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1167	1	While the SED proposes to increase flows, the available scientific evidence demonstrates that the proposal fails to provide the flow conditions necessary to achieve the Bay-Delta Plan's existing salmon protection objective, the proposed San Joaquin migratory fish viability objective, maintain fish in good condition, and protect the Public Trust. We therefore urge the SWRCB to adopt a flow range of 40-60% of unimpaired flow, and a starting point of 50%, consistent with the best available science and the requirements of State law.	Please refer to Master Response 2.1, Amendments to the Water Quality Control Plan, regarding the scientific justification for the flow objectives and the salmon doubling objective. Please refer to Master Response 1.1, General Comments, regarding protection of the public trust. Please refer to Master Response 3.1, Fish Protection, for the justification and description of the Plan Amendments for protecting fish and discussion of use of the best available science. Please refer to SED Appendix C, Technical Report on the Scientific Basis for Alternative San Joaquin River Flow and Southern Delta Salinity Standards for addition discussion of the use of the best available science. Please refer to Chapter 19, Analysis of Benefits to Native Fish Populations from Increased Flow between February 1 and June 30, for addition discussion of the use of the best available science.
1167	2	While the SWRCB has addressed several of those prior flaws, its revised proposal still fails to provide adequate flow conditions to protect and restore salmon and the health of these rivers.	Please see Master Response 1.1, General Comments, for regarding the LSJR flow alternatives and their development. Also, please refer to Master Response 3.1, Fish Protection, regarding the adequacy of the plan amendments for fish protection.
1167	3	We urge the SWRCB to revise the SED and adopt higher instream flows, consistent with the best available science.	Please see Master Response 1.1, General Comments, for a description of the LSJR flow alternatives and their development. Also, please refer to Master Response 3.1, Fish Protection, regarding the adequacy of the plan amendments for fish protection and the use of best available science.
1167	4	The Narrative Objective Must Be Revised to Be Consistent with the Existing Narrative Salmon Protection Objective, and the SED Must Demonstrate that the Program of Implementation is Likely to Achieve that Objective.Our 2013 comments on the draft SED provided detailed explanation why the language of the proposed San Joaquin River inflow narrative objective must be revised to be consistent with the existing salmon protection objective (also known as the salmon doubling objective), and we provided proposed changes to the San Joaquin River inflow narrative objective to accomplish this requirement. See TBI et al. 2013 at 3-6. Our 2013 comments also addressed the legal requirement that the Board demonstrate that the program of implementation is likely to achieve the salmon doubling objective. Id. at 3; id., Exhibit 2, at 10-11. In addition, our 2013 comments discussed at length how the SWRCB cannot balance away the achievement of the salmon doubling objective or the California Endangered Species Act ("CESA"), how the SWRCB must protect Public Trust resources to the extent feasible, and how the SWRCB must consider alternative water supplies in any balancing. Id. at 4, 42-46; id., Exhibit 2. Our 2013 comments regarding these points are hereby incorporated by reference; these comments apply to the narrative objective in the 2016 draft SED, to the SWRCB's duty to ensure that the flows are likely to achieve the narrative salmon protection objective and protect the Public Trust to the extent feasible, and to the limits on the SWRCB's authority to balance beneficial uses.Unfortunately, in Appendix K of the draft 2016 SED, the SWRCB failed to change the language of the San Joaquin River inflow narrative migratory fish viability objective to be consistent with the narrative salmon protection objective, even though the draft San Joaquin River inflow narrative objective included in the 2011 Revised Notice of Preparation for this proceeding explicitly included the salmon doubling objective. See Revised Notice of Preparation, April 1, 2011, Attachment 2. [Footnote 1: Similarly, the conclusion of the 2012 Technical Report on the Scientific Basis for Alternative San Joaquin River Flow and Southern Delta Salinity Objectives, which is included in the 2016 Draft SED, explicitly references the salmon doubling objective in its draft narrative objective for San Joaquin River flow. See SED, Appendix C, at 3-56. This provides additional evidence that the proceeding is intended to provide the flows necessary to achieve the salmon doubling objective. Inexplicably, this language was not included in the draft narrative objective	The 2006 Bay-Delta Plan includes the salmon protection objective which requires water quality conditions coupled with watershed actions to achieve a doubling of the natural production of Chinook salmon from the average production of 1967-1991, consistent with the provisions of State and federal law. Natural production refers to the number of returning adult salmon that are not of hatchery origin. To achieve doubling, the federal Anadromous Fish Restoration Program (AFRP) identified quantitative natural production targets as abundance estimates for fall-run Chinook salmon on each of the LSJR tributaries. The plan amendments do not modify the salmon protection objective and the natural production targets associated with the doubling objective remain intact. The LSJR flow objectives are focused on supporting and maintaining viable native San Joaquin River fish populations migrating through the Delta. Indicators of viability include not only population abundance, but also spatial extent, distribution, structure, genetic and life history diversity, and productivity. In contrast, the salmon protection objective is expressed in terms of abundance, consistent with the targets identified by AFRP. The narrative and numeric LSJR flow objective when implemented would benefit early life stages of fish populations and lead to progress toward achieving the natural production targets identified by AFRP for the Stanislaus, Tuolumne, and Merced Rivers. Biological goals can be developed that connect juvenile survival targets and other viability parameters to natural production targets for returning adults. Additional details are provided in the section providing responses to comments on biological goals.In response to this comment and related comments, please refer to Master Response 1.2, Water Quality Control Planning Process, for information regarding the scope of this proceeding and the focus on the San Joaquin River and eastside tributaries, and information regarding the State Water Board's consideration of beneficial uses. The master response also describes the legal requirements for establishing water quality objectives and other requirements related to this proceeding. Refer also to Master Response 2.1, Amendments to the Water Quality Control Plan, for a description of the project, information regarding the relationship between the LSJR flow objectives and the salmon doubling objective, and information regarding non-flow actions. Also see Master Response 2.1 for discussion of changes to the water quality control plan that are intended to clarify how adaptive implementation will work, as well as modifications suggested by commenters.Please refer to Master Response 2.2, Adaptive Implementation, for response to comments regarding how adaptive implementation can allow for deviations from the running average to allow for adaptive implementation, including flow shifting and flow shaping.Please refer to Chapter 7, Aquatic Biological Resources, Chapter 19, Analyses of Benefits to Native Fish Populations from Increased Flow between February 1 and June 30, and Master Response 3.1, Fish Protection, for information regarding the use of indicator fish species in the SED analysis, protection of fish, use of best available science, and benefits to the quantity and quality of fish habitat resulting from the

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		included in either the 2012 or 2016 draft SED. In addition, Appendix K to the 2016 revised SED references the doubling objective in identifying the biological goals and objectives for the program of implementation. SED, Appendix K, at 33 ("The salmonid biological goals for this program of implementation will be specific to the LSJR and its tributaries and will contribute to meeting the overall goals for each population, including the salmon doubling objective established in state and federal law."); see Hearing Transcript, Nov. 29, 2016, at 128-129.] We have therefore enclosed with these comments an updated redline of Table 3 (Appendix A), which includes proposed changes to the San Joaquin River inflow narrative flow objective to ensure it is consistent with the existing salmon protection objective.On the other hand, in Appendix K of the revised 2016 SED, the SWRCB appropriately included San Joaquin River inflow as a numeric objective, not just a narrative objective as in the 2013 draft SED. We strongly support this change to include flows as a numeric objective. However, the draft language in Table 3 does not appear to allow for deviations from the running average to allow for adaptive implementation (flow shifting and flow shaping) to attain the plan objectives. We have therefore also enclosed with these comments a redline of Table 3 that provides appropriately limited discretion for adaptive implementation of the running average of flows.More than 20 years ago, the SWRCB adopted the narrative salmon protection objective in the 1995 Bay Delta Water Quality Control Plan. And it has been nearly 30 years since California enacted the Salmon, Steelhead Trout, and Anadromous Fisheries Act into law in 1988, which first identified the State's salmon doubling program. Cal. Fish and Game Code §§6900 et seq. Yet as the SWRCB is well aware, salmon populations in the Stanislaus, Tuolumne, and Merced Rivers have not only failed to achieve the doubling objectives; rather, instead of increasing in abundance, on average salmon escapement has declined since the 1995 Plan was adopted.The 1995 Plan stated that there was scientific uncertainty whether the numeric flow objectives would achieve the narrative salmon protection objective. 1995 Bay-Delta Water Quality Control Plan at 28; State Water Resources Control Board Cases, 136 Cal.App.4th 674, 775-76 (2006). The SWRCB made a similar argument in Decision 1641. See Revised Decision 1641, at 61 ("Implementing the narrative objective for salmon protection requires a long-term process. A period of actual operation meeting the numerical objectives in the 1995 Bay-Delta Plan or the measures under the SJRA/VAMP, coupled with adequate monitoring, is required before the SWRCB can determine whether additional implementation measures are needed to meet this objective."). In the 2006 plan, it is clear that the San Joaquin River inflow objectives were intended to achieve the narrative salmon protection objective. See 2006 Bay Delta Water Quality Control Plan, at 33 ("D-1641 did not require separate actions to implement the narrative objective for salmon because the State Water Board expects that implementation of the numeric flow-dependent objectives and other non-flow measures will implement this objective.").However, there is now overwhelming scientific evidence that the flows required in the 1995 Plan for the Stanislaus, Tuolumne, Merced, and lower San Joaquin River are wholly inadequate to provide in-river survival of salmon necessary to achieve the objective. In fact, such scientific evidence has been available for more than a decade. For instance, the California Department of Fish and Game concluded more than a decade ago that:We noted, and the Draft Plan acknowledges, that salmon populations in the basin are below State and Federal "population doubling objectives" and, rather than increasing, are in fact declining. Further, the "equivalent fishery protection" standard, assumed to be achieved by the VAMP agreement and the State Water Board's adoption, remains unsatisfied. In your workshop, we and others presented substantial science-based evidence that these tributary salmon population longterm declines are directly related to magnitude, frequency, and duration of flow in the San	proposed flow objectives.Please refer to Master Response 5.2, Incorporation of Non-Flow Measures, for additional discussion of the role of non-flow measures and of the State Water Board's authority to implement non-flow measures.Please refer to Master Response 1.1, General Comments, regarding protection of the public trust and for information regarding compliance with CEQA, the approach to the SED analyses, and information about the program-level document and program-level analysis. .The comments incorporated by reference were made on the 2012 Draft SED. A lead agency need only respond to those comments submitted in response to a recirculated revised environmental document and is not required to respond to comments previously received during the earlier circulation period on a previous draft. In its September 15, 2016 notice of filing, recirculation, and opportunity for public comment on the revised SED, the State Water Board made clear that since, "the SED is being recirculated in its entirety, new oral and/or written comments must be made and submitted for the SED. Previous comments to the 2012 Draft SED will be part of the administrative record, but do not require a written response. The State Water Board will only respond to those timely comments made and submitted in response to the recirculated SED." Therefore, this information is already part of the administrative record and will not receive a written response.

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		Joaquin River during the spring.Letter from Ryan Broddrick to Tam Dudoc, Nov. 8, 2006 at 2. In 2013, the California Department of Fish and Wildlife concluded that higher instream flows in the winter-spring period, in the range of 50-60% of unimpaired flow, were necessary to achieve the narrative salmon protection objective. CDFW 2013 (comments on 2012 SED). The SWRCB has acknowledged this scientific information regarding the decline of salmon populations in these tributaries and the primary importance that spring instream flows play in determining survival and abundance of salmonids. See, e.g., SWRCB 2010; 2012 SED; 2016 SED.As a result of this overwhelming scientific evidence regarding the inadequacy of existing flows in the 1995 Plan to achieve the narrative salmon protection objective, the SWRCB's obligation in this proceeding is to establish new instream flows necessary to achieve the narrative salmon protection objective. As we noted in our prior comments, the Court of Appeals emphasized in 2006 that:[d]etermining what actions were required to achieve the narrative salmon protection objective was part of the Board's obligation in formulating the 1995 Bay–Delta Plan in the first place. (See §§ 13050, subd. (j)(3) [a water quality control plan must include "[a] program of implementation needed for achieving water quality objectives"], 13242, subd. (a) [a "program of implementation for achieving water quality objectives" must include "[a] description of the nature of actions which are necessary to achieve the objectives"].)… If the Audubon Society parties are correct in their contention that scientific evidence shows the flows needed to achieve the narrative salmon protection objective must be greater than the Vernalis flow objectives of the 1995 Bay–Delta Plan, then that evidence may provide a basis for changing the Vernalis flow objectives in the next regulatory proceeding to review and revise the water quality control plan for the Bay–Delta.State Water Resources Control Board Cases, 136 Cal.App.4th at 776-77. The court of appeals 1986 decision in U.S. v. SWRCB reached a similar conclusion, holding that, "Once the Board establishes water quality objectives which ensure reasonable protection of beneficial uses (§ 13241), the Board has the added responsibility to complete the water quality control plan by preparing an implementation program to achieve the water quality objectives." 182 Cal.App.3d 82, 119 (1986). Because the scientific evidence is available and overwhelming, now is the time to adopt flow standards to achieve the narrative salmon protection objective. Commercial and recreational fishermen, businesses, communities and conservation groups have waited – and suffered – decades for adequate flows to restore and sustain salmon populations on these rivers.Moreover, the decision by the Court of Appeals in the State Water Resources Control Board Cases provides a strong rebuttal to argument that the Board could now approve flows less than those necessary to achieve the narrative salmon protection objective, or could approve a plan that substantially delays implementation of flows that are scientifically demonstrated to be likely to achieve the narrative salmon protection objective. [Footnote 2: In addition, the Board does not have discretion to delay implementation of statutory obligations, including the statutory obligation under sections 5937 or 5946 of the Fish and Game Code that requires the owner of any dam to release sufficient flows from dams and reservoirs to maintain fish downstream in good condition. See California Trout v. Superior Court, 218 Cal.App.3d 187, 201, 203-211 (1990).] Although some water users argued that the SWRCB could substitute the Vernalis Adaptive Management Plan for the full San Joaquin River inflows called for under the 1995 Plan as part of a staged implementation of the San Joaquin River inflow objectives or as an interim, experimental stage of those objectives, the Court disagreed and concluded this would constitute an unlawful, de facto amendment of the 1995 Plan. 136 Cal.App.4th at 726-736. The court emphasized that nothing in the Plan itself expressly authorized a staged or delayed implementation of the Plan, notwithstanding the language of section 13242(b) of the Water Code, and that	

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		"regardless of the timing issue, the Board has failed to identify anything in the plan that authorized it to implement a flow objective other than the Vernalis pulse flow objective, even temporarily." Id. at 726-27. Moreover, as the Court noted, section 13247 of the Water Code requires that a water quality plan be implemented, preventing the Board from implementing measures less than those required by the plan without changing the plan itself. Id. at 730. And as noted above, there has been widespread scientific understanding, for more than a decade, that current flows are inadequate to achieve the narrative salmon protection objective, undermining any argument for further delay in achieving the objective.Finally, we note that the SWRCB's Notice of Preparation for Phase I did not notify the public of any potential changes to the narrative salmon protection objective, and instead limited the notice to changes to the San Joaquin River inflow objective and South Delta salinity objective. See Fourth Revised Notice, December 22, 2016. Indeed, as noted above, the 2011 revised notice explicitly included salmon doubling as part of the narrative flow objective for the San Joaquin River, see Revised Notice of Preparation, April 1, 2011, Attachment 2, and language in the SED references the salmon doubling objective in identifying the biological goals and objectives for the program of implementation for the San Joaquin River inflow objectives. SED, Appendix K, at 33. This proceeding is not proposing any changes to the narrative salmon protection objective, nor could the SWRCB do so. As we emphasized in our 2013 comments, …the salmon doubling requirements of state and federal law is an expression of the Board's responsibilities under the Public Trust. The Board must abide by the Legislature's determination that the doubling of natural production of salmon is a statewide policy (Cal. Fish & Game Code § 6902(a)) and the water quality control plan should be consistent with that policy. The salmon doubling policy is intended to ensure that the State does more than meet the absolute minimum requirements of the state and federal Endangered Species Acts. As with section 5937 of the Fish and Game Code, section 6900 et seq is a legislative expression of the Public Trust, and the Board lacks authority to balance away achievement of this state policy. (See California Trout, Inc. v. State Water Resources Control Bd., 207 Cal.App.3d 585, 622-625, 631 (1989); SWRCB Decision 1631 at 172; SWRCB Decision 1644 at 27; Exhibit 1). TBI et al. 2013 at 3-4; see also TBI et al. 2013, Exhibit 2.After more than 20 years of waiting, it is time for the SWRCB to adopt flow requirements for the Stanislaus, Tuolumne, Merced, and lower San Joaquin River that are likely to provide the instream flow conditions necessary to achieve the narrative salmon protection objective in the existing Plan. However, as discussed below, the proposal fails to provide flow and water quality conditions that are reasonably likely achieve the narrative salmon protection objective in the Plan.	
1167	5	The SED and Existing Scientific Information Demonstrates that Current Flows Violate Section 5937 of the Fish and Game Code, and the SWRCB Must Ensure that Instream Flows Below Reservoirs Are Sufficient to Maintain Fish in Good Condition.For more than a century, California law has required the owner of any dam to release sufficient flows to maintain fish in good condition below the dam. Cal. Fish and Game Code § 5937. The requirements of section 5937 evolved from a series of statutory protections for instream flows and fisheries, dating from California's earliest days of statehood. See Karrigan Bork et al., The Rebirth of California Fish and Game Code § 5937: Water for Fish, 45 U.C. Davis L. Rev. 809 (2012). The protections required by section 5937 or its predecessors have been in place since dams were constructed on the Stanislaus, [Footnote 3: The Ninth Circuit Court of Appeals has recently reaffirmed the legal duty of the Bureau of Reclamation to comply with section 5937, holding that, "This code section not only allows, but requires BOR to allow sufficient water to pass the Lewiston Dam to maintain the fish below the Dam. The use of the unconditional "shall" indicates that such required releases are not dependent on having a	Please refer to Master Response 1.2, Water Quality Control Planning Process, for a discussion of the public trust doctrine and the water quality control planning process. When considering the public trust in water, the adoption and implementation of a water quality control plan generally satisfies the State Water Board's public trust duty. Please also refer to Master Response 1.1, General Comments, for additional information about the public trust and Fish and Game Code 5937. Please refer to Master Response 3.1, Fish Protection, for a discussion of the current fish decline, the need for increased flow, the purpose of the plan update and the narrative objective, fish analyses, the use of best available science and the consideration of other information, the justification and description of the plan amendments for protecting fish, and the plan amendment benefits.

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		proper water permit." San Luis & Delta Mendota Water Authority v. Haugrud, __ F.3d ___, 2017 WL 677537 at *12 (Feb. 21, 2017).] Tuolumne, and Merced Rivers, particularly the more recent and larger reservoirs.Despite these legal protections, the scientific evidence in the SED and in other sources unambiguously demonstrates that salmon and other native fish below the dams on these three tributaries have not been maintained in good condition. For instance, despite historically being the largest run on many of these rivers, spring run Chinook salmon have largely been extirpated from these rivers (although remnant populations have been discovered on the Tuolumne and Stanislaus Rivers in recent years). See, e.g., SED at 7-16 to 7-17; NMFS, 5-Year Review: Summary and Evaluation of Central Valley Spring-run Chinook Salmon Evolutionary Significant Unit, April 2016. [Footnote 4: This report from NMFS is available online at: http://www.westcoast.fisheries.noaa.gov/publications/status_reviews/salmon_steelhead/2016/2016_cv-spring-runchinook.pdf and is hereby incorporated by reference.] Similarly, despite historically large populations, Central Valley Steelhead currently is listed as a threatened species under the federal Endangered Species Act, with only remnant populations remaining on these rivers. SED at 7-17 to 7-18, 7-32. In 2016, NMFS concluded that this distinct population segment remained at risk of extinction, and observed that only small numbers of wild steelhead (as opposed to hatchery produced steelhead) were observed in recent years in most of the Central Valley monitoring programs. NMFS, 5-Year Review: Summary and Evaluation of Central Valley Steelhead Salmon Evolutionary Significant Unit, May 2016. [Footnote 5: This report from NMFS is available online at: http://www.westcoast.fisheries.noaa.gov/publications/status_reviews/salmon_steelhead/2016/2016_cv-steelhead.pdf and is hereby incorporated by reference.] Populations of fall run Chinook salmon, the backbone of the State's salmon fishery, have remained low in most years on these rivers. SED at 7-15, 7-32 to 7-33, 7-36 to 7-38, 7-40 to 7-41. According to data from CDFW, the abundance of fall run Chinook salmon on the Tuolumne and Merced Rivers have declined substantially since the 1980s, and on all three rivers have exhibited clear boom and bust cycles with extremely low abundance in dry years and droughts. TBI et al. 2013 at 4-5; Cal. Dept. of Fish and Wildlife, California Central Valley Chinook Population Database Report, GrandTab 2016.04.11. [Footnote 6: This report is available online at: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84381&inline=1 and is hereby incorporated by reference.] Moreover, the majority of fall run Chinook salmon that return to spawn on these rivers are hatchery fish, demonstrating that natural production of fall run Chinook salmon is even worse than absolute abundance and escapement numbers indicate. See Melodie Palmer-Zwahlen and Brett Kormos, Recovery of Coded-Wire Tags from Chinook Salmon in California's Central Valley Escapement, Inland Harvest, and Ocean Harvest in 2012, California Department of Fish and Wildlife Administrative Report 2015-4, November 2015; [Footnote 7: This report is available online at: http://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=112524 and is incorporated by reference.] Melodie Palmer-Zwahlen and Brett Kormos, Recovery of Coded-Wire Tags from Chinook Salmon in California's Central Valley Escapement, Inland Harvest, and Ocean Harvest in 2011, California Department of Fish and Wildlife Administrative Report 2013-2, December 2013; [Footnote 8: This report is available online at: http://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=75609 and is incorporated by reference.] Brett Kormos, Melodie Palmer-Zwahlen, and Alice Low, Recovery of Coded-Wire Tags from Chinook Salmon in California's Central Valley Escapement and Ocean Harvest in 2010, California Department of Fish and Wildlife Administrative Report 2012-2, March 2012. [Footnote 9: This report is available online at: http://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=44306 and is incorporated by reference.]Moreover, the overwhelming scientific evidence in the SED, our prior comments	

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		on the SED and these comments on the revised SED, and comments of other state and federal fishery agencies in this proceeding demonstrate that the failure to maintain fish in good condition below dams on the Stanislaus, Tuolumne and Merced Rivers is a result of the failure to release sufficient flow downstream. See, e.g., SWRCB 2010; TBI et al. 2013; CDFW 2013; NMFS 2013; SED, Appendix C. As a result, there can be no question that these dam owners are and have been in violation of section 5937 of the Fish and Game Code.The SWRCB has an obligation in this proceeding to ensure that instream flows are sufficient to maintain fish in good condition below these reservoirs, and cannot seek to balance away achievement of these statutorily mandated expressions of the Public Trust. See California Trout v. State Water Resources Control Board, 207 Cal.App.3d 585 (1989); TBI et al. 2013 at 45. Moreover, the Board cannot unreasonably delay the imposition of adequate permit terms and conditions to protect these Public Trust values. California Trout v. Superior Court, 218 Cal.App.3d 187 (1990). Chapter 1 of the SED should be revised to acknowledge the Board's authority and obligations under section 5937 of the Fish and Game Code.For decades, water rights holders on the Stanislaus, Tuolumne, and Merced Rivers have reaped the water supply and other benefits of reservoirs and dams on these rivers, while failing to meet their responsibilities to maintain fish in good condition. There is no time for further delay. The SWRCB must take timely action to impose terms and conditions that require the release of sufficient flow to maintain fish in good condition below the dams and reservoirs on these three rivers.	
1167	6	The SED Fails to Utilize Scientifically Sound Analyses Regarding the Effects of Flow Alternatives on Fisheries and Ecosystems, the SED fails to demonstrate that the Program of Implementation is Likely to Achieve the Narrative Salmon Protection Objective and the San Joaquin Migratory Fish Viability objective, and the Preferred Alternative Fails to Provide Flows that are Likely Adequate to Achieve the Narrative Salmon Protection Objective or Maintain Fish in Good Condition.The Board must demonstrate that its water quality control plan is reasonably likely to attain plan objectives. Regarding the existing narrative salmon protection objective, that means that the plan must provide for levels of fresh water flow that are consistent with attaining natural production of Chinook salmon that is double the 1967-1991 average production [Footnote 10: Production is the number of Age 2+ salmon in the ocean that emanate from a given watershed. The number is currently estimated based on subsequent escapement (return of adults to each watershed) and assumptions about survival of migrating adults and hatchery contributions to escapement.] for each of the three San Joaquin tributaries. With regard to the SED's focus on maintenance of "viable" populations, the Board needs to demonstrate that its plan supports appropriate levels of all attributes that define a viable population, including abundance (e.g., production), productivity (e.g., survival rates), life history diversity, genetic diversity, and spatial distribution of populations (McElhaney et al. 2000; Lindley et al. 2007).A variety of tools and data sets exist that permit analysis of the potential for plan alternatives to meet plan objectives; however, the SED does not employ these tools and data sets to demonstrate the adequacy of its preferred alternative. In addition, the SED does not address the need to restore self-sustaining populations of spring-run Chinook salmon to the lower San Joaquin River's three main tributaries (NMFS 2014; Franks 2012). As a result, the SED does not employ the best available science regarding the effect of flow levels on attainment of plan objectives.	Please refer to response to comment 1167-4.Please refer to Master Response 2.1, Amendments to the Water Quality Control Plan, for a discussion of the science and policy justification for the plan amendments.Please refer to Chapter 7, Aquatic Biological Resources, for information regarding the use of indicator fish species in the SED analysis and spring-run Chinook salmon. The SED analysis uses fall-run Chinook salmon and Central Valley steelhead as an indicator species for coldwater anadromous fish. The SED recognizes that the San Joaquin River Restoration Program is attempting to re-establish a spring-run Chinook salmon population on the upper SJR. At this time, spring-run Chinook salmon are not established in the LSJR and three eastside tributaries, and the plan amendments focus on flow conditions for salmon bearing tributaries. Please refer to Master Response 2.1, Amendments to the Water Quality Control Plan, for additional information about the San Joaquin River Restoration Program. The comment referenced the Recovery Plan for the Evolutionary Significant Units of Sacramento River Winter-Run Chinook Salmon and Central Valley Spring-Run Chinook Salmon and the Distinct Population Segment of California Central Valley Steelhead (NMFS, 2014) (Recovery Plan) and spring-run chinook salmon. The Recovery Plan identifies choosing one of the three eastside LSJR watersheds Stanislaus River (above Goodwin dam), Merced River (above Crocker-Huffman dam) or Tuolumne River (above La Grange dam) as a candidate for spring-run re-introduction (see Figure 3-5 in NMFS 2014). Similarly, the recovery plan recommends choosing one of these three watersheds as a candidate for steelhead re-introduction below the Goodwin, Crocker-Huffman, and LaGrange dams on the Stanislaus, Tuolumne, and Merced Rivers, respectively. The responses of Central Valley fall-run Chinook salmon to changes in flow, water temperature, and other flow-related variables have been well studied and provide a general indication of the overall response of the ecosystem to hydrologic change.
1167	7	The SED fails to adequately analyze the environmental impacts of alternatives because it fails to consider the best available scientific information showing the strong relationships	Please see Master Response 3.1, Fish Protection, specifically regarding the problem statement of fish decline and why flow is needed, best available science, and predation. Also refer to Appendix C, "Scientific Basis for Developing Alternate San Joaquin River Flow Objectives," for detailed information regarding how the

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		between flow rates, volume, and variability with salmon survival. In our comments on the draft 2012 SED, we presented evidence of strong positive relationships between Chinook salmon escapement (and production) and several flow metrics. However, although the SWRCB has acknowledged these relationships and confirmed the likely causal connection between freshwater flow rates in the winter-spring and subsequent salmon abundance, see, e.g., SWRCB 2010, the SED fails to analyze the effect of its flow alternatives in light of these relationships in a scientifically credible manner. As we discuss below, there is strong scientific support for these prior analyses, and more recent scientific information that was not available in 2012. The SED must be revised to include analyses of the alternatives that accounts for the effect of these relationships on production / subsequent escapement.1. Production and escapement of San Joaquin salmon is strongly correlated with river flow rates during the months of egg incubation and juvenile migration; no other variable explains the pattern of salmon escapement to the San Joaquin River's main tributaries through time.In our previous comments (TBI et al. 2010, Ex. 3; TBI et al. 2013), we demonstrated that winter-spring flows at Vernalis are correlated with salmon production in the ocean. Similar analyses of the relationships between instream flows and subsequent escapement (or production) of Chinook salmon were included in the SWRCB's 2010 Flow Criteria Report, which the SWRCB concluded was based on the best available science. SWRCB 2010 at 56-60, 119-121; see also Figure 1 [ATT 10]. These and similar analyses were included in the SED, as a technical appendix on the scientific basis for San Joaquin River flow objectives. SED Appendix C.Recently, we explored the flow-abundance analysis by investigating whether factors in addition to seasonal flow levels (as measured at Vernalis) were significantly correlated with historical San Joaquin salmon escapement. Although it has been suggested that density of predators on juvenile salmon, such as Striped Bass, plays a role in the decline of San Joaquin salmon population, see, e.g., draft SED at 7-35 and 7-46, a recent analysis of the effect of predator density on Central Valley Chinook salmon productivity and abundance (Grossman 2016) concluded:… it has recently been proposed that Striped Bass populations be significantly reduced to facilitate recovery of endangered Central Valley Chinook Salmon …[however] the most likely outcome of Striped Bass removal is that a competing predator will increase in abundance and there will be little reduction in predation mortality for Chinook Salmon. It is likely that the most productive management strategy for decreasing predation on Chinook Salmon and other Delta fishes is to restore natural habitat and flows, especially in predation hot spots.Grossman 2016 at 16. Moyle and Bennett 2010 raised similar concerns and noted that, "reducing the striped bass population may or may not have a desirable effect. In our opinion, it is most likely to have a negative effect. … We stress that attempting to reduce striped bass and other predator populations is unlikely to make a difference in saving endangered fishes, and will serve only to distract attention from some of the real problems." Moyle and Bennett 2010 at 3.We analyzed whether a statistically significant relationship exists between adult Striped Bass abundance in the Delta and salmon escapement, and we found no significant negative correlation between annual indices of adult Striped Bass abundance in the Delta (Peterson Index; Stevens et al. 1985) in the year when salmon migrate to the ocean and San Joaquin River basin Chinook salmon abundance 2 or 3 years later when those same salmon return as adults (Figure 2) [ATT 11].Similarly, ocean conditions also have been posited as potential drivers of Central Valley Chinook salmon populations. That relationship is complex and likely results from an interaction between conditions that juvenile salmon experience in their freshwater habitat and those	relationship between salmon escapement and flow was used in developing the unimpaired flow approach.The content provided by the commenter does not contradict the information contained in the SED Chapter 7, Aquatic Biological Resources, or Chapter 19, Analyses of Benefits to Native Fish Populations from Increased Flow between February 1 and June 30, and would not change the impact determination made in Chapter 7. The information provided regarding the relationship between flow and subsequent escapement is in general agreement with the SED, and the relationship was used to develop the scientific basis for the unimpaired flow approach. Regarding the information provided by the commenter on the lack of significant relationships between striped bass and Chinook escapement, between ocean conditions and Chinook escapement, and between hatchery releases and Chinook production, the commenter does not provide a recommendation beyond stating non-substantive information. The SED adequately analyzes the impacts of the plan amendments (see Master Response 1.1, General Comments, for information about the adequacy of the SED) and the information provided by the commenter does not contradict the impact assessments or analysis in the SED.

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		that they find when they enter the marine environment. For instance, Satterthwaite et al. 2014 found strong evidence of an interaction between ocean conditions and ocean entry timing of Central Valley Chinook salmon. Similarly, while documenting the potential linkage between ocean conditions in the mid-2000s and the subsequent fall-run Chinook salmon stock collapse and ocean fishery closure, Lindley et al. 2009 noted that: "…long-term declines in the condition of freshwater habitats are expected to result in increasingly severe downturns in abundance during episodes of poor ocean survival." Lindley et al. 2009 at 38. These authors also identified constrained life-history diversity among juvenile Central Valley Chinook salmon as a factor that magnifies the effect of ocean conditions on subsequent ocean production and escapement.Both Pacific Decadal Oscillation (PDO; Mantua et al. 1997) and North Pacific Gyre Oscillation (NPGO; De Lorenzo et al. 2008) characterize variation in Pacific Ocean temperatures and have been linked to marine ecosystem productivity and salmon escapement; however, we found no statistically significant correlation between these two metrics and escapement of San Joaquin River salmon through time (Figure 3) [ATT 12]. The lack of significant linear statistical relationships between the historic pattern of San Joaquin River Chinook salmon production and ocean conditions does not mean that ocean conditions have no effect on salmon production, but it does suggest that ocean conditions are not responsible for the overall pattern in year-to-year salmon returns.Finally, although year-to-year variation in hatchery production of Chinook salmon (both on the Merced River in the San Joaquin basin and on the nearby Mokelumne River) could potentially influence total San Joaquin River Chinook salmon escapement, we found no statistical correlation between San Joaquin River adult escapement and prior releases of fish from the Merced hatchery or total annual Merced hatchery plus Mokelumne hatchery releases (Figure 4) [ATT 13].These statistical analyses provide additional scientific evidence that flow is the strongest determinant of San Joaquin Chinook salmon escapement 2.5 years later. The SED should be modified to evaluate the likely effect of its flow alternatives on future abundance of San Joaquin salmon using the empirical relationship between Chinook salmon abundance in the San Joaquin's tributaries and flow levels as measured at Vernalis. Under current landscape conditions (e.g., geometry of the tributaries and lower San Joaquin River) and reservoir operations, the persistent and significant relationship between flow levels (measured at Vernalis during winter-spring in year x+1) and subsequent escapement (measured in year x+3) is a reasonable tool for predicting future abundance of salmon in response to changes in flow levels. This relationship could be further refined by incorporating spawning stock into the flow-abundance relationship (e.g., to account for the apparently strong, flow-dependent carrying capacity limitation on production of juvenile Chinook salmon from some San Joaquin River tributaries. Sturrock and Johnson 2016 presentation to the SWRCB; see infra).	
1167	8	The SED fails to acknowledge or analyze recurrence frequency of flow levels that the Board and CDFW acknowledge are associated with viable populations or the attainment of population abundance levels required by state and federal law.Productivity (survival rate) in fresh water that supports rapid population growth, up to system carrying capacity, is an essential feature of Chinook population viability (McElhany et al. 2000; Lindley et al. 2007). As a result, both the SED's proposed narrative objective ("viable" populations of Chinook salmon on the San Joaquin tributaries) and the requirement of state law that reservoirs release flows sufficient to maintain populations of fish below dams in good condition (Cal. Fish and Game Code § 5937) require that flow rates and other environmental conditions support the potential for rapid population growth in most years. High fecundity and typical egg and juvenile survival rates make Chinook salmon populations capable of explosive growth (Healy 1991; Quinn 2005; SEP 2016 [Footnote 11: The final report of the Scientific	Please see Master Response 1.1, General Comments, for information regarding compliance with CEQA, the approach to the SED analyses, and information about the program-level document and program-level analysis. The SED contains reasonable assumptions to disclose a full range of potential environmental impacts. Please see Master Response 3.1, Fish Protection, for information about comments presenting information that does not conflict with, or contradict, the key scientific information used to support the impact determinations or benefit assessments made. Master Response 3.1 also addresses comments regarding SalSim results and interpretation; expected benefits of implementation of the plan amendments; and biological goals, including discussion of implementation of the plan amendments will contribute to meeting salmon doubling objectives.Please refer to Master Response 2.2, Adaptive Implementation, regarding adaptive implementation of the Plan amendments including flow shifting.Please also see Master Response

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		Evaluation Process (SEP 2016) is enclosed as Appendix B.]). For example, Quinn 2005 (Table 15-1) reports average survival rates from a range of managed Chinook salmon populations of 17.5 adults per spawning female. The health and viability of salmon populations rely on intense competition on the spawning grounds, which result from high survival rates throughout earlier stages of the life cycle. Indeed, the ecology, behavior, and even morphology of Chinook salmon are shaped by intense competition for mates and spawning territories in populations where abundance is most often limited by constrained carrying capacity for spawning salmon (e.g., Healy 1991; Quinn 2005).Numerous studies presented to the SWRCB (e.g., CDFG 2010; TBI et al. 2010, exhibit 3; TBI et al. 2013) demonstrate the relationship between average winter-spring flow levels in the San Joaquin River at Vernalis >5,000 cfs and subsequent increases in Chinook salmon escapement. In our analyses of the effect of the flow alternatives in the 2012 SED, we found that achieving the necessary recurrence frequency of years with ≥5,000 cfs seasonal average flow (the threshold associated with potential population growth) would require a flow regime of between 50-60% of the San Joaquin's unimpaired winter-spring flow (TBI et al. 2013). In the absence of a change in the San Joaquin flow-population growth relationship, flow prescriptions <50% UIF are likely to result in a low frequency of salmon population growth that is inconsistent with attainment of the narrative salmon protection objective or the narrative San Joaquin migratory fish viability objective. The SED fails to analyze the effects of flow alternatives in achieving these flow rates and the likely effects on subsequent escapement based on this relationship. The SED should be revised to do so.The SED also fails to analyze the recurrence frequency of average winter-spring flow levels that are believed to correspond with attainment of the AFRP doubling target, and thus the existing salmon protection objective. TBI et al. 2010, exhibit 3 found that San Joaquin salmon populations approached target levels when average March-Jun flows were >10,000 cfs. To generate average flows >10,000 cfs during the winter-spring period in ½ of years, a flow prescription between 60-75% of unimpaired flows would be necessary (TBI et al. 2013). Under current conditions, flow prescriptions that require <60% UIF are unlikely to result in adequate habitat space for production of the number of juvenile salmon that are necessary to attain the doubling objective.Regarding flow levels associated with population growth (>5,000 cfs Mar-Jun average) and target abundance (>10,000cfs Mar-Jun average), the State Board concluded:"Available scientific information indicates that average March through June flowsof 5,000 cfs on the San Joaquin River at Vernalis represent a flow threshold at which survival of juveniles and subsequent adult abundance is substantially improved for fall-run Chinook salmon and that average flows of 10,000 cfs during this period may provide conditions necessary to achieve doubling of San Joaquin basin fall-run. Both the AFRP and DFG flow recommendations to achieve doubling also seem to support these general levels of flow…."SWRCB 2010 at 119.Attainment of these seasonal average flow levels on San Joaquin salmon escapement will not be affected by manipulation of the hydrograph within the winter-spring months ("flow shaping") because they are based on the volume of flow during the season. Of concern, however, is that in some of its alternatives the SED allows water that would otherwise flow during the Feb-Jun period to be retained in storage until later in the year (or subsequent years) in order to manage reservoir storage ("flow shifting"). Any shifting of flow out of the Feb-Jun period will necessarily result in a lower volume of flow during this season, and such flow shifting therefore is very likely to reduce the frequency of meeting or exceeding the critical seasonal average flow thresholds described above. The analyses presented in our prior comments, as updated here, remain valid. These analyses demonstrate that the Preferred Alternative is unlikely to achieve the existing narrative salmon protection objective in the Plan or the proposed San Joaquin migratory fish viability objective in the SED. The SED should be revised to include these	3.2, Surface Water Analyses and Modeling, regarding hydrologic modeling.Please note that there may be differing opinions as to how to approach an analysis for a given resource or which data sets should be used, but these differing opinions do not equate to inadequacy.

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		and/or similar analyses of the effects of the flow alternatives on subsequent salmon escapement, production, and/or on juvenile survival.	
1167	9	The SED fails to examine the relationships between river flow rates and both juvenile salmon productivity and the life-history diversity that leads to greater population resilience in the face of uncertain conditions in the Delta, Bay, and Pacific Ocean environments.The best available science demonstrates that the relationship between freshwater flow rates during egg incubation and juvenile rearing and migration and Chinook salmon escapement back to the San Joaquin Rivers tributaries ~2.5 years later can be explained by increases in (a) juvenile salmon productivity (i.e., the number of juveniles leaving a San Joaquin tributary per adult salmon returning to that tributary the previous fall) and/or (b) survival of juvenile salmon in environments downstream of the tributaries and mainstem San Joaquin River (i.e., in the Delta, Bay, and/or marine environments) as a result of conditions experienced in the freshwater environment.Zeug et al. 2014 documented a strong positive relationship between both flow volume and flow variance and juvenile salmon outmigration from the Stanislaus River relative to adult escapement the prior fall. Their analysis found that the cumulative volume of flow during the 120 day rearing period in the winter/ spring months was the strongest predictor (R2=0.68) of juvenile salmon survival between the rotary screw trap ("RST") at Oakdale (near the bottom of the spawning reach) and the RST at Caswell, 9 km upstream from the confluence with the lower San Joaquin River. Similarly, discharge variance (the variability of flow during this period) was a strong predictor of survival between these RSTs on the Stanislaus River (R2=0.66).[Footnote 12: As the U.S. Fish and Wildlife Service demonstrated in its presentation to the SWRCB at the January 2017 hearing date, a longer averaging period for flows (7 days vs 3 days) results in reduced flow variability. In addition, flow shaping is also likely to reduce flow variability.] Their analysis also concluded that increased cumulative flow volume and flow variance during the rearing period resulted in higher numbers of pre-smolts successfully migrating downstream. The authors concluded that:A strong positive response in survival, the proportion of pre-smolt migrants and the size of smolts were observed when cumulative flow and flow variance were greater. Together, these data suggest that periods of high discharge in combination with high discharge variance are important for successful emigration as well as migrant size and the maintenance of diverse migration strategies. Survival of migrating juveniles was higher when both cumulative discharge and discharge variance were greater.Zeug et al. 2014 at 9. The analysis presented in our 2010 and 2013 comments demonstrated that average flow rates (which is simply a different expression of total volume) during the rearing period result in higher subsequent escapement. Zeug et al. 2014 demonstrates that total flow volume during the winter/spring months explains much of the variability in juvenile survival during the rearing periods, with substantially higher survival resulting from higher flow volumes. The authors suggest that floodplain inundation, reduced exposure to predators, and higher turbidity are potential mechanisms explaining these relationships. The analysis presented in Zeug et al. 2014 could be used in the SED to analyze the likely effects of flow alternatives on survival in the Stanislaus River, and the SED should be revised to include discussion of Zeug et al. 2014. [Footnote 13: The SED's use of a 7 day running average will result in greater variability than the 14 day running average proposed in 2012, although, as discussed infra, variability may be reduced or eliminated through flow shaping and shifting and variability would be increased through use of a 3 day running average instead.]Similarly, SEP (2016) calculated egg-juvenile survival rates on the Stanislaus by estimating the number of eggs deposited by each annual cohort of adult Chinook salmon returning to the Stanislaus River and comparing that total to estimated juvenile abundance near the river's confluence with the San Joaquin River the following spring. Those data	Please see Master Response 1.1, General Comments, for information regarding compliance with CEQA, the approach to the SED analyses, and information about the program-level document and program-level analysis. Please see Master Response 3.1, Fish Protection, for information about comments presenting information that does not conflict with, or contradict, the key scientific information used to support the impact determinations or benefit assessments made. Master Response 3.1 discusses the adequacy of modeling to support the analyses and expected benefits from implementation of the plan amendments. Specifically see the master response to comments regarding SalSim modeling, use of best available information, and biological goals. Also refer to Master Response 1.2, Water Quality Control Planning Process, regarding authorities and regulations governing the water quality control planning process.Please refer to Master Response 2.1, Amendments to the Water Quality Control Plan, and Master Response 2.2, Adaptive Implementation, for additional information about flow diversity, mimicking the natural hydrograph, biological goals and monitoring. Please also see Master Response 2.1 for a discussion of commenter requested modifications to the plan amendments, including averaging periods and the intent that biological goals should be specific, measurable, achievable, result-focused, and include a time frame for when they will be achieved

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		reveal uniformly poor survival (mean = 1.1%) when flows were <~438TAF (53% of the median year unimpaired flow) in the Feb-Jun period (Figure 5 [ATT 14]). In the six years when Feb-Jun flows were >438 TAF, estimated egg-to-outmigrant survival averaged 9.4%. In every year that flow was greater than this level, estimated survival was higher than the highest survival recorded when flows were below 438 TAF. Thus, for salmon that spawn in the Stanislaus River, juvenile survival rates that are consistent with population growth are very unlikely to occur under current conditions when Feb-Jun flows <53% of the median Feb-Jun unimpaired flow for the Stanislaus River. The frequency of years with flows greater than this threshold must increase substantially in order to encourage positive population growth rates to occur frequently, as they would in a viable salmon populations and one that is being maintained in good condition. Frequent population growth will be needed to attain the narrative salmon protection objective and frequent occurrence of juvenile survival rates that support population growth will be required to maintain the required abundance of salmon after the target is attained. As with our prior analyses, which demonstrated the importance of seasonal flow rates on San Joaquin salmon success, this analysis likewise demonstrates that the Preferred Alternative is unlikely to achieve either the proposed narrative San Joaquin migratory fish viability objective in the SED or the existing narrative salmon protection objective in the Plan, and that greater seasonal volume of flow (a metric that is unaffected by flow shaping) is required.SEP (2016) has calculated the spawner-to-juvenile outmigrant productivity levels that are needed to support population doubling (and thus the narrative salmon protection objective) within a reasonable amount of time on the Stanislaus River, and is developing analogous targets for the Tuolumne and Merced Rivers. By making reasonable assumptions regarding improvements to salmon survival in the Delta (an important outcome for Phase II of the SWRCB's Water Quality Control Plan Update), the SWRCB can determine productivity levels that are necessary to achieve the salmon protection and San Joaquin migratory fish viability objectives. A viable population would require survival rates that are typical of Chinook salmon populations in other watersheds throughout their range (e.g., Healy 1991; Quinn 2005). Indeed, survival rates necessary to serve each of these three goals (growth, resilience, species-typical) have been determined for the Stanislaus River population of Chinook salmon (SEP 2016) and analogous targets for the Tuolumne and Merced populations are in process. The SED should adopt these SMART (specific, measurable, attainable, relevant, and time-bound) biological targets in order to guide adaptive management and ensure attainment of the existing narrative doubling objective and proposed viability objectives.Like productivity (population growth rates), life history diversity (e.g., the range of ages and body size at migration) is considered to be a key attribute of salmonid population viability (McElhany et al. 2000; Lindley et al. 2007). A diverse portfolio of life history types is believed to stabilize population dynamics and lead to greater population resilience (Lindley et al. 2009; Carlson and Satterthwaite 2011) by improving the prospect that at least some fraction of the migrant cohort will encounter favorable conditions in subsequent environments downstream – in other words, improvements in the distribution of life history types among juvenile migrants allows for improved average survival downstream (e.g., Satterthwaite et al. 2014). The importance of providing conditions that support juvenile life history diversity within salmon populations is an emerging theme in research on and management of Pacific salmon populations, including those in the Central Valley (Beechie et al. 2006; Lindley et al. 2009; Miller et al. 2010; Satterthwaite et al. 2014; Zeug et al. 2014; Sturrock et al. 2015). Indeed, Carlson and Satterthwaite (2011) recommended prioritizing restoration of San Joaquin Basin Chinook salmon populations as the most effective means of buffering the larger Central Valley Chinook salmon fishery against catastrophic population collapses. Whereas much research has focused on smolts, fry and parr life history strategies are critically important to	

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		maintaining population viability of Chinook salmon populations on the San Joaquin tributaries (Sturrock et al. 2015; Sturrock and Johnson 2016 presentation to the SWRCB). For instance, Sturrock et al. 2015 wrote that:The loss of genetic and life history diversity has been documented across many taxonomic groups, and is considered a leading cause of increased extinction risk. Juvenile salmon leave their natal rivers at different sizes, ages and times of the year, and it is thought that this life history variation contributes to their population sustainability, and is thus central to many recovery efforts …. Juvenile [Chinook salmon] abundance and outmigration behavior [on the Stanislaus River in 2000 and 2003] varied with hydroclimatic regime, while downstream survival appeared to be driven by size- and time-selective mortality. Although fry survival is generally assumed to be negligible in this system, >20% of the adult spawners from outmigration year 2000 had outmigrated as fry. In both years, all three phenotypes contributed to the spawning population, however their relative proportions differed... Sturrock et al. 2015 at 1.Yet despite the SED's emphasis on "viable" salmonid populations, and the specific mention of genetic and life history diversity as indicators of viability in the proposed narrative San Joaquin migratory fish viability objective, the SED fails to analyze the effect of tributary and mainstem flow levels and flow variance on the production of different Chinook salmon or O. mykiss juvenile life history types. In addition to overall greater productivity in the egg-to-juvenile outmigrant segment of the salmon life-cycle, increases in winter-spring flow rates and variability correspond to increased production of fry and parr juvenile salmon life history types that contribute to subsequent adult returns (Figure 6 [ATT 15]; Sturrock et al. 2015; Zeug et al. 2014; Sturrock et al. in prep) and the size of outmigrating smolt (Zeug et al. 2014). The SED should incorporate results from these studies that demonstrate a relationship between flow volume and variability on production of a range of body sizes among juvenile Chinook salmon migrants. For instance, one way that the SED can analyze effects of flow alternatives on the timing of juvenile outmigration and life history diversity is to analyze the effect of flow alternatives on the duration of suitable migration temperatures.Finally, the SED should adopt SMART targets for life-history diversity among San Joaquin River Chinook salmon juveniles. These targets can and should include a minimum seasonal period in which juvenile Chinook salmon migration is expected to occur and minimum distribution of size classes that should be detected during migrations. Such SMART targets have been developed for the Stanislaus River populations (both spring-run and fall-run) of Chinook salmon (SEP 2016) and are in process for the other two tributaries and lower San Joaquin River; the SED should incorporate these targets in order to ensure attainment of the narrative salmon protection objective, narrative San Joaquin migratory fish viability objective, and requirement that fish populations be maintained in good condition on the San Joaquin tributaries.	
1167	10	The SED fails to analyze the need and potential for re-establishing self-sustaining viable populations of spring-run Chinook salmon in the lower San Joaquin River's three main tributaries and the positive effect that such restoration will have on the persistence of this run across the Central Valley and on the maintenance of the Chinook salmon commercial fishery.The number and diversity of somewhat independent units of Chinook salmon populations (their spatial distribution) is another key attribute of population viability (McElhany et al. 2000; Lindley et al. 2007). The San Joaquin River, and in particular, its Stanislaus River, Tuolumne River, and Merced River tributaries, historically supported some of the Central Valley's largest populations of spring-run Chinook salmon (Yoshiyama et al. 1998; Moyle 2002). These populations were extirpated at the end of the 20th century, but spring-run Chinook salmon (or, at least, Chinook salmon displaying behaviors typical of the spring-run evolutionary significant unit) have been observed recently in these waterways	Please see the response to comment 1167-4. Please also see Master Response 3.1, Fish Protection, for information about the best available science used in the SED and comments presenting information that does not conflict with or contradict the key scientific information used to support the impact determinations or benefits assessments in the SED.

