

APPENDIX E-1

**SUPPORTING DOCUMENTATION FOR DEVELOPMENTAL ANALYSIS,
PREFERRED PLAN AND ALTERNATIVES PROPOSED BY OTHERS**

ATTACHMENT B

GRAVEL MOBILIZATION FLOW AVAILABILITY

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Table B-1 below shows each water year, its designation using the SJI 60-20-20 index, and the total unimpaired flow at La Grange gage. In Wet (W) and Above Normal (AN) water years, sufficient flow would be available to provide two days of 6,500 cfs (26 TAF) with up and down ramping limits. In the 42-year period of record from 1971 through 2012, there are 21 years designated either W or AN. Wet and Above Normal water years that follow critical water years may not have sufficient predicted spills to provide gravel mobilization flows. This occurred in three of the 21 years in the '71-'12 period, leaving 19 of 42 years where sufficient water would be available to provide gravel mobilization flows. The release of gravel mobilization flows may also be limited by the status of fall-run Chinook or *O. mykiss* fry in the river, requiring consultation with resource agencies prior to releasing gravel mobilization flows.

Table 5 below is from the Operations Model simulation of the Districts' Preferred Plan. The complete results are provided in Appendix E-1, Attachment G. Table 5 lists under column DPP-1, TAF Resulting the year-by-year estimated flow in thousand acre-feet for the February through June period, inclusive, as measured at the USGS La Grange gage. There are 19 years in which the "TAF Resulting" exceeds the "TAF Required" by more than 100,000 acre-feet. In these years, there is sufficient flows to release 26 TAF, plus ramping, for gravel mobilization purposes.

As an additional check on years when there would be sufficient "TAF Resulting" flow to provide the gravel mobilization flow of 26 TAF, plus ramping, Tables 11 and 13 below (also from the Operations Model simulation of the Districts' Preferred Plan) show the years in which either seven consecutive days of a given flow or 14 consecutive days of a given flow would occur. In Table 11, there are 13 years in which a flow of 5,500 cfs occurred for seven consecutive days (totaling 76 TAF) and in Table 13, there are 14 years in which there occurred 14 consecutive days of 4,000 cfs (111 TAF).

A review of these tables indicates that sufficient flow would be available under the Districts' Preferred Plan to provide the 26 TAF of gravel mobilization flows in 25 percent to 35 percent of the years, or once every three to four years. Gravel mobilization flows would not be able to be provided during years of extended droughts; however, sediment-laden tributary flows would also be significantly reduced.

Table B-1. Water year, its designation using the SJI 60-20-20 index, and the total unimpaired flow at La Grange gage.

Water Year	San Joaquin Index	Unimpaired Flow at La Grange (TAF)	Base Case Flow at La Grange (TAF)	Water Year	San Joaquin Index	Unimpaired Flow at La Grange (TAF)	Base Case Flow at La Grange (TAF)
1971	BN	1,678	539	1992	C	832	105
1972	D	1,209	151	1993	W	2,556	235
1973	AN	2,031	613	1994	C	832	182
1974	W	2,239	1,050	1995	W	3,878	2098
1975	W	2,031	887	1996	W	2,305	1281
1976	C	672	185	1997	W	3,170	1954
1977	C	382	94	1998	W	3,308	2226
1978	W	2,900	349	1999	AN	2,094	974
1979	AN	1,912	876	2000	AN	1,949	916
1980	W	3,033	1,818	2001	D	1,096	233
1981	D	1,055	252	2002	D	1,430	137
1982	W	3,805	2,275	2003	BN	1,634	233
1983	W	4,632	3,689	2004	D	1,304	355
1984	AN	2,556	1,463	2005	W	2,973	1488
1985	D	1,233	340	2006	W	3,304	2270
1986	W	2,990	1,496	2007	C	850	182
1987	C	656	179	2008	C	1,146	119
1988	C	820	94	2009	BN	1,677	156
1989	C	1,312	116	2010	AN	1,881	349
1990	C	845	103	2011	W	3,536	2376
1991	C	1,104	116	2012	D	888	213

