Appendix L

Sensitivity Analyses

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Sensitivity Analyses

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L.1 Introduction

The purpose of this appendix is to test the sensitivity of the State Water Board's Water Supply Effects (WSE) model representation of the Lower San Joaquin River (LSJR) Alternatives 2, 3, and 4 to changes in certain model parameters. Two sensitivity scenarios were evaluated: (1) increasing the river flow rates above which minimum unimpaired flow requirements are no longer applicable; and (2) increasing the minimum flow in the Stanislaus River at Goodwin to meet the requirements of the National Marine Fisheries (NMFS) *Biological Opinion and Conference Opinion on the Long-Term Operations of the Central Valley Project and State Water Project* (BO) Reasonable and Prudent Alternative 3.1.3 (RPA). The sensitivity analysis compares the output of the WSE model as modified for each of these two scenarios against the WSE model output used in this substitute environmental document (SED) for the LSJR alternatives. Specifically, the resulting river flows, diversions, and end-of-September storages are compared. Flow was analyzed at the confluence of each tributary with the SJR and at Vernalis on the SJR. Diversions were analyzed as the total amount of water diverted from each of the three eastside tributaries (the Stanislaus, Tuolumne, and Merced Rivers) and the three tributaries as a whole. Storage was analyzed at New Melones Reservoir, New Don Pedro Reservoir, and Lake McClure for the Stanislaus, Tuolumne, and Merced Rivers, respectively.

L.2 Sensitivity to Increasing the Maximum Required Tributary Flows

The minimum percent unimpaired flow requirements for the LSJR alternatives are not intended to apply on a tributary when river flow approaches a level of concern for downstream flooding on that tributary. As such, river flow levels on each tributary above which the target unimpaired flow requirements are no longer applicable (maximum required tributary flow) can be specified in the WSE model. These levels, however, are only the point at which minimum flow requirements no longer apply; they are not maximum tributary flow limits. Flows in the tributaries might be greater than these levels due to flood releases from the major upstream reservoirs. This section evaluates the sensitivity of WSE model results to changes in these maximum required tributary flows.

As described in Appendix C, *Technical Report on the Scientific Basis for Alternative San Joaquin River Flow and Southern Delta Salinity Objectives* (Section 5.3.1), the maximum required tributary flows included in the WSE modeling for the LSJR alternatives were monthly average flows of 2500 cfs, 3500 cfs, and 2000 cfs on the Stanislaus, Tuolumne, and Merced Rivers, respectively. These were based roughly on the median of the average monthly unimpaired flows February–June for water years 1984–2009. Another possible basis for the maximum required flows on each of the tributaries could be the NOAA flood action stages. These are established river stages which, when reached by a rising stream, represent the level where some type of mitigation action is needed in preparation for possible flooding (NWS 2012). Such flood action stages, however, are evaluated on an averaging period much shorter than on a monthly basis (e.g., instantaneous or daily average); therefore, some method for considering them in the monthly average calculation methodology of the WSE model is required.

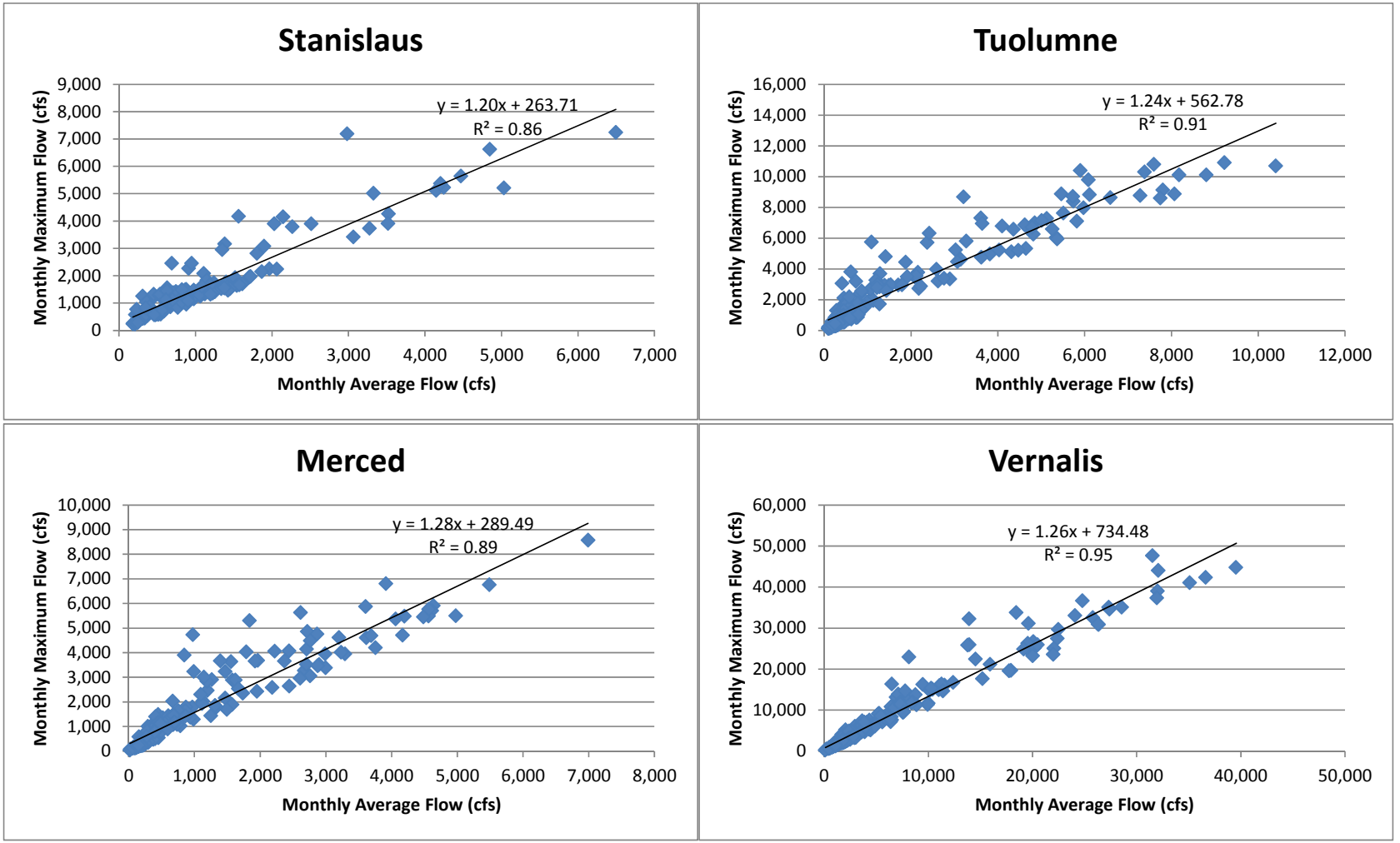
The objectives of the analysis in this section is to: (1) determine monthly average flow on each of the three eastside tributaries that corresponds to a monthly average flow, including a daily flow value

similar to the NOAA instantaneous flood action stages on the tributaries; and (2) determine the sensitivity of the WSE model if the WSE maximum required flows are changed to values more similar to the NOAA flood action stages for each tributary (i.e., Adjusted Alternative WSE model runs).

