

20.1 Introduction

This chapter presents the preferred Lower San Joaquin River flow (LSJR) and southern Delta water quality (SDWQ) alternatives and a summary of their associated impact analyses. The LSJR alternatives and SDWQ alternatives analyzed in the preceding chapters and in the appendices were selected in order to evaluate and compare the different environmental, economic, and hydropower effects of a broad range of conceivable LSJR flow and southern Delta water quality requirements. The preferred alternatives were identified after reviewing and considering this information and information included in the administrative record for this substitute environmental document (SED). Accordingly, the preferred alternatives were not identified in the preceding chapters or in the appendices at the end of this SED but are instead identified in this chapter. Proposed changes to the 2006 Bay-Delta Plan reflecting the preferred alternatives is included in Appendix K, *Revised Water Quality Control Plan*. The Preferred LSJR Alternative includes the same provisions as LSJR Alternatives 2–4 (described in Chapter 3, *Alternatives Description*), but includes a different percent (35 percent) of unimpaired February–June flow requirements for the Stanislaus, Tuolumne, and Merced Rivers. The Preferred SDWQ Alternative is SDWQ Alternative 2, which calls for salinity levels of 1.0 deciSiemens per meter (dS/m) (see Chapter 3 and Appendix K).

The Preferred LSJR Alternative (35 percent unimpaired flow) is not explicitly analyzed in the preceding chapters of this SED. Instead, the Preferred LSJR Alternative falls within the range of alternatives analyzed in those chapters (20–60 percent of unimpaired flows) and is, accordingly, encompassed by those analyses. As the Preferred SDWQ Alternative is SDWQ Alternative 2, it was explicitly analyzed in the preceding SED chapters. A summary of the impact analyses for the Preferred LSJR Alternative is presented in Section 20.2 and Section 20.3 presents the conclusions of the analyses of the Preferred LSJR Alternative and Preferred SDWQ Alternative.

20.2 Preferred LSJR Alternative Impact Analysis

Since the Preferred LSJR Alternative (35 percent unimpaired flow) falls between LSJR Alternative 2 (20 percent unimpaired flow) and LSJR Alternative 3 (40 percent unimpaired flow), in order to determine the level of impact under the Preferred LSJR Alternative, impacts determinations under LSJR Alternatives 2 and 3 were evaluated. Where LSJR Alternatives 2 and 3 have the same level of significance, it was determined that the Preferred LSJR Alternative would have the same level of significance. Where there is a difference between the impact levels under LSJR Alternative 2 and 3, an analysis was conducted to determine if the impacts for the Preferred LSJR Alternative aligns with LSJR Alternative 2 or 3. As with LSJR Alternatives 1–4, the State Water Resource Control Board’s (State Water Board) Environmental Checklist was used to determine levels of significance and identify potential environmental impacts related to the Preferred LSJR Alternative. In addition, an economic analysis was done to determine economic impacts related to the Preferred LSJR Alternative. Table 20-1 restates all the impacts analyzed in the SED and the levels of significance

associated with LSJR Alternatives 2 and 3. Where there is a difference between impact levels under LSJR Alternatives 2 and 3, an impact analysis is presented in Sections 20.2.1 through 20.2.10 followed by an economic analysis of the Preferred LSJR Alternative in Section 20.2.11. Impacts analyzed in this chapter are indicated in bold in Table 20-1.

Table 20-1. Impacts and Levels of Significance for LSJR Alternatives 2 and 3

Impact	LSJR Alternative 2	LSJR Alternative 3	Resource Area	SED Chapter
HYD-1	S	LS	Water Supply, Surface Hydrology, and Water Quality	5
HYD-2	LS	LS		
WS-1	LS	S		
WQ-1	LS	LS		
WQ-2	LS	LS		
WQ-3	S	LS		
WQ-4	S	LS		
FLO-1	LS	LS		
FLO-2	LS	LS		
AQUA-1	LS	LS	Aquatic Resources	7
AQUA-2	LS	LS		
AQUA-3	S	LS		
AQUA-4	S	LS		
AQUA-5	S	LS		
AQUA-6	LS	LS		
AQUA-7	S	LS		
AQUA-8	LS	LS		
AQUA-9	LS	LS		
AQUA-10	S	LS		
AQUA-11	S	LS		
AQUA-12	S	LS		
AQUA-13	LS	LS		
BIO-1	S	LS	Terrestrial Biological Resources	8
BIO-2	LS	LS		
BIO-3	LS	LS		
BIO-4	S	LS		
BIO-5	S	LS		
GW-1	LS	S	Groundwater Resources	9
REC-1	LS	S	Recreational Resources and Visual Quality	10
REC-2	LS	LS		
REC-3	LS	LS		
AG-1	LS	S	Agricultural Resources	11
AG-2	LS	LS		
CUL-1	LS	LS	Cultural Resources	12
CUL-2	LS	LS		
CUL-3	LS	LS		

Impact	LSJR Alternative 2	LSJR Alternative 3	Resource Area	SED Chapter
SP-1	LS	LS	Service Providers	13
SP-2	LS	S		
SP-3	LS	LS		
SP-4	LS	S		
ECC-1	LS	LS	Energy Resources and Climate Change	14
ECC-2	LS	LS		
ECC-3	LS	S		
ECC-4	LS	S		
ECC-5	LS	LS		

S = significant and unavoidable
 LS = less than significant
 Bold = impacts addressed in this chapter (impacts that have different levels of significance under Alternatives 2 and 3)

20.2.1 Water Supply, Surface Hydrology, and Water Quality Impacts Analysis

Chapter 5, *Water Supply, Surface Hydrology, and Water Quality*, discusses potential impacts on the water supply, surface hydrology, and water quality in the plan area. As shown in Table 20-1, there are seven impacts identified in Chapter 5, of which three impacts have the same levels of significance between LSJR Alternatives 2 and 3. It is reasonably assumed that for these impacts—HYD-2, WQ-1, and WQ-2—the Preferred LSJR Alternative would have the same, less-than-significant impacts. Below is an impacts analysis for HYD-1, WS-1, WQ-3, and WQ-4, which did not have the same levels of significance between the two alternatives. As described in Chapter 5, significant impacts on water supply, surface hydrology, or water quality (salinity or temperature) would result if the alternatives would: substantially reduce river flows, substantially reduce annual surface water supply diversions, violate salinity or temperature water quality objectives, or substantially degraded water quality such that it does not protect agricultural beneficial uses.

Hydrologic Impact

HYD-1: Substantially reduce monthly river flow values caused by the percent unimpaired flow objective (*Less than significant*)

Significant impacts on hydrology may occur due to significant reductions in flows. Hydrologic impacts of the Preferred LSJR Alternative were analyzed using the State Water Board’s WSE modeling output showing the changes in flows under the Preferred LSJR Alternative (35 percent unimpaired flow February–June) compared to baseline and LSJR Alternatives 2 (20 percent unimpaired flow) and 3 (40 Percent unimpaired flow). Figure 20-1 shows the resulting distribution of total annual February–June flows on each of the three eastside tributaries and on the SJR at Vernalis for the Preferred LSJR Alternative, LSJR Alternatives 2 and 3, and baseline. The distribution of the Preferred LSJR Alternative is similar to the distribution of LSJR Alternative 3 and much greater in magnitude than LSJR Alternative 2. Table 20-2 summarizes the flow effects compared to baseline for LSJR Alternatives 2 and 3 and the Preferred LSJR Alternative. The total average February–June flow difference from baseline for the Preferred LSJR Alternative falls between LSJR Alternatives 2 and 3 and is close to LSJR Alternative 3.

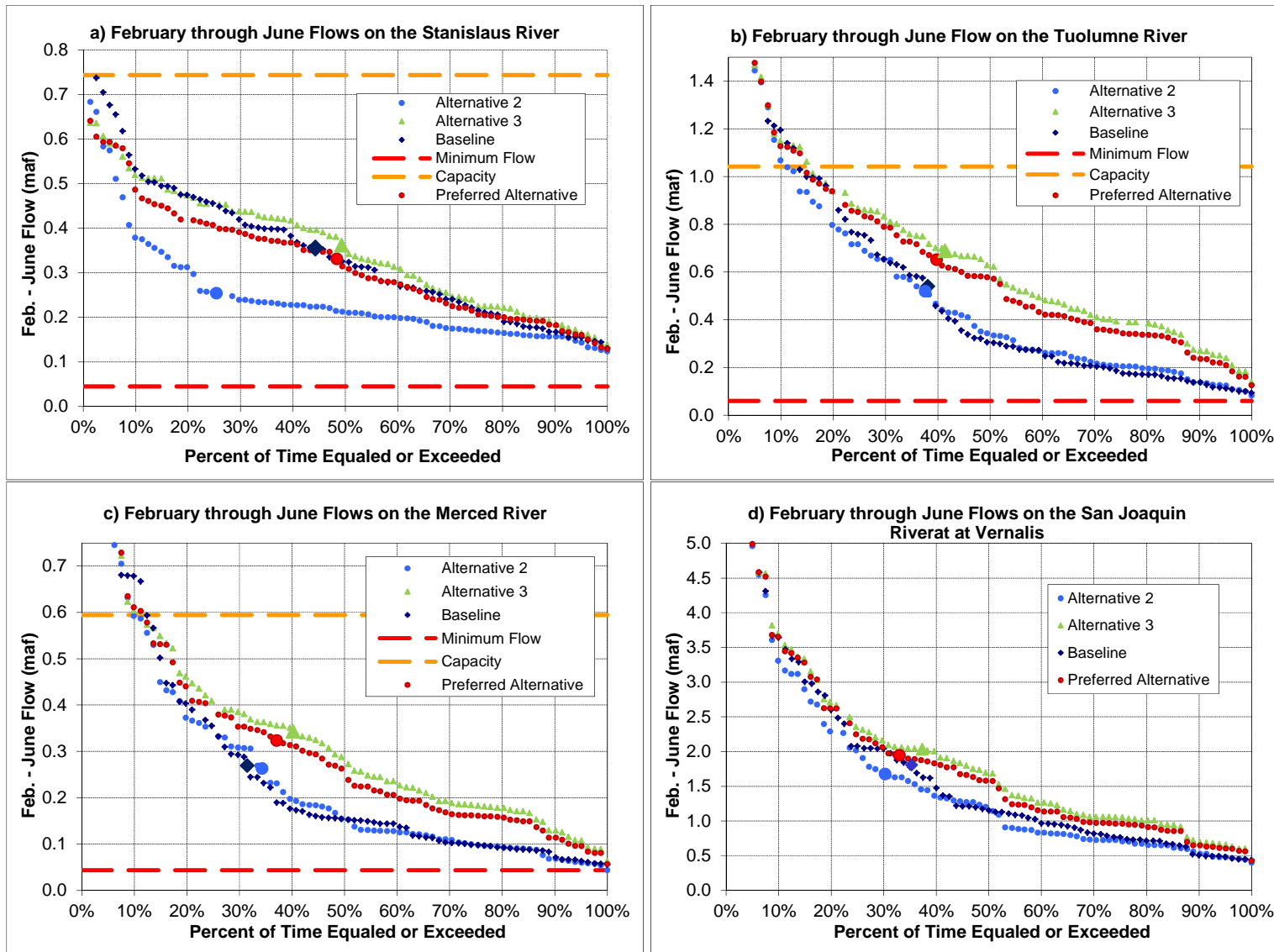


Figure 20-1. February–June Flow for the Baseline, Preferred LSJR Alternative, LSJR Alternative 2 and LSJR Alternative 3 (Preferred Alternative, Alternative 2, and Alternative 3) on the: a) Stanislaus River, b) Tuolumne River, c) Merced River, and d) SJR at Vernalis (maf = million acre-feet)