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		(e.g., Franks 2012) and restoration of multiple self-sustaining populations to Central Valley rivers draining the southern Sierra is a prime element in the NMFS' Endangered Species Act recovery plan for this species (NMFS 2014). Restoration of spring-run Chinook salmon populations in the Central Valley and eventual ESA de-listing will have important benefits to recreational and commercial fishing off the California coast (the spring-run's endangered status constrains the public fishery); the Board should analyze the effects of alternative flow levels on the restoration and maintenance of springrun Chinook salmon populations below the dams on the Stanislaus, Tuolumne, and Merced Rivers.	
1167	11	The SED fails to examine how inadequate flows limit carrying capacity and the production of juvenile salmon populations from the three tributaries.The SED fails to analyze how flow alternatives contribute to the existence of adequate habitat to support juvenile salmon production that is consistent with attainment of the narrative salmon protection objective. The maximum number of individuals of a given species that an area's habitat can sustain over the long term is known as the area's "carrying capacity." The carrying capacity of habitats on the San Joaquin Rivers tributaries and lower San Joaquin River mainstem must be adequate to support salmon doubling– in other words, there must be adequate space of sufficient quality to accommodate the number of spawning adults, eggs and juveniles, respectively, that are necessary to attain the production targets (i.e., after accounting for mortality between the different life stages). There is strong evidence that low flows cause insufficient carrying capacity (spawning/incubation habitat or juvenile rearing habitat or both) that limits production of juvenile salmon from the San Joaquin River's tributaries and on the lower San Joaquin River; at higher flow rates, carrying capacity constraints on juvenile production are reduced. The SED must analyze how flow alternatives affect the ability of the tributaries and lower San Joaquin River mainstem to achieve and maintain the salmon protection objective, and the influence of different flow levels on the potential for and efficacy of other approaches to generating additional habitat space (i.e., increasing carrying capacity). Below, we demonstrate that such analyses are possible using available data and tools.Evidence suggests that the salmon carrying capacity of San Joaquin tributaries is driven by flowlevels and that AFRP production targets cannot be achieved or maintained when low flow conditions occur frequently, as they do currently. The SWRCB's finding that seasonal average flows >10,000 cfs correspond with attainment of AFRP doubling objectives is consistent with the idea that habitat availability limits total population size on the San Joaquin tributaries. Similarly, Zeug et al. 2014 found that prior abundance of spawners is, in general, a poor predictor of juvenile survival/passage on the Stanislaus. In addition, in their 2016 presentation to the SWRCB, Sturrock and Johnson reported that the number of juvenile salmon produced on the Stanislaus River was unresponsive to the adult spawning stock in years with low winter-spring flow rates, but that production of juveniles (in all size classes studied) was well-correlated with the number of spawning adults in years with high flows (Figure 6; Sturrock et al. in prep.; see also SEP 2016). These findings indicate that carrying-capacity on the tributaries is limited at low flow conditions and increases at higher flows during winter and spring.Flow-mediated carrying capacity may result from the effect of flow levels on a number of factors (or combination of factors) that are important determinants of salmon spawning and juvenile rearing and migration success. For example, through their effect on suitable temperatures, flow levels may affect the spatial and temporal availability of potential spawning and incubation habitat. Similarly, flow levels affect river temperature and availability of migration cues in ways that permit or prohibit successful juvenile rearing and migration. Also, river flow levels determine the magnitude and timing of availability of shallow off-channel rearing habitats that affect juvenile salmon growth and survival during their residence in fresh water (Sommer et al. 2001; Jeffres et al.	Please see the response to comment 1167-4.Please see Master Response 3.1, Fish Protection, for information about comments presenting information that does not conflict with, or contradict, the key scientific information used to support the impact determinations or benefit assessments made. Master Response 3.1 discusses the adequacy of modeling to support the analyses and expected benefits from implementation of the plan amendments. Specifically see the master response to comments regarding SalSim modeling, floodplain modeling, use of best available information, biological goals, and the role of non-flow measures. Also refer to Master Response 5.2, Incorporation of Non-Flow Measures, for additional discussion of the role of non-flow measures and of the State Water Board's authority to implement non-flow measures.Please also note that there may be differing opinions as to how to approach an analysis for a given resource or which data sets should be used, but these differing opinions do not equate to inadequacy.

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		2008).We note that the need for improved river flows to increase juvenile salmon survival and carrying capacity for various life history strategies on the San Joaquin River mainstem or its tributaries will not be eliminated (and, in some cases, may not even be reduced) as a result of physical manipulation of the riverbed or floodplain ("habitat restoration"). Indeed, the suitability of salmon habitat is an interaction of water quality (broadly construed) and the landforms that the water flows over and through. The relationship between the success of salmon habitat restoration and river flow rates is evident in the outcomes of restoration projects such as the multiple components of the "Special Run Pool 9 and 7/11" project led, in part, by Turlock Irrigation District and Modesto Irrigation Districts, which were intended to "reduce/eliminate habitat favored by predatory bass species and replace it with high quality Chinook salmon habitat" (TID and MID 2006 at ES-2) and increase juvenile Chinook salmon rearing habitat availability and quality, among other purposes.[Footnote 14: This multi-part, multi-million dollar project, funded in part by CBDA, was the subject of a presentation to the State Water Board during its December 20, 2016 Modesto hearing on the Phase I SED.] Consultants to these water districts have admitted that post-project monitoring revealed that these projects largely failed to reduce density of salmon predators, increase Chinook salmon rearing habitat, or increase Chinook salmon survival; these outcomes were each attributed to low flows in the years that followed project implementation. For example, in explaining the "continued high abundance of smallmouth and largemouth bass at the SRP 9," the synthesis report concludes:The most important goal of the project was to increase Chinook salmon outmigrant survival. Several studies have identified a positive relationship between spring flows and Chinook salmon outmigrant survival from the Tuolumne River, as well as recruitment to the population in subsequent years (e.g., TID/MID 1992b, 2004a). This restoration project was based on studies conducted in the early 1990s that concluded that predation by largemouth and smallmouth bass was a significant source of density independent mortality for outmigrant salmon (TID/MID 1992a). It is notable that this study was conducted during low flow years, when bass are expected to be most abundant (Brown and Ford 2002) and predator efficiency is expected to be high. The results may be most applicable to dry year conditions.TID and MID 2006 at 133 (emphasis added). The report then hypothesizes that the project may have successfully reduced the rate of river flow needed to provide a "safe velocity corridor" from >2000 cfs pre-project to >300 cfs post-project; discussion of other elements of the project reveal that "the greatest benefits of the project for rearing salmon occur during flows > 1,500 cfs." Id. at 135. The success or failure of these particular projects notwithstanding, it is clear that project proponents acknowledge that their benefits are flow-dependent and generally increase as flows increase. Thus, even if the SWRCB is presented with evidence that habitat restoration activities will occur on the tributaries or lower San Joaquin River mainstem, it cannot assume that these restoration activities will be protective of Chinook salmon populations without increases in river flow rates (below we address how the SWRCB should estimate the flow levels needed to provide benefits from one kind of habitat restoration – floodplain inundation).The SED does not explore the carrying capacity of the San Joaquin River or its three main tributaries or the effect of flow regime alternatives on the imposition or alleviation of carryingcapacity constraints on local Chinook salmon populations. Although it is possible that the current relationship between flow levels and carrying capacity for Chinook salmon juveniles (and thus, attainment of the AFRP doubling targets) could be affected by significant and widespread improvement in the quality and availability of off-channel rearing habitats (generically, "floodplains"), precise tailoring of releases to achieve particular environmental services, carryover storage requirements that improve temperature conditions, or a mixture of these approaches, the SED fails to analyze both the potential for this effect and the appropriate level of flow combined with specific levels of	

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		non-flow restoration. It is essential to analyze the interaction between the required flow regime and of any of these “alternatives” to flow, because the performance of these “alternatives” depends directly on the amount of water dedicated to environmental purposes. The SED must be modified so that it accounts for the effect of flow on available habitat and the efficacy of physical manipulations to the river (e.g., gravel augmentation or earth-moving on the floodplains) that are intended to expand carrying capacity for juvenile salmon.	
1167	12	The SED’s analysis of the effect of flow alternatives on the availability of shallow inundated rearing habitat for juvenile salmon is flawed.The SED acknowledges the importance of periodic inundation of shallow water habitats (loosely “floodplains”) to the health and productivity of both aquatic and riparian ecosystems. SED at §19.3. The SED identifies specific benefits (including increased survival and growth) of shortterm inundation for salmonid populations of the San Joaquin River valley as well as benefits that accrue to “steelhead, sturgeon, splittail…, bank swallow, western pond turtle, Fremont cottonwood and many other species.” SED at 19-54. However, the SED does not describe a specific target for inundated floodplain habitat that is needed to support desired populations of salmon, populations of other organisms, or key ecosystem processes (e.g., food generation and transport; aquifer recharge; seedling germination) that rely on floodplain inundation. Instead, the SED reports a wetted-acre days metric in its assessment of the availability of shallow inundated salmon rearing habitat under different flow prescriptions, and the SED’s analysis of changes in this metric boils down to ‘more is better.’ Because there is no quantified objective for salmon production (or other SMART targets), the SED does not provide a way to evaluate whether incremental changes in habitat availability, as indexed by “wetted acre days,” produce meaningfully better outcomes that support viable salmonid populations and/or contribute to meeting salmon doubling targets.In fact, “wetted acre days” is an inadequate indicator of actual useful habitat available to fish populations. Habitat is defined by numerous physical variables that can be measured in the field (e.g., cover and substrate) and measured or modeled assuming different flow conditions (e.g., depth, velocity, and duration of inundation). Acres that are inundated to a depth that is too shallow, for too short a period, at the wrong time, and/or that lack appropriate cover and substrate, may be included in the calculation of “wetted acre days,” but they would provide little ecological value to migrating juvenile salmon and other fish.In contrast to the approach in the SED, the Central Valley Flood Protection Plan (CVFPP; CDWR 2016a) modeled the habitat needed to support the salmon doubling objective for fall run Chinook salmon, including habitat needs in the San Joaquin Basin. As explained in more detail in the attached appendix to these comments (Appendix C), the CVFPP used estimated mortality rates for Chinook salmon after they exit Central Valley rivers to determine the number of juveniles that would need to exit each Central Valley tributary in order to result in AFRP production targets for that tributary (i.e., [number of juveniles exiting rivers] = [AFRP population natural production target] ÷ [post-riverine survival rate for Central Valley Chinook salmon]) and then used the Emigrating Salmonid Habitat Estimation model (ESHE; SJRRP 2012) to determine the number of acres of suitable rearing habitat required to support that number of juveniles. EHSE employs user-defined inputs (including field and laboratory estimates) of Chinook salmon juvenile growth, migration rate, and territory size, spawning location and timing (where and when fish enter the model), initial abundance, and mortality rates to estimate total habitat need in defined river reaches for each day that juvenile salmon are in the river. After “fish” enter the model, the population need for habitat at any location changes as individuals grow, migrate, and die. For each reach, the maximum habitat area needed on any one day during the migration season represents the total inundated habitat	Please see master Response 1.1, General Comments, for general information regarding program-level analysis, methods and modeling, and use of best available science. Please see Master Response 3.1, Fish Protection, regarding the purpose of modeling to evaluate fish protection, the adequacy of the floodplain analysis, which describes the use of modeled monthly flow in the floodplain analysis, and the use of acre-days to evaluate the benefits of increased floodplain inundation. The State Water Board recognizes there are multiple methods for determining the amount of floodplain habitat available under different flow scenarios. The modeling of monthly flows using the Water Supply Effects (WSE) model provides an appropriate level of analysis to sufficiently support a program-level evaluation of the plan amendments and inform the public and decision-makers on the range and magnitude of benefits and impacts. For information regarding the purpose of modeling and the appropriate use of models and model results in the SED, please see Master Response 3.2, Surface Water Analyses and Modeling. Please also refer to Master Response 2.1, Amendments to the Water Quality Control Plan, regarding the importance of flow connectivity and the protection of flows downstream of the LSJR, the geographic area of the plan amendments and why the upper San Joaquin River is not included, and clarification of the salmon doubling objective.Chapter 19, Analyses of Benefits to Native Fish Populations from Increased Flow between February 1 and June 30, shows results for approximately 30-day (depending on the month) duration events; tables 19-22 to 19-27 indicate monthly average flows will be higher more often in response to implementation of the plan amendments, in the range that is meaningful for floodplain habitat, compared to baseline conditions. The adaptive implementation process will allow the fine tuning of flows to achieve specific habitat targets (e.g., floodplain timing, magnitude, and duration) that may be identified for individual tributaries or reaches in support of the narrative objective. Through adaptive implementation, flows higher than what are shown in the Chapter 19 floodplain tables can be achieved for part of a given time period. For example, one part of a 30-day period could be 3,000 cfs and the other part could be 1,000 cfs for a 30-day average of 2,000 cfs. Please see Master Response 2.2, Adaptive Implementation, for clarification and examples of adaptive implementation, which include potential shaping or shifting of flows that, in concert with non-flow actions (e.g. floodplain restoration), serve to maximize the benefits of the proposed plan amendments. For discussions on the role of non-flow measures in population recoveries and integration of non-flow measures into the plan amendments, please see Master Response 5.2, Incorporation of Non-flow Measures, and Master Response 2.1.The purpose of the environmental review process is to disclose potential environmental impacts to the public and decision-makers. The SED gives consideration to potential economic effects in Chapter 20, Economic Analysis, per the requirements of Water Code Section 13141 and Section 13241. The SED is not required to include a cost-benefit analysis as the commenter seems to suggest. Please see Master Response 1.2, Water Quality Control Planning Process, regarding consideration of beneficial uses by the State Water Board and the State Water Board’s authorities. Please see Master Response 1.1 regarding general responses to economic-related comments, including those attempting to compare costs and benefits.

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		acreage needed in that reach to support the juvenile population that will lead to AFRP doubling targets. The sum of these reach-specific maxima across a river is the total area of inundated habitat needed on that river.The SED should use the ESHE model to analyze rearing habitat required on the three tributaries and the lower mainstem San Joaquin River to support required salmon populations. The estimate of required rearing habitat for each waterway should be incorporated into the final SED as SMART environmental targets that guide adaptive implementation of plan. Below, we illustrate the proper approach to estimating habitat needs necessary to support the existing narrative salmon protection objective.We analyzed the potential for different flow regimes (30-60% UIF as a 7-d running average) to produce CVFPP 2016 estimates of habitat need in the Stanislaus, Tuolumne, and Merced Rivers during the median year of inundation (which differs from the median year of volume; see Appendix D). The ESHE model estimates acreage of habitat required to support a target population assuming that each of the acres is 100% suitable; however, perfect habitat suitability is never found in the real world, so ESHE habitat estimates must be expanded based on an estimate of habitat suitability (i.e., [total actual rearing acreage required] = [ESHE estimated acreage] ÷ [habitat suitability] [Footnote 15: Habitat suitability is expressed as a percentage of perfect suitability.]). We made several liberal assumptions regarding how much suitable rearing habitat would be generated by different flow regimes. For example, we assumed that available floodplain acreage would be relatively high quality when inundated for the proper duration (i.e., mostly appropriate depth, flow velocity, cover, etc.). Floodplain habitat must be inundated for a certain amount of time in order to attain high quality. Specifically, in low gradient areas, habitat must inundate for a minimum of 10 consecutive days before it will begin to generate significant prey items for Chinook salmon (Jeffres unpublished data) and reaches high levels after approximately 14 days (Grosholz and Gallo 2006); thus, we assumed that inundated habitat through the lower half of the tributaries and all of the lower San Joaquin mainstem would reach high suitability after 10 days. High gradient floodplains generate a different kind of food supply more quickly (i.e., terrestrial invertebrates that fall into the water column; R. Henery, California Science Director for Trout Unlimited, personal communication), so we assumed that those reaches of habitat would reach their highest suitability after just 3 days of inundation. We also assumed that the timing of peak habitat need corresponded with the timing of peak flow (i.e., habitat inundation).Our analysis revealed that, under current conditions, the full acreage of habitat identified in the CVFPP (2016) will not be inundated on any of the tributaries or the lower mainstem San Joaquin River during the median year of inundation, assuming a 7d average of unimpaired hydrograph (Figures D2 through D-5, Appendix D). This is a result of the current geometry (e.g., levees, incised channels) of these rivers; habitat restoration involving significant earth-moving will be necessary to increase the area inundated under future flow regimes. If reservoir releases are timed optimally (“flow shaping”), a flow regime between 50-60% UIF will inundate all of the targeted rearing habitat needed required in the lower San Joaquin in the wettest one-third of years (i.e., the 33% exceedance year for floodplain inundation; Figure D-6, Table D-4, Appendix D). Even in such an above-normal year, flow prescriptions ≤40% will not result in any days of complete inundation of the necessary habitat and will require that more than 5100 ac of habitat to be restored to a condition that will inundate under the 40% UIF hydrograph (and almost 6800 ac under the 30% hydrograph). [Footnote 16: The necessary inundated habitat acreage may be achieved with less physical habitat restoration if habitat is restored to higher suitability than that assumed here or by using more aggressive flow shaping (effectively creating temporary flows that reflect much higher % UIF flow prescriptions). Aggressive flow shaping would require “borrowing” flows from other parts of the Feb-Jun measurement period which could result in negative conditions for juvenile salmon (e.g., increased temperature,	

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		poor migration cues, less habitat inundation) during the period from which the needed water was "borrowed" (see Temperature Appendix E). For example, flow could be reduced in the early part of the season because the size of the block (i.e., the seasonal volume of unimpaired flow) is highly uncertain until at least April. However, reductions in flows during the early part of the Feb-Jun period will tend to reduce success of the fry outmigrant life history type, which represents an important component of subsequent escapement and overall life history diversity on the tributaries (Zeug et al. 2014; Sturrock et al. 2015; Sturrock et al. in prep.). As noted above, flow shaping is also likely to result in reduced flow variability, and Zeug et al. 2014 demonstrates that decreased flow variability is associated with decreased migratory survival.]Migrating juvenile salmon require rearing habitat throughout the course of their migrations (or, more accurately, individuals require feeding and resting habitat wherever their metabolism demands on their journey – the distribution of those different individual needs creates a need for well-distributed habitat along the migratory corridor). It is worth noting that outputs from the ESHE model can be used to determine the optimal spatial (and temporal) distribution of Chinook salmon rearing habitat. The SWRCB should evaluate habitat distribution results from new ESHE model runs as candidates for environmental objectives to include in the final SED.Our estimates, based on CVFPP findings, illustrate the approach the SWRCB should take to (a) develop SMART environmental targets for rearing habitat and (b) evaluate how different flow levels contribute to attainment of those habitat targets. However, the model can and should be rerun for the final SED in order to incorporate appropriate assumptions. For example, because available habitat is likely to be of lower quality than we assumed, the habitat needs we identified from CVFPP outputs likely underestimate the actual need for inundated habitat acreage on the tributaries and the lower San Joaquin River mainstem to achieve either the existing narrative salmon protection objective.[Foot note 17: This analysis is focused solely on habitat needs for fall run Chinook salmon, not on spring run Chinook salmon or other species.] Similarly, because the timing of peak habitat need and the timing of peak flow may not match, the flow-habitat levels identified in our example may underestimate the % UIF required to inundate the requisite habitat. Also, the CVFPP estimates did not cover habitat needs upstream of the CVFPP's geographic purview and so they do not include habitat needs in the upper reaches of the rivers. Furthermore, juvenile salmon survival rates assumed in the CVFPP do not account for likely improved future survival rates in the tributaries and in the Delta that result from improved standards in Phase I and Phase II. Finally, the CVFPP habitat estimates do not account for fish entering the lower San Joaquin River from the SJRRP reaches upstream of the Merced confluence; the SWRCB should account for the flow and habitat related needs of restoration program fish as they migrate through the lower San Joaquin River. The SEP (2016) has developed SMART targets for the extent of rearing and spawning habitat in the Stanislaus River and analogous objectives for the Tuolumne, Merced, and lower San Joaquin Rivers are in process, as are targets that specify the proper distribution of that habitat; the Board should adopt these targets to guide adaptive implementation of the plan and ensure that the tributaries and lower San Joaquin mainstem are a capable of supporting the existing narrative salmon protection objective as well as the survival and life history diversity targets associated with the proposed narrative San Joaquin migratory fish viability objective.Regardless of specific inputs and outputs, our habitat analyses illustrate relationships between flow and availability of inundated salmonid rearing habitat that have important implications for the feasibility and implied costs of any flow regimes for the San Joaquin tributaries and mainstem. In general, at higher flow levels:• More habitat acreage will be inundated. For example, our analysis indicates that 3,820 additional acres of habitat would be inundated in the median year for inundation on the tributaries and lower San	

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		Joaquin mainstem under a 60% flow alternative than under a 30% UIF flow regime • Less habitat restoration will be needed. In our example, the increase in inundated habitat produced by differing flow levels alone resulted in a 28% reduction in the amount of habitat that would need to be restored under a 60% UIF versus a 30% UIF flow regime • Less flow shaping will be necessary to achieve the desired inundated habitat acreage and duration. As a result, the risk of modifying the hydrograph in a way that produces poor conditions for migrating or rearing juvenile salmon is reduced. • Availability of potential restoration sites increases. A greater range of elevations can be inundated under higher river stages that would accompany flow regimes of 50-60% UIF than would occur under those ≤40% UIF; this translates to a greater acreage of potential restoration sites. • The cost of needed habitat restoration will decrease, as will the time and resources needed to complete the necessary habitat restoration.In short, habitat restoration will be necessary to reconnect the tributaries and lower mainstem San Joaquin Rivers to an acreage of their floodplains that is sufficient to support target salmon populations; however, the amount of restoration and cost of the required earth-moving decrease at higher flows and the availability of potential restoration sites increases under higher flow prescriptions. The analysis in the SED is flawed because it does not analyze the benefits of different flow prescriptions with respect to a population objective (i.e., the existing doubling targets); such an approach is necessary to generate SMART targets for rearing habitat. As a result, the SED ignores major societal obligations, costs, and obstacles associated with low flow prescriptions; any cost-benefit analysis of the SED's different alternatives is incomplete and biased without accounting for the effect of flow regimes on habitat availability.Failure to attain the habitat restoration targets identified by the CVFFP (or more refined estimates that should be produced) should not be interpreted to mean that attainment of the existing narrative salmon protection standard is not possible. Rather, challenges in attaining needed rearing habitat for salmon reveal limitations on the potential for this management option to replace the need for flow and its associated in-channel habitat improvements (e.g., attainment of satisfactory temperatures). If inundated rearing habitat needs are not satisfied on the tributaries, additional improvements to in-channel survival upstream will need to be combined with additional rearing habitat downstream (i.e., in the lower San Joaquin River mainstem or the Delta).	
1167	13	The SED's analysis of the effect of flow alternatives water temperature conditions in the San Joaquin River and its tributaries is flawed.Analyzing temperature effects of different flow management alternatives is valuable because temperature dictates many processes and outcomes in the aquatic environment, particularly for ecothermic (cold-blooded) organisms like salmon, their prey, and many of their predators. However, temperatures must be linked to actual biological relationships and thresholds in order to understand the effect of temperature differences among alternatives. The draft SED presents all temperature changes of 1oF as though they have equal benefit, regardless of the absolute temperatures or life stages involved. However, as discussed below, the approach in the SED is scientifically inaccurate.Temperature tolerances differ among Chinook salmon life stages and are characterized by thresholds and curvilinear effects (Temperature Appendix E, Figure E-2). For example, a 1 degree Fahrenheit temperature difference between alternatives that both produce lethal results, detrimental results, or optimal results is not a biologically meaningful	As described in the captions for Chapter 19, Analyses of Benefits to Native Fish Populations from Increased Flow between February 1 and June 30, Tables 19-4, 19-5, 19-7, 19-8, 19-10, 19-11, 19-13, and 19-14, changes of greater than 1°F are highlighted red or green to aid the visual review of these tables and do not necessarily represent significant changes to salmon and steelhead temperature habitat. These tables are included to provide information in addition to tables 19-3, 19-6, 19-9, and 19-12. These temperature results, and the temperature results described in Chapter 7, Aquatic Biological Resources, and Appendix F.1, Hydrologic and Water Quality Modeling, are used to inform conclusions made in the SED. Many of the reductions in temperature from the plan amendments are meaningful, because they are within the range that is important to salmon and steelhead. Please see Chapters 7 and 19 for more information. The SED evaluations include flow shifting. Please see the Appendix F.1 section titled "Shifting of Flow Requirement." As described in Appendix K, Revised Water Quality Control Plan, and various locations throughout the SED, the program of implementation includes adaptive implementation in order to optimize flows and make adaptive adjustments based on new information. The program of implementation also

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		outcome. For any life stage, temperature changes in the range between “optimal” and “detrimental” (i.e., within the “sub-optimal” range of temperatures; see SEP (2016) for a discussion of the terms “optimal”, “sub-optimal”, and “detrimental”) are likely to produce real biological effects that translate to differences in population dynamics; however, within the “sub-optimal” temperature range, a 1oF change between two alternatives will have different population consequences depending on where the absolute temperatures fall in the “sub-optimal” range. As a result of its simplistic rule for identifying meaningful temperature differences among alternatives, the SED fails to identify significant effects of its flow alternatives and implies that there will be different outcomes even when and where none are likely.We analyzed the potential for different flow alternatives described in the draft SED to produce temperature-related effects that would translate to meaningfully different biological outcomes, including those that may prevent the tributaries from supporting required populations of salmon (Appendix E). We used temperature modeling results presented in Chapter 19 of the draft SED and temperature thresholds reported in USEPA (2003) and SEP (2016). Chapter 19 of the SED employs USEPA (2003) thresholds as a benchmark for effects. SEP (2016) also uses the USEPA values but includes additional temperature levels found in the literature that define “optimal” conditions and biologically significant thresholds that fall in the temperature range between EPA’s beneficial and its lethal thresholds; this latter set of intermediate temperature thresholds allowed us to distinguish between “fair” and “poor” temperature conditions (Appendix E, Figure E-2). The overarching point is that a range of temperature related effects with real biological significance occur between well-defined temperatures that create “optimal” (no temperature stress) conditions and lethal conditions.The SED’s temperature results reveal that different flow alternatives can be expected to produce very different biological outcomes as a result of the different temperature regimes they generate during the February-June period.[Footnote 18: The carryover storage requirements in the SED resulted in few meaningful temperature differences among alternatives on any of the rivers between September and January.] On the Stanislaus River, flow regimes between 50% and 60% unimpaired flow (“UIF”) result in optimal incubation conditions (no temperature related mortality) to river mile 28.2 (“1/2 river”) through February of the warmest 10% of years, as opposed to fair conditions (associated with some temperature-related mortality) for alternatives ≤40% UIF (Appendix E, Figure E-3). Fair conditions persist through March at river mile 43.7 (“3/4 river”) under 50% and 60% UIF flow regimes, whereas poor incubation conditions (high temperature-related mortality) or worse are expected at this point in the river under alternatives ≤40% UIF. These are very real and important differences in temperature conditions that will result in significant reduction in the miles of the Stanislaus River that will available for salmon incubation (and a reduction in carrying capacity) under the 40% UIF flow regime during warmer years than would occur under ≥50% UIF conditions.All flow regimes are expected to produce poor-temperature conditions, on average, on the Stanislaus River during May of the warmest 10% of years (Figure E-3), and this makes successful migration during April of the warmest 10% of years all the more important. Migrating juvenile Chinook salmon will experience some temperature stress, on average, from at least RM 13.3 under the 40% UIF alternative during April, whereas conditions remain optimal or close to optimal to the confluence under the ≥50% UIF flow regimes. As with spawning and incubation conditions, there will be significant temperature benefits to juvenile Chinook salmon migrating from the Stanislaus River under the ≥50% UIF alternatives in the warmest years as compared to alternatives that reserve less water for environmental protection.Temperature conditions modeled in the draft SED can be	includes annual reporting, as part of the San Joaquin River Monitoring and Evaluation Program, which shall describe any flow shifting operations performed. As explained in the program of implementation, biological goals for salmonids will specifically be developed for abundance; productivity as measured by population growth rate; genetic and life history diversity; and population spatial extent, distribution, and structure. Furthermore, reasonable contributions to these biological goals include, among other measures, meeting temperature targets. Please refer to Master Response 3.1, Fish Protection, for a description of the importance of biological goals from a population monitoring perspective. Master Response 3.1 also provides information regarding the adequacy of modeling to support the analyses. Specifically refer to the temperature sub-section with discussions regarding the use of USEPA recommended temperature criteria, and reductions in sublethal and lethal temperatures. Please also refer to Master Response 2.1, Amendments to the Water Quality Control Plan, for the project description and clarification regarding the methods used during the February through June period for making adaptive adjustments to the LSJR flow objective, and for the need to balance beneficial uses. Please also refer to Master Response 2.2, Adaptive Implementation, regarding clarifying descriptions, and examples, of the adaptive implementation process.Please refer to Master Response 1.1, General Comments, for information regarding compliance with CEQA and the adequacy of the SED.

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		expected to produce severe constraints for the Tuolumne River salmon population that impair population viability and the prospect of achieving or maintaining federal and state salmon doubling requirements (Figure E-4). At 40% UIF, both incubation and migration periods for Chinook salmon on the Tuolumne River will be truncated by a month as compared to ≥50% UIF alternatives. Under flow regimes ≥50% UIF, incubating salmon eggs on the Tuolumne River can be expected to experience low levels of temperature-related mortality during February and March of the warmest years down to at least RM 38.29 ("3/4 river"); temperature related mortality at this point in the river would be high under 40% UIF and incubation failure would occur here under alternatives with ≤30% UIF (Figure E-4). Whereas temperature conditions remain optimal-to-fair for migrating and rearing juvenile salmon through May at 60% UIF, and are at worst "fair" through May at 50% UIF, temperature related mortality for migrating juveniles will increase significantly at ≤40% UIF. Temperatures experienced by migrating juvenile salmon at 40% UIF are substantially higher (1.4-1.7oF) under 40% UIF than at 50% UIF in April for at least 13 river miles (between "¼ river" and "confluence") and become "poor" under 40% UIF upstream of the confluence during May. These results clearly indicate that the Tuolumne River's carrying capacity for Chinook salmon will be severely constrained by limited incubation habitat in at least 1 of 10 years (and probably more frequently) at flow levels ≤40% UIF and carrying capacity will increase at flow levels ≥50% UIF.Major differences in temperature-related stress between alternatives with ≤40%UIF and those with ≥50% UIF can be expected for juvenile Chinook salmon rearing and migrating along the Merced River corridor in April and in May during the warmest 10% of years (Figure E-5). In April, ≥50% UIF leads to conditions that are "fair" (low stress) in the lower 13 miles of the river, whereas 40% UIF flow levels produce "poor" (high stress) temperature conditions. Average temperature conditions in May of the warmest years will be poor under ≥50% UIF, but under ≤40% UIF, temperatures during May are "detrimental" (a level associated with nearly complete failure to complete the life cycle). Thus, flows ≥50% UIF result in 2 additional months, and many additional river miles, of suitable rearing and migration habitat compared to regimes ≤40% UIF – temperature related impacts at ≤40% UIF represent a severe constraint on the Merced's ability to support a viable and self-sustaining salmon population. Analysis of 7DADM temperature values in years with average temperature conditions (50% exceedance values) revealed similar patterns to those detected in the analysis of the warmest years (90% exceedance values; Figures E-3 through E-5). Higher % UIF flow prescriptions generally led to lower temperatures during the incubation and/or juvenile rearing and migration life stages. Although monthly mean temperatures of average years were, by definition, lower than those for the 90% exceedance years, temperature limitation on salmon productivity and carrying capacity in the tributaries would still be expected at flows ≤40%UIF.Finally, temperatures expected in the lower San Joaquin River at Vernalis would prevent juvenile salmon migration during the average day in Mays of the warmest years under flow alternatives with ≤30% UIF; the 60% UIF flow regime produced temperatures that were more than 1oF less than those expected under 40% UIF (Figure E-6) – such a temperature difference is expected to produce real improvement in salmon survival and condition. Under average temperature conditions (i.e., "mean" year temperatures), juvenile rearing and migration in the lower San Joaquin River during June will be more successful (especially during the earlier parts of the month) under flows ≥50% UIF than at lower flows. The truncation of juvenile Chinook salmon migration as a result of high temperatures expected under lower flow alternatives described in the SED represents a severe impact to the tributaries' ability to attain the existing narrative salmon protection objective, both through its impact on population survival rates (productivity) and because the limited time for successful development under low flow alternatives represents a reduction in the rivers'	

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		carrying capacity. Furthermore, because the reduction in migration opportunities will affect late migrating, smolt-sized salmon disproportionately, the low flow alternatives are likely to have severe negative effects on the life-history diversity attribute of population viability. The SED must analyze and account for these potential limitation son population viability and condition in evaluating and selecting a flow alternative.The draft SED's analysis of temperature effects is flawed because it does not discriminate meaningful temperature differences from those which are unlikely to produce detectable biological responses. Substantial benefits to the productivity and resilience (i.e., viability) of San Joaquin valley salmon populations accrue under flow regimes ≥50% UIF that will not occur under flow regimes with ≤40% UIF. Temperatures presented in the draft SED for flow regimes ≤40% UIF would be expected to produce frequent catastrophic declines in fall-run Chinook salmon populations, with concomitant impacts to the ecosystems and fisheries that rely on these fish. Also, because temperature conditions that occur under flow proposals with ≤40% UIF would limit carrying capacity of the San Joaquin River's tributaries, even under average conditions, such flow alternatives would not be expected to support attainment and maintenance of AFRP population targets for these rivers.Lastly, the analysis of temperature impacts in the SED and that performed above assumes no flow shifting or flow shaping (i.e., "borrowing" water from one part of the Feb-Jun period in order to produce desired effects in another part of the year). However, these adjustments to a 7 day moving average of unimpaired approach are almost certain to result in worse temperature conditions for the time periods from which the flow is borrowed. The draft SED does not anticipate or clearly describe how the water budget (the % UIF) will interact with (and potentially limit) flow-shaping operations and/or the need to restore juvenile rearing habitat for Chinook salmon even though these elements of the Draft SED's proposed management regime are inextricably linked. The draft SED fails to reveal these linkages or to explore how they will affect the implementation or efficacy of future flow standards.	
1167	14	The SED fails to analyze the effect of alternatives on dissolved oxygen levels in the lower San Joaquin River or its tributaries.The SED incorrectly claims "adverse effects associated with low DO levels have not been documented in reaches of the SJR or the three eastside tributaries" (SED at 7-66). This statement is contradicted by the observation that"During the fall adult salmon migration season, when LSJR inflows to the Bay- Delta are less than 1,500 cfs, low DO levels in the SJR at the Stockton Deep Water Ship Channel (e.g., less than 6 ppm) create a chemical migration barrier to upstream migrating adult salmon. Failure of SJR Basin salmon to reach the spawning grounds results in negative spawning impacts on the SJR fall-run Chinook salmon population (CDFG 2011a)."SED at 7-50.As described in our previous comments (TBI et al. 2013), low dissolved oxygen levels are a longstanding and persistent problem in the lower San Joaquin River and some of its tributaries (citing CVRWQCB and CBDA 2006). Low DO levels can block migration of adult salmon and such effects have been documented on the lower San Joaquin River (Hallock et al. 1970); sturgeon are even more sensitive to low DO levels than salmon (Cech and Doroshov 2004) and conditions that frequently prevail in the lower San Joaquin River would be expected to block migrations of both green and white sturgeon adults and juveniles (CVRWQCB and CBDA 2006).A mechanical oxygenation system has been installed in the Stockton Deepwater Ship Channel (SDWSC) to combat low DO levels. We demonstrated in our prior comments (TBI et al. 2013) that violations of the existing DO standard for this area are frequent when flows in the SDWSC are <1,000 cfs. We also demonstrated that when flows are <2,000 cfs at Vernalis flows in the SDWSC are generally <1,000 cfs. The Draft SED's proposed minimum flow levels (1,000 cfs at Vernalis) will result in flows in the SDWSC that are well below 1,000 cfs. Thus, despite the implementation of non-flow measures (the SDWSC aeration system), it is likely	The commenter is correct in that several studies have documented adverse effects from low dissolved oxygen (DO) in the San Joaquin River and this correction has been made to the SED, where the SED has stated otherwise. This scenario is properly described in in Chapter7, Aquatic Biological Resources, in the Water Quality section discussing the Southern Delta.Also, as described under Impact AQUA-4, higher spring flows and lower water temperatures in the LSJR tributaries and LSJR will likely improve water quality conditions (including dissolved oxygen levels) relative to baseline conditions. As described in Appendix C, Technical Report on the Scientific Basis for Alternative San Joaquin River Flow and Southern Delta Salinity Objectives, a more natural flow regime would benefit the ecosystem in two ways: first, due to the direct relationships and interaction between flow, temperature, and dissolved oxygen, more natural flow would ameliorate negative effects of warm temperature and low dissolved oxygen; and second, an indirect effect of a more natural flow regime in the spring would be dilution of other water quality constituents which can negatively impact fish and wildlife beneficial uses (e.g., salinity, boron, nutrients, trace metals, and pesticides). Thus, the content provided by the commenter does not contradict the information contained in Chapter 7 or Chapter 19, Analyses of Benefits to Native Fish Populations from Increased Flow between February 1 and June 30, and would not change the impact determination made in Chapter 7. No updates were made to these chapters.Please refer to Master Response 1.1, General Comments, for information regarding compliance with CEQA and the adequacy of the SED. The State Water Board is not considering additional water quality objectives in this proceeding. Please also see Master Response 2.1, Amendments to the Water Quality Control Plan, for the project description. Master Response 1.2, Water Quality Control Planning Process, provides information about the scope of the Bay-Delta Plan proceedings.

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		that the preferred alternative will result in DO levels that are below the minimum required for migrating salmon, steelhead, green sturgeon, white sturgeon, and other aquatic organisms. When such conditions prevail in the fall, adult fall-run Chinook salmon and steelhead migrations will be affected; when these conditions occur in the spring, migrations of adult spring-run Chinook salmon, adult steelhead, juvenile spring-and fall run Chinook and steelhead, green and white sturgeon, and striped bass are likely to be adversely impacted by low DO in the SDWSC. The SED must adopt flow standards that are reasonably likely to eliminate dissolved oxygen impairment of fish and wildlife beneficial uses in the lower San Joaquin River (including, but not limited to, the Stockton Deepwater Ship Channel); the best available science indicates that flow levels greater than the SED's proposed 1,000 cfs minimum at Vernalis will be required.	
1167	15	The SED Fails to Adequately Analyze the Effect of Flow Alternatives on in-Channel Habitat Conditions such as Turbidity and Flow Variability.The SED's analysis of flow alternatives on in-channel habitat conditions is limited to temperature effects. The effects of increased sediment transport and turbidity in the river channels and the southern Delta as a benefit to fish populations were not analyzed, despite the fact that: • increased flows will tend to transport additional sediments and increase water column turbidity; • increased turbidity generally improves habitat quality (i.e., survival) for both migrating and estuarine-resident native fishes that live in the south Delta, including Delta smelt (SED at 7-133); and • turbidity levels in the lower San Joaquin River and southern Delta are unnaturally low (SED at 7-133) and increases in turbidity can have significant positive effects in limiting known ecological stressors such as invasive aquatic macrophytes (Boyer and Sutula 2015) and threats to water quality, such as toxic algal blooms (Berg and Sutula 2015).The draft SED (Chapter 6) evaluates only the potentially adverse effects of turbidity and erosion (they are "less than significant"). Because it fails to describe the potential for increased frequency of sediment mobilizing flows and changes in baseline turbidity of the lower San Joaquin River and southern Delta, the draft SED ignores differences in potentially important ecological benefits of the flow alternatives. The SED should be revised to account for these positive effects and analyze, to the extent possible, potential differences in sediment transport and turbidity under hydrographs that track natural runoff timing (e.g., a 7 day moving average of UIF) as compared to fully engineered (shaped) hydrographs.The SED must integrate evaluations of flow on habitat and water quality conditions. Flows that inundate floodplains but do not produce adequate temperatures for juvenile salmon attempting to rear in those habitats will not lead to attainment of the existing salmon protection objective or proposed San Joaquin migratory fish viability objective. Flow levels that achieve adequate temperature protections throughout the juvenile Chinook salmon migration and rearing season, and inundate adequate habitat area while simultaneously supporting other important habitat characteristics are those that have a reasonable likelihood of attaining plan objectives for salmonids.We have identified multiple quantitative approaches that the SWRCB should apply to evaluating the likelihood that flow alternatives will attain the narrative salmon protection objective and the San Joaquin migratory fish viability objective. In a system that will not be physically modified (i.e., "restored" by earth-moving activities), the strong and significant empirical relationships between seasonal flow and both abundance and productivity of San Joaquin River salmon populations remain the best	Please refer to Master Response 1.1, General Comments, for information regarding compliance with CEQA and the adequacy of the SED. The State Water Board recognizes that there are multiple methodologies for assessing benefits to fish and wildlife. The benefits analysis in Chapter 19, Analyses of Benefits to Native Fish Populations from Increased Flow between February 1 and June 30, focused on two of the most important habitat attributes; temperature and floodplain. However, Chapter 19 and Appendix C, Technical Report on the Scientific Basis for Alternative San Joaquin River Flow and Southern Delta Salinity Objectives, recognize that there are many other benefits expected from the plan amendments, including, but not limited to beneficial effects on geomorphic processes (refer to SED Appendix C, Section 3.7.4) and water quality (refer to SED Appendix C, Section 3.7.7).In addition to proposing amendments to the LSJR flow objectives, the State Water Board recognizes that non-flow measures have a complementary role to flow-based restoration. As described in Appendix K, Water Quality Control Plan Update, and Chapter 16, Evaluation of Other Indirect and Additional Actions, non-flow measures may include floodplain and riparian habitat restoration, reduction of vegetation-disturbing activities in floodplains and floodways, gravel augmentation, enhancement of in-channel complexity, improvement of temperature conditions, predatory fish controls, and invasive aquatic vegetation control. Please see Master Response 5.2, Incorporation on Non-Flow Measures, for more information.Please refer to Master Response 3.1, Fish Protection, regarding the adequacy of the temperature analysis, the importance of flows in June, the consideration of predation, and anticipated measure benefits of the plan amendments. Please also refer to Master Response 2.1, Amendments to the Water Quality Control Plan, regarding the importance of flow connectivity and the protection of flows downstream of the LSJR. The SED provides information as to when and where there is potential to provide habitat benefits if flows are managed with no adaptive implementation. However, flow will be managed through adaptive implementation to maximize benefits to fish. This process will be informed by the STM Working Group (see SED Appendix K, Revised Water Quality Control Plan, and Master Response 2.2, Adaptive Implementation), which will likely have participation from the following entities that have expertise in LSJR, Stanislaus, Tuolumne, and Merced Rivers fisheries management, hydrology, operations, and monitoring and assessment needs: DFW; NMFS; USFWS; and water users on the Stanislaus, Tuolumne, and Merced Rivers. This implementation approach will allow the management of water for floodplain habitat, temperature habitat, weighted usable area, migration flows, or other functional habitat attributes. Please see Master Response 2.2, regarding clarifying descriptions, and examples, of the adaptive implementation process, including the structure and governance of the STM Working Group. Refer to Master Response 3.1, regarding how the unimpaired flow approach with adaptive implementation will furthers management for functional flows.The purpose of the environmental review process is to disclose potential environmental impacts to the public and decision-makers. The State Water Board is not required to include a cost-benefit analysis, as the commenter seems to suggest. Please see Master Response 1.2, Water Quality Control Planning Process, regarding consideration of beneficial uses by the State Water Board. Please see Master Response 1.1, General Comments, for general information regarding economic-related comments, including those attempting to compare costs and benefits.