L.2.1 Methodology

To estimate the monthly average flow that would be expected to include a given daily flow value, a relationship was developed on each of the three eastside tributaries between the maximum observed river flow that occurred during each month to the observed average flow over that month. Linear regression was used to relate the resulting paired time series of the monthly maximum and monthly average flows on each tributary. Historical observed river data for 1984–2003 was used from U.S. Geological Survey (USGS) stream gages throughout the plan area—the same set of data used in Appendix C—for the Stanislaus River at Ripon, the Tuolumne River at Modesto, the Merced River at Stevinson, and the SJR at Vernalis. The relationships developed for the SJR and each tributary are shown in L-1.

The NOAA flood action stages are generally less than the full channel capacities determined by the U.S. Army Corps of Engineers (USACE) and do not have an averaging period. The action stages for the Stanislaus, Tuolumne, and Merced Rivers are shown in Table L-1. Using these relationships, the monthly average flow associated with a daily average flow equal to the NOAA flood action stages for each tributary were determined and are also presented in Table L-1, together with the values included in the WSE model used for this SED.



L-1. Relationships between Maximum Daily Average Flow (cfs) and Associated Monthly Average Flow (cfs) on the Stanislaus, Tuolumne, and Merced Rivers and the SJR at Vernalis (cfs = cubic feet per second)

The WSE model was then run for each LSJR alternative using maximum required flows (as a monthly average) on each tributary corresponding the NOAA flood action stage. Because this increased river flow in LSJR Alternative 4, the diversion delivery curve was further adjusted following the methodology in Appendix F.1, *Hydrologic and Water Quality Modeling*, to minimize impacts on coldwater pool and maximize diversions. No other changes were made to the inputs for LSJR Alternatives 2, 3, and 4 within the WSE model. The sensitivity to this change is determined by comparing the Adjusted Alternative WSE model runs to the LSJR Alternative 2, 3, and 4 model runs.

Table L-1. Maximum Required Tributary Flows Included in SED WSE Model and Those Based on NOAA Flood Action Stage

Location	WSE Model Alternatives (cfs)	NOAA Flood Action Stage [ft] and [cfs]	Equivalent Monthly Average Flow (cfs)
Stanislaus River at Ripon	2,500	13 ft or 8,500 cfs	6,800
Tuolumne River at Modesto	3,500	50.5 ft or 6,600 cfs	4,900
Merced River near Stevinson	2,000	67 ft or 3,200 cfs	2,300
San Joaquin River near Vernalis	NA	24.5 ft or 22,000 cfs	16,800[1]

cfs = cubic feet per second

ft = feet

[1]SJR channel capacity not used as a reference and not as an input.