Table 20-2. Average February–June Baseline Flow and Difference from Baseline for LSJR Alternatives 2 and 3 and the Preferred LSJR Alternative on each Tributary and on SJR at Vernalis

	Stanislaus River near Ripon TAF/ (%)	Tuolumne River near Modesto TAF / (%)	Merced River near Stevinson TAF / (%)	San Joaquin River near Vernalis TAF/ (%)
Baseline	355 / (100)	540/ (100)	270/ (100)	1804/ (100)
Difference from Baseline for LSJR Alternative 2	-93 / (-26)	-21 / (-4)	-7 / (-2)	-121 / (-7)
Difference from Baseline for Preferred LSJR Alternative ¹	-24 / (-7)	111 / (21)	54 / (20)	141 / (8)
Difference from Baseline for LSJR Alternative 3	4 / (1)	148 / (27)	72 / (27)	225 / (12)

Notes: Resulting flow effects on the tributaries are as calculated near the confluence with the SJR, specifically at Ripon, Modesto, and Stevinson.
TAF = thousand acre-feet

As demonstrated in Table 20-2, the flows associated with the LSJR Preferred LSJR Alternative are slightly less than LSJR Alternative 3 and considerably higher than LSJR Alternative 2 flows. Compared to baseline, flows under the Preferred LSJR Alternative are higher on the Merced, Tuolumne, and SJR at Vernalis, but slightly lower on the Stanislaus River. While flows may be slightly more than 5 percent lower than baseline on the Stanislaus River under the Preferred LSJR Alternative, as indicated in Figure 20-1(a), those reduction in flows compared to baseline are minimal and would only occur in the wetter 40 percent of years when potential impacts would be minimized due to already relatively high flow conditions. Further, total flows from the LSJR Watershed would be higher under the Preferred LSJR Alternative and would have generally beneficial effects for the watershed. Additionally, the National Marine Fisheries Service biological opinion Stanislaus River reasonable and prudent alternative, including Action 3.1.3 (NMFS BO) flows required on the Stanislaus River are included in the baseline. However, these flows are not included in the WSE modeling of the LSJR alternatives, including the Preferred LSJR Alternative. Instead, the WSE modeling of the LSJR alternatives assumes that a certain percent (i.e., 35 percent) of unimpaired flow would be met. As a result, when the WSE model results are compared to baseline, the modeling shows some flow reductions in the Stanislaus River. However, because the LSJR alternatives would not directly result in any changes to the NMFS BO flow requirements on the Stanislaus River, actual reductions in flows below the NMFS BO flows would be unlikely. While the NMFS BO flow requirements may change in the future as a result of coordination between the State Water Board, NMFS, and others, it is not expected that flows would be reduced to a level that would result in impacts related to flow. Based on the above, impacts under the Preferred LSJR Alternative would be less than significant for HYD-1.

Water Supply Impact

WS-1: Substantially reduce surface water supply diversions caused by a change in river flows or reduce exports to CVP and SWP export service areas caused by a change in river flows (Significant and unavoidable)

Water supply impacts of the Preferred LSJR Alternative were analyzed by comparing WSE modeling output showing the changes in diversions under the Preferred LSJR Alternative (35 percent unimpaired February–June flow) compared to baseline and LSJR Alternatives 2 (20 percent unimpaired flow) and 3 (40 Percent unimpaired flow). Water supply impacts were estimated by quantifying modeled changes in the volume of diversions and the modeled end-of-September storage in New Melones, New Don Pedro, and New Exchequer Reservoirs. Reductions in diversions of more than 5 percent were considered to result in significant impacts to water supply.

Figure 20-2 contains the resulting distribution of total annual diversions from each of the eastside tributaries and the combined effect of the three tributaries for the LSJR under the Preferred LSJR Alternative, LSJR Alternatives 2 and 3, and baseline. The distribution of total annual diversions for the Preferred LSJR Alternative is close to the distribution for LSJR Alternative 3 and much greater than LSJR Alternative 2. Table 20-3 summarizes the diversion effects compared to baseline for LSJR Alternatives 2 and 3 and the Preferred LSJR Alternative. The average annual diversion differences from baseline under the Preferred LSJR Alternative are between those for LSJR Alternatives 2 and 3, but closer to LSJR Alternative 3.

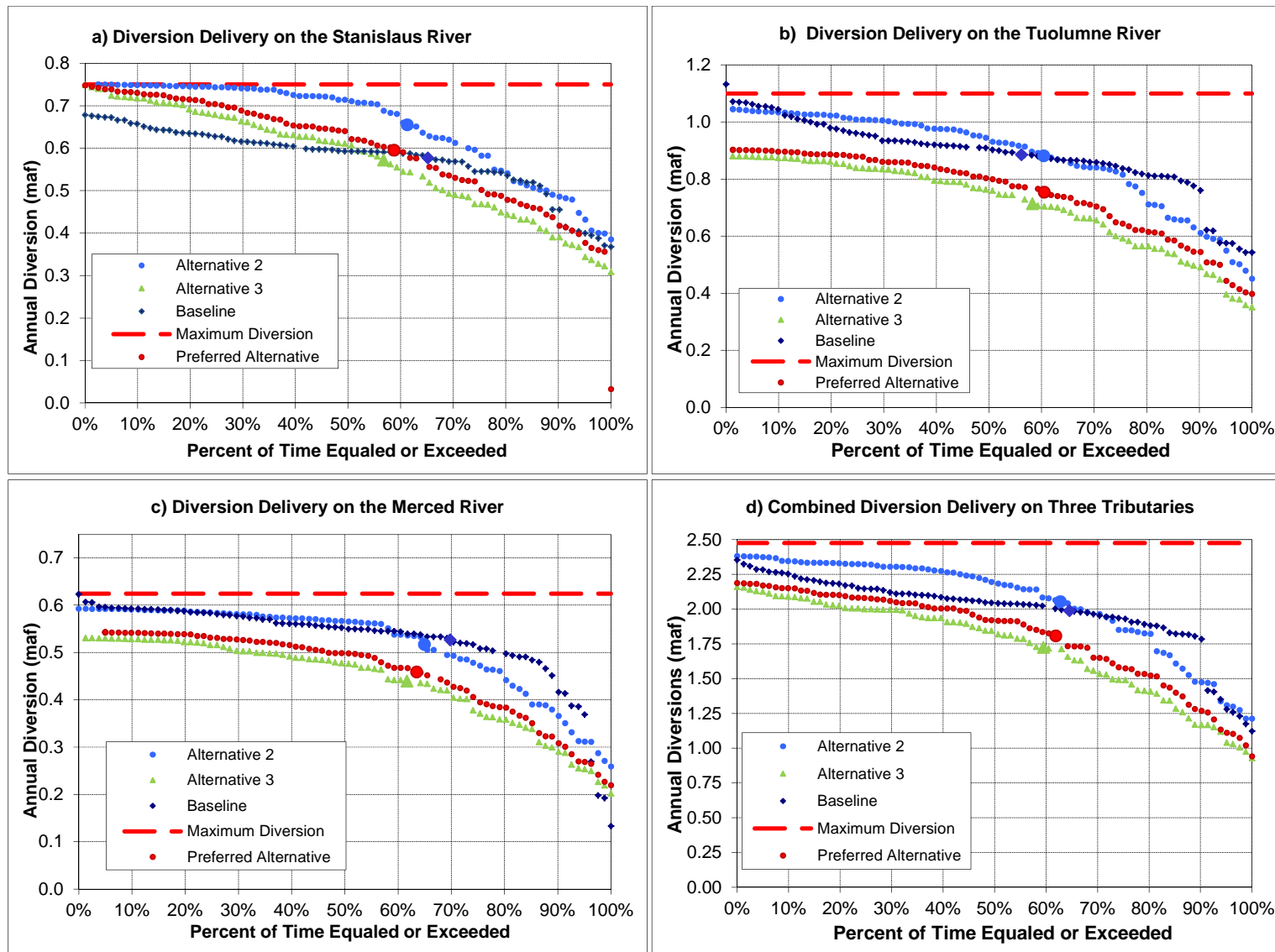


Figure 20-2. Annual Diversions for the Baseline, the Preferred LSJR Alternative, LSJR Alternative 2 and LSJR Alternative 3 (Preferred Alternative, Alternative 2, and Alternative 3) from the: a) Stanislaus River, b) Tuolumne River, c) Merced River, and d) Three Tributaries Combined (maf = million acre-feet)

Table 20-3. Average Annual Baseline Diversions and Difference from Baseline for LSJR Alternatives 2 and 3 and the Preferred LSJR Alternative on each Tributary and the Tributaries Combined

Alternative	Combined (TAF/%)	Stanislaus (TAF/%)	Tuolumne (TAF/%)	Merced (TAF/%)
Baseline	1,989	577	885	527
Difference from Baseline for LSJR Alternative 2	64 / 3	72 / 12	-6 / -1	-10 / -2
Difference from Baseline for Preferred LSJR Alternative	-181 / -9	18 / 3	-132 / -15	-67 / -13
Difference from Baseline for LSJR Alternative 3	-268 / -13	-8 / -1	-173 / -20	-87 / -17

TAF = thousand acre-feet

Estimated diversions associated with the Preferred LSJR Alternative would decrease by 9 percent for the plan area and decrease by 14 percent and 10 percent in the Tuolumne and Merced Rivers, respectively. Estimated diversions increased by 3 percent on the Stanislaus River. Because the Preferred LSJR Alternative substantially changes diversions (by more than 5 percent) in the plan area, the Preferred LSJR Alternative is considered to have a significant impact on water supplies. As with LSJR Alternative 3 described in Chapter 5, there are no feasible mitigation measures. Impacts to water supplies under the Preferred LSJR Alternative would be significant and unavoidable.

