		Excess Riparian Demand	0	0	0	0	0	0	0
		Excess Pre-1914 Demand	0	0	0	0	0	0	0
		Excess Post-1914 Demand	0	0	0	24,712	0	0	0
		Excess Total Demand	0	0	0	24,712	0	0	0
GDW	**Goodwin Dam (Stanislaus River)**	Full Natural Flow (FNF)[(2)]	37,482	37,205	59,580	29,745	9,160	1,519	664
		Riparian Demand	16	86	223	231	234	105	24
		Pre-1914 Demand	40,766	52,239	65,990	32,167	16,654	11,728	8,863
		Post-1914 Demand	163,412	132,016	124,387	195,457	62,184	7,793	4,550
		Total Demand	204,195	184,341	190,601	227,855	79,072	19,627	13,438
		Excess Riparian Demand	0	0	0	0	0	0	0
		Excess Pre-1914 Demand	3,300	15,120	6,633	2,653	7,728	10,314	8,223
		Excess Post-1914 Demand	163,412	132,016	124,387	195,457	62,184	7,793	4,550
		Excess Total Demand	166,713	147,137	131,020	198,111	69,913	18,108	12,773
TLG	**Tuolumne River - La Grange Dam**	Full Natural Flow (FNF)[(2)]	57,402	85,233	144,508	62,181	16,146	10,358	6,819
		Riparian Demand	60	53	41	18	2	2	3
		Pre-1914 Demand	76,766	202,990	238,103	73,941	17,886	7,890	11,104
		Post-1914 Demand	52,128	73,341	80,150	76,359	28,389	10,819	7,273
		Total Demand	128,954	276,384	318,294	150,318	46,278	18,711	18,380
		Excess Riparian Demand	0	0	0	0	0	0	0
		Excess Pre-1914 Demand	19,423	117,810	93,636	11,778	1,743	0	4,288
		Excess Post-1914 Demand	52,128	73,341	80,150	76,359	28,389	8,353	7,273
		Excess Total Demand	71,552	191,151	173,786	88,137	30,132	8,353	11,561

Notes:

(1) "Demand" values shown above are computed by selecting all of the water rights located upstream of the particular FNF station as set forth in SWRCB's WRUDS 2015-06-09.xlsx spreadsheet, and then sorting and summing monthly Demand amounts for each water right type.

(2) Monthly Full Natural Flow (FNF) is based on the summation of daily FNF data for each month. Daily FNF data copied and pasted from SWRCB spreadsheet WY 2014-2015 CDEC Supply Tables.xlsx in PRA folder 2015/Supply-Demand Charts.

TABLE 2-4
SWRCB Demand in Excess of Supply for FNF Basins Within the Sacramento River and San Joaquin River Watersheds[1]

(all values in acre-feet)

			SWRCB Demand Within FNF Basin						
FNF Station	**Reckoning Location**	**Supply/Demand Component**	**Mar**	**Apr**	**May**	**Jun**	**July**	**Aug**	**Sep**
MRC	**Merced River near Merced Falls**	Full Natural Flow (FNF)[2]	17,373	25,264	39,402	18,369	7,206	1,135	143
		Riparian Demand	4	5	6	7	7	7	6
		Pre-1914 Demand	1,798	2,348	1,417	561	400	542	504
		Post-1914 Demand	70,567	140,663	112,883	208,378	941	14	14
		Total Demand	72,369	143,016	114,307	208,945	1,347	563	524
		Excess Riparian Demand	0	0	0	0	0	0	0
		Excess Pre-1914 Demand	0	0	0	0	0	0	367
		Excess Post-1914 Demand	54,995	117,752	74,905	190,576	0	0	14
		Excess Total Demand	54,995	117,752	74,905	190,576	0	0	381
MIL	**Friant Dam - Millerton (San Joaquin River)**	Full Natural Flow (FNF)[2]	33,781	38,202	75,936	55,867	23,748	7,815	3,017
		Riparian Demand	135	148	176	209	211	183	178
		Pre-1914 Demand	1,866	2,261	2,091	590	70	0	0
		Post-1914 Demand	73,366	63,614	172,197	294,869	177,442	114,224	82,096
		Total Demand	75,367	66,022	174,464	295,668	177,722	114,407	82,274
		Excess Riparian Demand	0	0	0	0	0	0	0
		Excess Pre-1914 Demand	0	0	0	0	0	0	0
		Excess Post-1914 Demand	41,586	27,820	98,528	239,800	153,974	106,592	79,257
		Excess Total Demand	41,586	27,820	98,528	239,800	153,974	106,592	79,257
Subtotal Sacramento (BND, ORO, YRS, FOL)		Excess Riparian Demand	0	0	0	0	0	0	0
		Excess Pre-1914 Demand	0	0	0	0	8,154	10,067	4,064
		Excess Post-1914 Demand	1,613,783	1,920,048	681,991	502,239	239,520	179,289	149,195
		Excess Total Demand	1,613,783	1,920,048	681,991	502,239	247,674	189,356	153,258
Subtotal San Joaquin (MHB, MKM, GDW, TLG, MRC, MIL)		Excess Riparian Demand	0	0	0	0	83	210	185
		Excess Pre-1914 Demand	22,724	132,930	100,269	15,613	11,316	11,342	13,328
		Excess Post-1914 Demand	313,624	353,882	380,705	731,900	245,623	123,577	91,644
		Excess Total Demand	336,348	486,812	480,974	747,513	257,021	135,128	105,157
Total Sacramento - San Joaquin Combined		Excess Riparian Demand	0	0	0	0	83	210	185
		Excess Pre-1914 Demand	22,724	132,930	100,269	15,613	19,470	21,409	17,391
		Excess Post-1914 Demand	1,927,407	2,273,930	1,062,695	1,234,139	485,142	302,865	240,839
		Excess Total Demand	1,950,131	2,406,860	1,162,965	1,249,752	504,696	324,484	258,415

Notes:
(1) "Demand" values shown above are computed by selecting all of the water rights located upstream of the particular FNF station as set forth in SWRCB's WRUDS 2015-06-09.xlsx spreadsheet, and then sorting and summing monthly Demand amounts for each water right type.
(2) Monthly Full Natural Flow (FNF) is based on the summation of daily FNF data for each month. Daily FNF data copied and pasted from SWRCB spreadsheet WY 2014-2015 CDEC Supply Tables.xlsx in PRA folder 2015/Supply-Demand Charts.

TABLE 2-5

SWRCB Demand in Excess of Supply for UF Subbasins Within the Sacramento River and San Joaquin River Watersheds[1]

(all values in acre-feet)

			SWRCB Demand Within UF Subbasin						
UF Subbasin	UF Name	Supply/Demand Component	Mar	Apr	May	Jun	July	Aug	Sep
UF 1	Sacramento Valley Floor	Unimpaired Flow[2]	0	0	0	0	0	0	0
		Riparian Demand	3,096	3,640	9,910	10,995	11,154	10,873	5,944
		Pre-1914 Demand	9,679	12,845	17,738	12,940	15,824	21,758	18,234
		Post-1914 Demand	17,747	54,822	107,442	112,997	85,374	76,261	66,937
		Total Demand	30,521	71,307	135,090	136,932	112,352	108,892	91,115
		Excess Riparian Demand	3,096	3,640	9,910	10,995	11,154	10,873	5,944
		Excess Pre-1914 Demand	9,679	12,845	17,738	12,940	15,824	21,758	18,234
		Excess Post-1914 Demand	17,747	54,822	107,442	112,997	85,374	76,261	66,937
		Excess Total Demand	30,521	71,307	135,090	136,932	112,352	108,892	91,115
UF 2	Putah Creek near Winters	Unimpaired Flow[2]	0	0	0	0	0	0	0
		Riparian Demand	131	199	282	135	125	103	91
		Pre-1914 Demand	11	11	10	7	5	3	3
		Post-1914 Demand	90,086	26,702	4,990	12,424	3,315	2,779	1,760
		Total Demand	90,228	26,912	5,283	12,565	3,445	2,885	1,854
		Excess Riparian Demand	131	199	282	135	125	103	91
		Excess Pre-1914 Demand	11	11	10	7	5	3	3
		Excess Post-1914 Demand	90,086	26,702	4,990	12,424	3,315	2,779	1,760
		Excess Total Demand	90,228	26,912	5,283	12,565	3,445	2,885	1,854
UF 3	Cache Creek near Rumsey	Unimpaired Flow[2]	0	0	0	0	0	0	0
		Riparian Demand	346	300	535	794	824	706	287
		Pre-1914 Demand	28,677	16,653	1,333	958	1,418	817	975
		Post-1914 Demand	59,493	32,779	7,640	3,387	752	2,354	4,481
		Total Demand	88,516	49,733	9,508	5,140	2,994	3,877	5,742
		Excess Riparian Demand	346	300	535	794	824	706	287
		Excess Pre-1914 Demand	28,677	16,653	1,333	958	1,418	817	975
		Excess Post-1914 Demand	59,493	32,779	7,640	3,387	752	2,354	4,481
		Excess Total Demand	88,516	49,733	9,508	5,140	2,994	3,877	5,742
UF 4	Stony Crek at Black Butte	Unimpaired Flow[2]	0	0	0	0	0	0	0
		Riparian Demand	2	17	22	22	22	17	7
		Pre-1914 Demand	0	0	0	0	0	0	0
		Post-1914 Demand	36,180	38,258	9,877	279	647	172	207
		Total Demand	36,181	38,274	9,898	301	669	189	214
		Excess Riparian Demand	2	17	22	22	22	17	7
		Excess Pre-1914 Demand	0	0	0	0	0	0	0
		Excess Post-1914 Demand	36,180	38,258	9,877	279	647	172	207
		Excess Total Demand	36,181	38,274	9,898	301	669	189	214

Notes:

(1) "Demand" values shown above are computed by selecting all of the water rights located within the particular UF subbasin as set forth in SWRCB's WRUDS 2015-06-09.xlsx spreadsheet, and then sorting and summing monthly Demand amounts for each water right type.

(2) Assumes no unimpaired flow Supply, commensurate with the SWRCB's omission of contributing flows from these UF subbasins in its reckoning of daily Supply.

TABLE 2-5

SWRCB Demand in Excess of Supply for UF Subbasins Within the Sacramento River and San Joaquin River Watersheds[(1)]

(all values in acre-feet)

UF Subbasin	UF Name	Supply/Demand Component	Mar	Apr	May	Jun	July	Aug	Sep
			SWRCB Demand Within UF Subbasin						
UF 5	**Sacramento Valley West Side Minor Streams**	Unimpaired Flow[(2)]	0	0	0	0	0	0	0
		Riparian Demand	3	5	16	15	14	12	11
		Pre-1914 Demand	0	0	0	0	0	0	0
		Post-1914 Demand	72	11	11	5	0	0	1
		Total Demand	75	16	28	21	14	12	13
		Excess Riparian Demand	3	5	16	15	14	12	11
		Excess Pre-1914 Demand	0	0	0	0	0	0	0
		Excess Post-1914 Demand	72	11	11	5	0	0	1
		Excess Total Demand	75	16	28	21	14	12	13
UF 7	**Sacramento Valley East Side Minor Streams**	Unimpaired Flow[(2)]	0	0	0	0	0	0	0
		Riparian Demand	2,993	4,360	4,633	4,593	5,625	4,677	4,765
		Pre-1914 Demand	1,887	5,380	8,216	8,726	7,778	7,454	7,278
		Post-1914 Demand	2,831	2,340	3,491	2,925	1,986	1,227	1,099
		Total Demand	7,711	12,080	16,341	16,244	15,389	13,358	13,142
		Excess Riparian Demand	2,993	4,360	4,633	4,593	5,625	4,677	4,765
		Excess Pre-1914 Demand	1,887	5,380	8,216	8,726	7,778	7,454	7,278
		Excess Post-1914 Demand	2,831	2,340	3,491	2,925	1,986	1,227	1,099
		Excess Total Demand	7,711	12,080	16,341	16,244	15,389	13,358	13,142
UF 10	**Bear River near Wheatland**	Unimpaired Flow[(2)]	0	0	0	0	0	0	0
		Riparian Demand	2	15	16	16	17	17	16
		Pre-1914 Demand	1,450	3,883	1,351	949	2,558	864	748
		Post-1914 Demand	18,802	4,391	15,238	9,359	8,272	3,340	1,364
		Total Demand	20,254	8,289	16,604	10,324	10,846	4,221	2,128
		Excess Riparian Demand	2	15	16	16	17	17	16
		Excess Pre-1914 Demand	1,450	3,883	1,351	949	2,558	864	748
		Excess Post-1914 Demand	18,802	4,391	15,238	9,359	8,272	3,340	1,364
		Excess Total Demand	20,254	8,289	16,604	10,324	10,846	4,221	2,128
UF 12	**San Joaquin Valley East Side Minor Streams**	Unimpaired Flow[(2)]	0	0	0	0	0	0	0
		Riparian Demand	1,117	2,561	4,149	4,695	4,686	4,344	3,034
		Pre-1914 Demand	748	435	192	188	286	257	62
		Post-1914 Demand	7,476	6,777	5,890	4,203	3,571	3,447	2,441
		Total Demand	9,341	9,773	10,231	9,086	8,544	8,049	5,537
		Excess Riparian Demand	1,117	2,561	4,149	4,695	4,686	4,344	3,034
		Excess Pre-1914 Demand	748	435	192	188	286	257	62
		Excess Post-1914 Demand	7,476	6,777	5,890	4,203	3,571	3,447	2,441
		Excess Total Demand	9,341	9,773	10,231	9,086	8,544	8,049	5,537

Notes:

(1) "Demand" values shown above are computed by selecting all of the water rights located within the particular UF subbasin as set forth in SWRCB's WRUDS 2015-06-09.xlsx spreadsheet, and then sorting and summing monthly Demand amounts for each water right type.

(2) Assumes no unimpaired flow Supply, commensurate with the SWRCB's omission of contributing flows from these UF subbasins in its reckoning of daily Supply.

TABLE 2-5

SWRCB Demand in Excess of Supply for UF Subbasins Within the Sacramento River and San Joaquin River Watersheds[1]

(all values in acre-feet)

			SWRCB Demand Within UF Subbasin						
UF Subbasin	**UF Name**	**Supply/Demand Component**	**Mar**	**Apr**	**May**	**Jun**	**July**	**Aug**	**Sep**
UF 15	**Calaveras River at Jenny Lind**	Unimpaired Flow[2]	0	0	0	0	0	0	0
		Riparian Demand	314	310	320	220	156	124	111
		Pre-1914 Demand	702	291	36	1	62	79	1
		Post-1914 Demand	19,388	33,954	30,450	15,946	148	102	125
		Total Demand	20,404	34,555	30,806	16,167	366	305	236
		Excess Riparian Demand	314	310	320	220	156	124	111
		Excess Pre-1914 Demand	702	291	36	1	62	79	1
		Excess Post-1914 Demand	19,388	33,954	30,450	15,946	148	102	125
		Excess Total Demand	20,404	34,555	30,806	16,167	366	305	236
UF 17	**San Joaquin Valley Floor**	Unimpaired Flow[2]	0	0	0	0	0	0	0
		Riparian Demand	3,548	5,135	6,339	7,443	6,747	4,801	2,561
		Pre-1914 Demand	3,332	2,141	1,178	330	170	100	100
		Post-1914 Demand	9,395	14,702	12,042	17,924	19,880	13,336	11,948
		Total Demand	16,275	21,978	19,559	25,697	26,797	18,237	14,609
		Excess Riparian Demand	3,548	5,135	6,339	7,443	6,747	4,801	2,561
		Excess Pre-1914 Demand	3,332	2,141	1,178	330	170	100	100
		Excess Post-1914 Demand	9,395	14,702	12,042	17,924	19,880	13,336	11,948
		Excess Total Demand	16,275	21,978	19,559	25,697	26,797	18,237	14,609
UF 20	**Chowchilla River at Buchanan Reservoir**	Unimpaired Flow[2]	0	0	0	0	0	0	0
		Riparian Demand	14	11	13	10	6	2	3
		Pre-1914 Demand	0	0	0	0	0	0	0
		Post-1914 Demand	6,115	6,394	3,108	676	10	9	12
		Total Demand	6,129	6,405	3,120	686	17	11	14
		Excess Riparian Demand	14	11	13	10	6	2	3
		Excess Pre-1914 Demand	0	0	0	0	0	0	0
		Excess Post-1914 Demand	6,115	6,394	3,108	676	10	9	12
		Excess Total Demand	6,129	6,405	3,120	686	17	11	14
UF 21	**Fresno River near Daulton**	Unimpaired Flow[2]	0	0	0	0	0	0	0
		Riparian Demand	29	19	38	56	53	30	7
		Pre-1914 Demand	0	0	0	0	0	0	0
		Post-1914 Demand	6,393	6,211	29	7	6	5	5
		Total Demand	6,423	6,230	67	63	59	36	12
		Excess Riparian Demand	29	19	38	56	53	30	7
		Excess Pre-1914 Demand	0	0	0	0	0	0	0
		Excess Post-1914 Demand	6,393	6,211	29	7	6	5	5
		Excess Total Demand	6,423	6,230	67	63	59	36	12

Notes:

(1) "Demand" values shown above are computed by selecting all of the water rights located within the particular UF subbasin as set forth in SWRCB's WRUDS 2015-06-09.xlsx spreadsheet, and then sorting and summing monthly Demand amounts for each water right type.

(2) Assumes no unimpaired flow Supply, commensurate with the SWRCB's omission of contributing flows from these UF subbasins in its reckoning of daily Supply.

TABLE 2-5

SWRCB Demand in Excess of Supply for UF Subbasins Within the Sacramento River and San Joaquin River Watersheds[1]

(all values in acre-feet)

UF Subbasin	UF Name	Supply/Demand Component	SWRCB Demand Within UF Subbasin						
			Mar	Apr	May	Jun	July	Aug	Sep
UF 24	**San Joaquin Valley West Side Minor Streams**	Unimpaired Flow[2]	0	0	0	0	0	0	0
		Riparian Demand	3	0	0	0	0	0	0
		Pre-1914 Demand	0	0	0	0	0	0	0
		Post-1914 Demand	23	25	20	11	5	4	4
		Total Demand	26	25	20	11	5	4	4
		Excess Riparian Demand	3	0	0	0	0	0	0
		Excess Pre-1914 Demand	0	0	0	0	0	0	0
		Excess Post-1914 Demand	23	25	20	11	5	4	4
		Excess Total Demand	26	25	20	11	5	4	4
Subtotal Sacramento[3] (UF 1, 4, 5, 7, 10)		Excess Riparian Demand	6,095	8,036	14,598	15,641	16,831	15,596	10,744
		Excess Pre-1914 Demand	13,016	22,109	27,304	22,615	26,159	30,075	26,259
		Excess Post-1914 Demand	75,632	99,821	136,059	125,566	96,280	81,001	69,608
		Excess Total Demand	94,743	129,966	177,961	163,821	139,270	126,672	106,611
Subtotal San Joaquin (UF 12, 15, 17, 20, 21, 24)		Excess Riparian Demand	5,025	8,035	10,858	12,423	11,648	9,301	5,715
		Excess Pre-1914 Demand	4,782	2,867	1,406	519	518	436	163
		Excess Post-1914 Demand	48,791	68,064	51,540	38,768	23,621	16,905	14,535
		Excess Total Demand	58,597	78,966	63,804	51,710	35,788	26,642	20,412
Total Sacramento - San Joaquin Combined[3]		Excess Riparian Demand	11,120	16,071	25,456	28,064	28,479	24,896	16,459
		Excess Pre-1914 Demand	17,798	24,976	28,710	23,134	26,678	30,511	26,422
		Excess Post-1914 Demand	124,423	167,885	187,599	164,334	119,901	97,906	84,143
		Excess Total Demand	153,340	208,932	241,765	215,532	175,058	153,313	127,023

Notes:

(1) “Demand” values shown above are computed by selecting all of the water rights located within the particular UF subbasin as set forth in SWRCB’s WRUDS 2015-06-09.xlsx spreadsheet, and then sorting and summing monthly Demand amounts for each water right type.

(2) Assumes no unimpaired flow Supply, commensurate with the SWRCB's omission of contributing flows from these UF subbasins in its reckoning of daily Supply.

(3) Exclues UF 2 (Putah Creek) and UF 3 (Cache Creek).