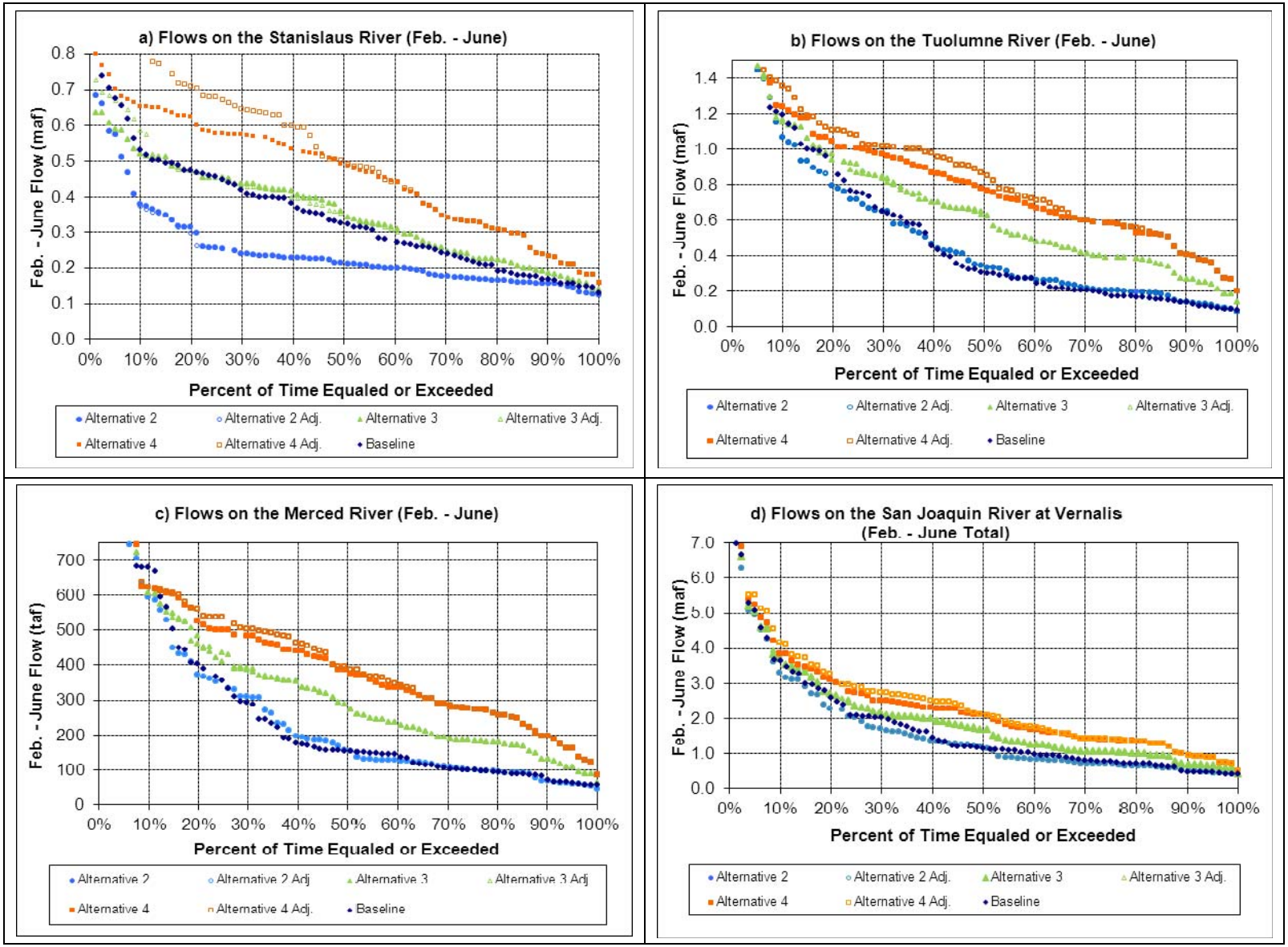
L.2.2 Results

The resulting WSE model flows (presented as an exceedance plot of the February–June total flows) for the LSJR alternatives (solid marker points) and the adjusted alternatives (open marker points) are shown in L-2. In general, the 60 percent alternative (LSJR Alternative 4) is most affected, the 40 percent alternative (LSJR Alternative 3) is only slightly affected on the Stanislaus, and the 20 percent alternative (LSJR Alternative 2) is not affected. For all three eastside tributaries and the SJR at Vernalis, LSJR Alternatives 2 and 3 are not sensitive to the changes in the maximum required tributary flows and result in a nearly identical distribution of February–June flows. This is further shown in Table L-2, which contains the average baseline and the difference from baseline due to the LSJR alternatives and the adjusted alternatives for each tributary and the SJR at Vernalis. With the exception of the Stanislaus River and Vernalis, LSJR Alternatives 2 and 3 result in little to no change in the average difference from baseline when the channel capacity is changed. LSJR Alternative 4 shows the most sensitivity primarily on the Stanislaus River, and only a small increase in the difference from baseline on the other two tributaries (the Tuolumne and Merced Rivers) and the SJR at Vernalis. This difference is mostly in the less than 50 percent exceedance values (higher flow years) with minimal differences in the greater than 50 percent exceedance values. Only LSJR Alternative 4 is somewhat sensitive to the change, and the result would be an increased flow.

The resulting WSE model diversions (presented as an exceedance plot of the annual diversions) for the LSJR alternatives (solid marker points) and the adjusted alternatives (open marker points) are shown in L-3. For all three eastside tributaries and the sum of these tributaries, LSJR Alternatives 2 and 3 are not sensitive to changes in maximum required tributary flows and result in a nearly

identical distribution of annual diversions. This is further shown in Table L-3, which contains the average baseline and the difference from baseline due to the alternatives and the adjusted alternatives for each tributary and the sum of the three tributaries. With the exception of the Stanislaus River and Vernalis, LSJR Alternatives 2 and 3 result in little to no change in the average difference from baseline when the maximum required tributary flows are changed. LSJR Alternative 4 shows the most sensitivity, primarily on the Stanislaus (an increase in the difference from baseline of 9 percent), and only a small increase in the difference from baseline on the other two tributaries (the Tuolumne and the Merced) and the SJR at Vernalis. This difference is fairly constant across the distribution, resulting in nearly parallel exceedance plots. Only LSJR Alternative 4 is somewhat sensitive to the change, and the result would be a decrease in diversions.

The resulting WSE model end-of-September storages (presented as an exceedance plot of the annual end-of-September storage) for the LSJR alternatives (solid marker points) and those with changed maximum required tributary flows (open marker points) are shown in L-4. For all three eastside tributaries, LSJR Alternatives 2 and 3 are not sensitive to the changes in the maximum required tributary flows and result in a nearly identical distribution of annual end-of-September storages. This is further shown in Table L-4, which contains the average baseline and the difference from baseline due to the alternatives and the adjusted alternatives for each tributary. With the exception of the Stanislaus River, LSJR Alternatives 2 and 3 result in little to no change in the average difference from baseline when the maximum required tributary flows are changed. LSJR Alternative 4 shows the most sensitivity, primarily on the Stanislaus (an increase in the difference from baseline of 18 percent), and only a small increase in the difference from baseline on the other two tributaries (the Tuolumne and Merced Rivers) and the SJR at Vernalis. This difference is most prevalent on the Stanislaus for higher storages and shows little change at lower storages. Furthermore, the change in channel capacity causes the reservoir never to fill to capacity in this month. To adjust this, the diversion delivery curve could be adjusted; however, this would lead to additional losses in diversions. Only LSJR Alternative 4 is somewhat sensitive to the change, and the result would be a decrease in in the end-of-September storage, primarily on the Stanislaus River.

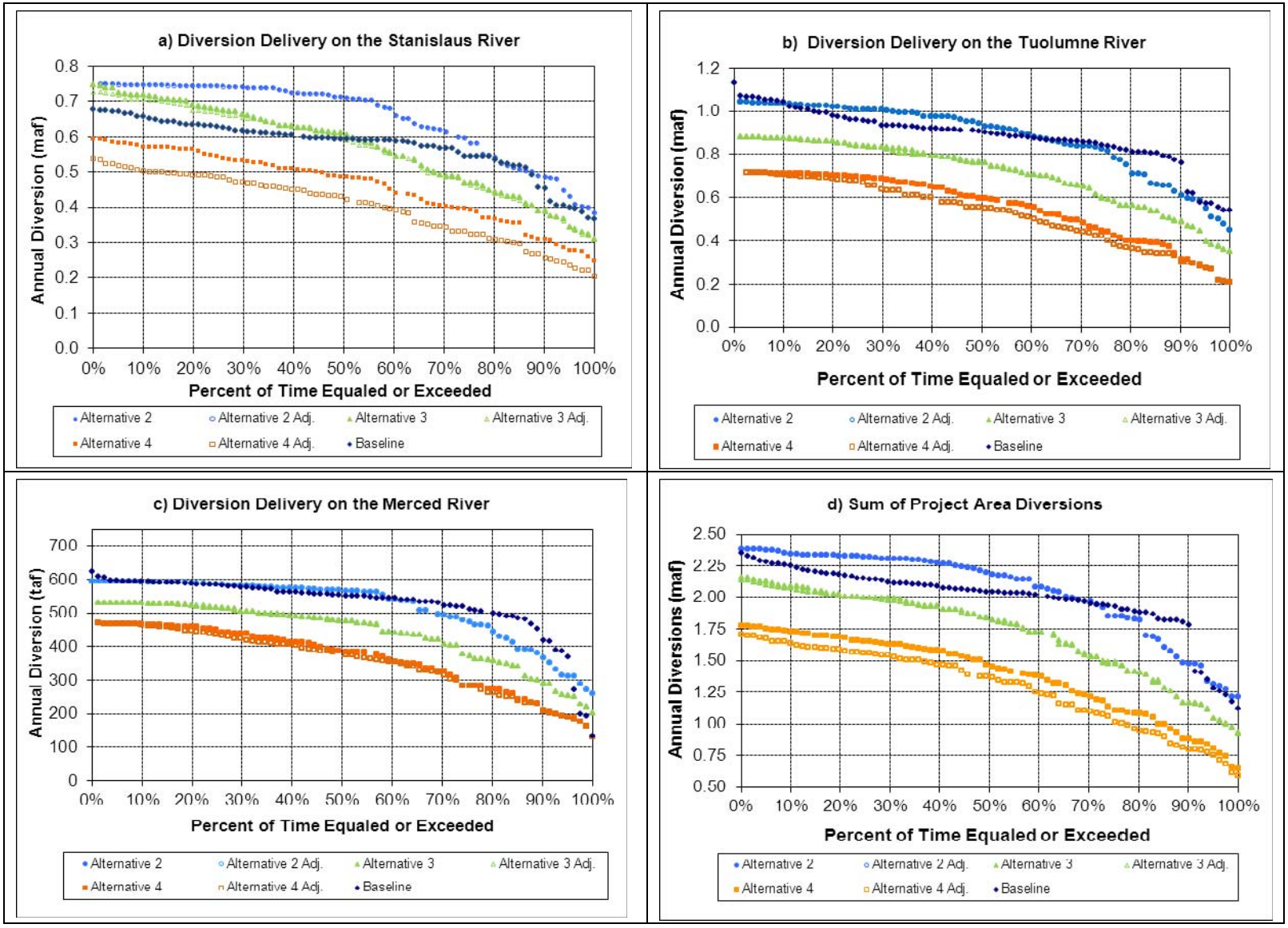


L-2. Total River Flow (TAF) for February through June across 82 Years of Simulated Hydrology on the Stanislaus, Tuolumne, and Merced Rivers, and the LSJR at Vernalis for LSJR Alternatives 2, 3, and 4 as Represented by the WSE Model and with Maximum Required Flow Adjusted to NOAA Flood Action Stage on Each Tributary (Adj. = adjusted; TAF = thousand acre-feet)