Water Quality Impacts

WQ-3: Substantially degrade water quality by increasing water temperature caused by reduced river flows (*Less than significant*)

Substantial increases in water temperature could result in significant impacts on water quality. Water quality impacts related to temperature from the Preferred LSJR Alternative were analyzed by comparing temperature modeling for the Preferred LSJR Alternative (35 percent unimpaired February–June flow) to baseline and LSJR Alternatives 2 (20 percent unimpaired flow) and 3 (40 percent unimpaired flow). Temperature modeling was done with the U.S. Army Corps of Engineers’ (USACE) HEC 5Q river and reservoir hydraulic and water quality model. More information about this modeling effort is discussed in Appendix F.1., *Hydrologic and Water Quality Modeling*, Section 4. Figures 20-3 and 20-4 show the model results of average monthly baseline temperatures on the Stanislaus, Tuolumne, and Merced Rivers 1980–2003 under the Preferred LSJR Alternative, LSJR Alternatives 2 and 3, and baseline.

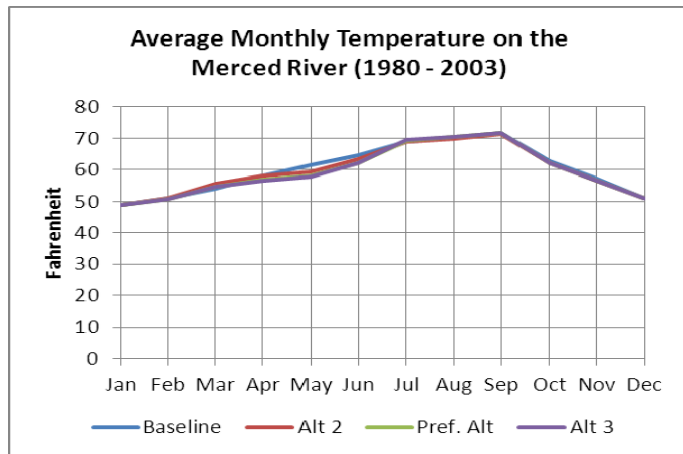
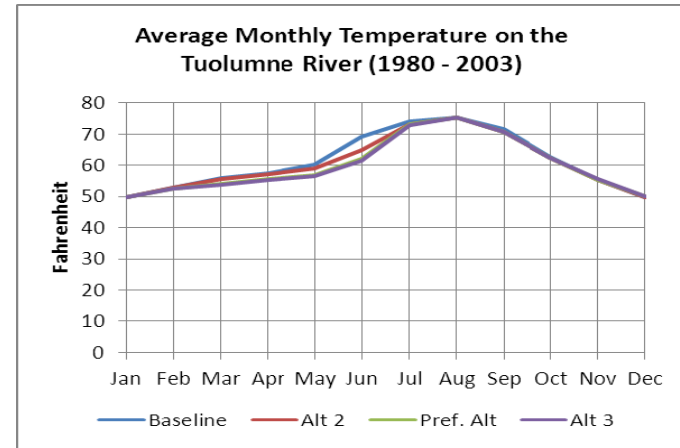
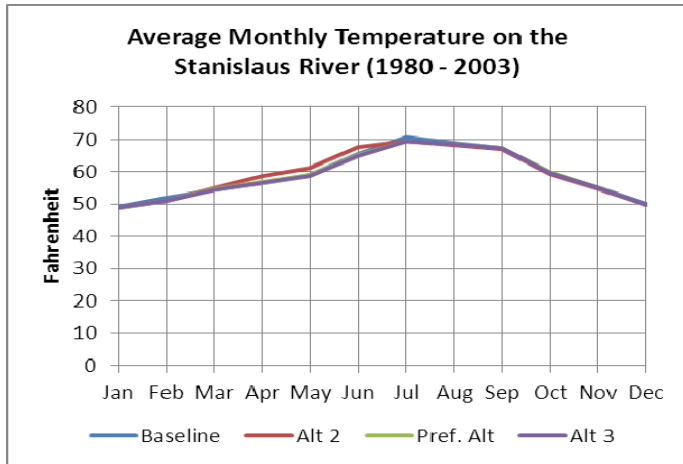


Figure 20-3. Modeled Average Monthly Temperature for the Baseline and the Preferred Alternative, LSJR Alternative 2, and LSJR Alternative 3 (Preferred Alternative, Alternative 2, and Alternative 3) on the Stanislaus, Tuolumne, and Merced Rivers for 1980–2003

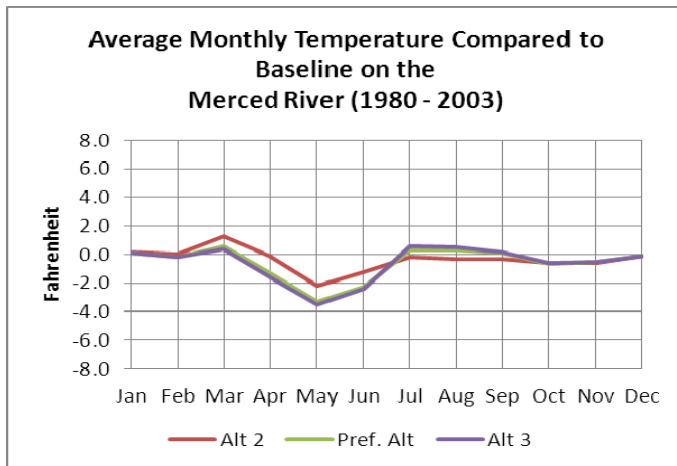
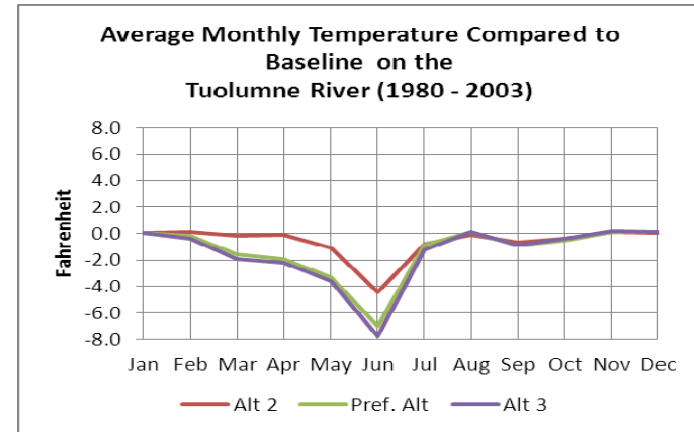
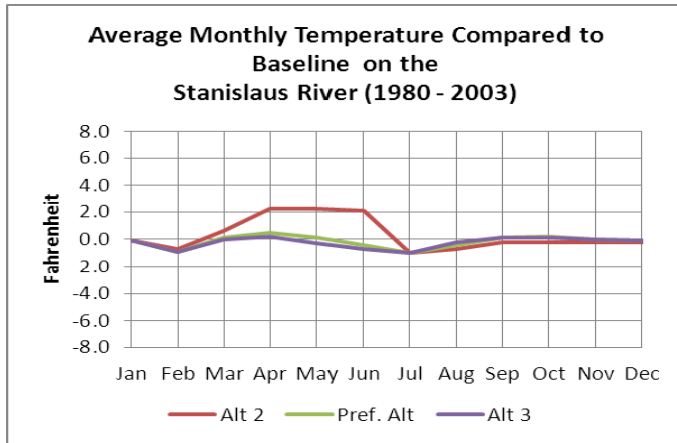


Figure 20-4. Average Difference Compared to Baseline of Modeled Temperature for the Preferred LSJR Alternative, LSJR Alternative 2, and LSJR Alternative 3 (Preferred Alternative, Alternative 2, and Alternative 3) on the Stanislaus, Tuolumne, and Merced Rivers for 1980–2003

As demonstrated in Tables 20-4 through 20-6, the average monthly temperatures associated with the Preferred LSJR Alternative are close to that of LSJR Alternative 3. Temperatures did not increase substantially (by more than two degrees) in the Stanislaus, Tuolumne, and Merced Rivers under the Preferred LSJR Alternative. Therefore, the Preferred LSJR Alternative would have a less-than-significant impact on water quality due to temperature effects.

Table 20-4. Stanislaus River Average Monthly Modeled Temperature Compared to Baseline (1980–2003)

	Baseline	LSJR Alternative 2 (°F / %)	Preferred LSJR Alternative (°F / %)	LSJR Alternative 3 (°F / %)
January	49.0	-0.1 / 0	-0.1 / 0	-0.1 / 0
February	51.8	-0.7 / -1	-0.9 / -2	-0.9 / -2
March	54.5	0.6 / 1	0.1 / 0	0.0 / 0
April	56.5	2.2 / 4	0.5 / 1	0.2 / 0
May	58.9	2.2 / 4	0.1 / 0	-0.3 / -1
June	65.5	2.1 / 3	-0.4 / -1	-0.7 / -1
July	70.6	-1.0 / -1	-1.0 / -1	-1.0 / -1
August	68.9	-0.7 / -1	-0.4 / -1	-0.2 / 0
September	67.2	-0.2 / 0	0.1 / 0	0.1 / 0
October	59.6	-0.2 / 0	0.2 / 0	0.1 / 0
November	54.9	-0.2 / 0	0.0 / 0	0.0 / 0
December	50.0	-0.2 / 0	-0.1 / 0	-0.1 / 0

°F = Fahrenheit

Table 20-5. Tuolumne River Average Monthly Modeled Temperature Compared to Baseline (1980–2003)

