River Garden Farms Company
Application to Appropriate Water

Attachment 2
Water Availability Analysis

MBK ENGINEERS

Water Resources • Flood Control • Water Rights

MEMORANDUM REPORT

DATE: January 20, 2012

TO: Ms. Barbara Evoy, Deputy Director
Division of Water Rights, State Water Resources Control Board

FROM: Gary Kienlen and Bryan Busch

SUBJECT: Water Availability Analysis for River Garden Farms Company Application to Appropriate Water

INTRODUCTION

The purpose of this report is to provide information required under California Water Code Section 1275 (a) to demonstrate whether water is available for appropriation; and to summarize the results of a water availability analysis conducted for the subject application by River Garden Farms Company, located within the Sacramento River watershed in Yolo County.

SUMMARY

River Garden Farms Company (RGF) proposes to divert water from the Sacramento River for rice straw decomposition, wildlife enhancement, and recreational purposes from about November 1 to about March 1 of the following year. For the following reasons, Term 91 provides an appropriate method for demonstrating that unappropriated water is available in the Sacramento River and its tributaries and that inclusion of Term 91 in a permit issued pursuant to RGF's application will ensure that its diversions will not affect other legal users of water if future conditions and requirements change. The State Water Resources Control Board (SWRCB) concluded in its Decision 1594 (D-1594) that due to uncertainties and lack of information regarding return flows, groundwater accretions, tributary inflow, riparian and appropriative use, and other factors, the Term 91 method provides a simple and acceptable method for determining water availability on a real-time basis. Further, in considering recent applications within the Sacramento Valley for similar purposes and seasons, the Division of Water Rights (Division) has agreed that Term 91 provides an appropriate mechanism to determine when unappropriated water exists.[1] These findings are further supported by the SWRCB in its recent Decision 1650 (D-1650). In addition, the Sacramento River has not been declared as fully appropriated during the proposed season of diversion. Background and support for these findings, including the results of CalSim II modeling efforts similar to those submitted in the D-1650 proceedings, are provided later in this report. This supporting information demonstrates that unappropriated water exists at RGF's proposed points of diversion during the

[1] Application 31436 of Reclamation District 108, Application 31175 and 31176 of A&G Montna Properties, LP, Application 31191 of Garden Highway Mutual Water Company, and Application 31572 of Leal/Odysseus.

requested season of November 1 to March 1, except for approximately 15% of the time during November, based on a monthly time step using the CalSimII model. Based on the historical implementation of Term 91 by the SWRCB, it is assumed that the November curtailments would be limited to the period between November 1 and November 15.

RGF understands that a permit issued pursuant to its application will include Term 91 and that its ability to divert and use water may, at times, be curtailed in accordance with the provisions of that permit term. As stated above, RGF is proposing to divert water for rice straw decomposition, wildlife enhancement, and recreational purposes. During periods when diversions under a permit issued pursuant to the subject application may be curtailed, RGF may delay their water use until such time as water is available under the permit or rely on alternative water supplies, such as groundwater or purchased water.

As stated above, the Term 91 analysis demonstrates that unappropriated water is available during the season proposed by RGF. A review of flows in the Sacramento River at RGF's point of diversion was also conducted. As identified later in this report, the proposed direct diversion rate under this application is less than 1% of the average daily flow in the Sacramento River in the vicinity of the point of diversion between November and March of 1938 through 2010. Additionally, the 62 cubic feet per second diversion rate represents approximately 2% of the minimum daily flow observed during the same time period. Flow and other requirements to meet fishery needs are set forth in the 1995 Water Quality Control Plan (1995 WQCP). These requirements are incorporated in the Term 91 calculation by definition as part of the in-basin uses and are currently being met by the Projects.

PROJECT DESCRIPTION

RGF proposes to divert up to 7,000 acre-feet of surface water for rice straw decomposition, wildlife enhancement, and recreational purposes, such as hunting and bird watching, from about November 1 to about March 1 of the succeeding year. The place of use is located within the Pacific Flyway. The total quantity to be diverted has been estimated by assuming that it will require approximately 2.0 acre-feet of water per acre during the requested season to flood and maintain 3,500 acres to a depth of 8 inches. This depth is the ideal depth for waterfowl habitat and is sufficient to decompose rice straw. The total quantity also includes an amount for flow through the flooded fields to prevent waterfowl diseases which can result from stagnant water. The lands to be flooded are currently under cultivation and irrigated under other water rights held by RGF and its Settlement Contract with the U.S. Bureau of Reclamation (Reclamation).

RGF is located within Yolo County, north of the town of Knights Landing. RGF is proposing to utilize existing facilities and points of diversion located at its Townsite Pumping Plant on the Sacramento River and at Jacob's Point on Reclamation District 108's (RD 108) Lateral 14A. The Townsite Pumping Plant is currently being equipped with a positive barrier fish screen facility, and will be fully operational before the diversion of any water from the Sacramento River. The fish screen will be built to the design criteria of the California Department of Fish and Game (DFG), the US Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS). The maximum rate of diversion at the Townsite

Pumping Plant is 62 cfs. Water diverted at Jacob's Point consists of rain water runoff and drainage from RD 108's service area. The maximum rate of diversion from Lateral 14A will be 61 cfs. Absent diversion and use by RGF, the drain water would be pumped by RD 108 to the Sacramento River at Rough and Ready Pumping Plant or El Dorado Bend Pumping Plant.

AVAILABILITY OF WATER FOR APPROPRIATION

Reclamation and the CA Department of Water Resources (DWR) are responsible for operating the Central Valley and the State Water Projects (CVP and SWP), respectively. The State Water Resources Control Board (SWRCB) issued Decision 1485 (D-1485) in August 1978, which set forth standards for water quality and outflow requirements for the Sacramento-San Joaquin River Delta (Delta) and assigned responsibility for meeting those requirements to the CVP and SWP (collectively referred to as the Projects). The SWRCB denied reconsideration and upheld D-1485 in its order WRO 78-17 in October 1978. In March 1980, the SWRCB adopted Standard Permit Term 91 (Term 91). Term 91 required the Projects to develop a reasonably accurate method to calculate when supplemental project water is being released by the Projects. The SWRCB issued Order WRO 81-15 in November 1981, approving the calculation method and confirming certain definitions as required under Term 91. WRO 81-15 also revised Term 91 to incorporate the calculation method and definitions as approved by the SWRCB. Term 91 was originally adopted as an interim measure to allow resolution of protests by Reclamation and DWR of new applications.

To develop a long term solution to water availability within the Delta watershed, the SWRCB authorized a water availability study in Resolution 80-18. Although Division staff had originally proposed an in depth analysis of water supply and demand within the Delta watershed, this approach was discontinued as identified in SWRCB Decision 1594 (D-1594) *"due to lack of adequate data for factors such as return flow, groundwater accretions, unmeasured tributary inflow, riparian use, appropriative use, and Delta consumptive use"* (D-1594 at pages 9 & 10). Consequently, the SWRCB reviewed several methods for determining water availability within the Delta watershed, ultimately adopting the Term 91 method stating it "*to be a simple and acceptable method for determining water availability on a real-time basis*" (D-1594 at page 24). Term 91 is included in all water right permits with priority dates after August 16, 1978 which authorize diversions from the Sacramento River, its tributaries, and the Delta that are greater than 1.0 cfs by direct diversion or storage of more than 100 acre-feet per year. D-1594 was affirmed by the SWRCB with certain amendments in its Order WRO 84-2.

The same issues relating to the lack of adequate data which were identified in D-1594 exist today, making a detailed analysis of water availability within the Delta watershed impractical at best. The Term 91 method accounts for all in-basin uses in determining when water is available. Therefore, since flows required for water quality and fish and wildlife are by definition considered in-basin uses, unlike traditional methods for assessing water availability based on historical flow data, the Term 91 method is adaptable to future changes in water quality or minimum flow requirements by the SWRCB. Further, unlike assessing water availability based on historical flow data and face values of water rights, the Term 91 method provides a real-time assessment of availability. D-1594 states that:

"...water is considered available for Term 91 permittees at all times when natural flow is sufficient to meet inbasin demands and Delta water quality standards. If the natural flow is sufficient to meet inbasin demands and the Projects release stored water only to satisfy their export demands, then water is still considered available for Term 91 permittees." (D-1594 at page 14)

D-1594 defines natural flow as any surface water in the Delta watershed except for CVP/SWP storage releases (see footnote at page 14, D-1594).

We have evaluated water availability using available data from Reclamation and the DWR consistent with the Term 91 methodology as described in D-1594. According to Term 91, water is unavailable for appropriation when Supplemental Project Water is being released to satisfy inbasin entitlements. Term 91 defines Supplemental Project Water as:

"...that water imported to the basin by the Projects plus water released from Project storage which is in excess of export diversions, Project carriage water, and Project inbasin deliveries",

and, in-basin entitlements as:

"...all rights to divert water from streams tributary to the Sacramento-San Joaquin Delta or the Delta for use within the respective basins of origin or the Legal Delta, unavoidable natural requirements for riparian habitat and conveyance losses, and flows required by the State Water Resources Control Board for maintenance of water quality and fish and wildlife. Export diversions and Project carriage water are specifically excluded from the definition of inbasin entitlements."

In D-1594 the SWRCB found that:

"Under the Term 91 Method, water is not available for diversion by Term 91 permittees when two conditions exist simultaneously. First, the Delta must be "in balance". The Delta is defined as being "in balance" when the CVP and SWP are being operated to meet water quality conditions in the Delta. The controlling conditions are usually water quality standards established by the Board. Water is considered to be available for appropriation if the Delta is not "in balance".

The second condition for the Term 91 Method relates to Project storage releases and exports. Under the Term 91 Method, water is not available if Project exports plus "carriage water" requirements are less than Project storage releases and imports from the Trinity River." The availability of water using the Term 91 Method can be expressed by the following equation:

$AW = (EX + CW) - SR$

Where: $AW =$ *Available Water*

$SR =$ *Project Storage Releases plus Trinity River imports*

$EX =$ *Export Diversion through the Delta-Mendota Canal, Contra Costa Canal*

and California Aqueduct."

CW = Carriage water, i.e. the amount of additional Delta outflow required to compensate for currents created by the export pumps

D-1594 goes on to say:

> *"If AW is greater than zero, then water is available for diversion by Term 91 permittees. Water is not available for diversion when project storage releases plus Trinity River imports are greater than Project export diversions plus carriage water. In this latter case, a portion of Project storage releases is assumed to be needed to maintain Delta water quality standards. Additional upstream depletion of natural flows would require increased Project storage releases to meet Delta standards.*
>
> *"Stated another way, water is considered available for Term 91 permittees at all times when natural flow is sufficient to meet inbasin demands and Delta water quality standards. If the natural flow is sufficient to meet inbasin demands and the Projects release stored water only to satisfy their export demands, then water is still considered available for Term 91 permittees. This is true even though the Projects have large direct diversion rights under their early priority applications. (USBR Exh. 8, 9 and 10.) Since water is considered available for inbasin use by Term 91 permittees at times when the natural flow is insufficient to satisfy the Projects' earlier direct diversion export rights, the Term 91 Method implicitly assumes that the watershed protection statutes apply to the CVP and the SWP. (Water Code Sections 11128, 11460-11463.) The method does not involve identifying the particular county within which water originates. Thus, it makes no assumptions with respect to the county of origin statutes. (Water Code Sections 10505 and 10505.5.)"*

Table 1 identifies the periods when the SWRCB has issued notices of curtailment pursuant to Term 91.