Table L-2. Average February–June Baseline Flow and Difference from Baseline for LSJR Alternatives 2, 3, and 4 and the Adjusted[1] Alternatives on Each Eastside Tributary and at Vernalis

Alternative	SJR at Vernalis (TAF/%)	Stanislaus at Ripon (TAF/%)	Tuolumne at Modesto (TAF/%)	Merced at Stevinson (TAF/%)
Baseline	1804	355	540	270
LSJR Alternative 2 (20%) difference from baseline	-130 / -7	-103 / -29	-21 / -4	-6 / -2
LSJR Alternative 3 (40%) difference from baseline	226 / 13	3 / 1	149 / 28	74 / 27
LSJR Alternative 4 (60%) difference from baseline	555 / 31	115 / 32	291 / 54	149 / 55
Adjusted Alternative 2 difference from baseline	-130/ -7	-103 / -29	-21 / -4	-6 / -2
Adjusted Alternative 3 difference from baseline	239 / 13	10 / 3	153 / 28	76 / 28
Adjusted Alternative 4 difference from baseline	665 / 37	174 / 49	332 / 61	159 / 59

TAF = thousand acre-feet
[1] WSE model maximum tributary flow adjusted to match NOAA flood action stage expressed as a monthly average.

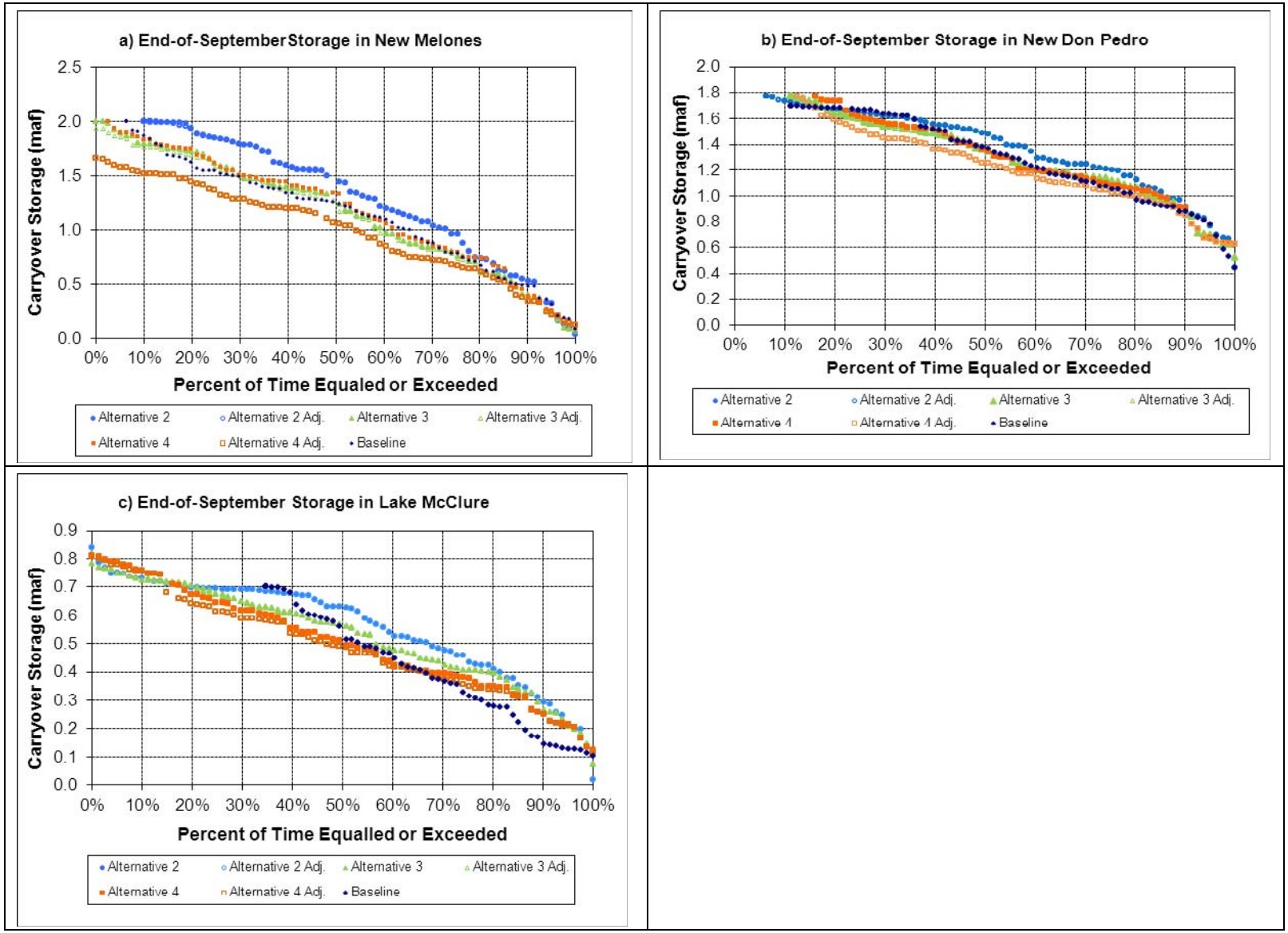


L-3. Total Annual Diversion Deliveries (TAF) across 82 Years of Simulated Hydrology on the Stanislaus, Tuolumne, and Merced Rivers and the SJR at Vernalis for LSJR Alternatives 2, 3, and 4 as Represented by the WSE Model and with Maximum Required Flow Adjusted to NOAA Flood Action Stage on Each Tributary (Adj. = adjusted; TAF = thousand acre-feet)

Table L-3. Average Annual Baseline Diversions and Difference from Baseline for LSJR Alternatives 2, 3, and 4 and the Adjusted[1] Alternatives on Each Eastside Tributary and the Tributaries Combined

Alternative	Combined (TAF/%)	Stanislaus (TAF/%)	Tuolumne (TAF/%)	Merced (TAF/%)
Baseline	1,989	577	885	527
LSJR Alternative 2 (20%) difference from baseline	64 / 3	72 / 12	-6 / -1	-10 / -2
LSJR Alternative 3 (40%) difference from baseline	-268 / -13	-8 / -1	-173 / -20	-87 / -17
LSJR Alternative 4 (60%) difference from baseline	-613 / -31	-121 / -21	-329 / -37	-163 / -31
Adjusted Alternative 2 difference from baseline	63 / -3	78 / 14	-5 / -1	-10 / -2
Adjusted Alternative 3 difference from baseline	-273 / -14	-12 / -2	-174 / -20	-87 / -17
Adjusted Alternative 4 difference from baseline	-703 / -35	-174 / -30	-358 / -40	-171 / -32

TAF = thousand acre-feet
[1] WSE model maximum tributary flow adjusted to match NOAA flood action stage expressed as a monthly average.