TABLE 3-1

Modesto Irrigation District - Return Flows To Rivers, 2000-2015[(1)]

(all values in acre-feet)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2000	1,218	0	878	4,356	7,216	5,368	6,111	6,890	7,675	6,113	0	0	45,825
2001	0	0	1,513	5,616	5,469	4,846	6,076	5,111	5,893	6,190	0	0	40,714
2002	0	0	3,686	5,264	4,850	5,529	5,272	5,632	4,967	5,425	0	0	40,625
2003	0	0	3,021	3,603	3,483	4,884	4,852	4,665	4,127	4,349	944	0	33,928
2004	0	0	2,507	4,329	3,408	2,190	3,866	4,160	4,462	3,571	0	0	28,493
2005	0	0	0	2,505	3,866	3,426	5,243	3,925	6,187	5,343	851	0	31,346
2006	0	0	79	5,506	5,306	4,788	6,015	8,746	6,795	5,366	334	0	42,935
2007	0	0	2,990	5,722	2,954	3,763	4,245	5,120	4,714	3,836	0	0	33,344
2008	0	0	599	5,850	4,945	4,296	4,761	5,436	4,830	4,215	0	0	34,932
2009	0	0	1,769	2,779	3,723	3,459	4,634	5,049	4,151	4,204	0	0	29,768
2010	0	0	1,523	4,502	4,774	4,049	5,368	5,965	5,912	5,159	0	0	37,252
2011	0	0	6,240	7,453	8,372	7,291	6,796	8,060	7,874	7,075	6,883	0	66,044
2012	0	0	4,574	6,653	6,777	6,987	5,984	6,592	6,924	5,250	0	0	49,741
2013	0	0	6,509	5,788	5,681	5,779	5,458	6,744	6,203	4,783	0	0	46,945
2014	0	0	0	3,048	2,083	1,456	2,956	3,626	2,696	1,581	0	0	17,446
2015	0	0	0	1,160	1,668	1,408	1,819	1,878	2,112	2,115	0	0	12,160
Average	**76**	**0**	**2,243**	**4,633**	**4,661**	**4,345**	**4,966**	**5,475**	**5,345**	**4,661**	**563**	**0**	**36,969**
2015 as a % of Average	**0%**	**-**	**0%**	**25%**	**36%**	**32%**	**37%**	**34%**	**40%**	**45%**	**0%**	**-**	**33%**
2015 as a % of 2014	**-**	**-**	**-**	**38%**	**80%**	**97%**	**62%**	**52%**	**78%**	**134%**	**-**	**-**	**70%**

Notes:

(1) Values based on tables prepared by Modesto Irrigation District titled "Water Spilled Through Canal System" for water years 2000 to 2015.

TABLE 4-1
2015 Treated Effluent Discharge to Sacramento River from Sacramento Regional Wastewater Treatment Plant

	2015 Monthly Average Treated Effluent Discharge													Total Mar
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	to Oct
Flow (cfs)*	170	200	190	190	170	160	160	170	160	160	170	220	-	-
Amount (AF)	10,448	11,102	11,677	11,300	10,448	9,516	9,833	10,448	9,516	9,833	10,111	13,521	127,752	82,571

* Monthly values for CDEC station SPE (Sac Regional Wastewater Treatment Plant) per query on January 9, 2016.

TABLE 4-2

Analysis of City of Stockton Reported Diversions[(1)] and Discharge[(2)] to Delta

(all values in acre-feet)

2012	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
Wastewater Treatment Plant Effluent	2,342.8	2,108.9	2,286.8	2,313.6	2,254.1	1,742.2	2,009.8	2,580.0	2,174.0	2,253.2	2,127.7	2,692.3	26,885.4
Delta Water Supply Project Diversion*	-	-	-	-	-	-	-	878.0	213.1	1,174.1	829.4	664.3	3,759.0
Effluent Net of Diversion	**2,342.8**	**2,108.9**	**2,286.8**	**2,313.6**	**2,254.1**	**1,742.2**	**2,009.8**	**1,702.0**	**1,960.9**	**1,079.1**	**1,298.2**	**2,028.0**	**23,126.4**
Ratio - Net Effluent/WWTP Effluent	-	-	-	-	-	-	-	0.66	0.90	0.48	0.61	0.75	0.86

*Construction of the intake and pump station was completed in August 2012.

2013	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
Wastewater Treatment Plant Effluent	2,336.6	2,175.4	2,339.8	2,270.5	2,122.5	1,805.9	2,257.8	2,003.1	2,193.3	2,054.3	1,945.9	2,050.7	25,555.8
Delta Water Supply Project Diversion	772.1	788.8	196.3	2.4	37.6	33.0	19.8	747.8	1,285.2	1,515.7	1,270.2	934.3	7,603.0
Effluent Net of Diversion	**1,564.5**	**1,386.6**	**2,143.6**	**2,268.1**	**2,085.0**	**1,772.9**	**2,238.0**	**1,255.3**	**908.1**	**538.6**	**675.7**	**1,116.3**	**17,952.8**
Ratio - Net Effluent/WWTP Effluent	0.67	0.64	0.92	1.00	0.98	0.98	0.99	0.63	0.41	0.26	0.35	0.54	0.70

2014	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
Wastewater Treatment Plant Effluent	2,142.6	2,254.7	2,429.8	2,285.8	1,728.8	1,892.5	1,983.4	2,260.2	2,245.2	2,201.2	2,013.8	2,683.9	26,121.9
Delta Water Supply Project Diversion	573.7	296.4	15.7	0.0	0.0	0.0	797.4	589.9	263.1	574.3	863.4	763.0	4,736.7
Effluent Net of Diversion	**1,568.9**	**1,958.3**	**2,414.1**	**2,285.8**	**1,728.8**	**1,892.5**	**1,186.1**	**1,670.3**	**1,982.1**	**1,627.0**	**1,150.5**	**1,920.9**	**21,385.2**
Ratio - Net Effluent/WWTP Effluent	0.73	0.87	0.99	1.00	1.00	1.00	0.60	0.74	0.88	0.74	0.57	0.72	0.82

2012-14 Average Ratio Net/WWTP	**0.70**	**0.75**	**0.95**	**1.00**	**0.99**	**0.99**	**0.79**	**0.68**	**0.73**	**0.49**	**0.51**	**0.67**	**0.79**

2015	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
Wastewater Treatment Plant Effluent	2,131.9	2,085.2	2,033.9	1,940.5	1,911.5	1,751.7	-	-	-	-	-	-	-
Estimated Effluent Net of Diversion [(3)]	***1,494***	***1,570***	***1,942***	***1,940***	***1,895***	***1,736***	-	-	-	-	-	-	-

Notes:

(1) Delta Water Supply Project diversions as reported in annual Progress Reports by Permittee for Permit 21176 (Application 30531A) of City of Stockton Municipal Utilities Dept.

(2) Discharge of Wastewater Treatment Plant effluent as reported in City of Stockton Municipal Utilities Dept. Monthly Operations and Maintenance Report for June 2013, June 2014, and June 2015.

(3) 2015 Estimated Effluent Net of Diversion computed as WWTP Effluent multiplied by 2012-14 average ratio of Net Effluent vs. WWTP Effluent.

TABLE 4-3

City of Tracy - 2015 Estimated Treated Effluent Discharge

Year	Month	2014 Effluent Flow[1]		2015 Cumulative Water Use Conservation Achieved[2]	Est. 2015 Effluent Flow[3]
		(MG)	(AF)	(%)	(AF)
2014	Jan	291.49	895	-	895
	Feb	271.28	833	-	833
	Mar	303.88	933	-	933
	Apr	290.67	892	-	892
	May	297.30	912	-	912
	Jun	266.11	817	29.6%	575
	Jul	270.09	829	29.6%	584
	Aug	274.11	841	29.6%	592
	Sep	259.99	798	29.6%	562
	Oct	270.88	831	29.6%	585
	Nov	270.02	829	29.6%	583
	Dec[3]	323.60	993	29.6%	699
Total		**3,389.42**	**10,402**	**-**	**8,644**

Notes:

1. 2014 data from SWRCB in response to a PRA request, email from SWRCB's Andrew Tauriainen to Jeanne Zolezzi of Herum\Crabtree\Sontag dated November 3, 2015.

2. Percent water use conservation is cumulative value for June through October 2015 for City of Tracy per SWRCB's monthly report archive dated December 1, 2015. (http://www.waterboards.ca.gov/water_issues/programs/conservation_portal/conservation_reporting.shtml).

3. Treated effluent discharge assumed to be the same as 2014 for January through May. For June and later discharge is assumed to parallel water use reduction based on implementation of SWRCB urban water conservation regulations, applied to 2014 instead of 2013 base year.

TABLE 4-4

City of Turlock - 2015 Estimated Treated Effluent Discharge to San Joaquin River

Month	Effluent Discharge[1]				2015 Cumulative Water Use Conservation Achieved (%)[2]	Estimated 2015 Effluent Discharge[3]
	2013		2014			
	(cfs)	(AF)	(cfs)	(AF)		(AF)
Jan	15.3	941	13	799	-	799
Feb	15.2	844	12.8	711	-	711
Mar	15.6	959	13.5	830	-	830
Apr	15.6	928	14.2	845	-	845
May	15.5	953	12.7	781	-	781
Jun	14.9	887	12.7	756	26%	656
Jul	13.5	830	13	799	26%	614
Aug	13.5	830	13.6	836	26%	614
Sep	13.3	791	13	774	26%	586
Oct	14.7	904	13.5	830	26%	669
Nov	14.5	863	13.1	780	26%	638
Dec	13.1	805	13.6	836	26%	596
Total		**10,536**		**9,577**	**-**	**8,340**

Notes:

1. Effluent discharge to San Joaquin River per City's Petition for Change WW0088.

2. Percent water use conservation is cumulative value for June through October 2015 for City of Turlock per SWRCB's monthly report archive dated December 1, 2015.
(http://www.waterboards.ca.gov/water_issues/programs/conservation_portal/conservation_reporting.shtml).

3. Treated effluent discharge assumed to be the same as 2014 for January through May. For June and later discharge is assumed to parallel water use reduction based on 2013 base year associated with implementation of SWRCB urban water conservation regulations.

TABLE 5-1
Stanislaus, Tuolumne and Merced Rivers
Actual Flow in Excess of Full Natural Flow, 2015

River	Amount (acre-feet)[1]													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total	Mar - Oct Total
Stanislaus[2]	1,341	50	6,768	8,763	0	518	1,968	7,855	8,404	18,500	8,200	1,269	63,635	52,775
Tuolumne[3]	0	0	0	1,075	0	0	0	619	137	2,686	0	204	4,721	4,516
Merced[4]	5,249	685	0	0	0	0	672	2,586	4,013	15,690	476	862	30,233	22,960
Total	6,590	735	6,768	9,838	0	518	2,639	11,059	12,554	36,875	8,676	2,336	98,588	80,251

Notes:

(1) Monthly amounts shown were derived from daily data obtained from CDEC for the stations described in notes (2) through (4). Monthly amounts were computed by summing the difference between daily actual flow and daily Full Natural Flow for all days in the month when daily Actual Flow exceeded daily Full Natural Flow.

(1) Actual Flow and Full Natural Flow for Stanislaus River retrieved from CDEC station Goodwin Dam (GDW).

(2) Actual Flow for Tuolumne River retrieved from CDEC station Tuolumne River Below La Grange Dam Near La Grange (LGN); Full Natural Flow retrieved from CDEC station Tuolumne River - La Grange Dam (TLG).

(3) Actual Flow for Merced River retrieved from CDEC station Merced River at Shaffer Bridge Near Cressy; Full Natural Flow retrieved from CDEC station Merced River near Merced Falls.

FIGURES

CDEC Full Natural Flow (FNF) Stations

Station ID	Name	Distance to Legal Delta Boundary (River Miles)
BND	Sacramento River At Bend Bridge	199
ORO	Oroville Dam	90
YRS	Yuba River Near Smartville	68
FOL	Folsom Lake	28
MHB	Cosumnes River At Michigan Bar	32
MKM	Mokelumne Mokelumne Hill	56
GDW	Goodwin Dam	62
TLG	Tuolumne R La Grange Dam	65
MRC	Merced R Nr Merced Falls	103
MIL	Friant Dam (Millerton)	197

Approximate Point of Diversion
CDEC FNF Station
Legal Delta Boundary
Watershed of CDEC FNF Gage
County Boundary

Source: Legal Delta Boundary represents the legal Delta established under the Delta Protection Act (Section 12220 of the Water Code) passed in 1959. Dataset per the Department of Water Resources (DWR), 2001.
CDEC FNF Gage Watersheds based on Hydrologic Unit (HUC) boundaries from the Water Boundary Dataset, Natural Resources Conservation Service (NRCS), 2015.
Base map per Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community.

FIGURE 2A

Map Showing Proximity of CDEC Full Natural Flow (FNF) Stations to Legal Delta Boundary