Table 5. Minimum Required and Resulting River February - June Flows at La Grange

WY	SJI	Base Case		DPP-1			
		TAF Required	TAF Resulting	TAF Required	TAF Resulting	% of Base Case Required	% of Base Case Resulting
76-77	Drought	133	133	172	172	129%	129%
87-92	Drought	403	403	451	451	112%	112%
1971	BN	173	399	173	417	100%	105%
1972	D	84	96	146	146	174%	152%
1973	AN	154	515	219	415	142%	81%
1974	W	176	760	223	767	127%	101%
1975	W	176	728	223	752	127%	103%
1976	C	83	83	102	102	123%	123%
1977	C	50	50	70	70	140%	140%
1978	W	154	193	216	219	140%	113%
1979	AN	176	683	223	691	127%	101%
1980	W	177	1,205	224	1,241	126%	103%
1981	D	101	151	146	219	145%	146%
1982	W	159	1,862	219	1,862	138%	100%
1983	W	176	2,287	223	2,298	127%	100%
1984	AN	177	552	224	617	126%	112%
1985	D	112	247	146	267	130%	108%
1986	W	154	1,388	219	1,342	142%	97%
1987	C	91	91	101	101	112%	112%
1988	C	50	50	70	70	140%	140%
1989	C	72	72	70	70	97%	97%
1990	C	59	59	70	70	119%	119%
1991	C	72	72	70	70	98%	98%
1992	C	60	60	70	70	116%	116%
1993	W	154	154	216	216	140%	140%
1994	C	93	93	101	101	108%	108%
1995	W	154	1,482	216	1,483	140%	100%
1996	W	177	1,126	224	1,140	126%	101%
1997	W	176	859	223	888	127%	103%
1998	W	176	1,667	223	1,680	127%	101%
1999	AN	176	774	223	781	127%	101%
2000	AN	177	791	224	832	126%	105%
2001	D	100	140	146	210	146%	150%
2002	D	86	86	142	142	165%	165%
2003	BN	130	182	169	169	130%	93%
2004	D	82	295	146	216	177%	73%
2005	W	154	1,289	219	1,235	142%	96%
2006	W	176	1,759	223	1,769	127%	101%
2007	C	94	94	101	101	108%	108%
2008	C	75	75	70	70	94%	94%
2009	BN	106	106	166	166	157%	157%
2010	AN	158	218	223	223	141%	102%
2011	W	176	1,489	223	1,500	127%	101%
2012	D	104	118	146	183	141%	156%
Average (1971-2012)		129	581	168	595	131%	102%
Average (1980-2009)		125	636	163	650	130%	102%
Total (1971-2012)		5,411	24,398	7,073	24,981	131%	102%
Total (1980-2009)		3,746	19,067	4,885	19,496	130%	102%

The average volume of 40% of the February - June unimpacted inflow for the period of record is 583 TAF.

The total volume of 40% of the February - June unimpacted inflow for the period of record is 24,495 TAF.

To reflect actual operations, water year type determinations are implemented in the model on April 16 of each year. Therefore, minimum flow requirements for the period October 1 through April 14 are determined based on the previous water year type. In the table above the required flow is summarized by water year (October 01 through September 30); which, if the previous year and current year water year types are not the same, will result in the required flow reflecting a combination of two water year types.

Table 11. February through June La Grange Consecutive 7 Day Flow Count

February through June of Water Year	DPP-1 Total La Grange Flow										
	Occurrences Of Flows Greater Than or Equal To Threshold Flow Value (cfs) For At Least 7 Days										
	1,500	2,000	2,500	3,000	3,500	4,000	4,500	5,000	5,500	6,000	6,500
1971	2	2	0	0	0	0	0	0	0	0	0
1972	0	0	0	0	0	0	0	0	0	0	0
1973	2	2	1	1	0	0	0	0	0	0	0
1974	2	1	2	2	2	2	0	0	0	0	0
1975	2	2	3	3	2	1	0	0	0	0	0
1976	0	0	0	0	0	0	0	0	0	0	0
1977	0	0	0	0	0	0	0	0	0	0	0
1978	1	1	0	0	0	0	0	0	0	0	0
1979	1	1	2	1	2	1	0	0	0	0	0
1980	1	1	3	2	2	3	2	2	1	1	1
1981	1	0	0	0	0	0	0	0	0	0	0
1982	1	2	3	2	2	2	3	3	3	3	3
1983	1	2	2	3	3	3	3	2	3	3	4
1984	2	2	1	2	1	0	0	0	0	0	0
1985	0	0	0	0	0	0	0	0	0	0	0
1986	1	1	1	2	2	3	1	1	1	1	2
1987	0	0	0	0	0	0	0	0	0	0	0
1988	0	0	0	0	0	0	0	0	0	0	0
1989	0	0	0	0	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	0	0	0	0	0
1991	0	0	0	0	0	0	0	0	0	0	0
1992	0	0	0	0	0	0	0	0	0	0	0
1993	1	1	0	0	0	0	0	0	0	0	0
1994	0	0	0	0	0	0	0	0	0	0	0
1995	1	1	1	1	1	1	1	2	4	3	3
1996	2	2	3	3	4	3	2	1	1	0	0
1997	2	2	1	1	1	1	1	1	1	1	1
1998	1	1	1	1	2	3	3	4	4	3	3
1999	2	2	2	2	2	1	1	1	1	1	0
2000	1	1	1	2	2	1	1	1	1	1	0
2001	1	0	0	0	0	0	0	0	0	0	0
2002	0	0	0	0	0	0	0	0	0	0	0
2003	1	0	0	0	0	0	0	0	0	0	0
2004	1	0	0	0	0	0	0	0	0	0	0
2005	1	2	2	2	2	4	3	2	2	1	1
2006	2	2	2	2	2	3	3	3	2	2	2
2007	0	0	0	0	0	0	0	0	0	0	0
2008	0	0	0	0	0	0	0	0	0	0	0
2009	1	0	0	0	0	0	0	0	0	0	0
2010	1	1	0	0	0	0	0	0	0	0	0
2011	1	1	1	1	1	1	1	2	2	1	1
2012	1	0	0	0	0	0	0	0	0	0	0
Total number of periods where flow is greater than threshold flow for at least seven consecutive days	37	33	32	33	33	33	25	25	26	21	21
Number of years flows NOT achieved for threshold period	14	20	24	24	25	26	29	29	29	30	32