	Baseline	LSJR Alternative 2 (°F / %)	Preferred LSJR Alternative (°F / %)	LSJR Alternative 3 (°F / %)
January	49.9	0.0 / 0	0.0 / 0	0.0 / 0
February	52.8	0.1 / 0	-0.2 / 0	-0.4 / -1
March	55.8	-0.2 / 0	-1.6 / -3	-1.9 / -3
April	57.4	-0.1 / 0	-1.9 / -3	-2.2 / -4
May	60.2	-1.1 / -2	-3.3 / -5	-3.6 / -6
June	69.2	-4.4 / -6	-7.0 / -10	-7.8 / -11
July	74.0	-0.8 / -1	-0.9 / -1	-1.2 / -2
August	75.4	-0.1 / 0	0.1 / 0	0.1 / 0
September	71.5	-0.7 / -1	-0.9 / -1	-0.9 / -1
October	62.8	-0.4 / -1	-0.5 / -1	-0.4 / -1
November	55.3	0.1 / 0	0.1 / 0	0.2 / 0
December	49.9	0.0 / 0	0.1 / 0	0.1 / 0

°F = Fahrenheit

Table 20-6. Merced River Average Monthly Modeled Temperature Compared to Baseline (1980–2003)

	Baseline	LSJR Alternative 2 (°F / %)	Preferred LSJR Alternative (°F / %)	LSJR Alternative 3 (°F / %)
January	48.7	0.2 / 0	0.1 / 0	0.1 / 0
February	50.9	0.0 / 0	-0.2 / 0	-0.2 / 0
March	54.2	1.3 / 2	0.6 / 1	0.4 / 1
April	58.1	-0.1 / 0	-1.3 / -2	-1.6 / -3
May	61.4	-2.2 / -4	-3.3 / -5	-3.5 / -6
June	64.5	-1.2 / -2	-2.3 / -4	-2.4 / -4
July	69.0	-0.2 / 0	0.3 / 0	0.6 / 1
August	70.0	-0.3 / 0	0.3 / 0	0.5 / 1
September	71.6	-0.3 / 0	0.1 / 0	0.2 / 0
October	62.7	-0.6 / -1	-0.7 / -1	-0.6 / -1
November	57.1	-0.6 / -1	-0.5 / -1	-0.5 / -1
December	51.0	-0.1 / 0	-0.1 / 0	-0.1 / 0

°F = Fahrenheit

WQ-4: Substantially degrade water quality by increasing contaminant concentrations caused by reduced river flows (*Less than significant*)

Substantial reductions in flows could result in increased pollutant loads and resulting significant impacts on water quality. Water quality impacts from the Preferred LSJR Alternative were analyzed by comparing flows under the Preferred LSJR Alternative (35 percent unimpaired February–June flow) to baseline and LSJR Alternatives 2 (20 percent unimpaired flow) and 3 (40 percent unimpaired flow). It is assumed for this analysis that changes in river flows will change the dilution of any contaminants and Clean Water Act Section 303(d) listed pollutants that enter the rivers from point- and nonpoint sources. Pollution loads are assumed to not be dependent on river flows, but concentrations would decrease with increased flows and increase with decreased flows. For this evaluation, impacts on water quality from reduced flows were considered significant when reduced flows resulted in ten percent or more of the number of years (over the 82 years of simulated hydrology) for a given month with a concentration ratio above 1.5.

For purposes of analysis, a flow value of 265 cubic feet per second (cfs) is used for the Stanislaus and Tuolumne Rivers and 150 cfs is used for the Merced River to represent the minimum flow value to maintain a pollution concentration ratio of 1.5. Tables 20-7 through 20-9 are the interpolated average monthly flow values for the Preferred LSJR Alternative.

Table 20-7. Stanislaus River Flows at Ripon (cfs) for the Preferred LSJR Alternative

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	Annual (TAF)
Stanislaus at Ripon Flow (cfs)													
Minimum	103	126	200	158	323	309	432	282	150	236	185	9	262
10%	496	285	250	216	408	458	621	616	272	363	365	312	373
20%	613	301	286	259	503	517	763	931	398	415	380	363	420
30%	983	326	311	296	615	595	914	1,066	575	432	393	393	445
40%	1,016	350	327	314	691	654	1,044	1,347	744	438	414	422	492
50%	1,076	367	352	336	778	741	1,154	1,591	965	448	439	434	543
60%	1,172	380	357	351	836	814	1,247	1,841	1,133	457	439	437	575
70%	1,217	430	386	383	924	977	1,376	2,023	1,292	509	460	479	621
80%	1,296	470	456	459	1,160	1,141	1,510	2,193	1,507	585	512	544	683
90%	1,380	546	512	614	1,625	1,563	1,643	2,233	2,010	747	669	906	855
Maximum	2,256	3,321	5,140	8,770	3,213	4,822	2,455	2,527	4,654	4,611	2,702	3,113	2,276
Average	1,042	448	475	600	911	928	1,157	1,527	1,066	589	539	574	595

cfs = cubic feet per second

TAF = thousand acre-feet

Table 20-8. Tuolumne River Flows at Modesto (cfs) for the Preferred LSJR Alternative

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	Annual (TAF)
Tuolumne at Modesto (cfs)													
Minimum	194	207	217	208	200	200	465	604	200	169	167	153	229
10%	285	247	257	316	269	493	949	1,215	527	237	257	243	412
20%	390	326	327	427	384	710	1,106	1,657	799	299	326	323	508
30%	459	387	413	436	490	807	1,306	1,967	1,299	339	349	353	571
40%	482	448	438	518	661	938	1,488	2,156	1,697	378	379	369	636
50%	547	462	471	573	987	1,261	1,710	2,570	1,982	420	402	410	763
60%	635	483	530	613	1,274	1,887	1,906	2,825	2,365	526	485	512	956
70%	719	563	599	714	1,790	2,946	2,179	3,059	2,663	582	553	575	1,228
80%	938	632	740	1,728	3,179	3,368	2,611	3,093	3,306	1,066	568	595	1,489
90%	1,238	803	1,870	3,645	4,857	4,185	3,106	3,166	6,648	3,479	618	947	1,849
Maximum	3,175	5,956	7,624	17,734	6,847	9,258	8,029	6,356	13,730	8,340	2,862	3,053	3,936
Average	683	605	908	1,383	1,704	2,060	1,952	2,461	2,636	1,118	476	562	999

cfs = cubic feet per second

TAF = thousand acre-feet

Table 20-9. Merced River Flows at Stevinson (cfs) for the Preferred LSJR Alternative

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	Annual (TAF)
Merced at Stevinson (cfs)													
Minimum	155	194	206	270	150	150	194	228	150	35	35	2	156
10%	266	315	329	330	152	215	471	578	255	68	54	31	227
20%	283	348	358	378	190	298	549	761	305	90	74	54	277
30%	309	366	379	394	240	340	662	990	484	117	100	69	310
40%	344	382	387	414	332	386	755	1,152	670	160	123	80	336
50%	366	388	403	446	538	464	836	1,386	859	175	159	92	406
60%	461	400	414	484	756	542	933	1,532	984	224	201	134	535
70%	619	413	435	618	1,038	757	1,008	1,658	1,216	304	811	445	681
80%	808	430	495	1,326	1,735	1,054	1,137	1,813	1,851	1,119	1,060	566	864
90%	1,104	606	1,167	1,892	2,915	1,492	1,280	2,276	2,570	2,209	1,233	640	1,053
Maximum	2,459	2,154	4,463	9,912	5,135	5,810	4,452	5,511	7,455	5,943	2,444	1,369	2,416
Average	560	460	649	938	1,047	814	901	1,438	1,230	701	473	271	572

cfs = cubic feet per second

TAF = thousand acre-feet

February–June, the Preferred LSJR Alternative flow is not less than 265 cfs for the Stanislaus and Tuolumne Rivers or 150 cfs on the Merced River in more than ten percent of the 82 years of simulation. For the months of July–January the WSE model was programed to provide the same CALSIM¹ baseline flow, (or greater, in the case of some flood releases). Because the Preferred LSJR Alternative flows are not less than the minimum flow values in more than ten percent of the 82 years if simulation, the Preferred LSJR Alternative would have a less than-significant-impact on water quality due to increasing contaminant concentrations (WQ-4).

20.2.2 Flooding, Sediment, and Erosion Impacts Analysis

Chapter 6 of this SED, *Flooding, Sediment, and Erosion*, discusses potential impacts on river channel flooding, erosion, and sediment transport in the plan area. As shown in Table 20-1, there are two impacts identified in Chapter 6, both of which would be less than significant. Accordingly, it is assumed that for FLO-1 and FLO-2, the Preferred LSJR Flow Alternative would have less-than significant impacts.

20.2.3 Aquatic Resources Impacts Analysis

Chapter 7, *Aquatic Resources*, discusses potential impacts on aquatic resources in the plan area. As shown in Table 20-1, there are 14 impacts identified in Chapter 7, of which seven have the same significance determinations for both LSJR Alternatives 2 and 3. Because the Preferred LSJR

¹ CALSIM is a generalized water resources simulation model for evaluating operational alternatives of the State Water Project/Central Valley Project system. CALSIM II is the latest application of the generic CALSIM model to simulate SWP/CVP operations. CALSIM and CALSIM II are products of joint development between the Department of Water Resources and the U.S. Bureau of Reclamation. This document uses CALSIM and CALSIM II interchangeably.

Alternative falls between LSJR Alternatives 2 and 3, for these impacts (AQUA-1, AQUA-2, AQUA-6, AQUA-8, AQUA-9, AQUA-13) the Preferred LSJR Alternative would have the same, less-than-significant impacts. Below is an impacts analysis for AQUA-3, AQUA-4, AQUA-5, AQUA-10, AQUA-11, and AQUA-12, which did not have the same levels of significance between the two alternatives.

AQUA-3: Changes in quantity/quality of spawning, rearing, and migration habitat resulting from changes in flow (*Less than significant*)

Significant impacts on aquatic resources may result from substantial changes in the quantity and quality of spawning, rearing, and migration habitat resulting from changes in flows. Potential impacts from the Preferred LSJR Alternative relative to changes in habitat were analyzed by comparing flows under the Preferred LSJR Alternative (35 percent unimpaired February–June flow) to baseline and LSJR Alternatives 2 (20 percent unimpaired flow) and 3 (40 percent unimpaired). Significant impacts would result from substantial reductions in flows (i.e. reduction in monthly median flows of 10 percent or more).