Wagner & Bonsignore
Consulting Civil Engineers, A Corporation

January 2016

FIGURE 2B
Full Natural Flow vs. SWRCB Demand Upstream of FNF Stations
March 2015

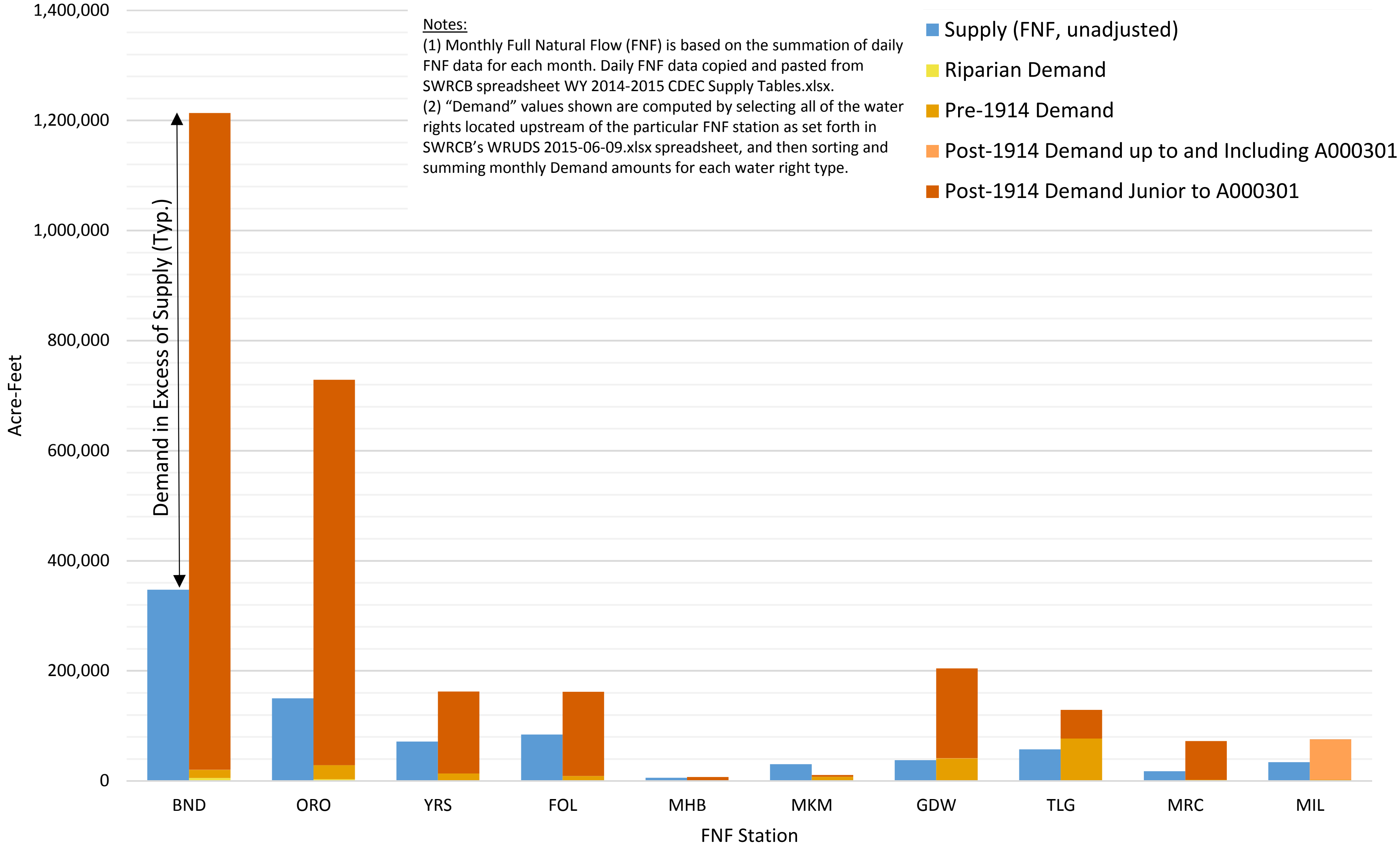


FIGURE 2C
Full Natural vs. SWRCB Demand Upstream of FNF Stations
April 2015

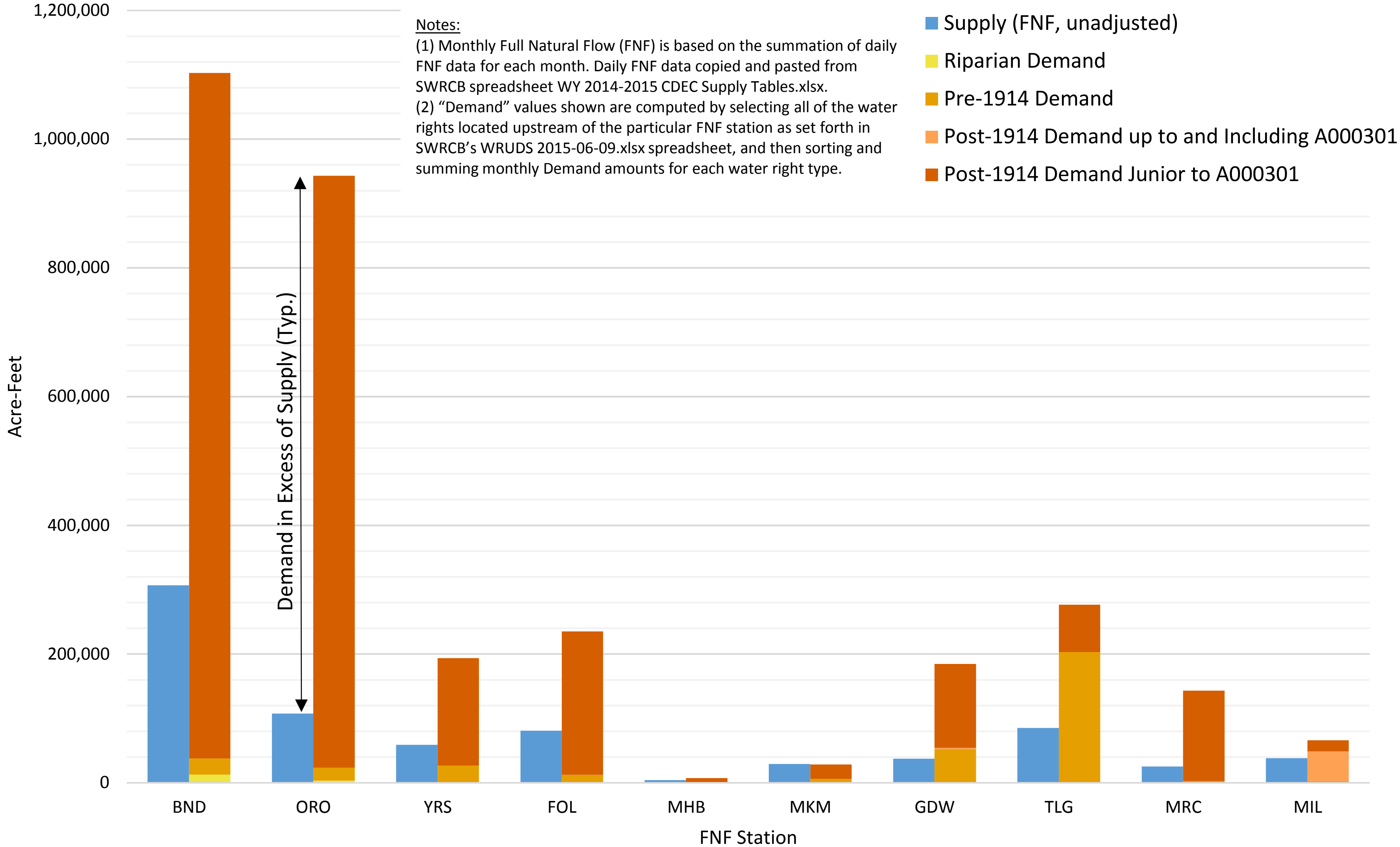


FIGURE 2D

Full Natural Flow vs. SWRCB Demand Upstream of FNF Stations

May 2015

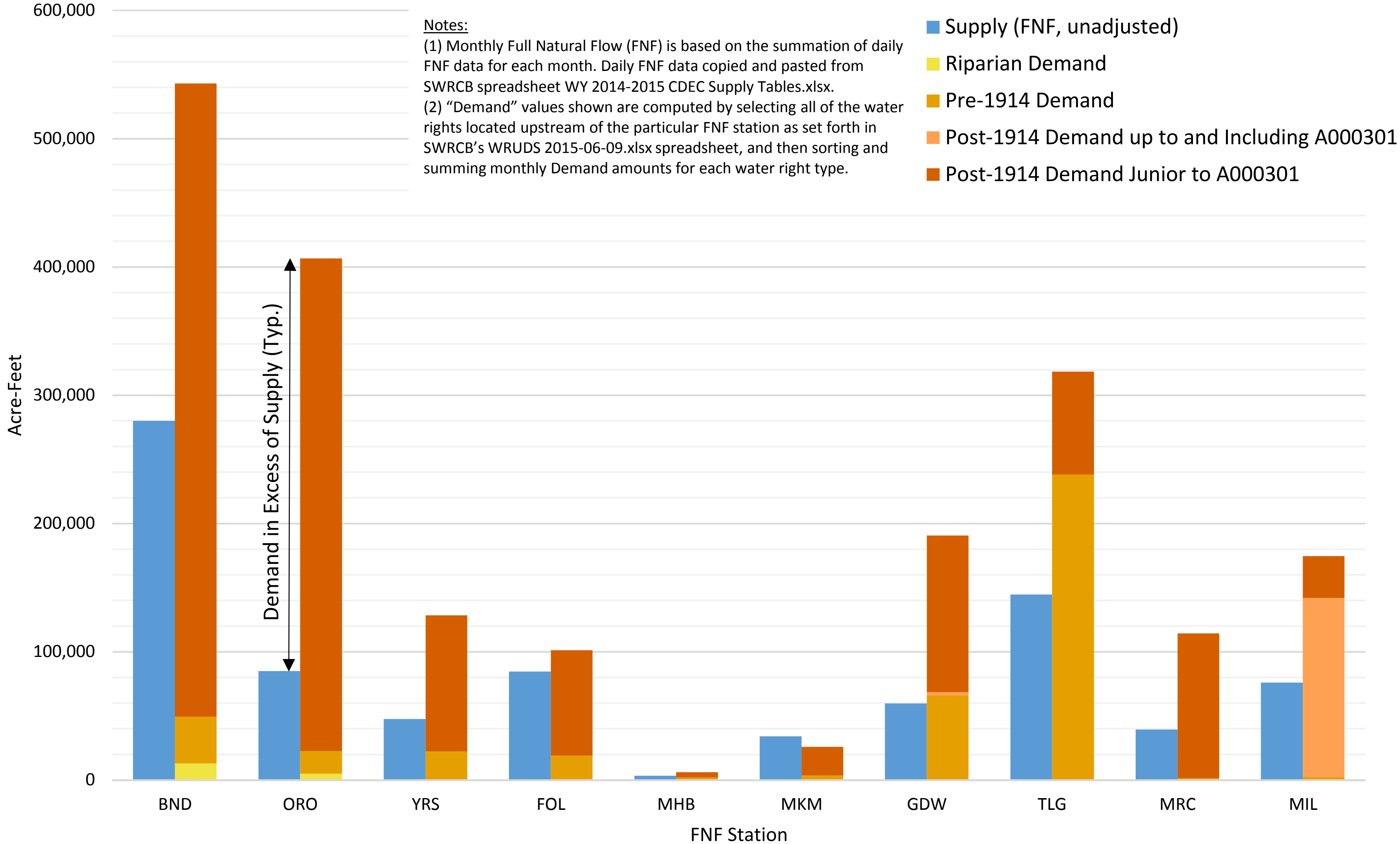


FIGURE 2E
Full Natural vs. SWRCB Demand Upstream of FNF Stations
June 2015

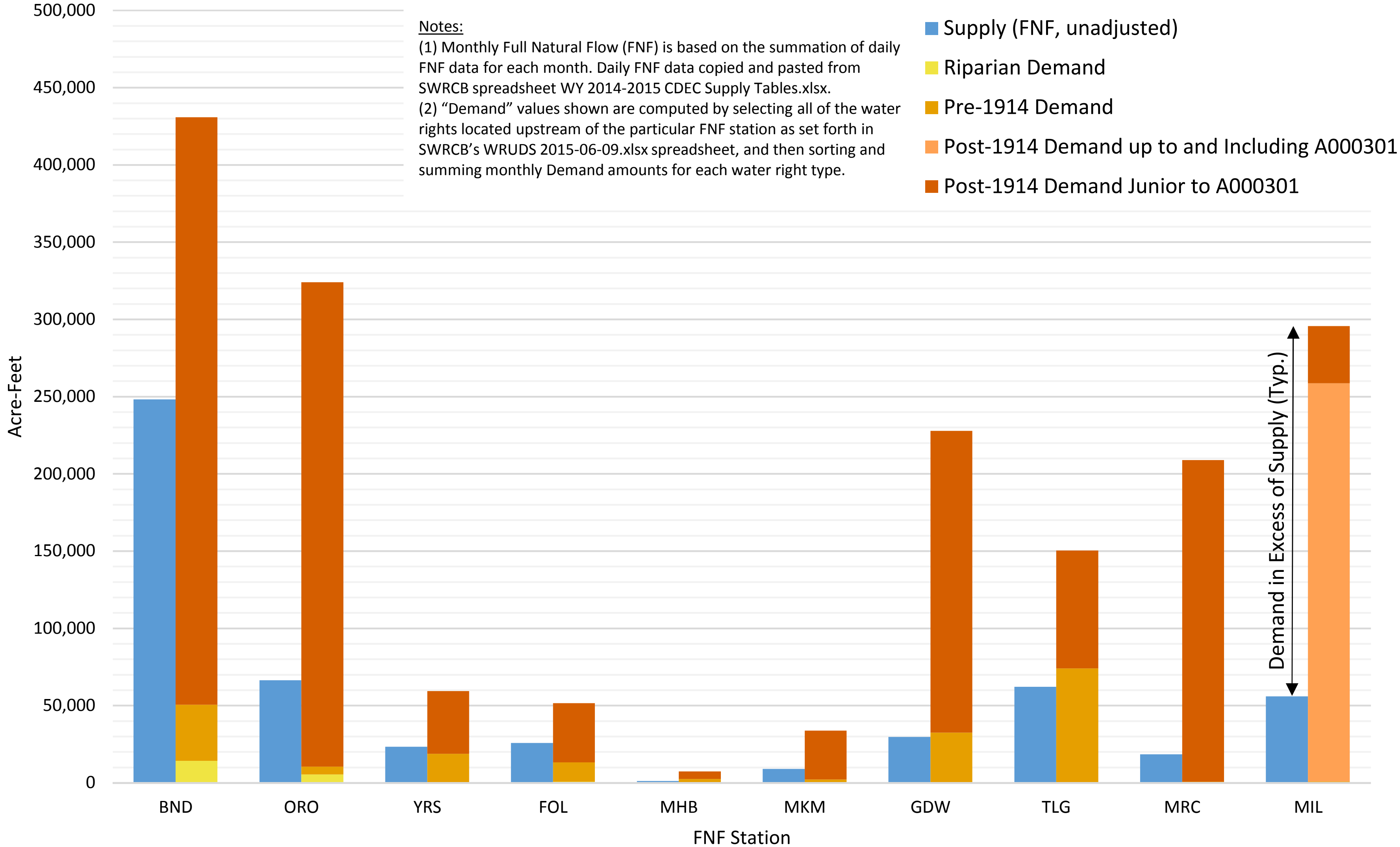


FIGURE 2F
Full Natural Flow vs. SWRCB Demand Upstream of FNF Stations
July 2015

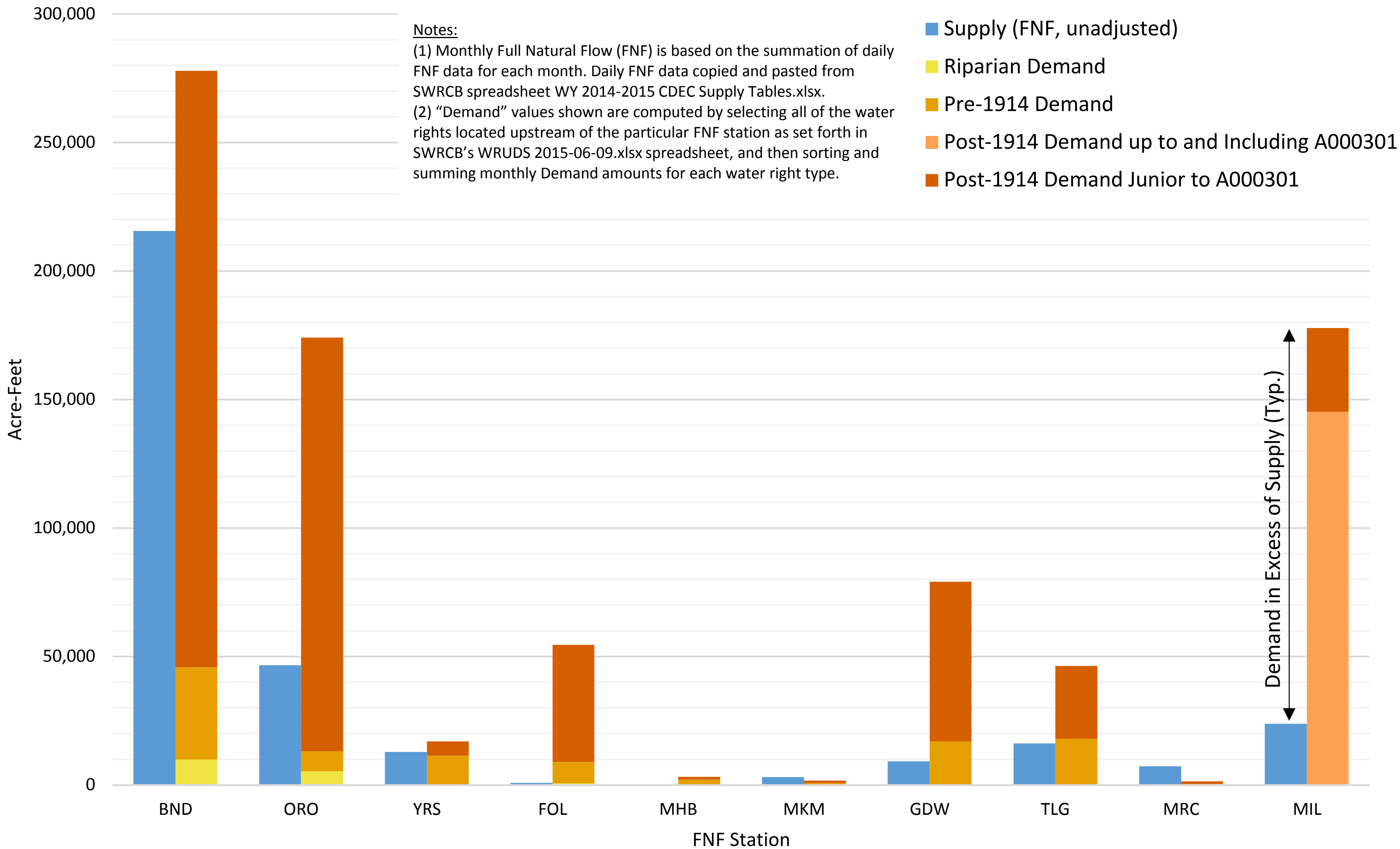


FIGURE 2G

Full Natural Flow vs. SWRCB Demand Upstream of FNF Stations

August 2015

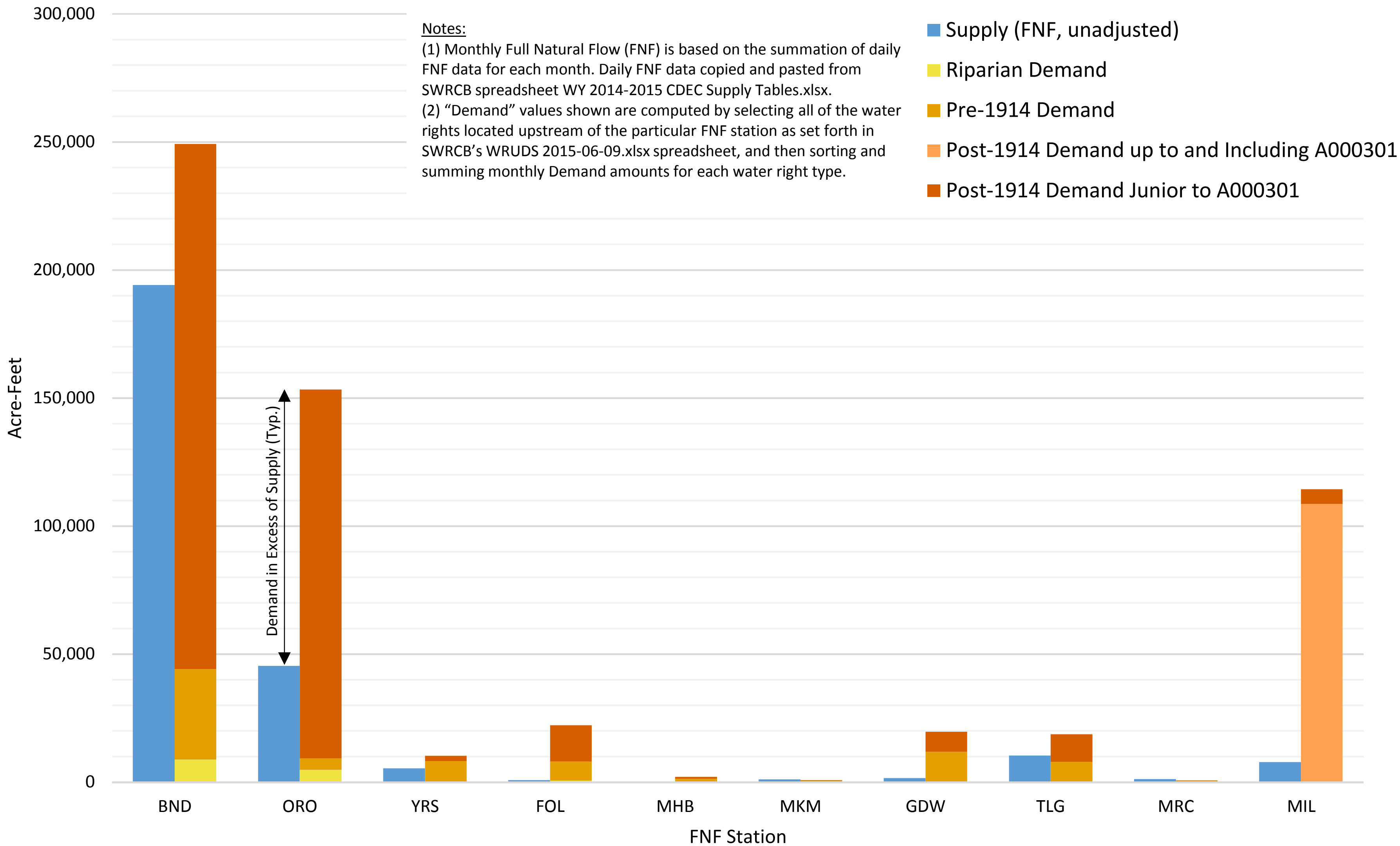
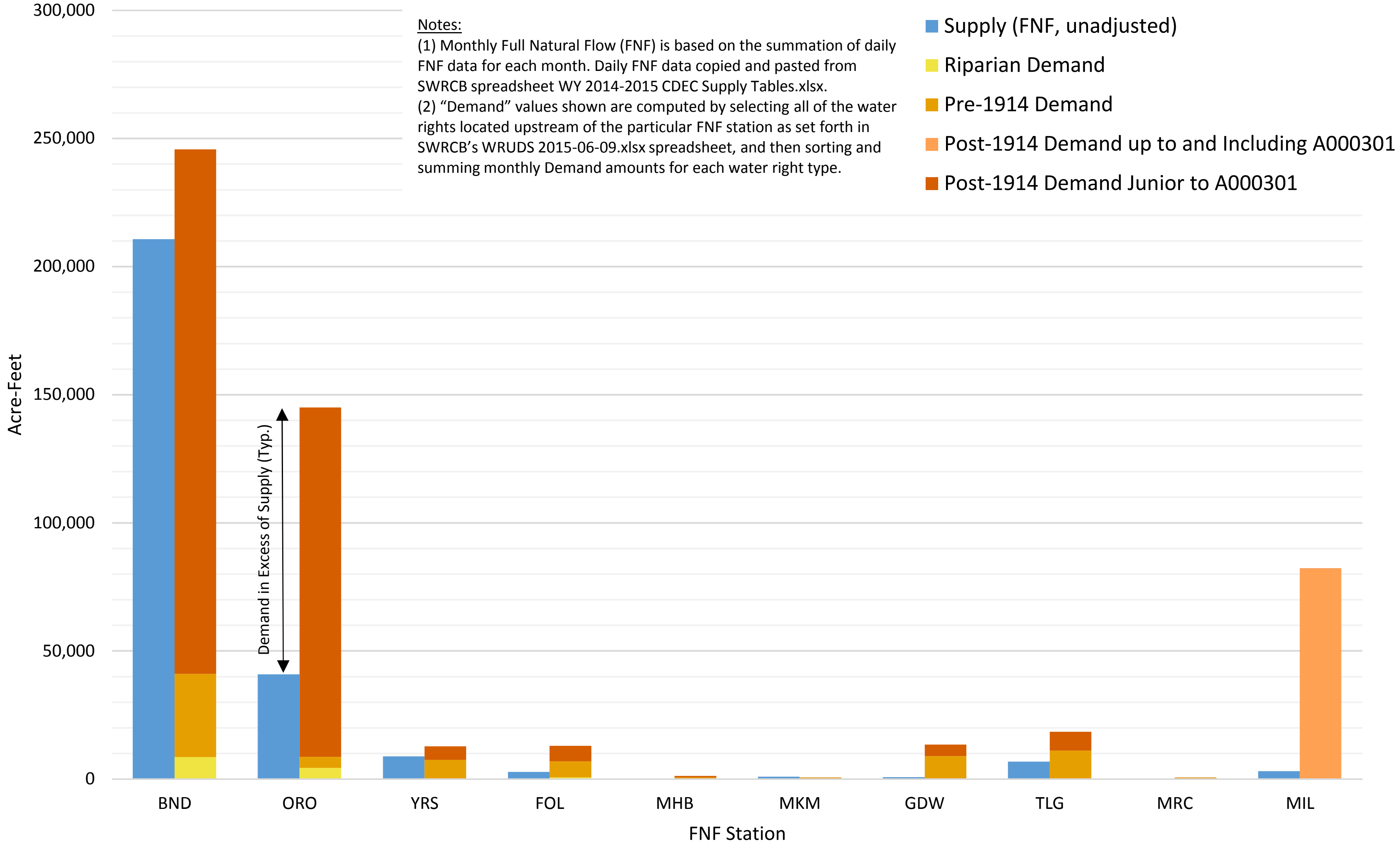
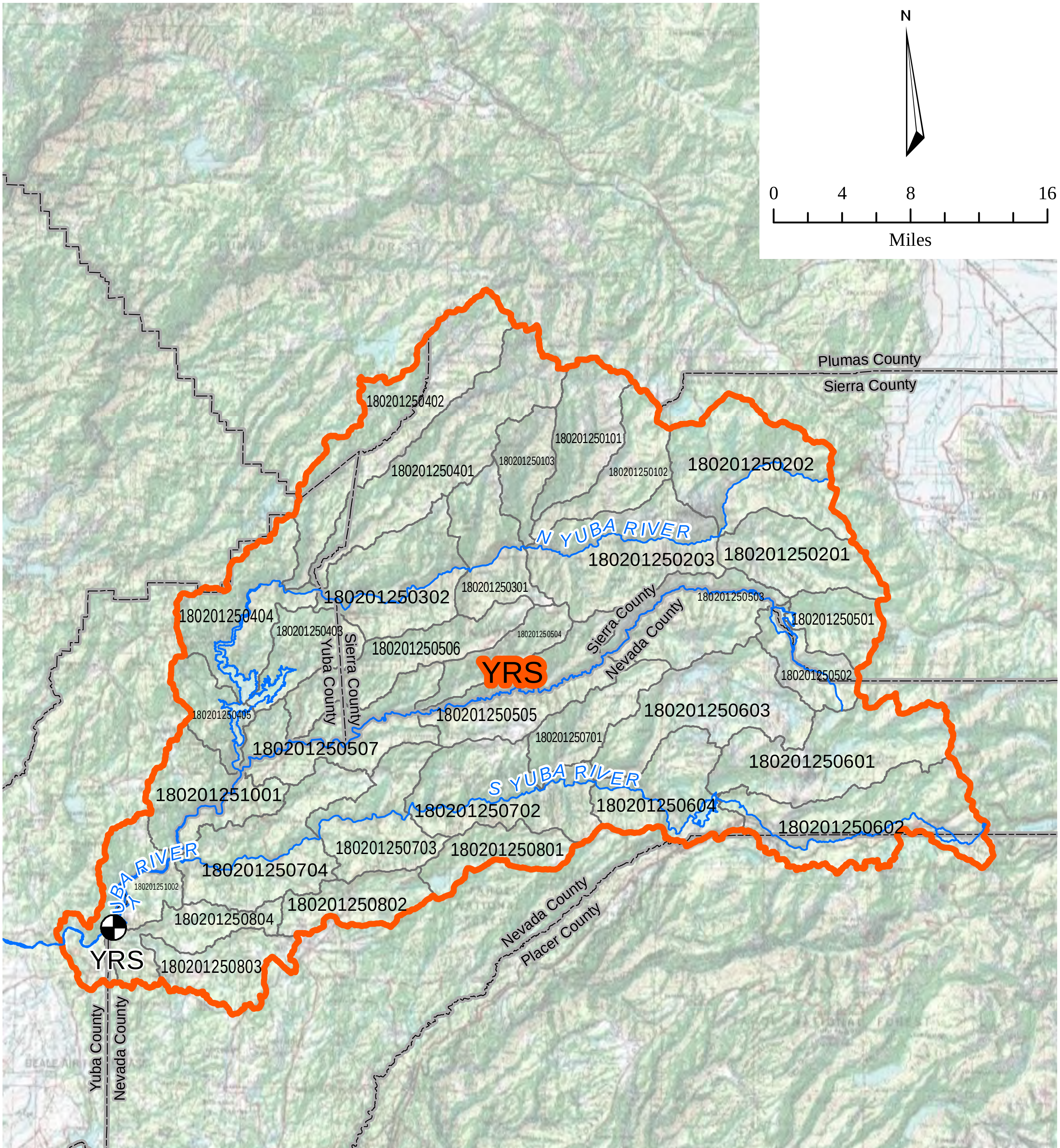


FIGURE 2H
Full Natural Flow vs. SWRCB Demand Upstream of FNF Stations
September 2015





CDEC FNF Station

Watershed of CDEC FNF Gage (based on HUC12 boundaries)

Hydrologic Unit (HUC12)

County Boundary

Source: Hydrologic Unit (HUC) boundaries from the Water Boundary Dataset, Natural Resources Conservation Service (NRCS), 2015.
CDEC FNF Gage Watersheds based on Hydrologic Unit (HUC) boundaries from the Water Boundary Dataset, Natural Resources Conservation Service (NRCS), 2015.
Base map per Copyright:© 2013 National Geographic Society, i-cubed.