L-4. End-of-September Storage Across 82 Years of Simulated Hydrology on the Stanislaus, Tuolumne, and Merced Rivers and the SJR at Vernalis for LSJR Alternatives 2, 3, and 4 as Represented by the WSE Model and with Maximum Required Flow Adjusted to NOAA Flood Action Stage on Each Tributary (maf = million acre-feet; Adj. = adjusted).

Table L-4. Average Annual Baseline End-of-September Storage and Difference from Baseline for LSJR Alternatives 2, 3, and 4 and the Adjusted[1] Alternatives on Each Eastside Tributary

Alternative	New Melones Stanislaus (TAF/%)	New Don Pedro Tuolumne (TAF/%)	Lake McClure Merced (TAF/%)
Baseline	1166	1324	496
LSJR Alternative 2 (20%) difference from baseline	148 / 13	62 / 5%	63 / 13%
LSJR Alternative 3 (40%) difference from baseline	6 / 1	4 / 0%	33 / 7%
LSJR Alternative 4 (60%) difference from baseline	32 / 3	9 / 1	8 / 2%
Adjusted Alternative 2 difference from baseline	165 / 14	62 / 5	63 / 13%
Adjusted Alternative 3 difference from baseline	-29 / -2	-1 / 0	31 / 6%
Adjusted Alternative 4 difference from baseline	-172 / -15	-56 / -4	-7 / -1%

TAF = thousand acre-feet

[1] WSE model maximum tributary flow adjusted to match NOAA Flood Action Stage expressed as a monthly average.

L.3 Sensitivity to Minimum Stanislaus River Flow

The purpose of this section is to evaluate the river flows and water supply impacts of the LSJR alternatives assuming concurrent compliance with the National Marine Fisheries Service's *Biological Opinion and Conference Opinion on the Long-Term Operations of the Central Valley Project and State Water Project* (NMFS BO) Reasonable and Prudent Alternative 3.1.3 (RPA) (NMFS 2009). The associated river flows and water supply impacts are then compared against those for the LSJR alternatives alone (as they are evaluated in this SED). Generally the RPA requires additional flow to be released from New Melones Reservoir on the Stanislaus River based on available storage in New Melones Reservoir and projected inflows to New Melones Reservoir (New Melones Index). The intent of the RPA is to increase habitat for listed species and affects flows downstream at Vernalis. The proposed LSJR alternatives have a similar purpose as the RPA, although the purpose of the alternatives is different in the specific timing and magnitude.

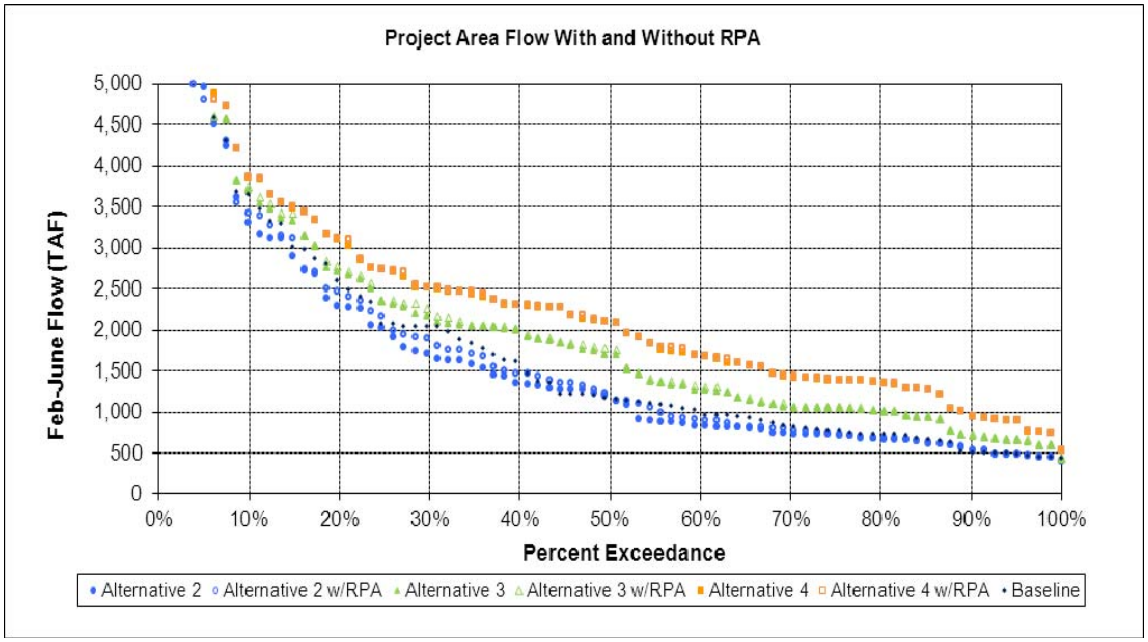
For this analysis, the WSE modeling of the LSJR alternatives (as already described in this SED) was modified to also include compliance with the RPA when the LSJR alternatives were not already otherwise in compliance. This was achieved by using the RPA as a set of minimum flows to replace those used in the WSE model for the LSJR alternatives. This in effect requires that the minimum flow be the greater of the RPA or the percentage of unimpaired flow. The schedule of RPA flows can be found in Appendix D, *Evaluation of LSJR Alternative 1 and SDWQ Alternative 1 (No Project Alternative)*.

Differences in river flow between each LSJR alternative with and without the RPA are assessed using the sum of February–June flows. Diversions are summarized as the annual diversion for each calendar year. Storage is compared using the end-of-September storage in New Melones Reservoir for each water year 1922–2003. Exceedance plots are used to graphically display results to show overall sensitivity to this change for each alternative. Adding the RPA required slight changes to the diversion delivery curves used in LSJR Alternatives 2 and 3 in New Melones Reservoir to minimize impacts on coldwater pool. The same methodology discussed in Appendix F.1, *Hydrologic and Water Quality Modeling*, was used to determine these new diversion delivery curves. The Tuolumne and Merced Rivers are unaffected by the RPA. All other model inputs and assumptions were unchanged for these RPA comparison model runs.