Changes to flows under the Preferred LSJR Alternative are described in Section 20.2.1 above. As demonstrated in Table 20-2, the flows associated with the Preferred LSJR Alternative are slightly less than LSJR Alternative 3 and considerably higher than LSJR Alternative 2 flows. Compared to baseline, flows under the Preferred LSJR Alternative are higher on the Merced, Tuolumne, and SJR at Vernalis, but slightly lower on the Stanislaus River. While flows may be lower than baseline on the Stanislaus River under the Preferred LSJR Alternative, as indicated in Figure 20-1(a), those reduction in flows compared to baseline are minimal (less than 10 percent) and would only occur in the wetter 40 percent of years when potential impacts would be minimized due to already relatively high flow conditions. Further, total flows from the LSJR and its tributaries would be higher under the Preferred LSJR Alternative and would have generally beneficial effects on aquatic biological resources. Additionally, the NMFS BO flows required on the Stanislaus River are included in the baseline. However, these flows are not included in the WSE modeling of the LSJR alternatives, including the Preferred LSJR Alternative. Instead, the WSE modeling of the LSJR alternatives assumes that a certain percent (i.e., 35 percent) of unimpaired flow would be met. As a result, when the WSE model results are compared to baseline, the modeling shows some flow reductions in the Stanislaus River. However, because the LSJR alternatives would not directly result in any changes to the NMFS BO flow requirements on the Stanislaus River, actual reductions in flows below the NMFS BO flows would be unlikely. Based on the above, impacts under the Preferred LSJR Alternative would be less than significant for AQUA-3.

AQUA-4: Changes in exposure of fish to stressful water temperatures resulting from changes in reservoir storage and releases (*Less than significant*)

Significant impacts on aquatic resources may occur as the result of increased exposure of fish to stressful water temperatures resulting from changes in reservoir storage and releases. Impacts related to temperature from the Preferred LSJR Alternative were analyzed by comparing flows and temperatures under the Preferred LSJR Alternative (35 percent unimpaired February–June flow) to baseline and LSJR Alternatives 2 (20 percent unimpaired flow) and 3 (40 percent unimpaired flow). Water temperature is recognized as a primary stressor for sensitive aquatic species (Chinook salmon and steelhead) in the SJR Basin. Exposure of these species to elevated water temperatures can cause thermal stress and lead to reductions in survival through a number of direct and indirect effects. Significant impacts would result if there were substantial increase in water temperatures that cause lethal and sublethal effects on sensitive aquatic species. As indicated in Tables 20-4

through 20-6 for WQ-3, changes in temperatures under the Preferred LSJR Alternative compared to baseline are no greater than the 10 percent threshold for AQUA-4 and similar to LSJR Alternative 3. As a result, impacts would be less than significant for the Preferred LSJR Alternative.

AQUA-5: Changes in exposure to pollutants resulting from changes in flow (dilution/mobilization effects) (*Less than significant*)

Significant impacts on aquatic resources may occur as the result of increased exposure to pollutants from changes in flows. Impacts from the Preferred LSJR Alternative on pollutants were analyzed by comparing flows under the Preferred LSJR Alternative (35 percent unimpaired February–June flow) to baseline and LSJR Alternatives 2 (20 percent unimpaired flow) and 3 (40 percent unimpaired flow). Substantial decreases in flows could increase concentrations of pollutants and thus have significant impacts on aquatic biological resources. As discussed in AQUA-3, it is not expected that flows would be significantly decreased under the Preferred LSJR Alternative. In fact, flows would generally increase in the SJR resulting in less than significant impacts pursuant to AQUA-5. Further, while flows may decrease slightly on the Stanislaus River pursuant to the Preferred LSJR Alternative, it is not expected that actual reductions in flows would occur due to implementation of the NMFS BO RPA flows. Taken together, there would be a less-than-significant impact on AQUA-5 from the Preferred LSJR Alternative.

AQUA-7: Changes in redd dewatering and fish stranding losses resulting from flow fluctuations (*Less than significant*)

Significant impacts on aquatic resources may occur as the result of changes in redd dewatering and fish stranding losses resulting from flow fluctuations. Impacts to redd dewatering from the Preferred LSJR Alternative were analyzed by comparing flows under the Preferred LSJR Alternative (35 percent unimpaired February–June flow) to baseline and LSJR Alternatives 2 (20 percent unimpaired flow) and 3 (40 percent unimpaired flow). Redd dewatering and fish stranding impacts may occur as the result of flow fluctuations. Significant impacts related to redd dewatering and fish stranding were assumed when there were substantial increases (10 percent or more) in the occurrence of February and March flows dropping by more than an average of 1 foot per month. Tables 20-10 through 20-12 show the modeled results for the frequency that the river depth decreases by more than 1 foot in February and March under the Preferred LSJR Alternative.

Table 20-10. Percent of Time Greater than 1 foot Decrease in Depth from Previous Month for the Stanislaus River

	FEB	MAR
Baseline	6	7
LSJR Alternative 2		
% of time greater than 1 foot decrease	6	21
Difference between Baseline and LSJR Alternative 2	0	14
Preferred LSJR Alternative		
% of time greater than 1 foot decrease	5	22
Difference between Baseline and Preferred LSJR Alternative	-1	15
LSJR Alternative 3		
% of time greater than 1 foot decrease	5	22
Difference between Baseline and LSJR Alternative 3	-1	15
Note: negative numbers indicate a reduction in the occurrence of 1 foot depth exceedances.		

Table 20-11. Percent of Time Greater than 1 foot Decrease in Depth from Previous Month for the Tuolumne River

	FEB	MAR
Baseline	5	4
LSJR Alternative 2		
% of time greater than 1 foot decrease	10	6
Difference between Baseline and LSJR Alternative 2	5	2
Preferred LSJR Alternative		
% of time greater than 1 foot decrease	8	5
Difference between Baseline and Preferred LSJR Alternative	3	1
LSJR Alternative 3		
% of time greater than 1 foot decrease	7	4
Difference between Baseline and LSJR Alternative 3	2	0
Note: negative numbers indicate a reduction in the occurrence of 1 foot depth exceedances.		

Table 20-12. Percent of Time Greater than 1 foot Decrease in Depth from Previous Month for the Merced River

	FEB	MAR
Baseline	4	15
LSJR Alternative 2		
% of time greater than 1 foot decrease	7	24
Difference between Baseline and LSJR Alternative 2	3	9
Preferred LSJR Alternative		
% of time greater than 1 foot decrease	9	17
Difference between Baseline and Preferred LSJR Alternative	5	2
LSJR Alternative 3		
% of time greater than 1 foot decrease	9	15
Difference between Baseline and LSJR Alternative 3	5	0

As indicated in Tables 20-10, 20-11, and 20-12 above, river depths under the Preferred LSJR Alternative change by more than 1 foot less than 10 percent of the time on the Tuolumne and Merced Rivers. In March on the Stanislaus River, the river depth decreases by more than 1 foot more than 10 percent of the time. However, due to the fact that overall flows during the February–June time frame under the Preferred LSJR Alternative are similar to baseline, there would be sufficient water available to adaptively manage flows to avoid significant impacts on aquatic resources from redd dewatering. In addition, as described above for AQUA-3, it is unlikely that flows would actually be reduced on the Stanislaus River due to implementation of the NMFS BO RPA flows. Taken together, there would be a less-than-significant impact on AQUA-7 from the Preferred LSJR Alternative.

AQUA-10: Changes in predation risk resulting from changes in flow and water temperature (*Less than significant*)

Significant impacts on aquatic resources may occur as the result of increased predation risk from changes in flows. Impacts related to predation from the Preferred LSJR Alternative were analyzed by comparing flows under the Preferred LSJR Alternative (35 percent unimpaired February–June flow) to baseline and LSJR Alternatives 2 (20 percent unimpaired flow) and 3 (40 percent unimpaired flow). Significant decreases in flows could increase predation risk and result in significant impacts to aquatic biological resources. As discussed in AQUA-3, it is not expected that flows would be significantly decreased under the Preferred LSJR Alternative. Flows would generally increase in the SJR, so impacts would be less than significant.

AQUA-11: Changes in disease risk resulting from changes in flow, water temperature, and water quality (*Less than significant*)

Significant impacts on aquatic resources may occur as the result of increased disease resulting from changes in flow, water temperature and water quality. Impacts related to disease from the Preferred LSJR Alternative were analyzed by comparing flows and temperatures under the Preferred LSJR Alternative (35 percent unimpaired February–June flow) to baseline and LSJR Alternatives 2 (20 percent unimpaired flow) and 3 (40 percent unimpaired flow). Significant decreases in flows,

increases in water temperatures, and water quality concerns could result in significant impacts related to disease for aquatic biological resources. As discussed in AQUA-3, 4 and 5 above, the Preferred LSJR Alternative is not expected to have significant impacts on flows, water temperature, or water quality. Accordingly, the Preferred LSJR Alternative would have less-than-significant impacts on aquatic resources.

AQUA-12: Changes in fish transport resulting from changes in flow (*Less than significant*)

Significant impacts on aquatic resources may occur as the result of changes in fish transport resulting from changes in flows. Impacts from the Preferred LSJR Alternative relative to fish transport were analyzed by comparing flows under the Preferred LSJR Alternative (35 percent unimpaired February–June flow) to baseline and LSJR Alternatives 2 (20 percent unimpaired flow) and 3 (40 percent unimpaired flow). Changes in flows on the three eastside tributaries and mainstem SJR can affect migration rates of outmigrating salmonids from the major SJR tributaries to the Bay-Delta during the primary spring outmigration period (February–June). Significant reductions in flows could result in significant impacts on aquatic biological resources related to fish transport. To assess impacts related to fish transport resulting from changes in flow, a qualitative assessment was performed based on published literature and the comparison of flows for the Preferred LSJR Alternative with baseline flows that was performed in AQUA-3. As discussed above for AQUA-3 and HYD-1, the Preferred LSJR Alternative is not expected to have significant impacts due to changes in flows. As a result, significant impacts would also not be expected to fish transport resulting from changes in flows. Accordingly, impacts under AQUA-12 would be less than significant.

20.2.4 Terrestrial Biological Resources Impacts Analysis

Chapter 8, *Terrestrial Biological Resources*, discusses potential impacts on terrestrial biological resources in the plan area. As shown in Table 20-1, there are five impacts identified in Chapter 8, of which two impacts have the same levels of significance between LSJR Alternatives 2 and 3. It is assumed that for these impacts, BIO-2 and BIO-3, the Preferred LSJR Alternative would have the same, less-than-significant, impact. Below is an impacts analysis for BIO-1, BIO-4, and BIO-5, which did not have the same levels of significance between the two alternatives.