FIGURE 2I

Map Showing Example of Hydrologic Unit (HUC12) Boundaries

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January 2016

Q:\Drawings\BYRON BETHANY IRRIGATION DISTRICT - 3737\Litigation\GIS\Example HUC.mxd

FNF Identifier per CDEC	Reckoning Location
BND	Sacramento River At Bend Bridge
ORO	Oroville Dam (Feather River)
YRS	Yuba River Near Smartville
FOL	Folsom Lake (American River)
MHB	Cosumnes River At Michigan Bar
MKM	Mokelumne-Mokelumne Hill (Mokelumne River)
GDW	Goodwin Dam (Stanislaus River)
TLG	Tuolumne River - La Grange Dam
MRC	Merced River Near Merced Falls
MIL	Friant Dam - Millerton (San Joaquin River)

UF Subbasin	UF Name
UF 1	Sacramento Valley Floor
UF 2	Putah Creek Near Winters
UF 3	Cache Creek above Rumsey
UF 4	Stony Creek at Black Butte
UF 5	Sacramento Valley West Minor Side Streams
UF 7	Sacramento Valley East Side Minor Streams
UF 10	Bear River near Wheatland
UF 12	San Joaquin Valley East Side Minor Streams
UF 15	Calaveras River at Jenny Lind
UF 17	San Joaquin Valley Floor
UF 20	Chowchilla Reservoir at Buchanan Reservoir
UF 21	Fresno River near Daulton
UF 24	San Joaquin Valley West Side Minor Streams

Source: Legal Delta Boundary represents the legal Delta established under the Delta Protection Act (Section 12220 of the Water Code) passed in 1959. Dataset per the Department of Water Resources (DWR), 2001.
CDEC FNF Gage Watersheds based on Hydrologic Unit (HUC) boundaries from the Water Boundary Dataset, Natural Resources Conservation Service (NRCS), 2015.
UF Subbasin Watersheds based on *Figure 1, California Central Valley Unimpaired Flow Areas*, California Central Valley Unimpaired Flow Data, Fourth Edition, California Department of Water Resources, May 2007, and are approximate.
Base map per Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community.

FIGURE 2J

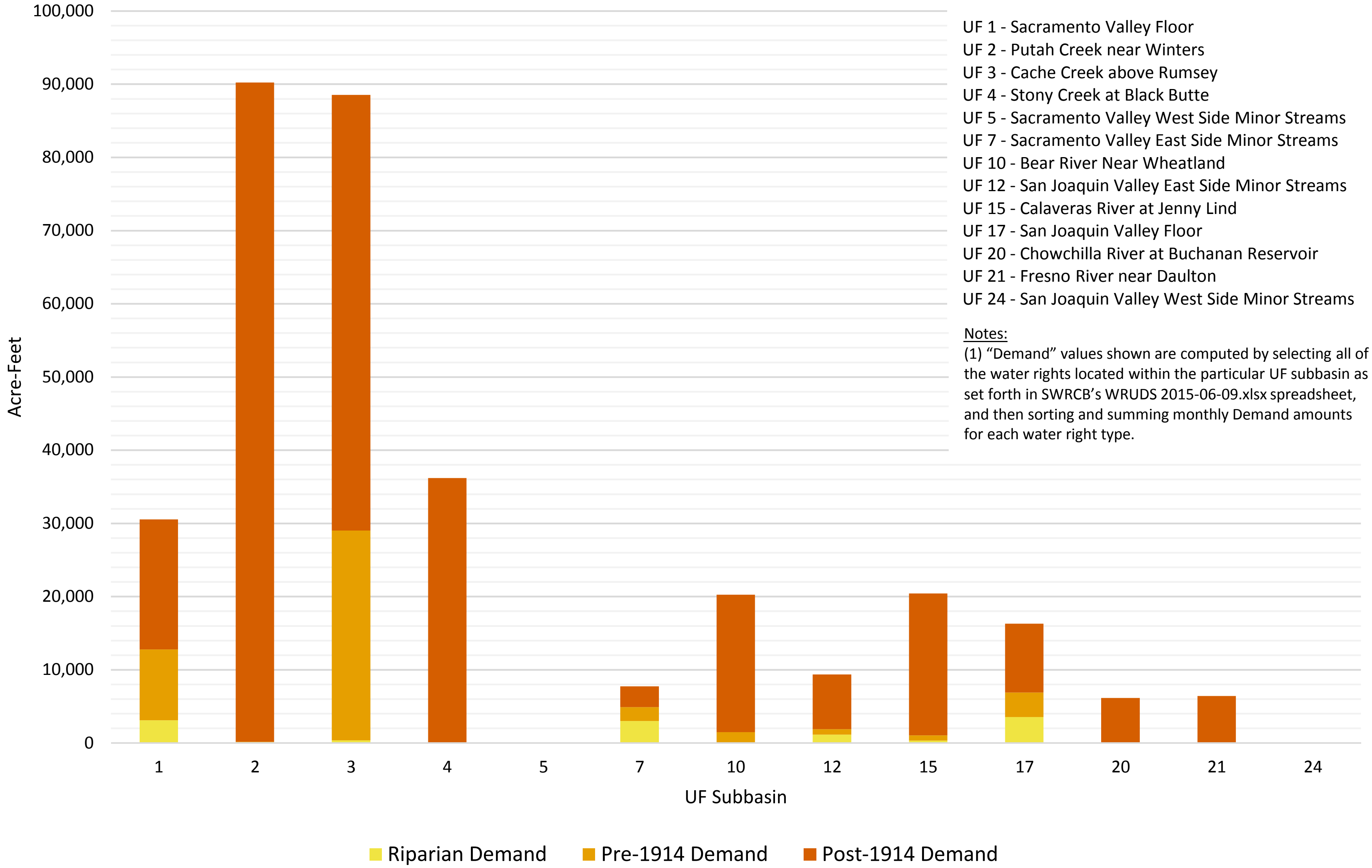
Map Showing Full Natural Flow (FNF) and Unimpaired Flow (UF) Watersheds within the Central Valley of California

Wagner & Bonsignore
Consulting Civil Engineers, A Corporation

Q:\Drawings\BYRON BETHANY IRRIGATION DISTRICT - 3737\Litigation\GIS\Overview map.mxd

January 2016

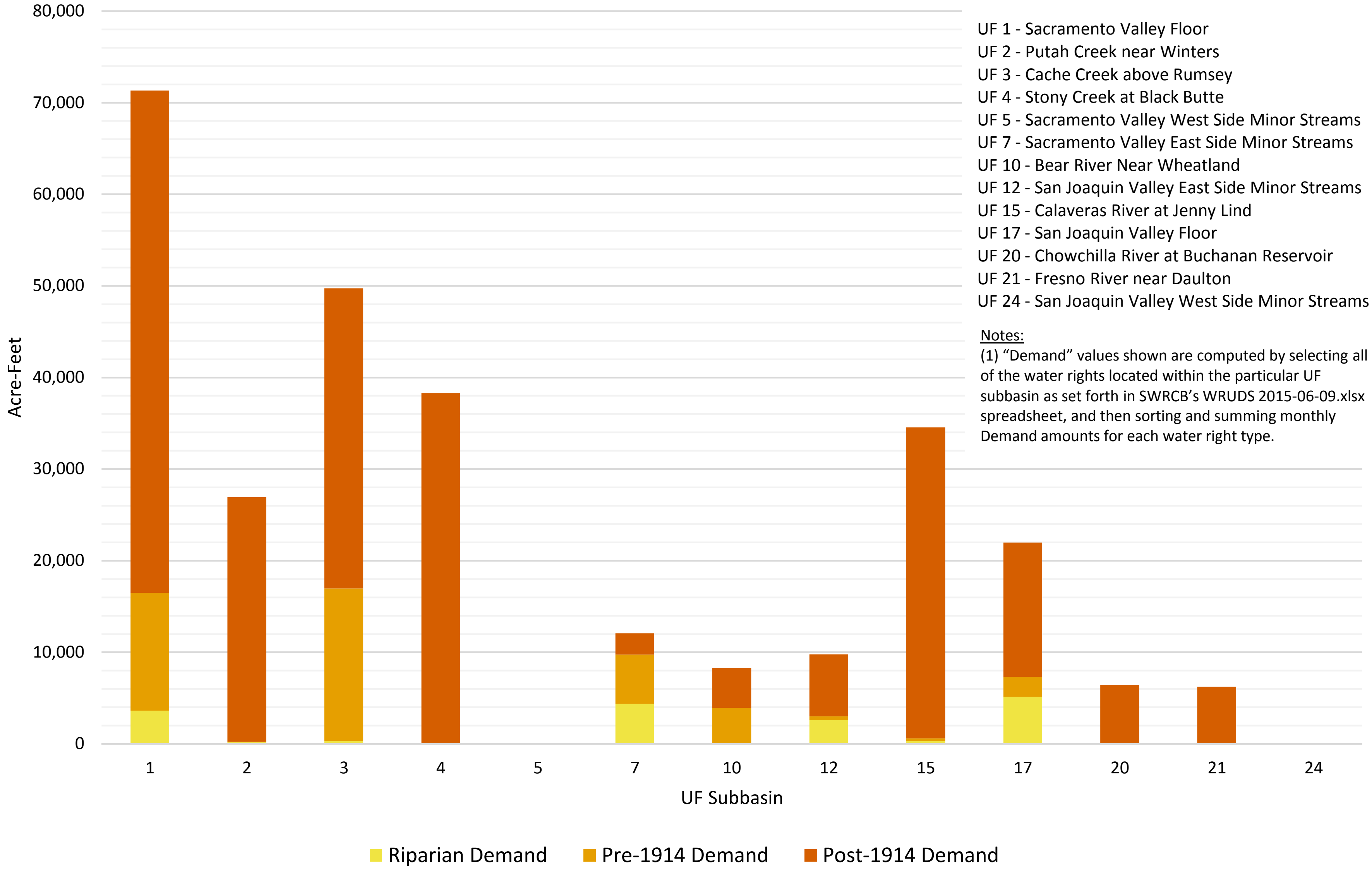
FIGURE 2K
SWRCB Demand Within UF Subbasins
March 2015



UF 1 - Sacramento Valley Floor
UF 2 - Putah Creek near Winters
UF 3 - Cache Creek above Rumsey
UF 4 - Stony Creek at Black Butte
UF 5 - Sacramento Valley West Side Minor Streams
UF 7 - Sacramento Valley East Side Minor Streams
UF 10 - Bear River Near Wheatland
UF 12 - San Joaquin Valley East Side Minor Streams
UF 15 - Calaveras River at Jenny Lind
UF 17 - San Joaquin Valley Floor
UF 20 - Chowchilla River at Buchanan Reservoir
UF 21 - Fresno River near Daulton
UF 24 - San Joaquin Valley West Side Minor Streams

Notes:
(1) "Demand" values shown are computed by selecting all of the water rights located within the particular UF subbasin as set forth in SWRCB's WRUDS 2015-06-09.xlsx spreadsheet, and then sorting and summing monthly Demand amounts for each water right type.

FIGURE 2L
SWRCB Demand Within UF Subbasins
April 2015



Notes:
(1) "Demand" values shown are computed by selecting all of the water rights located within the particular UF subbasin as set forth in SWRCB's WRUDS 2015-06-09.xlsx spreadsheet, and then sorting and summing monthly Demand amounts for each water right type.

FIGURE 2M
SWRCB Demand Within UF Subbasins
May 2015

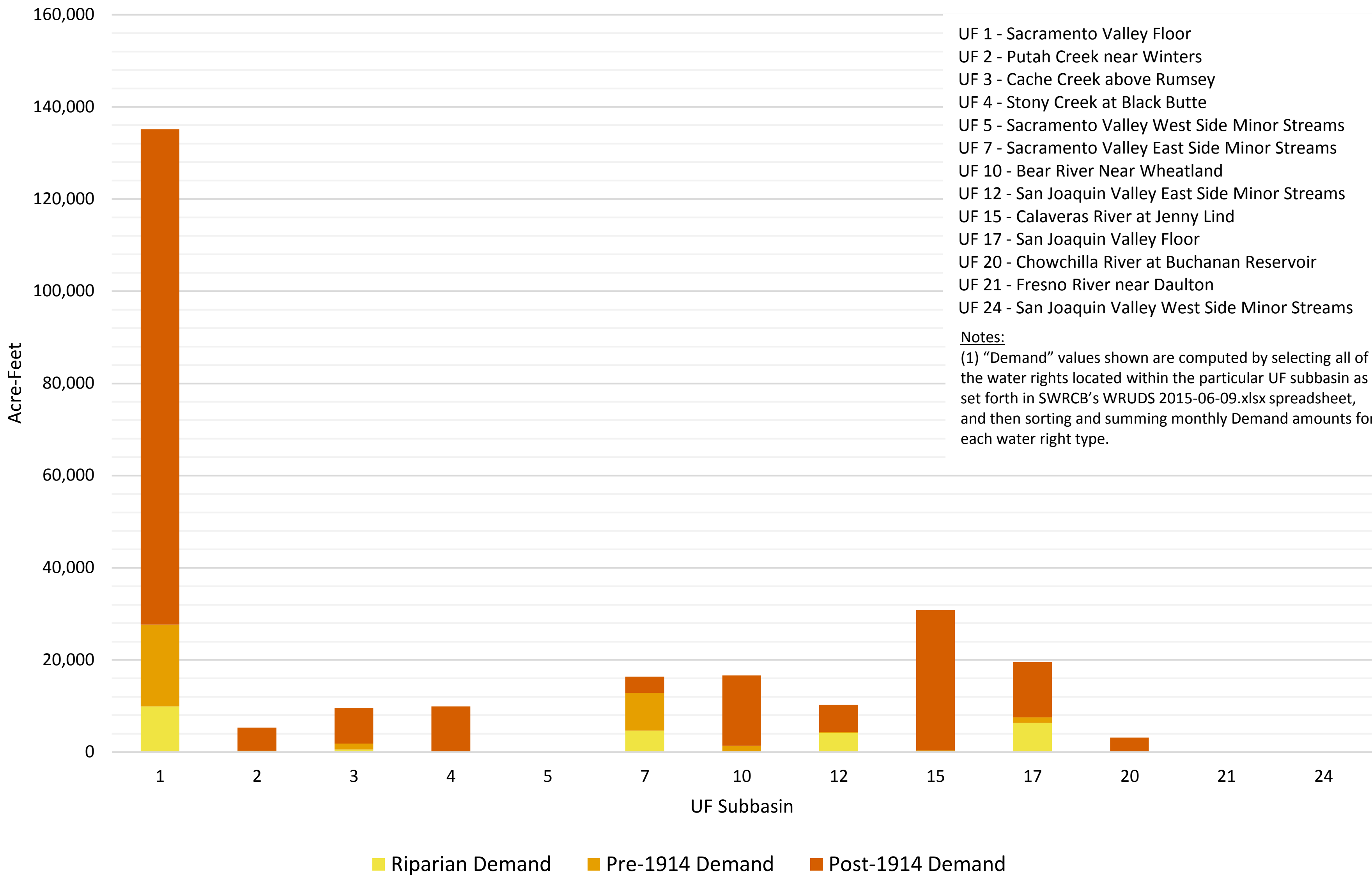
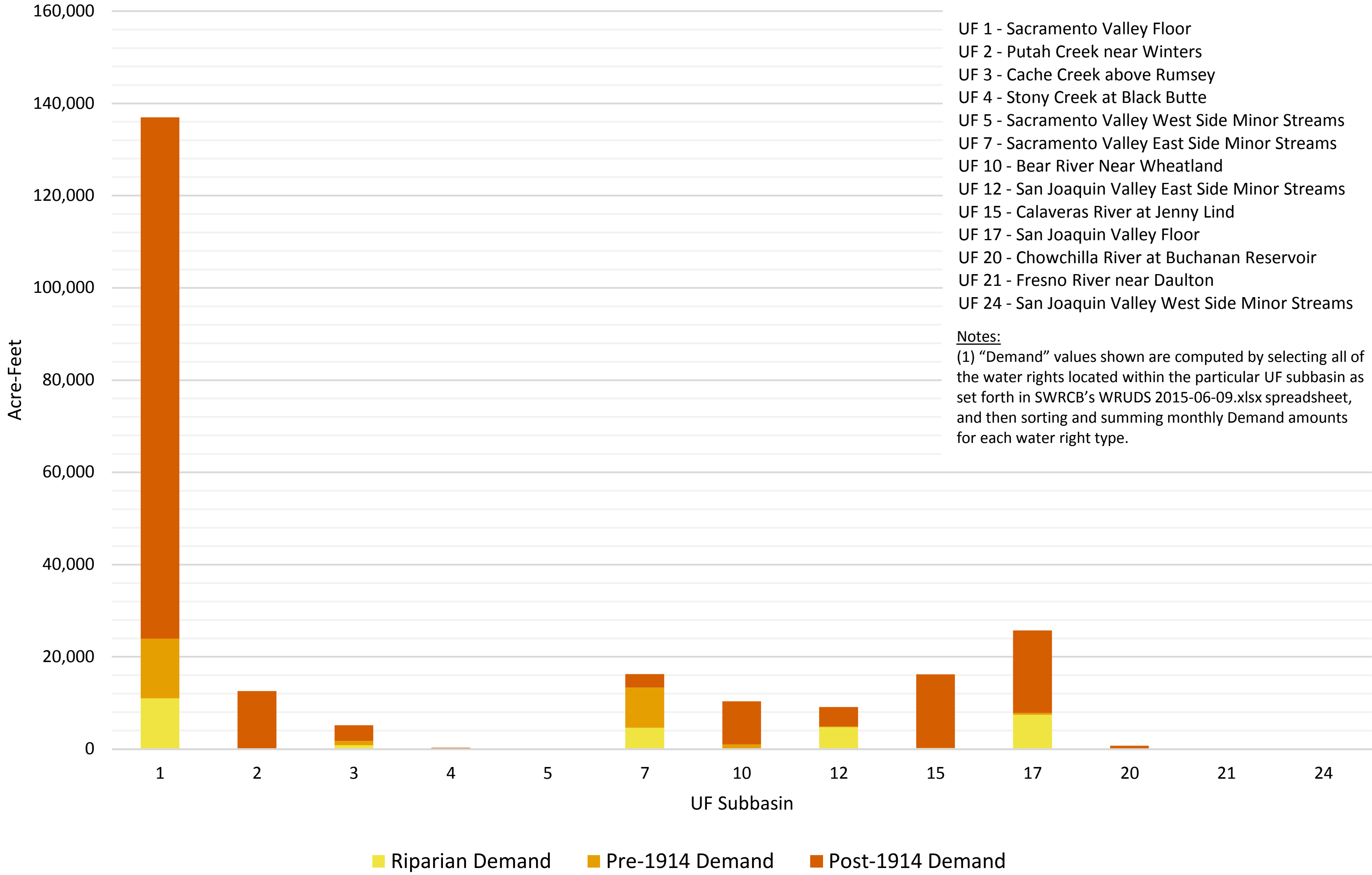