Table 1. Term 91 Periods of Curtailment

Year	Curtailment Period	Year	Curtailment Period	Year	Curtailment Period
1984	6/22 – 8/31	1993	7/27 – 8/31	2002	6/17 – 8/31 & 10/10 – 11/15
1985	5/15 – 8/31	1994	6/15 – 8/31	2003	7/3 – 8/31
1986	7/2 – 8/6	1995	None	2004	5/31 – 8/31
1987	5/12 – 8/31	1996	7/22 – 8/20	2005	None
1988	6/21 – 9/7	1997	6/18 – 8/24	2006	None
1989	6/21 – 8/31	1998	None	2007	5/15 – 8/31 & 9/21 – 10/5
1990	5/14 – 8/31	1999	6/29 – 8/18	2008	6/2 – 11/15
1991	6/10 – 8/31	2000	6/28 – 8/16	2009	6/14 – 8/31
1992	5/21 – 11/15	2001	6/4 – 8/31	2010	7/16 – 8/31

As indicated in Table 1, the SWRCB has implemented Term 91 curtailments during the period from November 1 to March 1 in only three of the 27 years since 1984; those being 1992, 2002, and 2008. In all instances, the curtailment extended only until November 15, encompassing only a small portion of the diversion season proposed under RGF's application.

Appendix A contains 12 charts, Figures A1 through A12, summarizing the daily Supplemental Project Water releases as calculated by Reclamation during the November 1 to March 1 diversion season proposed by RGF for water years 2000 through 2011. The charts also show the periods during which the Delta was in excess and balanced condition, as well as when curtailments under Term 91 were in effect. As identified above, according to D-1594, water is not available for diversion by Term 91 permittees when the Delta is in balanced condition and Supplemental Project Water is being released by the CVP and SWP. The latter condition exists when Supplemental Project Water releases are positive or above the zero line on the charts. Figures A1-A12 show these conditions exist infrequently during the season requested under the subject application.

CONSIDERATION OF SENIOR WATER RIGHTS AND FUTURE CONDITIONS

Historical Term 91 analysis does not account for diversions under water rights that may have been applied for, approved, or perfected after the historical period analyzed. In order to ensure unappropriated water can be expected to exist for future appropriation, these water rights must be considered.

As was identified in testimony in the proceedings leading to D-1650, numerous factors result in the face value of permits vastly exceeding the amount that is available for appropriation. These include, but are not limited to, multiple permits and licenses for repeated diversion and re-diversion of the same water before it is delivered to its ultimate destination, return flows, and

demands during fall periods. The Feather River area contains about 110,000 acres of rice, mostly in the Western Canal, Biggs-West Gridley, Sutter Extension Water District, as well as other smaller districts. Typically, about 70% of rice acres are flooded, 10% apply water for decomposition without flooding, and 20% do not apply water for decomposition. Total rice straw decomposition demand for this area is about 130,000 AF, and on average, about 40,000 AF of this demand is met from precipitation. Table 2 displays the rice straw decomposition water demands within the Feather River area. Figure 1 contains a chart showing the additional demand for rice straw decomposition for the Feather River area input to CalSim II for this analysis. Rice decomposition demand shown in Table 2 may be partially satisfied by precipitation, which is variable and considered in this analysis.

Table 2. Feather River Area Rice Decomposition Demand (inches)

	October	November	December	January	Total
Flooded	7	5	5	2	19
Non-flooded	4	3			7

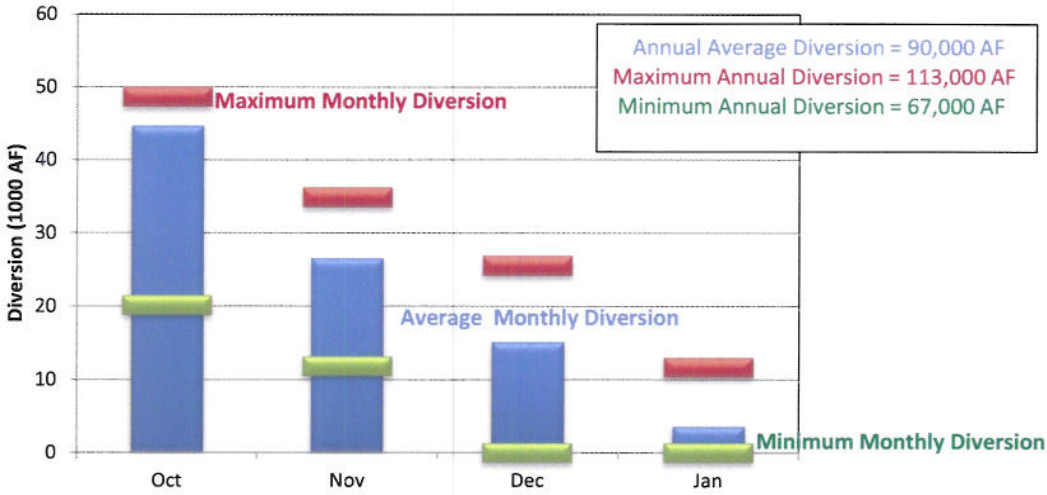

Figure 1 - Feather River Area Rice Straw Decomposition Diversions

Figure 2 contains a chart showing the effect of including Feather River area rice straw decomposition demands on Term 91 curtailments. This analysis is performed using a future level CalSim II model simulation developed by DWR for its Delivery Reliability Report (DRR), which was used as the cumulative condition for the analysis. Based on the analysis, changes only occur during October and November. In October, curtailments increased from 6% to 13% of the time, and from 10% to 15% of the time in November. Thus, for the purpose of estimating the frequency of future curtailments using CalSim II, it is necessary to include Feather River area rice decomposition demands.

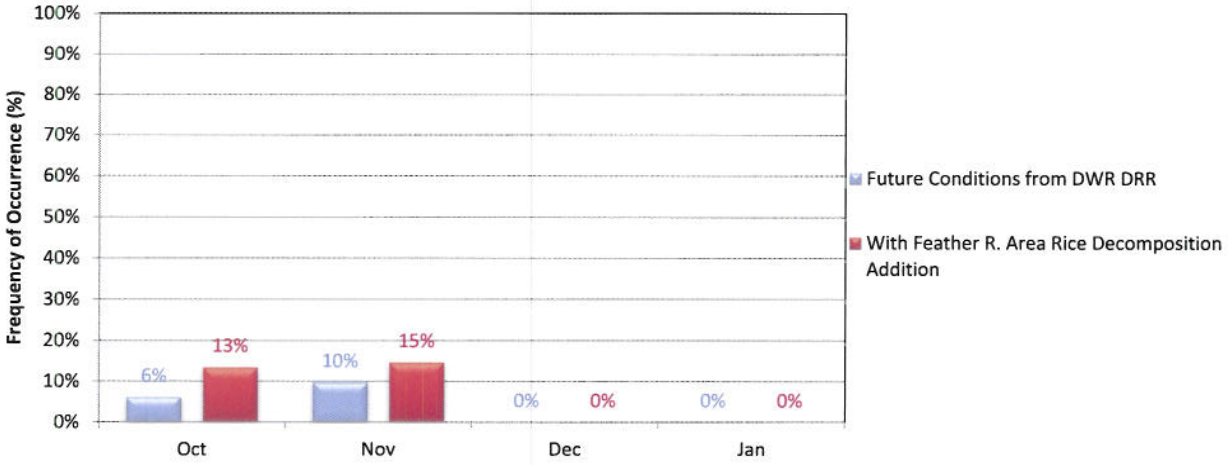

Figure 2 - Effect of Feather River Area Rice Decomposition Demand on Term 91

Adjustment to Term 91 for Planning Analysis Using CalSim II

In order for the SWRCB to impose Term 91 curtailments, the Delta must be in a balanced condition; and satisfaction of inbasin entitlements requires release of Supplemental Project Water by the CVP or the SWP. Although the SWRCB did impose a curtailment during May 2007, the Delta was not in balance. The post-processor precludes curtailment when surplus conditions exist in the Delta. This adjustment results in decreased frequency in curtailments in some months as can be seen in Figure 3.

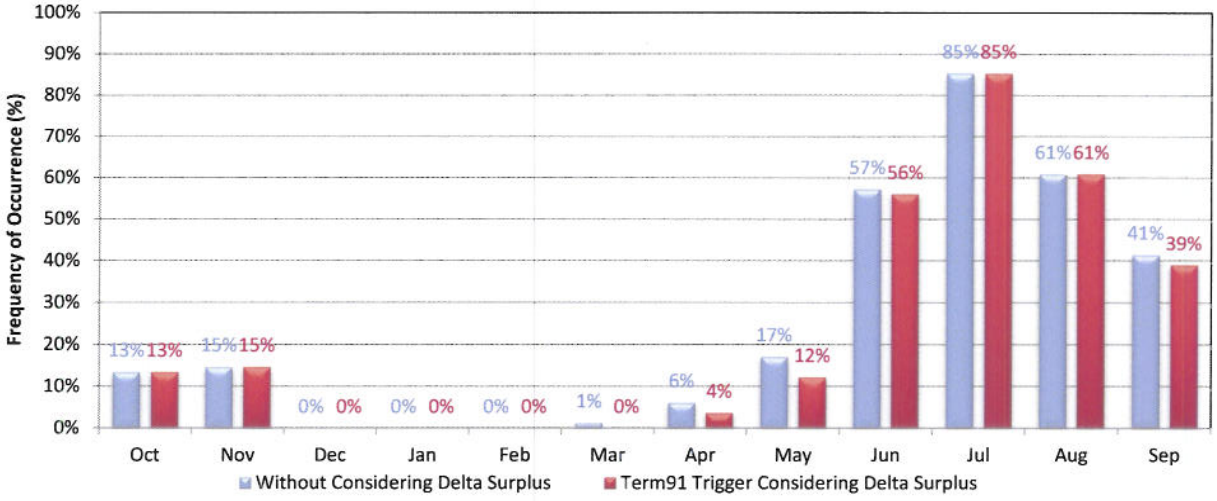

Figure 3 - Effect of Frequency of Term 91 Curtailments Due to Consideration of Delta Surplus

As identified previously, when the SWRCB imposes curtailments for the summer period, curtailments are typically imposed through the end of August, when Sacramento Valley agricultural demands decrease significantly. This regulatory procedure is not reflected in an analysis that only considers hydrologic conditions; therefore, this procedure has been incorporated into the analysis. If the month of July is subject to curtailment based on the monthly planning analysis, it is assumed the entire month of August will also be subject to

curtailments. Figure 4 shows the effect of incorporating this assumption into the analysis; curtailments in August increased from 61% to 85% of the time.

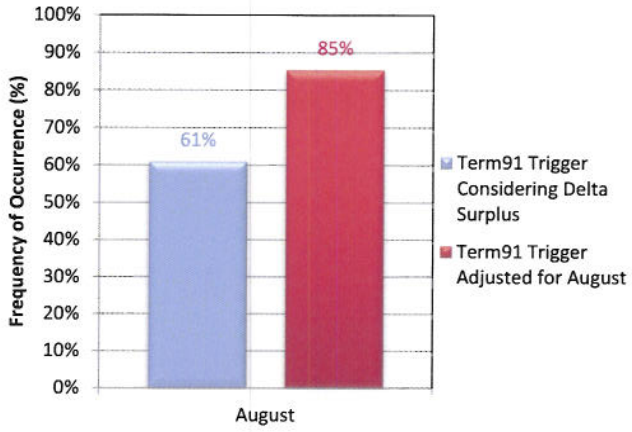

Figure 4 - Effect of August Addition on Term 91

Term 91 curtailment periods calculated by the post-processor are sometimes influenced by nuances in the CalSim II model simulation that may impose curtailments inappropriately; therefore, adjustments have been made to calculations in the post-processor. These nuances occur when Shasta and/or Folsom Reservoirs fall to dead pool and storage withdrawals are not properly calculated (these conditions would not occur in actual operations). This adjustment only affects extreme conditions, but is necessary when analyzing the driest of years. Figure 5 shows the effect this manual adjustment made to the CalSim II modeling and post-processor.