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		predictors of the potential for flow alternatives to meet plan objectives. In addition, the relationship between flow and productivity (survival) and diversity of successful life-history types emigrating from the tributaries provides a strong basis for evaluating the effects of different flow alternatives at a local level. Finally, data and analytical tools are available to analyze some (but not all) of the functional mechanisms by which flow alternatives produce salmon habitat so that the SWRCB can analyze the likely efficacy and relative costs of some "alternatives" to flow – integration of results from temperature and floodplain inundation-habitat creation models is required, at a minimum, to evaluate the potential for widespread restoration of rearing habitat to support the narrative doubling objective and the salmon viability objective.	
1167	16	The SED's reliance on outputs of the SALSIM model is not consistent with the best available scientific information, as the SED acknowledges, and the SED should not rely on these results.Rather than incorporate the wealth of scientific information and robust relationships that link flow levels to San Joaquin Chinook salmon abundance, productivity, life history diversity, and both spatial and temporal habitat availability, the draft SED only analyzes the relative performance of its flow alternatives using the CDFW SALSIM model. The SED itself, as well as comments from SWRCB and CDFW staff in the public hearing, acknowledge that the SALSIM model is flawed and currently does not represent the best available science. As CDFW staff acknowledged, inputs to the model are known to be flawed, and that the modeled estimates of salmon production in the draft SED "are likely substantially lower than they should be." CDFW presentation to the SWRCB on 1/3/2017. CDFW's presentation shows that the current model overestimates egg mortality and underestimates juvenile mortality, and that it fails to adequately account for the effects of flows and water temperatures during the winter/spring period. Id. Regarding SalSIM results, the SED admits that the effects of floodplain inundation and water temperature "are not represented by the model in a manner that is consistent with current scientific information." SED at 19-74. In addition, the SED admits that the SALSIM model also understates the effects of improved instream flows on success of migrating and rearing juvenile salmon because salmon returns during the first several years of the model (1994-1997) are not affected by any instream flow improvements in those years, and years 2005-2009 are affected by ocean conditions and the model forces production to decline in those years regardless of the flow conditions. SED at 19-85.The SalSIM results do not track the historical response of San Joaquin salmon production and escapement with winter-spring flows in the San Joaquin River, as measured at Vernalis. As the SED notes, even were the model inputs valid, model outputs are useful only for relative comparison. SED at 19-76 and 19-85. However, even relative comparisons among model alternatives presented in SED Table 19-32 (also Figure 19-14) do not support the SED's choice of preferred alternative because (a) there is no indication that the preferred alternative is likely to attain the existing narrative salmon protection objective or the proposed San Joaquin migratory fish viability objective (see analyses below) and (b) there is no comparison of the relative performance of the specific operational schemes (flow shifting and aggressive flow shaping) that are part of the preferred alternative under any environmental allocation other than 40% UIF. CDFW explained in its presentation to the SWRCB that they are recalibrating the model after correcting flawed model inputs. However, we recommend that the final SED should not rely on SALSIM results. SALSIM modeling that is included in the Final SED should be accompanied by appropriate caveats regarding reliability of the model results, and any SALSIM model results that are presented in the SED should focus on juvenile production, rather than escapement, since this proceeding is focused on actions during the winter/spring time period that affect juvenile	Please see Master Response 3.1 regarding State Water Board use of SalSim and acknowledgement of model limitations, SED use of best available science, and justification for the plan amendments, including discussion of the current pattern of fish decline and the need for increased flow. As explained in this master response, the State Water Board did not rely upon SalSim, either for impact determinations in the SED or for its conclusions regarding fish benefits. Chapter 19, Analyses of Benefits to Native Fish Populations from Increased Flow between February 1 and June 30, provides a use advisory for SalSim and describes SalSim limitations. Appendix C, Technical Report on the Scientific Basis for Alternative San Joaquin River Flow and Southern Delta Salinity Objectives, Section 3.6, Analyses of Flow Effects on Fish Survival and Abundance, summarizes much of the fish versus flow literature considered in the SED. More recent studies (e.g. Sturrock et al. 2015; State Water Board 2017; TID and MID 2013; USFWS 2014; Zueg et al. 2014) continue to provide evidence of the importance of suitable flow and related habitat conditions during the spring time period.As explained in Appendix K, Revised Water Quality Control Plan, Chapter IV, Program of Implementation, biological goals for salmonids will specifically be developed for abundance, productivity as measured by population growth rate, genetic and life history diversity, and population spatial extent, distribution, and structure. Furthermore, reasonable contributions to these biological goals include, among other measures, meeting temperature targets. Please refer to Master Response 3.1, Fish Protection, for a description of the importance of biological goals from a population monitoring perspective.The SED provides information as to when and where there is potential to provide habitat benefits if flows are managed with no adaptive implementation. However, flow will be managed through adaptive implementation to maximize benefits to fish. This process will be informed by the STM Working Group (see SED Appendix K, and Master Response 2.2, Adaptive Implementation), which will likely have participation from the following entities that have expertise in LSJR, Stanislaus, Tuolumne, and Merced Rivers fisheries management, hydrology, operations, and monitoring and assessment needs: DFW; NMFS; USFWS; and water users on the Stanislaus, Tuolumne, and Merced Rivers. This implementation approach will allow the management of water for floodplain habitat, temperature habitat, weighted usable area, migration flows, or other functional habitat attributes. Please see Master Response 2.2, regarding clarifying descriptions, and examples, of the adaptive implementation process, including the structure and governance of the STM Working Group. Refer to Master Response 3.1, regarding how the unimpaired flow approach with adaptive implementation will essentially provide management for functional flows.This comment refers to CDFW's comments. For the full context of the comments and a complete response to those remarks, please refer to the index of commenters in Volume 3 to locate the material from the November 2016 public hearing, which will be identified by the person's name and is assigned a letter number.

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		production.	
1167	17	The SED Fails to Analyze Potential Adverse Environmental Impacts of Waiving Instream Flow Requirements in Future Drought Emergencies, as Authorized in the Program of Implementation.In the Program of Implementation, the SWRCB proposes to authorize waivers of the proposed flow requirements,[Footnote 19: Notwithstanding this language in the SED, state law requires the SWRCB and all other state agencies to implement water quality standards that are in an adopted water quality control plan. Cal. Water Code § 13247. The SWRCB cannot use an administrative action, such as a petition for temporary urgency change petition, to change water quality standards absent the waiver of section 13247 by the Governor, an action that is wholly inappropriate for drought conditions that are reasonably certain to recur. In addition, any such waivers of water quality standards, such as through adoption of a temporary urgency change petition, would likely violate the Clean Water Act without review and approval of the U.S. Environmental Protection Agency.] based upon a determination of a state or local state of emergency. SED, App. K, at 35. Although not specifically stated, we presume that the SWRCB would consider extended droughts to constitute a state of emergency under this section. However, droughts should not be considered an unexpected emergency, because they are a fact of life in California. The modern hydrologic record includes several multiyear drought sequences, and hydrologic modeling accounts for these historic droughts. The SED's failure to plan for extended drought conditions is wholly inappropriate and unlawful, and the failure to identify likely adverse environmental impacts that would result from future waivers – and potential mitigation measures for such impacts – violates CEQA.We recognize that specific off-ramps from the proposed flow requirements may be appropriate during extended multi-year drought periods, provided that the SED: (1) establishes in advance of these periods the hydrologic criteria and triggers to determine when such waivers would be appropriate, rather than ad hoc or arbitrary political criteria; (2) identifies default compliance measures during such waivers, and; (3) analyzes the likely effects of imposing the default compliance measures in order to ensure that these waivers would not result in significant adverse environmental impacts and that the objectives are still achieved over time.[Footnote 20: Equally important, the SWRCB must evaluate whether more protective measures are needed in non-drought years to ensure population viability and achievement of objectives will be maintained in light of the expected frequency and duration of drought years in the future.] However, the SED wholly fails to take these steps: it fails to quantify the frequency, magnitude, and duration of such waivers; it fails to identify potential measures that would be required instead, and; it fails to analyze the environmental impacts of implementing alternative measures. As a result, the SED fails to identify likely adverse impacts of the proposed action, and fails to analyze whether the proposed action is likely to achieve the narrative salmon doubling objective. This is unlawful.As the SWRCB is well aware, the approval of temporary urgency change petitions to weaken or waive existing water quality standards during the recent drought has had devastating impacts on fish and wildlife. See, e.g., Defenders of Wildlife et al., Request for Emergency Regulations, August 9, 2016; [Footnote 21: This document is available online at: https://www.defenders.org/publications/dow-nrdctbi_ request_for_emergency_regulations_final.pdf and is hereby incorporated by reference.] Central Valley Project and State Water Project, 2016 Drought Contingency Plan (January 15, 2016), at 13-15;[Footnote 22: This report is available online at: http://www.waterboards.ca.gov/waterrights/water_issues/programs/drought/docs/plans/2	Please see Master Response 2.1, Amendments to the Water Quality Control Plan, regarding the emergency provision and drought planning, and modifications suggested by commenters.

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		016dcpfebnov.pdf and is hereby incorporated by reference.] letter from NMFS to USBR and DWR regarding reinitiation of consultation, August 17, 2016.[Footnote 23: This letter is available online at http://www.westcoast.fisheries.noaa.gov/publications/Central_Valley/Water%20Operations/nmfs_response_to_recla mation_s_request_to_reinitiate_the_2009_cvpswp_operations_consultation_-_august_17__2016.pdf and is incorporated by reference.] Waiving the proposed flow requirements during future droughts is also likely to cause significant adverse environmental impacts on salmon and other fish and wildlife. For instance, increased water temperatures are likely to result from reduced instream flow requirements, which would likely cause significant adverse impacts on incubating egg and/or juvenile salmonid survival. Reduced instream flows also would likely increase predation, reduce dissolved oxygen in the river, and ultimately result in lower salmon survival. This conclusion is consistent with the scientific information presented in our comments and in the SED, which demonstrates lower salmon survival at lower flow volumes.However, the SED completely fails to analyze the potential environmental impacts of waivers of instream flow objectives pursuant to this authority. Moreover, the declaration of a state of emergency resulting from drought conditions is an arbitrary political, not a specifically defined hydrologic, determination; for instance, in recent years, drought declarations have remained in place during the first wet year following a drought sequence (2011, 2017), and this could result in major hydrologic alteration and adverse impacts to fisheries. Instead of relying on an arbitrary political determination of drought, the SED must identify hydrologic conditions that could justify an offramp from the instream flow objectives. We recommend that the Board should not allow such offramp conditions to be implemented unless and until unimpaired flow conditions are critically dry for at least the prior two consecutive years, and have provided similar language in our redline of Appendix K.	
1167	18	The Program of Implementation Fails to Ensure that Discretion in Flow Shaping and Volume will Achieve Water Quality Control Plan Objectives and the SMART Biological and Environmental Targets Used to Track Compliance and Effectiveness.In Appendix K of the SED, the SWRCB proposes a deeply flawed governance scheme, and inappropriate levels of discretion to change flows and flow standards, without analyzing whether such foreseeable changes are likely to achieve the plan objectives and without requiring that the narrative salmon protection objective and all SMART biological and environmental targets will be met with the change. See Draft SED, Appendix K, at 29-31. In addition, Table 3 is inconsistent with this language in the Program of Implementation allowing for greater flexibility. We have provided a redline of this language in Appendix K and Table 3 of the SED, consistent with the discussion below.The draft plan relies on “adaptive implementation” of the preferred alternative (Appendix K). Adaptive implementation is expected to reflect scientific information that emerges from monitoring or studies on the tributaries or from elsewhere. The intent of “adaptive implementation” is thus quite similar to the better-known rubric of “adaptive resource management” (“ARM”), proposing to use adaptive implementation to optimize flows to achieve the objectives. SED, Appendix K at 30. However, the draft plan provides very little specificity regarding what it means to “optimize” flows or what information will be utilized to determine the optimal level of flow in any given year or time	Please see response to comment 1167-4 and 1167-49 through 1167-61. Please see Master Response 2.1, Amendments to the Water Quality Control Plan, and Master Response 2.2, Adaptive Implementation, for responses to comments regarding the program of implementation, biological goals, adaptive methods, STM Working Group structure and governance, and examples of how adaptive implementation can occur. Master Response 2.1 also addresses modifications suggested by commenters. The Biological Goals section in Appendix K, Revised Water Quality Control Plan, has been modified to state: “Biological goals should be specific, measurable, achievable, result-focused, and include a time frame for when they will be achieved.”Please refer to Master Response 3.1, Fish Protection, for responses to comments regarding fish benefits of the plan amendments, which include flow shaping and shifting.

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		period within that year. ARM requires the expression of desired outcomes in terms of targets that are specific, measureable, achievable, relevant to a plan goal, and time bound (SMART); without such targets, it is impossible to know if the plan is successful or when and to what end plan elements should adapt. The draft SED suggests that future adaptive management decisions should be focused towards achieving such targets, but it does not provide examples of the targets or incorporate known SMART targets that are integral to achieving the existing narrative salmon protection objective and proposed San Joaquin migratory fish viability objective.The SEP (2016) has defined SMART targets that define the biological outcomes (i.e., egg-to juvenile survival/productivity; life history timing and diversity) necessary to attain the narrative salmon protection objective for San Joaquin River fall-run Chinook salmon, and the requirement that dam operators maintain fish populations in good condition for fall-run, spring-run Chinook salmon, and both resident and anadromous populations of Oncorhynchus mykiss. In addition, SEP (2016) identifies the timing and spatial extent of the physical, chemical, and biological conditions that best available science indicates are necessary to achieve those biological targets. Several of these targets are referenced in section III of these comments. The SWRCB should adopt key SMART targets (particularly, egg-to-juvenile survival/productivity, and both timing and size-distribution targets for life history diversity) for fall-run and spring-run Chinook salmon, and both resident and anadromous forms of O. mykiss as well as the supporting environmental objectives into its final SED so that these targets can guide adaptive management and the program of implementation.More generally, the proposed standards for making adaptive changes in Appendix K, and the proposed governance scheme for who would decide to make such changes, are deeply flawed and fail to ensure that the plan objectives are likely to be achieved. With respect to the standards for making changes in implementation, Appendix K would authorize changes in implementation that would change the percent of unimpaired flow, shape flows within the February to June period , shift flows to later in the year, or modify the minimum base flow. SED, Appendix K at 29-31. As currently drafted, the language would allow changes if they would achieve “any” biological goals and would not require the Board to find that with the change, implementation is likely to achieve the Plan’s existing salmon protection objective. Id. at 30. In addition, the language creates a huge loophole for experiments in implementation, which do not require the changes to be based on meeting SMART targets and/or plan objectives. Id. at 31. This is wholly inappropriate, and instead, any changes in implementation must be made solely to achieve all SMART targets and plan objectives, including the narrative salmon protection objective.With respect to the governance scheme, the SED proposes to establish a working group of water users, fishery agency staff, and other experts who would have a decision-making role. Id. at 32. However, the SED does not require any members to represent the public interest, conservation groups, or the fishing industry (let alone roughly equal representation of interests), raising basic issues of fairness. Moreover, the specific decision rules, to the extent identified in the SED, are likely to lead to gridlock and a failure to achieve the Plan objectives and SMART targets.For instance, the governance proposal requires the concurrence of all members of the working group for the Executive Director to approve any changes to the percent of unimpaired flow within the range, or changes to the minimum flows. Id. at 30-31. Given the broad opposition from tributary water users to a percent of unimpaired flow approach and to the specific flow range in this and the prior draft SED, their rejection of the scientific information that justifies flow requirements, and their refusal to participate in the scientific process to establish SMART targets, it is exceedingly unlikely that water users would agree to higher unimpaired flows within the range. At the same time, it is wholly inappropriate to give water users power to veto changes on flows within the range; changes on the percent of unimpaired flow and minimum flow levels must be made, based on the	

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		best available science, on the likelihood to achieve the plan objectives and SMART targets. With respect to adaptive implementation decisions that shape flow (instead of relying on the running average) or which shifts flows to later in the year, the SED proposes that the Executive Director can approve the changes if one or more members of the working group agrees. Id. As a result, for any of these proposed changes, the likely outcome is gridlock where unanimity is required, and dueling recommendations when it is not. And the process will likely be very resource intensive process, as DWR and USBR's various stakeholder processes have demonstrated, with very little benefit.Instead of the expensive, unwieldly, and unfair process proposed in the SED, we urge the SWRCB to create a public process for all stakeholders – including water users and the public – to provide input on decisions, but ultimately the SWRCB must require that fishery agencies and SWRCB make final decisions on adaptive implementation. This is consistent with the approach taken in the 2008 and 2009 biological opinions, after the prior consensus based approach to adaptive implementation was an abject failure that jeopardized the continued existence of endangered species and was found to violate the Endangered Species Act. Of course water users and reservoir operators should provide input, but all decisions should be made by the fishery agencies and SWRCB. Absent such changes, the governance scheme is almost certain to fail, jeopardizing achievement of the objectives. Regardless of the structure, the decision-making process and the results should be subject to periodic independent scientific review organized by the Delta Science Program or the SWRCB itself.In addition to these problems that apply to all of the adaptive implementation measures, the specific adaptive implementation measures (a) through (d) also must be revised.First, Appendix K proposes to allow the Executive Director to alter the required percent of unimpaired flow within the 30-50% flow range every year.[Footnote 24: There is no scientific justification for allowing for 30% of unimpaired flow, as the best available science demonstrates this flow level is not likely to achieve a viable salmon population, let alone achieve the narrative salmon doubling objective required by the Plan.] However, given the 3 year life cycle of Chinook salmon, it is very likely that several years of monitoring data from implementation will be necessary before there is sufficient information to justify a change within the flow range, particularly given the changes in year to year hydrology. In addition, by changing the percentage of unimpaired flow on an annual basis, the scientific information generated by the monitoring program will be of limited utility, because there will be even smaller sample sizes and additional covariates (changes in flow volumes / rates and other operations) against which to evaluate effects. Instead, we recommend that Appendix K explicitly require a review of percentage of flow within the flow range every 5 years, reviewing the monitoring data, progress towards achieving the salmon doubling objective, and independent scientific peer review by the Delta Science Program. This provides greater certainty to stakeholders and ensures a more robust scientific framework for decision-making.Second, we agree that changes from a 7 day running average [Footnote 25: As demonstrated by the testimony of the U.S. Fish and Wildlife Service on DATE, using a 7 day running average already loses much of the variability of flow. Given the importance of flow variability, see Zeug et al. 2014, a 3 day running average should instead be encouraged.] can be appropriate in some instances order to achieve SMART targets and the plan objectives, but as discussed above, before making any such change the SWRCB or Executive Director must make a finding that the change is necessary to achieve the plan objectives (including the doubling objective) and all SMART targets. A key benefit of the use of a running average is to mimic the variability of the natural hydrograph, which is critical to juvenile salmonid survival. In addition, the language in the SED may unintentionally result in lesser flow volume than that required by a strict running average, and we have included language to ensure that the full flow volume available on a running average is also available through flow shaping.Lastly, the SED	

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		inappropriately proposes to allow substantial shifting of flow from the spring period to the summer or fall months. Such flow shifting is likely to cause significant adverse effects on achieving the plan objectives, since best available science demonstrates that the actual volume of flow in this period is the strongest statistical predictor of juvenile salmon survival. See Zeug et al. 2014. Moreover, the SED largely fails to analyze the potential environmental effects of such flow shifting, particularly at levels below 40% of unimpaired flow (the draft currently would allow for less than 30% of the unimpaired flow during these months). Instead of allowing flow shifting from February through June, we recommend allowing flow shifting only from flows in the month of June; this allows some flexibility to address water temperatures and other concerns, but also ensures that the bulk of flows are released in the spring months when they affect juvenile salmon survival. To the extent there are substantial problems in other months that do not arise from implementation of increased spring flows, the SWRCB should establish water quality objectives for those other months.	
1167	19	The Program of Implementation Must Include Enforceable Carryover Storage Requirements in Upstream Reservoirs to Mitigate and Avoid Impacts, Consistent with the Substitute Environmental Document.The SED appropriately analyzes and discloses that it requires implementation of enforceable carryover storage requirements at upstream reservoirs, in order to mitigate potentially significant adverse impacts that might otherwise result. Such measures are clearly within the SWRCB's authority, and they are appropriate. Moreover, because the SED fails to analyze potential adverse impacts in the absence of carryover storage requirements, it would be unlawful for the SWRCB to fail to implement these requirements. Nonetheless, we recommend that the SWRCB, consistent with the analysis in the SED, should revise the Program of Implementation to more clearly require implementation of enforceable carryover storage requirements at upstream reservoirs. [Footnote 26: Appendix K appropriately includes language in the Program of Implementation requiring the imposition of mitigation measures to avoid unreasonable impacts to groundwater using its existing authorities, including authorities under Article X, Section 2 of the Constitution and the Sustainable Groundwater Management Act. SED, Appendix K at 28.]The SWRCB unquestionably has the legal authority to impose downstream water temperature or carryover storage requirements at upstream reservoirs, in order to prevent harm to Public Trust resources. See, e.g., Water Rights Order 90-5; Water Rights Order 91-03, at 10-11 (explaining that, "[i]f the Bureau failed to meet the temperature control requirements in Order WR 90-5 because it did not retain sufficient cold water in storage, and retention of cold water was within the Bureau's reasonable control, the Bureau would be in violation of Order 90-5."); Water Rights Order 2015-0043 (order denying in part and granting in part petitions for reconsideration and addressing objections, upholding requirements to establish carryover storage requirements for Shasta, New Melones, and Folsom reservoirs); letter from Tom Howard to Ron Milligan, July 8, 2016, at 2 (approving the 2016 Shasta water temperature plan, conditioned upon meeting cold water pool requirements and requiring reductions in reservoir releases if such conditions are not met); Order Approving in Part and Denying in Part a Petition for Temporary Urgency Changes in permit Terms and Conditions Requiring Compliance with San Joaquin River Flows, April 19, 2016, Term and Condition 5 ("Reclamation shall achieve an end of September 2016 carryover storage level of 415 TAF in New Melones Reservoir."); Water Rights Decision 1644, at 177-78 (requiring implementation of temperature management plan and reserving continuing authority to establish water temperature requirements for the lower Yuba River for the protection of fishery resources). Reservoir carryover storage requirements are appropriate mitigation measures under CEQA, intended to avoid significant adverse environmental impacts that might otherwise result.[Footnote 27:	Please see Master Response 2.1, Amendments to the Water Quality Control Planning Process, regarding the LSJR Flow Program of Implementation, including reservoir carryover storage. Please also see Master Response 2.1 for a discussion of commenter-requested modifications to the plan amendments about the carryover storage requirement. The carryover storage requirement is an integral part of the LSJR plan amendments and not, as suggested by the commenter, mitigation required under CEQA. Please also see Master Response 1.2, Water Quality Control Planning Process, for discussion of State Water Board authorities related to the water quality control planning process, including the public trust doctrine, and for a description of the distinction between the program of implementation and implementing the plan amendments through a water rights proceeding. Adoption of the plan amendments, by itself, does not impose enforceable requirements on any entities. Rather, the State Water Board will implement the LSJR flow objectives in future proceedings, including through water right adjudications, water quality actions, or regulation (see SED Chapter 3 and SED Appendix K).

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		Similarly, under the physical solution doctrine and section 5937 of the Fish and Game Code, the Board has authority and duty to require reservoir operations to maintain fish in good condition, such as maintaining carryover storage and/or a coldwater pool, when at other times the water rights holder benefits from substantial water diversions from the river. See also SWRCB Water Rights Order 90-16. As the California Department of Fish and Wildlife concluded in a recent amicus brief to the Ninth Circuit Court of Appeals, As early as 1932, a California Court of Appeal held that a water right holder has no authority to divert and use the waters of the state "regardless of its duty in so doing to protect the fish therein" and that "the grant of the right to erect a dam" must "be construed to be under the implied condition to keep open the fishways." People v. Glenn-Colusa Irrigation Dist., 127 Cal. App. 30, 36-37 (1932). Amicus Curiae Brief of the California Department of Fish and Wildlife in Support of Federal Cross-Appellants/Appellees, San Luis & Delta Mendota Water Authority v. Jewell, Case No. 14-17479, Ninth Circuit Court of Appeals, December 21, 2015.]The SED appropriately includes reservoir carryover storage requirements in the modeling and analysis of potential environmental impacts. Implementation of such measures is necessary to avoid the likely adverse impacts that would otherwise result, and because the SED does not analyze these potential adverse impacts in the absence of such requirements. The SWRCB would violate CEQA if it failed to implement carryover storage requirements consistent with those included in the SED, because the SED does not analyze potential impacts if such reasonable carryover storage requirements are not implemented.	
1167	20	The SED Fails to Consider the SWRCB's Legal Authority to Require Water Rights Holders to Invest in Habitat Restoration and Other Non-Flow Measures.As discussed in our prior comments, the SWRCB has legal authority to require water rights holders to invest in habitat restoration and other non-flow measures under the physical solution doctrine. See 2013 Comments, Exhibit 2, at 6-7. For instance, in Decision 1631, the SWRCB ordered the Los Angeles Department of Water and Power to undertake habitat restoration projects in order to reduce flow requirements, stating that, "as part of a physical solution allowing for diversion of water for municipal use, LADWP can be required to undertake waterfowl habitat restoration measures. Waterfowl habitat restoration can serve to restore public trust uses while requiring a smaller commitment of water." Decision 1631 at 118; see SWRCB Water Rights Order 98-05 (approving habitat restoration measures implementing Decision 1631). The SWRCB and the courts have discussed the physical solution doctrine in other decisions and orders as well. See, e.g., SWRCB Water Rights Order 90-16 (holding that under the physical solution doctrine and section 5937 of the Fish and Game Code, the Board can require releases from a reservoir greater than unimpaired inflow during certain times of the year, in order to keep fish in good condition); Decision 1630 (discussing the physical solution doctrine in the context of the SWRCB's decision finding waste and unreasonable use and mandating water conservation measures in the Imperial Irrigation District); City of Barstow v. Mojave Water Agency, 23 Cal.4th 1224, 1249-51 (2000). The SED ignores the authority of the SWRCB to require water rights holders to invest in habitat restoration and other non-flow measures as part of the program of implementation, and it should be revised accordingly.	Please refer to Master Response 5.2, Incorporation of Non-Flow Measures, for information regarding the State Water Board's authority to require non-flow measures and the physical solution doctrine.Please refer to Master Response 1.1, General Comments, regarding public trust and State Water Board authorities.
1167	21	The SED's Analysis of Changes in CVP/SWP Water Exports is Flawed Because it Fails to Consider the Right of Upstream Water Users to Dedicate these Flows Under Section 1707.As we discussed in our prior comments, tributary water rights holders have the right to temporarily dedicate water to instream flow through the Delta under sections 1707(c) and 1725 of the Water Code, and prevent downstream water users, including the CVP and SWP, from diverting any of this flow absent a transfer agreement between the parties. See TBI et	Please refer to Master Response 1.2, Water Quality Control Planning Process, for a discussion of implementation of the plan amendments through water rights proceedings. The plan amendments neither modify water rights nor affect water right holders' ability to modify water rights in accordance with applicable law, such as Water Code section 1707. Master Response 1.2 also describes the scope of the State Water Board's Bay-Delta Plan proceedings, including consideration of export requirements.For information regarding the analysis of exports in the SED, please see Chapter 5, Surface Hydrology and Water Quality,

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		al. 2013 at 42. By dedicating flow to instream use under section 1707(c), these flows would not contribute to meeting instream flow requirements such as new Delta outflow requirements adopted in Phase II. Cal. Water Code § 1707(c). As we discussed in our prior comments, this would not cause an injury to downstream water rights holders. TBI et al. 2013 at 42 (citing State Water Resources Control Board Cases, 136 Cal.App.4th 674, 798-806 (2006)). However, the SED's analysis of potential changes in water exports by the CVP and SWP fails to consider this legal right, and the draft Program of Implementation likewise ignores this legal right. See SED at 5-78 and Appendix K. The SWRCB should revise the SED and Appendix K to explicitly recognize this right, and condition the discussion of changes in Delta exports in the SED accordingly.	Section 5.4.2, Methods and Approach, Exports and Outflow. Further, please refer to Master Response 1.1, General Comments, for a discussion of the programmatic nature of the SED.
1167	22	The SED Fails to Adequately Consider the Feasibility of Protecting Public Trust Resources Because it Fails to Consider Improvements in Water Use Efficiency and Alternative Water Supplies.In order to fulfill its mandatory duty to protect the Public Trust to the extent feasible, as well as to balance potential impacts to other beneficial uses of water in setting water quality standards, the SWRCB must consider the availability of water supplies from wastewater recycling, improved water use efficiency, urban stormwater capture, and other sources. Unfortunately, the SED fails to do so. We have discussed the necessity of this analysis of alternative supplies at length in our prior comment letters, and those prior comments are fully incorporated by reference. See TBI et al. 2013; TBI et al. 2013 Exhibit 2. We briefly summarize those points again:• First, the SWRCB has considered the availability of recycled water and other water supplies in determining the feasibility of protecting Public Trust resources in Mono Lake. See Decision 1631 at 165-168, 176-177. Similar feasibility analysis was required by the courts in decisions to protect Public Trust resources in Putah Creek and the American River. See Brian Gray, Ensuring the Public Trust, 45 U.C. Davis Law Rev. 973 (2012). • Second, the SWRCB is required to consider the need to develop and use recycled water in establishing water quality objectives, see Cal. Water Code § 13241(f), and this approach of considering alternative water supplies is consistent with the statutory obligation to reduce reliance on the Delta and invest in regional and local water supplies, see Cal. Water Code § 85021. The necessity of consideration of alternative water supplies in determining the feasibility of protecting Public Trust resources is essentially an exercise of the physical solution doctrine, where such a physical solution can reasonably accommodate both consumptive uses and protection of the Public Trust. See Brian Gray, Ensuring the Public Trust, 45 U.C. Davis Law Rev. 973 (2012). Unlike consumptive users of water, there are no alternative water supplies for salmon and other native fish species in these tributaries. • Third, the SWRCB lacks the authority to balance away statutory expressions of the Public Trust, such as section 5937 of the Fish and Game Code or the California Endangered Species Act, and likewise lacks the authority to balance away achievement of the narrative salmon doubling objective. See, e.g., California Trout, Inc. v. State Water Resources Control Bd., 218 Cal.App.3d 187, 195 (1990); Decision 1631 at 12, 172; Decision 1644 at 27. • Fourth, while the SWRCB must consider economic impacts, it must also consider economic benefits of protecting Public Trust resources, including the benefits of improved water quality, recreation, and sport and commercial fishing. In addition, the fact that alternative water supplies would incur some additional costs does not preclude protecting Public Trust resources; instead, the question is whether these costs make protection of the Public Trust infeasible. See Decision 1631 at 176-177. Unfortunately, the revised SED fails to	Recycled water is discussed in Section 13.4 and 13.5 of Chapter 13, Service Providers, Section 16.2.4 of Chapter 16, Evaluation of Other Indirect and Additional Actions, and in the Executive Summary (Section ES10, Intended Uses of The SED). As identified in the Executive Summary, "To the extent that the LSJR alternatives result in reduced surface and groundwater supplies available for diversion, they will promote the development of recycled water as the need for alternate sources of water increase. Recycled water could also be used to offset the use of potable water for non-potable uses such as landscape irrigation, process water and irrigated agriculture for nonhuman consumptive crops." The information contained in the Executive Summary, Chapter 13 and Chapter 16 allows the State Water Board to consider recycled water within the context of the water quality control planning process. Throughout the SED, including in Chapter 9, Groundwater Resources, Chapter 11, Agricultural Resources, and Chapter 22, Integrated Discussion of Potential Municipal and Domestic Water Supply Options, the SED discusses how local water suppliers, regional groundwater management agencies, and irrigation districts could improve water management using advanced water technologies, increase water use efficiency, establish and improve conjunctive use of surface water and groundwater, and use recycled water.Please see Master Response 1.1, General Comments for a description of the plan amendments and information regarding compliance with CEQA and the State Water Board's authorities and the public trust doctrine. As explained in Master Response 1.2, Water Quality Control Planning Process, when considering the public trust in water, the adoption and implementation of a water quality control plan generally satisfies the State Water Board's public trust duty. Also see Master Response 1.2, on information regarding the State Water Board's consideration of beneficial uses, costs, and benefits, and Water Code section 13241. The State Water Board considered economics in Chapter 20, including economic effects to recreation and fisheries (see Section 20.3.5 regarding fisheries and section 20.3.6 regarding recreation). In addition, please see Master Response 8.4, Non-Agricultural Economic Considerations, for a discussion of ecosystem services and potential benefits. Please refer to Master Response 2.1, Amendments to the Water Quality Control Plan, regarding the justification for the plan amendments.

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		meaningfully analyze the availability of alternative water supplies, including improved agricultural and urban water use efficiency, water recycling, or groundwater banking and recharge projects. As a result, the SED overstates likely water supply impacts and fails to provide the information necessary for the Board to determine the feasibility of fully protecting Public Trust resources consistent with the SWRCB's 2010 report (or any lower flow alternative). The SED must be revised to consider alternative water supply projects, including those discussed infra.	
1167	23	The SED's Analysis of Water Supply Impacts is Flawed and Overestimates Likely Impacts.The SED also fails to accurately assess likely water supply impacts to both urban and agricultural water users. The analysis of potential water supply impacts in the SED appropriately begins by modelling the potential reduction in total surface water supplies under the alternatives. However, the analysis of total water supply impacts in the SED is inaccurate because it fails to consider the likely effects on water supply from waiving flow requirements during future droughts, as authorized in the Program of Implementation. As the SED demonstrates, potential water supply impacts under the alternatives are minimal in wet and above normal years and higher in dry and critically dry years. See SED at ES-26. As a result, the failure to consider the effects of weakening or waiving flow requirements in future droughts – as the SED authorizes – results in substantially overestimating likely water supply impacts, as well as potential impacts to agricultural acreage, economics, and employment. The analyses and text in the SED should be revised to be consistent with the authority in the Program of Implementation to waive or weaken flow standards during future drought emergencies, and with our comments regarding changes to this authority.	Please see Master Response 1.1, General Comments, for information regarding compliance with CEQA and the adequacy of the SED. Please see Master Response 2.1, Amendments to the Water Quality Control Plan, regarding the emergency provision and the incorporation in the plan amendments and consideration in the SED. Please also see Master Response 2.1 for a discussion of commenter requested modifications to the plan amendments.
1167	24	The analysis of potential agricultural water supply impacts is flawed.The SED assumes that the City and County of San Francisco would enter into water transfer agreements with agricultural water users, paying those users to bear the water supply impact. However, while the SED accounts for the economic impact to SFPUC from these water transfers, it fails to account for the economic benefits to agricultural users from such transfer agreements; thus it overstates the economic impacts to agricultural users in its analysis of economic impacts. Some stakeholders have argued that such water transfer agreements are not likely to occur, in which case, the water supply impacts to agricultural users would be lower than the 14% reduction in surface water supplies under the 40% flow alternative demonstrated in the SED (and impacts to urban users would be higher by an equal amount, consistent with the estimates in Appendix I of the SED).[Footnote 28: Indeed, San Francisco appears to have waived any legal argument regarding the assessment of economic or water supply impacts as those are apportioned between agricultural and urban water users. See City and County of San Francisco 2013 comments on draft SED, at 5 ("the draft SED should not draw conclusions in its current analysis about how water rights issues will be addressed between the SFPUC and the Districts.").] The SED should be revised to quantify the reduced water supply impacts to agricultural water users without the assumed water transfers to SFPUC, consistent with the analysis of potential urban water supply impacts in Appendix I.The SED also assesses potential impacts to groundwater, providing estimates of potential water supply impacts with no increase in groundwater pumping, with 2009 levels of groundwater pumping, and with 2014 levels of groundwater pumping. See SED, Appendix G at G-28 to -29. However, because this is a water quality plan, and not a water rights decision, the specific impacts to any water rights holder or category of user cannot be determined with great specificity. Importantly, while the SWRCB has the general obligation to follow the rule of priority in	Please see Master Response 8.5, Assessment of Potential Effects on the San Francisco Bay Area Regional Water System, regarding the analysis of effects on CCSF. The analysis of impacts to agricultural resources is considered conservative (worst case) because it assumes a reduction to surface water used to satisfy agricultural demands (see Appendix G, Agricultural Economic Effects of the Lower San Joaquin River Flow Alternatives: Methodology and Modeling Results; Master Response 3.5, Agricultural Resources; and Master Response 8.1, Local Agricultural Economic Effects and the SWAP model). Thus, the analysis describes potential effects that would include those potentially produced by a water transfers to CCSF. To the extent that water is not transferred to CCSF then it would instead be available for agricultural use in the plan area and the agricultural effects would be reduced (see Executive Summary, Section ES5.4, Effects of the Flow Proposal).Also, please see Master Response 3.5, Agricultural Resources, for discussion of potential improvements to irrigation efficiency. Please refer to Master Response 5.2, Incorporation of Non-Flow Measures, for specific information regarding State Water Board's authority to require non-flow measures in the plan amendments. Please refer to Master Response 1.1, General Comments, and Master Response 1.2, Water Quality Control Planning Process, for information regarding State Water Board authority. Finally, please see Chapter 16, Evaluation of Other Indirect and Additional Actions, for discussion of other beneficial actions, such as floodplain restoration.

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		implementing new flow objectives, the rule of priority is not absolute: Although the rule of priority is not absolute, the Board is obligated to protect water right priorities unless doing so will result in the unreasonable use of water, harm to values protected by the public trust doctrine, or the violation of some other equally important principle or interest.El Dorado Irr. Dist. v. State Water Res. Control Bd., 142 Cal.App.4th 937, 944 (2006). Thus, where application of the rule of priority would result in impacts to drinking water for human health and safety, or would allow the continuation of wasteful irrigation practices, it likely must yield. Similarly, if urban water users offered to pay agricultural water users for improvements in agricultural water use efficiency, which would enable those agricultural water users to conserve water that would be available for transfer, such an offer may constitute a physical solution that the Board could order be implemented. Such an agreement would be substantially similar to the SWRCB's actions regarding the funding of water conservation measures by the Imperial Irrigation District (including lining of the All-American Canal) through water transfer agreements that paid for the conserved water. See Decision 1600; Water Rights Order 88-20; Revised Water Rights Order 2002-0013.[Footnote 29: By citing this authority, we do not take a position regarding the merits of this transfer agreement, including with respect to impacts to the Salton Sea and its Public Trust resources. The SWRCB would have to carefully analyze any such agreement for transfer of conserved water, either as part of Phase III or in a separate water rights proceeding.]Indeed, as we discussed in detail in our 2013 comments and attached analysis by the Pacific Institute, there are substantial opportunities to improve agricultural water use efficiency by water rights holders in this proceeding that could create significant conserved water. TBI et al. 2013; id., Exhibit 4. However, the revised SED fails to consider potential improvements in agricultural water use efficiency, and thus fails to accurately assess the likely water supply impacts of the alternatives on agricultural water rights holders. As we also noted in our prior comments, the Board has the authority to require implementation of conservation and efficiency measures to avoid waste and reduce or avoid impacts. Id. The SED wholly fails to analyze the potential to reduce or avoid water supply impacts through improvements to irrigation efficiency, including pressurizing water supply systems so water is available on demand and other analyses in our prior comments. The SED also fails to analyze the potential for multi-benefit projects, such as floodplain restoration, to provide ecosystem benefits while also increasing groundwater recharge and supply (particularly on the Merced and Stanislaus Rivers).	
1167	25	The analysis of potential water supply impacts to the SFPUC is flawed.With respect to potential water supply impacts to the San Francisco Public Utility Commission's ("SFPUC) retail and wholesale service area, the SED also inaccurately estimates potential impacts. First, the analysis in the SED assumes urban water demand levels that are dramatically higher than current uses. In assessing urban water supply impacts, the SED assumes a demand level of 260 MGD (290TAF); however, according to SFPUC's 2015 Urban Water Management Plan,[Footnote 30: SFPUC's 2015 Urban Water Management Plan is available online at: https://sfwater.org/modules/showdocument.aspx?documentid=9300 and is hereby incorporated by reference.] urban demand in the wholesale and retail area was reduced to 175 MGD (222TAF) in 2015-2016. Even prior to the imposition of mandatory water conservation measures, SFPUC has estimated total wholesale and retail demand in 2012-2013 was 223 MGD. See Appendix F.[Footnote 31: Appendix F includes a PDF file and an Excel spreadsheet prepared by SFPUC, both of which were transmitted by staff from SFPUC to staff from NRDC.] By using inflated urban demand numbers, the SED overestimates likely water supply impacts, and the SED at a minimum should use the 2012-	Please see Master Response 8.5, Assessment of Potential Effects on the San Francisco Bay Area Regional Water System, regarding the State Water Board's evaluation of potential reductions in water supply and associated economic considerations and other impacts within the SFPUC Regional Water System (RWS) service area with implementation of the plan amendments. The master response identifies the main points of disagreement or differing assumptions between the SED and the comments. As described in Master Response 8.5, the SED identified reasonably foreseeable actions that could be taken by affected entities to comply with the plan amendments and in response to reduced surface water supplies. As discussed in the SED, including in Chapter 16, Evaluation of Other Indirect and Additional Actions, the SED appropriately evaluates and discloses the reasonably foreseeable actions affected entities may undertake to address possible surface water supply reductions. The actions evaluated in the SED did not include the severe mandatory rationing described by SFPUC because it was not reasonably foreseeable that a water supplier would impose drastic mandatory water rationing on its customers without first attempting other actions to replace any reductions in water supplies with alternative sources of water, such as through water transfers. Also see Master Response 8.5 regarding the assumptions made pertaining to urban water demand, and for a discussion regarding groundwater storage and recovery, recycled water, and water

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		2013 estimate of 223 MGD. See infra. In addition, the substantial reduction in urban water demand in the SFPUC service area occurred with virtually no economic impacts, contrary to the extravagant claims by SFPUC's economist in 2013, demonstrating the absurdity of those prior estimates. Indeed, SFPUC's economist has published research concluding that urban water agencies substantially overestimate future water demand. See Steven Buck, Hilary Soldati, and David Sunding, Forecasting Urban Water Demand in California: Rethinking Model Evaluation.[Footnote 32: This paper is available online at: http://ageconsearch.umn.edu/bitstream/205737/2/buck%20et%20al_forecasting%20water%20demand_aaea2015.pdf and is hereby incorporated by reference.]In addition, the analysis in the SED and Appendix I wholly ignores potential for wastewater recycling, improved urban water use efficiency, groundwater banking, urban stormwater capture, and additional local projects to offset or reduce demand for water from the Tuolumne River. Appendix I only considers water transfers, desalination, and Delta water exports, ignoring the substantial potential increases in supply and reductions in demand resulting from other local water supply projects (including several projects that are being planned or actually being implemented).For instance, the 2014 report by NRDC and the Pacific Institute entitled Untapped Potential estimated that the Bay Area region could increase water supply by 980,000 acre feet per year through stormwater capture, improved water use efficiency, agricultural water use efficiency, and wastewater recycling.[Footnote 33: This paper is available online at: https://www.nrdc.org/resources/untapped-potential-californias-water-supply and is hereby incorporated by reference.] It is important to keep in mind that the estimates in that report account for the fact that these water supply tools may not always be additive; for instance, increases in urban water use efficiency (particularly indoor water use, and assuming no population growth) will reduce the water supply available from wastewater recycling. In addition, while that 2014 analysis is broader than the SFPUC wholesale area, it demonstrates the great potential for improving sustainable water management in the SFPUC region. Information from Untapped Potential, from the 2015 Urban Water Management Plan for SFPUC, and from other sources [Footnote 34: For instance, SFPUC, BAWSCA, and other Bay Area agencies are collaborating on a Bay Area Regional Reliability effort, which has identified a number of existing projects to improve regional water supply reliability and is evaluating investments in additional projects, including potable reuse projects, groundwater projects, and interties and transfer agreements. A summary is available online at: http://www.bayareareliability.com/wpcontent/uploads/2016/04/Bay-Area-Regional-Reliability-2014-Fact-Sheet-5-6-14.pdf?545d25 and is hereby incorporated by reference.] provide more detail regarding the potential yield from these sustainable water supply tools, which should be considered in the SED.[Footnote 35: For information regarding the cost of these and similar sustainable water supplies, we recommend that the SWRCB consider the Pacific Institute's 2016 report entitled The Cost of Alternative Water Supply and Efficiency Options in California. That report and appendices are available online at: http://pacinst.org/publication/costalternative-water-supply-efficiency-options-california/ and are hereby incorporated by reference.] Cumulatively, these water supply sources and improvements in water use efficiency can reduce water supply impacts and help offset reductions in surface water supplies from the Tuolumne River. The SED should be revised to account for these potential measures.	conservation as it applies to the SFPUC RWS service area. While the 2016 Recirculated Draft SED's analyses and conclusions differ from the SFPUC's, the SED's analyses are supported by substantial evidence. Also, please see Master Response 8.5 regarding water supply planning and demand management. The comment suggested that the State Water Board should evaluate other actions, such as improved urban water use efficiency, reservoir enlargement, urban storm water capture, groundwater banking, and additional local projects to offset or reduce demand.Well-conceived storm water management actions provide multiple benefits for California communities, including improved water quality, increased water supply, increased space for public recreation, increased tree canopy, enhanced stream and riparian habitat area, as well as many other benefits. Storm water management actions also provide opportunities for groundwater banking. The State Water Board Resolution No. 2009-0011 (State Water Board 2009 Policy for Water Quality Control for Recycled Water) identified the goal for California to increase the use of storm water over use in 2007 by at least 500,000 acre-ft/year by 2020, and by at least one million acre-ft/year by 2030. The Bay Area Regional Reliability Drought Contingency Plan, December 2017, at Table D-1 (Brown and Caldwell 2017) describes the status of Regional Stormwater Capture as "Conceptual". While the State Water Board encourages stormwater capture and related actions, the projects that would implement these types of actions are not sufficiently widespread or developed to be considered reasonably foreseeable sources of water supply that would support a conclusion that the water supply impacts are less than previously disclosed in the SED. Chapter 16 identifies broad ranges of indirect actions based on various sources of existing information, including information from sources like urban water management plans or other environmental documents. However, given the number of unknowns (including funding, teaming partners, demand and supply projections, etc.) the precise details of each and every project that could possibly be undertaken within the State of California is not discussed. Furthermore, the plan amendments do not mandate or require any action evaluated in Chapter 16 be implemented. The Draft Supplemental Final EIR/EIS for the expansion was released in June of 2017 (CCWD 2017). The expansion of Los Vaqueros Reservoir was identified in the Final Bay Area Regional Reliability Drought Contingency Plan in December 2017. That report identified the expansion of Los Vaqueros, and SFPUC's role in this project as "an engaged BARR Agency" that would benefit from the project by adding additional diversity to the SFPUC and BAWSCA agencies water supply portfolios. The State Water Board recognizes this type of project has the potential to reduce water supply effects to the SFPUC RWS service area. However, this information generally became public after the public release of the 2009 Bay-Delta Plan Notice of Preparation, and after California voters approved Proposition 1, which includes funding for water storage projects, and the same year as the release of the Recirculated SED (September 2016).
1167	26	Stormwater Capture: In the 2014 Untapped Potential report, NRDC and the Pacific Institute estimated potential increases in urban water supply from stormwater capture within	Please see response to Comment 1167-25.