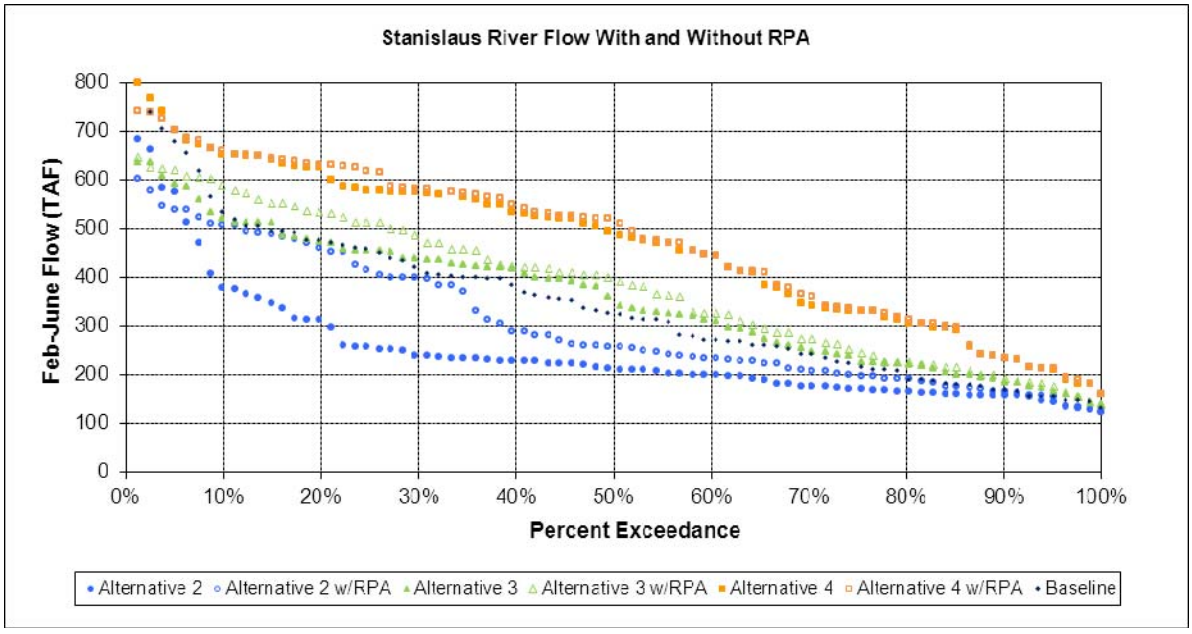
L.3.1 Flows

The resulting WSE model estimates of river flows (presented as an exceedance plot of the February–June total flows across 82 years of modeled hydrology) for LSJR Alternatives 2, 3, and 4 without the RPA (solid marker points) and those including concurrent compliance with the RPA (open marker points) are shown in L-5 for the flow at Vernalis and in L-6 for the flow on the Stanislaus River alone. Flows on the Tuolumne and Merced Rivers are unaffected by the RPA. LSJR Alternative 2 exhibits a substantial increase in flows at Vernalis and in the Stanislaus River when adding the RPA, evidenced by a shift upward in the exceedance plot. LSJR Alternatives 3 and 4 are only slightly sensitive to the increase in the minimum flow, primarily at lower exceedance probabilities, and result in nearly the same distribution of February–June flow.

This is further shown in Table L-5 and Table L-6 for estimates of flow at Vernalis and the Stanislaus River, respectively, showing the average alternative flows and the difference when the RPA is added. This shows that LSJR Alternative 2 is most sensitive to concurrent compliance with the RPA, and results in generally increased flow. River flows at Vernalis and on the Stanislaus are only marginally affected for LSJR Alternatives 3 and 4.



L-5. Exceedance Plot of February–June Estimates of Flow in the San Joaquin River at Vernalis Across 82 Years of Hydrology for LSJR Alternatives 2, 3, and 4 and Baseline, with and without Concurrent Compliance with the NMFS Stanislaus River RPA (TAF = thousand acre-feet)



L-6. Exceedance Plot of February –June Estimates of Flow in the Stanislaus River at Ripon across 82 Years of Hydrology for LSJR Alternatives 2, 3, and 4 and Baseline, with and without Concurrent Compliance with the NMFS Stanislaus River RPA (TAF = thousand acre-feet)

Table L-5. Estimates of Average February–June Flow, with Percent Differences, for the SJR at Vernalis for LSJR Alternatives 2, 3, and 4, with and without Concurrent Compliance with the NMFS Stanislaus River RPA

	Alternative (TAF)	Alternative w/RPA (TAF)	Difference from Alternative (TAF)	Difference from Alternative (%)
LSJR Alternative 2	1,674	1,734	60	4
LSJR Alternative 3	2,031	2,061	30	1
LSJR Alternative 4	2,359	2368	9	0

TAF = thousand acre-feet
RPA = National Marine Fisheries *Biological Opinion and Conference Opinion on the Long-Term Operations of the Central Valley Project and State Water Project* Reasonable and Prudent Alternative 3.1.3

Table L.-6. Estimates of Average February–June Flow, with Percent Differences, for the Stanislaus River at Ripon for LSJR Alternatives 2, 3, and 4, with and without Concurrent Compliance with the NMFS Stanislaus River RPA

	Alternative (TAF)	Alternative w/RPA (TAF)	Difference from Alternative (TAF)	Difference from Alternative (%)
LSJR Alternative 2	254	313	59	23%
LSJR Alternative 3	362	389	27	7%
LSJR Alternative 4	473	479	6	1%

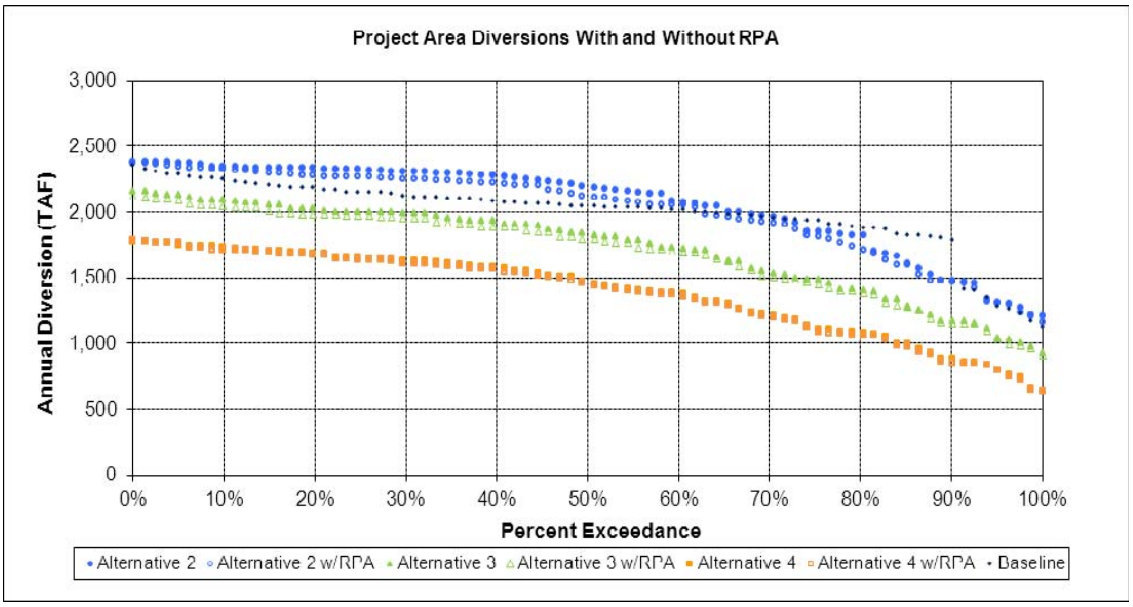
TAF = thousand acre-feet
RPA = National Marine Fisheries *Biological Opinion and Conference Opinion on the Long-Term Operations of the Central Valley Project and State Water Project* Reasonable and Prudent Alternative 3.1.3