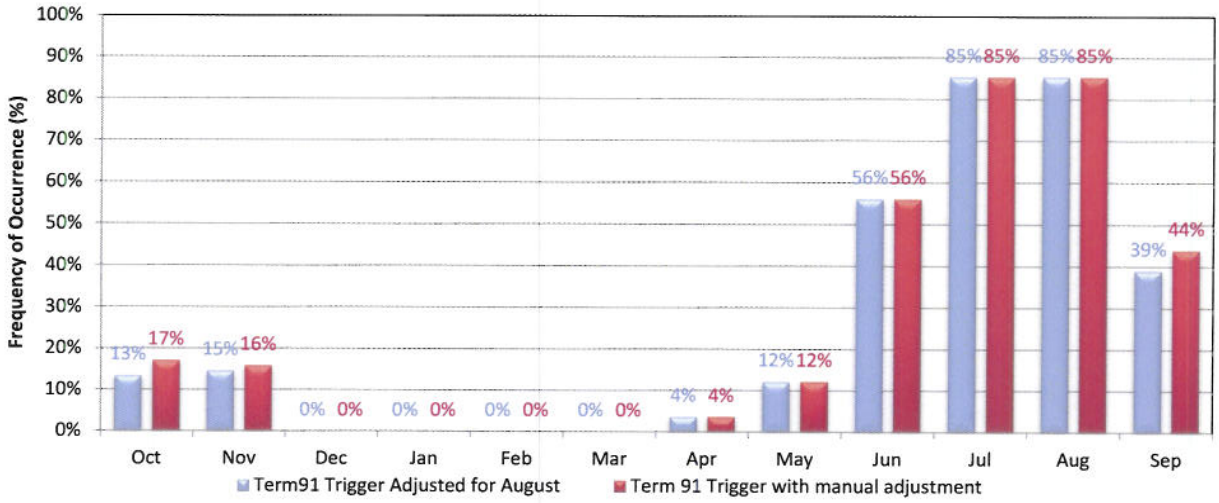

Figure 5 - Effect of Modeling Nuance on Term 91

As can be seen from Figure 5, after adjusting for the nuances in the CalSim II model and making the manual adjustment to the post-processor, the analysis indicates Term 91 curtailments occur 16% of the time in November and no curtailments would occur during the months of December through March.

Changes in Regulatory Standards

Figure 6 summarizes Term 91 curtailments based on historical hydrological conditions and the SWRCB's implementation procedures. To understand how changes in regulatory conditions may affect the frequency of Term 91 curtailment periods, an analysis was performed comparing frequency of Term 91 curtailments under current operating criteria, and those assuming D-1641 requirements. Current Project operating criteria include D-1641 requirements plus implementation of CVPIA, RPAs in the 2008 Fish and Wildlife Service Biological Opinion for the Coordinated Operations, and the 2009 National Marine Fisheries Services Biological Opinion for OCAP [2]. The D-1641 condition does not include implementation of CVPIA or the biological opinions, although assumptions for the San Joaquin River flows are based on satisfying RPAs under the salmon BO (this will tend to underestimate effects of regulatory changes). This analysis was performed using CalSim II simulations which were developed to support testimony to the SWRCB during the Delta Outflow proceedings in February 2010.

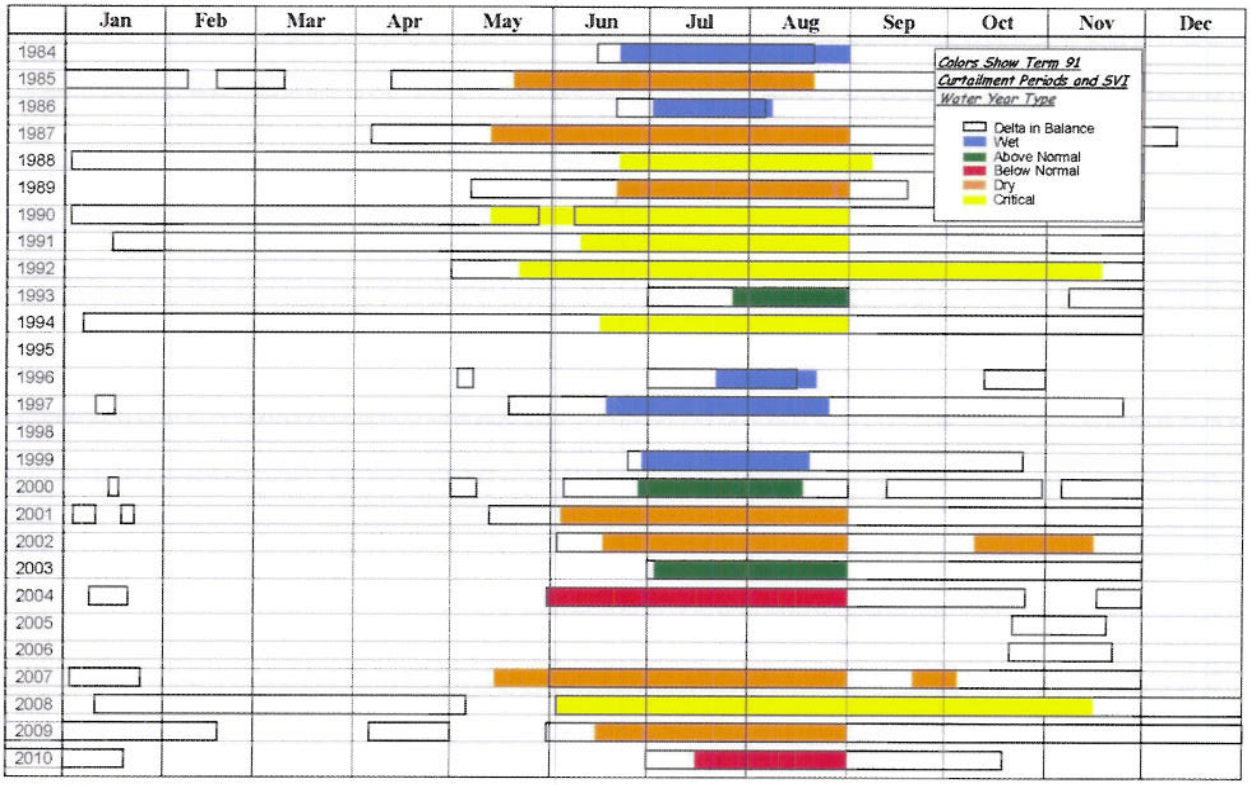

Figure 6 - Historical Delta Balanced Conditions and Term 91 Curtailment Periods

The CalSim II model simulations were performed at an existing level of development using the model run from the DWR DRR, rather than for the future (cumulative condition) model run from the DWR DRR. These CalSim II model simulations were not modified to include the

[2] See Formal Endangered Species Act Consultation on the Proposed Coordinated Operations of the Central Valley Project and State Water Project (Reference # 81420-2008-F-1481-5) (FWS, December 2008) and the Biological Opinion and Conference Opinion on the Long-Term Operations of the Central Valley Project and State Water Project (NMFS, June 2009).

Feather River area rice straw decomposition demand. Results from this analysis are displayed in Figure 7 and include adjustments for Delta surplus and August curtailments as previously discussed. The analysis shows that implementation of CVPIA and the salmon and smelt BOs may result in a slight decrease in the frequency of Term 91 curtailment periods during the April through June period, and an increase during the September through November period. Decreases in spring time curtailments are probably due to Delta export restrictions, while the increases in September through November are mostly due to the Fall X2 requirement in the smelt BO. It is important to note that even with consideration of D-1641 and the BOs, the analysis indicates no curtailments occur during the months of December through March. As this analysis demonstrates, Term 91 ensures that changes in regulatory conditions are accounted for in determining when water is available for appropriation.

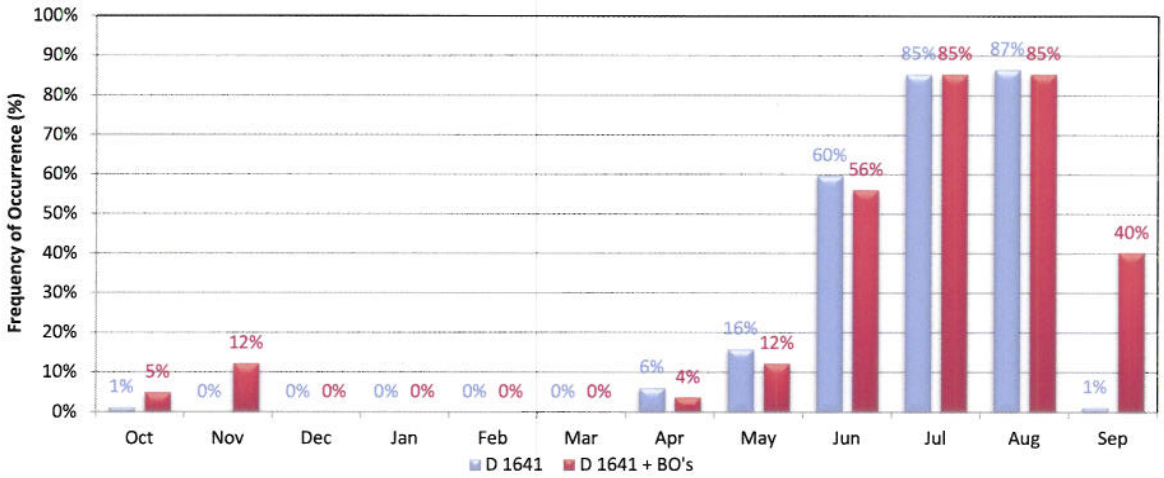

Figure 7 - Percent of Time Curtailment Periods Occur under D1641 and Current Conditions

EVALUATION OF IMPACTS ON FLOWS AND FISHERY RESOURCES

The Sacramento River in the vicinity of RGF provides habitat for resident and migratory fish species. During the winter period when the proposed diversion operation would occur, the primary fish species of interest inhabiting the area include juvenile winter-run Chinook salmon, spring-run Chinook salmon, Central Valley steelhead, and fall-run and late fall-run Chinook salmon. The proposed project would divert either drain water due to precipitation and return flows, where there are no fish, or from the Sacramento River through a positive barrier fish screen. For the protection of the juvenile salmonoids and other fish, the positive barrier fish screen will be designed and operated in accordance with the criteria developed by NMFS and DFG.

Table 3, below, provides a summary of the average and minimum daily flow rates for the Sacramento River below Wilkins Slough, based on the US Geological Survey's (USGS) 1938 through 2010 water discharge records for Station 11390500. A table containing the average and minimum flow rates for the USGS gauge is contained in Appendix B.