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		counties in the SFPUC service area as follows: [ATT 1]Of course, the SFPUC wholesale area is not conterminous with these county boundaries, particularly for Santa Clara and Alameda Counties, so the total potential for increased water supply from stormwater capture within the wholesale service area is lower than that shown in the table above.In addition, SFPUC's 2015 Potable Offset Investigation Summary Report found that onsite nonpotable water supplies could offset up to 6.73 MGD (approximately 7,500 acre feet per year) of retail potable demands from the Regional Water System by 2040, assuming 100% participation and installation of onsite infrastructure. See SFPUC, Potable Offset Report at ES-4.[Footnote 36: That report is available online at: http://sfwater.org/Modules/ShowDocument.aspx?documentID=9363 and is hereby incorporated by reference.] This includes onsite non-potable supplies from rainwater and stormwater (e.g. rain barrels), graywater (e.g. retrofitted clothes washers, laundry-to-landscape systems), blackwater (e.g. in dual plumbed buildings), and seepage water (e.g. in municipal open spaces). That report established a target of 1 MGD from onsite reuse by 2040. Id. at ES-5. The SFPUC's 2015 UWMP, in contrast, projects only 0.4 MGD of non-potable water supplies by 2040 (SFPUC 2015 UWMP, Table 6-7). While it may not be feasible to generate the full 6.73 MGD from non-potable supplies, there is clearly additional potential to develop onsite water reuse systems to reduce demand for water from the Tuolumne River. The SED should be revised to discuss how stormwater capture and offsite non-potable water supply projects could reduce water supply impacts and help offset reductions in surface water supplies from the Tuolumne River.	
1167	27	[ATT 1: Table of potential yield of stormwater capture for counties in SFPUC service areas]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1167	28	Wastewater recycling: There is tremendous potential for dramatic increases in sustainable water supplies through investments in wastewater recycling in the SFPUC retail and wholesale area. Currently, very little of the treated wastewater in the retail or wholesale area is recycled, and the vast majority of it is discharged into the ocean or bay. For instance, in its 2015 UWMP, SFPUC estimates that in the retail service area only 0.2MGD of recycled water was delivered in 2015, accounting for only 0.29% of retail water supply, and that this will increase to only 3.9MGD by 2040 (accounting for less than 5% of total supply).Table 6-6 from the UWMP demonstrates that even in drought conditions in 2015, more than 65 MGD (approximately 72,800 acre feet per year) of treated wastewater was discharged from wastewater treatment plants in SFPUC retail service area. For both the retail and wholesale service area, there is substantial potential for increased water recycling. Data compiled from the SWRCB's California Integrated Water Quality System Project (except as noted below) identified the following discharges from wastewater treatment plants located in the SFPUC wholesale and retail service area: [Footnote 37: Note that this table includes discharges in the retail service area that were included above.]Of course, increases in indoor water use in the retail or wholesale service area will also increase potential for wastewater recycling; indeed, the table above shows that in some areas, there were substantial declines in wastewater discharges between 2014 and 2015 as urban water use declined. While SFPUC has not identified significant increases in water recycling in its UWMP, other agencies in the service area have done so. For instance, San Jose's UWMP explains that the Santa Clara Valley Water District is in the process of developing at least 20,000 acre feet per year, and up to 45,000 acre feet per year of potable reuse capacity. See San Jose 2015 UWMP at 61. Ultimately, while not all of these discharges may feasibly be recycled, there can be no question that there is substantial untapped potential in terms of increased water supply from water recycling in the service area that were not considered in the SED. The SED	Please see response to Comment 1167-25.

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		should be revised to discuss how water recycling could reduce water supply impacts and help offset reductions in surface water supplies from the Tuolumne River.	
1167	29	[ATT 2: Table 6-7 from SFPUC's 2015 UWMP]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1167	30	[ATT 3: Table 6-6 from SFPUC's 2015 UWMP]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1167	31	Urban Water Use Efficiency: San Francisco is rightfully proud of its urban water use efficiency, and residents in the City have substantially reduced per capita water use in recent years. As the table below shows, in 2015 SFPUC's retail per capita water use was 81 gallons per capita day (GPCD) and its residential per capita water use was 44 residential gallons per capita day (R-GPCD). In addition, SFPUC estimates that it achieved approximately 9.6 MGD in water savings through conservation from 2005-2015. SFPUC 2015 Retail Water Conservation Plan at ES-2. [Footnote 39: This document is available online at: https://sfwater.org/modules/showdocument.aspx?documentid=8760 and is incorporated by reference.] In contrast, water use within the wholesale service area is higher than within the retail service area. In 2014-2015, per capita water use amongst the member agencies of the Bay Area Water Supply and Conservation Agency (BAWSCA), all of whom are SFPUC wholesale customers, averaged 105.7 GPCD and a residential average of 64.7 R-GPCD. See BAWSCA Annual Survey FY2014-15 at ES-9. [Footnote 40: This report is available online at: http://bawsca.org/uploads/userfiles/files/BAWSCA_AnnualSurvey_FY2014-15.pdf and is hereby incorporated by reference.] Only 8 of the BAWSCA member agencies had a residential per capita water use less than 50 R-GPCD.More importantly, the UWMP predicts dramatic increases in wholesale demand that greatly outpace population growth. According to data in the UWMP, from 2015-2020, the retail population is expected to increase by 3.8%, while demand is expected to increase by 10.6%; the wholesale population is expected to increase by 4.6%, with an expected increase in demand of 24.2%. See 2015 SFPUC UWMP at Tables 3-3, 3-4, 4-1, and 4-2. As the table below [ATT 5] demonstrates, this results in a dramatic increase in demand that outpaces population growth.The dramatic increase in demand between 2015 and 2020 is not a function of population growth; indeed, the UWMP estimates that water demand will increase at a slower rate than population growth from 2025 to 2040. As discussed above, even SFPUC's outside economist has acknowledged that urban water agencies routinely overestimate future water demand. Buck et al. 2015. Other experts have reached similar conclusions. See, e.g., Matthew Herberger et al., A Community Guide for Evaluating Future Urban Water Demand, Pacific Institute 2016. [Footnote 41: This report is available online at: http://pacinst.org/app/uploads/2016/08/A-Community-Guide-for-Evaluating-Future-Urban-Water-Demand-1.pdf and is hereby incorporated by reference.]For instance, if demand in the SFPUC service area increases by only 4.34% between 2015 and 2020 (identical to rate of population growth), then demand in 2020 would be 206.7 MGD, and demand in 2035 would be 223.9 MGD, as shown in the table below. Instead of assuming an unrealistic and dramatic increase in demand between 2015 and 2020, which is necessary to justify use of a 260 MGD demand estimate, the SED should use an estimated demand of 223 MGD for SFPUC.Reductions in demand in recent years have demonstrated that the region can successfully reduce per capita water use without impacting the economy. If per capita demand remains near 2015 levels, overall demand will be substantially lower than predicted in the UWMP and could help reduce or avoid impacts from reduced surface water supplies	Please see response to Comment 1167-25.

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		from the Tuolumne River. The SED should be revised to analyze how improved water use efficiency could reduce water supply impacts and help offset reductions in surface water supplies from the Tuolumne River.	
1167	32	[ATT 4: Table of SFPUC's retail per capita water use]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1167	33	[ATT 5: Population and demand data from SFPUC 2015 UWMP]	The commenter provided this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1167	34	[ATT 6: Table of Demand Increases for SFPUC]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1167	35	Groundwater Banking and Recovery Projects.According to materials provided by the SFPUC, the San Francisco groundwater project is expected to begin operating in 2017, and will reduce demand by 4 MGD. See Appendix F. In addition, SFPUC anticipates that the Westside Basin Conjunctive Use project could reduce drought year demand by 7 MGD on the San Francisco Peninsula. Id. The SED should be revised to discuss how these and related projects could reduce water supply impacts and help offset reductions in surface water supplies from the Tuolumne River.	Please see response to Comment 1167-25.
1167	36	Los Vaqueros Reservoir ExpansionThe Contra Costa Water District is currently evaluating a substantial additional expansion of the Los Vaqueros reservoir, increasing storage capacity to as much as 275,000 acre feet. See Contra Costa Water District, Los Vaqueros Reservoir Expansion, available online at: http://www.ccwater.com/706/Los-Vaqueros-Studies. SFPUC and other wholesale customers are helping to fund completion of studies of the reservoir expansion and are considering partnering in this project. The SED should be revised to discuss the potential for this project to reduce water supply impacts and help offset reductions in surface water supplies from the Tuolumne River.	Please see response to Comment 1167-25.
1167	37	SFPUC's analyses of potential impacts are deeply flawed and misleading. In 2013, SFPUC presented highly misleading and inaccurate estimates of potential economic impacts from reductions in water supply, which have been proven faulty by SFPUC's reduction in demand during the drought without major economic impacts. Unfortunately, in recent months SFPUC has continued to publicly present highly misleading and inaccurate analyses and claims regarding water supply impacts from implementation of the preferred alternative. See Appendix F. It is important for the SWRCB and public to understand the significant flaws in their analysis. First, SFPUC has not analyzed potential water supply impacts from the preferred alternative, but instead has analyzed how SFPUC might choose to implement any water supply impacts. In order to calculate potential rationing, SFPUC's model assumes an 8.5 year design drought (1987-1992 followed by 1976-1977), and therefore assumes that any dry or critically dry year is the beginning of an 8.5 year drought sequence that is longer and more severe than any drought in the modern record. While it is clearly commendable to plan for droughts, these model assumptions predict rationing in many years where SFPUC has substantial water in storage. Indeed, our review of their spreadsheet model results indicate that total storage in the SFPUC system over the period of record analyzed in the model never drops below 400,000 acre feet (and does so only after the 1987-1992 5 year drought sequence). For example, under the 265 MGD demand assumption and 40% unimpaired flow scenario, [Footnote 42: Storage levels are generally higher under lower demand scenarios, which makes intuitive sense.] the following amounts of water are in	The commenter is commenting on analyses prepared by another commenter as part of a project that is different than the plan amendments. This comment does not make a general comment regarding the plan amendments or raise significant environmental issues, but instead focuses on another commenter's analyses. As such, no further response is required.To review responses to comments submitted by other entities within the comment period on the 2016 Recirculated Draft SED, please refer to the index of commenters in Volume 3 to locate the letter number(s) of interest. SFPUC's comments are addressed, in part, in Master Response 8.5, Assessment of Potential Effects on the San Francisco Bay Area Regional Water System.Please also see the response to comment 1167-23.

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		system storage: [ATT 7]The extremely conservative nature of SFPUC's 8.5 year design drought drives these conclusions, and SFPUC can of course modify that design drought. SFPUC's model simply does not demonstrate water supply impacts, but instead how they may choose to implement those impacts – assuming that SFPUC does not take any other actions to develop water supplies. However, that assumption – that the model fails to consider reasonable investments in improved water use efficiency, wastewater recycling, stormwater capture, and other projects – is unreasonable, and is the second flaw in their analysis. The model results demonstrate that at lower levels of system demand, the frequency and severity of rationing declines even using their model assumptions: [ATT 8]This demonstrates that improvements to water use efficiency and development of local and regional water supplies will reduce or avoid these impacts. Yet SFPUC only included a few potential projects in the 265 MGD model scenario (Westside Basin Conjunctive Use, SF Groundwater, and existing SF recycled water), and their analysis did not include those projects in the lower demand scenarios. As discussed above, there are substantial opportunities for improved water use efficiency and local water supply projects in the SFPUC service area that are ignored in this analysis.Third, SFPUC's model assumes that water supply impacts will be split between SFPUC and agricultural districts in a manner similar to the SWRCB's Scenario 2 in the SED. This would suggest that even in years when SFPUC would otherwise divert no water from the river, they would have to contribute substantial flow from the water bank in the reservoir. However, if the split between SFPUC and the agricultural districts is more similar to Scenario 1 in the SED, the impacts on SFPUC would be lower.Fourth, like the SED, SFPUC's model fails to consider the authority to waive or weaken instream flow requirements during drought emergencies, as authorized in the Program of Implementation. This is likely to dramatically change the model results, particularly as suggested in our comments, because it would provide greater certainty regarding the hydrologic conditions that would trigger that authority and the default flow conditions that would result.Ultimately, like their deeply flawed economic analysis in 2013, SFPUC's rationing analysis in 2016 is substantially flawed, and overestimates how SFPUC is likely to implement changes resulting from the Board's decision. Rather than continuing to provide such misleading analyses, we hope and expect that SFPUC will work with the conservation community and the public to help develop sustainable water supply projects, including expanded wastewater recycling and continued water use efficiency efforts, which help reduce reliance on the Delta and sustain the economy and the environment.	
1167	38	[ATT 7: Table of SFPUC System Storage]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1167	39	[ATT 8: Table of SFPUC Rationing for Different MGD Bases]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1167	40	Now is the time for the SWRCB to act decisively to restore ecological balance and protect the Public Trust by requiring the flows necessary to achieve the narrative salmon protection objective, the proposed narrative San Joaquin migratory fish viability objective, and maintain salmon and other native fish in good condition. For the reasons stated herein, we urge the SWRCB to adopt an alternative that establishes a range of 40-60% of unimpaired flow, with a starting point of 50%, and to revise the SED consistent with the comments herein.	Please refer to response to comment 1167-4 and 1167-6.As stated in Master Response 2.1, Amendments to the Water Quality Control Plan, regarding the justification for the LSJR plan amendments, LSJR Alternative 3 best meets the project goals and objectives.
1167	41	[ATT 9: Figure 1: San Joaquin Salmon Escapement strongly correlated with winter-spring	The commenter is providing this attachment for reference purposes in support of their comments. Those

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		flows]	comments are addressed in these responses to comments; therefore, no additional response is required.
1167	42	[ATT 10: Figure 2: Striped bass abundance in the Delta v. Chinook salmon escapement 2.5 years later. If Striped Bass abundance explained the pattern of salmon escapement, there would be a negative correlation between the two parameter, because striped bass are expected to prey on migrating juvenile salmon. No significant correlation was detected.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1167	43	[ATT 11: Figure 3: Two measures of ocean condition hypothesized to be relevant to Central Valley Chinook salmon success in the ocean vs. Chinook salmon escapement 2.5 years later. No significant correlation was detected.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1167	44	[ATT 12: Figure 4: Combined releases of fall-run Chinook salmon at Merced and Mokelumne River hatcheries vs. Chinook salmon escapement to the San Joaquin River 2.5 years later. No significant correlation was detected.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1167	45	[ATT 13: Figure 5: Estimated survival of fall-run Chinook salmon versus flow in the Stanislaus River. Survival is calculated as [expanded juvenile production as detected by Caswell Rotary Screw Trap] divided by {Chinook salmon escapement to the Stanislaus River the previous fall (GrandTab) * estimated sex ratio * eggs per spawning female).]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1167	46	[ATT 14: Figure 6: Spawners the Previous Fall (thousands)]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1167	47	[ATT 15: Version 12 Model Documentation (Model as used in TBI et al. comments on 2012 SED) and the Bay Institute's San Joaquin River Simulated Daily Unimpaired Flow Model (Version 16-2) Documentation]	The commenter provided this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1167	48	[ATT 16: Appendix A to letter 1167. Redline of Proposed Revisions to Appendix K and Table 3]	The commenter provided this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1167	49	[From ATT 16]Narrative & Minimum 7-day running average flow rate (cfs) for February through June [insert][Footnote 14: From February 1 to May 31, any deviations from the minimum 7 day running average flow rate shall be made solely to achieve the narrative salmon protection and San Joaquin migratory fish viability objectives and SMART targets. Any such deviations must be approved in advance by the Executive Director, with the concurrence of the Fish and Wildlife Service, National Marine Fisheries Service, and California Department of Fish and Wildlife after consultation with the STM Working Group. The volume of water available under the unimpaired flow standard shall be fully utilized within this time period and shall not be shifted to later in the year. From June 1 to June 30, any deviations from the minimum 7 day running average flow rate shall be made solely to achieve the narrative salmon protection objective, this narrative objective, and SMART targets, and such deviations must be approved in advance by the Executive Director, with the concurrence of the Fish and Wildlife Service, National Marine Fisheries Service, and California Department of Fish and Wildlife after consultation with the STM Working Group. Notwithstanding any approved deviations from the minimum 7 day running average flow rate, the minimum base flow value shall be achieved at all times during February through June.][insert][Value:] Maintain inflow conditions from the San Joaquin River watershed to the Delta at Vernalis sufficient to support and maintain the natural production of viable native San Joaquin River watershed fish populations migrating through the Delta, [insert] including but not limited to	Recommended track changes in the comment were not made to the plan amendments. Please refer to Master Response 2.1, Amendments to the Water Quality Control Plan, for response to comments that recommend adding a biological goal to the LSJR flow objective or to the program of implementation to govern changes between the percent of unimpaired flow within the adopted range. Please also see Master Response 2.1 for response to comments regarding unimpaired flow and functional flow and the averaging period for the LSJR flow objectives. Please also refer to the section describing modifications to the plan amendments and suggestions for changing percent of unimpaired flow within the adopted range.Regarding SMART targets outlined in suggested footnote 15, clarifying language was added to the Biological Goals section of Appendix K that addresses the SMART concept.Please refer to Master Response 2.1, regarding suggested modifications to the plan amendments for information about including quantitative biological goals in the LSJR narrative objective, and the salmon protection objective. Please refer to the section describing modifications to the program of implementation and biological goals regarding SMART concepts. The suggestion to modify adaptive methods for flow shifting limits the flexibility to identify functional flows with the available block of water defined by the percent of unimpaired flow. Therefore, these changes are not made. Please refer to Master Response 2.2, Adaptive Implementation, for additional information regarding flow shifting and shaping and benefits of adaptive implementation. The suggestion to require concurrence from state and federal fish and wildlife agencies is not consistent with the State Water Board retaining final authority regarding LSJR flow objectives and implementation. These agencies are invited to participate in the STM Working Group. Therefore, these changes are not made. Please refer to Master Response 2.1, and 2.2, for additional information about STM Working Group.

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		doubling of natural production of San Joaquin River Chinook salmon and steelhead populations migrating through the Delta from the average production of 1967 – 1991 [insert]. Inflow conditions that reasonably contribute toward maintaining viable native migratory San Joaquin River fish populations include, but may not be limited to, flows that more closely mimic the natural hydrographic conditions to which native fish species are adapted, including the relative magnitude, duration, timing, [insert] variability [insert], and spatial extent of flows as they would naturally occur. Indicators of viability include population abundance, spatial extent, distribution, structure, genetic and life history diversity, and productivity. [insert][Footnote 15: Specific, measureable, attainable, relevant, and time bound (SMART) biological and environmental targets will be used to measure progress towards meeting the narrative objectives, as defined by the following indicators of viability: average annual natural production of 78,000 fall-run Chinook salmon (22,000 from the Stanislaus; 38,000 from the Tuolumne; and 18,000 from the Merced); maintenance of viable spring-run Chinook salmon populations; natural production of 10,000 steelhead from at least two rivers in the San Joaquin basin; successful splittail spawning once in every three years; and successful green and white sturgeon spawning once in every seven years.][insert]	
1167	50	[From ATT 16]A percent of unimpaired flow between 30% - 50% inclusive, from each of the Stanislaus, Tuolumne, and Merced Rivers shall be maintained from February through June. [insert][Footnote 16: Unimpaired flow represents the natural water production of a river basin, unaltered by upstream diversions, storage, or by export or import of water to or from other watersheds. The total volume of water must be at least equal to the volume of water that would be released each day by tracking the minimum unimpaired flow percentage on a daily basis from February through June. The percent of unimpaired flow required to be dedicated to instream flow shall be reassessed every five years, based on the progress in achieving the narrative salmon protection objective, this narrative objective, the indicators of viability, and SMART targets, including independent scientific review by the Delta Science Program. Any changes to the percent of unimpaired flow within the identified range shall be adopted after a public hearing before the State Water Resources Control Board and shall be made solely in order to achieve the narrative salmon doubling objective, this narrative objective, and quantified biological metrics.][insert]	Recommended track changes in the comment were not made to the plan amendments. Please refer to response to comment 1167-49.Please refer to Master Response 2.2, regarding adaptive implementation methods. The total volume of water determined by the percent of unimpaired flow is the same regardless of the averaging period, as discussed Master Response 3.2, Surface Water Analyses and Modeling section describing calculation of unimpaired flow. No change is made to the plan amendments. The program of implementation and the periodic review of the WQCP are together sufficiently robust processes to evaluate the efficacy of the LSJR flow objectives. The recommended change is therefore not made. Please see Master Response 2.1, Amendments to the Water Quality Control Plan, regarding changing percent of unimpaired flow within the adopted range. The recommended change is not made.
1167	51	[From ATT 16]Implementation of February through June LSJR Flow ObjectivesBy 2022, the State Water Board will fully implement the February through June LSJR flow objectives through water right actions or water quality actions, such as Federal Energy Regulatory Commission (FERC) hydropower licensing processes. [Footnote 8: To refine the implementation actions and provide for coordination with ongoing FERC proceedings in the LSJR watershed, the February through June LSJR flow objective may be phased in over time, but must be fully implemented by 2022.]The State Water Board [delete] will [delete] [insert] shall [insert] exercise its water right and water quality authority to [delete] help [delete] ensure that the flows required to meet the LSJR flow objectives are used for their intended purpose and are not diverted for other purposes. [insert] The State Water Board shall consider, on the request of any water rights holder, the dedication of these flows to instream use and Delta outflow under section 1707(c) of the Water Code. However, the State Water Board may also approve water transfers between downstream water users and upstream water rights holders, provided that plan requirements, including objectives for Delta outflow, are being achieved. [insert] In order to help ensure that actions taken in response to implementation of the LSJR flow objectives do not result in unreasonable redirected impacts to groundwater resources, the State Water Board will take actions as necessary pursuant to its authorities, including its authorities to prevent the waste,	Recommended track changes in the comment were not made to the plan amendments. Please refer to Master Response 1.2, Water Quality Control Planning Process, for a discussion of implementation through water rights proceedings. The plan amendments neither modify water rights or nor affect water right holders' ability to modify water rights in accordance with applicable law, such as Water Code section 1707 or other provisions of state law governing changes to water rights. The change regarding Water Code section 1707 is not necessary because it restates the State Water Board's authority under section 1707. The proposed changes regarding transfers would limit the State Water Board's discretion and ability to consider applicable legal requirements and to appropriately condition transfers of water depending on the specific circumstances of the petition. These changes are not made. Minor word changes in text and headings were not made because they are not necessary. The proposed plan amendments appropriately describe the State Water Board's ability to implement the Bay-Delta Plan given available information, priorities, and resources. Please refer to Master Response 2.1, Amendments to the Water Quality Control Plan, for response to comments regarding carryover storage requirements and suggested modification to the plan amendments. No change was made to the proposed plan amendments. Please see response to comment 1167-40 regarding the commenter's recommended change of the required 40 percent of unimpaired flow to 50 percent. Please refer to Master Response 2.1, Amendments to the Water Quality Control Plan, regarding the scientific justification for the LSJR percent of unimpaired flow requirements and the Vernalis base flow requirement. No change was made to the proposed plan amendments. Recommended track changes in the

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		unreasonable use, unreasonable method of use, and unreasonable method of diversion of water (Cal. Const., art. X, § 2; Wat. Code, §§ 100, 275) and to enforce the Sustainable Groundwater Management Act (SGMA) (Wat. Code, § 10720 et seq.).When implementing the LSJR flow objectives, the State Water Board [delete] will [delete] [insert] shall [insert] include minimum reservoir carryover storage [insert] requirements, consistent with those measures analyzed in the Substitute Environmental Document [insert], [delete] targets or other requirements [delete] to help ensure that providing flows to meet the flow objectives will not have adverse temperature or other impacts on fish and wildlife [delete]or, if feasible, on other beneficial uses [delete]. The State Water Board will also take actions as necessary to ensure that implementation of the flow objectives does not impact supplies of water for minimum health and safety needs, particularly during drought periods. Actions may include, but are not limited to, assistance with funding and development of water conservation efforts and regional water supply reliability projects and regulation of public drinking water systems and water rights.Although the lowest downstream compliance location for the LSJR flow objectives is at Vernalis, the objectives are intended to protect migratory LSJR fish in a larger area, including within the Delta, where fish that migrate to or from the LSJR watershed depend on adequate flows from the LSJR and its salmon bearing tributaries.It is the State Water Board's intention that an entity's implementation of the LSJR flow objectives, including implementation through flow requirements imposed in a FERC process, will meet any responsibility to contribute to the LSJR inflow component of the Delta outflow objective in this Plan. The State Water Board, however, may further consider and reallocate responsibility for implementing the Delta outflow objective in any subsequent proceeding, including a water right proceeding.Flow Requirements for February through JuneThe LSJR flow objectives for February through June shall be implemented by requiring [delete] 50 [delete] [insert] 40 [insert] percent of unimpaired flow, based on a minimum 7-day running average, from each of the Stanislaus, Tuolumne, and Merced Rivers. This required percentage of unimpaired flow, however, may be adjusted within the range allowed by the LSJR flow objectives through adaptive methods detailed below. The required percentage of unimpaired flow is in addition to flows in the LSJR from sources other than the LSJR Tributaries. The required percentage of unimpaired flow does not apply to an individual tributary during periods when flows from that tributary could cause or contribute to flooding or other related public safety concerns, as determined by the State Water Board or Executive Director through consultation with federal, state, and local agencies and other persons or entities with expertise in flood management. In addition, the LSJR base flow objective for February through June shall be implemented by requiring a minimum base flow of [delete]1,000 [delete] [insert]2,000 [insert] cfs, based on a minimum 7-day running average, at Vernalis at all times. This minimum base flow, however, may be adjusted within the range allowed by the LSJR base flow objective through adaptive methods detailed below. When the percentage of unimpaired flow requirement is insufficient to meet the minimum base flow requirement, the Stanislaus River shall provide 29 percent, the Tuolumne River 47 percent and the Merced River 24 percent of the additional total [delete]out[delete]flow needed to achieve and maintain the required base flow at Vernalis.The Executive Director may approve changes to the compliance locations and gage station numbers set forth in Table 3 if information shows that another location and gage station more accurately represent the flows of the LSJR tributary at its confluence with the LSJR.Adaptive Methods for February through June FlowsAdjustments to the February through June unimpaired flow requirements allowed by the LSJR flow objectives should be implemented in a coordinated [delete] and adaptive [delete] manner [insert] to achieve maximum benefit for fish and	comment were not made to the plan amendments. Adaptive implementation of the percent of unimpaired flow enables the magnitude and timing of flows to be adjusted, within a prescribed range, as long as changes achieve better protection of fish and wildlife than would be achieved by the minimum 7-day running average percent of unimpaired flow and existing biological goals approved by the State Water Board are being met. These criteria serve the same function as the comment-recommended criteria for guiding adaptive implementation. Please refer to Master Response 2.1, Amendments to the Water Quality Control Plan, for discussion of adaptive implementation, specific modifications that were made to the plan amendments, and suggested modifications that were not made to the plan amendments. Please also refer to Master Response 2.2, Adaptive Implementation, for additional information regarding adaptive methods. Recommended track changes in the comment were not made to the plan amendments. Please refer to response to comment 1167-49 for discussion of how biological goals and SMART concepts are addressed elsewhere in the plan amendments. Please refer to Master Response 2.1, Amendments to the Water Quality Control Plan for specific information regarding San Joaquin Monitoring and Evaluation Program. Please refer to Master Response 2.1, Amendments to the Water Quality Control Plan, regarding the membership, role, governance, and decision-making process of the STM Working Group. Please refer to response to comment 1167-49 and 1167-50.

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		wildlife beneficial uses in that year [insert], taking into account current information. Specifically, FERC licensing proceedings on the Merced and Tuolumne Rivers, other scientific review processes initiated to develop potential management strategies on a tributary basis, and the San Joaquin River Monitoring and Evaluation Program (SJRMEP) described below are expected to yield additional scientific information that will inform future management of flows for the protection of fish and wildlife beneficial uses.Adaptive implementation [insert] shall [insert] [delete] could also [delete] optimize flows to achieve [insert] the narrative salmon protection and San Joaquin migratory fish viability objectives and associated indicators of viability, as measured by attainment of SMART (specific, measurable, attainable, relevant, and time-bound) biological and environmental targets [insert] [delete] while also allowing for consideration of other beneficial uses, provided that these other considerations do not reduce intended benefits to fish and wildlife [delete].[insert] Every five years, the State Water Resources Control Board shall evaluate potential modifications to the percent of unimpaired flow required to be dedicated to instream flow within the range of 40 percent to 60 percent, inclusive. The evaluation shall be based on the progress in achieving the narrative salmon protection and San Joaquin migratory fish viability objectives, and SMART targets, as identified in the comprehensive report, including independent scientific review by the Delta Science Program. Any changes to the percent of unimpaired flow within the identified range shall be adopted after a public hearing before the State Water Resources Control Board and shall be made solely in order to achieve the narrative objectives and SMART targets. [insert]Adaptive adjustments to the flow requirements as forth in (a) – ([insert]c)[insert][delete]d)[delete] below may be approved by the State Water Board on an annual or long-term basis, or by the Executive Director as provided below, if information produced through the monitoring and review processes described in this program of implementation, or other best available scientific information, indicates that the change for the period at issue will satisfy the following criteria for adaptive adjustments: (1) it will be sufficient to [insert] achieve the narrative salmon protection and San Joaquin migratory fish viability objectives [insert] [delete] support and maintain the natural production of viable San Joaquin River watershed fish populations migrating through the Delta [delete]; and (2) it will meet [delete] any [delete] [insert] all SMART targets [insert] [delete] existing biological goals [delete] approved by the State Water Board.[delete] a) The required percent of unimpaired flow may be adjusted to any value between 30 percent and 50 percent, inclusive. The Executive Director may approve changes within this range on an annual basis if all members of the Stanislaus, Tuolumne, and Merced Working Group (STM Working Group), described below, agree to the changes. [delete][delete] b) [delete] [insert]a)[insert] The required percent of unimpaired flow for February through June may be managed as a total volume of water and released on [delete] an adaptive [delete] [insert] a [insert] schedule during that period [insert] that deviates from the 7 day running average, provided that [insert] [delete] where [delete] scientific information indicates a flow pattern different from that which would occur by tracking the unimpaired flow percentage would better protect fish and wildlife beneficial uses [insert] and is necessary to achieve the narrative salmon protection and San Joaquin migratory fish viability objectives and SMART targets [insert]. The total volume of water must be at least equal to the volume of water that would be released [insert] each day [insert] by tracking the [insert] minimum [insert] unimpaired flow percentage [insert] on a daily basis [insert] from February through June. [insert] The total volume of water for the February 1 to May 31 period shall be used within the months of February to May each year.[insert] The Executive Director may approve such changes on an annual basis if the change is recommended by [insert] the U.S. Fish and Wildlife Service, National Marine Fisheries Service, and California Department of Fish and Wildlife after consultation with	

Table 4-1. Responses to Comments			
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		[insert] [delete] one or more members of [delete] the STM Working Group.[delete]c) [delete] [insert] b) [insert] The release of a portion of the[delete] February through [delete] June [insert] 1 to June 30 [insert] unimpaired flow may be [insert] shifted earlier in the migration season (February 1 through May 31) or [insert] delayed until after June to prevent adverse effects to fisheries, including temperature, that would otherwise result from implementation of the February through June flow requirements. The ability to [insert] advance release of flow prior to June or [insert] delay release of flow until after June is only allowed when the unimpaired flow requirement is greater than [delete] 30 [delete] [insert] 40 [insert] percent. If the requirement is greater than [delete] 30 [delete] [insert] 40 [insert] percent but less than [insert] 60 [insert] [delete] 40 [delete] percent under (a) above, the amount of flow that may be released after June is limited to the portion of the unimpaired flow requirement over [delete] 30 [delete] [insert] 40 [insert] percent [insert in the month of June [insert]. [delete] (For example, if the flow requirement is 35 percent, 5 percent may be released after June.) If the requirement is 40 percent or greater under (a) above, then 25 percent of the total volume of the flow requirement may be released after June. (For example, if the requirement is 50 percent, at least 37.5 percent unimpaired flow must be released in February through June and up to 12.5 percent unimpaired flow may be released after June.) If after June the STM Working Group determines that conditions have changed such that water held for release after June should not be released by the fall of that year, the water may be held until the following year.[delete] [insert] Any changes shall be approved by [insert] tThe Executive Director [delete] may approve changes [delete] on an annual basis, [insert] provided that [insert] [delete] if [delete] the change is recommended [insert] jointly [insert] by [insert] the U.S. Fish and Wildlife Service, National Marine Fisheries Service, and California Department of Fish and Wildlife, after consultation with the STM Working Group [insert] [delete] one or more members of the STM Working Group [delete].[delete] d) [delete] [insert] c) [insert] The required base flow [insert] at Vernalis [insert] for February through June may be adjusted to any value between [delete] 800 [delete] [insert] 1,800 [insert] and [delete] 1,200 [delete] [insert] 2,200 [insert] cfs, inclusive. The Executive Director may approve changes within this range on an annual basis, [insert] provided that the change is recommended jointly if by the U.S. Fish and Wildlife Service, National Marine Fisheries Service, and California Department of Fish and Wildlife after consultation with the STM Working Group [insert] [delete] all members of the STM Working Group [delete] agree to the changes.Any of the adjustments in (a)- [delete] (d) [delete] [insert] (c) [insert] above may be made independently of each other or combined. The adjustments in (a) [insert] and [insert], (b) [delete], and (c) [delete] may also be made independently on each of the Stanislaus, Tuolumne, and Merced Rivers, so long as the flows are coordinated to achieve [insert] the narrative salmon protection and San Joaquin migratory fish viability objectives and SMART targets [insert] [delete] beneficial results [delete] in the LSJR related to the protection of fish and wildlife beneficial uses. [delete] Experiments may also be conducted within the adaptive adjustments in (a)-(d), subject to the approvals provided therein, in order to improve scientific understanding of needed measures for the protection of fish and wildlife beneficial uses, such as the optimal timing of required flows. Any experiment shall be coordinated with the SJRMEP and identify the scientific uncertainties to be addressed and the actions that will be taken to reduce those uncertainties, including monitoring and evaluation. [delete]	
1167	52	[From ATT 16]Stanislaus, Tuolumne and Merced Working GroupThe State Water Board will establish a STM Working Group to assist with the implementation, monitoring and effectiveness assessment of the February through June LSJR flow requirements. Specifically, the State Water Board will seek recommendations from the STM Working Group on [insert]	Please refer to Master Response 2.1, Amendments to the Water Quality Control Plan, for response to comments that recommend adding a biological goal to the LSJR flow objective or to the program of implementation to govern changes between the percent of unimpaired flow within the adopted range. Please also see Master Response 2.1 for response to comments regarding the averaging period for the LSJR

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		SMART targets [insert] [delete] biological goals [delete]; procedures for implementing the adaptive methods described above; annual [delete] adaptive [delete] operations plans; and the SJRMEP, including special studies and reporting requirements. Each of these activities is described in more detail below.The State Water Board will seek participation in the STM Working Group by the following entities who have expertise in LSJR, Stanislaus, Tuolumne, and Merced Rivers [insert] fish population [insert] [delete] fisheries [delete] management, hydrology, operations, and monitoring and assessment needs: the DFW; NMFS; USFWS; and water users on the Stanislaus, Tuolumne, and Merced Rivers. The STM Working Group will also include State Water Board staff and may include any other persons or entities the Executive Director determines to have appropriate expertise. Subgroups of the STM Working Group may be formed as appropriate and State Water Board staff may also initiate activities in coordination with members of the STM Working Group.	flow objectives and the rules for changing percent of unimpaired flow within the adopted range, including flow shaping and flow shifting.Regarding SMART targets, clarifying language was added to the Biological Goals section of Appendix K that addresses the SMART concept.Minor word changes in text and headings were not made because they are not necessary. The proposed plan amendments appropriately describe the State Water Board's ability to implement the Bay-Delta Plan given available information, priorities, and resources.
1167	53	[From ATT 16][insert] SMART [insert] Biological [insert] and Environmental Targets [insert] [delete] Goals [delete][delete] Biological goals [delete] [insert] SMART targets [insert] will be used to inform the [delete] adaptive methods, [delete] [insert] adaptation of the program of implementation and [insert] evaluate the effectiveness of this program of implementation, the SJRMEP, and future changes to the Bay-Delta Plan. [insert] The development of SMART targets will be overseen by the Delta Science Program.[insert] The State Water Board will [insert] also [insert] seek recommendations on [delete] the [delete] [insert] these SMART targets [insert] [delete] biological goals [delete] from the STM Working Group, State Water Board staff, and other interested persons. [insert] The SMART targets shall be consistent with the narrative salmon protection and San Joaquin migratory fish viability objectives. [insert] The State Water Board [insert] shall [insert] [delete] will consider [delete] [insert] approve [insert] [delete] approval of the [delete] [insert] SMART targets for each tributary and the LSJR [insert] [delete] goals [delete] within 180 days from the date of the Office of Administrative Law's (OAL) approval of this amendment to the Bay-Delta Plan [insert] . [insert] [delete] and [delete] [insert] The State Water Board [insert] may [insert] subsequently [insert] modify the [insert] SMART targets, after notice and comment, [insert] based on new information developed through the monitoring and evaluation activities described below or other pertinent sources of scientific information [insert], provided that the revised SMART targets are consistent with the narrative salmon protection and San Joaquin migratory fish viability objectives and are developed with the input of the Delta Science Program [insert]. [delete] Biological [delete] [insert] SMART targets [insert] [delete] goals will [delete] [insert] shall [insert] [delete] specifically [delete] be developed for LSJR salmonids,[delete] as salmonids are among the fish species most sensitive to LSJR flow modifications. The State Water Board may seek recommendations on biological goals for [delete] [insert] and [insert] other [delete] LSJR species as [delete] [insert] fish and wildlife beneficial uses as [insert] appropriate. [delete] Biological goals [delete] [insert] SMART targets [insert] will [delete] specifically [delete] be developed for abundance; productivity as measured by population growth rate; genetic and life history diversity; and population spatial extent, distribution, and structure. Within a given tributary, reasonable contributions to productivity [delete] may include meeting measures of quality and quantity of spawning and rearing habitat, fry production, and [delete] [insert] shall include [insert] juvenile outmigrant survival to the confluence of each tributary to the LSJR [insert] and survival through the SSJR corridor to the Delta [insert].The salmonid [insert] SMART targets [insert] [delete] biological goals [delete] for this program of implementation will be specific to the LSJR and its tributaries and will [insert] be consistent with the narrative salmon protection and San Joaquin migratory fish viability objectives [insert] [delete] contribute to meeting the overall goals for each population, including the salmon doubling objective established in	Recommended track changes in the comment were not made to the plan amendments. Please refer to the SED, Appendix K, to view the changes made to the Biological Goals section of the program of implementation. A summary of the modifications made to the Biological Goals section of the plan amendments is provided in the Summary of Modifications Table in Master Response 2.1. A bulleted list of biological goals that need to be developed for salmonids is provided and takes the place of the list that was provided in sentence format in the DRSED. The text states that biological goals may include temperature targets in response to multiple comments that suggested temperature targets to be part of or replace the LSJR flow objectives. While this action does not replace the LSJR flow objectives with temperature targets or require temperature targets, it identifies temperature targets as a measure of water quality and spawning, rearing, and migration habitat that is a reasonable contribution to biological goals. Clarifying language was added to the Biological Goals section of Appendix K that addresses the SMART conceptPlease refer to response 1167-49 and 50. The text changes recommended by the comment are not necessary and are not made. The program of implementation includes sufficient opportunities for development of biological goals based on best available scientific information and coordination with stakeholders and public agencies in a transparent process. Please refer to response to comment 1167-49, 1167-50, and 1167-52 for additional response to this comment.

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		state and federal law. Biological goals [delete] [insert] SMART targets [insert] for salmonid populations will be consistent with best available scientific information, including information regarding viable salmonid populations, recovery plans for listed salmonids, or other appropriate information.	
1167	54	[From ATT 16]Unimpaired Flow ComplianceImplementation of the unimpaired flow requirement for February through June will require the development of information and specific measures to achieve the flow objectives and to monitor and evaluate compliance. The STM Working Group, or State Water Board staff as necessary, will, in consultation with the Delta Science Program, develop and recommend such proposed measures. The State Water Board or Executive Director [delete] will consider approving the [delete] [insert] shall approve a final set of [insert] measures within 180 days from the date of OAL's approval of this amendment to the Bay-Delta Plan. The approved measures will inform State Water Board water right proceedings, FERC licensing proceedings, or other implementation actions to achieve the February through June flows.	Recommended track changes in the comment were not made to the plan amendments. Please refer to Master Response 2.1, Amendments to the Water Quality Control Plan, for a summary of changes that were not made to the plan, including changes to the program of implementation and adaptive implementation framework.Please refer to Master Response 2.2, Adaptive Implementation for additional response to comments regarding adaptive implementation and unimpaired flow compliance methods. The recommended changes are not made.Minor word changes in text and headings were not made because they are not necessary. The proposed plan amendments appropriately describe the State Water Board's ability to implement the Bay-Delta Plan given available information, priorities, and resources.
1167	55	[From ATT 16]Procedures for Implementation of Adaptive Methods[delete] The [delete] [insert] Upon concurrence of the U.S. Fish and Wildlife Service, National Marine Fisheries Service, California Department of Fish and Game, in consultation with the [insert] STM Working Group, [delete] or [delete] [insert] the Executive Director [insert] [delete] State Water Board staff as necessary, will [delete] [insert] shall [insert], in consultation with the Delta Science Program, develop proposed procedures for allowing [delete] the adaptive [delete] adjustments to the February through June flow requirements discussed above. The State Water Board or Executive Director will consider approving procedures for allowing those [delete] adaptive [delete] adjustments within one year following the date of OAL's approval of this amendment to the Bay-Delta Plan.	Recommended track changes in the comment were not made to the plan amendments. As described in the Master Response 2.1, Amendments to the Water Quality Control Plan, fisheries agencies including USFWS, NMFS and CDFW, will be invited to participate in the STM Working Group. The suggestion to require concurrence from state and federal fish and wildlife agencies is not consistent with the State Water Board retaining final authority regarding LSJR flow objectives and implementation. These agencies are invited to participate in the STM Working Group. Therefore, these changes are not made. Please refer to Master Response 2.1, and 2.2, for additional information about STM Working Group.
1167	56	[From ATT 16]Annual [delete] Adaptive [delete] Operations PlanThe STM Working Group or members or subsets of the STM Working Group, as appropriate, will be required to submit proposed annual plans for [delete] adaptive [delete] implementation actions (annual operations plans) for the coming season by January 10 of each year for approval by the State Water Board or Executive Director. The State Water Board recognizes that an annual operations plan is based on a forecast from the best available information and may not accurately reflect actual conditions that occur during the February through June period. Accordingly, the State Water Board will consider this factor and whether the hydrologic condition could have been planned for in evaluating deviations from approved operations plans. [insert] Annual operations plans shall describe operational alternatives under a range of potential hydrological exceedence scenarios (wetter than normal, drier than normal, and median exceedence). [insert] [delete] An annual operations plan shall include actions and operations that consider and will work under a reasonable range of hydrological conditions.[delete] It shall also identify how unimpaired flows are calculated and adjustments to be made as updated information becomes available, such as DWR's Bulletin 120. [Foot note 9: Bulletin 120 is a publication issued four times a year, in the second week of February, March, April, and May by the California Department of Water Resources. It contains forecasts of the volume of seasonal runoff from the state's major watersheds, and summaries of precipitation, snowpack, reservoir storage, and runoff in various regions of the State.] An annual operations plan shall be informed by the review activities described below and may be modified with the approval of the State Water Board or Executive Director.	Recommended track changes in the comment were not made to the plan amendments. The program of implementation, including the description of operations plans, contains an appropriate level of detail. Appendix K states that operations plans will include "actions and operations that consider and will work under a reasonable range of hydrological conditions." This language generally encompasses the suggestion in the track changes comment and is at an appropriate level of detail. Please refer to Master Response 2.1, Amendments to the Water Quality Control Plan, for details regarding the annual operations plans, and for a summary of changes that were not made to the plan, including changes to the program of implementation and adaptive implementation framework.Please refer to Master Response 2.2, Adaptive Implementation for additional response to comments regarding adaptive implementation.