L.3.2 Diversions

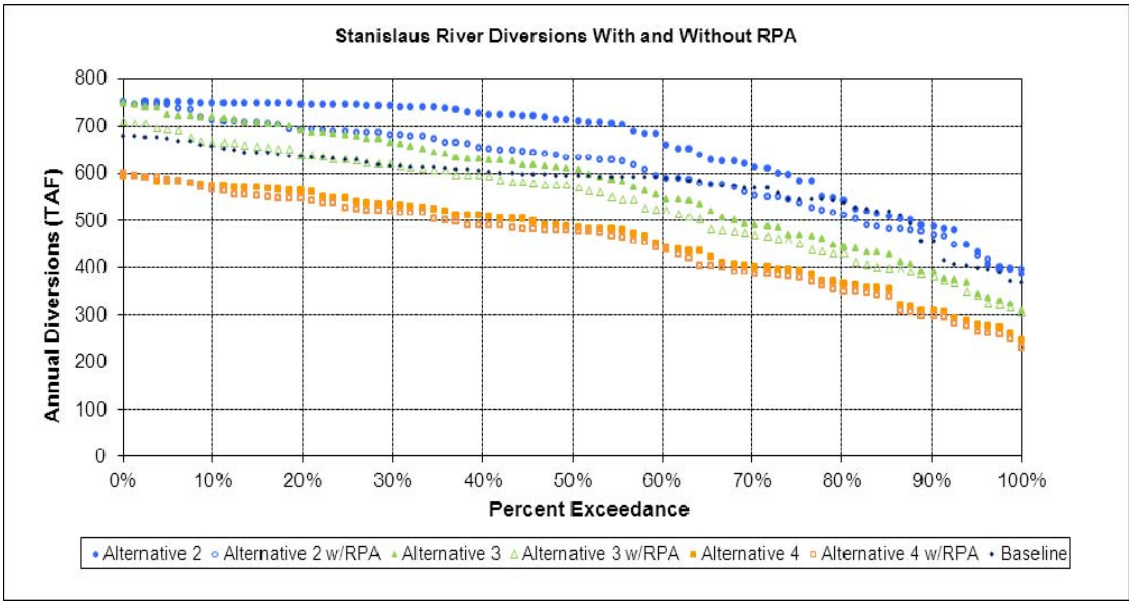
The resulting WSE model estimates of surface water diversions (presented as an exceedance plot of the annual surface water diversion across 82 years of simulated hydrology) for the three LSJR alternatives without the RPA (solid marker points) and with concurrent compliance with the RPA (open marker points) are shown in L-7 for the combined tributaries and L-8 for the Stanislaus River. Diversions from the Tuolumne and Merced Rivers are unaffected by the RPA. LSJR Alternative 2 exhibits a substantial decrease in diversions from the Stanislaus River when adding the RPA, evidenced by a shift downward in the exceedance plot. LSJR Alternatives 3 and 4 are only slightly sensitive to the RPA and result in nearly the same distribution of annual diversions.

This is further shown in Table L-7 and Table L-8 for the estimated total surface water diversions on the three tributaries and the Stanislaus River, respectively, showing the average alternative diversions and the difference when the RPA is added. This shows LSJR Alternative 2 is most

sensitive to the change, with generally decreased surface water diversions. Surface water diversions are only marginally affected for LSJR Alternatives 3 and 4.



L-7. Exceedance Plot of Annual Surface Water Diversions from the Three Eastside Tributaries across 82 Years of Hydrology for LSJR Alternatives 2, 3, and 4 and Baseline, with and without Concurrent Compliance with the NMFS Stanislaus River RPA (TAF = thousand acre-feet)



L-8. Exceedance Plot of Annual Surface Water Diversions from the Stanislaus River across 82 Years of Hydrology for LSJR Alternatives 2, 3, and 4 and Baseline, with and without Concurrent Compliance with the NMFS Stanislaus River RPA (TAF = thousand acre-feet)

Table L-7. Estimates of Annual Surface Water Diversions, with Percent Differences, from all Three Eastside Tributaries for LSJR Alternatives 2, 3, and 4, with and without Concurrent Compliance with the NMFS Stanislaus River RPA

	Alternative (TAF)	Alternative with RPA (TAF)	Difference from Alternative (TAF)	Difference from Alternative (%)
LSJR Alternative 2	2,053	2,008	-45	-7
LSJR Alternative 3	1,725	1,695	-30	-2
LSJR Alternative 4	1,383	1,371	-12	-1

TAF = thousand acre-feet
RPA = National Marine Fisheries *Biological Opinion and Conference Opinion on the Long-Term Operations of the Central Valley Project and State Water Project* Reasonable and Prudent Alternative 3.1.3

Table L-8. Estimates of Annual Surface Water Diversions, with Percent Differences, from the Stanislaus River for LSJR Alternatives 2, 3, and 4, with and without Concurrent Compliance with the NMFS Stanislaus River RPA