BIO-1: Have a substantial adverse effect on any riparian habitat or other sensitive natural terrestrial communities identified in local or regional plans, policies, regulations or by Department of Fish and Game (DFG) and U.S. Fish and Wildlife Service (USFWS) (*Less than significant- see discussion for BIO-5*)

BIO-4: Have a substantial adverse effect, either directly or through habitat modifications, on any terrestrial animal species identified as a candidate, sensitive, or special-status species in local or regional plans, policies, or regulations, or by DFG and USFWS (*Less than significant- see discussion for BIO-5*)

BIO-5: Conflict with the provisions of an adopted habitat conservation plan, natural community conservation plan, or other approved local, regional, or state habitat conservation plan, or conflict with any local policies or ordinances protecting biological resources (*Less than significant*)

Significant impacts on terrestrial biological resources may result from changes in flows and their effects on riparian habitat. Impacts from the Preferred LSJR Alternative related to terrestrial

biological resources were analyzed by comparing flows under the Preferred LSJR Alternative (35 percent unimpaired February–June flow) to baseline and LSJR Alternatives 2 (20 percent unimpaired flow) and 3 (40 percent unimpaired flow). Lower flows would reduce riparian habitat and adversely affect riparian or sensitive terrestrial communities dependent on that habitat. More flow would generally increase riparian habitat and benefit sensitive terrestrial species dependent on that habitat. Flow effects are described in Section 20.2.1 under hydrologic impacts (HYD-1). The Preferred LSJR Alternative would have flows similar to LSJR Alternative 3 and have little difference from baseline. Compared to baseline, flows under the Preferred LSJR Alternative are higher on the Merced, Tuolumne, and SJR at Vernalis, but slightly lower on the Stanislaus River. While flows may be lower than baseline on the Stanislaus River under the Preferred LSJR Alternative, as indicated in Figure 20-1(a), those reduction in flows compared to baseline are minimal (less than 10 percent) and would only occur in the wetter 40 percent of years when potential impacts would be minimized due to already relatively high flow conditions. Further, total flows from the LSJR and its tributaries would be higher under the Preferred LSJR Alternative and would have generally beneficial effects on terrestrial biological resources. Additionally, the NMFS BO flows required on the Stanislaus River are included in the baseline. However, these flows are not included in the WSE modeling of the LSJR alternatives, including the Preferred LSJR Alternative. Instead, the WSE modeling of the LSJR alternatives assumes that a certain percent (i.e., 35 percent) of unimpaired flow would be met. As a result, when the WSE model results are compared to baseline, the modeling shows some flow reductions in the Stanislaus River. However, because the LSJR alternatives would not directly result in any changes to the NMFS BO flow requirements on the Stanislaus River, actual reductions in flows below the NMFS BO flows would be unlikely. Based on the above, impacts under the Preferred LSJR Alternative would be less than significant for BIO-1, BIO-4, and BIO-5.

20.2.5 Groundwater Resources Impact Analysis

Chapter 9, *Groundwater Resources*, analyzes potential impacts on groundwater resources from the LSJR alternatives. Chapter 9 evaluates one impact (GW-1) that has a different significance level between LSJR Alternatives 2 and 3. An analysis of GW-1 is provided below.

Impact GW-1: Substantially deplete groundwater supplies or interfere substantially with groundwater recharge (*Significant and unavoidable*)

Significant impacts to groundwater resources may occur as a result of increased groundwater pumping to make up for reduced surface water supplies pursuant to the LSJR alternatives. Impacts from the Preferred LSJR Alternative related to groundwater resources were analyzed by comparing changes in surface water supplies under the Preferred LSJR Alternative (35 percent unimpaired February–June flow) to baseline and LSJR Alternatives 2 (20 percent unimpaired flow) and 3 (40 percent unimpaired flow). As more water is provided to meet tributary flows under the LSJR alternatives, less water is available for diversions and storage. To replace reduced diversion volumes, diverters would likely use more groundwater to make up for some or all of their reduced surface water supplies. Significant increases in groundwater pumping (more than 5 percent increase) would be assumed to result in significant impacts to groundwater resources. Section 20.2.1 analyzes water supply effects and impacts (WS-1) associated with the Preferred LSJR Alternative. As demonstrated in Section 20.2.1, the Preferred LSJR Alternative has similar effects to LSJR Alternative 3, which result in surface water diversion reductions greater than 5 percent. The reduced surface water diversions would be expected to result in an increase in groundwater

replacement pumping of greater than 5 percent, resulting in a significant impact on groundwater resources (GW-1). As with LSJR Alternative 3 described in Chapter 9, there are no feasible mitigation measures. Accordingly, impacts to groundwater resources under the Preferred LSJR Alternative would be significant and unavoidable.

20.2.6 Recreational Resources and Visual Quality Impact Analysis

Chapter 10, *Recreational Resources and Visual Quality*, analyzes potential impacts on recreational resources and visual quality from the LSJR alternatives. Changes in flow rates and reservoir operations under the LSJR Alternative may impact recreational beneficial uses. Chapter 10 identifies three potential impacts focused on opportunities for recreation, impacts on recreational facilities, and potential degradation of visual character on the rivers and at the reservoirs (REC-1, REC-2, and REC-3, respectively). As stated in Chapter 10, there would be a less-than-significant impact on recreational facilities and visual quality for all LSJR Alternatives for REC-2 and REC-3. Therefore, the Preferred LSJR Alternative would have a less-than-significant impact on REC-2 and REC-3. Chapter 10 evaluates one impact (REC-1) that has a different significance level between LSJR Alternatives 2 and 3. An analysis of REC-1 is provided below.

REC-1: Substantially reduce the use of existing recreation facilities or opportunities on rivers or at reservoirs (*Significant and unavoidable*)

Impacts to recreational resources from reduced use of recreational facilities and reduced recreational opportunities may result from changes in flows and reservoir levels. Impacts from the Preferred LSJR Alternative related to recreational opportunities were analyzed by comparing flows and reservoir levels under the Preferred LSJR Alternative (35 percent unimpaired February–June flow) to baseline and LSJR Alternatives 2 (20 percent unimpaired flow) and 3 (40 percent unimpaired flow). LSJR Alternative 2 would have a less-than-significant impact on recreational opportunities or the use of existing recreation facilities on rivers or at reservoirs (REC-1). LSJR Alternative 3 would have a significant and unavoidable impact due to a significant reduction (greater than 10 percent) in low flows for swimming and wading (<500cfs). Flow conditions were analyzed using the WSE model. Tables 20-13 through 20-15 show the distribution of monthly flows across different recreationally significant flow ranges in the Stanislaus, Tuolumne, and Merced Rivers. The Preferred LSJR Alternative flow frequency was linearly interpolated between LSJR Alternatives 2 and 3.

Table 20-13. Percentage of Years with Monthly Stanislaus River Flows within Specified Recreational Ranges (WSE Model Results for 1922–2003)

Range of Flows	Seasonal Average (%)	Difference from Baseline (%)
Baseline		
<500 cfs	53	-
500–1,500 cfs	32	-
1,500–2,500 cfs	11	-
>2,500 cfs	4	-
LSJR Alternative 2		
<500 cfs	55	2
500–1,500 cfs	35	3
1,500–2,500 cfs	8	-3
>2,500 cfs	2	-2
Preferred LSJR Alternative		
<500 cfs	51	-2
500–1,500 cfs	31	-2
1,500–2,500 cfs	17	6
>2,500 cfs	1	-3
LSJR Alternative 3		
<500 cfs	50	-3
500–1,500 cfs	29	-3
1,500–2,500 cfs	20	9
>2,500 cfs	1	-3
Note: Rounding may cause some columns not to add up to 100 percent.		
cfs = cubic feet per second		

Table 20-14. Percentage of Years with Monthly Tuolumne River Flows within Specified Recreational Ranges (WSE Model Results for 1922–2003)

Range of Flow	Seasonal Average (%)	Difference From Baseline (%)
Baseline		
<500 cfs	48	-
500–1,500 cfs	36	-
1,500–2,500 cfs	5	-
>2,500 cfs	11	-
LSJR Alternative 2		
<500 cfs	40	-8
500–1,500 cfs	39	3
1,500–2,500 cfs	12	7
>2,500 cfs	10	-1
Preferred LSJR Alternative		
<500 cfs	38	-10
500–1,500 cfs	30	-6
1,500–2,500 cfs	12	7
>2,500 cfs	21	10
LSJR Alternative 3		
<500 cfs	37	-11
500–1,500 cfs	27	-9
1,500–2,500 cfs	12	7
>2,500 cfs	24	13
<p>Note: Rounding may cause some columns not to add up to 100 percent. Shaded rows indicate greater than 10 percent difference from baseline for low flow regimes.</p>		
<p>cfs = cubic feet per second</p>		

Table 20-15. Percentage of Years with Monthly Merced River Flows within Specified Recreational Ranges (WSE Model Results for 1922–2003)

Range of Flow	Seasonal Average (%)	Difference From Baseline (%)
Baseline		
<500 cfs	66	-
500–1,500 cfs	22	-
1,500–2,500 cfs	5	-
>2,500 cfs	6	-
LSRJ Alternative 2		
<500 cfs	58	-8
500–1,500 cfs	31	9
1,500–2,500 cfs	6	1
>2,500 cfs	6	0
Preferred LSJR Alternative		
<500 cfs	51	-15
500–1,500 cfs	31	9
1,500–2,500 cfs	13	8
>2,500 cfs	5	-1
LSJR Alternative 3		
<500 cfs	49	-17
500–1,500 cfs	31	9
1,500–2,500 cfs	15	10
>2,500 cfs	5	-1
Notes: Rounding may cause some columns not to add up to 100 percent.		
Shaded rows indicate greater than 10 percent difference from baseline for low flow regimes.		
cfs = cubic feet per second		

The recreational opportunities on the Stanislaus River are relatively unaffected by the Preferred LSJR Alternative. The Tuolumne and Merced Rivers are more affected by the Preferred LSJR Alternatives and exhibit up to a 15 percent reduction in the frequency of low flow conditions supporting swimming and wading and is considered a significant impact. As with LSJR Alternative 3 described in Chapter 10, there are no feasible mitigation measures. Accordingly, impacts to recreational resources under the Preferred LSJR Alternative would be significant and unavoidable.

However, this is a conservative analysis given that the reductions in low flows for swimming and wading would occur during May and June and would not occur during the remainder of the peak swimming and wading season. In addition, these impacts would be offset by other recreational opportunities related to improved conditions for kayaking and whitewater rafting at higher flows. Mitigation measures associated with the Preferred LSJR Alternative are the same as for LSJR Alternative 3 described in Chapter 10.