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1167	57	[From ATT 16]Implementation of October Pulse Flow ObjectiveThe October pulse flow objective is currently implemented through water right actions. The State Water Board will reevaluate the assignment of responsibility for meeting the October pulse flow objective during a water right proceeding, FERC licensing proceeding, or other proceeding [insert] no later than 2022 [insert]. Through water right, FERC licensing, or other processes, the State Water Board will require monitoring and special studies to determine what, if any, changes should be made to the October pulse flow objective and its implementation. The State Water Board may require such monitoring and special studies to be part of the SJRMEP. The State Water Board will evaluate the need to modify the October pulse flow objective in a future update of the Bay-Delta Plan based on information developed through these processes.	Recommended track changes in the comment were not made. As discussed in Master Response 2.1, Amendments to the Water Quality Control Program, the program of implementation commits the State Water Board to fully implement the February through June LSJR flow objectives by 2022. The October pulse flow objective is currently being implemented, therefore the proposed modification to reevaluate the assignment of responsibility by 2022 is unnecessary and potentially infeasible in light of the State Water Board's priority of implementing the February through June LSJR flow objectives in the first instance.
1167	58	[From ATT 16][insert] Variances Upon Determination of a [insert] State of EmergencyAt its discretion, or at the request of any affected responsible agency or person, the State Water Board may authorize a temporary [insert] variance [insert] [delete] change [delete] in the [delete] implementation of the [delete] LSJR flow objectives in a water right proceeding if the State Water Board determines that [delete] either (i) there is an emergency as defined in the California Environmental Quality Act (Pub. Resources Code, § 21060.3) or (ii) [delete] the Governor of the State of California [delete] or a local governing body [delete] has declared a state [delete] or local [delete] emergency pursuant to the California Emergency Services Act (Gov. Code, §§ 8550 et seq.) and LSJR flow requirements affect or are affected by the conditions of such emergency. Before authorizing any temporary [delete] change [delete] [insert] variance [insert], the State Water Board must find that measures will be taken to reasonably protect the fish and wildlife beneficial use in light of the circumstances of the emergency. [insert] These provisions regarding variances shall not apply to drought conditions that have lasted less than two consecutive years that are identified as Critically Dry water year types in the San Joaquin River basin. [insert]	Recommended track changes in the comment were not made. The emergency provision in the plan amendment for LSJR flows has not been be modified in response to track changes comments for several reasons. First, the emergency provision is sufficiently rigorous in terms of what qualifies as an emergency and is based established state law. Second, the wide variety of emergencies that may occur are not predictable and the State Water Board needs the ability to act quickly under an array of emergency circumstances. As such, it is not desirable to further define what the State Water Board must find in order to authorize a temporary change in the implementation of the LSJR flow objectives in a water right proceeding. Third, with respect to drought conditions, most are not declared emergencies and are accommodated through the adaptive management methods in the LSJR flow objectives, as explained below. Finally, it is appropriate to include the emergency provision to account for emergencies that may occur and affect meeting the flow objectives; it is not intended to routinely relax flow requirements. Minor word changes in text and headings were not made because they are not necessary. The proposed plan amendments appropriately describe the State Water Board's ability to implement the Bay-Delta Plan given available information, priorities, and resources. Please refer to Master Response 2.1, Amendments to the Water Quality Control Plan, for additional discussion regarding commenter suggested changes to the emergency provision.
1167	59	[From ATT 16]San Joaquin River Monitoring and Evaluation ProgramIn order to determine compliance with the LSJR flow objectives, inform adaptive implementation, investigate the technical factors involved in water quality control, and potential needed future changes to the LSJR flow objectives, including flows for other times of the year, a comprehensive monitoring, special studies, evaluation, and reporting program is necessary. The State Water Board will require in water right permits and water quality certifications, as appropriate, annual and comprehensive monitoring, evaluation, and reporting. Pursuant to its authorities, including Water Code section 13165, comprehensive monitoring will be required to address both the individual and cumulative impacts of diversions and discharges to fish and wildlife beneficial uses. The following requirements, at a minimum, shall be imposed:1) Monitoring, special studies, and evaluations of the effects of flow and other factors on the viability of native LSJR watershed fish populations throughout the year, including assessment of abundance, spatial extent (or distribution), diversity (both genetic and life history), and productivity. [insert] In particular, regular monitoring of juvenile salmon production and size and timing of migration will be required on each of the three tributaries and in the lower San Joaquin River and regular adult migration monitoring (which will, at a minimum, produce an estimate of the number and timing of adult salmon migrants) will be implemented in the lower San Joaquin River below its confluence with the Stanislaus River). [insert]2) Consideration of recommendations from entities with relevant Central Valley monitoring plans to improve standardization of methods, including the	Recommended track changes in the comment were not made. Please refer to Master Response 2.1, Amendments to the Water Quality Control Plan, for response to comments regarding the San Joaquin River Monitoring and Evaluation Program and appropriate level of detail for a planning document. Minor word changes in text and headings were not made because they are not necessary. The proposed plan amendments appropriately describe the State Water Board's ability to implement the Bay-Delta Plan given available information, priorities, and resources.

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		quantification of bias and precision of population estimates.3) Regular external scientific review of monitoring, evaluation, and reporting. Monitoring should be integrated and coordinated with new and ongoing monitoring and special studies programs in the LSJR, including pursuant to federal biological opinion requirements, FERC licensing proceedings for the Tuolumne and Merced Rivers, Central Valley Regional Water Board requirements, and the Delta Science Program.	
1167	60	[From ATT 16]Annual reportingTo inform [delete] the next year's [delete] operations and other activities [insert] in subsequent years [insert], the State Water Board will require preparation and submittal of an annual report to the State Water Board by December 31 of each year. The annual report shall describe implementation of flows, including any flow shifting done pursuant to the annual adaptive operations plan, monitoring and special studies activities, and implementation of other measures to protect fish and wildlife during the previous water year, including the actions by other entities identified in this program of implementation. The annual report shall also identify any deviations from the annual adaptive operations plan and describe future special studies. The State Water Board may hold public meetings to receive and discuss the annual report.	Recommended track changes in the comment were not made. Please refer to Master Response 2.1, Amendments to the Water Quality Control Plan, for response to comments regarding the San Joaquin River Monitoring and Evaluation Program, appropriate level of detail for a planning document, and annual reporting. Minor word changes in text and headings were not made because they are not necessary. The proposed plan amendments appropriately describe the State Water Board's ability to implement the Bay-Delta Plan given available information, priorities, and resources.
1167	61	[From ATT 16]Comprehensive ReportingAdditionally, every [delete] three to [delete] five years following implementation of this update to the Bay-Delta Plan, the State Water Board will require preparation and submittal of a comprehensive report that, in addition to the requirements of annual reporting [delete] , reviews [delete] [insert]: (1) describes [insert] the progress toward meeting the [insert] narrative salmon protection and San Joaquin migratory fish viability objectives and SMART targets; (2) reviews information gained regarding testable hypotheses that were the basis of management and operations during the report period; and, (3) [insert] identifies any recommended [delete] changes [delete] [insert] adaptations [insert] to the implementation of the flow objectives. The comprehensive report and any recommendations shall be peer-reviewed by an appropriate independent science panel, which will make its own conclusions and recommendations. The State Water Board will hold public meetings to consider the comprehensive report, technical information, and conclusions or recommendations developed through the peer review process. This information will be used to inform potential adaptive changes to the implementation of the flow objectives and, as appropriate, future potential changes to the Bay-Delta Plan. In order to leverage expertise and limited resources (financial and otherwise), parties are encouraged to work collaboratively in one or more groups and in consultation with the STM Working Group, USBR and DWR, in meeting the above monitoring and reporting requirements. The State Water Board may streamline monitoring and reporting obligations of parties working collaboratively with each other, the STM Working Group, USBR, DWR, the Delta Science Program or other appropriate parties.	Please refer to Master Response 2.1, Amendments to the Water Quality Control Plan, for response to comments regarding the San Joaquin River Monitoring and Evaluation Program, including comprehensive reporting.Recommended track changes in the comment were not made. Please refer to Master Response 2.1, Amendments to the Water Quality Control Plan, for response to comments regarding the San Joaquin River Monitoring and Evaluation Program, appropriate level of detail for a planning document, and comprehensive reporting. Minor word changes in text and headings were not made because they are not necessary. The proposed plan amendments appropriately describe the State Water Board's ability to implement the Bay-Delta Plan given available information, priorities, and resources.
1167	62	[ATT 17: Appendix B: November 2016 report from SEP Group: Conservation Planning Foundation for Restoring Chinook Salmon (Oncorhynchus Tshawytscha) and O. mykiss in the Stanislaus River]	The commenter provided this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1167	63	[ATT 18: Appendix C: Documentation regarding the CVFPP, Emigrating Salmonid Habitat Estimation Model: Central Valley Chinook Salmon Rearing Habitat Required to Satisfy the Anadromous Fish Restoration Program Doubling Goal. July 2016 Draft.]	The commenter provided this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.

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1167	64	[ATT 19: Appendix D: Analysis of Flow Effects on the Creation of and Need for Inundated Shallow Rearing Habitat on the Lower San Joaquin River and its Main Tributaries]	The commenter provided this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1167	65	[ATT 20: Appendix F. Spreadsheets of SFPUC System Storage]	The commenter provided this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1167	66	[ATT 21: Appendix G. Literature Cited in Section III]	The commenter provided this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1168	1	The SED proposes an EC objective of 1.0 deciSiemens per meter (dS/m) [Footnote 1: Salinity is measured in the Bay-Delta Plan Amendment in EC units, which can be expressed in either deciSiemens per meter or mircomhos per centimeter (µmhos/cm) (i.e., 1.0 dS/m=1,000 µmhos/cm).] as a rolling 30-day average for the protection of the agricultural beneficial use in the southern Delta. Without an appropriate program of implementation, applying a 1.0 dS/m EC objective to the City [of Stockton] and other municipal dischargers will result in an unnecessary burden on the City without measurable improvement in salinity in the Delta. Herein, the City describes the RWCF [Regional Wastewater Control Facility], discharge location, and permitting history. Further, the City explains the ambiguity caused by language indicating that compliance with the EC objective will be determined at the compliance locations, and the impacts analysis in the SED that assumes the proposed EC objective of 1.0 dS/m will be imposed as an end-of-pipe limit. To alleviate these concerns and eliminate any uncertainty, the City supports the recommended implementation language offered by the Central Valley Clean Water Association (CVCWA) and provides the same language here as Attachment 1 [ATT1].	Please see Master Response 3.6, Service Providers, for responses to comments regarding application of the salinity objectives to POTWs and regarding revisions to the Program of Implementation. Please see Appendix K for changes to the Program of Implementation related to POTWs.
1168	2	[ATT2: Figure 1: Map of RWCF Discharge Point and Brandt Bridge-Airport Way Compliance Segment.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1168	3	The City [of Stockton] and other southern Delta POTWs [publicly-owned treatment works] have a de minimis impact on salinity in the receiving waters. Before addressing the proposed program of implementation in the Draft Plan, it is important to note the relative contribution of POTWs to salinity in the Delta. In multiple sections, the SED identifies the main factors driving salinity levels in the Delta: "EC values in the southern Delta are affected primarily by the salinity of water flowing into the southern Delta from the SJR at Vernalis, salt discharged back into southern Delta channels that was previously diverted for irrigation, the combined CVP and SWP pumping influencing salinity in the southern Delta, and tidal mixing of inflow from the Pacific Ocean." (SED, p. 5-44; see also SED, Appendix C, p. 4-7.) In comparison, the SED states that the "WWTPs have only a small effect on southern Delta salinity." (SED, p. 13-23; SED, Appendix C, p. 4-7 ["Point sources of salt in the southern Delta have a small overall salinity effect."].) Given that POTWs have a minimal impact on salinity levels in the southern Delta, compliance strategies, like reverse osmosis (RO) and other desalination treatment systems, that focus on POTWs' impact will not necessarily result in achieving compliance with the objectives in the receiving water. Other contributing factors must be addressed before the State Water Board imposes costly measures on POTWs with little to no water quality benefit.	Please see Master Response 3. 6, Service Providers, for responses to comments regarding application of the salinity objectives to POTWs. Please see Appendix K for changes to the Program of Implementation related to POTWs.
1168	4	It is not clear where compliance will be determined. With respect to the program of implementation that is proposed in the Draft Plan and SED, the Draft Plan contains contradictory language regarding where compliance with the EC objective will be analyzed for POTWs [publicly-owned treatment works]. The compliance location is relevant to two	Please see Master Response 3. 6, Service Providers, for responses to comments regarding application of the salinity objectives to POTWs. Please see Appendix K for changes to the Program of Implementation related to POTWs.

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		different analyses that occur in NPDES permitting. First, as required by federal regulations, the regional water quality control board (regional water board) must evaluate whether pollutants "are or may be discharged at a level which will cause, have the reasonable potential to cause, or contribute to an excursion above any State water quality standard." (40 C.F.R. § 122.44(d)(1).) This is known as the "reasonable potential analysis." For pollutants that have the reasonable potential to cause or contribute to an excursion above a water quality objective, the regional water board must establish a water quality-based effluent limitation. (Id., § 122.44(d)(1)(iii).) Next, if reasonable potential exists, and an NPDES permit includes a water quality-based effluent limitation, the regional water board must determine whether the permittee is complying with the effluent limit. This compliance determination typically involves comparing the concentration of the pollutant in the effluent or the receiving water to the applicable limitation. The question of where to conduct the reasonable potential analysis and where to determine compliance was at issue in the City of Tracy litigation. In City of Tracy's NDPES permit issued in 2007, the Central Valley Water Board evaluated whether Tracy's discharge complied with the southern Delta EC objectives and the point of Tracy's discharge rather than the applicable compliance location listed in the 2006 Bay-Delta Plan. The court held that this was in error. Noting the language in the 2006 Bay-Delta Plan that "compliance locations will be used to determine compliance with the cited objectives," the court found that this language made the objectives "applicable only at the specified compliance locations." (Tracy Decision, p. 39.) Thus, the Central Valley Water Board was required to conduct the reasonable potential analysis at the Old River/Tracy Road Bridge compliance location rather than at the end of Tracy's discharge pipe. (Ibid.) Similarly, under the 2006 Bay-Delta Plan, Brandt Bridge is the appropriate location for reasonable potential analysis for the RWCF [Regional Wastewater Control Facility]. The Draft Plan includes the same language that the court interpreted in the 2006 Bay-Delta Plan: "water quality objectives cited for a general area, such as for the southern Delta, are applicable for all locations in that general area and compliance locations will be used to determine compliance with the cited objectives." (Draft Plan, p. 12.) The Draft Plan, however, changes the compliance locations to compliance segments. The compliance locations/segments in Table 2 are now listed as: San Joaquin River at Airport Way Bridge, Vernalis; San Joaquin River from Vernalis to Brandt Bridge; Old River from Middle River to Victoria Canal; and Old River/Grant Line Canal from Head of Old River to West Canal. (Id., p. 15.) The Draft Plan explains that by switching to river segments rather than specific points, "compliance with the southern Delta salinity objective can better be determined in a Delta environment subject to alternating tidal flows." (Draft Plan, p. 43.) The program of implementation tasks the California Department of Water Resources (DWR) and the U.S. Bureau of Reclamation (USBR) with developing "long-term monitoring protocols . . . to assess attainment of the salinity objective in the interior southern Delta." (Id., p. 45.) The monitoring and reporting protocols "shall include specific alternative compliance locations in, or monitoring protocols for, the three river segments that comprise the interior southern delta salinity compliance locations." (Ibid.) Prior to State Water Board approval of the monitoring and reporting protocols, "attainment of the salinity objective for the interior southern Delta will be assessed at stations C-6, C-8, and P-12." (Id., p. 43.) Once again, the language in the Draft Plan indicates that compliance with the southern Delta EC objective will be determined at the compliance locations, whether those locations are the current stations or future compliance points based on the monitoring and reporting protocols prepared by DWR and USBR and approved by the State Water Board. However, the analysis in the SED for SDWQ Alternatives 2 and 3 assumes that the Central Valley Water Board will apply the EC objective at the end-of-pipe and establish effluent limitations equal to the objective. (See SED, pp. 16-215 to 16-284.) With respect to the City [of Stockton]	

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		specifically, the SED assumes that the City would have to build RO facilities to consistently comply with the proposed 1.0 dS/m objective. (E.g., SED, p. 16-262.) In the City's case, compliance would never be appropriate at the end-of-pipe when the applicable water quality objective does not apply at the actual discharge location but six miles upstream. The City believes that based on the plain language in the Draft Plan, both reasonable potential and compliance with effluent limitations should be determined at the compliance locations, i.e., Brandt Bridge for the City's discharge from the RWCF. The City, in coordination with CVCWA and other southern Delta POTWs, proposes language for the program of implementation, provided in Attachment 1 [ATT1], to clarify this is the case. However, because the SED analyzes the possible environmental effects of SDWQ Alternatives 2 and 3 as if compliance is determined end-of-pipe, the City's response identifies the problems with such an approach.	
1168	5	The Program of Implementation in the Draft Plan is Inadequate for POTWs [Publicly-Owned Treatment Works]. As defined in Water Code section 13050(j), a water quality control plan, like the Bay-Delta Plan, must consist of: (1) beneficial uses to be protected; (2) water quality objectives; and (3) a program of implementation for achieving the water quality objectives. In establishing water quality objectives, the State Water Board must consider, among other factors, environmental characteristics of the water body, including the quality of water available in the water body; water quality conditions that could reasonably be achieved through coordinated control of all factors which affect water quality in the area; and economic considerations. (Wat. Code, § 13241.) Further, the program of implementation in the water quality control plan must include: (a) a description of the nature of actions which are necessary to achieve the water quality objectives; (b) a time schedule for the actions to be taken; and (c) a description of surveillance to be undertaken to determine compliance with the objectives. For POTWs, the Draft Plan and SED provide the following actions as the "reasonably foreseeable methods of compliance that service providers may take to comply with salinity requirements of SDWQ Alternative 2": -Develop new, less saline source water supplies; -Implement salinity pretreatment programs that reduce the amount of salts that are discharged to the sewer system; and -Implement an effluent desalination process at the wastewater treatment plant before treated effluent is discharged to the southern Delta. (SED, p. 16-215.) POTWs, and the City [of Stockton] specifically, have already implemented these "reasonably foreseeable methods of compliance," save for desalination. a. The City has developed surface water supplies and implemented source control.For example, the City's water supply is now largely comprised of surface water. The City purchases approximately 6,000 acre-feet per year (afa) from Stockton East Water District (SEWD). (City of Stockton, 2015 Urban Water Management Plan (July 2016) (UWMP), at p. 5-1.) Additionally, the City pursued and completed its Delta Water Supply Project in 2012. For this project, the City acquired rights to divert up to 33,600 afa of surface water supply from the San Joaquin River pursuant to Water Code section 1485. To divert and treat this water supply, the City constructed a new surface water intake, a water treatment plant, pump stations, and pipelines. (SED, p. 16-216.) The City has a contract with Woodbridge Irrigation District to purchase up to 6,500 afa when water from the San Joaquin River is not available due to endangered species protections. The City developed these surface water supplies at a cost of approximately $230 million to its ratepayers. (Id., p. 16-217.) With the completion of the Delta Water	Please see Master Response 3.6, Service Providers, for responses to comments regarding salinity reduction options for POTWs.

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		Supply Project in 2012, the City experienced an immediate reduction in effluent salinity as shown in Figure 2 [ATT9]. Since 2012, when the Delta Water Supply Project became operational, the annual average EC concentration in 2012, 2013, and 2014 was lower than the annual average EC concentration in 2009, 2010, and 2011. The annual average EC effluent concentration subsequently increased in 2015 and 2016 due to water conservation in the extreme drought years. This increase in concentration also demonstrates what will likely happen in future drought years when conservation efforts intensify and surface water supplies are curtailed. After the purchase of surface water from SEWD and Woodbridge Irrigation District, and the completion and operation of the Delta Water Supply Project, the remaining portion of the City's water supply is sourced from groundwater. However, this is not a large portion. In 2015, an extreme drought year when surface water was curtailed, the City's total water supply for 2015 was 24,843 acre-feet, and of that total, the City used 6,628 acre-feet of groundwater. (UWMP, p. 5-11.) Thus, any hypothetical conversion to surface water from the remaining portion of the City's water supply composed of groundwater would only have a marginal effect on effluent salinity. The reduction of effluent salinity by moving to less saline water supplies has already been realized. In addition, the less saline surface water supplies suggested by the SED are hypothetical. The SED states that municipal dischargers could simply "procur[e] and provid[e] alternate low-salinity water sources to water users in a service area," but also admits that the "location, timing of construction, details of operation, and source of low-salinity water are all unknown." (SED, p. 16-217.) The City has experience in pursuing the SED's suggested method of compliance. Any surface water supply must have a reliable, or sufficiently senior, water right to ensure a municipal drinking water supply is not subject to curtailment during summer months, drought years, or shortages based on endangered species protection. Variability in supply obtained under the existing contract from SEWD drove the City to pursue its own water right from the Delta. Stockton invested millions in developing a supplemental surface supply under SEWD's Central Valley Project contract from the New Melones Reservoir only to realize that investment has failed to deliver a reliable supply. Stockton's experience is that contract water is difficult to obtain, highly variable, expensive, and does not satisfy the long term goal of protecting groundwater sources and improving water quality. Indeed, these factors may be exacerbated by the SED and Draft Plan's proposed unimpaired flow objectives. For all these reasons, the first suggested method of compliance is not a reasonable method of achieving the objective proposed in SDWQ Alternative 2. The City has already procured and incorporated surface water into its water supply resources and obtained the corresponding reduction in effluent salinity. Similarly, the City already implements a pretreatment program and a salinity minimization plan under its NPDES permit. Both the City's 2008 Permit and the most recently adopted 2014 Permit require the City to submit and implement a pollution prevention plan for salinity that meets the requirements of Water Code section 13263.3(d)(3). (2008 Permit, p. 22; 2014 Permit, p. 16.) Under its NPDES Permit, the City is also responsible for all Control Authority pretreatment requirements under part 403 of title 40 of the Code of Federal Regulations. Thus, the City has long been implementing source control; improvements in salinity from this compliance method are not anticipated. b. Building RO will have almost no impact on salinity in the receiving water. The remaining action left in the program of implementation is desalination effluent treatment. The State Water Board has previously recognized that forcing RO technology on POTWs in the southern Delta, before implementing other measures to reduce salt loads in the Delta, is not a "reasonable approach." (State Water Board Order WQ 2005-0005, In the Matter of the Petition of City of Manteca for Review of Waste Discharge Requirements Order No. R5-2004-0028 [NPDES No. CA0081558] and Cease and Desist Order No. R5-2004-0029 Issued by the California Regional Water Quality Control Board, Central Valley Region (2005), p. 14.)	

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		Yet, the SED and Draft Plan now propose that the City and other POTWs "could implement such programs"" (SED, p. 16-262.) The cost of building and operating RO is significant. For the RWCF to operate reliably to meet a 1,000 µmhos/cm EC effluent limitation as a monthly average, approximately 14.8 MGD of flow would require RO treatment. This estimate is based on the following assumptions: 1. EC cannot exceed 1,000 µmhos/cm as a monthly average; 2. An effluent EC equal to 1,267 µmhos/cm, which is the maximum monthly average EC for the period January 1, 2009, through January 1, 2017; 3. Average dry weather flow capacity of 55 MGD; 4. 98 percent removal efficiency (Water Reuse by Metcalf & Eddy, 2007); and 5. A 25 percent safety factor to account for daily and monthly variability flow and EC. The City estimates the capital costs to construct an RO facility to treat approximately 14.8 MGD of effluent from the RWCF [Regional Wastewater Control Facility] to be approximately $93.3 million. Annual operation and maintenance costs would total $9.2 million. These planning level costs are based on technical memorandum prepared by Larry Walker Associates (2012), Technical Evaluation of a Variance Policy and Interim Salinity Program for the Central Valley Region, prepared for the Central Valley Water Board Salinity Variance Program Staff Report (June 2014). Further, there are significant environmental effects caused by RO facilities. The treatment is energy intensive and would result in increased greenhouse gas emissions. (SED, p. 16-273 [stating that impacts of RO from increased greenhouse gas emissions are significant and unavoidable].) Likewise, the operation of RO facilities produces highly saline brine, which introduces the difficult problem of brine disposal. In this regard, the SED's analysis of brine disposal is inadequate and unrealistic. Given the comprehensive effort in the Central Valley to manage salinity through the Central Valley Salinity Alternatives for Long-Term Sustainability process (CV-SALTS) and other regulatory processes, it seems unlikely that disposing of brine in landfills would be a viable option. For the City, the most likely method of brine disposal would be trucking the waste to an offsite, and likely offshore, disposal facility. Most importantly, constructing and operating RO facilities will not have an effect on achieving compliance with the proposed EC objective in SDWQ Alternative 2. Analysis of the effect of the RWCF effluent discharge on EC at Brandt Bridge was conducted utilizing modeling results from mixing zone studies previously completed by the City for its 2014 Permit. The mixing zone studies utilized DSM2 to simulate the historical San Joaquin River flow and RWCF effluent discharge conditions for the period January 2009 through July 2014 in the river upstream and downstream of the outfall. This modeling is documented in reports submitted to the Central Valley Water Board for development of the 2014 Permit. The modeling included simulation of the effluent fraction at Brandt Bridge, which is represented in DSM2 by model node 11. The plot below [ATT12] shows the San Joaquin River EC at Brandt Bridge for two conditions. The first is the 30-day average EC measured at Brandt Bridge (reported on the California Data Exchange Center, Station ID "BDT"). The second condition shows the simulated EC for a scenario in which the RWCF effluent is not present at Brandt Bridge. The simulated EC was calculated from the modeled EC fraction, historical monthly average effluent EC levels, and historical Brandt Bridge EC according to a mass-balance calculation. As described previously, the RWCF effluent is rarely present at Brandt Bridge; hence, there is no difference in EC for these two scenarios most of time. That is, for 96 percent of the period from 2009-2014, the effluent EC from the RWCF had no effect on EC at Brandt Bridge. During the brief time when a very	

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		small fraction of effluent is present at Brandt Bridge, the effect of the RWCF effluent depends on the ambient background EC at Brandt Bridge, the effluent EC, and the amount of effluent present. The modeling shows that a very small fraction of effluent was present at Brandt Bridge in the summer of 2013, which is illustrated by the difference between the light blue line representing measured EC and the yellow line representing the condition in which it is assumed effluent is not present. Effluent EC was about 950 µmhos/cm during this time, so removing that minor contribution would result in a lower river EC, as shown in the plot. However, in either case, the EC is well below the proposed EC objective of 1,000 µmhos/cm. Because effluent from the RWCF rarely reaches the Brandt Bridge compliance location, constructing and operating RO to comply with a 1.0 dS/m effluent limitation would not have an effect on salinity in the San Joaquin River at Brandt Bridge. Forcing the City to construct RO facilities, a project which will have significant and unavoidable impacts, would not help achieve the objective in the receiving water. This proposed method of compliance for POTWs is inadequate and unreasonable.	
1168	6	[ATT9: Figure 2: City of Stockton RWCF Annual Average Effluent EC, 2009-2016.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1168	7	[ATT10: Figure 3: Planning Level Costs for Reverse Osmosis (RO) Treatment.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1168	8	[ATT11: Figure 4: Additional Greenhouse Gas Emissions Associated with the Operation of RO Treatment Systems.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1168	9	[ATT12: Figure 5: Estimated 30-day Average EC at Brandt Bridge, prepared by Robertson-Bryan, Inc.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1168	10	The State Water Board should adopt CVCWA's proposed implementation language. To ensure that POTWs [publicly-owned treatment works] are regulated in a manner that is effective and not overly burdensome, the program of implementation for the proposed southern Delta salinity water quality objective should include the provisions recommended by CVCWA and included herein as Attachment 1 [ATT1]. The draft language eliminates the ambiguity regarding compliance locations and instructs the Central Valley Water Board to conduct reasonable potential analyses for dischargers at the historic compliance locations: San Joaquin River at Airport Way Bridge, Vernalis; San Joaquin River at Brandt Bridge; Old River near Middle River; and Old River at Tracy Road Bridge. This will ensure that available dilution will be considered, as required by Code of Federal Regulations, title 40, section 122.44(d)(1)(ii). Further, the draft language addresses how the Central Valley Water Board should calculate water quality-based effluent limitations based on the southern Delta EC objectives and performance-based effluent limitations. The City [of Stockton], in coordination with CVCWA, recommends that water quality-based effluent limitations be based on mass-based load allocations developed through a watershed loading analysis and facility-specific water quality modeling analysis, akin to the waste load allocation (WLA) process used with total maximum daily loads (TMDL), as described in U.S. Environmental Protection Agency (USEPA) regulations and NPDES permit guidance. This mass-based load allocation can be developed using any reasonable allocation scheme that meets antidegradation requirements and other California water quality standards. (See USEPA, Technical Support Document for Water Quality-Based Toxics Control (1991), p. 69.) Water quality-based effluent limitations could also be based on dilution, if the discharger so requests. Finally, NPDES permits for southern Delta POTWs should also include other	Please see Master Response 3.6, Service Providers, for responses to comments regarding application of the salinity objectives to POTWs and regarding revisions to the Program of Implementation.

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		provisions to ensure that mass loadings of salinity will not unreasonably increase in the future.	
1168	11	The SED does not adequately analyze the impacts of SDWQ Alternative 2. The City [of Stockton] believes that the State Water Board can address its concerns by adopting the proposed implementation language. These concerns extend to the adequacy of the environmental analysis included in the SED under the standards required by the California Environmental Quality Act (CEQA). The SED concludes that SDWQ Alternative 2 is the environmentally superior alternative. (SED, p. 18-33.) This alternative was selected after comparing the impacts of a no-project alternative, SDWQ Alternative 2, and SDWQ Alternative 3. (SED, p. 18-32.) CEQA requires that when "the environmentally superior alternative is the 'no project' alternative, the EIR shall also identify an environmentally superior alternative among the other alternatives." (Cal. Code Regs., tit. 14, § 15152.6(e)(2).) As the SED states, this involves evaluating which alternative would result in the fewest significant impacts yet still achieve project objectives. (SED, p. 18-32.) However, the SED selects SDWQ Alternative 2 as the environmentally superior alternative when it will result in significant and unavoidable impacts (on service providers), while SDWQ Alternative 3 will not result in any significant and unavoidable impacts. (SED, p. 18-32.) The SED attempts to massage its preferred alternative into the environmentally superior alternative by essentially re-evaluating the impacts of the 1.4 dS/m objective proposed in SDWQ Alternative 3. This results in an analysis that is inconsistent with the rest of the SED. Specifically, the SED's evaluation of the SDWQ alternatives' impacts on agricultural uses found that there would be a less-than-significant impact on agricultural uses under both SDWQ Alternatives 2 and 3. (SED, pp. 11-56 - 11-57.) It also concludes that neither alternative is likely to affect historical salinity levels in the southern Delta. (SED, p. 11-56.) Even in evaluating the slightly higher salinity level in SDWQ Alternative 3, the SED finds that the most salt-sensitive crop grown in the southern Delta, dry beans, would not suffer yield losses greater than 10 percent, which is less than the significance threshold identified in the SED. (SED, p. 11-57.) Thus, the SED concludes that SDWQ Alternative 3 would not have a significant impact on agriculture in the southern Delta. (SED, p. 11-57.) Despite this, the SED inexplicably concludes that SDWQ Alternative 3 would not meet the project goal of reasonably protecting agricultural uses, and could not be the environmentally superior alternative. (SED, p. 18-33.) This analysis is inconsistent with the earlier conclusion that SDWQ Alternative 3 would not have a significant impact on agricultural uses. An even more concerning example of this re-evaluation of SDWQ Alternative 3 is in the SED's discussion of the significant impacts that SDWQ Alternative 2 will have on service providers. The SED first correctly states that SDWQ Alternative 3 "would be considered the environmentally superior alternative because it has fewer significant and unavoidable impacts." (SED, p. 18-32.) Then, it begins to erode the conclusion reached in chapter 13 that SDWQ Alternative 2 would have significant and unavoidable impacts on service providers, but SDWQ Alternative 3 would not. The SED now states that "significant and unavoidable impacts could still occur under SDWQ Alternative 3 because of the program of implementation and the potential for agricultural return flow salinity control or low lift pumping stations." (SED, p. 18-32.) The SED continues and provides that because "the potential combination of methods of compliance under the SDWQ alternatives is unknown, so is the scope, magnitude and location of the significant and unavoidable impacts." (SED, p. 18-32.) This makes no sense. If SDWQ Alternative 3 truly has the potential to result in significant and unavoidable consequences to service providers, then the discussion and analysis in chapter 13 should reflect this. It seems difficult to come to such a conclusion, when the SED is premised on service providers needing to implement RO to reach the objective proposed in SDWQ	Please see Master Response 2.4, Alternatives to the Water Quality Control Plan, for discussion of the Alternatives analyzed. Also, please see Master Response 3.6, Service Providers, for responses to comments regarding potential impacts on service providers and regarding revisions to the Program of Implementation. Please also see Master Response 2.1, Amendments to the Water Quality Control Plan, which explains why Chapter 18 states that SDWQ Alternative 3 would not meet the plan amendments' goal of reasonably protecting agricultural uses as well as SDWQ Alternative 2. Chapter 18's summary of impacts and comparison of alternatives has also been revised in light of the changes to Appendix K. Please see Appendix K for revisions to the Program of Implementation related to POTWs.

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		Alternative 2, which is unnecessary for the cities to do under SDWQ Alternative 3. Additionally, the uncertainty that the SED brings forward about SDWQ Alternative 3's impacts in this chapter should have been raised and discussed in chapters 13 and 16, where the impacts of SDWQ Alternative 3 on service providers were analyzed. The proposed approach recommended by the City, namely ensuring that the program of implementation provides manageable means for POTW compliance with the proposed salinity objective, could result in a finding in chapter 13 that SDWQ Alternative 2, the State Water Board's preferred alternative, would have less-than-significant impacts on service providers. Everything else being the same, this would put SDWQ Alternative 2 and SDWQ Alternative 3 on equal footing in terms of neither having significant and unavoidable impacts, and it might allow the State Water Board to find that SDWQ Alternative 2 is the environmentally superior alternative.	
1168	12	[From ATT1:] To be inserted in the Revised Water Quality Control Plan, contained in Appendix K to the SED, after section VI.B.1.v, and replacing sections IV.B.1.vi-vii:v. DWR's and USBR's water rights shall be conditioned to require continued operations of the agricultural barriers at Grant Line Canal, Middle River, and Old River at Tracy, or other reasonable measures, to address the impacts of SWP and CVP export operations on water levels and flow conditions that might affect southern Delta salinity conditions, including the assimilative capacity for local sources of salinity in the southern Delta. The water right conditions shall require any necessary modifications to the design and operations of the barriers or other measures as determined by the COP.	Please see Master Response 3.6, Service Providers, for responses to comments regarding application of the salinity objectives to POTWs and regarding revisions to the Program of Implementation. Please see Appendix K for revisions to the Program of Implementation related to POTWs.
1168	13	[From ATT1:] To be inserted in the Revised Water Quality Control Plan, contained in Appendix K to the SED, after section VI.B.1.v, and replacing sections IV.B.1.vi-vii:vi. In addition to the above requirements, the salinity water quality objective for the southern Delta will be implemented through the Lower San Joaquin River flow objectives, which will increase inflow of low salinity water into the southern Delta during February through June and thereafter under adaptive implementation to prevent adverse effects to fisheries. [Strikethrough] This [/Strikethrough] These implementation measures will assist in achieving the southern Delta water quality objective.	Please see Master Response 3.6, Service Providers, for responses to comments regarding application of the salinity objectives to POTWs and regarding revisions to the Program of Implementation. Please see Appendix K for revisions to the Program of Implementation related to POTWs.
1168	14	[From ATT1:] To be inserted in the Revised Water Quality Control Plan, contained in Appendix K to the SED, after section VI.B.1.v, and replacing sections IV.B.1.vi-vii:vii. The Central Valley Regional Water Board shall regulate [Strikethrough] impose discharge controls on [/Strikethrough] in-Delta discharges of salts by agricultural, domestic, and municipal dischargers consistent with applicable state and federal law, including, but not limited to, establishing water-quality based effluent limitations and compliance, monitoring and reporting requirements as part of the reissuance of National Pollutant Discharge Elimination System (NPDES) permits under the Clean Water Act and the regulations thereunder. [Strikethrough] Publicly-owned treatment works (POTWs) regulated by NPDES permits that discharge salinity constituents above water quality objectives for EC may qualify for a variance of up to ten years pursuant to the Central Valley Regional Water Board Resolution R5-2014-0074. Actions by POTWs to comply with water quality objectives for EC include, without limitation, source control, such as reducing salinity concentrations in source water supplies; pretreatment programs, such as reducing water softener use among water users; and desalination. [/Strikethrough]	Please see Master Response 3.6, Service Providers, for responses to comments regarding application of the salinity objectives to POTWs and regarding revisions to the Program of Implementation. Please see Appendix K for revisions to the Program of Implementation related to POTWs.
1168	15	[From ATT1:] To be inserted in the Revised Water Quality Control Plan, contained in Appendix K to the SED, after section VI.B.1.v, and replacing sections IV.B.1.vi-vii:viii.	Please see Master Response 3.6, Service Providers, for responses to comments regarding application of the salinity objectives to POTWs and regarding revisions to the Program of Implementation. Please see Appendix

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		Determining Reasonable Potential To Cause Or Contribute To An Exceedance Of The Southern Delta Salinity Water Quality Objective (Reasonable Potential Analysis): Federal regulations at 40 C.F.R. 122.44(d)(1)(ii) require that, "When determining whether a discharge causes, has the reasonable potential to cause, or contributes to an in-stream excursion above a narrative or numeric criteria within a State water quality standard, the permitting authority shall use procedures which account for existing controls on point and nonpoint sources of pollution, the variability of the pollutant or pollutant parameter in the effluent . . . , and where appropriate, the dilution of the effluent in the receiving water." To account for the factors identified in 40 C.F.R. 122.44(d)(1)(ii), such as existing controls on point and nonpoint sources of pollution, the variability of the pollutant or pollutant parameter in the effluent, and the dilution of the effluent in the receiving water, the Central Valley Regional Water Board shall consider the following factors when conducting the Reasonable Potential Analysis for salinity: (a) Compliance Locations for Reasonable Potential Analysis: When evaluating whether a discharge by a Publicly-owned treatment works (POTW) regulated by an NPDES permit has the reasonable potential to cause or contribute to an in-stream excursion of the southern Delta EC objectives, the Central Valley Regional Water Board shall consider available dilution of the effluent in the receiving water, as determined at the following compliance location closest to the point of discharge: San Joaquin River at Airport Way Bridge, Vernalis; San Joaquin River at Brandt Bridge; Old River near Middle River; and Old River at Tracy Road Bridge. (b) Controllable Factors Policy: Controllable water quality factors are not allowed to cause further degradation of water quality in instances where other factors have already resulted in water quality objectives being exceeded. Controllable water quality factors are those actions, conditions, or circumstances resulting from human activities that may influence the quality of the waters of the State, that are subject to the authority of the State Water Board or Regional Water Board, and that may be reasonably controlled. Where the salinity of a facility's discharge exceeds the southern Delta salinity water quality objective, but sampling and/or modeling demonstrate that the facility's discharge will not cause any meaningful change or degradation of the receiving water (i.e., downstream salinity is determined by upstream conditions), the facility is not meaningfully or 'reasonably' causing or contributing to an exceedance of the southern Delta salinity water quality objective. In these cases, where the cause of the exceedance is due to uncontrollable factors, the cessation of the facility's discharge would not meaningfully impact downstream receiving water conditions. Consequently, the discharge would not have reasonable potential to cause or contribute to an exceedance of the southern Delta salinity water quality objective, and water quality-based effluent limitations are not required. (c) Consideration of Dilution and Assimilative Capacity: When conducting the Reasonable Potential Analysis, federal regulations allow procedures that account for existing controls on point and nonpoint sources of pollution and that consider dilution of the effluent in the receiving water. DWR's and USBR's water rights are existing controls that provide sufficient flow (i.e., through the Lower San Joaquin River flow objectives) and other measures (e.g., southern Delta agricultural barrier program) to provide dilution and assimilative capacity for local sources of salinity in the southern Delta. When conducting the Reasonable Potential Analysis for NPDES permitted dischargers within the southern Delta, the Central Valley Regional Water Board shall consider these existing controls and dilution by allowing for use of assimilative capacity on an annual average basis. (d) Insufficient Data/Information to Conduct a Reasonable Potential Analysis: Data may be unavailable or insufficient for the Central Valley Regional Water Board to conduct the Reasonable Potential Analysis. If data are unavailable or insufficient to conduct the Reasonable Potential Analysis, the Central Valley Regional Water Board shall require additional monitoring at the applicable compliance location in place of a water-quality	K for revisions to the Program of Implementation related to POTWs.

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		based effluent limitation. The discharger may satisfy the additional monitoring requirement through participation in a regional monitoring program. In addition, to ensure salinity discharge is minimized, the Central Valley Regional Water Board shall consider including (1) a performance-based effluent limitation derived in accordance with section IV.B.1.ix.b; (2) a salinity evaluation and minimization plan; (3) participation in the Central Valley Regional Water Board's Salinity Management Strategy for the 2017 Central Valley Salinity and Nitrate Management Plan (SNMP) or a similar program as described in subsection IV.B.1.x.f below.	
1168	16	[From ATT1:] To be inserted in the Revised Water Quality Control Plan, contained in Appendix K to the SED, after section VI.B.1.v, and replacing sections IV.B.1.vi-vii:ix. Derivation of Effluent Limitations: (a) Water Quality-based Effluent Limitations When Reasonable Potential Exists: 1. After considering the factors in section IV.B.1.viii, where a discharge is found to have reasonable potential to cause or contribute to an in-stream exceedance of the southern Delta salinity objectives, a water quality-based effluent limitation is required. 2. Unless otherwise requested by the discharger, the Central Valley Regional Water Board shall calculate a final water quality-based effluent limitation by calculating a mass-based load allocation, using a watershed loading analysis consistent with methods for developing a Wasteload Allocation in the USEPA Technical Support Document for Water Quality-Based Toxics Control (1991) (USEPA TSD), and use the mass-based load allocation as the final water quality-based effluent limitation. 3. At the request of the discharger, the Central Valley Regional Water Board may calculate a final water quality-based effluent limitation by using a steady state model to determine critical ambient conditions as an annual average concentration at compliance locations specified in IV.B.1.viii.a to calculate and apply appropriate dilution factors determined through DWR DSM2 or equivalent modeling; or by using a dynamic model following procedures described in the USEPA TSD to calculate dilution credits. (b) Performance-based Effluent Limitations: If the Central Valley Regional Water Board determines that a performance-based effluent limitation is necessary because there is insufficient data to conduct a Reasonable Potential Analysis, or because a facility is unable to achieve immediate compliance with a final water quality-based effluent limitation derived in accordance with IV.B.1.ix.a, the performance-based effluent limitation shall be a mass-based limit calculated as an annual average and shall account for water conservation during drought and growth in the service area.	Please see Master Response 3.6, Service Providers, for responses to comments regarding application of the salinity objectives to POTWs and regarding revisions to the Program of Implementation. Please see Appendix K for revisions to the Program of Implementation related to POTWs.
1168	17	[From ATT1:] To be inserted in the Revised Water Quality Control Plan, contained in Appendix K to the SED, after section VI.B.1.v, and replacing sections IV.B.1.vi-vii:x. Compliance with Water Quality-Based Effluent Limitations: When a POTW [publicly-owned treatment works] regulated by an NPDES permit cannot comply with final water quality-based effluent limitations related to southern Delta salinity objectives calculated in compliance with section IV.B.1.ix.a, the Central Valley Regional Water Board may use the following options: (a) Issue a variance pursuant to the Central Valley Regional Water Board Resolution R5-2014-0074, or pursuant to any subsequent salinity variance adopted by the Central Valley Regional Water Board; (b) Adopt a narrative or best management practice-based effluent limitation; (c) Issue an in-permit compliance schedule for a period of up to 50 years to allow for	Please see Master Response 3.6, Service Providers, for responses to comments regarding application of the salinity objectives to POTWs and regarding revisions to the Program of Implementation. Please see Appendix K for revisions to the Program of Implementation related to POTWs.

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		implementation of the Central Valley Regional Water Board's Salinity Management Strategy contained in the SNMP; (d) Require participation in the development of a total maximum daily load (TMDL) for EC in the southern Delta; (e) Require participation in efforts to implement the Salinity Management Strategy contained in the SNMP; and/or (f) Implement other actions consistent with policies adopted into the Water Quality Control Plan for the Sacramento-San Joaquin River Basin by the Central Valley Regional Water Board (e.g., offsets, alternative compliance projects).	
1168	18	[ATT3: Final Decision for City of Tracy v. California State Water Resources Control Board.]	This attachment was included with the comment letter. The attachment does not make a general comment regarding the plan amendments or raise a significant environmental issue.
1168	19	[ATT4: Notice of Entry of Judgment Granting Peremptory Writ of Mandamus for City of Stockton v. SWRCB.]	This attachment was included with the comment letter. The attachment does not make a general comment regarding the plan amendments or raise a significant environmental issue.
1168	20	[ATT5: Notice of Entry of Order for City of Stockton v. SWRCB.]	This attachment was included with the comment letter. The attachment does not make a general comment regarding the plan amendments or raise a significant environmental issue.
1168	21	[ATT6: City Of Stockton Regional Wastewater Control Facility Annual Progress Report and Update for Pollution Prevention Plan for Salinity.]	This attachment was included with the comment letter. The attachment does not make a general comment regarding the plan amendments or raise a significant environmental issue.
1168	22	[ATT7: City Of Stockton Regional Wastewater Control Facility (NPDES Permit Order No. R5-2014-0070), Salinity Pollution Prevention Plan Annual Progress Report.]	This attachment was included with the comment letter. The attachment does not make a general comment regarding the plan amendments or raise a significant environmental issue.
1168	23	[ATT8: City of Stockton Ordinance No. 2015-12-08-1601.]	This attachment was included with the comment letter. The attachment does not make a general comment regarding the plan amendments or raise a significant environmental issue.
1169	1	The SED uses a Water Supply Effects (WSE) model developed by the SWB staff and others simulate the operations of Don Pedro reservoir and reservoirs on the other tributaries. The model has a distinct advantage over real-time operations in that it has perfect hindsight and foresight. This feature allowed the staff and consultants to "game" the model in a way to develop alternatives that attempted to maximize water for the February through June period apparently without causing what appeared to be significant effects on water supply and reservoir storage. Instead of actually modeling the proposed project of 40% of unimpaired flow on a running 7-day average from February through June, the SED moves water around. It proposes shifting water into other time periods that would significantly modify water operations and severely limit the water supply reliability of the Don Pedro project. For example, the authors suggest flow shifting during certain years to move water into later periods of the season without any consideration of the flood control operations of the project. Don Pedro, like many other reservoirs in the Central Valley, is operated for flood control and operations from October through June can be constrained by the need to provide flood control. The SED does not even address this issue and instead puts thousands of acres and hundreds of thousands of people at risk. Figure 1 [ATT1] is TID's estimate of water supply shortages as compared to the SED. TID's analysis indicates shortages in 83 of the 115 years while as opposed to shortages in only 15 years without the SED.	Refer to Master Response 3.2, Surface Water Analyses and Modeling for discussions of model allocation based on seasonal foresight, flow shifting, and reservoir carryover storage. Estimated water supply effects of the proposed project are disclosed throughout the SED. Reservoir operations in the WSE model do account for flood control storage limitations, as described in Appendix F.1, Hydrologic and Water Quality Modeling, Section F.1.2.7. Modeled scenarios do not increase flood risk, as asserted by commenter.Water supply shortages in the SED analysis are described in Chapter 5, Hydrology, and elsewhere. For example, Table 5-20b indicates the inability to meet the entirety of Tuolumne River district demands in 50 percent of years in LSJR Alternative 3, compared to approximately 10 percent of years in baseline. See also Master Response 3.2, Surface Water Analyses and Modeling for more discussion of water supply reliability.