Table 3 - Summary of Discharge in the Sacramento River below Wilkins Slough

Water Years	Average Daily Flow (cfs)				Minimum Daily Flow (cfs)			
	Nov	Dec	Jan	Feb	Nov	Dec	Jan	Feb
1939-2010	7,829	11,907	15,019	16,765	2,890	3,460	4,150	4,050

Although this gauge is located approximately 28 miles upstream, it is the closest on the Sacramento River to RGF's point of diversion. A review of the Division's eWRIMS database found two water right permits between RGF's point of diversion and the Wilkins Slough gauge during the season of diversion proposed by RGF; Permit 20933 (Application 30410) of Pelger Mutual Water Company and Permit 21274 (Application 31436) of RD 108. Together, the maximum rate of diversion authorized under these two permits is 300 cfs; 60 cfs under Permit 20933 and 240 cfs under Permit 21274. After adjusting the daily flow rates identified in Table 3 to account for the 300 cfs under these two senior water rights, the maximum rate of diversion from the Sacramento River requested under the Application, 62 cfs, represents only about two percent of the lowest minimum daily flow rate in the Sacramento River below Wilkins Slough during the 1938 through 2010 period, and less than one percent of the average lowest average daily flow observed during this historical period. As identified previously, in addition to diverting water from the Sacramento River at its Townsite Pumping Plant, RGF is proposing to divert drain water from Lateral 14A at Jacob's Point under arrangements with RD 108. Diversions at Jacob's Point are by gravity. The maximum capacity of the facility is 61 cfs. Drain water not diverted by RGF or used within RD 108 is pumped into the Sacramento River upstream of the Townsite Pumping Plant. The timing and quantity of this return flow to the river is variable and uncertain. Due to the infrastructure between Jacob's Point and the return flow to the river, including RD 108's internal operations, it is unlikely that RGF's diversions at Jacob's Point would have a direct effect on flows in the Sacramento River. Although it is unlikely that RGF would divert water at the maximum capacity at both Jacob's Point and the Townsite Pumping Plant simultaneously, the combined capacity at the two points of diversion is 123 cfs; 62 cfs at the Townsite Pumping Plant and 61 cfs at Jacob's Point. This combined capacity represents less than five percent of the lowest minimum daily flow in the Sacramento River below Wilkins Slough during the 1938 through 2010 period; and less than two percent of the lowest average daily flow during this period.

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Attachments
Appendices

Water Availability Analysis

Appendix A
Daily Supplemental Project Water Releases

Term 91 Supplemental Project Water Releases
November 1, 1999 - March 1, 2000

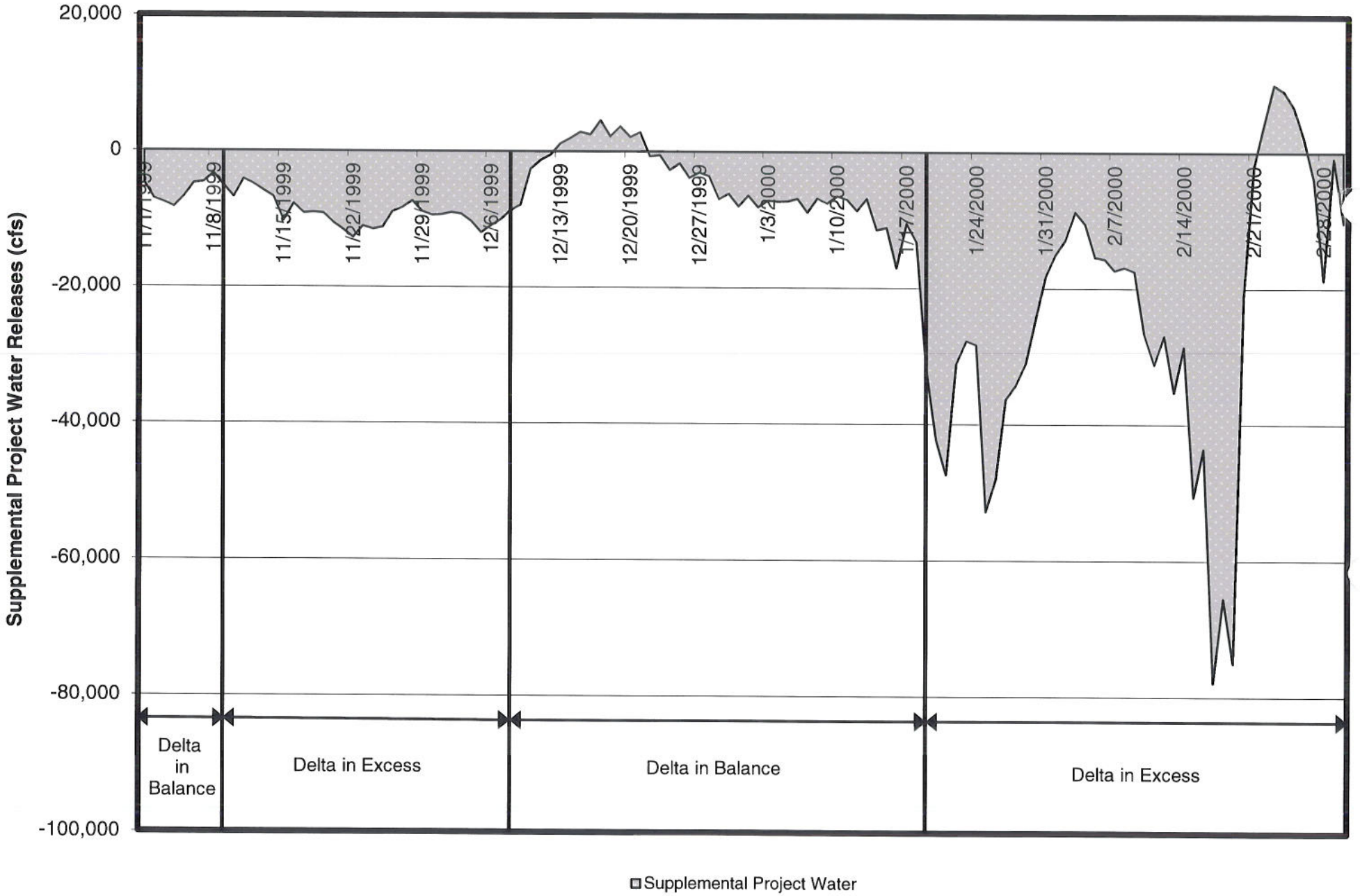

Figure A1

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Term 91 Supplemental Project Water Releases
November 1, 2000 - March 1, 2001

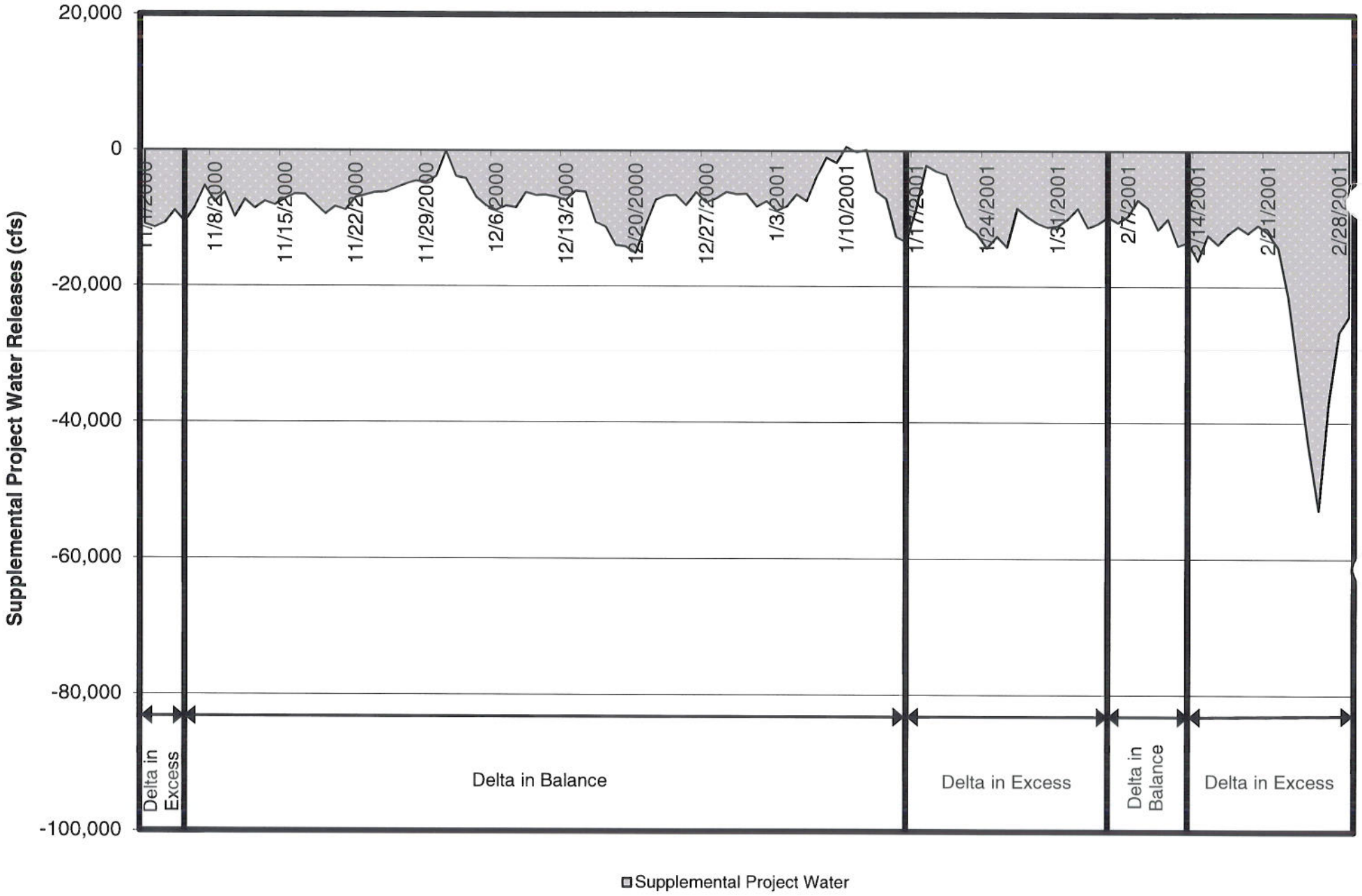

Figure A2

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Term 91 Supplemental Project Water Releases
November 1, 2001 - March 1, 2002