20.2.7 Agricultural Resource Impacts Analysis

Chapter 11, *Agricultural Resources*, analyzes impacts on agricultural resources from the LSJR alternatives. Increased tributary flows pursuant to the LSJR alternatives would result in fewer water supplies available for agricultural purposes. Chapter 11 identifies two agricultural impacts related to conversion of farmland to nonagricultural uses (AG-1) and other changes in the environment that may reduce land available for agricultural uses (AG-2).

LSJR Alternatives 2 and 3 would have a less-than-significant impact on other changes in the existing environment that could result in a conversion of farmland to nonagricultural use (AG-2).

Accordingly, because the Preferred LSJR Alternative falls between LSJR Alternatives 2 and 3, it was assumed to have the same less-than-significant impact on AG-2. Chapter 11 evaluates one impact (AG-1) that has a different significance level between LSJR Alternatives 2 and 3. An analysis of AG-1 is provided below.

AG-1: Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance to nonagricultural uses (*Significant and unavoidable*)

Impacts on agricultural resources from conversion of Prime or Unique Farmland or Farmland of Statewide Importance to nonagricultural uses may result from changes in water supplies for agricultural purposes. Impacts from the LSJR alternatives related to conversion of farmland were analyzed by comparing water supply impacts under the LSJR alternatives to baseline. These supplies were then used in the Statewide Water Agricultural Production model (SWAP) to determine the agricultural production under the LSJR alternatives compared to baseline.² Below is a comparison of total crop acreage in production for LSJR Alternatives 2 and 3 relative to baseline. Because the Preferred LSJR Alternative falls between LSJR Alternative 2 and 3, the impact on agricultural production for the Preferred LSJR Alternative was linearly interpolated from LSJR Alternatives 2 and 3. Similar to the analysis in Chapter 11, the analysis was conducted by comparing the difference in crop acreages at the 80 percent exceedance level. Prime Farmland, Unique Farmland, and Farmland of Statewide Importance are defined as having adequate water supply 8 out of 10 years (represented by the 80 percent exceedance level of irrigated crop acreage).

Table 20-16. Average Annual Acres of Irrigated Land for the Entire Plan Area

	Total Acreage in Production at 80% Exceedance	Difference From Baseline	% Difference From Baseline
Baseline	934,820		
LSJR Alternative 2	915,569	-19,251	-2
Preferred LSJR Alternative	828,821	-105,999	-11
LSJR Alternative 3	799,905	-134,915	-14

Significant impacts were assumed when crop production acreage was reduced by greater than 10 percent. As demonstrated above (Table 20-16), the Preferred LSJR Alternative would reduce total crop production by greater than 10 percent. Therefore, the Preferred LSJR Alternative would have a significant impact on the potential conversion of Prime Farmland, Unique Farmland, or Farmland of

² More information about SWAP and its application can be found in Appendix G, *Agricultural and Economic Effects of the Lower San Joaquin River Flow Alternatives*.

Statewide Importance to nonagricultural uses (AG-1). Similar to LSJR Alternative 3, there are no feasible mitigation measures. Accordingly, the Preferred LSJR Alternative would have a significant and unavoidable impact on agriculture relative to AG-1.

20.2.8 Cultural Resources Impacts Analysis

Chapter 12 of this SED, *Cultural Resources*, discusses potential impacts on cultural resources in the plan area. Table 20-1 identifies three cultural resources that may be impacted by the LSJR alternatives. There may be: substantial adverse changes in the significance of historical or archaeological resources; disturbances of human remains, including those interred outside formal cemeteries; and disturbances or destruction of a unique paleontological resource or site or unique geologic feature (CUL-1, CUL-2, and CUL-3, respectively). For each of these impacts, LSJR Alternatives 2 and 3 were determined to have a less-than-significant impact. Because the effects of the Preferred LSJR Alternative are generally within the bounds of LSJR Alternatives 2 and 3, it is also determined that the Preferred LSJR Alternative would have a less-than-significant impact on CUL-1, CUL-2, and CUL-3.

20.2.9 Service Providers Impacts Analysis

Chapter 13 of this SED, *Service Providers*, discusses potential impacts on service providers in the plan area. Impacts on service providers may result from reductions in water supplies under the Preferred LSJR Alternative. Impacts from the Preferred LSJR Alternatives related to service providers were analyzed by comparing water supply impacts under the Preferred LSJR Alternatives to LSJR Alternatives 2 and 3. Water supply impacts were estimated by changes in the volume of diversions and the end-of-September storage in New Melones, New Don Pedro, and New Exchequer Reservoirs.

Table 20-1 identifies four potential impacts the LSJR alternatives may have on service providers in the plan area. LSJR Alternatives 2 and 3 had the same level of significance for two impacts: potentially degrading water quality for drinking purposes and having potentially insufficient water supplies available to service providers relying on exports (SP-1 and SP-3 respectively). Because the effects of the Preferred LSJR Alternative are within the bounds of LSJR Alternatives 2 and 3, it is determined that the Preferred LSJR Alternative would have the same, less-than-significant, impacts on SP-1 and SP-3.

SP-2: Require or result in the construction of new or expanded water treatment facilities or water supply infrastructure, the construction of which could cause significant environmental effects (*Significant and unavoidable-see SP-4*)

SP-4: Require or result in the construction of new wastewater treatment facilities or expansion of existing facilities or infrastructure, the construction or operation of which could cause significant environmental effects (*Significant and unavoidable*)

As demonstrated in Section 20.2.1, the average monthly diversions associated with the Preferred LSJR Alternative are close to that of LSJR Alternative 3, both of which result in a significant reduction in supplies of more than 5 percent and a resulting significant impact on service providers for SP-2 and SP-4. For the same reasons, the Preferred LSJR Alternative would also result in significant impacts for SP-2 and SP-4. As with LSJR Alternative 3 described in Chapter 13, there are no feasible

mitigation measures. Impacts to service providers under the Preferred LSJR Alternative would be significant and unavoidable.

20.2.10 Energy Resources and Climate Change Impacts Analysis

Chapter 14, *Energy Resources and Climate Change*, discusses potential impacts on energy resources and climate change in the plan area. As shown in Table 20-1, there are five impacts identified in Chapter 14, of which three impacts have the same levels of significance between LSJR Alternatives 2 and 3. It is assumed that for these impacts, ECC-1, ECC-2, and ECC-5, the Preferred LSJR Alternative would have the same, less-than-significant impacts. Below is an impacts analysis for ECC-3 and ECC-4, which did not have the same levels of significance between the two alternatives.

ECC-3: Generate GHG emissions, either directly or indirectly, that have a significant impact on the environment (*Significant and unavoidable- see ECC-4*)

ECC-4: Conflict with an applicable plan, policy, or regulation adopted for the purposes of reducing GHG emissions (*Significant and unavoidable*)

Energy resources are dependent on hydrologic conditions. When there is high flow, more water is available for diversion through power plant turbines, and there is generally greater flexibility in the timing of reservoir releases to produce power. Higher required flows for environmental benefit decrease available water diversions, causing groundwater pumping increases. The increased electrical demand for groundwater pumping creates an increase in greenhouse gas emissions. Greenhouse gases (GHG) are generated by non-hydropower electrical generation and by groundwater pump use.

The estimated annual GHG emissions per the LSJR alternative are shown in Table 20-17. Based on the information presented in Table 20-17, a linear interpolation between LSJR Alternatives 2 and 3 was used to estimate the total GHG emissions for the Preferred LSJR Alternative.

Table 20-17. Estimated Annual Greenhouse Gas (GHG) Emissions Compared to Baseline

Alternative	GHG from Power Generation (MT CO ₂ e/year)	GHG from Energy Consumption (MT CO ₂ e/year)	Total GHG Emissions (MT CO ₂ e/year)
Baseline Conditions	0	0	0
LSJR Alternative 2	-2,157 ¹	2,294	137
Preferred LSJR Alternative	9,706	29,389	39,095
LSJR Alternative 3	13,660	38,420	52,081

MT CO₂e/year = metric ton carbon dioxide equivalent per year

¹ Modeled results indicate that LSJR Alternative 2 would result in an increase in hydropower production.

Using the linear interpolation, the Preferred LSJR Alternative would produce more than 10,000 metric ton carbon dioxide equivalent per year, resulting in a significant impact on energy resources and climate change (ECC-3 and ECC-4). As with LSJR Alternative 3 described in Chapter 14, there are no feasible mitigation measures. Accordingly, impacts to energy resources and climate change impacts under the Preferred LSJR Alternative would be significant and unavoidable.

20.2.11 Economic Analyses

Chapter 18, *Economic Analyses*, analyzes the economic impact of the LSJR alternatives using the SWAP model. The Preferred LSJR Alternative was not specifically analyzed in Chapter 18, but Preferred LSJR Alternative effects can be estimated from a linear interpolation based on the effects of LSJR Alternatives 2 and 3.

Agricultural Production

Modifying water available for diversions would cause changes in agricultural production. Changes in agricultural production are analyzed in two parts. The direct effect of changes in water availability is a change in the types and amounts of crops to be grown. The secondary effect of changes in water availability relates to the larger agricultural employment sector; a change in crop production may require more or less people to grow and harvest the crop resulting in changes in the regional economy. Agricultural production and the regional economic impact are further discussed in Appendix G, *Agricultural Economic Effects of Lower San Joaquin River Flow Alternatives*.

Table 20-18 Estimated Average Annual Baseline Crop Production Revenue and Changes Associated with LSJR Alternatives 2 and 3 and the Preferred LSJR Alternative

Agricultural Production	LSJR Alternative 2		Preferred LSJR Alternative		LSJR Alternative 3	
	Change	% Change	Change	% Change	Change	% Change
Irrigated acreage	12,280	1	-46,799	-5	-66,500	-7.0
Crop revenues (\$millions)	\$9	0.3	-\$28	-1.0	-\$40	-1.5

As shown above in Table 20-18, a 5 percent reduction in irrigated acreage is estimated for the Preferred LSJR Alternative. Similarly, a 5 percent reduction in irrigated acreage results in a 1 percent loss in crop revenues. Table 20-19 below follows this analysis by analyzing regional economic effects. If the Preferred LSJR Alternative reduces crop acreage compared to baseline, then the regional agricultural sector would have less output and there would be a slight decrease in jobs.