Table 13. February through June La Grange Consecutive 14 Day Flow Count

February through June of Water Year	DPP-1 Total La Grange Flow										
	Occurrences Of Flows Greater Than or Equal To Threshold Flow Value (cfs) For At Least 14 Days										
	1,500	2,000	2,500	3,000	3,500	4,000	4,500	5,000	5,500	6,000	6,500
1971	2	1	0	0	0	0	0	0	0	0	0
1972	0	0	0	0	0	0	0	0	0	0	0
1973	1	1	1	0	0	0	0	0	0	0	0
1974	1	1	2	2	1	0	0	0	0	0	0
1975	1	1	1	1	0	0	0	0	0	0	0
1976	0	0	0	0	0	0	0	0	0	0	0
1977	0	0	0	0	0	0	0	0	0	0	0
1978	1	1	0	0	0	0	0	0	0	0	0
1979	1	1	2	1	1	1	0	0	0	0	0
1980	1	1	3	2	1	1	1	1	1	1	1
1981	0	0	0	0	0	0	0	0	0	0	0
1982	1	2	2	2	2	2	3	3	3	3	2
1983	1	1	1	2	2	2	2	2	2	2	3
1984	2	2	1	1	0	0	0	0	0	0	0
1985	0	0	0	0	0	0	0	0	0	0	0
1986	1	1	1	2	2	1	1	1	1	1	2
1987	0	0	0	0	0	0	0	0	0	0	0
1988	0	0	0	0	0	0	0	0	0	0	0
1989	0	0	0	0	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	0	0	0	0	0
1991	0	0	0	0	0	0	0	0	0	0	0
1992	0	0	0	0	0	0	0	0	0	0	0
1993	1	1	0	0	0	0	0	0	0	0	0
1994	0	0	0	0	0	0	0	0	0	0	0
1995	1	1	1	1	1	1	1	1	2	1	1
1996	2	2	2	1	2	1	1	1	1	0	0
1997	2	2	1	1	1	1	1	1	1	1	1
1998	1	1	1	1	2	3	3	3	3	3	1
1999	1	2	1	1	1	1	1	1	0	0	0
2000	1	1	1	2	1	1	1	1	0	0	0
2001	0	0	0	0	0	0	0	0	0	0	0
2002	0	0	0	0	0	0	0	0	0	0	0
2003	1	0	0	0	0	0	0	0	0	0	0
2004	0	0	0	0	0	0	0	0	0	0	0
2005	1	2	2	2	2	3	2	2	1	1	1
2006	2	2	2	2	2	3	3	2	2	2	2
2007	0	0	0	0	0	0	0	0	0	0	0
2008	0	0	0	0	0	0	0	0	0	0	0
2009	1	0	0	0	0	0	0	0	0	0	0
2010	1	1	0	0	0	0	0	0	0	0	0
2011	1	1	1	1	1	1	1	2	1	1	1
2012	0	0	0	0	0	0	0	0	0	0	0
Total number of periods where flow is greater than threshold flow for at least fourteen consecutive days	29	29	26	25	22	22	21	21	18	16	15
Number of years flows NOT achieved for threshold period	18	20	24	25	27	28	29	29	31	32	32