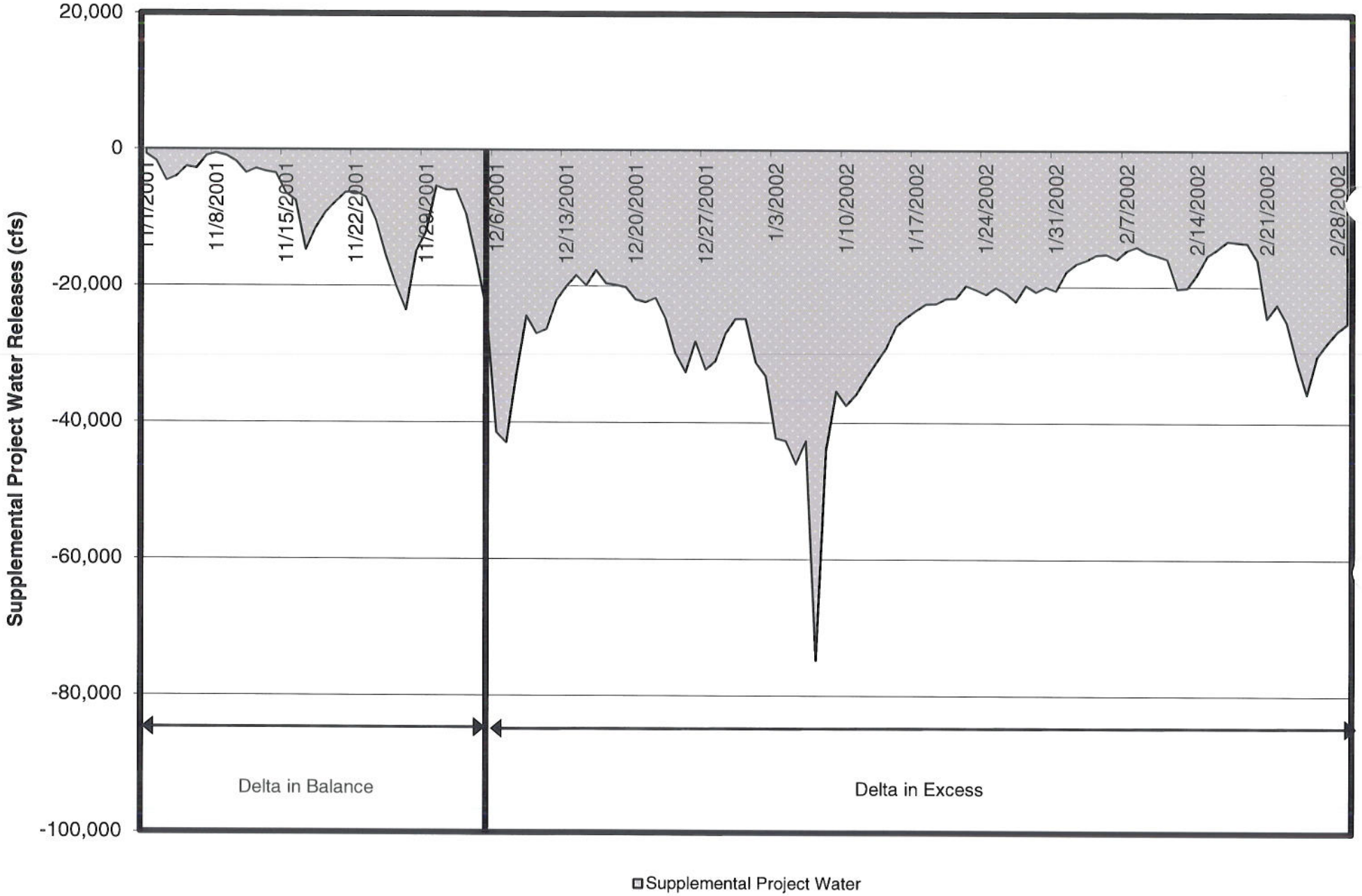

Figure A3

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Term 91 Supplemental Project Water Releases
November 1, 2002 - March 1, 2003

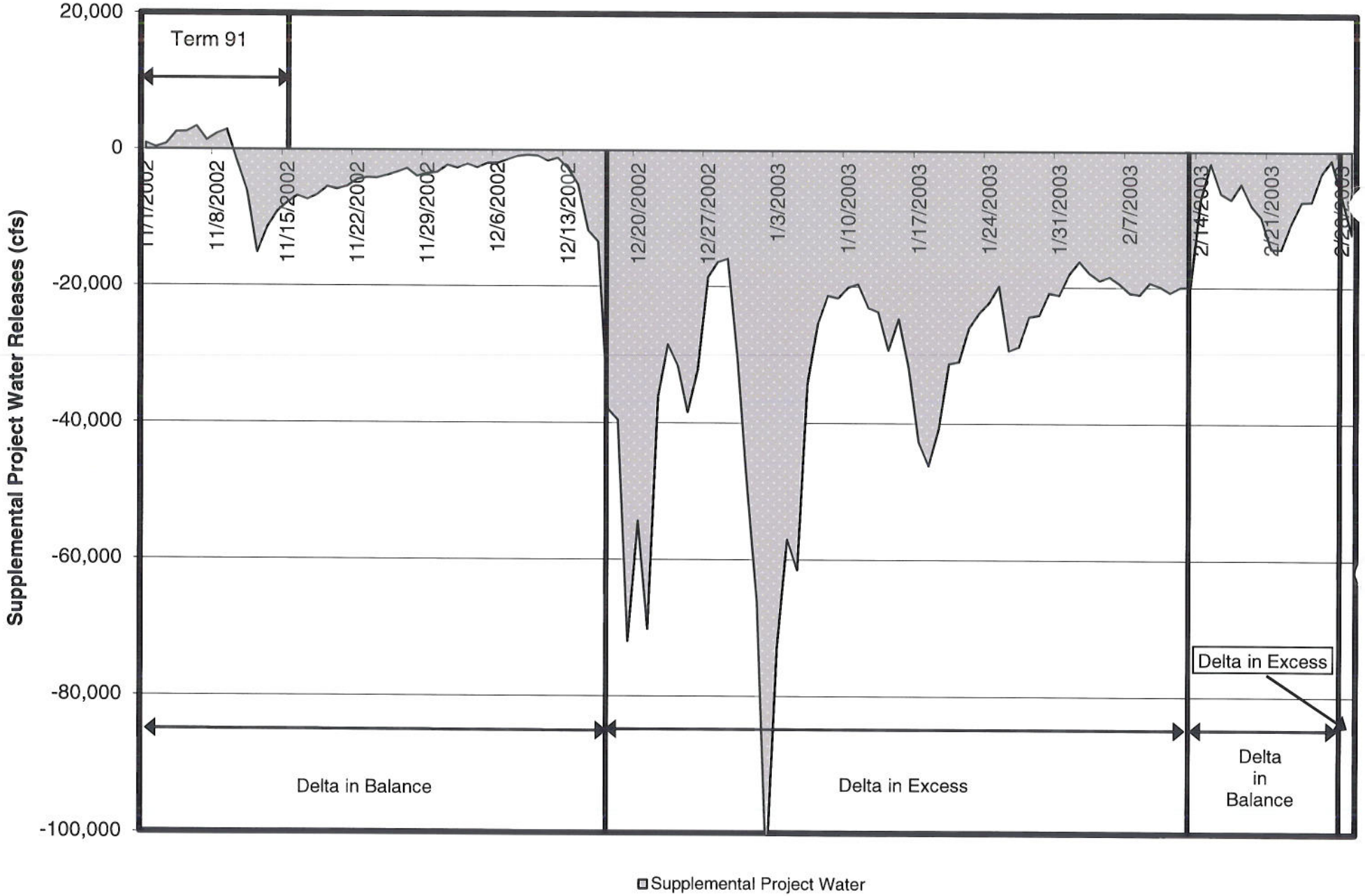

Figure A4

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Term 91 Supplemental Project Water Releases
November 1, 2003 - March 1, 2004

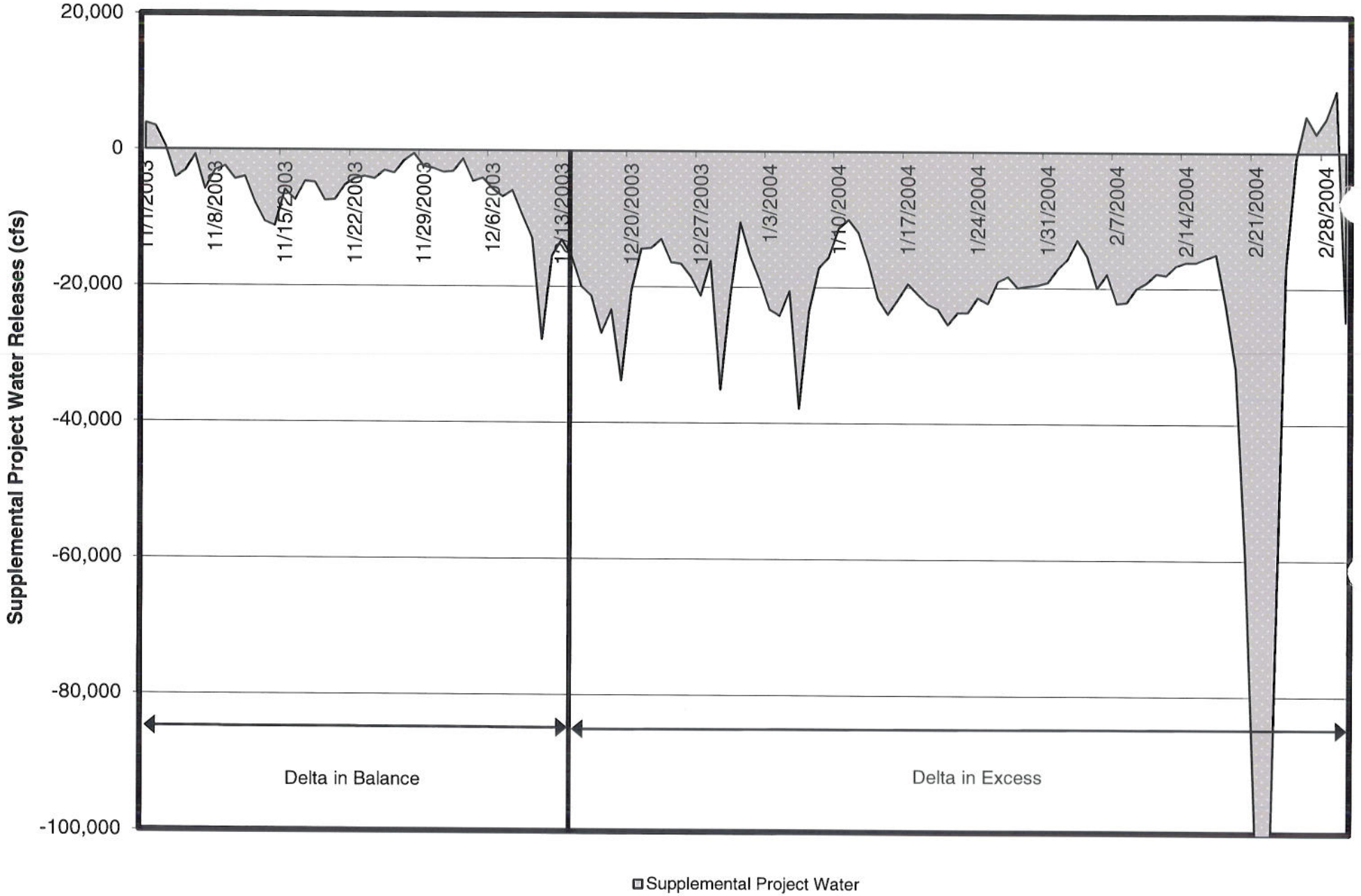

Figure A5

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Term 91 Supplemental Project Water Releases
November 1, 2004 - March 1, 2005