Table 20-19. Estimate Average Annual Change in Crop Production and Related Sector Compared to Baseline

Regional Economic Effects	LSJR Alternative 2		Preferred LSJR Alternative		LSJR Alternative 3	
	Change	% Change	Change	% Change	Change	% Change
Agriculture-related effects						
Total sector output (\$millions)	\$15	0.3	-\$48	-1.1	-\$69	-1.5
Total sector jobs	102	0.3	-323	-1.1	-465	-1.5

As demonstrated above, total agricultural sector output and related sector jobs are estimated to go down by 1 percent. A 1 percent decrease in agricultural sector output and jobs results in a decrease of \$48 million in total sector output and 323 jobs.

Hydropower Generation

Hydropower generation is discussed in detail in Appendix J, *Hydropower and Electric Grid Analysis of Lower San Joaquin River Flow Alternatives*. Power generation in late summer and early fall decreases as more unimpaired flow is required for environmental benefits. This is a result of water previously stored for late summer diversions being released February–June to meet unimpaired flow targets. Table 20-20 presents the average annual hydropower generation for LSJR Alternatives 2 and 3 and the Preferred LSJR Alternative. Additionally, Table 20-20 presents the potentially lost revenue associated with these alternatives.

Table 20-20. Average Annual Hydropower Revenue Compared to Baseline

	LSJR Alternative 2		Preferred LSJR Alternative		LSJR Alternative 3	
	Change	% Change	Change	% Change	Change	% Change
Hydropower Production Generation (gigawatt hours)	6	0.4	-22	-1.4	-38	-2.4
Hydropower revenue (\$millions)	\$0.9	1	-\$1.4	-1.4	-\$2.5	-3

The Preferred LSJR Alternative is estimated to reduce average annual hydropower generation by 22 gigawatt hours, which represents a loss of \$1.4 million in revenue. In general, the Preferred LSJR Alternative would result in a 1.4 percent reduction in power generated and revenue lost.

Recreation Impacts

Recreational economic impacts are evaluated using visitor days, benefits, and spending. The primary recreational activities include swimming, kayaking, boating, and wading in the tributaries and reservoirs. Admission fees and spending associated with these activities is analyzed in Chapter 18, *Economic Analyses*. Below is a summary of the recreational impact as compared to baseline.

As shown in Table 20-21, the Preferred LSJR Alternative would reduce the number of recreational visitor days on the tributaries and at the reservoirs by 33,450 visitor-days. This results in an average annual loss of \$920,000 in revenue.

Table 20-21. Average Annual Impact on Recreation Areas as Visitor Days Compared to Baseline

Recreation	LSJR Alternative 2	Preferred LSJR Alternative	LSJR Alternative 3
	Change	Change	Change
Use (visitor-days)	0	-33,450	-44,600
User net benefits (\$millions)	\$0	-\$0.42	-\$0.56
Visitor spending (\$millions)	\$0	-\$0.50	-\$0.67

20.3 Conclusions

The summarized environmental impacts of the Preferred LSJR Alternative are presented in Table 20-22. The impacts of the Preferred LSJR Alternative were within the bounds of analysis provided by the LSJR alternatives (LSJR Alternatives 2 and 3). Generally, the Preferred LSJR Alternative had impacts close to those of LSJR Alternative 3. As a result, it is expected the Preferred LSJR Alternative would have very similar cumulative impacts to those of LSJR Alternative 3 as summarized in Chapter 16, *Cumulative Impact Summary, Growth-Inducing Effects, and Irreversible Commitment of Resources* Table 16-2 and at the end of Chapters 5-14. Thus, it is expected to result in cumulative impacts to the following resources: water supply, surface hydrology, and water quality; groundwater resources; recreational resources; service providers; and, energy resources and climate change. The analysis performed for this chapter interpolates the results of LSJR Alternatives 2 and 3 with the Preferred LSJR Alternative. As identified in Chapter 17, *Summary of Impacts and Comparison of Alternatives*, LSJR Alternative 3 is considered the environmentally superior alternative when compared to LSJR Alternative 1, 2, and 4, because of the expected type and magnitude of impacts. Since Preferred LSJR Alternative is very similar to LSJR Alternative 3, it is expected to be more environmentally superior when compared to LSJR Alternative 2 and LSJR Alternative 4.

Table 20-22. Summary of Preferred LSJR Alternative Impacts Determinations

Impact	Preferred LSJR Alternative Significance Determination
HYD-1: Substantially reduce monthly river flow values caused by the percent unimpaired flow objective	Less than significant
HYD-2: Substantially alter hydrology such that regulating reservoir operations are limited	Less than significant
WS-1: Substantially reduce surface water supply diversions caused by a change in river flows or reduce exports to CVP and SWP export service areas caused by a change in river flows	Significant and unavoidable
WQ-1: Violate water quality objectives by increasing the number of months with EC above the water quality objectives for salinity at Vernalis or southern Delta compliance stations	Less than significant
WQ-2: Substantially degrade water quality by increasing Vernalis and/or southern Delta salinity (EC) such that agricultural beneficial uses are impaired	Less than significant
WQ-3: Substantially degrade water quality by increasing water temperature caused by reduced river flows	Less than significant
WQ-4: Substantially degrade water quality by increasing contaminant concentrations caused by reduced river flows	Less than significant
FLO-1: Substantially alter the existing drainage pattern of the site or area through the alteration of the course of a stream or river in a manner that would result in substantial erosion or siltation on or offsite	Less than significant
FLO-2: Substantially alter the existing drainage pattern of the site or area through the alteration of the course of a stream or river or substantially increase the rate of surface runoff in manner that would result in flooding on or offsite	Less than significant
AQUA-1: Changes in availability of warmwater species reservoir habitat resulting from change in reservoir water levels	Less than significant

Impact	Preferred LSJR Alternative Significance Determination
AQUA-2: Changes in availability of coldwater species reservoir habitat resulting from changes in reservoir storage	Less than significant
AQUA-3: Changes in quantity/quality of spawning, rearing, and migration habitat resulting from changes in flow	Less than significant
AQUA-4: Changes in exposure of fish to stressful water temperatures resulting from changes in reservoir storage and releases	Less than significant
AQUA-5 : Changes in exposure to pollutants resulting from changes in flow (dilution/mobilization effects)	Less than significant
AQUA-6: Changes in exposure to suspended sediment and turbidity resulting from changes in flow (mobilization)	Less than significant
AQUA-7: Changes in redd dewatering and fish stranding losses resulting from flow fluctuations	Less than significant
AQUA-8: Changes in spawning habitat quality resulting from changes in flood flows	Less than significant
AQUA-9: Changes in food availability resulting from changes in flow, nutrient transport, and water quality (food web support)	Less than significant
AQUA-10: Changes in predation risk resulting from changes in flow and water temperature	Less than significant
AQUA-11: Changes in disease risk resulting from changes in flow, water temperature, and water quality	Less than significant
AQUA-12: Changes in fish transport resulting from changes in flow	Less than significant
AQUA-13: Changes in southern Delta and estuarine habitat resulting from changes in SJR inflows and export effects	Less than significant
BIO-1 : Have a substantial impacts on any riparian habitat or other sensitive natural terrestrial communities identified in local or regional plans, policies, regulations or by Department of Fish and Game (DFG) and U.S. Fish and Wildlife Service (USFWS)	Less than significant
BIO-2: Have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrologic interruption, or other means	Less than significant
BIO-3: Facilitate an increase in distribution and abundance of invasive plants or nonnative wildlife	Less than significant
BIO-4: Have a substantial adverse effect, either directly or through habitat modifications, on any terrestrial animal species identified as a candidate, sensitive, or special-status species in local or regional plans, policies, or regulations, or by DFG and USFWS	Less than significant
BIO-5: Conflict with the provisions of an adopted habitat conservation plan, natural community conservation plan, or other approved local, regional, or state habitat conservation plan, or conflict with any local policies or ordinances protecting biological resources	Less than significant

Impact	Preferred LSJR Alternative Significance Determination
GW-1: Substantially deplete groundwater supplies or interfere substantially with groundwater recharge	Significant and unavoidable
REC-1: Substantially reduce the use of existing recreation facilities or opportunities on rivers or at reservoirs	Significant and unavoidable
EC-2: Substantially degrade the functionality of existing recreation facilities on the rivers or at reservoirs	Less than significant
EC-3: Substantially degrade the existing visual character or quality of the reservoirs	Less than significant
AG-1: Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance to nonagricultural uses	Significant and unavoidable
AG-2: Other changes in the existing environment which, due to their location or nature, could result in a conversion of farmland to nonagricultural use	Less than significant
CUL-1: Substantial adverse change in the significance of a historical or archaeological resource	Less than significant
CUL-2: Disturbance of human remains, including those interred outside formal cemeteries	Less than significant
CUL-3: Disturbance or destruction of a unique paleontological resource or site or unique geologic feature	Less than significant
SP-1: Substantially degrade water quality for municipal drinking water purposes	Less than significant
SP-2: Require or result in the construction of new or expanded water treatment facilities or water supply infrastructure, the construction of which could cause significant environmental effects	Significant and unavoidable
SP-3: Result in substantial changes to San Joaquin River inflows to the Delta such that insufficient water supplies would be available to service providers relying on CVP/SWP exports	Less than significant
SP-4: Require or result in the construction of new wastewater treatment facilities or expansion of existing facilities or infrastructure, the construction or operation of which could cause significant environmental effects	Significant and unavoidable
ECC-1: Adversely affect the reliability of California's electric grid	Less than significant
ECC-2: Result in inefficient, wasteful, and unnecessary energy consumption	Less than significant
ECC-3: Generate GHG emissions, either directly or indirectly, that have a significant impact on the environment	Significant and unavoidable
ECC-4: Conflict with an applicable plan, policy, or regulation adopted for the purposes of reducing the GHG emissions	Significant and unavoidable
ECC-5: Effect of global climate change on the LSJR and SDWQ alternatives	Less than significant

The Preferred SDWQ Alternative is SDWQ Alternative 2, which is analyzed explicitly in the SED. The Preferred SDWQ Alternative would impact municipal service providers to the extent wastewater treatment plants would have to comply with NPDES effluent limitations based on the new objectives, or a salinity management plan developed by the Central Valley Board that otherwise implements those objectives. Other potential impacts on the environment resulting from the Preferred SDWQ Alternative are less than significant. A summary of SDWQ Alternative 2 impacts, which is the same as the Preferred SDWQ Alternative, is presented in Chapter 17, *Summary of Impacts and Comparison of Alternatives*, Tables 17-1 and 17-2.