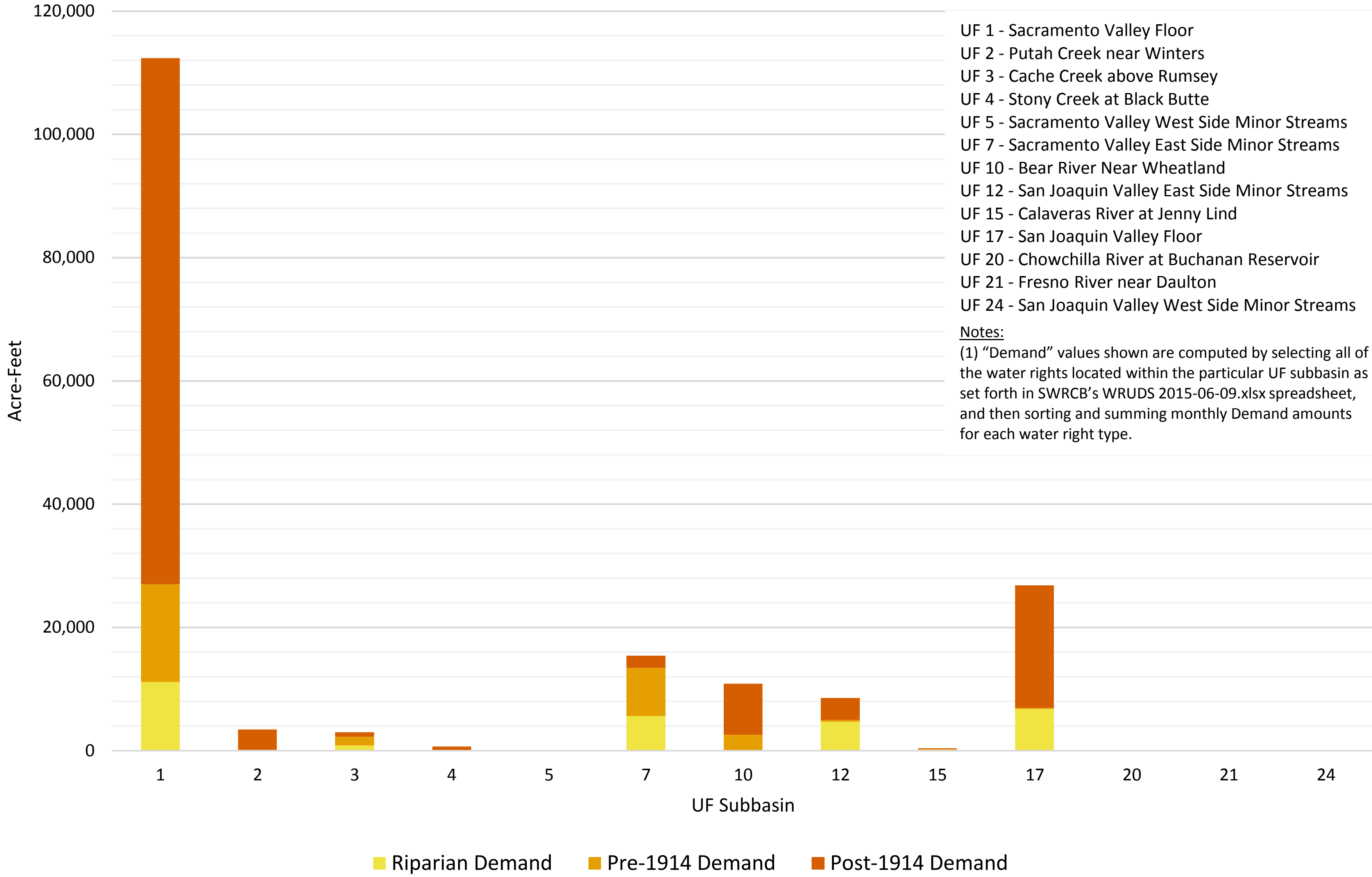
FIGURE 2N
SWRCB Demand Within UF Subbasins
June 2015



UF 1 - Sacramento Valley Floor
UF 2 - Putah Creek near Winters
UF 3 - Cache Creek above Rumsey
UF 4 - Stony Creek at Black Butte
UF 5 - Sacramento Valley West Side Minor Streams
UF 7 - Sacramento Valley East Side Minor Streams
UF 10 - Bear River Near Wheatland
UF 12 - San Joaquin Valley East Side Minor Streams
UF 15 - Calaveras River at Jenny Lind
UF 17 - San Joaquin Valley Floor
UF 20 - Chowchilla River at Buchanan Reservoir
UF 21 - Fresno River near Daulton
UF 24 - San Joaquin Valley West Side Minor Streams

Notes:
(1) "Demand" values shown are computed by selecting all of the water rights located within the particular UF subbasin as set forth in SWRCB's WRUDS 2015-06-09.xlsx spreadsheet, and then sorting and summing monthly Demand amounts for each water right type.

FIGURE 2O
SWRCB Demand Within UF Subbasins
July 2015



UF 1 - Sacramento Valley Floor
UF 2 - Putah Creek near Winters
UF 3 - Cache Creek above Rumsey
UF 4 - Stony Creek at Black Butte
UF 5 - Sacramento Valley West Side Minor Streams
UF 7 - Sacramento Valley East Side Minor Streams
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UF 17 - San Joaquin Valley Floor
UF 20 - Chowchilla River at Buchanan Reservoir
UF 21 - Fresno River near Daulton
UF 24 - San Joaquin Valley West Side Minor Streams

Notes:
(1) "Demand" values shown are computed by selecting all of the water rights located within the particular UF subbasin as set forth in SWRCB's WRUDS 2015-06-09.xlsx spreadsheet, and then sorting and summing monthly Demand amounts for each water right type.

FIGURE 2P
SWRCB Demand Within UF Subbasins
August 2015

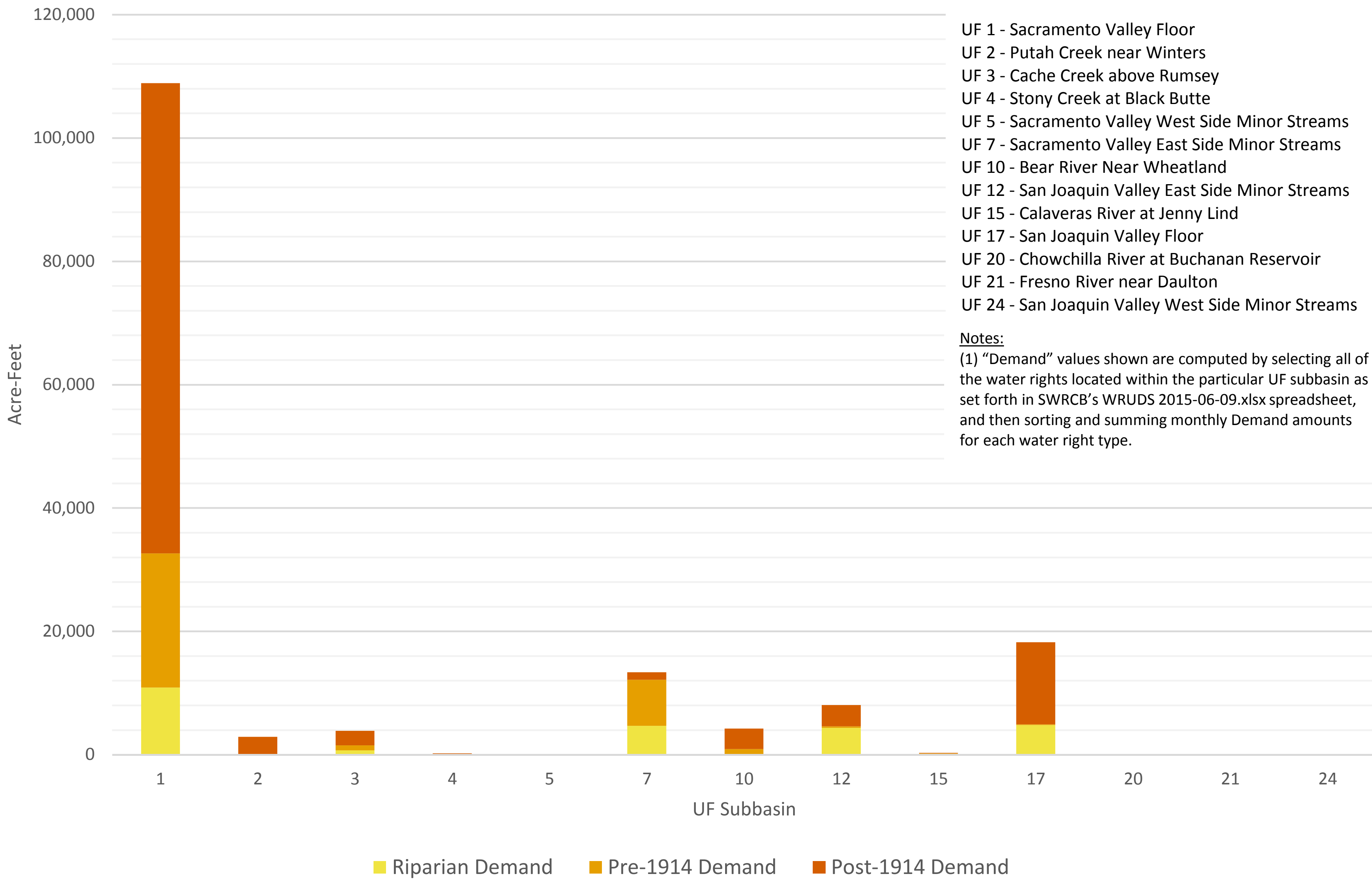
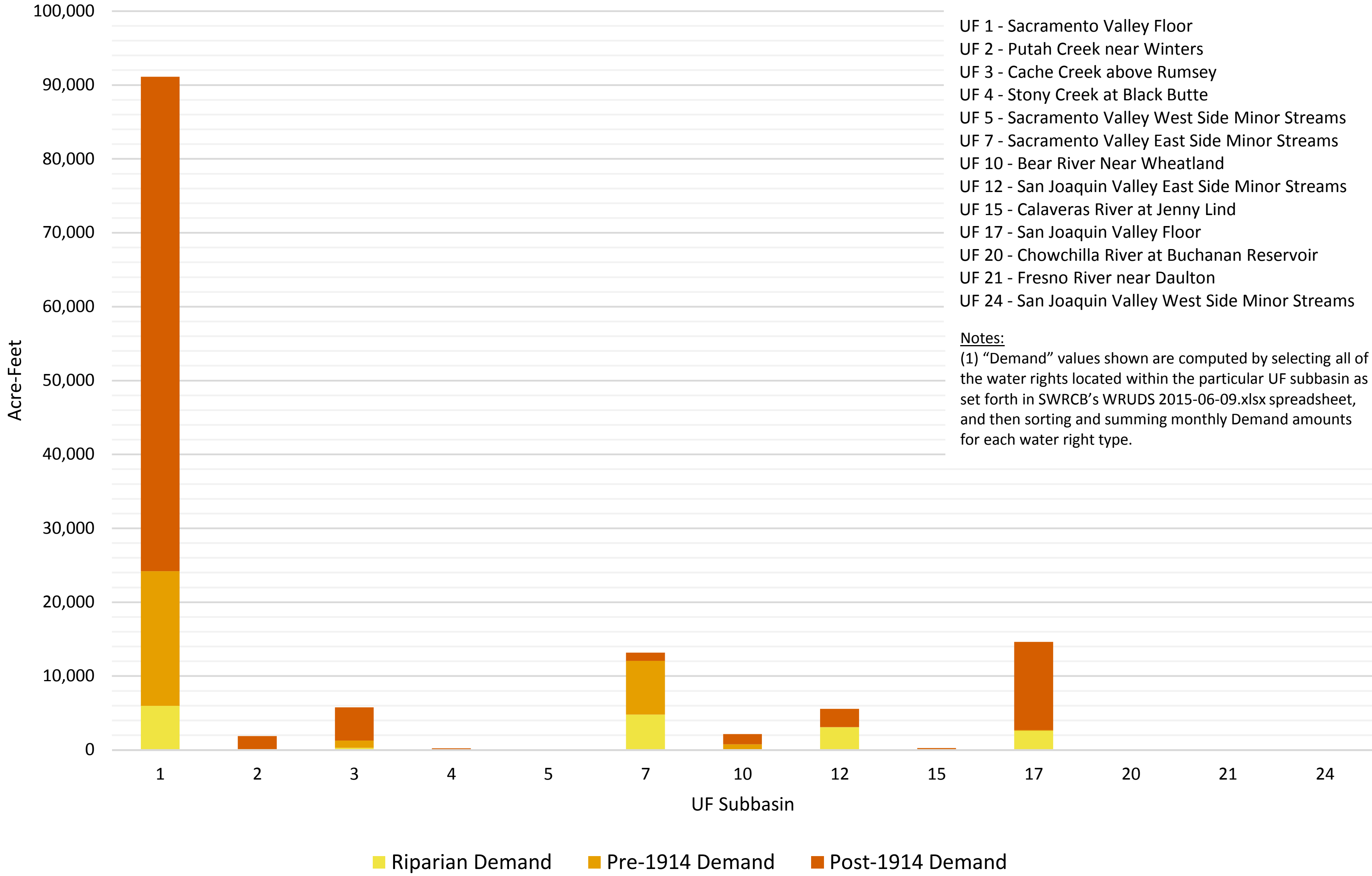


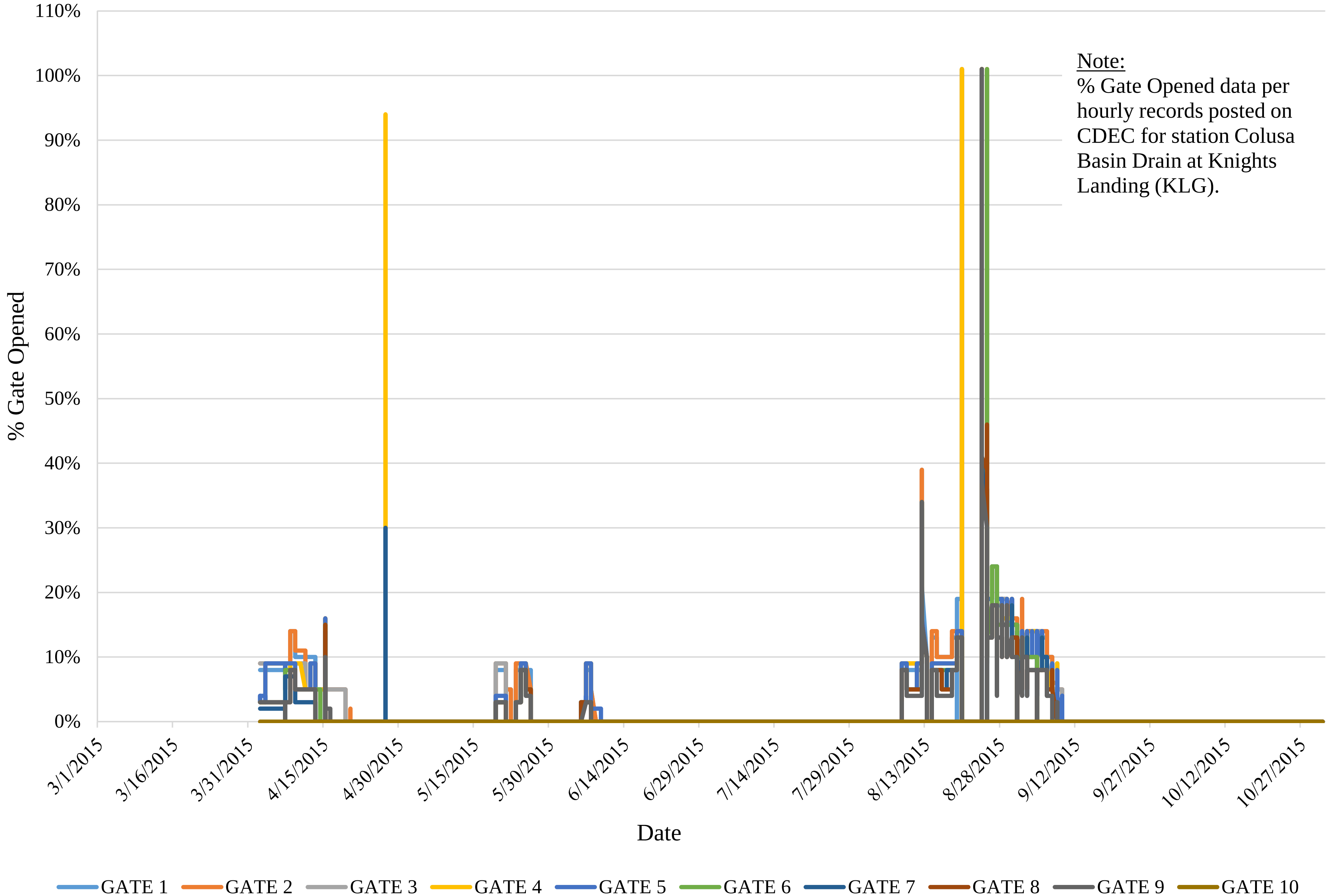
FIGURE 2Q
SWRCB Demand Within UF Subbasins
September 2015



UF 1 - Sacramento Valley Floor
UF 2 - Putah Creek near Winters
UF 3 - Cache Creek above Rumsey
UF 4 - Stony Creek at Black Butte
UF 5 - Sacramento Valley West Side Minor Streams
UF 7 - Sacramento Valley East Side Minor Streams
UF 10 - Bear River Near Wheatland
UF 12 - San Joaquin Valley East Side Minor Streams
UF 15 - Calaveras River at Jenny Lind
UF 17 - San Joaquin Valley Floor
UF 20 - Chowchilla River at Buchanan Reservoir
UF 21 - Fresno River near Daulton
UF 24 - San Joaquin Valley West Side Minor Streams

Notes:
(1) "Demand" values shown are computed by selecting all of the water rights located within the particular UF subbasin as set forth in SWRCB's WRUDS 2015-06-09.xlsx spreadsheet, and then sorting and summing monthly Demand amounts for each water right type.

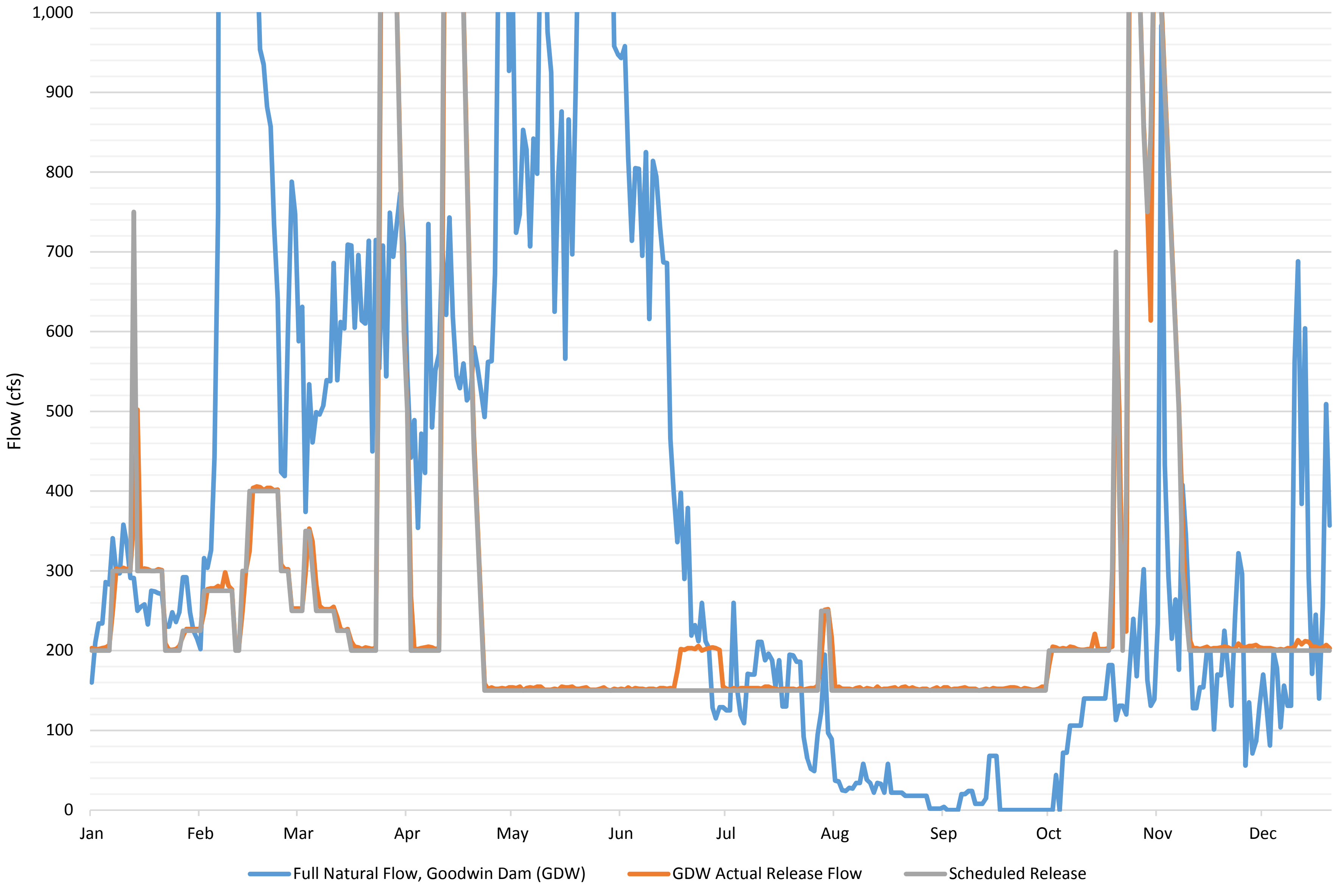
FIGURE 3A
Colusa Basin Drain Control Structure
Percent Gate Opened, April 2 to October 31, 2015



Note:
% Gate Opened data per hourly records posted on CDEC for station Colusa Basin Drain at Knights Landing (KLG).