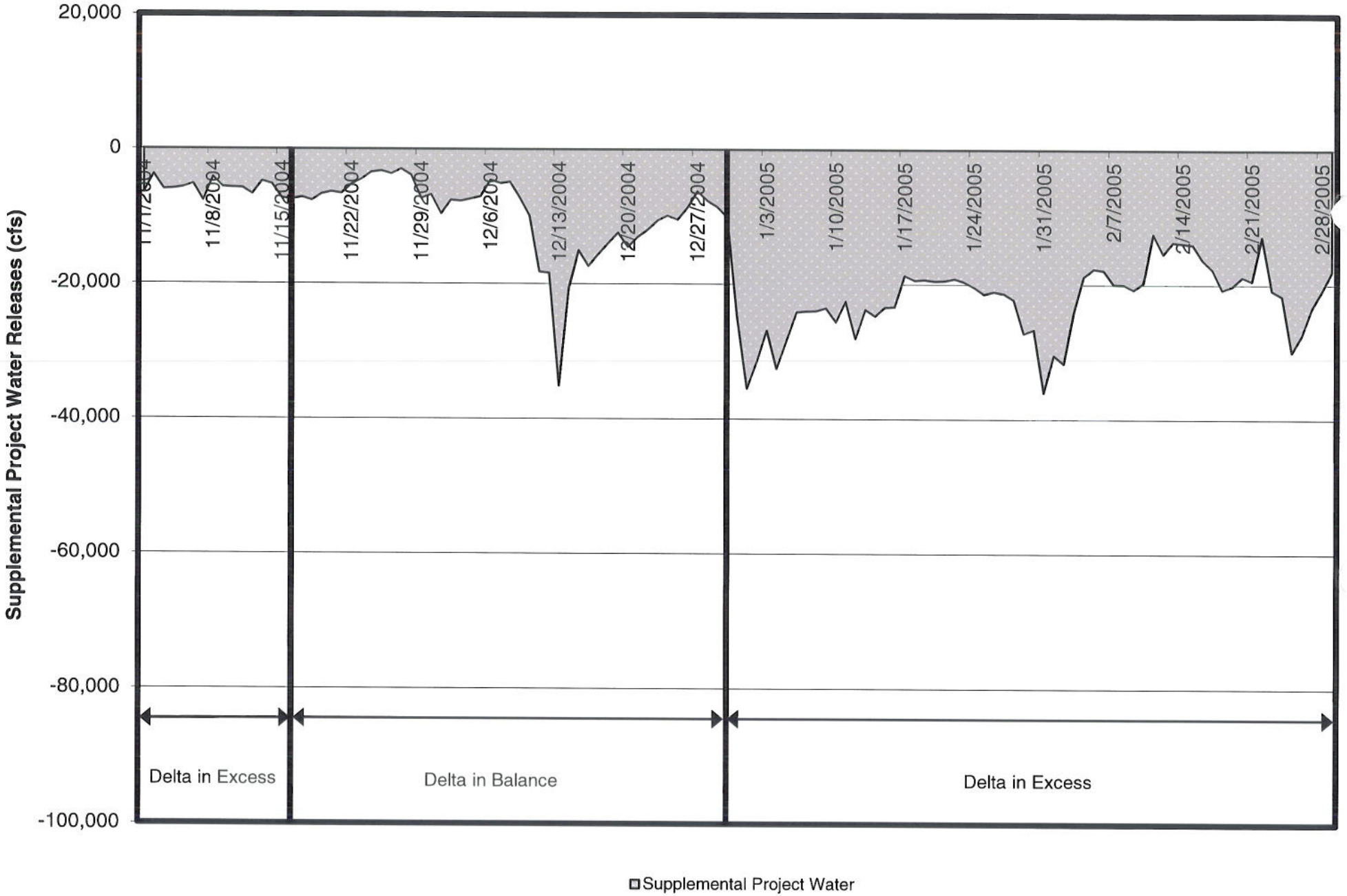

Figure A6

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Term 91 Supplemental Project Water Releases
November 1, 2005 - March 1, 2006

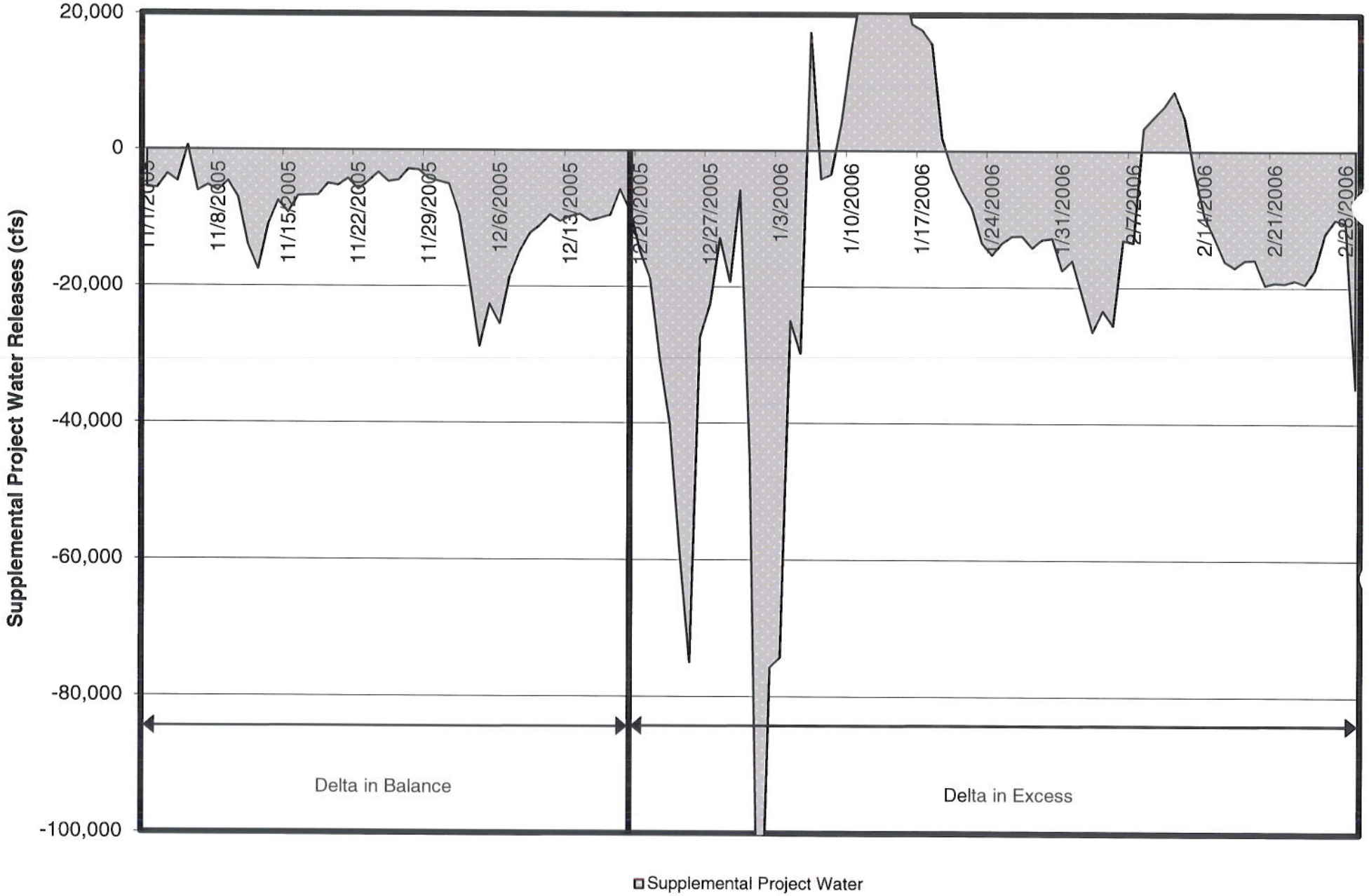

Figure A7

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Term 91 Supplemental Project Water Releases
November 1, 2006 - March 1, 2007

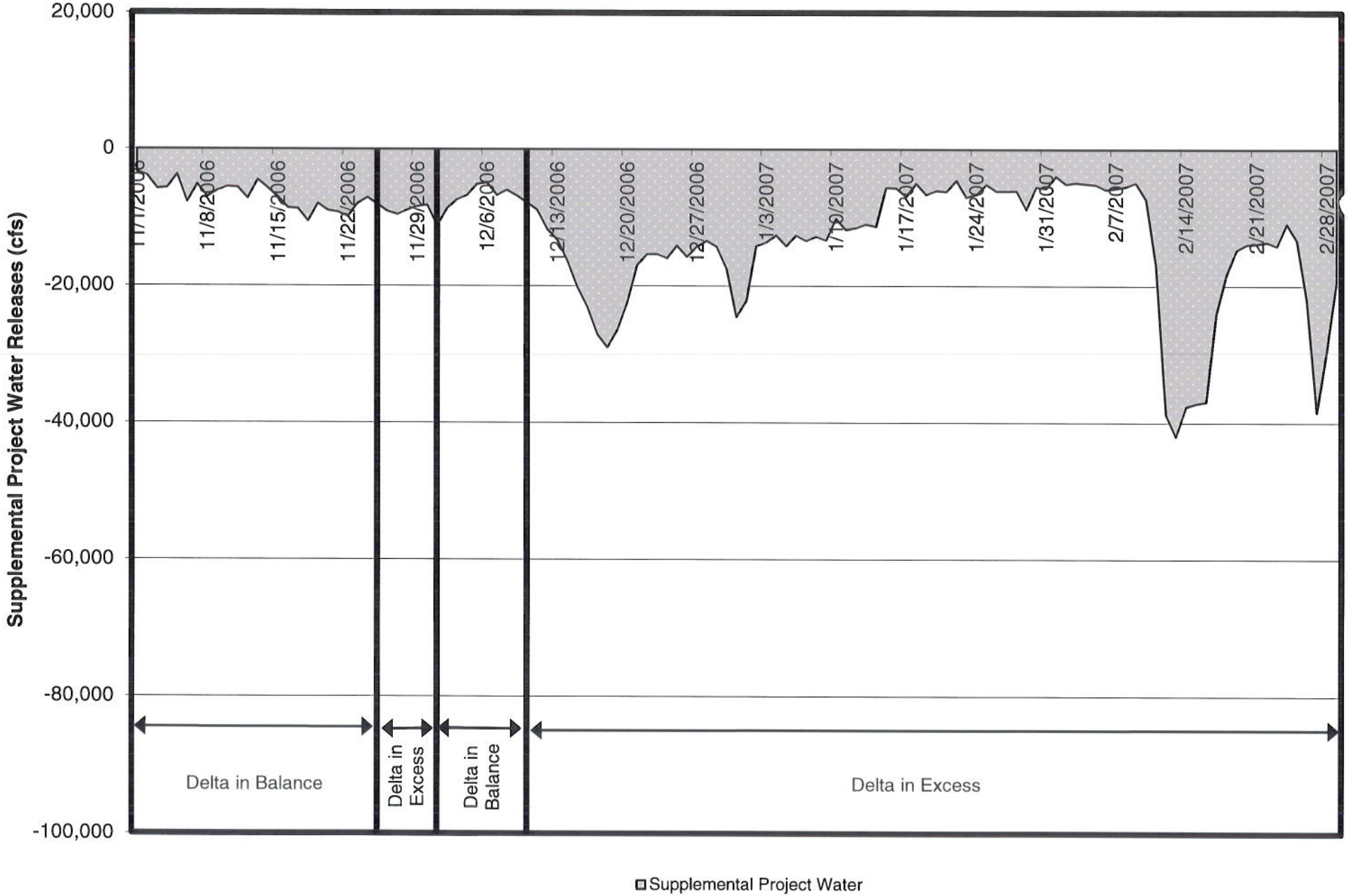

Figure A8

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Term 91 Supplemental Project Water Releases
November 1, 2007 - March 1, 2008