Table 4-1. Responses to Comments			
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1169	2	[ATT1: Figure 1. TID Water Supply Shortages.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1169	3	GroundwaterAppendix A [ATT6] enclosed with this letter is a review by Todd Groundwater of the SED's groundwater analysis and specific comments about the shortcomings of the analysis. Among the many concerns is that TID finds that the groundwater impact analysis in the SED fails to follow standard hydrogeologic practice and does not meet the standard of care for a CEQA impact analysis. Furthermore, the SED greatly underestimates the impact of reduced water deliveries to TID on groundwater levels.	Please see response to Comment 1169-4
1169	4	The geographic scale of the groundwater impact analysis is overly narrow, addressing only effects on pumping and recharge in the affected irrigation districts while ignoring the broader effects on groundwater subbasins. The result is an inadequate and misleading assessment of impacts to groundwater resources. As a result of these defects, the SED should be revised accordingly to present an honest assessment of groundwater impacts. Leaving the areas outside of the districts out of the impact analysis ignores the broader challenges of groundwater management at the subbasin scale, especially considering the existing requirements of SGMA, which requires that local agencies within subbasins coordinate their efforts to manage groundwater sustainably. In fact, much of the water that would contribute to instream flow increases under the LSJR alternatives is water that has historically contributed to groundwater recharge or, in the future, could be used to increase recharge above historical levels. Thus, the SED alternatives would substantially foreclose on future opportunities to manage groundwater basins sustainably, while sustaining current levels of pumping and agricultural production. The implication, which is not addressed in the SED, is that future groundwater pumping would have to be reduced relative to existing conditions. In direct conflict with this, the assumption is incorrectly made that not only will it be possible to continue existing levels of groundwater pumping, but that groundwater pumping could be increased to offset the loss of surface water dedicated to instream flows under the SED alternatives. There is simply not enough water to both increase instream flows per the LSJR alternatives and to manage groundwater basins sustainably at current levels of development. As a result of the flawed assumption regarding the future availability of groundwater, the impacts of the LSR alternatives are understated. Furthermore, less water available for recharge within the TID, for example, will impact water supplies and groundwater levels within TID's portion of the subbasin, and may impact the water available on the eastern side of the subbasin as well. This was not evaluated.	Please see Master Response 1.1, General Comments, for a discussion the programmatic scope of the SED, adequacy of the approach, CEQA requirements for a program-level analysis, use of best available data, and substantial evidence. The level of detail in the SED is reasonable and appropriate for a program-level analysis. The State Water Board acknowledges that uncertainty is inherent in any programmatic planning effort of this geographic and temporal scale. In preparing the SED, the State Water Board strived to use the best available science, consistent with State CEQA Guidelines. A wide range of published literature, official reports and personal communication is cited to reasonably and objectively disclose the environmental setting of the plan area. The State Water Board acknowledges there is more than one way to approach an impact analysis and many data sources are available. However, the State Water Board is not obligated to conduct an exhaustive analysis using every approach, modeling tool, and data set available. Chapter 9, Groundwater, assesses the impacts of the plan amendments on the four subbasins in the plan area. The SED focuses on pumping and recharge by those entities that will be affected by the plan amendments, because the potential impacts to the groundwater basin are a function of their responses to reduced surface supplies. The SED adequately discloses groundwater impacts on a programmatic basis, including recharge impacts. Broader effects to the subbasin by existing parties who have no surface water supplies and are solely pumping groundwater from an overdrafted basin in order to irrigate their crops are not effects of the plan amendments and must be resolved through SGMA.Please see Master Response 3.4, Groundwater and the Sustainable Groundwater Management Act for discussions on the approach to the groundwater impact analysis, groundwater recharge, potential increases in groundwater pumping, and SED consideration of SGMA. The SED does not require or encourage increased groundwater pumping or assume that groundwater pumping could completely offset surface water reductions. The SED analyses reflect that the historical local response to reduced surface water availability has been to choose to increase groundwater pumping; therefore, the SED was required to analyze this reasonably foreseeable action and its impacts on the groundwater basin from this local response.Chapter 9, Groundwater Resources, acknowledges that groundwater overdraft could be exacerbated if groundwater users choose to pump more groundwater in response to reduced surface water supplies. SGMA was passed by the legislature in 2014 to address overdraft issues and associated negative impacts to groundwater basins from over-extraction. SGMA requires local public agencies in the plan area form groundwater sustainability agencies (GSAs) by June 30, 2017 and draft groundwater sustainability plans (GSPs) by 2020 for critically overdrafted basins and 2022 for all other basins. GSAs have 20 years to implement GSPs and achieve sustainability. GSAs are now formed in the plan area, but GSPs have yet to be drafted or implemented. It would be speculative to assume how pumpers in each area would respond to implementation of the LSJR flow objectives, because it will depend on many individual and collective decisions including, but not limited to, the discrete actions of local water users in response to reductions in surface water, crop choices in response to markets and other factors, conservation measures, and implementation of SGMA. The State Water Board acknowledges reaching sustainability in these overdrafted basins will be challenging, but the plan amendments do not conflict with SGMA. Instead, knowledge of the plan amendments during the GSP drafting phase allows for integrated planning of scarce water resources that does not trade impacts between surface and groundwater.Please also see Master Response 3.5, Agricultural Resources, for a discussion on impacts on agricultural resources and Master Response 8.1, Local Agricultural Economic Effects and the SWAP Model, and Master Response

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			8.2, Regional Agricultural Economic Effects, for information regarding agricultural economic effects.
1169	5	The groundwater impact analysis fails to account for the potential effects of increased groundwater pumping on existing groundwater wells, particularly domestic water supply wells. The assumption is incorrectly made that not only will it be possible to continue existing levels of groundwater pumping, but that groundwater pumping could be increased to offset the loss of surface water dedicated to instream flows under the SED alternatives. There is simply not enough water to both increase instream flows per the LSJR alternatives and to manage groundwater basins sustainably at current levels of development. As a result of the flawed assumption regarding the future availability of groundwater, the impacts of the LSJR alternatives are understated. In Section 9.2, Environmental Setting, the various communities in each groundwater subbasin that rely partly or solely on groundwater as a supply source are briefly listed, but their groundwater supply infrastructure and operations are not described. Furthermore, the hundreds of domestic water supply wells in the region serving rural residences are not even mentioned. Although the volume of municipal and domestic well production is relatively small compared to agriculture, these users are in many cases solely dependent on groundwater, and their wells are typically not as deep as agricultural wells. These factors make the nonagricultural groundwater uses particularly vulnerable to changes in groundwater conditions, especially declining groundwater levels. Because the impact analysis does not address the effects of assumed large increases in groundwater pumping on groundwater levels, potential effects on existing wells, particularly shallow production wells, are ignored. Because the impact analysis does not address the effects of assumed large increases in groundwater pumping on groundwater levels, the SED failed to evaluate the potential effects on existing wells, particularly shallow production wells.	The SED does not ignore impacts to existing wells, shallow wells, or domestic well users. Chapter 9, Groundwater Resources, Section 9.2.2, Subbasin Groundwater Use, provides an overview of groundwater conditions in the four main subbasins underlying the plan area (Eastern San Joaquin, Modesto, Turlock, and extended Merced Subbasin), using the best available data that could reasonably collect at the time the SED was being developed. Chapter 13, Service Providers, Section 13.2.1, Lower San Joaquin River and Tributaries, provides discussions on service providers in the plan area, the sources of water relied on by services providers, the existing quality of those water sources, and domestic wells in the plan area.Chapter 22, Integrated Discussion of Potential Municipal and Domestic Water Supply Management Options, Section 22.2.4, Domestic Wells and Household Water Shortages, provides an estimate of the number of domestic wells in the region.Please see Master Response 2.7, Disadvantaged Communities, for further discussions regarding private domestic wells and small community water systems.Please see response to Comment 1169-4 regarding the SED approach to the groundwater impact analysis, sustainable groundwater management, and economic effects.
1169	6	The rationale and threshold for defining potentially significant groundwater impacts is arbitrary and misleading. The assumption that an average annual reduction in the groundwater balance for a subbasin (caused by increased groundwater pumping and reduced recharge from surface water) equivalent to 1 inch or more of water across the subbasin could be potentially significant is arbitrary and unsupported. Additionally, spreading the impact across the entire subbasin underestimates the impacts with the irrigation district. The approach taken to the evaluation of ecosystem restoration [must be] clear, thorough, understandable and tied to specific metrics and conclusions.	Please see Master Response 3.4, Groundwater and the Sustainable Groundwater Management Act, for discussion on the criteria used to evaluate impacts to groundwater resources, including the one-inch regional threshold.Please also see response to Comment 1169-29 regarding the geographic scale of the groundwater impact analysis.
1169	7	Not including the likely effects of Sustainable Groundwater Management Act (SGMA) in baseline conditions results in gross underestimation of the water supply shortages that would result from the Lower San Joaquin River alternatives. Because SGMA will likely reduce the volumes of groundwater that can be extracted in the future, not increase them (as assumed for the SED impact analysis), the SWRCB has adopted an unrealistic, seriously flawed baseline condition, resulting in the water supply shortages caused by the proposed LSJR alternatives being grossly understated. After acknowledging the likely effects of SGMA, the SED states: "However, since the groundwater protections that will be afforded by SGMA cannot be determined at this time with precision, this chapter evaluates the potential impacts on groundwater levels from LSJR alternatives without including SGMA as an ameliorating factor, which means that estimates of impacts are likely more conservative (i.e., worse) than would occur in the groundwater basins over time." The fact that the SWRCB elected to leave SGMA out of the baseline is incredible on its own; however, the statement that doing so results in conservative (worse) estimates of impacts is contrary to the Board's own assessment. It would appear from this statement that the SWRCB	Please see Master Response 3.4, Groundwater and the Sustainable Groundwater Management Act, regarding the use of 2009 groundwater pumping levels in the baseline groundwater analysis, the speculative nature of projecting a future condition groundwater baseline under SGMA, and groundwater recharge.SGMA was not included in the baseline, because, as noted in response to Comment 1169-4, SGMA plans are not yet written and groundwater sustainability could be implemented through projects and programs in a number of ways. For example, groundwater sustainability agencies could implement projects to increase recharge in wet years and programs to decrease groundwater extraction through conservation and other means. Therefore, any future-condition baseline “with SGMA” is purely speculative. However, SGMA was properly included in the analyses as an existing legal requirement to prevent further degradation of the groundwater basins and as a potential cumulative limit on future irrigation supplies (Chapter 9, Section 9.4.3, Impacts and Mitigation Measures; Chapter 22, Section 22.4.1, Potential Impacts of LSJR Alternatives). The SED does not assume that SGMA and recharge will offset reductions in surface water supply. The SED also does not assume that groundwater pumping capacity would remain at 2009 or 2014 levels. As discussed in response to Comment 1169-4, the SED reflects the historical local response to choose to increase groundwater pumping when surface water availability is reduced. Chapter 9, Groundwater

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		rationalizes that the "groundwater protections that will be afforded by SGMA," rather than limiting future groundwater extractions, will somehow enable the vast increases in pumping it assumes to be possible to offset the reductions in surface water supplies due to the LSJR alternatives. Because SGMA will likely reduce the volumes of groundwater that can be extracted in the future, not increase them, the SWRCB has adopted an unrealistic, seriously flawed baseline condition, resulting in the water supply shortages caused by the proposed LSJR alternatives being understated. The SWRCB indicates that the subbasin could offset impacts caused by the SED by implementing SGMA and recharging the groundwater, however the SWRCB fails to provide any analysis as to where that water will come from. A draft report from DWR [Footnote 1: California Department of Water Resources, Draft Water Available for Replenishment Report (January 2017).] evaluating water available for replenishment contradicts the SWRCB's assumption that there is water available for replenishment. The proposed SED will impact the subbasin by reducing the existing recharge, causing TID customers to rely more on the groundwater without a means of recharging it. This will compound the existing overdraft within the subbasin, making it even more difficult to comply with SGMA. The SED misses the mark with respect to evaluating the range of potential impacts, by assuming that additional recharge is available to offset some of the SED impacts. The SED should evaluate the potential range of impacts to groundwater, and the assumptions used seem to miss the worst case scenario. In order to truly bracket the possible range, the SED should also evaluate the impacts of reduced agricultural water supplies, without additional recharge, combined with increased pumping to offset the reduced surface water supplies.	Resources, shows what the impacts on groundwater resources would be if irrigation districts decide to replace reduced surface water supply with groundwater up to 2009 and 2014 levels. For information on assumptions for the level of pumping associated with 2009 and 2014 infrastructure in the WSE model, please see Master Response 3.2, Surface Water Analyses and Modeling. As discussed in Chapter 11, Agricultural Resources, if additional groundwater pumping could not fully replace the reduction in surface water, the SED assumes there would be impacts on agricultural resources. The SED also acknowledges that such substitute pumping could exacerbate groundwater overdraft, and is not likely to be sustainable with or without the plan amendments. Chapter 9 states that impacts on groundwater resources estimated without including SGMA are likely conservative (i.e., worse) than what would occur if SGMA was included, because under SGMA, such levels of groundwater pumping would likely be limited and the impact on groundwater resources less.
1169	8	The methods for estimating irrigation demands described in Chapter 11 and Appendix G do not follow generally accepted, peer-reviewed technical approaches. The generally accepted methodology for estimating irrigation demands involves the following steps in sequence for each crop in the cropping pattern: 1) estimating actual crop water use, 2) subtracting the portion of actual crop water use satisfied by precipitation to get the applied water requirement, 3) applying on-farm efficiency factor to account for on-farm losses and to estimate the farm water delivery requirement, and 4) applying a distribution system efficiency factor to account for system level losses and to estimate the diversion requirement. In contrast to this, the SED uses an unconventional methodology that is difficult to follow. The SED should rely on generally accepted practices and terminology, such as those described in the first edition and the recently released second edition of Manual 70 Evaporation, Evapotranspiration and Irrigation Water Requirements of the American Society of Civil Engineers (ASCE) series of Manuals and Reports on Engineering Practice (ASCE 2016) and peer-reviewed literature on modeling of irrigation distribution and on-farm systems.	The methods and terminology used for the analysis to calculate applied water are described in detail in Appendix G and Appendix F.1. The comment is incorrect as the SED does follow the same steps described in the comment to determine applied water demands for each district; however, terms may be used differently in the SED. Total consumptive crop water use for each district (step 1 in the comment) is referred to as the consumptive use for applied water (CUAW) in the SED and is a set timeseries based on Calsim II CUAW demands calculated using the DWR consumptive use model. USBR developed these estimates based on land use data, crop surveys, information from irrigation districts, and from river gages. CUAW varies monthly and from year to year dependent on climatic factors (including precipitation, step 2 in the comment). Deep percolation factors are applied to the CUAW demands to account for the portion of applied water lost to groundwater recharge and surface runoff is accounted for separately as part of the Operational Spills and Returns from each district, but it is still included in the overall diversion demand (Step 3 in the comment). Finally, distribution loss factors are applied to other diversion demands to account for distribution losses from surface water diversions (Step 4 in the comment). Please refer to Master Response 3.2, Surface Water Analyses and Modeling, regarding the methods for determining applied water demand.
1169	9	The agricultural economic impacts presented in Appendix G are understated for a number of reasons. Because SGMA and its effects are not included in baseline conditions, the impact analysis allows unrealistic assumptions to be made regarding the volumes of groundwater that could be pumped in the future, resulting in understated estimates of agricultural water supply shortages.	Please see Master Response 3.4, Groundwater and the Sustainable Groundwater Management Act, for discussion of SGMA implementation.
1169	10	The agricultural economic impacts presented in Appendix G are understated for a number of reasons. Analysis of economic impacts is limited to the effects of increased water supply shortages on on-farm crop production only, to the neglect of impacts on related dairy and cattle production and food processing operations.	Please see Master Response 3.5, Agricultural Resources, for discussion of the potential effects on dairies and livestock operations. Please see Master Response 8.2, Regional Agricultural Economic Effects, for discussion of the potential economic effects on dairies and food processors.

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1169	11	The agricultural economic impacts presented in Appendix G are understated for a number of reasons. To the extent that intra-district markets do not actually exist, the assumed movement of water is not possible and therefore the economic impacts of water shortages are underestimated.	Please see Master Response 8.1, Local Agricultural Economic Effects and the SWAP Model, for discussion of the SWAP model and the assumptions about intra-district transfers.
1169	12	The agricultural economic impacts presented in Appendix G are understated for a number of reasons. The analysis apparently assumes that irrigated agricultural can expand and contract perfectly from year to year according to the available water supply, which is not realistic. Rather, farmers tend to scale their core operations, particularly capital investments in permanent crop production, based the amounts of water they expect to receive on a highly reliable basis.	Production of annual crops, such as grain, can expand and contract from year to year in response to water supply conditions. This is common practice during droughts to conserve water. Permanent crops can't be fallowed and brought back into production the following year, but other management methods can be applied, such as deficit irrigation, to keep them in production through periods of water shortage. Please see Master Response 8.1, Local Agricultural Economic Effects and the SWAP Model, for discussion of the SWAP model and its assumptions. Also, please see Master Response 8.1 regarding the scope of the agricultural economic analysis and a potential contraction in the agricultural industry.
1169	13	The agricultural economic impacts presented in Appendix G are understated for a number of reasons. The impact analysis assumes that future groundwater pumping lifts, and therefore costs, will be the same in the future as they have been recently, ignoring the higher cost of pumping as groundwater levels decline due to the assumed increases in pumping.	Please see Master Response 8.1, Local Agricultural Economics Effects and the SWAP Model, regarding the scope of the economic analysis and groundwater pumping costs.
1169	14	The agricultural economic impacts presented in Appendix G are understated for a number of reasons. The economic analysis fails to account for the decrease in land values that will certainly result from the reduction in water supply reliability and increase in cost (fixed costs of irrigation district operations will be spread over fewer acre-feet of surface water, more relatively expensive groundwater will need to be pumped, and the cost of groundwater pumping will increase as groundwater levels decline). What happens to the growers who are capitalized based on existing levels of productivity and land values when land productivity suddenly declines, land values decrease, and they are no longer able to service their debts?	Please see Master Response 8.1, Local Agricultural Economics Effects and the SWAP Model, regarding the scope of the economic analysis and groundwater pumping costs.
1169	15	The agricultural economic impacts presented in Appendix G are understated for a number of reasons. The perspective for assessing impacts to agricultural resources is overly narrow, focusing primarily on the potential for the LSJR alternatives to induce conversion of Prime Farmland, Unique Farmland and Farmland of Statewide significance to nonagricultural uses, neglecting the broader agricultural economy.	Please see Master Response 3.5, Agricultural Resources, for discussion of the methodology used to determined impacts to agricultural resources.
1169	16	The agricultural economic impacts presented in Appendix G are understated for a number of reasons. The analysis assumes that dry land farming is a feasible means of keeping agricultural lands in production during times when water supplies are short, but does not appear to take into account that rainfall alone is not adequate to sustain even low water use, winter crops in years of low rainfall.	Please see Master Response 3.5, Agricultural Resources, for discussion of dry land farming.
1169	17	The economic analysis methodology is confusing with regard to the use and limitations of models. On page 11-1, second paragraph, the SED states: ". . . the management decisions of individual agricultural producers (farmers) are more sophisticated and driven by more variables than can be accounted for in modeling." Then on page 11-2, it is explained that the Statewide Agricultural Production (SWAP) model is used to evaluate impacts. These statements are contradictory.	Chapter 11, Agricultural Resources, is the environmental impact analysis regarding agricultural resources; Chapter 20, Economic Analyses, provides an economic effects analysis regarding local and regional agricultural economics. Please see Master Response 8.1, Local Agricultural Economic Effects and the SWAP Model, regarding a description of the SWAP model and its capabilities. The SWAP model is the best available tool to analyze potential economic effects on agriculture based on rational grower decisions. It has been widely used and peer reviewed. It is infeasible for any model to account for the numerous decisions and real world variables related to agricultural economics and Chapter 11 and Master Response 8.0 and 8.1 acknowledge this. Models, including SWAP, allow comparative analyses to inform decision makers and the public regarding potential changes between baseline conditions and alternative conditions.

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1169	18	Hydropower The 2016 SED fails to adequately capture the extent of the damages to the San Joaquin Valley, using biased and inconsistent assumptions that dramatically undervalue the effects of the unimpaired flow and increased carryover storage on hydroelectricity and agriculture. As explained in Appendix B, the SED does not adequately account for the value lost from hydropower generation under LSJR Alternative 3, the 40% unimpaired flow alternative. Though the quantity of electricity lost under LSJR Alternative 3 is minimal, the value lost is quite significant. The value lost in electricity results from the LSJR Alternative 3's constraints on the flexibility of generation from the New Don Pedro Project (Don Pedro). The analysis reveals that the quantity of hydropower lost under the proposed alternative belies the true loss in value in hydropower. One of the most valuable assets of Don Pedro is its flexible capacity, or ability to generate power at any time with limited start-up and shut down costs. With the continual growth of intermittent renewables in California's energy market, flexible generation will continue to increase in value, as it can respond to the increasing volatility in generation resulting from intermittent renewable generation. The LSJR Alternative 3, however, would significantly restrict Don Pedro's flexibility, and in turn one of TID's chief sources of flexible generation. When considering the SED's impact on flexibility, and damages to Don Pedro's generation can be calculated to 4 components: (1) loss of value in energy, (2) loss of value in capacity, (3) loss of value ancillary services, (4) loss of consumer surplus. The total Net Present Value (NPV) damages from 2018-2040 are shown [in ATT2].	This comment reflects a general introduction of concerns related to hydropower. See Master Response 8.4, Non-Agricultural Economic Considerations, regarding the effects of hourly fluctuations in power generation, which explains how the SED acknowledges and accounts for the flexibility of hydropower generation. Additional details addressing the commenter's four components are included in responses below.
1169	19	[ATT2: Table of Total Net Present Value (NPV) Damages from 2018-2040.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1169	20	Economic Analysis Deficiencies A review of the SED's Agricultural Economic Analysis by ERA Economics (attached as Appendix C [ATT8]) demonstrates that there are several potential deficiencies that warrant additional clarification. This review identified 10 key deficiencies, summarized below [ATT3] and in more detail in Appendix C. The deficiencies are such that the SWB economic analysis will require substantial revisions as recommended in Appendix C.	This comment does not raise significant environmental issues related to the analysis of impacts discussed in the SED or make a general comment regarding the plan amendments. Please see response to comments 1169-150 through 1169-162 related to economic considerations.
1169	21	[ATT3: Table of economic analysis deficiencies.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required. Please see response to comment 1169-20.
1169	22	Climate Change Contrary to the SWB's own resolution adopting a Comprehensive Response to Climate Change, adopted on March 7, 2017, the SED relies exclusively on past hydrology for its assessment of water availability and water supply impacts. Instead of using tools that are readily available, the SWB chooses to ignore the reality that future runoff patterns, available precipitation, temperature changes, and other factors will significantly impact the assumptions it has made in the SED. Numerous climate change models indicate a progressively altered snow and runoff regime in the watershed. Snow accumulation is reduced and snow melts earlier in the spring. Fall and early winter runoff increases while late spring and summer runoff decreases. Total runoff is projected to decrease under the climate change scenarios evaluated, in some cases marginally and others significantly. The SED failed to evaluate any of these possible future scenarios. Even if the SWB chooses to ignore the climate change models, a review of past Tuolumne River hydrology clearly shows that variability in the annual runoff is changing. Historical climate trends are more evident in graphs than in numerical tables. The historical streamflow record in the Tuolumne is 121 years, from 1897 to the present. Figure 2 [ATT4] shows the annual flow volume at La Grange	The State Water Board used the best available science throughout the SED. A variety of data were obtained for the water quality planning process, including quantitative data from peer-reviewed published literature on topics specific to the plan area; peer-reviewed published literature outside the plan area but on topics relevant to the plan amendments; unpublished quantitative data from within the plan area and from outside of the plan area; qualitative data or personal communication with topical experts; and expert opinion if no other sources. Chapter 14, Energy and Greenhouse Gases, Section 14.2.3, Climate Change, and Section 14.3, Regulatory Background, describe the changes that are expected to occur in the San Joaquin Valley and the Delta as a result of climate change. Climate change is discussed under Impact EG-5 in Chapter 14, Section 14.4.3, Impacts and Mitigation Measures. Chapter 14, Energy and Greenhouse Gases, and Appendix J, Hydropower and Electric Grid Analysis of Lower San Joaquin River Flow Alternatives, identify effects to flow and hydropower based on a simulation period of 82 years for power plants on the three eastside tributaries. Please see Master Response 3.2, Surface Water Analyses and Modeling, for a discussion of climate change as it relates to the quantitative analysis.

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		with linear upper and lower bounds, one standard deviation above and below the mean. Standard deviations are calculated over a 25-year period so the upper and lower bounds begin 25 years after the historical record begins. If annual streamflow is 'normally distributed', the annual streamflow in any year will have a 68 percent chance of falling within the upper and lower bounds. The statistical bounds in Figure 2 [ATT4] show what is evident visually; as time advances the annual flow range from high flows to low flows expands. Figure 3 [ATT5] shows the same information with the Coefficient of Variation, which is the variability of annual flows relative to the mean. Figure 4 [ATT9] shows the historical Tuolumne River annual flow volume--the mean annual flow volume. The vertical line at 1965 is a marker--annual flows from 1897 to 1965 appear less variable than flows after 1965. In Figure 3, 1966 is the year where the Coefficient of Variation starts to increase. The failure of the SWB to recognize and acknowledge this variability is key to understanding the impacts to water supply, the loss of valuable hydropower resources, the inability to sustain and maintain natural production of viable native fish populations, the permanent damage to perennial crops and the associated economic losses. By not presenting information on the variability in runoff due to climate change, the SED significantly underestimates the extent of potential damages incurred by the LSJR Alternatives.	
1169	23	[ATT4: Figure 2. Annual Flow at La Grange, with Upper and Lower Bounds on Standard Deviation from the Mean.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1169	24	[ATT5: Figure 3. Annual Flow at La Grange. Annual Flow Volume and Coefficient of Variation for 25-year Mean Values.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1169	25	[ATT9: Figure 4. Annual flow volume at La Grange, less the mean annual flow volume.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1169	26	The State Water Board proposal and its singular focus on unimpaired flows is the wrong choice for the state's future. As you are aware, various parties including water districts, state agencies, and environmental organizations are engaged in voluntary settlement discussions. The discussions are complex. The resumption of a regulatory proceeding will polarize the parties, effectively negating the progress made to date, and jeopardizing any real opportunity to achieve a voluntary settlement. TID urges the State Water Board to set aside the unimpaired flows approach and recognize that the best outcome can be achieved through comprehensive, collaborative approaches that include "functional flows" as well as non-flow solutions that contribute real benefits.	Please see Master Response 1.1, General Comments, and Master Response 2.1, Amendments to the Water Quality Control Plan, for responses to comments by the State Water Board supporting voluntary agreements, including a discussion of flow and non-flow measures. Non-flow measures are also discussed in Chapter 3, Alternatives Description, and evaluated in Chapter 16, Evaluation of Other Indirect and Additional Actions. Please see Master Response 2.4, Alternatives to the Water Quality Control Plan Amendments, for responses to comments regarding the purpose and goals of the plan amendments and the inability of non-flow measures to meet them. Please also see Master Response 3.1, Fish Protection, for a clarifying discussion regarding unimpaired flows versus functional flows.
1169	27	[ATT6: Appendix A. March 15, 2017 Memorandum from Gus Yates to TID. Comments on Groundwater Impact Analysis for the Turlock Subbasin.]	The commenter provided this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1169	28	[From ATT6:] The Substitute Environmental Document (SED) for the Lower San Joaquin River (LSJR) flow program greatly underestimates the impact of reduced water deliveries to Turlock Irrigation District (TID) on groundwater levels. This was the result of inappropriate averaging of impacts over a large area and unrealistic assumptions regarding future increases in groundwater pumping in response to decreased surface water deliveries. In addition, the SED summarily dismisses concerns regarding the economic impacts of groundwater declines by asserting that issues related to groundwater imbalance will be solved at a future date by the Sustainable Groundwater Management Act (SGMA).However, even a cursory analysis of local water resources conditions indicates that SGMA would not be able to offset future increases in groundwater pumping with increased recharge because	Please see response to Comment 1169-4.

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		nearly all potential sources of water for replenishment are themselves tributary to the Tuolumne, Merced and San Joaquin Rivers. Those sources could not be developed for supplemental groundwater recharge without decreasing river flows and exacerbating the very problem the LSJR flow program is attempting to solve. The inevitable result of reduced water deliveries to TID at the magnitudes contemplated in the LSJR flow program is fallowing of substantial amounts of cropland with significant associated economic impacts.	
1169	29	[From ATT6:] The SED underestimates groundwater impacts by averaging them over too large an area. The SED incorrectly asserts that evaluation of impacts at a geographic scale smaller than whole subbasins is infeasible: "The impacts of the LSJR alternatives on groundwater elevations, aquifer storage, and risk of subsidence cannot be determined with certainty because groundwater conditions vary within each aquifer subbasin and water users would have varied responses to reduced surface water deliveries." (page 9-2) It would have been a simple matter--using numbers already contained in the SED--to apply the change in surface-water deliveries to irrigation district service areas rather than entire subbasins. In the case of the Turlock Subbasin, the TID service area (151,000 irrigated acres; Table 9-5) covers only 43 percent of the Subbasin area (349,000 acres; Table 9-2) and is entirely within the western half of the subbasin. The SED should have applied the anticipated change in groundwater pumping and water levels to the service area, not the entire subbasin. This geographic factor increases the estimated impact by a factor of 2.3 (1/0.43 = 2.3). Averaging groundwater impacts over an entire subbasin also overlooks existing acute groundwater problems in local areas. In the case of the Turlock Subbasin, there is a deep pumping trough in the eastern half of the Subbasin, which does not receive surface water for irrigation. The pumping trough has been clearly evident in water-level contour maps for years, such as the spring 2016 contours obtained from a California Department of Water Resources website and shown in Figure 1 [ATT6:ATT3]. Hydrographs of water levels in four wells near the pumping trough are shown in Figure 2 [ATT6:ATT4] and demonstrate the chronic overdraft in that area. Increased groundwater pumping in TID will exacerbate this overdraft. To correct this geographic averaging error, TID simulated the localized effects of replacement groundwater pumping under LSJR Alternative 3 using a groundwater flow model of the Turlock Subbasin.	As discussed in response to comment 1169-4, the level of detail in the SED is reasonable and appropriate for a program-level analysis and is not meant to be, nor required to be, a site-specific analysis of, for example, each cone of depression or potential cone of depression in each basin. Moreover, it is speculative to assume how pumpers in each area will respond to implementation of the flow objectives, because it will depend on many individual and collective decisions including, but not limited to, the discrete actions of local water users in response to reductions in surface water, crop choices in response to markets and other factors, and implementation of SGMA and conservation measures.The SED standardizes potential groundwater effects by dividing the estimated net change in groundwater balance by the subbasin surface area (not the irrigation-district service area), because the analysis is at the subbasin level. As noted in the comment, groundwater effects could extend outside of the irrigation district service area (e.g., into the eastern part of the Turlock Subbasin which does not receive surface water for irrigation); an analysis at the district scale would not capture these potential effects.Chapter 9, Groundwater Resources, Section 9.4.3, Impacts and Mitigation Measures, acknowledges the effects would vary depending on location and the specific actions of individual water users. Some locations within the subbasin might experience a greater reduction in net recharge than others. Existing cones of depression could deepen or new cones of depression could develop as a result of overdraft. These types of changes require site-specific information that is outside the scope of the program-level analyses of the SED.Please see Master Response 3.4, Groundwater and the Sustainable Groundwater Management Act, for further discussion regarding the thresholds and criteria used to evaluate impacts on groundwater resources, and consideration of groundwater pumping outside of irrigation districts.
1169	30	[From ATT6:] A long-term decline of 10 inches per year is significant and unsustainable.The SED used a significance threshold of 1 inch per year (in/yr) of deficit in the groundwater balance, equivalent to about 10 in/yr of water-level decline (page 9-46, last two paragraphs). This threshold is unreasonably large and inconsistent with SGMA. For example, average annual water-level declines in the four hydrographs from the overdrafted part of the Turlock Subbasin (Figure 2 [ATT6:ATT4]) are 10-22 in/yr. In other words, the SED asserts that increasing the existing amount of overdraft by 50-100 percent is less than significant. This is clearly absurd. A threshold of significance of 0 in/yr would almost achieve sustainability (the existing deficit at the Eastside pumping trough would remain) and thus more likely comply with SGMA. Although the SED concluded that impacts of LSJR Alternatives 3 and 4 on groundwater levels and storage would be significant and unavoidable, the use of an inappropriately high significance threshold deemphasizes the importance of those impacts.	Please see Master Response 3.4, Groundwater and the Sustainable Groundwater Management Act, for further discussion regarding the thresholds and criteria used to evaluate impacts on groundwater resources.The threshold of a one-inch length equivalent reduction in recharge was used in the SED, a CEQA document, to help the State Water Board to determine if each of the LSJR alternatives have significant environmental impacts to groundwater resources. This threshold does not imply that the State Water Board believes a 10-inch average annual decline of groundwater levels should be the threshold for determining the status of an aquifer (e.g., chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply) for the purpose of complying with SGMA. GSAs in the plan area will determine the significant and unreasonable conditions (i.e., undesirable results) within their subbasin after detailed technical assessment and stakeholder consultations as required by SGMA.
1169	31	[From ATT6:] Assuming that groundwater pumping capacity in TID will remain at the 2009 or 2014 capacity is unrealistic and greatly underestimates future replacement pumping.The SED assumes that groundwater pumping in surface-water delivery areas would increase in response to reduced deliveries, but only up to the amount of pumping capacity that was	Please see response to Comment 1169-7.

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		available in 2009 (page 9-46, first paragraph). This is an unrealistic assumption. Faced with a foreseeable long-term decrease in surface-water deliveries, farmers will drill more wells until the pumping capacity provides the same reliability as the existing combination of surface deliveries and well capacities. The SED concedes this point by noting that well capacity increased from 2009 to 2014 in response to drought conditions (page 9-46, first paragraph). At the very least, the SED should have used 2014 well capacities as a base. If additional wells were installed due to drought, how can it be argued that additional wells would not be installed in response to permanent delivery curtailment under the SJR flow program? The realistic assumption is that over the long run farmers will install enough well capacity to fully replace the foregone surface deliveries. This is the amount that would keep all of their land in production. The effect of the incorrect assumption regarding replacement pumping was to underestimate future increases in groundwater pumping, by a factor of 2.3 for the LSJR Alternative 3 for example. This is the ratio of the decrease in releases from Turlock Lake for surface-water deliveries to TID growers to the estimate of change in the subbasin groundwater balance under that alternative. LSJR Alternative 3--which requires 40 percent of baseline river flows--is referenced in this memorandum as "SED40." With full replacement, groundwater pumping would increase by an amount equal to the reduction in surface-water releases from Turlock Lake for irrigation. The decrease in TID releases from Turlock Lake under SED40 would average about 98,300 AFY after accounting for changes in releases from LaGrange Dam to the Tuolumne River and reduced deliveries from LaGrange Dam to Modesto Irrigation District (Monier, 2016). In contrast, the SED (Table 9-12) estimates that under the SED40 alternative the groundwater budget of the Turlock Subbasin would become more negative by 43,600 AFY, which is equivalent to 1.5 in/yr over the 349,000-acre subbasin area. When return flows are accounted for, a decrease of 1 AFY in surface water delivery results in a negative shift of 1 AFY in the groundwater budget, assuming full replacement pumping. Thus, the SED's estimate of the increase in pumping is only 44 percent of the correct estimate (43,600 / 98,300 = 0.44).	
1169	32	[From ATT6:] The SED ignores the effects of replacement pumping on river flows, which create a positive feedback loop requiring even greater increases in pumping.The SED assumes a constant rate of groundwater seepage into the lower ends of the Tuolumne and Merced rivers and into the San Joaquin River of 30,000 AFY (page 9-14, third paragraph). It further asserts that "groundwater-surface water interactions have a relatively small effect on river flow, generally changing flow by plus or minus 2 cubic feet per second (cfs) per mile (USGS 2015)." This dismissal of the importance of groundwater-surface water interaction is unsupportable and incorrect for several reasons: -A small amount of surface flow is equivalent to a large amount of groundwater flow. A percolation rate of 2 cfs/mi along the 114 miles of river bounding the Turlock Subbasin equals 228 cfs of recharge, which is equivalent to 166,000 AFY. This is nearly four times the SED estimate of change in the subbasin groundwater budget (43,600 AFY per SED Table 9-12). Thus, the magnitude of groundwater-surface water interaction cited from the USGS study is significant in the context of the groundwater budget. -The USGS estimates of river flow gains and losses were for existing (2009?) conditions. The USGS did not simulate the effect of increased pumping on those gains and losses, which is the relevant question for evaluating LSJR flow impacts. -The USGS model was poorly calibrated to river flows. Thirty-two percent of simulated monthly river flows differed from measured flows by more than 500 cfs in the calibration simulation (USGS page 44). Therefore, the reliability of the USGS model for evaluating river flow gains and losses on the order of 2 cfs is questionable. -In the long run, rivers, drains and storage are the only head-dependent boundaries that can respond to the GW budget deficit. When a groundwater flow system experiences a change in one budget item--in this	Chapter 9, Groundwater Resources, explains that the Stanislaus, Tuolumne, and Merced Rivers include both gaining (i.e., groundwater recharges the river) and losing (i.e., river recharges the groundwater) reaches. However, the site-specific locations where the rivers are gaining or losing is difficult to determine. In either scenario, groundwater-surface water interactions are likely to have a relatively small impact on total river flow when compared to the changes in groundwater recharge and increased pumping evaluated in the SED. Therefore, the groundwater impact analysis assumes this interaction is the same in each of the LSJR alternatives. Appendix G, Agricultural Economic Effects of Lower San Joaquin River Flow Alternatives: Methodology and Modeling Results, identifies other factors that could change, but are assumed to be constant for the LSJR alternatives, including increased percolation from the rivers, which could slightly reduce groundwater effects. The potential effect of increased river seepage on surface water flows is discussed in Master Response 3.2, Surface Water Analyses and Modeling. The USGS 2015 report says that groundwater-surface water interactions generally change the flow in a portion of the Merced River by plus or minus two cubic feet per second per mile (2 cfs/mi). This is not the same as a regional percolation rate of 2 cfs/mi, as the commenter claimed. Furthermore, neither the 2 cfs/mi nor the 30,000 AFY values were used in the groundwater impact analysis. Please see Appendix G, Agricultural Economic Effects of Lower San Joaquin River Flow Alternatives: Methodology and Modeling Results, for further details regarding the assumptions for the groundwater balance and method used in the groundwater impact analysis.Evaluation of groundwater-surface water interaction requires site-specific information and dynamic groundwater modeling, which are beyond the scope of the SED. Furthermore, dynamic modeling is unnecessary for making reasonable determinations of potential changes in groundwater demand and use for the SED programmatic analysis. Please see response to Comment 1169-4

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		case additional groundwater pumping--the system responds with compensating changes in head-dependent boundary flows. Although the groundwater system extends beyond the rivers to the north, west and south, it is reasonable to assume that water levels in those areas will decline in response to the LSJR flow program by amounts similar to the declines within the Turlock Subbasin. Therefore, the Turlock Subbasin cannot rely on increased inflow from adjacent subbasins to balance its own water budget. The TID groundwater modeling analysis showed the proportions of response among the head-dependent boundaries. Over the first 40 years of LSJR Alternative 3 implementation, nearly two-thirds of the water budget response was from rivers. Because replacement pumping would diminish river and drain flows, the assumed upstream reservoir releases would no longer be sufficient to meet the target flows at downstream compliance points. Consequently, additional water would need to be released from the reservoirs to the rivers. This sets up a positive feedback loop in which decreased surface water deliveries result in replacement pumping, which increases net depletion of river flows thereby requiring increased releases to the river and further decreases in surface water deliveries. The SED ignored this feedback loop. Understanding the groundwater-surface water interaction is fundamental to evaluating the true impacts of the LSJR flow program. TID simulated the effect of replacement pumping on net river percolation using a groundwater flow model of the Turlock Subbasin.	for further information on the SED approach to the groundwater impact analysis.
1169	33	[From ATT6:] Groundwater modeling provides a more realistic estimate of the large impact of the LSJR flow program on groundwater levels and depletion of river flows.TID used its existing groundwater flow model of the Turlock Subbasin to obtain more realistic estimates of the effects of the LSJR flow program on groundwater levels, groundwater budgets and river flows. A description of the model including data and assumptions important to simulating LSJR flow alternatives is presented in Appendix A [ATT6:ATT21] of this memorandum. Groundwater flow during 2013-2052 was simulated under two scenarios: Base Case and LSJR Alternative 3 (SED40). Both simulations assumed constant land use corresponding to 2012 land use and 1973-2012 hydrology. Monthly surface water deliveries to TID and releases to the Tuolumne River from LaGrange Reservoir were developed by adding SED40 flow criteria to the existing operating rules for New Don Pedro Reservoir, LaGrange Dam and other Tuolumne River facilities (Monier, 2016). An additional set of operating rules and physical relationships was applied to translate the time series of releases from Turlock Lake into corresponding time series of canal deliveries, canal seepage, drainage well pumping, rented well pumping, and supplemental well pumping. Crop irrigation demand was estimated from crop area, rainfall, reference evapotranspiration, soil properties, root depth and irrigation efficiency. Groundwater pumping was assumed to supply any irrigation demand not met by surface water deliveries (that is, full replacement pumping). Water-level hydrographs for the Base Case and SED40 simulations at five locations across the basin illustrate the impact of SED40 on groundwater levels. The hydrograph locations are shown in Figure 3 [ATT6:ATT5] and the hydrographs are shown in Figure 4 [ATT6:ATT6]. The first three locations are in the western half of the subbasin where the Corcoran Clay is present. Hydrographs are shown for shallow wells screened above the clay and for "intermediate zone" wells below the clay. Simulated water levels for the SED40 scenario steadily declined relative to Base Case water levels throughout the simulation period at all locations. Furthermore, the amount of divergence increased from west to east (from well pair S260/M054 to well pair S382/M114) because of greater distance from rivers. The rivers are head-dependent boundaries that compensate for increased pumping by an increase in percolation from the river and/or a decrease in groundwater seepage to the river. At the westernmost hydrograph location (wells S260/M054) SED40 water levels were	Please see Master Response 3.4, Groundwater and the Sustainable Groundwater Management Act, regarding the approach to the groundwater impact analysis, including discussions of groundwater modeling and data. Please see response to Comment 1169-4 regarding the programmatic scope of the impact analyses and SED use of best available science.The State Water Board acknowledges there is more than one way to approach modeling and analysis and recognizes there may be differing opinions as to how to approach a groundwater impact analysis. However, the State Water Board is not obligated to conduct an exhaustive analysis using every approach, modeling tool, and data set available and differing opinions do not equate to inadequacy. Furthermore, a disagreement among experts does not make the SED inadequate. As discussed in response to comment 1169-4, the level of detail in the SED is reasonable and appropriate for a program-level analysis. Moreover, the information provided by the commenter (i.e., simulated results for SED40) would not change the "significant and unavoidable" groundwater impact determinations for LSJR Alternative 3.The results provided by the commenter differ from the SED, because TID modeled different assumptions and inputs than the SED groundwater impact analysis. First, groundwater modeling was not performed for the SED because groundwater modeling requires site-specific information, which is currently unknown and beyond the scope of the SED. Please see Master Response 3.4, SGMA and Groundwater, regarding groundwater modeling Second, the TID model assumed any irrigation demand not met by surface water deliveries was replaced with groundwater (i.e., full replacement pumping), which is not sustainable and will run afoul of SGMA. The groundwater impact analysis did not assume full replacement pumping; the analysis assumed (1) pumping was limited to 2009 and 2014 pumping levels (because that has been the historical response to reduced surface water) and (2) land would be fallowed if certain agricultural demands could not be met. Third, TID modeled groundwater-river interaction based on a potential increase in groundwater pumping and decrease in artificial recharge, and concluded that both groundwater levels and inflow from groundwater to the river would decrease. However, the TID model ignores groundwater-river interaction from the other direction—an increase in river flow due to the proposed flow objective could increase natural seepage from the river channel to the groundwater. Overall, the TID model appears to overestimate the impact on groundwater resources and its purported effects on surface water. Furthermore, increasing groundwater pumping to the detriment of surface streams is not sustainable or allowable under SGMA, which includes "depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water" as one of the six undesirable results that must be avoided to

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		18-20 feet lower than Base Case water levels at the end of the simulation. Near the center of the subbasin near the eastern edge of TID (wells S382/M114), water levels were 30 feet lower than Base Case water levels in both the shallow and intermediate zones. The divergence at that location was still increasing at the end of the simulation, indicating that storage changes and induced river recharge had not fully equilibrated with the increase in pumping. The amount of water-level divergence between the two scenarios diminished farther to the east, outside the area that currently receives surface water deliveries. At well M212 the water-level difference at the end of the simulation was 28 feet, and at well M167 it was 8 feet. Even though the amount of groundwater pumping near these wells was the same in both scenarios, water levels were nevertheless impacted by increased pumping to the west in TID. Hydrograph trends in the western half of the basin were more or less level in the Base Case simulation, but hydrographs in all parts of the subbasin were declining in the SED40 simulation. This confirms that the LSJR flow program with replacement groundwater pumping is not sustainable. Contour maps of groundwater elevation and change in elevation show how differences between the two scenarios vary across the subbasin. The top map in Figure 5a [ATT6:ATT8] shows simulated groundwater elevations in the shallow zone in July 2052 (the final year of the simulation) under the Base Case scenario. Note that the shallow zone is only present in the western half of the subbasin, corresponding to the areal extent of the Corcoran Clay. The middle map shows shallow-zone water levels under the SED40 scenario. In the Base Case scenario, the groundwater gradient was to the northwest, consistent with groundwater flow to the rivers. In contrast, a pumping trough had developed under the SED40 scenario. A pumping trough indicates a closed system and raises concerns about long-term salinity increases. The bottom map shows contours of the difference in shallow-zone water levels between the Base Case and SED40 simulations. The largest difference--about 30 feet--is near the eastern edge of TID in the central part of the basin. This area is farthest from the offsetting effects of induced river recharge. Changes in water levels followed a similar pattern in the intermediate zone, as shown in Figure 5b [ATT6:ATT9]. At its lowest point, the Eastside pumping trough was about 5 feet deeper under the SED40 scenario, demonstrating that the impacts of increased pumping in TID extend to the east. In the SED40 simulation (middle map), a second shallow pumping trough had developed in the western half of the subbasin. Again, this raises concerns regarding longterm accumulation of salinity in groundwater. Simulated groundwater budgets also reveal how the system responds to the increase in pumping. Figure 6 [ATT6:ATT10] shows average annual magnitudes of eleven types of basin outflow (bars extending below the X axis) and nine components of inflow (bars extending above the axis). For each item, the Base Case value is paired with the SED40 scenario value. Pumping at TID drainage, rented and supplemental wells is greater under SED40 than under the Base Case reflecting the assumption of replacement pumping. Drainage and rented wells are operated by TID. Supplemental wells are private irrigation wells used by farmers to supplement deliveries from the TID canal system. Some of the increase in pumping was balanced by decreased groundwater outflow to drains and rivers, and some was balanced by increased percolation from rivers. Those responses occurred along gaining and losing river reaches, respectively. The decrease in irrigated lands recharge reflected an assumption that irrigation efficiency is higher (and hence return flow is lower) in fields irrigated with groundwater than in fields irrigated with surface water. Table 1 [ATT6:ATT1] summarizes how these components of the water budget responded to SED40 conditions. It shows that increased percolation from rivers and decreased groundwater outflow to rivers and drains together accounted for 62 percent of the response to the increase in pumping. Discharges from drains flow to the rivers and contribute to flow needed to meet compliance. This confirms that the change in groundwater-surface water interactions--which was ignored in	achieve sustainability (Wat. Code, § 10721, subdv. x).