G:\BYRON BETHANY IRRIGATION DISTRICT - 3737\Water Rights\SWRCB ACL\Return Flows\Sacramento River\CBD data\3737-097P-Colusa Basin dam gate and flow data.xlsx, KLG CHART

FIGURE 5A
Stanislaus River - 2015 Flows



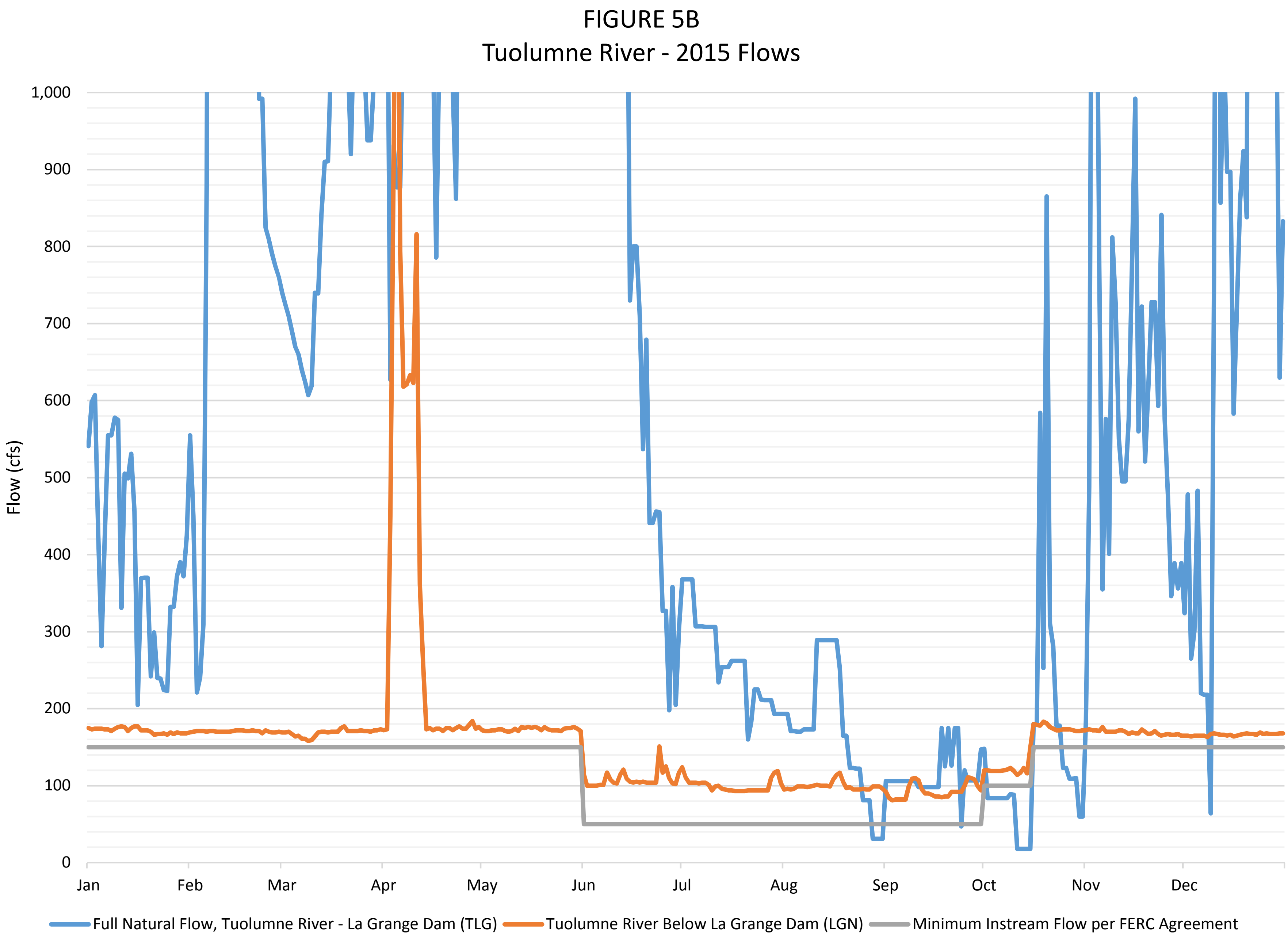
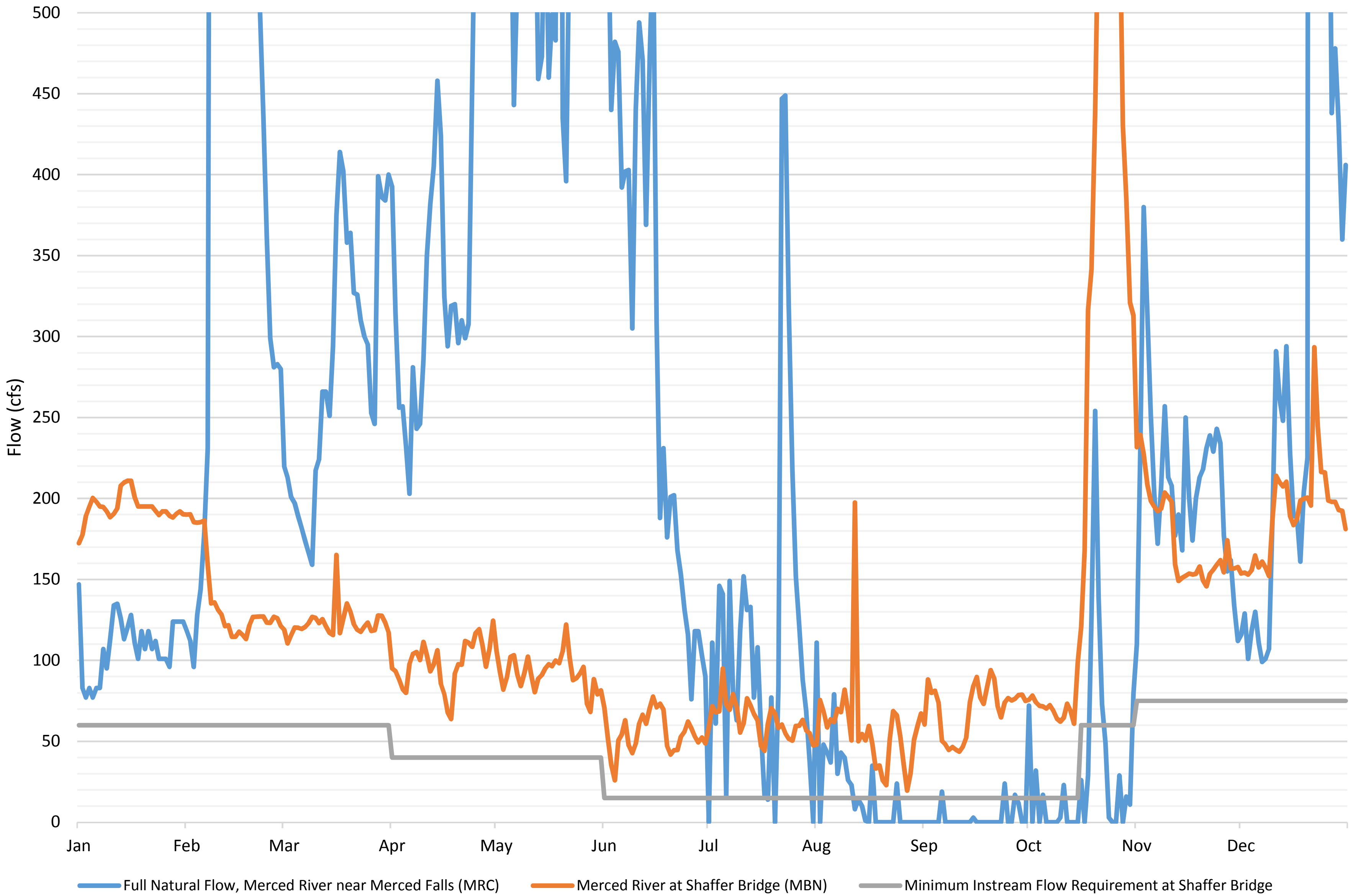


FIGURE 5B
Tuolumne River - 2015 Flows
Flow (cfs)
1,000
900
800
700
600
500
400
300
200
100
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Full Natural Flow, Tuolumne River - La Grange Dam (TLG)
Tuolumne River Below La Grange Dam (LGN)
Minimum Instream Flow per FERC Agreement

FIGURE 5C

Merced River - 2015 Flows



G:\BYRON BETHANY IRRIGATION DISTRICT - 3737\Water Rights\SWRCB ACL\Environmental Flows\Merced River\3737-002G-Merced Environmental Flows Analysis.xlsx, Chart

ATTACHMENTS

ATTACHMENT #1

	A	EW	EX	EY	EZ	FA	FB	FC	FD	FE	FF	FG	FH	FI	FJ
1	APP_ID	DEMAND_JAN	DEMAND_FEB	DEMAND_MAR	DEMAND_APR	DEMAND_MAY	DEMAND_JUN	DEMAND_JUL	DEMAND_AUG	DEMAND_SEP	DEMAND_OCT	DEMAND_NOV	DEMAND_DEC	DEMAND_TOTAL	DEMAND_APR-SEP
2	A000018	-	-	-	818	6,760	5,983	4,538	4,313	2,516	3,000	-	-	27,928	24,928
3	A000023	-	-	-	17,426	21,616	5,298	-	-	-	-	-	-	44,340	44,340
4	A000026	-	-	-	-	-	-	-	-	-	-	-	-	0	0
5	A000027	-	-	-	1,793	9,990	9,905	11,492	8,737	2,231	5,914	-	-	50,061	44,148
6	A000065	-	-	-	-	0	-	-	0	0	0	0	0	0	0
7	A000077A	-	-	278	1,592	2,193	-	-	-	-	-	-	-	4,062	3,784
8	A000135	125	50	375	-	-	-	-	-	-	-	-	-	550	0
9	A000138	394	364	435	519	757	826	903	893	837	754	490	421	7,592	4,733
10	A000186	-	-	-	459	468	459	468	468	459	468	9	-	3,258	2,781
11	A000230A	-	16	15	52	40	40	40	40	40	-	-	-	284	252
12	A000230B	-	-	-	155	419	419	419	156	-	-	-	-	1,568	1,568
13	A000234	28,056	57,948	73,142	46,106	139,578	257,784	144,902	108,425	81,951	36,949	20,648	24,785	1,020,276	778,746
14	A000244	-	-	-	3,621	12,493	11,050	8,041	4,466	1,721	3,720	-	-	45,111	41,391
15	A000245	-	-	-	11	20	30	30	30	30	30	-	-	181	151
16	A000301	-	-	1,075	1,726	3,349	3,277	4,429	3,904	2,753	661	-	-	21,173	19,437
17	A000322	42	42	94	119	127	10	15	13	11	8	2	0	482	295
18	A000334	-	-	-	-	-	-	-	-	-	-	-	-	0	0
19	A000338	113	113	75	38	-	-	-	-	-	-	-	25	363	38
20	A000405	0	0	0	3	18	33	33	33	32	30	0	0	183	152
21	A000420	-	-	-	-	93	93	93	93	93	93	-	-	558	465
22	A000421	225	225	225	-	-	-	-	-	-	-	-	75	750	0
23	A000462	-	-	-	3,270	9,061	9,105	9,132	3,789	1,730	-	-	-	36,086	36,086
24	A000476	921	62	707	59	104	94	-	-	44	61	325	1,362	3,737	300
25	A000480	-	-	224	275	1,108	1,909	1,845	1,611	1,368	572	52	93	9,056	8,115
26	A000481	1	1	1	1	1	1	1	1	1	1	1	1	12	6
27	A000486	38	33	58	-	-	-	-	-	-	-	-	-	128	0
28	A000533														
29	A000534	-	-	-	934	2,594	2,510	2,594	2,594	2,435	-	-	-	13,661	13,661
30	A000548	-	-	-	-	0	0	0	0	0	0	-	-	1	0
31	A000575	-	-	-	309	1,968	1,902	1,854	1,818	603	-	-	-	8,453	8,453
32	A000576	-	-	639	4,214	11,068	10,711	11,068	10,778	3,734	1,133	-	-	53,344	51,572
33	A000577	-	-	-	-	637	690	842	498	-	-	-	-	2,666	2,666
34	A000581	-	-	-	1,558	2,362	2,376	2,611	2,275	1,465	100	-	-	12,747	12,647
35	A000596	-	-	-	-	-	184	-	-	-	-	-	-	184	184
36	A000640	-	-	-	878	4,377	4,671	5,381	6,060	3,465	-	-	-	24,832	24,832
37	A000654	-	-	-	163	1,232	-	-	-	-	-	-	-	1,395	1,395
38	A000657	-	-	-	-	-	32	35	36	-	-	-	-	103	103
39	A000685														
40	A000732	-	-	564	564	564	564	564	564	564	564	-	141	4,655	3,385
41	A000735	-	-	-	0	139	121	121	118	33	-	-	-	531	531
42	A000742	-	-	-	278	1,290	1,339	1,019	530	419	-	-	-	4,875	4,875
43	A000760	135	123	213	196	3	-	-	-	-	-	16	78	763	199
44	A000763	-	-	479	2,147	12,210	12,651	13,922	7,823	806	609	-	-	50,648	49,560
45	A000770	-	-	-	111	495	481	4,544	5,652	76	115	-	-	11,474	11,360
46	A000771	-	500	500	1,000	1,000	1,210	1,000	1,000	1,000	900	900	-	9,010	6,210
47	A000772	0	0	0	0	0	0	0	0	0	0	0	0	1	0
48	A000784	-	-	-	523	529	522	529	529	524	529	-	-	3,687	3,157
49	A000829	-	-	-	-	-	-	-	-	-	-	-	-	0	0
50	A000862	-	-	-	20	30	30	30	28	23	11	8	-	179	160
51	A000878	-	-	-	1,610	6,127	6,163	6,771	5,901	3,087	259	-	-	29,918	29,659
52	A000879	-	-	-	123	1,326	1,333	1,465	1,277	71	56	-	-	5,650	5,594
53	A000880A	-	-	-	1,973	21,251	21,376	23,484	20,465	1,138	898	-	-	90,586	89,687
54	A000880B	-	-	-	49	93	90	42	22	44	-	-	-	340	340
55	A000880C	-	-	-	50	148	103	16	8	20	-	-	-	345	345
56	A000882A	-	-	-	-	44	39	34	23	-	-	-	-	139	139
57	A000882B	-	-	-	-	36	36	36	36	20	-	-	-	165	165
58	A000892	-	-	-	1,287	4,734	6,519	9,285	8,359	3,958	-	-	-	34,142	34,142
59	A000930														
60	A000959	-	-	-	127	751	778	814	814	599	-	-	-	3,882	3,882
61	A000992	9	14	35	62	68	59	48	48	24	-	14	2	383	309
62	A000993	28	12	18	37	30	10	-	-	-	-	3	2	139	76
63	A000994	36	13	7	10	12	5	-	-	-	-	1	0	85	27
64	A001024	-	-	-	-	-	-	-	-	-	-	-	-	0	0
65	A001029	-	-	-	-	1	1	1	1	1	1	-	-	7	6
66	A001036	-	-	-	-	11	11	11	11	11	-	-	-	53	53
67	A001041	78	78	247	242	415	631	784	844	695	363	78	78	4,535	3,612
68	A001042	277	43	234	455	16	109	-	-	-	-	-	-	1,133	579
69	A001056	-	-	328	460	2,337	2,261	2,337	2,337	1,135	535	-	-	11,730	10,867
70	A001060	-	-	-	13	15	15	15	15	15	13	-	-	98	85

Excerpt from SWRCB's 20150610_sacsjcombined.xlsx, WRUDS 2015-06-09 tab.

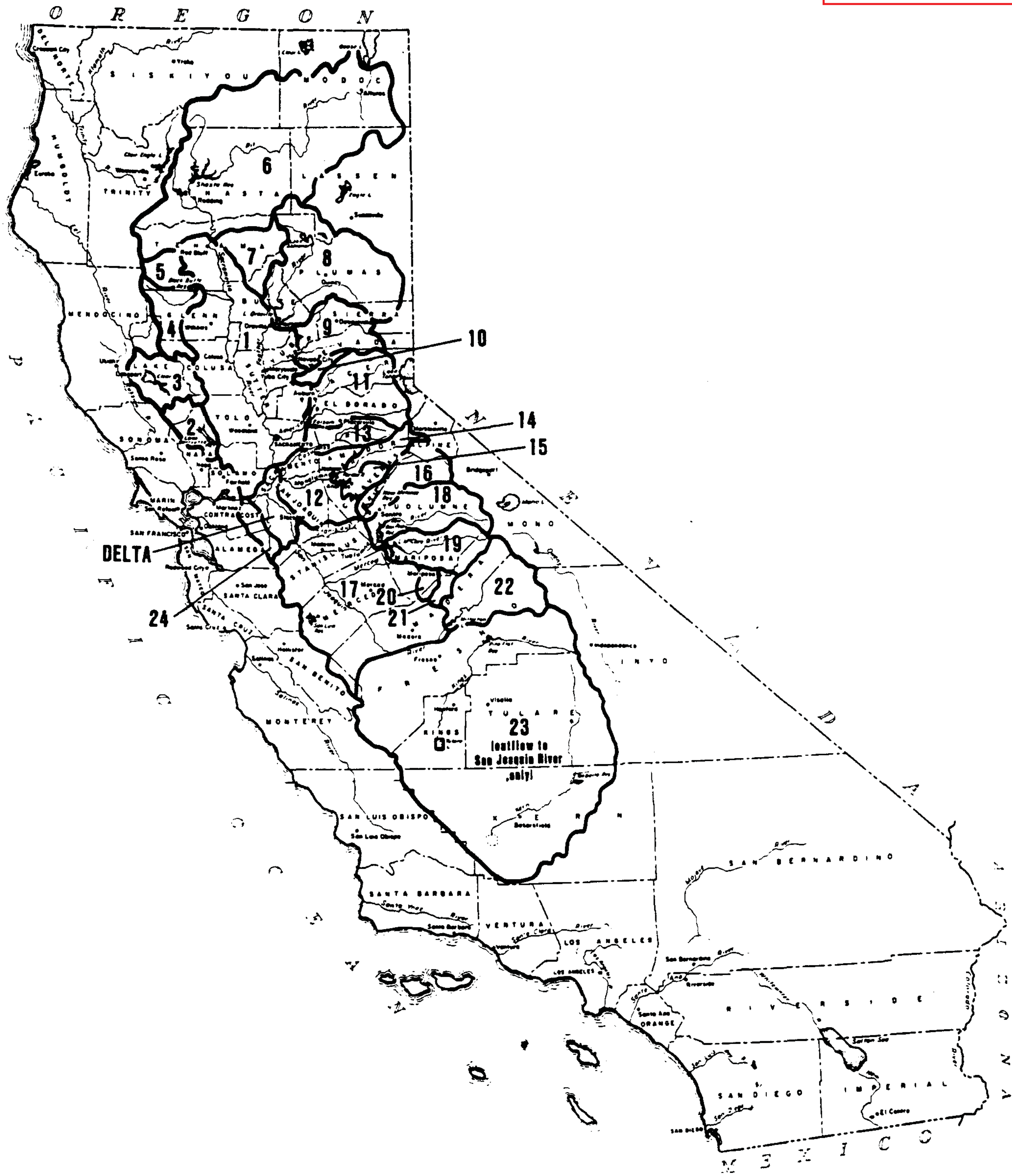
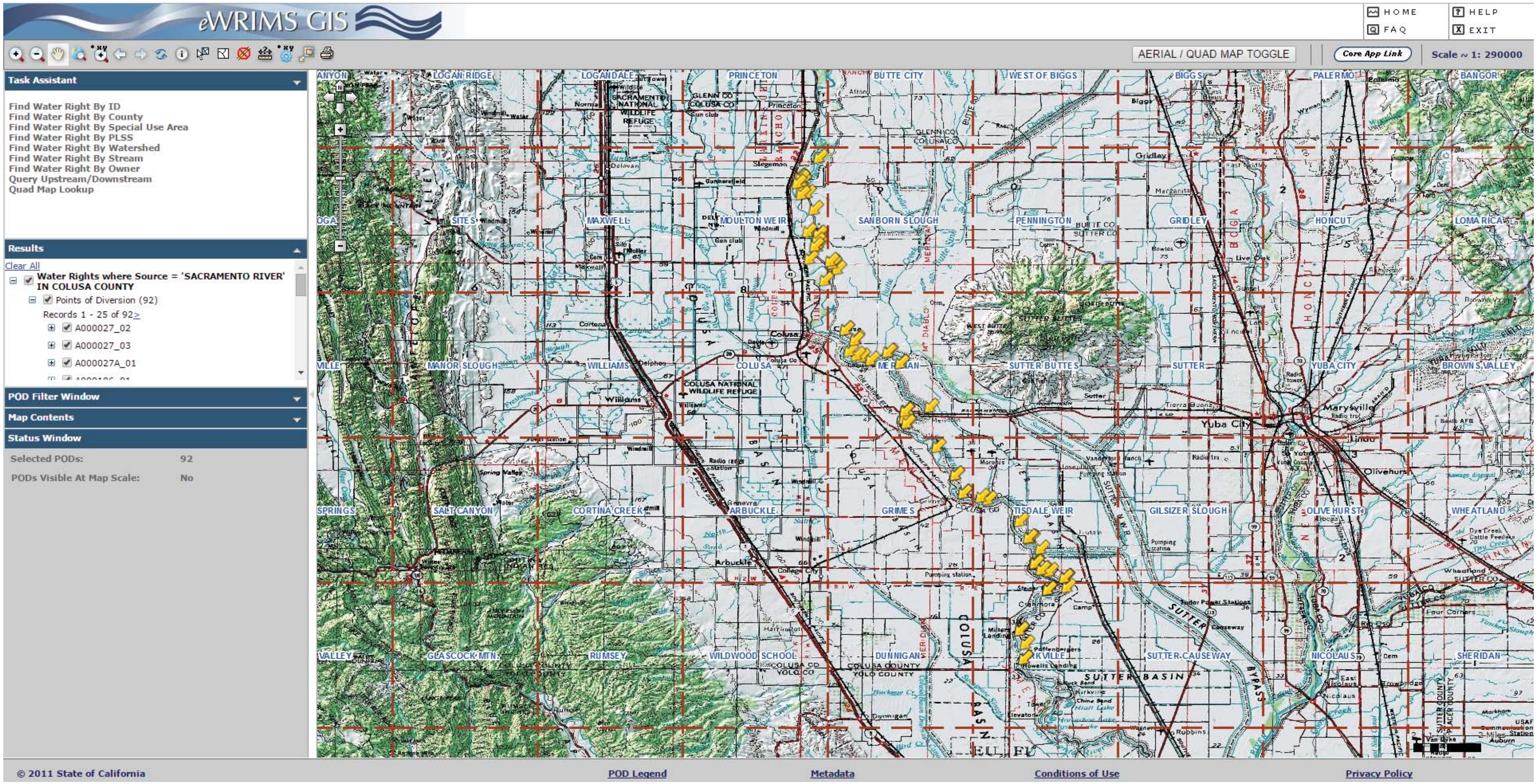


Figure 1. California Central Valley Unimpaired Flow Areas

From California Central Valley Unimpaired Flow Data, Fourth Edition Draft, by Bay-Delta Office, California Department of Water Resources, May 2007.