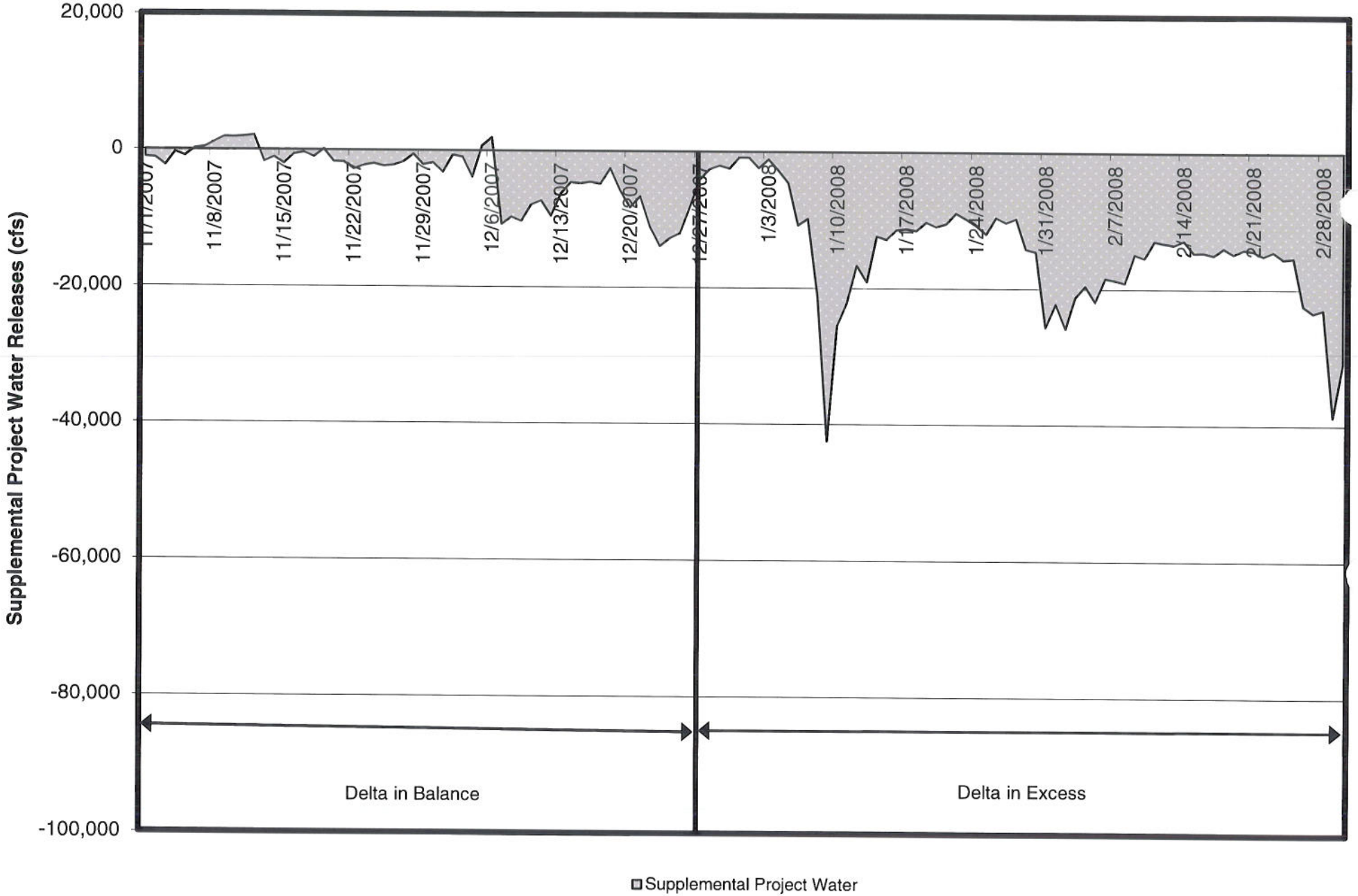

Figure A9

MBK*ENGINEERS*
1/20/2012

Term 91 Supplemental Project Water Releases
November 1, 2008 - March 1, 2009

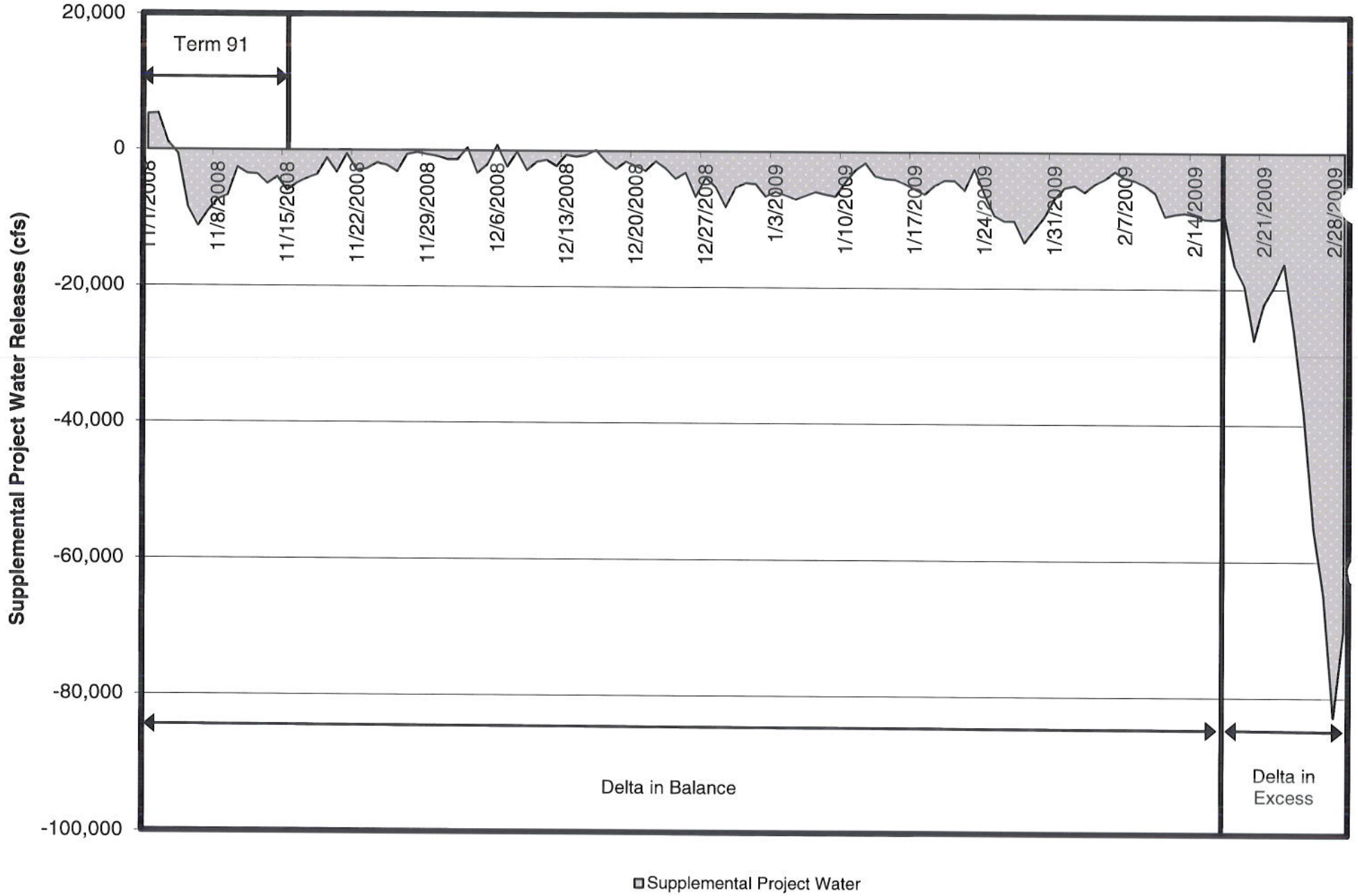

Figure A10

MBK*ENGINEERS*
1/20/2012

Term 91 Supplemental Project Water Releases
November 1, 2009 - March 1, 2010

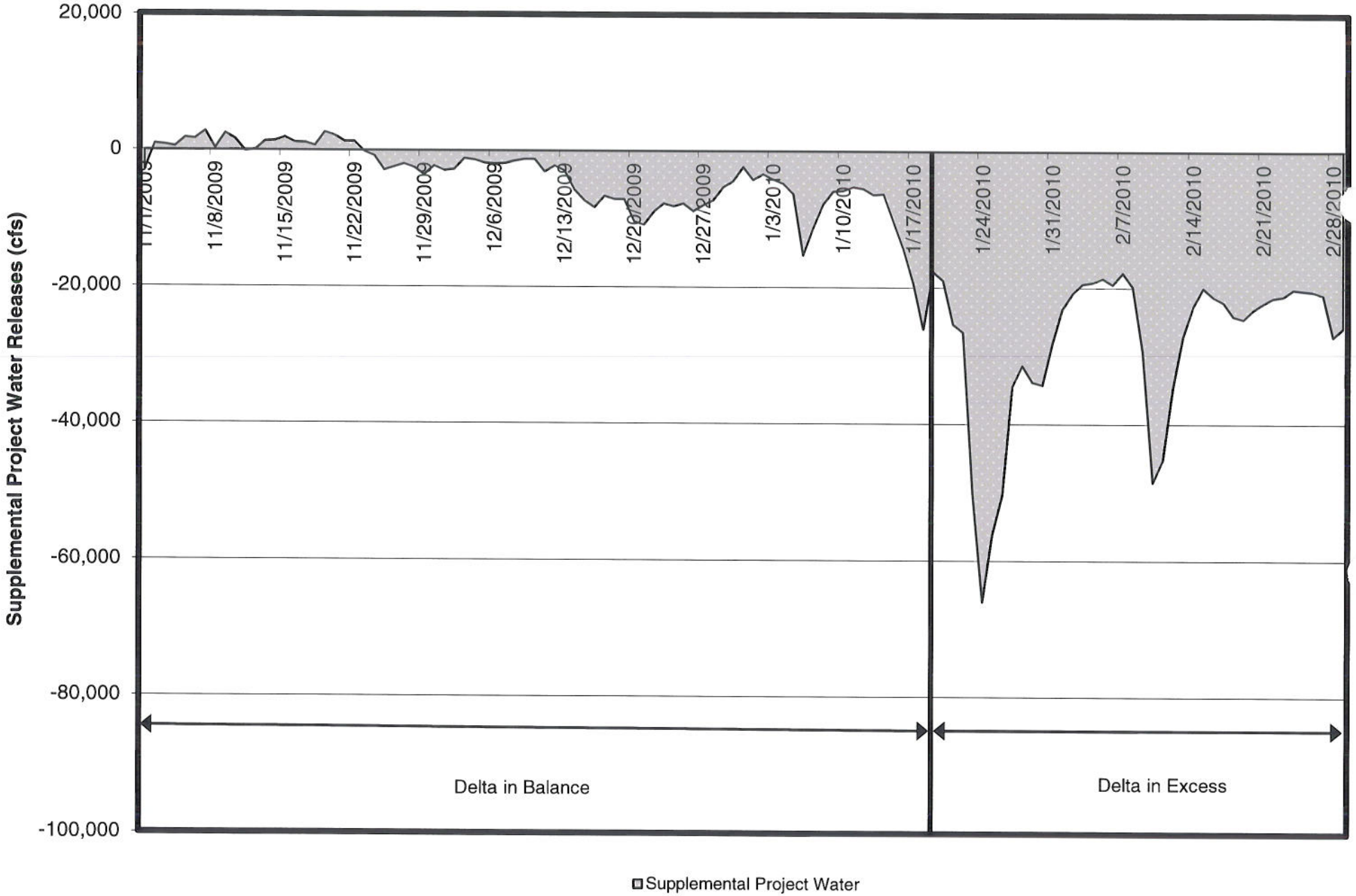

Figure A11

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1/20/2012

Term 91 Supplemental Project Water Releases
November 1, 2010 - March 1, 2011

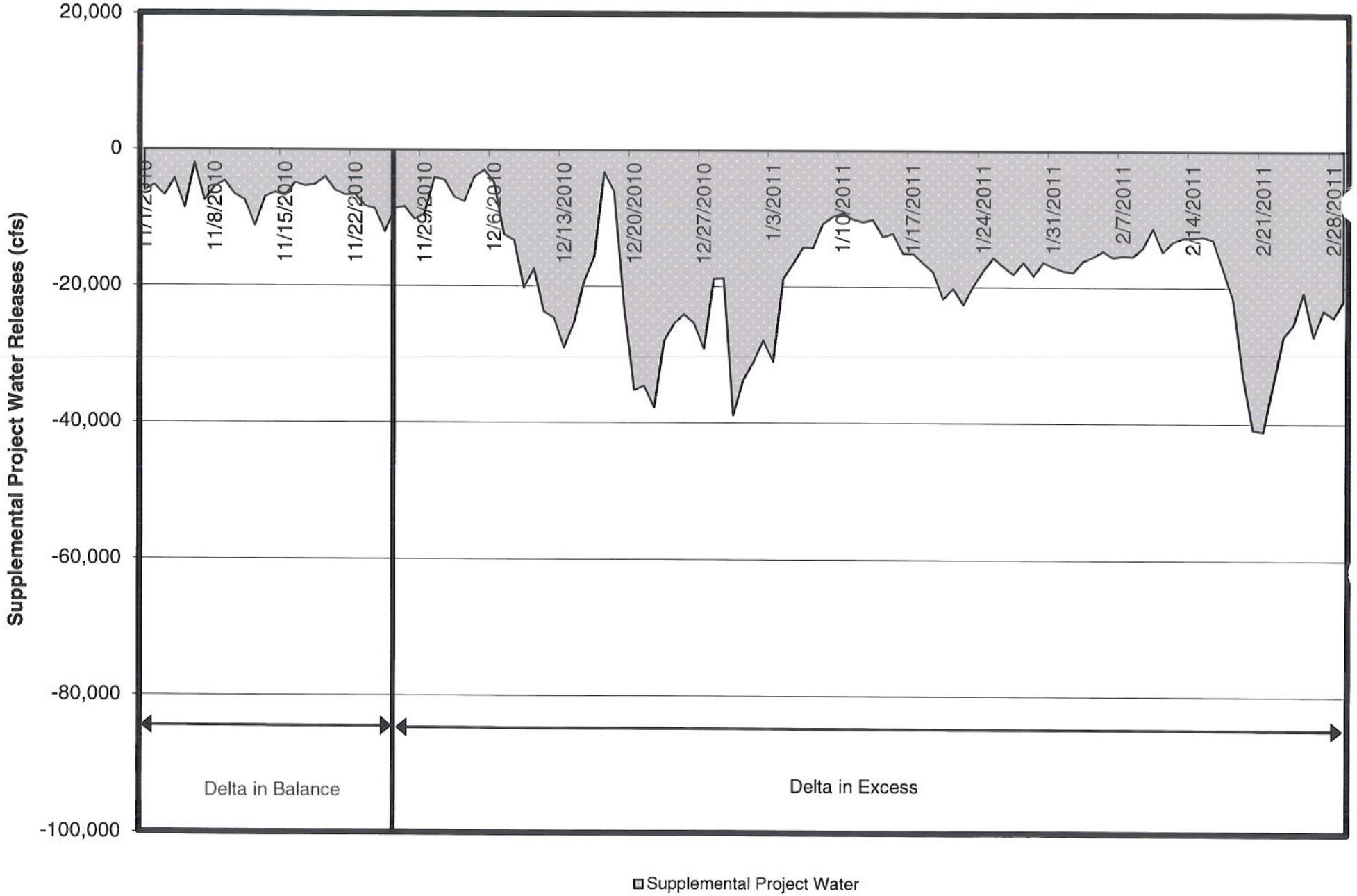

Figure A12

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Water Availability Analysis

Appendix B
Average and Minimum Daily Flow Rates for the Sacramento River near Wilkins Slough

Appendix B. Discharge in the Sacramento River below Wilkins Slough USGS Station 11390500

Water Year	Year Type	Average Daily Flow Rate (cfs)				Minimum Daily Flow Rate (cfs)			
		November	December	January	February	November	December	January	February
1939	Dry	6,138	8,372	7,902	8,648	5,240	6,060	6,390	6,700
1940	Above Normal	3,466	7,187	18,224	20,845	3,170	3,780	7,540	19,500
1941	Wet	5,944	11,654	21,490	21,500	4,690	4,480	20,000	20,300
1942	Wet	6,001	17,095	19,084	21,439	5,470	6,990	14,200	18,100
1943	Wet	6,604	10,605	15,646	19,893	4,830	7,130	8,020	17,600
1944	Dry	5,414	5,671	6,566	10,078	4,760	4,900	5,400	6,580
1945	Below Normal	6,313	8,815	8,249	15,653	**2,890**	4,940	6,880	8,800
1946	Below Normal	8,742	15,724	20,132	11,889	6,660	8,980	13,900	10,200
1947	Dry	7,082	9,607	7,210	9,385	5,750	7,300	6,390	5,300
1948	Below Normal	6,935	5,518	10,837	6,014	5,770	5,070	5,380	5,000
1949	Dry	7,006	7,904	7,240	7,089	6,670	6,770	5,680	5,320
1950	Below Normal	5,698	5,220	9,710	12,807	5,180	4,790	4,810	7,280
1951	Above Normal	11,316	19,395	17,239	20,721	5,770	9,820	11,800	16,500
1952	Wet	6,557	12,838	21,403	21,921	5,220	7,070	19,100	20,300
1953	Wet	5,745	17,103	23,352	15,424	5,090	5,760	20,400	9,080
1954	Above Normal	8,133	8,656	13,990	23,171	6,470	7,160	6,210	19,800
1955	Dry	8,990	13,261	11,709	8,319	5,620	6,700	8,980	7,460
1956	Wet	6,520	15,546	24,274	20,041	5,030	5,240	23,300	13,900
1957	Above Normal	8,035	7,296	6,736	7,880	7,120	6,470	5,580	5,090
1958	Wet	12,146	14,153	20,884	27,104	9,060	8,800	15,700	26,100
1959	Below Normal	8,001	7,458	16,503	18,757	7,780	6,640	6,280	11,600
1960	Dry	4,583	4,378	7,044	16,630	4,300	3,920	4,670	8,170
1961	Dry	6,876	10,512	7,023	22,389	5,140	6,400	6,140	14,500
1962	Below Normal	5,909	9,992	6,407	16,799	5,210	5,530	4,970	5,250
1963	Wet	7,489	14,656	10,585	22,443	6,720	8,730	8,210	18,200
1964	Dry	11,804	11,058	12,601	11,771	7,850	10,300	8,840	9,380
1965	Wet	8,609	13,691	25,342	18,786	5,640	5,820	24,500	10,500
1966	Below Normal	12,333	13,841	20,665	16,693	8,030	9,740	14,700	10,900
1967	Wet	11,727	21,861	14,191	20,882	6,990	14,500	7,080	13,700
1968	Below Normal	8,365	10,121	13,546	21,276	7,880	8,810	8,130	13,200
1969	Wet	8,467	15,402	21,020	26,111	7,960	7,950	9,510	24,400
1970	Wet	8,723	17,725	25,081	24,707	6,980	8,040	18,700	21,000