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		the SED--is a major impact of the LSJR flow program. This is extremely important because the effect directly undermines the objectives of the program by reducing river flows at downstream compliance points. Simply put, our modeling shows that for every acre-foot of water reallocated from TID to the Tuolumne River below LaGrange Dam, flows farther downstream along the Tuolumne, Merced and San Joaquin Rivers will be depleted by a combined total of 0.62 acre-foot due to the effects of increased groundwater pumping on net percolation from the rivers. TID did not attempt to simulate an additional iteration of the feedback loop, but it would have shown even greater amounts of replacement pumping, lower groundwater levels and greater amounts of net percolation losses from the rivers. The simulated impact of the SED40 scenario may be conservatively small because the model does not include boundary inflows that could also be impacted by the LSJR flow program. A separate groundwater flow model developed by Merced Irrigation District covers the Merced subbasin and also extends north about halfway across the Turlock subbasin (Amador, 2017). That model simulates the movement of groundwater between the subbasins. Simulations of future baseline and future LSJR flow program scenarios indicated that the Turlock Subbasin groundwater balance would become 13,100 AFY more negative under the SED40 scenario than the balance simulated by TID's model due to changes in Merced ID pumping within the Turlock Subbasin and changes in net flow between the subbasins, neither of which is included in TID's model. The effect of groundwater pumping on simulated river flows is particularly noticeable under low-flow conditions. For example, Figure 7 [ATT6:ATT11] shows profiles of simulated flow along the Tuolumne, Merced and San Joaquin Rivers in October 2032 under Base Case and SED40 conditions. The biggest effect was a decrease in groundwater and drain inflows along the lower reaches of the Tuolumne and Merced Rivers and the entire length of the San Joaquin River. At its confluence with the San Joaquin, Tuolumne River flow was 45 cfs (33 percent) lower under the SED40 scenario. In the Merced River, flow at the downstream end was 30 cfs (13 percent) lower and in the San Joaquin it was 60 cfs (20 percent) lower. Although these results are outside the February-June season targeted by the LSJR flow program, the depletion could have adverse biological effects not accounted for in the SED. Depletion of flow by groundwater pumping also occurred during February-June but was a smaller percentage of total flow. Seasonal differences in river flows can be seen more easily in the hydrograph of simulated Tuolumne River flows at the San Joaquin River confluence shown in Figure 8 [ATT6:ATT12]. Under SED40, flow was higher in spring due to increased reservoir releases but lower in summer and fall due to depletion by groundwater pumping. To the extent that the summer/fall depletion adversely impacts fish, water quality or other users, the SED failed to address this impact.	
1169	34	[ATT6:ATT1: Table 1. Response of Head-Dependent Fluxes to Changes in Specified Fluxes.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1169	35	[From ATT6:] SGMA will not be able to balance the Turlock Subbasin groundwater budget through increased recharge because all sources of water available for replenishment are tributary to the Tuolumne, Merced and San Joaquin Rivers and needed to meet LSJR flow requirements.The SED inadequately addresses the combined effects of SGMA and the LSJR flow program. The SED evades the issue by stating that "groundwater protections that will be afforded by SGMA cannot be determined at this time with precision" (page 9-3). This is incorrect. SGMA is very explicit about the undesirable results that must be prevented to demonstrate groundwater sustainability. The LSJR flow program would exacerbate three of the six undesirable effects listed in SGMA and possibly initiate the fourth. These are:	Please see response to Comment 1169-4 and response to Comment 1169-7 regarding groundwater recharge, the SED's consideration of SGMA, and the speculative nature of projecting how local pumpers will respond to implementation of the LSJR flow objectives.

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		-Chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply if continued over the planning and implementation horizon. -Significant and unreasonable reduction of groundwater storage. -Depletions of interconnected surface water that have significant and unreasonable impacts on beneficial uses of the surface water. -Significant and unreasonable land subsidence that substantially interferes with surface land uses. The water balance and groundwater modeling results demonstrate that the LSJR flow program will cause significant long-term lowering of groundwater levels, reduction in groundwater storage, and depletion of interconnected river flows. Because groundwater levels would eventually decline below historical minimums, subsidence could be initiated. Maximum annual groundwater pumping would also increase under the LSJR flow program if the reduction in surface water deliveries is replaced by groundwater pumping. Maximum annual pumping can be estimated by the difference between the largest and smallest annual amounts of delivered surface water. For the Base Case scenario, this difference was 299,000 AFY and for the SED40 scenario it was 575,000 AFY. TID has already experienced impacts of high rates of pumping during previous droughts, when relatively shallow domestic wells began to go dry as water levels declined. Dry-year declines would be even larger under the SED40 scenario, leading to even greater impacts. These undesirable results could theoretically be avoided by expanding groundwater recharge activities. However, for practical purposes, little or no water is available for replenishment because all potential local sources of stormwater, stream flow and wastewater discharge are already providing groundwater recharge or are tributary to the three rivers. In other words, those flows are already contributing to the LSJR flow requirements, and diverting them to water supply purposes would very likely end up requiring additional releases from the rim dams to continue meeting the requirements. There would be no net increase in water supply. To illustrate this point, municipal wastewater is already percolated at some treatment plants in the subbasin, and recycled water from others is already committed to irrigation and habitat enhancement projects, such as the North Valley Project. Rainfall runoff from lands overlying the subbasin only occurs under exceptionally wet conditions, when soils are already so saturated that additional infiltration is rejected. Growers in the eastern part of the subbasin are considering projects that would capture and infiltrate flows in small streams emanating from the eastern foothills, such as Sand, Mustang, MacDonald and Dry creeks. While that could benefit groundwater levels in the eastern part of the subbasin, it would divert water that currently contributes to flow in the Tuolumne, Merced and San Joaquin rivers. As a result, flows from these local streams are not likely to be available to compensate for the proposed reductions in irrigation supplies from the Tuolumne River. A recent report on water available for replenishment (WAFR) prepared by DWR for the SGMA Program implementation suggests that about 10,000 AFY of additional water might be available for replenishment in the Turlock Subbasin (DWR, 2017). That estimate is too high because the WAFR analysis was based entirely on Delta outflow generically pro-rated to individual subbasins and did not consider constraints specific to the Turlock Subbasin. Specifically, the WAFR analysis was based entirely on Delta outflow simulated using DWR's CalSim II model. That model did not account for the SED proposed LSJR flow requirements. The majority of water purportedly available for replenishment is available during February- June, which is exactly the season during which the LSJR flow requirements render the water unavailable. The WAFR report acknowledges that "more detailed analysis at a local level will need to be conducted by the GSAs as part of their groundwater sustainability plans (GSPs)." In addition,	

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		"these estimates of water available for replenishment need to be refined to provide ongoing support and technical assistance to GSAs." The SED needs to recognize the infeasibility of developing local water supplies to offset the decrease in existing surface-water deliveries under the LSJR flow program. SGMA may not be used as a mitigation measure for the SED. SGMA will, instead, require the subbasin to achieve sustainability. If, as noted above, recharge is not available to offset reduced surface water supplies, SGMA will reduce the ability to make up for lost surface water supplies with groundwater pumping, as envisioned by the scenarios described above. Simply put, without a means to recharge, SGMA will require reduced pumping to avoid undesirable results.	
1169	36	[From ATT6:] About 16 percent of TID irrigated area would have to be fallowed on average just to balance the subbasin water budget and avoid long-term water-level declines.Due to multiple erroneous assumptions, the SED substantially underestimated the magnitude of impacts on groundwater budgets and agriculture in TID. The comments logically lead to a conclusion that the LSJR flow program in conjunction with SGMA will result in fallowing of cropland in TID. Using LSJR Alternative 3 (SED40) as an example: 1. Surface water deliveries to TID would be decreased by about 98,300 AFY on average. 2. TID growers cannot replace the surface water with groundwater because increased pumping would chronically deplete storage and river flows. 3. The amount of water-level decline and storage depletion is significant and would not meet SGMA criteria for sustainability. Simulated long-term water-level declines under SED40 are as much as 30 feet in 40 years and include an area east of TID where overdraft has already caused a deep, unsustainable pumping trough. 4. Depletion of river flows is not permissible because of LSJR in-stream flow requirements. Flow depletion could not simply be offset by additional reservoir releases because those would result in still more pumping and depletion. 5. Groundwater management efforts pursuant to SGMA will not be able to offset replacement pumping by increasing recharge. Nearly all local sources of water available for replenishment are tributary to the Tuolumne, Merced and San Joaquin Rivers. No regional water supply systems (e.g., SWP or CVP) serve the Turlock Subbasin. 6. Therefore, the only way to meet LSJR flow requirements and simultaneously prevent long-term water-level declines and storage depletion would be to maintain groundwater pumping at or below current amounts. Without replacement pumping, growers will be forced to fallow land. 7. The average amount of land fallowed annually would be proportional to the decrease in long-term average surface-water deliveries for irrigation. For the SED40 case, the 98,300 AFY reduction in surface water releases from Turlock Lake for irrigation purposes equals 16 percent of average TID irrigation water supplies (611,800 AFY during 1991-2014 [TID, 2015]). Therefore, if averaged over the long run, approximately 16 percent of TID cropland would have to be fallowed under LSJR Alternative 3.	Please see Master Response 3.4, Groundwater and the Sustainable Groundwater Management Act, regarding the groundwater impact analysis and SED consideration of SGMA. The commenter assumed there is a proportional (one-to-one) relationship between surface water reduction volume and area of fallowed land. However, as described in Chapter 11, Agricultural Resources, growers could make adaptations that would keep land in agricultural production with less water, such as improving irrigation techniques and changing crop mixes. Please see Master Response 3.5, Agricultural Resources, for more information regarding the methodology and use of SWAP to determine impacts and demand management practices. Appendix G, Agricultural Economic Effects of Lower San Joaquin River Flow Alternatives: Methodology and Modeling Results, Table G.4-6e shows the estimated decrease in irrigated land for LSJR Alternative 3. Appendix G also provides further details regarding the assumptions and methodology used in the groundwater analysis.
1169	37	[From ATT6:] Variations in annual irrigation pumping would become much more extreme and cause unacceptably severe impacts on well owners.In addition to the average annual impacts of the LSJR flow program, there would be even more severe short-term impacts caused by large increases in groundwater pumping in individual years. Figure 9 [ATT6:ATT13] compares simulated annual agricultural groundwater pumping within TID under the Base Case and SED40 scenarios. The SED40 scenario assumed full replacement pumping, so the change in pumping from Base Case each year approximately equals the projected decrease in releases from Turlock Lake to the distribution canal system under the SED40 scenario. Under the Base Case scenario, agricultural pumping was exceptionally high (235,000 to 320,000 AFY) in 2017 and 2030- 2032, which correspond to hydrologic years 1977 and 1990-1992. Historically during those periods, numerous well owners reported loss	The SED adequately addresses groundwater impacts of the plan amendments. Please see response to Comment 1169-33 why full replacement pumping is not reasonable. Please see Master Response 3.4, Groundwater and the Sustainable Groundwater Management Act regarding the approach to the groundwater impact analysis.Please see responses to Comments 1169-4 and 1169-7 for discussions regarding SGMA and impacts on agricultural resources. Please also see Master Response 8.1, Local Agricultural Economic Effects and the SWAP Model, for discussion of how permanent crops are evaluated in the SED economic model. Chapter 13, Service Providers, acknowledges that private domestic wells are at a greater risk of running dry if significant groundwater impacts are allowed to continue for multiple years, especially in combination with drought, because private domestic wells are generally shallower than municipal and agricultural wells and

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		of well yield due to water-level declines. This especially impacted domestic wells, which are usually shallower than irrigation wells (Liebersbach, 2017). Regarding the impacts of the 1987-92 drought, in 1998 TID and Modesto Irrigation District submitted comments to the SWRCB on the 1995 Bay-Delta Water Quality Control Plan. Under the heading of groundwater impacts the comments indicated: "The Turlock basin is not capable of sustaining increased groundwater withdrawals to meet new demands. In 1988, the TID rented pumps from individual farmers and increased groundwater pumping over previous levels to reduce the impact of surface water delivery curtailments resulting from the ongoing drought. The lowered groundwater table resulted in a lawsuit by domestic well owners against the district which was eventually dismissed. The TID paid claims totaling more than $200,000 to claimants allegedly impacted by the district's pumping operations." This demonstrates that increased pumping during droughts can be problematic even under the Base Case scenario and would certainly be so with the much greater increases under the SED40 scenario. Under LSJR Alternative 3 (SED40 scenario), agricultural groundwater pumping in TID would more than double in many dry years. In 14 years of the 40-year simulation, pumping would exceed the 200,000 AFY threshold historically associated with decreased well yields, particularly during droughts. For instance, surface water supplies would be extremely limited during a drought similar to 1976-1977. In simulation year 2016 (hydrologic year 1976) pumping was projected to be approximately 466,000 AF in the SED40 scenario. In simulation year 2017 (hydrologic year 1977), agricultural pumping reached 577,000 AF. Similarly, for simulation years 2027-2032 (corresponding to the hydrologic years 1987-1992) replacement pumping in the SED40 scenario ranged from 357,000 AF to 467,000 AF (with an average of 420,000 AFY over the 6 year period). A large, single-year increase in groundwater pumping of these magnitudes would be agriculturally and economically devastating, much less a longer dry cycle similar to the 1976-77 and 1987-1992 droughts: -A significant percentage of crops grown in TID are tree and vine crops that cannot be fallowed for a year and resumed the following year. Water supply reliability is essential for those crops. -Domestic wells are at high risk of going dry because they are typically relatively shallow. There are about 2,900 domestic wells in TID. While it may be desirable from a long-term water management standpoint not to limit operation of basin storage based on the shallowest well, it would be a huge financial burden on rural residents to expect most of them to deepen their wells. Furthermore, the need would likely come abruptly. In the time series of pumping (Figure 9 [ATT6:ATT13]) SED40 pumping was similar to Base Case pumping until the fourth year of the simulation, when SED40 pumping soared to 470,000 AFY. Water-level declines associated with that large an increase in total pumping would impact many wells at once. The water-well drilling industry is not large enough to deepen up to 2,900 wells in one year. Furthermore, interruption of water supply at rural residences could create a health and safety issue that could not reasonably be addressed by water delivery trucks or other make-shift remedies. -Growers would be faced with the economic loss of losing their perennial crops or the very large expense of roughly doubling the number of irrigation wells. Again, when surface water deliveries abruptly drop it would not be feasible to drill enough additional wells to supply irrigation water before the permanent crops die. -Pumping, and/or fallowing of this magnitude were not analyzed in the SED. As a result, the SED clearly underestimates the impacts associated with the proposed project.	private entities generally do not have the resources to drill deep. Chapter 13 also discloses that private domestic well users could experience significant reductions in their groundwater supply, if local entities choose to replace reduced surface water supply with increased pumping in response to implementation of the plan amendments. However, as discussed in Master Response 3.6, Service Providers, SGMA provides GSAs with various authorities, including the ability to protect domestic well users by managing extractions and setting minimum thresholds that protect domestic wells.
1169	38	[From ATT6:] The SED fails to consider the cumulative impact of climate change on water supply and agricultural impacts.Watersheds draining the western slopes of the Sierra Nevada Mountains are shifting from snowmelt hydrologic regimes to rainfall hydrologic regimes. Locally, that will have a tremendous adverse impact on the water supply yields of New Don Pedro Reservoir and Lake McClure in addition to the impact of the LSJR flow	Please see Master Response 1.2, Water Quality Control Planning Process, regarding the process and the consideration of beneficial uses. Please see Master Response 6.1, Cumulative Analysis, regarding climate change related to cumulative conditions. Please see Master Response 3.2, Surface Water Analyses and Modeling, for a discussion of climate change as it relates to the quantitative analysis. The State Water Board did consider all the demand for water (see modeling description in Master Response 3.2 and Appendix F.1,

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		program. When precipitation falls as snow, the water reaches the reservoirs as a relatively steady flow in the early part of the irrigation season. A relatively large percentage of the water can be productively used for irrigation. When it falls as rain, it reaches the reservoirs as storm-related flood events in winter and early spring. A smaller percentage of annual runoff can be stored for water supply purposes due to the increased frequency of reservoir spills and/or the need for larger flood pools in the reservoirs. Climate change is not mentioned at all in the SED chapters on hydrology (Chapter 5) or groundwater (Chapter 9), nor was it accounted for in the Water Supply Effects model and other tools used for impact analysis (Appendix F). The loss of water supply due to climate change could easily be larger than the loss due to the LSJR flow program. Under Goal 6 of the LSJR flow program, the SWRCB must "take into consideration all of the demands" for water (page 3-2). In doing so, the impact of the LSJR flow program on water supplies must be considered on top of the impacts due to climate change.	Hydrologic and Water Quality Modeling). Please see Master Response 3.7, Greenhouse Gas Emissions and Analysis regarding quantifying GHG emissions and the scope and approach of the GHG analysis in Chapter 14, Energy and Greenhouse Gases.
1169	39	[From ATT6:] Page 9-13. 3rd full paragraph. When describing the San Joaquin Valley Groundwater Basin, the SED mentions that "Groundwater levels have declined by as much as 100 ft. in some areas, primarily in the southern and western-most portions of the basin outside of the plan area." This description doesn't recognize the cone of depression that has formed on the eastern side of the Turlock subbasin. Even though the Turlock subbasin was not identified as "critically overdrafted," Bulletin 118 recognizes the cone of depression and the localized overdraft. The SED misrepresents existing conditions by failing to disclose the current pumping trough and localized overdraft.	Chapter 9 acknowledges the cone of depression, including on page 9-29: "There is a fairly large cone of depression in the eastern portion of the Turlock Subbasin below land primarily irrigated with groundwater."
1169	40	[From ATT6:] Page 9-14. 1st paragraph under "Interactions between Rivers and Groundwater." The estimate of 30,000 AFY of groundwater discharge to the Tuolumne, Merced and San Joaquin rivers developed by the Turlock Groundwater Basin Association (2008) referred to discharge from the Turlock subbasin only. Groundwater also discharges into the rivers from the opposite sides in amounts probably comparable to the accretion from the Turlock side. Consequently, the WSE model specifically and the SED in general underestimates the extent of groundwater-surface water interaction and the magnitude of river flow depletion that will result from future increases in groundwater pumping.	Please see response to Comment 1169-32 and 1169-33.
1169	41	[From ATT6:] Page 9-15. 2nd paragraph under "Groundwater Balance and Elevations." The SED acknowledges that "if surface water applications are modified, then the subbasin's sustainable yield changes." A substantial amount of current groundwater yield derives from deep percolation of applied surface water. Furthermore, based on field evaluations within TID, growers tend to be more efficient in applying groundwater for irrigation than when applying surface water. Therefore, replacing surface water supplies with groundwater pumping will not only increase groundwater withdrawals but also decrease groundwater recharge.	Please see Master Response 3.4, Groundwater and the Sustainable Groundwater Management Act, regarding groundwater recharge.
1169	42	[From ATT6:] Page 9-15, last line and Figure 9-4. By describing only water-level changes during 2005-2010 and characterizing them as "generally small," the SED implies that groundwater is plentiful. Surface water deliveries during that period were above average. The SED should also describe the water-level declines during 2010-2015, which occurred within TID in addition to the eastern half of the subbasin. This would present a more complete and realistic picture of groundwater levels and availability.	The existing overdrafted nature of groundwater subbasins, including Turlock, is acknowledged throughout Chapter 9. Please See Master Response 2.5, Baseline and No Project, and Master Response 3.4, Groundwater and the Sustainable Groundwater Management Act, for discussions regarding the SED drought evaluation. Chapter 21, Drought Evaluation, describes how drought conditions, specifically the drought period of 2012-2015, are adequately characterized by the Water Supply Effects (WSE) model during the analysis period.
1169	43	[From ATT6:] Page 9-17. Table 9-4. The table describes groundwater declines and overdraft conditions within the subbasins. The estimate for the Turlock subbasin is too low because	Please see response to Comment 1169-4.

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		the referenced studies do not account for recent expansion of irrigated acreage in the eastern half of the subbasin. A study funded by DWR's Local Groundwater Assistance program documented an increase of 11,770 acres of irrigated cropland and 44,500 AFY of irrigation pumping from 2009 to 2014 (Todd Groundwater, 2016). Because that half of the basin is already in overdraft, the increase in pumping makes it even larger.	
1169	44	[From ATT6:] Page 9-18. Last paragraph before section 9.2.2. This section describes the subsidence that has occurred in the El Nido area. The last sentence in this paragraph states "Those areas that increased groundwater dependence while surface water was curtailed experienced subsidence during the drought periods, but very little subsidence between drought periods." Under the LSJR flow program, groundwater pumping in the western half of the Turlock subbasin would increase, especially during droughts. Because groundwater levels have historically been very stable, increased pumping combined with reduced recharge due to the SED would probably result in record low water levels during droughts and likely initiate subsidence.	Please see response to Comment 1169-4.Chapter 9, Groundwater Resources, acknowledges that groundwater overdraft could be exacerbated if groundwater users choose to pump more groundwater in response to reduced surface water supplies. SGMA was passed by the legislature in 2014 to address overdraft issues and associated negative impacts to groundwater basins from over-extraction. SGMA requires local public agencies in the plan area form groundwater sustainability agencies (GSAs) by June 30, 2017 and draft groundwater sustainability plans (GSPs) by 2020 for critically overdrafted basins and 2022 for all other basins. GSAs have 20 years to implement GSPs and achieve sustainability. GSAs are now formed in the plan area, but GSPs have yet to be drafted or implemented. It would be speculative to assume how pumpers in each area would respond to implementation of the LSJR flow objectives, because it will depend on many individual and collective decisions including, but not limited to, the discrete actions of local water users in response to reductions in surface water, crop choices in response to markets and other factors, conservation measures, and implementation of SGMA. The State Water Board acknowledges reaching sustainability in these overdrafted basins will be challenging, but the plan amendments do not conflict with SGMA. Instead, knowledge of the plan amendments during the GSP drafting phase allows for integrated planning of scarce water resources that does not trade impacts between surface and groundwater.
1169	45	[From ATT6:] Page 9-18. Bottom of the page. Stevinson Water District should be included in the list of agencies.	Stevinson Water District has been added in the list of agencies.
1169	46	[From ATT6:] Table 9-5. Acreage estimates. Irrigated acreage has increased in recent years in the far eastern part of the Turlock subbasin (Todd Groundwater, 2016). The irrigated area for non-district areas within Turlock subbasin should be increased by 7,580 acres, to 126,000 acres.	The SED's estimates for the total Irrigated acres in non-district areas are based on a GIS analysis of DWR 2010 agricultural land survey data, at the detailed analysis unit (DAU) level. These estimates correspond to agricultural land use levels around the baseline period of the SED (2010) and CEQA does not require the lead agency to continuously update the baseline acreages. Please see Master Response 2.5, Baseline and No Project, for discussion of Baseline land use. For more information, see Appendix G, Agricultural Economic Effects of the Lower San Joaquin River Flow Alternatives: Methodology and Modeling Results. Also, please see Master Response 3.5, Agricultural Resources, for responses to comments regarding acreage, crop mix, and use of DAU Acreage. Furthermore, the irrigated acreage for areas outside of the irrigation districts are presented to give context for the level of agricultural development in the groundwater subbasins. This information is not used in any impact determinations for the LSJR alternatives because agricultural areas outside of the irrigation districts are dependent on groundwater not surface water from the Eastside tributaries and therefore will not be directly affected by reduced surface water availability on the tributaries.
1169	47	[From ATT6:] Page 9-19. Last paragraph before "Groundwater quality." The SED states that ". . . the best indication of the potential for groundwater impacts that may occur if surface water diversions are reduced in drought years is the percentage of the irrigated area that falls within the irrigation district service areas and usually relies on surface water." This approach is reasonable because when surface water deliveries are replaced by groundwater pumping, there is a 1:1 impact on the groundwater balance. However, the impacts of lowered water levels within district service areas spread to adjacent non-district areas.	If irrigation districts decide to pump more groundwater in response to reduced surface water availability, then there would be a 1:1 impact on groundwater balance, but there are management options that the irrigation districts can adopt, and it is unknown what measures irrigation districts would adopt at this point. The impacts of groundwater level declines might spread to adjacent non-district area, but without knowing the measures irrigation districts would take to replace the reduced surface water supply, it is speculative to identify locations or estimate impacts. Please see response to Comment 1169-4 for further discussion.The SED assessed the impacts to groundwater resources at a subbasin scale by averaging the reduction in net groundwater recharge over the area of the subbasins. Please see response to Comment 1169-29 for further explanation of the approach.
1169	48	[From ATT6:] Page 9-20. First paragraph. The SED states, "The relatively low groundwater salinity on the eastern side can be attributed to the low salinity of Sierra Nevada runoff and	The information presented in Chapter 9, Groundwater Resources, Section 9.2.2, Subbasin Groundwater Use, is intended to summarize the groundwater resource uses in the four groundwater subbasins underlying the

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		application of surface water as a major irrigation source in the subbasins." While this may be true, there are saline soils on the western side of the Turlock Subbasin. Furthermore, the Turlock Subbasin has been identified in the CV-SALTS process as having higher salinity/nutrient levels than the other eastern subbasins. Once again, this comment points to important local variability that the SED conceals by averaging data over entire subbasins.	plan area and is not used in the impact determination.The SED recognizes the local variability of salinity in the plan area, as described in the latter half of the paragraph noted in the comment. It is not clear what "data" the commenter is referencing. If "data" refers to salinity, salinity was not analyzed as part of the groundwater impact analysis, and therefore, was never averaged over any subbasin. If "data" refers to the change in net groundwater recharge, then please see response to Comment 1169-29 for further explanation on normalizing net recharge over subbasin areas.Please see response to Comment 1169-4 regarding SED use of best available data and substantial evidence in the SED.
1169	49	[From ATT6:] Page 9-20. First paragraph. "In the Merced Groundwater basin, high TDS concentrations are principally the result of the migration of the deep saline water body which originates in regionally deposited marine sedimentary rocks that underlie the San Joaquin Valley." The Turlock subbasin could similarly experience upwelling of deeper saline groundwater if pumping increases in response to decreased surface water deliveries. Furthermore, increased use of groundwater for irrigation combined with decreased net outflows to rivers will tend to increase the rate of salt accumulation in groundwater due to evaporative concentration of minerals in water applied for irrigation that are later leached from the soil to the water table.	As described in Chapter 13, Service Providers, Section 13.2.1, Lower San Joaquin River and Tributaries, over pumping could affect groundwater quality in several ways (e.g., increasing the rate of saline water intrusion). Section 13.2.1 and Section 13.4.3, Impacts and Mitigation Measures, further explain that the process can be influenced by many factors which are location specific and depend on the actions that affected parties would take in response to a reduction of surface water.
1169	50	[From ATT6:] Page 9-29. First and last paragraphs. These paragraphs describe the cone of depression centered east of TID near Eastside Water District and Ballico-Cortez Water District, both of which rely entirely on groundwater. This pumping trough has been present for many years and continues to deepen. The SED does not discuss additional overdraft that is occurring even farther to the east in the Turlock Subbasin. Water levels in the eastern non-district foothills area declined approximately 160 feet from 1970 to 2013. Irrigated acreage has also increased substantially in that area since 2009, which has exacerbated the overdraft (Todd Groundwater, 2016).	Please see responses to Comment 1169-4 and Comment 1169-48 regarding the geographic scale of the SED and groundwater use within the plan area.
1169	51	[From ATT6:] Page 9-29. Under "Turlock Irrigation District." The SED estimates that the minimum pumping within the district for drainage and irrigation purposes is 100 TAF/year, and the maximum is 275 TAF/year (referencing the 2008 GWMP). More recent Agricultural Water Management Plan reports show that pumping within TID during 2010-2015 ranged from 81 to 192 TAF/y (TID 2012, 2015). However, these values account for pumping during the irrigation season only and do not include drainage pumping and some crop watering during the non-irrigation season.	As discussed in response to comment 1169-48, the information presented in Chapter 9, Groundwater Resources, Section 9.2.2, Subbasin Groundwater Use, is intended to summarize the groundwater resource uses in the four groundwater subbasins underlying the plan area and is not used in the impact determination. Information extracted from 2008 GWMPs regarding the minimum and maximum groundwater pumping is provided for reference only. As discussed in Master Response 3.4, Groundwater and the Sustainable Groundwater Management Act, the groundwater pumping data for Turlock Irrigation District (TID) used in the groundwater impact analysis is extracted from the TID 2012 Agricultural Water Management Plan, which is appropriate for estimating the level of baseline pumping for baseline (2009). Please see Master Response 2.5, Baseline and No Project, for why a lead agency is not required to continuously revise its baseline as circumstances change. Appendix G, Agricultural Economic Effects of the Lower San Joaquin River Flow Alternatives: Methodology and Modeling Results, and Appendix F1, Hydrologic and Water Quality Modeling, explain that estimates of minimum and maximum groundwater pumping for each irrigation district are based on the district's AWMP and response to the State Water Board's information request. These appendices also explain how additional groundwater pumping for irrigation shown in Figures 9-7a, b, and c is estimated. For further information on use of groundwater data, please see master Response 3.4. Please see response to comment 1169-4 regarding use of best available information.
1169	52	[From ATT6:] Page 9-29. Eastside Water District annexed additional land since the Turlock Basin Groundwater Management Plan was completed in 2008. Their area is now approximately 61,000 acres. Also, the acreage listed for Ballico-Cortez Water District appears to have an extra "0." It should be more like 6,700 acres.	Please see response to Comment 1169-48 regarding the SED summary of groundwater use in the plan area."67,000" has been modified to "6,700" in the subsection named "Eastside Water District and Ballico-Cortez Water District" in Chapter 9.

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1169	53	[From ATT6:] Page 9-37. Table 9-7 lists the Agricultural Water Management Plans referenced by the SED. For Turlock, the 2015 AWMP should have been used. It was readily available online (as required by the California Water Code).	Please see response to Comment 1169-4 regarding SED use of best available data and substantial evidence in the SED.
1169	54	[From ATT6:] Table 9-8. This table of water management strategies was purportedly developed from Agricultural Water Management Plans developed by water districts, including TID. It is unclear how the "All shortages managed with groundwater" column entry of "NA" (not applicable) for TID was determined. Within TID the only other water supply available to manage shortages is groundwater. It would be more accurate to put an "X" in that column for TID.	TID's 2012 Agricultural Water Management Plan (AWMP) indicates that groundwater is not the only means by which TID delays with surface water supply shortages. The AWMP explains there is "extensive use of internal water transfers to balance individual crop irrigation needs within the District" during periods of water shortage. TID also uses internal water transfers as a means to deal with these shortages. Therefore, it is appropriate to mark the column "All Shortages Managed with Groundwater" as "NA" in Table 9-8.Table 9-8 has been updated to clarify that although there would be increased groundwater pumping in response to surface water shortages, TID would also make "extensive use" of internal water transfers according to its 2012 AWMP.
1169	55	[From ATT6:] Page 9-41. Table 9-10. The table should include the East Stanislaus IRWMP.	East Stanislaus IRWMP has been added to Table 9-10.
1169	56	[From ATT6:] Page 9-42. Table 9-11. The list of urban water management plans in the region is incomplete. For example, the cities of Turlock and Ceres prepare UWMPs. Also, the SED was completed after the release of the 2015 UWMPs, and those most recent editions should have been used for information in the SED.	The beginning of the paragraph before Table 9-11 explains why 2015 UWMPs are not included in Table 9-11. As explained in the same paragraph, Table 9-11 lists the 2010 UWMPs that are relevant to the irrigation districts and four subbasins, and 2010 UWMPs relevant to the urban water suppliers are summarized in Chapter 13, Service Providers.
1169	57	[From ATT6:] Page 9-44. 2nd paragraph. "To the extent that water moves between subbasins, some of the groundwater impacts could have slight effects on adjoining subbasins, which would reduce the effects within the subbasins of concerns." This would not be true for the Turlock Subbasin, which is bounded by subbasins of concern. Groundwater modeling by Merced Irrigation District indicates that implementation of the LSJR flow program would decrease net groundwater flow from the Merced subbasin to the Turlock subbasin. For the SED40 scenario, their results suggest that impacts within the Turlock subbasin might be 13 percent larger than the impacts simulated using TID's groundwater model. Therefore, the SED's speculation about flows between subbasins is incorrect and results in an underestimation of the impacts to the Turlock Subbasin due to the LSJR flow program.	The sentence quoted in the comment describes a possible scenario of groundwater movement between subbasins, but it is not used as an assumption in the groundwater impact analysis.To evaluate groundwater movement between subbasins, groundwater modeling is needed. However, as discussed in response to Comment 1169-4, the SED is a programmatic assessment and groundwater modeling is not conducted for the SED.
1169	58	[From ATT6:] Page 9-44. 2nd paragraph. We acknowledge the difficulty of separating groundwater impacts by depth, but object to averaging impacts geographically over the entire subbasin area. Among other things, estimating average water-level declines over the entire Turlock subbasin underestimates the potential for subsidence. Most of the water-level declines caused by replacement pumping would occur within TID in the western half of the subbasin. Over time, that area would experience record low water levels, and it is also the part of the subbasin where compressible clay layers are most likely to be present. Consequently, subsidence is a real risk that the SED fails to adequately characterize.	Please see response to Comment 1169-29. Subsidence is programmatically addressed in Chapter 9, Groundwater.
1169	59	[From ATT6:] Page 9-46. 2nd paragraph under "Evaluation of Irrigation District Groundwater Balance and Impacts." Once again, the SED understates groundwater impacts by inappropriately averaging them over a large geographic area. The error is particularly blatant in this case because the SED calculated water balance impacts at the scale of water districts, then averaged the impacts over entire subbasins. The SED should have--and could have--calculated the water-level impacts at the scale of individual water districts where the water budget changes would occur.	Please see response to Comment 1169-29.
1169	60	[From ATT6:] Page 9-50. Figure 9-6. The period of record used for the analysis encompasses	Please see response to comment 1169-61, regarding Figure 9-6. Chapter 21, Drought Evaluation, describes

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		1922-2002, which is the period simulated by regional planning models such as CVSIM II. Updating those models is a large effort that is understandably beyond the scope of the SED analysis. However, the 2013-2016 drought was exceptionally severe. The SED should at least describe that drought in terms of precipitation, water supply shortages and groundwater levels. Even if those are within the range of conditions simulated during 1922-2002, the occurrence of the recent severe drought increases the statistical probability of droughts in characterizing future impacts.	how drought conditions, specifically the drought period of 2012-2015, are adequately characterized by the Water Supply Effects (WSE) model during the analysis period. For further discussion on the method and approach of the WSE model, please see Appendix F1, Hydrologic and Water Quality Modeling, and Master Response 3.2, Surface Water Analyses and Modeling.
1169	61	[From ATT6:] Page 9-50. Figure 9-6 partitioning of river base flow into end uses. This figure is for the Stanislaus River only. Similar figures for the Tuolumne and Merced rivers should be included.	Figure 9-6 is included as an example to illustrate the first step of the groundwater impact analysis. Partitioning for the Stanislaus, Tuolumne, and Merced Rivers are presented in Appendix G, Evaluation of San Joaquin River Flow and Southern Delta Water Quality Objectives and Implementation (see Figure G.2-1A, Partitioning of Baseline Diversions into End Uses).
1169	62	[From ATT6:] Page 9-51. Figure 9-7b. Historically, TID has experienced much more groundwater pumping and much less unmet demand than shown in Figure 9-7b. As documented elsewhere in the SED, TID lands are planted in predominantly permanent crops. In past dry cycles, there has not been the significant fallowing of permanent crops that would have had to occur to result in the amount of unmet demand shown in the figure. In addition, the sum of "minimum" and "additional" groundwater pumping in Figure 9-7b is less than 140,000 AFY during droughts. Historically, irrigation pumping in TID alone exceeded 200,000 AFY for multiple years during the 1976-1977 and 1987-1992 droughts. Furthermore, Figure 9-7b accounts only for irrigation pumping during the irrigation season. Additional pumping is required in the non-irrigation season for drainage, frost protection, unmet crop demand from rainfall, etc. The groundwater pumping identified in Table 3.5 in the AWMP only accounts for groundwater use during the irrigation season. The non-irrigation season pumping does not appear to be accounted for in the SED. As a result, the overall groundwater demand on the aquifer appears to be underestimated. Because of these errors, the SED analysis grossly underestimates the actual amount of pumping under historical conditions as well as the increase in pumping and the economic impacts of fallowing that would result from the LSJR flow program.	Please see response to Comment 1169-51 regarding how groundwater pumping for irrigation was estimated.Figure 9-7b is not intended to present historical groundwater use of TID. The figure presents modeling results for how much surface water and groundwater are available to meet applied water demands and how much unmet demand is left under Baseline conditions.The SWRCB used the best available data to conduct its analysis of district groundwater use. Minimum and maximum levels of groundwater pumping for TID are based on the reported levels of maximum and minimum groundwater use from TID's own 2012 Agricultural Water Management Plan (AWMP). These estimates include pumping from drainage wells, rental wells, and private wells during the irrigation season. Data regarding the amount of groundwater pumped during the non-irrigation season for drainage, frost protection and unmet crop demands outside of the irrigation season was not presented in TID's 2012 AWMP.Including estimates of groundwater pumping during the non-irrigation season is unnecessary for determining the effects of the LSJR alternatives. Impacts to groundwater resources are based on the change in groundwater pumping to replace reductions in surface water diversions from the Tuolumne River. Since the district does not use Tuolumne River surface water for meeting the non-irrigation season demands the amount of groundwater used to meet them will not change.
1169	63	[From ATT6:] Page 9-56. Figure 9-12. The volumes are based on the flawed assumption that pumping capacity will remain at 2009 or 2014 levels. As a result, it underestimates the likely impact of the SED alternatives on groundwater levels and budgets.	Please see response to Comment 1169-7.
1169	64	[From ATT6:] Page 9-59. 3rd full paragraph under "LSJR Alternative 2." "Under LSJR Alternative 2, the direction of groundwater flow would not change such that any existing localized groundwater contamination in the subbasins would be affected. . . . Furthermore, LSJR Alternative 2 would not cause a significant amount of applied surface water, which is relatively low EC, to be replaced with applied groundwater, which has relatively high EC. . . . Consequently, LSJR Alternative 2 would not cause an increase in salinity concentrations in the groundwater subbasins." This analysis understates salinity impacts in three respects. First, it underestimates the amount of groundwater that would be applied for irrigation. Second, it assumes that per-application irrigation efficiency is the same for surface water and groundwater. TID has found through empirical audits that irrigation efficiency is generally higher for groundwater users. This results in a higher degree of evaporative concentration of salts in the irrigation water. Third, TID's groundwater modeling shows that increased groundwater pumping to replace the lost surface water supplies in the western half of the Turlock subbasin would decrease the northwesterly groundwater gradients and even create a pumping trough. This decreases the amount of groundwater outflow, which is	The SED does not underestimate the amount of groundwater that would be applied for irrigation. As discussed in response to comment 1169-33, the groundwater impact analysis assumes replacement pumping up to 2009 and 2014 levels, unlike the TID model, which assumes full replacement pumping. The level of detail in the SED is reasonable and appropriate for a program-level analysis. As discussed in response to comment 1169-4, the SED is not meant to be, nor required to be, a site-specific analysis of, for example, each cone of depression or potential cone of depression in each basin. Moreover, it is speculative to assume how pumpers in each area would respond to implementation of the flow objectives, because it will depend on many individual and collective decisions including, but not limited to, the discrete actions of local water users in response to reductions in surface water, crop choices in response to markets and other factors, irrigation methods, and implementation of conservation measures and/or SGMA. As discussed in Chapter 9, Groundwater Resources, LSJR Alternative 2 would not likely result in groundwater quality (e.g., salinity) impacts, because "[e]stimated average net irrigation district groundwater balance under LSJR Alternative 2 is predicted to be either similar to or slightly less than under baseline conditions." In other words, LSJR Alternative 2 (without adaptive implementation) is very similar to baseline conditions and not expected to change salinity as a result. Please see Chapter 11, Agricultural Resources, Section 11.2.2, Lower San Joaquin

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		necessary to limit long-term salinity increases. Increased salinization of groundwater in the Turlock subbasin is an expected result of the LSJR flow program and a definite concern for long-term agricultural sustainability.	River Watershed and Eastside Tributaries, for information on irrigation and water quality.
1169	65	[From ATT6:] Page 9-60. 1st full paragraph. TID agrees with the statement that "it is reasonable to assume that localized groundwater contamination that exists in the subbasins could move in undesirable directions (i.e., toward water supply wells) and reduction in deep percolation of the relatively low EC surface water could also affect groundwater quality by causing a gradual increase in salinity." Even without accounting for greater evaporative concentration of applied irrigation water and decreased groundwater outflow, the SED appropriately finds this impact to be significant.	This comment does not raise significant environmental issues related to the analysis of impacts discussed in the SED or make a general comment regarding the plan amendments.
1169	66	[From ATT6:] Page 9-61. 1st full paragraph. It is the responsibility of a project applicant to fund mitigation measures identified as necessary in an environmental impact analysis. In this case, the SWRCB is the applicant and the lead agency for environmental review. The SED identifies "mitigation measures" but unreasonably assigns them to others to implement and fund. This section inappropriately uses SGMA as a mitigation measure. Although SGMA does require that agencies achieve sustainability, assigning SGMA implementation to local agencies as a means for "mitigating" for the SED impacts are inappropriate. SGMA was not designed to assign mitigation to local agencies for the SWRCB's actions. The additional impacts as a result of the SED will increase the costs associated with SGMA. It will make compliance with SGMA much more challenging as it reduces the surface water supplies available to achieve sustainability. Additionally, the SED ignores the fact that the SWRCB is the regulatory backstop to SGMA. As a result, if the local agencies are unable to achieve sustainability, made more difficult through the SED actions, the SWRCB would have to step in to achieve sustainability until such time as the local agencies can do so. SWRCB staff responsible for SGMA have been very clear that implementation of SGMA by the SWRCB would not involve anything to increase water supplies. It would simply involve reducing pumping until it falls within water supply constraints of the subbasin. However, the SED neglects to evaluate this possible future scenario, including the possible impacts to water supplies, agricultural crops, and the economy. Similarly, under the groundwater impacts section, the SED proposes as "mitigation" reductions in pumping to achieve sustainability. Reductions in pumping would reduce the amount of water available for irrigation supplies. That reduction in pumping was not evaluated and incorporated under the agricultural impacts section (where it was assumed that pumping would be able to be continued at existing levels). Therefore, the SED underestimates economic and other impacts of the LSJR flow program as a result of the proposed "mitigation" measure. The proposed "conjunctive water management program that would divert surface water during non-irrigation months (e.g., October-April) during wet years into unlined canals and designated field to recharge the groundwater" is just an untested concept. There is no analysis of whether or not such actions are feasible or if they would achieve the desired results. They are simply provided as mitigation. Such a program would be challenging. As indicated in the SED, these water supplies would likely only be available in wet years when storms have likely left fields extremely wet already, and canals are being used to convey local stormwater flows. Also, these flows are at a time when additional flows are required for the rivers under the SED, so the only water that would be available for recharge would likely be during very high flow periods. They would be the flashiest flows that are most difficult to capture and utilize. Additionally, most of the canals are lined, precluding recharge in this manner. Removing the lining would impact water supplies in dry years, causing additional seepage losses when limited supplies must be conserved. A majority of land within the TID is also permanently	Please see Master Response 1.1, General Comments, regarding the concept of mitigation as defined by CEQA and the need for mitigation measures under CEQA. Please see Master Response 3.4 for a discussion on using SGMA as a mitigation measure. As described in Master Response 3.4, it would be unreasonable to assume no groundwater pumping would occur based on historical information and based on SGMA requirements. Thus, the economic effects analysis includes some groundwater pumping using irrigation district capacities (described further in Appendix G). Furthermore, it would be speculative to assume any future reduction in groundwater pumping ability, either in response to implementation of the LSJR alternatives or under SGMA, to apply as a potential reduction in irrigation supplies. Chapter 17, Cumulative Impacts, Growth-Inducing Effects, and Irreversible Commitment of Resources, qualitatively describes potential effects to agricultural resources as a result of potential reduced pumping under SGMA. Chapter 9 acknowledges the State Water Board's complementary enforcement authorities, which at this point are mostly prospective, to ensure sustainable management of the groundwater basins in the plan area. Under SGMA, the State Water Board may, for example in 2020, exercise its enforcement authorities where groundwater sustainability agencies fail to adopt groundwater sustainability plans for high- and medium-priority basins or where such plans are inadequate. It is speculative to conjecture if, how, and where the State Water Board exercises its future enforcement authorities. Please also see the discussion of the various tools to achieve sustainability under SGMA in Master Response 3.4, Sustainable Groundwater Management Act and Groundwater.The feasibility of potential mitigation measure related to conjunctive water management program that would divert surface water during non-irrigation months (e.g., October-April) during wet years into unlined canals and designated field to recharge the groundwater is one of three broad categories of types of mitigation measures that could reduce potentially significant impacts to groundwater resources. This type of mitigation measure would depend on a number of factors including the amount of water available, type of soils, type of crops, and length of lined or unlined canals. As noted by the commenter this type of mitigation measure may only be able to be applied in certain areas within the plan area during periods of high flow. However, studies have shown that different crops in certain soil types could allow for this type of mitigation measure (Dahlke et al. 2018 and O'Geen et al., 2015). The UC Davis Soil Agricultural Groundwater Banking Index (SAGBI) map indicates that large portions of the plan area are considered to have moderate to excellent suitability for groundwater recharge (UCD 2018). Under the right circumstances, high flows may be diverted to recharge groundwater basins. As identified in Chapter 9, the types of mitigation measures listed may not reduce impacts to less than significant levels; as such, the impact to groundwater resources remains significant and unavoidable.