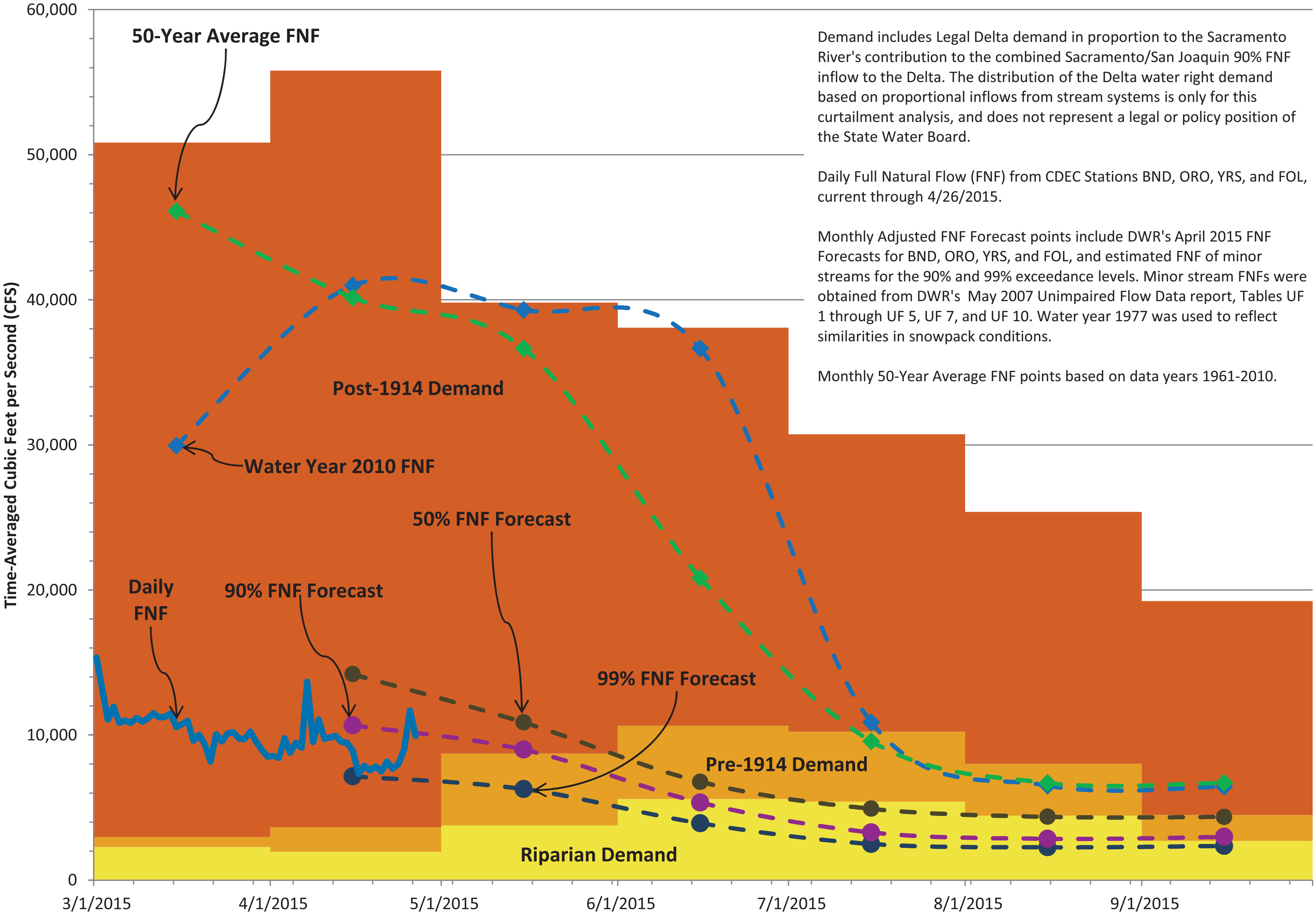
ATTACHMENT #3



Screen shot of SWRCB's on-line GIS map showing selection of all water rights on Sacramento River within Colusa County.

2015 Sacramento River Basin Supply/Demand

ATTACHMENT #4



Demand includes Legal Delta demand in proportion to the Sacramento River's contribution to the combined Sacramento/San Joaquin 90% FNF inflow to the Delta. The distribution of the Delta water right demand based on proportional inflows from stream systems is only for this curtailment analysis, and does not represent a legal or policy position of the State Water Board.

Daily Full Natural Flow (FNF) from CDEC Stations BND, ORO, YRS, and FOL, current through 4/26/2015.

Monthly Adjusted FNF Forecast points include DWR's April 2015 FNF Forecasts for BND, ORO, YRS, and FOL, and estimated FNF of minor streams for the 90% and 99% exceedance levels. Minor stream FNFs were obtained from DWR's May 2007 Unimpaired Flow Data report, Tables UF 1 through UF 5, UF 7, and UF 10. Water year 1977 was used to reflect similarities in snowpack conditions.

Monthly 50-Year Average FNF points based on data years 1961-2010.

4/29/2015

TABLE 26

SAN JOAQUIN River BASIN : ESTIMATION OF RETURN FLOW
(ACRE-FEET)

ATTACHMENT #5, 1/5

NO	GAGE STATION/STREAM	June	July	August	Sept.	NOTES
	A - STEVENSON (MERCED RIVER)					
1.	Estimated Flow	6050	2940	3370	1630	Table 25
2.	Natural Supply	15440	5000	1500	1500	Table 6
3.	Riparian Demand (Total)	4390	4390	3470	1630	Table 6
4.	Percent of Riparian Demand Met	60	40	40		Table 17
5.	Riparian Water Use	2630	1760	1390		3 x 4
6.	Supply for downstream Riparians	12810	3240	110		2 - 5
7.	Return Flow	0	0	3260		1 - 6
	B - TUOLUMNE CITY (TUOLUMNE RIVER)					
1.	Estimated Flow	8300	14160	2380	5940	Table 25
2.	Natural Supply	25440	5000	2500	2500	Table 7
3.	Riparian Demand	4400	2730	3290	1510	Table 7
4.	Percent of Riparian Demand Met	60	40	50		Table 17
5.	Riparian Water Use	2640	1090	1650		3 x 4
6.	Supply for downstream Riparians	22800	3910	850		2 - 5
7.	Return Flow	0	10250	1530		1 - 6

Tables 26 and 27 from SWRCB's Appendix To Drought '77 Dry Year Program Report, March 1978.

ATTACHMENT #5, 2/5

NO.	CAGE STATION/STREAM	June	July	August	Sept.	NOTES
	C - KOETIZ RANCH (STANISLAUS RIVER)					
1.	Estimated Flow	11,100	5,440	2,550	1,570	Table 25
2.	Natural Supply	30,440	5,000	2,500	2,500	Table 8
3.	Riparian Demand (Total)	4,400	2,730	3,290	1,510	Table 8
4.	Percent of Riparian Water Demand Met	60	40	50		Table 17
5.	Riparian Water Use	2,640	1,090	1,650		3 x 4
6.	Supply for downstream Riparians	27,800	3,910	850		2 - 5
7.	Return Flow	0	1,530	1,700		1 - 6
	D - VERNALIS (SAN JOAQUIN RIVER)					
1.	Estimated Flow	47,880	33,013	18,990	16,000	Table 25
2.	Inflow From San Joaquin River (Upper Basin)		2,975	2,113		Table
3.	Residual flow from San Joaquin River (Middle Basin)		30,038	16,877		1 - 2
4.	Natural Supply	71,320	15,000	6,500		$A_2+B_2+C_2$
5.	Riparian Demand on San Joaquin River	15,770	16,300	12,450		Table 9
6.	Percent of Riparian Demand Met	60	40	45		Table 17
7.	Riparian Water Use on San Joaquin River	9,460	6,520	5,600		5 x 6
8.	Total riparian demand in the San Joaquin River (Middle Basin)	17,340	10,460	10,290		$A_5+B_5+C_5+D_7$

ATTACHMENT #5, 3/5

NO.	GAGE STATION/STREAM	June	July	August	Sept.	NOTES
9.	Supply for downstream Riparians	53,950	4,540	0		
10.	Total return flow in the San Joaquin River (Middle Basin)			25,498	16,877	3 - 9
11.	Return flow from Rivers of Merced, Tuolumne & Stanislaus			11,780	6,990	$A_7+B_7+C_7$
12.	Return flow from San Joaquin River (Middle Reach)		13,718	10,387		9 - 11
	E - NEAR STOCKTON (CALAVERAS RIVER)					
1.	Estimated Flow	650	810	0	0	Table 25
2.	Natural Supply	0	0	0	0	Table 10
3.	Riparian Demand	306	264	130	61	Table 10
4.	Percent of Riparian Demand Met	0	0	0	0	Table 17
5.	Riparian Water Use	0	0	0	0	3 x 4
6.	Supply for Downstream Riparians	0	0	0	0	2 - 5
7.	Return Flow	650	810	0	0	1 - 6
	F - WOODBRIDGE (MOKELUMNE RIVER)					
1.	Estimated Flow	730	790	0	0	Table 25
2.	Natural Supply	6,532	1,000	0	0	Table 11
3.	Riparian Demand	5,310	5,490	4,340	1,960	Table 11
4.	Percent of Riparian Demand Met	60	20	0	0	Table 17
5.	Riparian Water Use	3,190	1,100	0	0	3 x 4

NO.	GAGE STATION/STREAM	June	July	August	Sept.	NOTES
6.	Supply ment for downstream riparians	3,342	0	0	0	2 - 5
7.	Return Flow	0	0	0	0	1 - 6
	G - McCONNEL (COSUMNES RIVER)					
1.	Flow	0	0	0	0	Table 25
2.	Natural Supply	0	0	0	0	Table 12
3.	Riparian Demand	4,800	4,800	3,780	1,340	Table 12
4.	Percent of Riparian Demand Met	0	0	0	0	Table 17
5.	Riparian Water Use	0	0	0	0	3 x 4
6.	Supply for Downstream Riparians	0	0	0	0	2 - 5
7.	Return Flow	0	0	0	0	1 - 6

ATTACHMENT #5, 4/5

TABLE 27

SACRAMENTO-SAN JOAQUIN RIVER BASINS: ESTIMATED SUPPLY FOR USE BY APPROPRIATORS UNDER PRE-1914 AND POST-1914 WATER RIGHTS

ATTACHMENT #5, 5/5

NO.	BASIN/STREAMS	ACRE-FEET May	June	July	August	NOTES
	A - SACRAMENTO RIVER BASIN (LOWER REACH)					
1.	Sacramento River (Below Knights Landing)	1130	1380	2090	4660	Table 18
2.	Colusa Basin Drain	31,500	15,940	15,830	31,000	Table 19
3.	Sutter Bypass	14,170	7,020	7,020	13,310	Table 20
4.	Feather & Yuba Rivers	0	0	0	0	Table 21
5.	American River	0	0	21,370	18,940	Table 22
6.	Subtotal	45,670	24,310	46,310	36,910	1 + 2+3+4+5
	B - SAN JOAQUIN RIVER BASIN					
1.	Merced River		0	0	3,260	Table 26, A-7
2.	Tuolumne River		0	10,250	1,530	Table 26, B-7
3.	Stanislaus River		0	1,530	1,700	Table 26, C-7
4A.	San Joaquin River (Upper Reach)			2,975	2,113	Table 26, D-2
4B.	San Joaquin River (Middle Reach)			13,718	10,387	Table 26, D-12
5.	Calaveras River		650	810	0	Table 26, E-7
6.	Mokelumne River		0	0	0	Table 26, F-7
7.	Cosumnes River		0	0	0	Table 26, G-7
8.	Subtotal		650	29,283	18,990	1+2+3+4A+4B+5+6+7
	TOTAL			75,593	55,900	

ATTACHMENT #6

Table 5-15. OID Drainage System Irrigation Season Water Balance Results, 2005 to 2011

Year	Number of Days	OID Allocation	Hydrologic Year Type	Inflows (af) Operational Spillage	**Tailwater to Drainage System (Closure)**	Runoff of Precipitation	Precipitation	Outflows (af) Drainwater Outflow	District Drainwater Reuse	Seepage	Private Drainwater Reuse	Evaporation	Riparian ET
2005	181	Full	Wet	15,024	**58,975**	3,049	10	52,852	9,932	10,729	3,108	266	171
2006	175	Full	Wet	18,187	**50,586**	704	6	46,611	8,918	10,373	3,145	265	171
2007	214	Partial	Dry	18,662	**56,793**	635	17	49,143	10,099	12,685	3,671	309	200
2008	205	Partial	Dry	16,689	**54,277**	54	2	43,577	11,092	12,151	3,695	309	199
2009	200	Full	Dry	16,944	**53,744**	2,461	12	47,550	9,668	11,855	3,596	299	193
2010	205	Full	Wet	17,351	**52,546**	2,305	25	48,740	7,729	12,151	3,137	285	184
2011	194	Full	Dry	14,928	**58,866**	2,303	19	53,717	7,391	11,499	3,062	272	176
Minimum				14,928	**50,586**	54	2	43,577	7,391	10,373	3,062	265	171
Maximum				18,662	**58,975**	3,049	25	53,717	11,092	12,685	3,695	309	200
Wet Year Average				16,854	**54,035**	2,019	14	49,401	8,860	11,084	3,130	272	176
Dry Year Average				16,806	**55,920**	1,363	12	48,497	9,562	12,047	3,506	297	192
Overall Average				16,826	**55,112**	1,644	13	48,884	9,261	11,635	3,345	286	185

Table 5-16. OID Overall Water District Water Balance Results, 2005 to 2011

Year	Number of Days	OID Allocation	Hydrologic Year Type	Inflows (af) System Inflows[1]	District Groundwater Pumping	Precipitation	Private Groundwater Pumping	OID and Private Recycled	Outflows Transfers (VAMP Pulse Flows)	Deliveries to Knights Ferry	Deliveries to Annual Contracts	Drainwater Outflow	Canal and Drain Seepage	Deep Percolation of Applied Water	Deep Percolation of Precipitation	Riparian ET and Evaporation	Crop ET of Applied Water	Crop ET of Precipitation	Change in Storage of Precipitation (ac-ft)
2005	181	Full	Wet	223,706	2,054	9,569	16,811	2,367	0	2,786	5,941	52,852	43,959	25,581	19,746	3,414	113,548	32,817	-46,136
2006	175	Full	Wet	225,614	1,518	9,076	18,417	2,328	0	2,494	5,256	46,611	42,502	28,920	14,097	3,405	119,448	21,499	-27,280
2007	214	Partial	Dry	261,896	7,505	15,012	21,583	2,586	2,185	2,994	5,442	49,143	51,973	35,640	11,695	3,976	143,000	15,288	-12,755
2008	205	Partial	Dry	244,606	14,862	6,027	22,090	2,526	7,260	2,876	7,665	43,577	49,787	23,428	9,772	3,967	145,597	13,062	-16,878
2009	200	Full	Dry	234,424	15,690	16,453	21,361	2,493	0	2,752	5,226	47,550	48,573	26,042	11,019	3,848	142,542	15,389	-12,521
2010	205	Full	Wet	217,143	5,683	35,203	17,802	2,526	0	2,390	4,277	48,740	48,104	16,050	21,292	3,667	122,456	25,583	-14,199
2011	194	Full	Dry	218,147	2,275	16,389	16,949	2,454	0	2,241	5,910	53,717	45,522	15,815	18,842	3,495	115,599	30,033	-34,961
Minimum				217,143	1,518	6,027	16,811	2,328	0	2,241	4,277	43,577	42,502	15,815	9,772	3,405	113,548	13,062	-46,136
Maximum				261,896	15,690	35,203	22,090	2,586	7,260	2,994	7,665	53,717	51,973	35,640	21,292	3,976	145,597	32,817	-12,521
Wet Year Average				222,154	3,085	17,949	17,677	2,407	0	2,557	5,158	49,401	44,855	23,517	18,378	3,495	118,484	26,633	-29,205
Dry Year Average				239,768	10,083	13,470	20,496	2,515	2,361	2,716	6,061	48,497	48,964	25,231	12,832	3,822	136,684	18,443	-19,279
Overall Average				232,220	7,084	15,390	19,288	2,469	1,349	2,648	5,674	48,884	47,203	24,496	15,209	3,682	128,884	21,953	-23,533

1. System Inflows for a given year correspond to the irrigation season, which may extend into October. As a result, the total system inflows presented may occur in two, separate water years (October 1 through September 30), which is the time period applied to OID's annual allotment per the 1988 stipulation and agreement with USBR.

ATTACHMENT #7, 1/2

TABLE 17

SACRAMENTO RIVER BASIN : COLUSA BASIN DRAIN RETURN FLOW

(Monthly Quantities in Acre-Feet)

NO.			MONTHLY WATER SUPPLY IN 1977						NOTES/REFERENCES
			APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	
1	Glenn Colusa I. D. - Total Diversion	824,409							Glenn-Colusa Irrigation Report on Water Measurement Program for 1976 - January 1977 Table 2
2	Monthly Diversions		124,960	163,180	158,210	160,640	134,330	59,830	
3	Percent of Total Diversion		0.15	0.20	0.19	0.19	0.16	0.07	2 ÷ 1
4	Monthly Drain Outflow		20,600	37,400	19,100	18,900	36,700	38,500	Glenn-Colusa Report
5	Outflow-Percent of Monthly Diversion		0.16	0.23	0.12	0.12	0.27	0.64	4 ÷ 2
6	Maxwell I. D. - Total Diversion - 1976	17,980							USBR Contract No. 6078A
7	Monthly Diversion		2,700	3,600	3,420	3,420	2,880	1,260	3 x 6
8	Assumed Monthly Outflow		430	830	410	410	780	810	5 x 7
9	Princeton-Codora-Glenn I. D. - Total Diversion - 1976	67,810							USBR Contract No. 849A
10	Monthly Diversion		10,170	13,560	12,880	12,880	10,850	4,750	3 x 9
11	Assumed Monthly Outflow		1,630	3,120	1,550	1,550	2,930	3,040	5 x 10
12	Provident I. D. - Total Diversion-1976	54,730							USBR Contract No. 856A
13	Assumed Monthly Diversion		8,210	10,950	10,400	10,400	8,760	3,830	3 x 12
14	Assumed Monthly Outflow		1,310	2,520	1,250	1,250	2,360	2,450	5 x 13
15	Reclamation District No. 108 - Total 1976 Diversion	232,000							USBR Contract No. 876A

Table 19 from SWRCB's Appendix To Drought '77 Dry Year Program Report, March 1978.

Table 19 (Contd.)