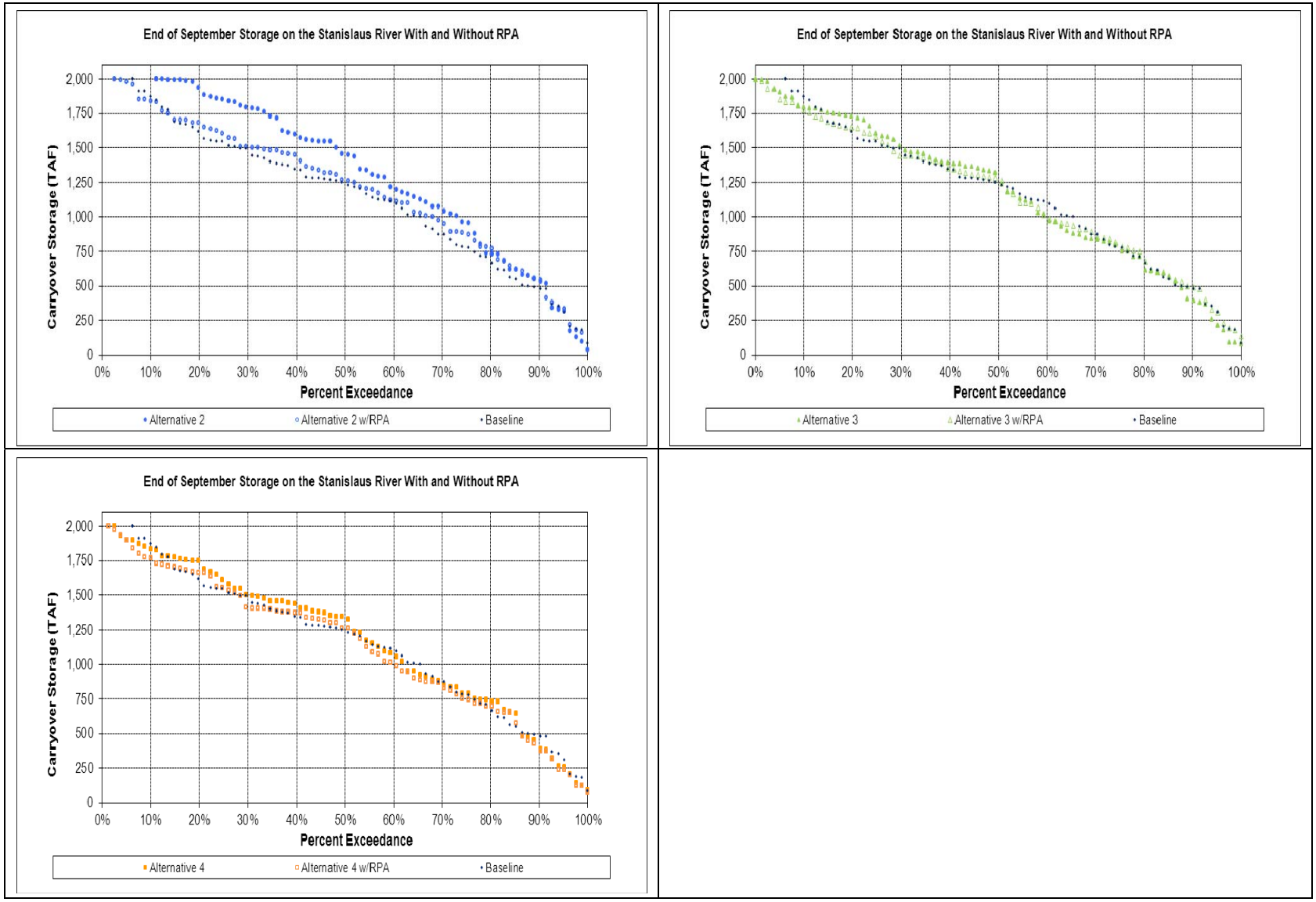
	Alternative (TAF)	Alternative w/RPA (TAF)	Difference from Alternative (TAF)	Difference from Alternative (%)
LSJR Alternative 2	655	608	-47	-8%
LSJR Alternative 3	571	539	-32	-6%
LSJR Alternative 4	461	449	-12	-3%

TAF = thousand acre-feet
RPA = National Marine Fisheries *Biological Opinion and Conference Opinion on the Long-Term Operations of the Central Valley Project and State Water Project* Reasonable and Prudent Alternative 3.1.3

L.3.3 Storage

The resulting WSE model estimates of end-of-September storage in New Melones Reservoir (presented as an exceedance plot across 82 years of simulated hydrology) for the LSJR alternatives without the RPA (solid marker points) and those including concurrent compliance with the RPA (open marker points) are shown in L-9. LSJR Alternative 2 exhibits a decrease in end-of-September storage, primarily at higher storage levels, when adding the RPA, as evidenced by a shift downward in the exceedance plot toward one similar to baseline. LSJR Alternatives 3 and 4 are only slightly sensitive to the RPA and result in nearly the same distribution of storage, which are both very similar to baseline. Reservoir storage on the Tuolumne and Merced Rivers are unaffected by the RPA.

This is further shown in Table L-9, which contains the average end-of-September storage for the LSJR alternatives and the difference with and without concurrent compliance with the RPA. By adding the RPA minimum flow, the end-of-September storage decreased 9 percent, less than 1 percent, and 4 percent for LSJR Alternatives 2, 3, and 4, respectively. This shows that LSJR Alternative 2 is most sensitive to the change and results in a slight decrease in storage. As demonstrated, end-of-September storages are generally lower with the RPA applied, but only marginally so for LSJR Alternatives 3 and 4.



L-9. Exceedance Plot of End-of-September Storage in New Melones Reservoir across 82 Years of Hydrology for LSJR Alternatives 2, 3, and 4 and Baseline, with and without Concurrent Compliance with the NMFS Stanislaus River RPA (TAF = thousand acre-feet)

Table L-9. Estimates of End-of-September Storage in New Melones Reservoir, with Percent Differences, for LSJR Alternatives 2 , 3, and 4, with and without Concurrent Compliance with the NMFS Stanislaus River RPA

	Alternative (TAF)	Alternative w/RPA (TAF)	Difference from Alternative (TAF)	Difference from Alternative (%)
LSJR Alternative 2	1,332	1,208	-124	-9
LSJR Alternative 3	1,163	1,158	-5	0
LSJR Alternative 4	1,186	1,142	-45	-4

TAF = thousand acre-feet
RPA = National Marine Fisheries *Biological Opinion and Conference Opinion on the Long-Term Operations of the Central Valley Project and State Water Project* Reasonable and Prudent Alternative 3.1.3

L.3.4 Summary

In summary, by requiring concurrent compliance with the NMFS BO RPA 3.1.3 (Stanislaus River minimum flow), the WSE model estimates that compared to LSJR Alternative 2 without concurrent compliance, that: (1) river flows on the Stanislaus River are generally increased, (2) surface water diversions are generally decreased, and (3) end-of-September storage in New Melones Reservoir is somewhat decreased. For LSJR Alternative 3, concurrent compliance with the RPA results in similar, but much smaller changes relative to that alternative without concurrent compliance with the RPA. Due to the relatively higher flows already required by LSJR Alternative 4, the effect of concurrent compliance with the RPA is relatively minimal. At Vernalis, the trends are similar yet relatively less pronounced as the RPA only applies to the Stanislaus River, and the relative change at Vernalis is diluted by the flows from the other tributaries, which are not changed by the RPA.

L.4 References

L.4.1 Printed References

National Marine Fisheries Service (NMFS). 2009. Endangered Species Act Section 7 Consultation. Biological Opinion and Conference Opinion on the Long-Term Operations of the Central Valley Project and State Water Project. June 2009.

National Weather Service (NWS). 2012. *National Weather Service: Advanced Hydrologic Prediction Service*. Last revised: Nov. 6, 2012. Available: <http://water.weather.gov/ahps2/index.php?wfo=sto>. Accessed: Nov. 27, 2012.