1971	Wet	12,966	24,945	22,794	17,386	7,470	21,300	17,800	10,900
1972	Below Normal	7,658	10,185	10,453	10,888	6,840	8,940	8,440	8,870
1973	Above Normal	13,894	15,516	23,155	25,811	7,340	9,780	14,200	23,600
1974	Wet	20,512	26,474	27,284	22,925	7,590	25,400	24,700	17,500
1975	Wet	10,586	12,061	9,801	21,826	8,180	9,200	8,590	8,840
1976	Critical	11,546	12,426	8,444	7,876	8,250	10,600	7,210	6,800
1977	Critical	4,445	4,103	6,766	5,749	4,070	3,710	5,350	4,730
1978	Above Normal	5,053	8,970	20,652	20,379	4,320	4,010	7,730	11,500
1979	Below Normal	6,767	7,397	10,951	14,133	5,630	7,280	6,720	5,590
1980	Above Normal	7,781	10,322	21,745	19,710	5,150	6,470	13,200	11,300
1981	Dry	6,107	9,725	11,274	13,607	4,590	6,540	5,910	8,860
1982	Wet	14,161	24,026	23,755	21,832	4,870	18,400	15,800	11,500
1983	Wet	14,009	22,177	18,026	28,439	9,540	12,400	10,400	27,500
1984	Wet	19,502	27,429	22,455	13,383	8,520	23,800	14,400	11,000
1985	Dry	16,861	17,987	9,481	9,259	7,000	11,200	8,670	7,560
1986	Wet	5,321	8,304	10,580	25,721	4,080	5,350	5,600	11,900
1987	Dry	6,764	7,409	8,103	10,897	5,710	7,080	5,980	6,580
1988	Critical	4,129	10,481	15,085	7,324	3,730	4,350	7,570	5,670
1989	Dry	7,129	8,006	8,184	6,831	4,250	6,020	6,240	5,830
1990	Critical	7,674	5,997	9,125	6,343	4,700	4,450	4,530	5,340
1991	Critical	4,446	4,944	5,281	5,013	3,850	4,530	4,370	**4,050**

Appendix B. Discharge in the Sacramento River below Wilkins Slough USGS Station 11390500

Water Year	Year Type	Average Daily Flow Rate (cfs)				Minimum Daily Flow Rate (cfs)			
		November	December	January	February	November	December	January	February
1992	Critical	3,956	4,480	6,290	15,992	3,730	3,670	4,790	4,680
1993	Above Normal	3,839	7,824	21,258	20,218	3,390	3,680	8,300	10,200
1994	Critical	5,468	8,185	7,207	11,436	5,190	5,880	5,820	5,990
1995	Wet	4,452	8,275	23,392	21,536	3,460	4,720	6,780	12,400
1996	Wet	5,292	11,137	16,275	26,003	4,790	5,390	7,810	22,500
1997	Wet	6,496	19,277	27,306	18,671	5,240	6,660	25,000	10,600
1998	Wet	6,792	11,462	21,895	29,086	4,180	7,310	7,190	27,500
1999	Wet	12,208	19,777	13,166	23,586	6,540	10,100	8,630	11,900
2000	Above Normal	6,788	8,794	12,556	25,945	5,080	7,040	6,290	18,600
2001	Dry	5,801	6,474	9,145	12,410	5,220	6,060	5,900	6,860
2002	Dry	6,824	17,076	18,832	10,687	4,520	9,550	10,200	8,370
2003	Above Normal	5,640	15,621	26,161	18,104	4,240	4,630	18,500	12,500
2004	Below Normal	5,417	16,411	18,329	21,048	4,670	5,500	10,500	11,000
2005	Above Normal	5,177	9,497	17,355	12,390	4,030	4,610	10,500	8,670
2006	Wet	5,811	15,357	26,597	20,143	4,950	6,240	18,200	11,900
2007	Dry	5,866	9,909	7,815	12,286	4,920	6,250	6,230	6,860
2008	Critical	5,224	6,597	13,119	15,534	4,320	5,390	6,400	9,470
2009	Dry	5,554	5,081	5,442	12,521	4,110	4,090	**4,150**	5,300
2010	Below Normal	4,126	4,887	13,946	17,086	3,820	**3,460**	4,750	11,900
Average Daily Flow Rate from WY 1939 to 2010		**7,829**	**11,907**	**15,019**	**16,765**				
Minimum Daily Flow Rate from WY 1939 to 2010						**2,890**	**3,460**	**4,150**	**4,050**