ATTACHMENT #7, 2/2

NO.		MONTHLY WATER SUPPLY IN 1977							NOTES/REFERENCES
			APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	
16	Assumed Monthly Diversion		34,800	46,400	44,080	44,080	37,120	16,240	3 x 15
17	Assumed Monthly Outflow		5,570	10,670	5,290	5,290	10,020	10,390	5 x 16
18	O. P. Davis Ranch - Total Diversion-1976	31,800							USBR Contract No. 2146A
19	Assumed Monthly Diversion		4,770	6,360	6,040	6,040	5,090	2,230	3 x 18
20	Assumed Monthly Outflow		760	1,460	730	730	1,370	1,430	5 x 19
21	Total Monthly Outflow		30,300	56,000	28,330	28,130	54,160	56,620	4 + 8 + 11 + 14 + 17 + 20
22	1977 USBR Cutback (25%)		22,720	42,000	21,250	21,100	40,620	42,470	USBR 1977 Deliveries Cutback by 25%
23	1977 Assumed Outflow		17,040	31,500	15,940	15,830	30,460	31,850	Assumed reduction due to conservation measures and recycling by 25%.

ATTACHMENT #8, 1/2

TABLE 15

SUMMARY OF MONTHLY STREAMFLOW, DIVERSIONS, AND ACCRETIONS - 1977

SACRAMENTO RIVER

	River Mile Above Sacramento	March	April	May	June	July	August	Sept.	October	Total
		Acre-Feet								
Shasta Lake										
Computed Inflow		245,440	200,060	223,320	195,410	180,100	197,000	235,960	231,090	1,708,380
Change in Storage		-24,900	-246,600	-87,000	-189,400	-257,200	-102,500	+52,600	+25,400	-829,600
Keswick Reservoir										
Imported from Trinity Div.		71,030	44,880	152,930	176,300	227,400	224,700	95,810	16,300	1,009,350
Release		333,350	474,280	451,910	555,130	656,050	512,960	273,530	215,930	3,473,140
Sacramento River at Keswick	250.5R	333,800	480,200	456,900	568,400	665,300	522,900	271,600	211,000	3,510,100
Clear Creek near Igo		3,150	3,010	3,550	2,940	3,020	3,070	2,260	2,390	23,390
Cow Creek near Millville		7,250	3,750	8,360	1,080	39	46	2,620	2,620	25,765
Battle Creek near Coleman F.H.		16,360	13,750	16,360	13,300	12,330	11,750	12,320	12,590	108,760
Cottonwood Creek near Cottonwood		8,970	8,100	10,150	4,430	3,051	2,880	5,380	5,772	48,733
Unmeasured Accretions		25,459	16,667	25,115	7,153	13,622	11,731	39,558	20,846	160,151
Diversions		2,089	23,177	8,235	28,903	30,862	27,177	17,038	13,218	150,699
Sacramento River near Red Bluff	209.7	392,900	502,300	512,200	568,400	666,500	525,200	316,700	242,000	3,726,200
Red Bank Creek near Red Bluff		444	25	511	0	0	0	28	0	1,008
Fish Water Release, Coyote Creek		7,962	7,740	12,815	8,990	1,490	1,958	0	2,933	43,888
Antelope Creek near Red Bluff1/		1,110	800	1,130	220	0	10	270	654	4,194
Mill Creek near Los Molinos1/		2,160	2,230	3,130	3,490	0	0	690	630	12,330
Elder Creek near Paskenta2/		0	0	0	0	0	0	0	0	0
Thomas Creek near Paskenta2/		0	0	0	0	0	0	0	0	0
Deer Creek near Vina1/		2,860	2,070	2,410	660	0	0	360	580	8,940
Unmeasured Accretions		4,560	3,701	5,435	-3,943	-4,283	2,551	-21,452	-10,872	-24,303
Diversions		8,796	16,466	17,431	41,417	32,607	12,319	6,296	7,325	142,657
Sacramento River near Vina Bridge	166.5R	403,200	502,400	520,200	536,400	631,100	517,400	290,300	228,600	3,629,600
Unmeasured Accretions		-1,248	-11,421	1,454	7,858	9,944	-18,863	-1,786	-1,987	-16,049
Diversions		47,852	109,079	80,654	111,358	117,244	100,037	29,714	22,013	617,951
Sacramento River at Hamilton City	149.5L	354,100	381,900	441,000	432,900	523,800	398,500	258,800	204,600	2,995,600
Stoney Creek near Orland3/		0	0	0	0	0	0	0	0	0
Mud Creek near Chico		85	29	148	0	26	47	47	0	382
Big Chico Creek at Chico		1,359	768	839	124	0	0	163	199	3,452
Unmeasured Accretions		9,829	-2,687	-8,790	-9,544	-12,767	4,135	3,651	18,115	1,942
Diversions		673	1,610	2,797	3,080	3,759	3,382	561	14	15,876
Sacramento River at Ord Ferry	130.8R	364,700	378,400	430,400	420,400	507,300	399,300	262,100	222,900	2,985,500
Unmeasured Accretions		-17,701	-9,463	4,253	-3,383	11,857	3,169	2,307	-17,476	-26,437
Diversions		3,999	17,937	9,853	17,217	15,257	12,969	3,907	1,124	82,263

1/ Observed zero flow at mouth July 20, 1977. Other months adjusted accordingly for computing accretions. Flow at gage listed in Table 6.
2/ 100 percent of flow intercepted by Tehama-Colusa Canal. Flow at gage listed in Table 6.
3/ 100 percent of flow intercepted by Glenn-Colusa Canal. Flow at gage listed in Table 6.

Metric Conversion: Acre-feet times 1233.5 equals cubic metres.
Miles times 1.6093 equals kilometres.

Table 15 from DWR's Bulletin 168, Sacramento Valley Water Use Survey 1977, dated October 1978.

ATTACHMENT #8, 2/2

TABLE 15 (Cont'd)

SUMMARY OF MONTHLY STREAMFLOW, DIVERSIONS, AND ACCRETIONS - 1977

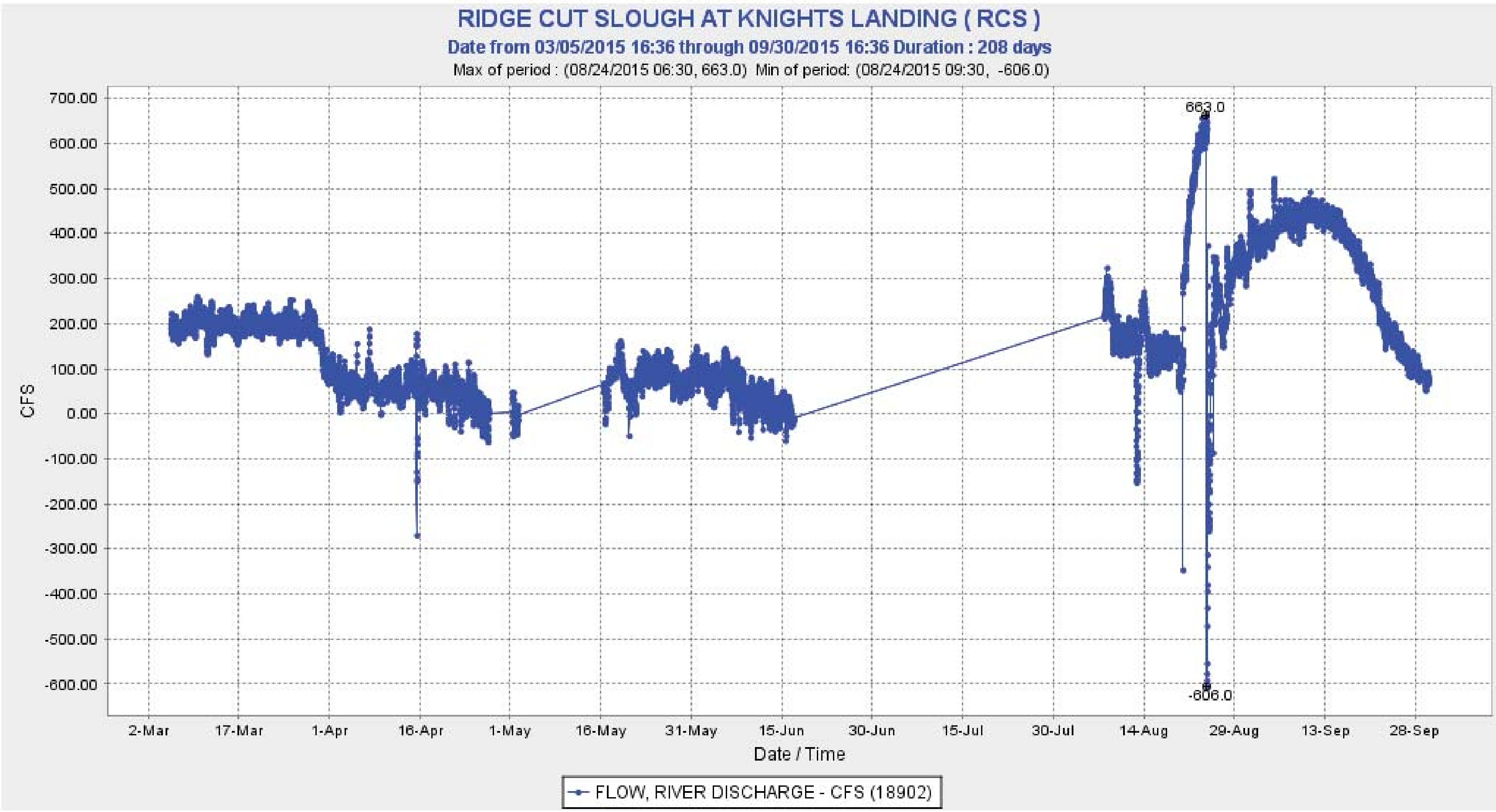
SACRAMENTO RIVER

	River Mile Above Sacramento	Acre-Feet March	April	May	June	July	August	Sept.	October	Total
Sacramento River at Butte City	115.8L	343,000	351,000	424,800	399,800	503,900	389,500	260,500	204,300	2,876,800
Unmeasured Accretions		25,597	12,814	4,013	-3,968	-9,993	5,868	1,167	2,731	38,229
Diversions		8,797	20,714	25,413	24,332	24,907	16,368	4,467	6,231	131,229
Sacramento River at Colusa	89.4R	359,800	343,100	403,400	371,500	469,000	379,000	257,200	200,800	2,783,800
Butte Slough Outfall	84.0L	0	0	708	0	0	0	0	0	708
R.D. 70 Drain	68.8L	637	595	801	378	97	190	470	202	3,370
Unmeasured Accretions		-16,562	-13,317	-2,592	672	-5,710	-1,867	6,728	5,994	-26,654
Diversions		27,075	67,378	49,617	76,150	72,187	56,123	22,498	2,296	373,324
Sacramento River below Wilkins Slough	62.9R	316,800	263,000	352,700	296,400	391,200	321,200	241,900	204,700	2,387,900
R.D. 108 Drain	53.8R	1,857	1,916	5,774	6,163	1.906	5,738	8,450	541	32,345
R.D. 787 Drain	37.0R	501	225	1,068	1,022	645	1,499	671	195	5,826
Sycamore Slough (R.D. 787)		0	0	248	496	0	4	219	0	967
Colusa Basin Drain	34.1R	7,200	589	29,750	83	149	18,540	27,990	778	85,079
Unmeasured Accretions		34,279	19,040	2,261	14,764	17,888	26,660	14,074	12,162	141,128
Diversions		11,937	23,570	19,701	28,428	21,988	17,241	6,304	1,976	131,145
Sacramento River at Knights Landing	34.0L	348,700	261,200	372,100	290,500	389,800	356,400	287,000	216,400	2,522,100
Sacramento Slough	21.2L	21,200	13,820	34,030	12,900	11,290	16,940	26,870	10,490	147,540
Feather River at Nicolaus		72,330	124,900	64,640	71,750	110,700	94,630	76,270	68,880	684,100
Natomas Cross Canal at Head		0	0	0	0	0	0	0	0	0
R.D. 1000 Drain No. 4		0	0	0	0	0	0	0	0	0
R.D. 1001 Drain		90	272	300	0	103	0	296	49	1,110
Unmeasured Accretions		-21,968	-20,294	2,661	-19,766	-30,292	-29,061	-10,864	-5,201	-134,785
Diversions4/		6,452	11,698	16,731	15,884	18,701	13,909	4,672	118	88,165
Sacramento River at Verona	19.6L	413,900	368,200	457,000	339,500	462,900	425,000	374,900	290,500	3,131,900
R.D. 1000 Drain No. 6 (Prichard Lake)		0	0	0	0	0	0	940	0	940
R.D. 1000 Drain No. 3	6.85L	1,676	430	2,209	0	0	0	3,032	0	7,347
R.D. 1000 Drain (2nd Bannon Slough)		0	0	0	0	0	0	0	110	110
Natomas East Main Drain		2,142	603	2,251	228	213	270	937	359	7,003
American River at Sacramento	1.1L	17,880	13,830	30,380	62,910	50,460	48,490	32,070	16,120	272,140
Unmeasured Accretions		-20,164	-4,864	-6,764	31,420	19,263	19,263	1,950	-17,706	22,398
Diversions		11,234	23,499	17,976	25,558	25,636	20,423	6,929	6,083	137,338
Sacramento River at Sacramento	0.6L	404,200	354,700	467,100	408,500	507,200	472,600	406,900	283,300	3,304,500
TOTAL MEASURED ACCRETIONS		177,223	199,452	231,562	191,164	195,519	206,062	202,353	126,092	1,529,427
TOTAL UNMEASURED ACCRETIONS		22,081	-9,824	27,046	21,263	9,529	23,586	35,333	6,606	135,620
TOTAL ACCRETIONS		199,304	189,628	258,608	212,427	205,048	229,648	237,686	132,698	1,665,047
TOTAL DIVERSIONS4/		128,904	315,128	248,408	372,327	363,148	279,948	102,386	60,398	1,870,647

4/ Includes diversions from Feather River below Nicolaus.

Metric Conversion: Acre-feet times 1233.5 equals cubic metres.
Miles times 1.6093 equals kilometres.

ATTACHMENT #9



Screen shot of CDEC plot for flow in Ridge Cut Slough (RCS), March 5 to September 30, 2015.

ATTACHMENT #10

SUMMARY

SRSC 2011 Diversions* =	1,298,598 AF
SRSC 2011 Return Flows (available for use downstream)* =	513,475 AF
Total 2011 Recirculation/Reuse by SRSCs =	397,838 AF

SUMMARY (Cont.)

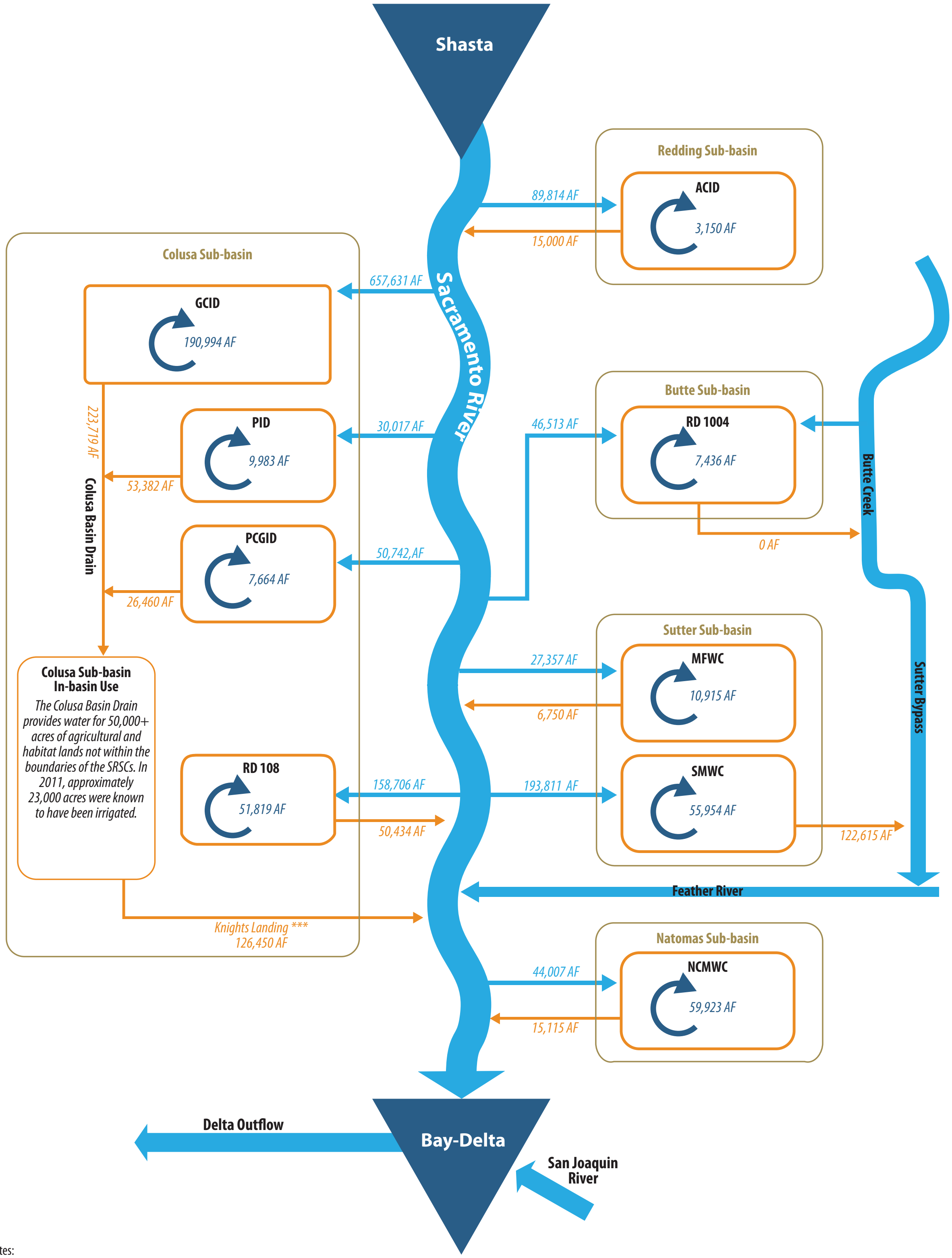
Total Cropped Acres for 2011** =	342,037 AC
Average Diversion for 2011 = (SRSC Diversion ÷ Total Cropped Acres)	3.80 AF/AC
Average Consumptive Use for 2011 = ((SRSC Diversion-SRSC Return Flow) ÷ Total Cropped Acres)	2.30 AF/AC

LEGEND

DIVERSIONS

RETURN FLOW

Total Recirculated for Reuse



Notes:

* Diversions and return flows are from 2011 SRSC water balance tables.

** Total cropped acres for 2011 includes 23,000 acres within the Colusa Sub-basin that rely on return flows from the SRSCs for surface water supplies.

***Return to river at Knights Landing is based on data obtained from the Department's Water Data Library. No data are available for May, June, and October.

AC = acre

AF = acre-feet

FIGURE 2-59
SCHEMATICS AND SUMMARY OF 2011 SRSC DIVERSIONS AND RETURN FLOWS

2010/2011 SACRAMENTO VALLEY REGIONAL WATER MANAGEMENT PLAN ANNUAL UPDATE

CH2MHILL.

WBG052312125814RDD_2-59

ATTACHMENT #11

FLOW SCHEDULE

Schedule / Occurrence	Days	Critical & below 6.4 %	Median Critical 8.0 %	Intermediate C-D 6.1 %	Median Dry 10.8 %	Intermediate D-BN 9.1 %	Median Below Normal 10.3 %	Intermediate BN-AN 15.5 %	Median Above Normal 5.1 %	Intermediate AN-W 15.4 %	Median Wet/ Maximum 13.3 %
October 1 - October 15	15	100 cfs 2,975 ac-ft	100 cfs 2,975 ac-ft	150 cfs 4,463 ac-ft	150 cfs 4,463 ac-ft	180 cfs 5,355 ac-ft	200 cfs 5,950 ac-ft	300 cfs 8,926 ac-ft	300 cfs 8,926 ac-ft	300 cfs 8,926 ac-ft	300 cfs 8,926 ac-ft
Attraction Pulse Flow		none	none	none	none	1,676 ac-ft	1,736 ac-ft	5,950 ac-ft	5,950 ac-ft	5,950 ac-ft	5,950 ac-ft
October 16 - May 31	228	150 cfs 67,835 ac-ft	150 cfs 67,835 ac-ft	150 cfs 67,835 ac-ft	150 cfs 67,835 ac-ft	180 cfs 81,402 ac-ft	175 cfs 79,140 ac-ft	300 cfs 135,669 ac-ft	300 cfs 135,669 ac-ft	300 cfs 135,669 ac-ft	300 cfs 135,669 ac-ft
Outmigration Pulse Flow		11,091 ac-ft	20,091 ac-ft	32,619 ac-ft	37,060 ac-ft	35,920 ac-ft	60,027 ac-ft	89,882 ac-ft	89,882 ac-ft	89,882 ac-ft	89,882 ac-ft
June 1 - September 30	122	50 cfs 12,099 ac-ft	50 cfs 12,099 ac-ft	50 cfs 12,099 ac-ft	75 cfs 18,149 ac-ft	75 cfs 18,149 ac-ft	75 cfs 18,149 ac-ft	250 cfs 60,496 ac-ft	250 cfs 60,496 ac-ft	250 cfs 60,496 ac-ft	250 cfs 60,496 ac-ft
Volume (ac-ft)	365	94,000	103,000	117,016	127,507	142,502	165,002	300,923	300,923	300,923	300,923

Tuolumne River flow schedule per New Don Pedro Proceeding P-2299-024, Settlement Agreement, 1995.