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		cropped. It is currently unclear how almonds and other tree crops respond to the additional water being applied in these wet cycles. Lastly, these proposed wet weather flows would need to be conveyed through the canals in the non-irrigation season, which is the only time the District is able to remove canals from service for essential maintenance. All of these constraints and subsidiary impacts are foreseeable and should have been evaluated in the SED. The SED fails to demonstrate that the proposed "mitigation measures" would be feasible, sufficient and successful in mitigating the proposed impacts.	
1169	67	[From ATT6:] Pages 9-62 through 9-64. LSJR Alternative 3. All of our above comments regarding LSJR Alternative 2 (SED pages 9-59 through 9-63) [see WQCP1.1169, comments 64-66] also apply to LSJR Alternative 3.	Please see response to Comments 1169-65 and 1169-66. Please note that LSJR Alternative 3 concludes impacts on groundwater quality would potentially be significant.
1169	68	[From ATT6:] Pages 9-65 through 9-66. All of our above comments regarding LSJR Alternative 2 (SED pages 9-59 through 9-63) [see WQCP1.1169, comments 64-66] also apply to LSJR Alternative 4.	Please see response to Comments 1169-65 and 1169-66. Please note that LSJR Alternative 4 concludes impacts on groundwater quality would be potentially significant.
1169	69	[From ATT6:] Pages 9-67 through 9-70. Subsidence impacts. The SED inappropriately limits its discussion of subsidence to areas where it has historically been measured. Although subsidence has [not] yet been detected in the Turlock subbasin, it will likely occur if groundwater pumping increases and water levels decline as a result of the LSJR flow program. Groundwater levels are most likely to decline in the western half of the subbasin, which is where the Corcoran clay is present. The Corcoran Clay is known to have subsidence potential. For all three LSJR alternatives, the SED states that, "Subsidence in the other subbasins is less likely to occur given that there is little evidence that the soils in these subbasins are subject to inelastic compaction." As a result they dismiss subsidence in basins other than the Extended Merced Subbasin. Studies done by the USGS have found significant potential for subsidence in the other subbasins within the project area. For example, one study measured little inelastic subsidence in the northern San Joaquin Valley during 2003-2010 but attributed that to the absence of drought and historical low groundwater levels during that period (Sneed and others, 2013). Another study simulated climate change through the remainder of the 21st century using a linked set of climate, hydrology, water operations and groundwater models (Hansen and others, 2012). In contrast to historical patterns, the models predicted greater subsidence on the eastern side of the San Joaquin Valley than on the western side because of a more drastic shift from surface water supplies to groundwater. Most of the Turlock Subbasin was in the two highest categories of projected subsidence ("great" and "extreme"). A compilation of clay compressibility data for the San Joaquin Valley derived from four different approaches found a fairly consistent average inelastic specific storage value of 3 x 10^-4 ft^-1 (Sneed, 2001). Studies referenced in that compilation found that about 60 percent of total alluvial thickness typically consisted of fine-grained materials. Thus, for a 600-foot-deep well there would typically be about 360 ft of fine-grained material with an overall inelastic storage coefficient of 0.11. This means that for 100 feet of water-level decline below the lowest historical water level, 11 feet of subsidence could be expected. Given simulated water-level declines of up to 30 feet in TID under SED40, this simple arithmetic suggests that 3 feet of subsidence might occur during that time frame. This is sufficient to collapse well casings and cause infrastructure concerns. The SED analysis of potential subsidence impacts in the Turlock subbasin is inadequate.	Chapter 9, Groundwater Resources, Section 9.4.2, Methods and Approach, recognizes that "Substantial groundwater depletion in an area with soils that are susceptible to inelastic compaction could result in subsidence." Impacts to groundwater were considered significant if an average decrease in irrigation district groundwater balance was equivalent to 1 inch per year or more, regardless of soil type. Subsidence risk is considered significant if reduction in net groundwater recharge is more than one inch in a subbasin where subsidence has previously occurred. Groundwater overdraft is known to occur in the southern portion of the plan area as a result of groundwater pumping. Therefore, impacts would be potentially significant and land subsidence as it relates to groundwater is discussed in Chapter 9, Groundwater Resources.Chapter 9, Groundwater Resources, acknowledges that groundwater overdraft could be exacerbated if groundwater users choose to pump more groundwater in response to reduced surface water supplies. SGMA was passed by the legislature in 2014 to address overdraft issues and associated negative impacts to groundwater basins from over-extraction. SGMA requires local public agencies in the plan area form groundwater sustainability agencies (GSAs) by June 30, 2017 and draft groundwater sustainability plans (GSPs) by 2020 for critically overdrafted basins and 2022 for all other basins. GSAs have 20 years to implement GSPs and achieve sustainability. GSAs are now formed in the plan area, but GSPs have yet to be drafted or implemented.
1169	70	[From ATT6:] Pages 9-67 through 9-70. SGMA as mitigation. The SED proposes SGMA as mitigation for groundwater impacts but fails to describe the foreseeable impacts of SGMA implementation. [We] demonstrate that substantial land fallowing will be the inevitable	Please see Master Response 3.4, Groundwater and the Sustainable Groundwater Management Act, for a discussion on using SGMA as a mitigation measure.

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		result of implementing SGMA in conjunction with the LSJR flow program. The SED must acknowledge this reality. The SWRCB again proposes SGMA as a mitigation measure. However, doing so implies that groundwater pumping might need to be reduced in order to reduce the potential for subsidence. However, the economic impacts of fallowing caused by the overall reduction in irrigation supply resulting from the LSJR program and SGMA has not been evaluated.	
1169	71	[From ATT6:] Page 9-70. Chapter 9 offers no discussion of cumulative impacts and refers to Chapter 16, where only growth-inducing impacts and irreversible commitment of resources are discussed. A major weakness throughout the SED groundwater analysis is the failure to adequately and honestly account for the cumulative impacts of the LSJR flow program with SGMA and with climate change. Both of these current and foreseeable factors greatly amplify the impact of the LSJR flow program on local water supplies and consequently on agriculture and the economy.	The cumulative impacts of SGMA and the plan amendments are discussion in Chapter 17, Cumulative Impacts, Growth-Inducing Effects, and Irreversible Commitment of Resources. Please see response to Comment 1169-4 for a discussion on the speculative nature of projecting a groundwater baseline that includes SGMA. Climate change is addressed in Chapter 14. Please also see the discussion of climate change in Master Response 3.2, Surface Water Analyses and Modeling.
1169	72	[From ATT6:] Page 9-71. References cited. It is unclear why the SWRCB used current sources for some data but not others. Some references cited were from 2016. However, the SED did not use up-to-date groundwater level data (available online from DWR) or the current updates of Agricultural Water Management Plans (2015) and Urban Water Management Plans (June 2016).	Please see Master Response 2.5, Baseline and No Project, for discussion regarding SED use of available information and data that best depicts the environmental setting for a particular resource; refer to the section on baseline conditions.
1169	73	[From ATT6:ATT21] TID groundwater model and simulation of LSJR Alternative 3 Numerical Model Development and CalibrationFor the past 15 years, TID has used a numerical groundwater model of the Turlock subbasin as an analysis tool to support water resources management. The model has been updated several times during that period to incorporate more recent input data, improve model calibration and add capabilities for simulating specific aspects of the groundwater flow and water management systems. The most recent complete documentation of the model was prepared in 2008 (Durbin, 2008). This appendix describes the main features of the model and documents data and assumptions used to simulate the future Base Case and SED40 scenarios. The model is a finite-element model that uses the FEMFLOW3D modeling software developed by the U.S. Geological Survey (Durbin and Bond, 1998). A map of the model grid is shown in Figure A-1 [ATT6:ATT14]. The simulated flow domain is bounded on the north, west and south by the Tuolumne, San Joaquin and Merced rivers, respectively. The eastern edge is a no-flow boundary representing granitic bedrock of the Sierra Nevada foothills. The model contains layers corresponding to geologic formations. Basin thickness and the number of layers both increase from east to west, as shown in Figure A-2 [ATT6:ATT15]. At the eastern edge only the Ione Formation layer is present in the model. At the western edge, the layers from top to bottom correspond to the Modesto Formation, a shallow aquitard (within the Modesto Formation), the Riverbank Formation, the Corcoran Clay, the Turlock Lake Formation, Mehrten Formation, Valley Springs Formation and Ione Formation. The layers pinch out or bend up to intersect the land surface, and the eastern extent of each model layer is truncated accordingly. The rivers are head-dependent boundaries in which seepage between the river and aquifer is a function of the water-level difference between the river surface and nearby water table and the wetted area and permeability of the riverbed. Where the river bottom is above the water table, river percolation is independent of water-table elevation and a function only of stage, width and bed permeability in the river. The river boundaries are in the top model layer. The edges of the deeper layers are no-flow boundaries. The hydraulic conductivity and specific storage of the model elements were estimated by calibration, in which simulated water levels during 1991-2012 were compared	The comment describes the TID groundwater model and the modifications and assumptions used to model the future Base Case and SED 40 scenarios. This description is provided as technical reference for other comments and does not actually comment on the SED or the plan amendments. Therefore, no further response is needed.

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		with measured water levels. Calibration was achieved by a combination of manual adjustments and optimization methods (PEST). The model incorporates spatial and temporal variations in land and water use in great detail. TID diverts surface water from the Tuolumne River and delivers it by a network of canals to agricultural lands throughout the western half of the subbasin. TID also pumps groundwater from a number of wells into the canal system to increase water availability in parts of the TID service area while decreasing shallow water table problems in other areas. Areas with shallow water table problems also have agricultural soil drainage systems. Those are included in the model as head-dependent drain boundaries. Most growers in the TID service area also operate wells to make up any differences between surface water supplies and irrigation demand, especially during droughts. Because canal operation is not perfect, some water spills from the terminal segments of the canal system back into the rivers. Growers outside the surface water delivery areas rely exclusively on wells for irrigation. A number of cities and towns pump groundwater for municipal use, riparian landowners along the rivers divert surface water privately to irrigate their fields, and a small part of Merced Irrigation District is in the Turlock subbasin adjacent to the Merced River. Irrigation demand, surface water deliveries, groundwater pumping, and recharge from canal leaks and irrigation return flow are all simulated using pre-processing programs that prepare the input files for FEMFLOW3D. For a specified time series of monthly surface water deliveries entering the canal system, these programs estimate drainage well and rented well pumping by TID, irrigation demand by crop and location (using monthly rainfall and reference evapotranspiration data), and supplemental pumping by growers. Municipal pumping data is obtained from the well operators. Canal leakage is estimated based on metered flow data from historical canal operations. Distributed recharge is estimated by means of a soil-moisture balance approach that incorporates root depth, available water capacity and assumed irrigation efficiency. During 1991-2012, distributed recharge from rainfall and irrigation return flow accounted for about two-thirds of total recharge. Percolation from rivers and canals accounted for about 13 percent and 7 percent, respectively. The remainder is divided roughly equally between Turlock Lake leakage and percolation of irrigation water, pipe leaks and septic systems in developed areas. Revisions to the model include improved estimates of irrigated area in the eastern part of the subbasin--where cropland has been expanding--and revised estimates of crop consumptive water use based on remote sensing data. Figure A-3 [ATT6:ATT16, ATT6:ATT17] shows hydrographs of simulated and measured water levels at 12 wells. This is a small subset of the 480 hydrographs evaluated during model calibration. Contours of simulated and measured water levels in April 2002 are shown in Figure A-4 [ATT6:ATT18] for intermediate-zone wells and in Figure A-5 [ATT6:ATT19] for shallow-zone wells. Although there are differences between simulated and measured water levels, the general patterns and trends match reasonably well. The magnitudes of the differences are comparable to previous calibrations of the model. Simulated annual groundwater budgets for the 1991-2012 calibration simulation are shown in Figure A-6 [ATT6:ATT20]. Two-thirds to three-fourths of the recharge is from percolation of rain and irrigation water on irrigated lands, especially lands within TID. Net recharge from rivers is the next largest source of recharge, followed by smaller amounts of leakage from Turlock Lake and canals. The largest outflows in descending order are to Eastside Water District wells, non-district wells, wells within TID, outflow to rivers, phreatophyte evapotranspiration and municipal wells. Groundwater storage was relatively low at the start of the simulation due to several preceding drought years. Several wet years increased storage by about 500,000 AF by 2001. A preponderance of dry years decreased groundwater storage by about the same amount by 2012.Data and Assumptions for Scenario Simulations The calibrated model was used to simulate two scenarios representing possible future conditions: Base Case and LSJR	

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		Alternative 3. The model grid, aquifer characteristics and boundary conditions remained the same as in the calibration simulation and were the same for both scenarios. Variables that were changed to represent future conditions are described in Table A-1 [ATT6:ATT2], along with relevant assumptions and data sources.	
1169	74	[ATT6:ATT2: Table A-1. Modeling Data and Assumptions for Simulation of Future Scenarios.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1169	75	[ATT6:ATT3: Figure 1. Map. Groundwater Elevations in Spring 2016.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1169	76	[ATT6:ATT4: Figure 2. Groundwater Hydrographs near Eastside Pumping Trough.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1169	77	[ATT6:ATT5: Figure 3. Hydrograph Locations.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1169	78	[ATT6:ATT6: Figure 4a. Hydrographs of Simulated Water Levels, Base Case, and SED40 Scenarios.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1169	79	[ATT6:ATT7: Figure 4b. Hydrographs of Simulated Water Levels, Base Case, and SED40 Scenarios.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1169	80	[ATT6:ATT8: Figure 5a. Contours of Simulated Shallow Groundwater Levels in July 2052.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1169	81	[ATT6:ATT9: Figure 5b. Contours of Simulated Intermediate Groundwater Levels in July 2052.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1169	82	[ATT6:ATT10: Figure 6. Average Annual Water Budgets for Base Case and SED40 Simulations.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1169	83	[ATT6:ATT11: Figure 7. Simulated River Flow Profiles in October 2032 (Dry Conditions).]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1169	84	[ATT6:ATT12: Figure 8. Hydrographs of Tuolumne River Flows under Base Case and SED40 Scenarios, 2013-2052.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1169	85	[ATT6:ATT13: Figure 9. Simulated Irrigation Pumping in TID, 2013-2052.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1169	86	[ATT6:ATT14: Figure A-1. Finite-Element Mesh.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1169	87	[ATT6:ATT15: Figure A-2. East-West Cross-Section Showing Hydrogeologic Units within he Groundwater Basin.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1169	88	[ATT6:ATT16: Figure A-3a. Hydrographs of Measured and Simulated Water Levels at Selected Calibration Wells, 1991-2012.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.

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1169	89	[ATT6:ATT17: Figure A-3b. Hydrographs of Measured and Simulated Water Levels at Selected Calibration Wells, 1991-2012.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1169	90	[ATT6:ATT18: Figure A-4. Intermediate Zone Water Levels, April 2002.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1169	91	[ATT6:ATT19: Figure A-5. Shallow Zone Water Levels, April 2002.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1169	92	[ATT6:ATT20: Figure A-6. Simulated Annual Groundwater Budgets, 1991-2012.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1169	93	[ATT7: Ascend Analytics, "Analysis and Critical Commentary on California's 2016 SED." March 17, 2017.]	The commenter provided this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1169	94	[From ATT7:] Under the Lower San Joaquin River Alternative 3 ('LSJR Alternative 3'), Turlock Irrigation District ('TID') and the larger San Joaquin Valley would face serious reductions in their water supply. The cutbacks in available water will cause irreparable harm to the region, threatening, particularly in the face of future drought, the economic and cultural livelihood of a vast section of California's agricultural heartland and one of the major centers of the world's almond industry.	Please see Master Response 1.1, General Comments, for responses to comments that either make a general comment regarding the plan amendments or do not raise significant environmental issues. Please see Master Response 8.0, Economic Analyses Framework and Assessment Tools, Master Response 8.1, Local Agricultural Economic Effects and the SWAP Model, and Master Response 8.2, Regional Economic Effects, regarding agricultural economic effects.
1169	95	[From ATT7:] The 2016 revised draft of the Substitute Environmental Document in Support of Potential Changes to the Water Quality Control Plan for the San Francisco Bay-Sacramento/San Joaquin Delta Estuary ('SED') fails to adequately capture the extent of the damages to the San Joaquin Valley, using biased and inconsistent assumptions that dramatically undervalue the effects of the unimpaired flow and increased carryover storage requirements on hydroelectricity.	Please see Master Response 3.2, Surface Water Analyses and Modeling, regarding hydropower and carryover storage. Please see Master Response 8.4, Non-Agricultural Economic Considerations, regarding hydropower economics. Please also see Master Response 1.1, General Comments, for responses to comments that either make a general comment regarding the plan amendments or do not raise significant environmental issues.
1169	96	[From ATT7:] Ascend Analytics ('Ascend') puts forth its analysis of the economic impacts of LSJR Alternative 3 on hydropower generated from the New Don Pedro Dam ('Don Pedro'), as well as its comments on the SED. For its analysis on hydropower, Ascend evaluates and compares sales of energy under baseline conditions and conditions induced by LSJR Alternative 3 over a 23-year horizon. Ascend's analysis reveals that the quantity of hydropower lost under the proposed alternative belies the true loss in value of hydropower. One of the most valuable assets of Don Pedro is its flexible capacity, or ability to generate power at any time with limited start-up and shut down costs. With the continual growth of intermittent renewables in California's energy market, flexible generating units will continue to increase in value, as they can respond to the increasing volatility in generation resulting from intermittent renewable generation. LSJR Alternative 3, however, would significantly restrict Don Pedro's flexibility, and in turn one of TID's chief sources of flexible generation. Ascend's analysis takes LSJR Alternative 3's impact on flexibility into account, and calculates the damages to Don Pedro's generation under five components: (1) loss of value in energy, (2) loss of value of reservoir storage capacity, (3) loss of value in flexible capacity, (4) loss of value in ancillary services, (5) loss of consumer surplus. The total net present value (NPV) of damages from 2018-2040 is shown in Table 1 [ATT7:ATT1].	Please see response to comment 1169-18 regarding hydropower and potential effects on flexibility.
1169	97	[ATT7:ATT1: Table 1. Damages for hydroelectricity under LSJR Alternative 3.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.

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1169	98	[From ATT7:] Hydropower LSJR Alternative 3 mandates 40% unimpaired flow requirements from February through June, as well as an increase in carryover storage from approximately 300 TAF to 800 TAF for the Don Pedro Reservoir. The SED states that these new requirements would have a minimal impact on Don Pedro's hydropower generation, reducing Don Pedro's revenues from hydropower by 1% (20-55). However, the SED's evaluation fails to adequately account for the actual value lost from hydropower generation under LSJR Alternative 3. Though the quantity of electricity lost under LSJR Alternative 3 is minimal, the value lost is quite significant. The value lost in electricity results largely from the constraints that LSJR Alternative 3 places on the flexibility of Don Pedro's hydropower generation.	The commenter indicates that the value of reduced hydropower generation at Don Pedro is understated because of reduced generating flexibility. The SED acknowledges that the change in quantity of electricity generated is minimal, but that there will be an effect on revenue, a point that is consistent with information contained in Chapter 20, Economic Analyses. See Master Response 8.4, Non-Agricultural Economic Considerations, related to hydropower and flexibility.
1169	99	[From ATT7:] Shifting Regional Dynamics and the Importance of Flexibility The energy market in California and the larger Western Electricity Coordinating Council (WECC) region is undergoing an unprecedented structural shift. The preeminent driver of the changing market dynamics is renewables, with renewables projected to be added to the WECC regional supply stack at 4 times the growth of base energy. Intermittent renewables such as wind and solar have negligible marginal costs, and bid at near-zero or negative prices, deriving their value mainly from renewable energy credits (RECs). As displayed in Figure 1 [ATT7:ATT2], the expected influx of cheap renewable generation shifts the supply stack to the right, effectively pricing the power plants with higher variable costs out of the market. The impact of this shift in supply fundamentals translates into broader changes in seasonal and hourly variability in power prices, discussed below, with direct carry-over to impinging on the value of Don Pedro. Figure 2 [ATT7:ATT3] illustrates more directly the downward pressure exerted by renewables on energy prices in the North of Path 15 (NP-15) zone within California ISO (CAISO). With 0% renewable penetration, the day-ahead price along the trend line is upwards of $40/MWh, while at 10% renewable penetration the day-ahead price on the trend line is approximately $25/MWh. Though increasing renewable penetration exerts downward pressure on power prices on average, it does not lower prices uniformly, and in fact causes prices to rise at certain points during the day. Solar generation in particular has a significant impact on the shape of hourly prices. As depicted in Figure 3 [ATT7:ATT4], the preponderance of solar generation during daytime hours produces the 'Duck Curve' in load, causing net load to drop in the daytime, and large ramping events from thermal generation units to occur in the evening as solar generation tails off. Figure 4 [ATT7:ATT5]below indicates that hourly prices mirror these generation behaviors. Figure 4 compares solar generation levels to the implied heat rate from 2014 to 2016. The implied heat rate, calculated by dividing the electricity price by the fuel price, gauges the maximum heat rate that would be profitable to operate given current electricity and fuel prices. The increasing solar generation over time has generally led to lower daytime implied heat rates. On the other hand, the evening implied heat rates have increased over time. The higher ramp rate requirements in the evenings induced by higher solar generation creates this increase in evening prices over time. Under these market conditions, additional pressure is put on inflexible generation, such as steam generation, since, with their long start-up and shut-down times and the high costs associated with them, they are not able to efficiently complement the intermittency of renewables. Many times inflexible generators have to stay online when they are out of the money, in order to eventually be in a position where they can operate profitably. On the other hand, since Don Pedro has no start up and shut down costs and high maximum ramp rates, it is in an excellent position to capture the value of morning and evening prices under current and future market conditions. Under LSJR Alternative 3, however, there will be more instances from February through June when Don Pedro will be compelled to release unimpaired flows during the day, when lowered energy	Please see Master Responses 8.4, Other Economic Considerations; and 3.2, Surface Water Hydrology and Hydrologic Modeling Using the Water Supply Effects Model regarding hydropower economic considerations and hydrologic changes as they relate to hydropower, respectively. The commenter notes a reality that exists regardless of the approval of the plan amendments: that increased renewable generation is transforming the market and how hydropower competes within it. The increased role of renewables are driven by factors that are unrelated to the plan amendments, especially California's Renewable Power Supply law and goals. The specific role that hydropower serves in providing flexibility not available with steam generation, and the hourly response to solar generation's daily ramp-down, continues to exist independent of the plan amendments. Master Response 8.4, Non-Agricultural Economic Considerations, explains that seasonal and hourly variability in power costs are acknowledged and considered within the SED, both in recognition of changing storage patterns and in selection of modeled prices.

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		prices from solar is flooding the market. During August to January, in order to replenish the reservoir, system operators would have less discretionary water available, especially during dry periods, with which they could serve peak load. Additionally, as intermittent renewable penetration increases, the volatility in power prices is expected to increase. Figure 5 to Figure 7 [ATT7:ATT6 to ATT7:ATT8] use CAISO market data over the last five years to illustrate the link between increased renewable generation and market price volatility. Figure 5 [ATT7:ATT6] shows the increasing proportion of load served by renewable generation on a monthly basis. Correspondingly, renewable generation grows steadily over the last five years from about 10 percent to over 20 percent. With the doubling of renewable generation, Figure 6 [ATT7:ATT7] shows a commensurate increase in the volatility of day-ahead prices. The day-ahead price volatility measures the percent variation in price (measured as the standard deviation in prices divided by the mean). The day-ahead price volatility calculations begin in 2014 at about 20% of price and doubles over 2.5 years to about 40% price. During this same 2.5 year period, renewable generation increased from 15% to 20%. However, the preponderance of price volatility effects derived from renewables resides in the real-time market [Figure 7, ATT7:ATT8]. The real-time price volatility begins at about 50% in 2014 and increase to about 300% in 2016. Figure 8 [ATT7:ATT9] provides insight into the general volatility patterns in the NP-15 real-time market, depicting the frequency of price spikes by month and year. Price spikes are defined here as when the price of power reaches or exceed $100/MWh in the real-time market. Figure 8 indicates two noteworthy patterns. Firstly, from a monthly perspective, the frequency of price spikes reaches its highest when renewables serve a greater proportion of system load. Secondly, frequency of price spikes generally peaks around 5:00 pm to 6:00 pm. During this late-afternoon, early-evening period, (1) generation is transitioning from solar to thermal generation; (2) solar generation is diminishing and particularly variable; (3) thermal generation prices are high due to start up and ramping costs; (4) the energy system is experiencing peak load. All these factors contribute to the increased frequency in price spikes. Figure 9 [ATT7:ATT10] illustrates that there is a direct relationship between renewable generation and the probability of a price spike occurring. As the amount of renewable generation in CAISO doubles from 2000 MW to 4000 MW, the probability of prices spikes in the real-time market correspondingly more than doubles. Don Pedro's flexible generation uniquely positions Don Pedro to act as a chief physical hedge in TID's supply mix against increasing market volatility. Yet the combination of the higher carryover storage requirement and increased flow requirements in LSJR Alternative 3 limits the capability of Don-Pedro to respond to these fluctuations. LSJR Alternative 3 additionally puts deleterious restrictions on Don Pedro's flexibility on a monthly scale. As Figure 10 [ATT7:ATT11] shows, the annual shape of the flows changes under LSJR Alternative 3. Higher levels of flow are expected from February to June due to the mandate for 40% unimpaired flows in this period, and, in order to both replenish the reservoir and maintain LJSR's higher carryover storage restrictions, less water will be released from August to January. Figure 10 presents the expected average monthly prices of energy in California from 2018-2040. From March to August the price of energy is expected to drop significantly, largely due to increased solar generation and demand. As Don Pedro generates coincident with flows, Don Pedro would be compelled under LSJR Alternative 3 to generate significantly more electricity during periods when the market price for power is rather low, and subsequently generate less in the later months of the year, when electricity prices rise. Thus, with the diminished flexibility under LSJR Alternative 3, Don Pedro will not only be constrained in its ability to optimize dispatch on an hourly scale, but on a monthly scale as well. As market forces increasingly spur a growth in the value of flexible generation, the SED proposal would effectively revoke Turlock Irrigation District's most valuable and cleanest source of flexible	

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		generation capacity.	
1169	100	[ATT7:ATT2: Figure 1. The changing supply stack of the WECC (Western Electricity Coordinating Council).]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1169	101	[ATT7:ATT3: Figure 2. Relation between renewable penetration and DA market prices.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1169	102	[ATT7:ATT4: Figure 3. The Duck Curve--Solar generation's impact on load.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1169	103	[ATT7:ATT5: Figure 4. Solar generation's impact on prices.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1169	104	[ATT7:ATT6: Figure 5. CAISO Average renewable proportion of load by month, Jan 2012 to June 2016.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1169	105	[ATT7:ATT7: Figure 6. CAISO volatility of day-ahead locational market price, Jan 2014 to June 2016.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1169	106	[ATT7:ATT8: Figure 7. CAISO volatility of real-time locational market price, Jan 2014 to June 2016.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1169	107	[ATT7:ATT9: Figure 8. Price spikes in NP-15 over course of year.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1169	108	[ATT7:ATT10: Figure 9. Relationship between the probability of Real-Time price spikes for CAISO and renewable generation.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1169	109	[ATT7:ATT11: Figure 10. Comparison of monthly generation under baseline and LSJR Alternative 3 relative to the forecast of the monthly market price for power.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1169	110	[From ATT7:] Value of Energy [One] component of Ascend's determination of the loss in long-term value under the proposed flow requirements is the value of energy. To model generation for the 2018-2040 study period, Ascend utilizes its PowerSimm software. PowerSimm optimizes hourly dispatch for Don Pedro to minimize costs with a mixed integer linear programming (MILP) problem. The impact on generation is quantified by running a base scenario and then a comparison run for generation under LSJR Alternative 3. Inputs for PowerSimm are TID's historical data on hydropower generation and existing flow regimes for Don Pedro from 1973 to 2015 under the baseline flow case and the LSJR Alternative 3 case, as evaluated by TID. To determine monthly generation, Ascend simulated future weather scenarios through PowerSimm. The purpose of introducing variability in weather over time is to remain consistent with actual observed climatic conditions that become obscured through using average conditions. Moreover, one of the major shortcomings of the SED is its failure to analyze the economic impacts of the increased flow and carryover storage requirements on hydroelectricity under more extreme scenarios. The SED instead only provides average estimates of annual damages. With the volatility of weather patterns expecting to increase in California in the future, it is vital for the region to understand the effect of LSJR Alternative 3 under drought conditions. Thus, in its analysis Ascend incorporates a multiyear drought, similar in character to the 1987-1992 drought, from 2020 to 2025. Don Pedro provides hydroelectricity for both TID and Modesto Irrigation District	The SED uses a transparent calculation by using long-term average prices over a full 82-year flow period to account for a truly wide range of conditions.The commenter provided an alternative simulation of hydroelectric power generation using different modeling software, which the State Water Board did not use. The software is described as utilizing historic generation and flow regime data for Don Pedro reservoir for the period 1973 through 2015, which is a different hydrologic period of record than was used in the SED. The State Water Board cannot respond to the validity of the comparison of the results presented by the commenter because they used a different model, different software, and a different hydrologic period when compared to the results presented in the SED.The fundamental basis provided by the commenters for carrying out its own simulation is that it suggests that the SED failed to consider "more extreme" weather conditions, and only provides "average estimates of annual damages." However, as described in Appendix J, Section J.2, Energy Generation Effects, monthly generation was simulated for an 82-year consecutive period of record. Thus, it includes a full range of extreme flow and carryover storage scenarios.The State Water Board reviewed the commenters' reported results, but did not review the PowerSimm model formulation or underlying assumptions prepared by the commenter; however, based on consideration of the commenter's description of the first 5 years, the results from PowerSimm and the findings in the SED seem to be consistent with that of the SED's modeling. In particular, "generation is comparatively greater from February to June for LSJR Alternative 3, while for the remaining months generation is greater for baseline" is similar to the findings in the SED (Section J-2) with the exception of October and January. The commenter's calculation of the "value of energy" seems problematic from their description, since it uses a forecasted price series in

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		(MID). However, the historical data only provides information on generation for TID, which takes approximately two-thirds of Don Pedro's annual generation. Thus, once PowerSimm developed monthly generation patterns for the study period, Ascend scaled the generation results by 1.5, to account for MID's portion of hydropower. Table 2 [ATT7:ATT12] shows the scaled results for monthly generation for the first 5 years of the study. As the results show, generation is comparatively greater from February to June for LSJR Alternative 3, while for the remaining months generation is greater for baseline. The value of energy is a function of the quantity of energy generated multiplied by the market price of power over the 2018-2040 study period. The market price of power utilized in this analysis is derived from OTC Global Holdings' forward price of power for NP-15. The monthly prices of power for the first 5 years of the study are listed below in Table 3 [ATT7:ATT13]. Monthly prices are lowest from March to June. The annual average of monthly prices is expected to increase every year; yet prices in 2019 from January to June are expected to decrease significantly. In 2019, the June price drops the by greatest percentage relative to all months, decreasing by 14%. Figure 11 [ATT7:ATT14] presents PowerSimm's evaluation of the year-to-year reduction of day-ahead sales of electricity for LSJR Alternative 3. The results show that electricity sales vary greatly depending on weather conditions. From 2020 to 2025 there is a significant reduction in sales because of drought conditions. Particularly during multi-year droughts, TID would have significantly less discretionary water with which they could generate electricity in the months after June due to the higher storage requirements and higher amounts of water that they would be mandated to release from February to June. On the other hand, during a few wet years with particularly high river flows, the proportional increase of flows under the 40% unimpaired flow requirement causes sales under LSJR Alternative 3 to be slightly greater than under baseline. The average annual reduction in electricity sales over the course of the study amounts to $810,709, which is over 2.5 times greater than the amount in reductions that the SED forecasts. Ascend's determination for the average reduction in sales under LSJR Alternative 3 corresponds to a 6% decrease relative to sales under baseline. Figure 12 [ATT7:ATT16] below depicts the net present value (NPV) of day-ahead sales of electricity from 2018 to 2040 under current flow requirements (Baseline) and LSJR Alternative 3. The NPV is calculated with a 4% discount rate to account for future cash flows. Under LSJR Alternative 3, TID would lose approximately $19.0 M in sales of electricity.	combination with a selected period of flow regimes. The price forecast calls for a large drop in energy prices in 2019, coincidentally just prior to a "drought period" from 2020 to 2025. This is the source of its calculation of total value, heavily weighted on the early years of the simulation. Yet selection of a different flow period of record might result in a very different outcome.
1169	111	[ATT7:ATT12: Table 2. Comparison of monthly generation for Don Pedro under baseline and LSJR Alternative 3.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1169	112	[ATT7:ATT13: Table 3. Monthly price of power for first 5 years of study.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1169	113	[ATT7:ATT14: Figure 11. Year-by-year reduction in day-ahead sale of electricity under LSJR Alternative 3.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1169	114	[ATT7:ATT15: Table 4. Average annual reductions in day-ahead sales for Don Pedro under LSJR Alternative 3.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1169	115	[ATT7:ATT16: Figure 12. Comparison of day-ahead sales of power for Don Pedro under current conditions and LSJR Alternative 3.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1169	116	[From ATT7:] Value of Reservoir Storage Capacity [One] component of the quantification of damages for Don Pedro is the value of lost water storage potential in the Don Pedro	The commenter appears to suggest that LSJR Alternative 3 requires that Don Pedro reservoir maintain a minimum pool of 800,000 acre-feet, as compared to its dead storage capacity of 309,000 acre-feet (and

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		reservoir that results in loss of potential generation capacity. Prevailing water flow conditions allow Don Pedro to draw from its reservoir as a contingency measure in scenarios of insufficient surface water flows. LSJR Alternative 3 restricts Don Pedro reservoir to maintain at least 800,000 acre-feet of water storage. Don Pedro's dead storage capacity is 309,000 acre-feet, and its historically lowest carryover storage was 422,000 acre-feet in 2015. With the proposed increase in carryover storage requirements, Don Pedro will be constrained in its ability to draw extra power from the reservoir. PowerSimm models future states of reservoir levels. With severe drought conditions being forecasted for future drought years, the reservoir levels are allowed to vary between 309,000 acre-feet and 1,900,000 acre-feet under baseline conditions and between 800,000 acre-feet and 1,900,000 acre-feet under LSJR Alternative 3. Stochastic simulations of future states allows capturing the variability in contingency requirements based on water flow availability to provide reliable power. Differences in modeled reservoir levels were translated into differences in potential power through dependence of power on acre-feet of water available. The conversion factor averages to 0.35 MWh/acre-feet. As Figure 13 [ATT7:ATT17] shows, the average loss in potential power available from the reservoir is 94 GWh while during the worst simulated year, the extra water drawn from the reservoir results in 158 GWh of lost energy potential. We discount power prices by 50% under this component, since the loss in reservoir storage is based on loss in potential energy sales. Assuming a discount rate of 4%, the NPV of the accumulated damages to lost energy potential are calculated to be $23.8 M over the study period.	historic low carryover storage of 422,000 acre-feet). The commenters further make the argument that the difference represents lost power production potential, especially during drought years.LSJR Alternative 3 would require additional flow be released in spring months, and that may necessitate carryover storage to reasonably protect fish and wildlife as described in Appendix K, Revised Water Quality Control Plan ("When implementing the LSJR flow objectives, the State Water Board will include minimum reservoir carryover storage targets or other requirements to help ensure that providing flows to meet the flow objectives will not have significant adverse temperature or other impacts on fish and wildlife or, if feasible, on other beneficial uses."). However, LSJR Alternative 3 does not mandate 800,000 acre-feet of storage. Instead, the analysis in the SED included a simulation of 82 years of hydrologic flow, including reasonable assumptions related to carryover storage, and therefore projected effects on change in power production (see Master Response 3.2, Surface Water Analyses and Modeling, regarding the hydrologic modeling, carryover storage, and hydropower effects).The commenters did not explain how the simulation of "future states of reservoir levels" was conducted, other than using the PowerSimm model. However, as noted in response to comment 1169-110, the formulation of the simulation including selection of the flow period and when "droughts" occur in the simulation would highly influence the calculation of loss. Early year losses are weighted more than late year losses by virtue of discounting.
1169	117	[ATT7:ATT17: Figure 13. Modeled reservoir losses (GWh) by water year type.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1169	118	[From ATT7:] Value of Flexible Capacity: Replacing Loss in Capacity with Batteries [One] component of the quantification of damages for Don Pedro is the value of capacity. Due to the 40% unimpaired river flows and the additional carryover storage required under LSJR Alternative 3, Don Pedro's capacity, or capability to generate power when profitable, is severely curtailed. Particularly in dry years, TID would have significantly less discretionary water, severely stunting Don Pedro's effective capacity. Thus under LSJR Alternative 3, Don Pedro, one of TID's most important zero-emission sources of flexible and dependable capacity, becomes an intermittent resource. To determine this loss of value, Ascend calculates replacement costs for the loss in zero-emission, flexible generation capacity. The most cost-effective, zero-emission replacement for hydropower capacity is load-shifting batteries. Ascend determines the replacement value by calculating the cost to supply 4 hours of sustained battery discharge at a level equal to the maximum hourly energy lost under LSJR Alternative 3 observed in the PowerSimm study. The maximum hourly energy lost under LSJR Alternative 3 relative to baseline is 128.5 MW, or 63% of Don Pedro's nameplate capacity. The installation cost of 4-hour load-shifting batteries is approximately $350/kWh multiplied by the battery capacity. Additionally, Ascend assumed a 15-year lifetime for load-shifting batteries, at which point the battery can be refurbished at 50% of its initial installation cost. Assuming a 4% interest rate and that battery installation costs remain unchanged at 350/kWh, Ascend calculated the NPV of battery installation over the course of the study period to be $256.1 M.	Please see Master Response 8.4, Non-Agricultural Economic Considerations, regarding potential loss of seasonal flexibility in power generation and effects of hourly fluctuations in power generation.The commenters appear to create a hypothetical source of "replacement power capacity" by essentially assuming a need for it, then assigning the capital cost of the replacement devices (batteries) as the "loss of capacity." Without evaluating the validity of the model's determination of how much battery capacity to purchase, we note that replacement power (or capacity) may be just as likely to come from other power sources in the larger energy market. In other words, the loss of flexible capacity to hydro facilities is already built into the SED calculations of effects to energy production, as reflected by the modeling of monthly generation in combination with the economic pricing analysis. It is not reasonable or appropriate to then further add battery storage to the cost or effect calculation.
1169	119	[From ATT7:] Value of Ancillary Services: Replacing Loss in Ancillary Services with Batteries [One] component that Ascend takes under consideration in its calculations of the loss of long-term value for Don Pedro is the value of ancillary services. Ancillary services provide a fast and flexible generation response to keep the supply system in balance with electricity	The commenter is relying upon a PowerSimm model with assumptions and algorithms different from what the State Water Board used in the SED, so a direct comparison with that model with what was used in the SED is not possible. However, some results from the commenter's energy analysis suggests that the commenter's findings may be overstated. For example, in Appendix J, annual generation in the Tuolumne

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		demand (load). There are two major components to ancillary services: 1) regulation reserves, and 2) contingent reserves. Regulation reserves are resources within the energy system that can respond rapidly to system-operator requests to balance out minute-to-minute fluctuations between supply and load, and keep the energy system operating at 60 Hz. Contingent reserves are resources that can be utilized in the event of unusual load requirements, particularly when a large generator trips offline. Table 5 [ATT7:ATT18] elucidates the sub-components of regulation reserves and contingent reserves. The intermittency of renewable generation largely determines the extent of regulation required, with solar in particular tending to have rapid fluctuations in generation that must be balanced out. As Figure 14 [ATT7:ATT19] shows, the volatility in solar generation (yellow line) disrupts the quiescent behavior of net-load, or load minus renewable generation (blue line), and regulation reserves (black line) is tasked with smoothing out the imbalances that arise from these fluctuations. TID is subject to rigorous ancillary service requirements, and Don Pedro services the chief portion of Turlock's ancillary service requirements. Table 6 [ATT7:ATT20] shows that on average Don Pedro services 68% of TID's Regulation-Up requirements. Moreover, TID sells generation from Don Pedro on the Spin and Regulation-Up market. With forecasts of increasing renewable penetration, the prices in the Spin and Regulation-Up markets are expected to increase. LSJR Alternative 3's constraints placed on Don Pedro's flexibility takes away Don Pedro's capability to furnish ancillary service requirements. Particularly during a dry year, we forecast that Don Pedro would not be able to provide any ancillary service requirements. Thus, Ascend determines the costs to replace Don Pedro's capability to furnish ancillary services with regulation batteries. According to PowerSimm's results, the maximum regulation requirement for Don Pedro would be 72.4 MW. Ascend calculated the NPV of costs to install a regulation battery of this capacity, plus 14% further capacity for additional reserves. The installation costs for regulation batteries are higher than load shifting batteries, amounting to $613/kWh. Ascend has assumed that regulation batteries have an eleven-year lifetime due to their extremely frequent charging/discharging. Assuming a 4% interest rate and that battery installation costs remain unchanged at $613/kWh, Ascend calculated the NPV of battery installation over the course of the study period to be $99.0 M.	(where New Don Pedro is located) is reduced by 2% for LSJR Alternative 3, and available generating capacity during peak energy-use months of July and August are reduced slightly from baseline for LSJR Alternatives 3 and 4 (Section J.4.5, Results and Conclusions). This contrasts with the commenter's suggestion that New Don Pedro would lose significant flexibility, and not be able to provide "any ancillary" service in dry years.
1169	120	[ATT7:ATT18: Table 5. Definitions of key ancillary services.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1169	121	[ATT7:ATT19: Figure 14.Comparison of regulation requirements for an energy system with higher and lower solar penetration.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1169	122	[ATT7:ATT20: Table 6. Average Percent of Ancillary Service Furnished by Don Pedro.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1169	123	[From ATT7:] Loss in Consumer Surplus Consumer surplus is the difference between how much consumers are willing and able to pay and how much they actually pay. In critically dry years, with greatly reduced power availability (i.e., reduced supply), the retail prices in the North San Joaquin Valley increases, reducing consumer surplus. Moreover, increased prices of basic commodities that result from substantially reduced agricultural output decreases consumers' willingness to pay for energy. Thus, the decrease in consumer surplus is a factor of increased retail price of electricity as well as a decreased willingness to pay. Ascend models the change in demand and supply of energy in the affected region through existing data on energy demand and historical power price dynamics. The potential change in the supply curves follows from the LSJR Alternative 3 flow requirements with demand response	Please see response to 1169-110 regarding the model the commenter used. The SED considered the effect on hydropower generation in all year types, including critically dry years, which is built into the overall analysis and conclusions. The SED also notes that ratepayers would not be substantially affected (see Section 20.3.4, Effects on Hydropower Generation, Revenues, and the Regional Economy) from changes in hydropower generation. So, there is no basis to conclude that "retail prices [of energy?] in the North San Joaquin Valley increases." Furthermore, there is no basis to conclude that there will be increased prices of basic commodities from reduced agricultural output.As articulated in Master Response 8.4, Non-Agricultural Economic Considerations, the long-run nature of the proposed plan amendments suggests that changed water supply conditions will factor into long-term planning by hydropower operators, and that both suppliers and demand responses must reflect the new energy environment. As such, it is possible and even

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		and loss in consumer surplus determined from the long-run elasticities of demand for electricity of -0.50. Ascend determines the loss in consumer surplus over the study period to be $16.4 M.	likely that historic short-run price and demand responses may not be fully representative of future conditions, and it is possible that the Ascend model is overstating the impact on consumers.
1169	124	[From ATT7:] Overall Damages - Hydropower The five components of Don-Pedro's loss in value under the proposed flow requirements amount to $388.7 M. The largest portion of the damages come from the replacement costs incurred by the loss in capacity (61.8%), and ancillary services (23.9%).	As noted in responses to comments 1169-110, -116, -118, -119, and -123 that form the basis for the total cited in this comment, the calculation by the commenter of the losses associated with Don Pedro reservoir are based on individual components with problematic assumptions and estimation procedures resulting in very high estimates of economic effects. In contrast, the SED contains a transparent procedure for estimating the effects on hydropower utilizing a full 82 period of record.
1169	125	[ATT7:ATT21: Table 7. Total damages for Don Pedro's generation under LSJR Alternative 3.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1169	126	[From ATT7:] Modeling Limitations - Outdated Prices of Power In its evaluation of hydropower revenue, the SED uses prices of power from the 80th percentile of the 2006 prices of power, since these prices most closely matched the median price for power from 1998 to 2009 (20-51). The energy market 11 years ago, however, does not adequately capture current market conditions. The influx of intermittent renewables is causing the energy market to undergo a dramatic shift, which has radically altered the monthly prices of power. The SED states, "Changes in summer hydropower generation will have a slightly greater effect on revenues because the price of energy is generally greater in summer than during the cooler months" (J- 6). While historically this has been the case, the expected influx of solar generation has significantly modified the forecasts for the monthly price for power. Figure 15 [ATT7:ATT22] illustrates the forecasted monthly prices for power from 2017 to 2019. Prices from April to June are forecasted to decline annually. The price of power in June decreases at an especially rapid rate, rendering June with the lowest monthly prices by 2019. Moreover, the information provided in the SED on the average price of power in CAISO from 1998 to 2009 is implausible. The SED offers no verifiable source for their prices of power, stating only that "monthly values available from the California Independent System Operators (ISO) during the 2006 calendar year were used in the assessment" (20-51). There are unexplained gaps in their presented monthly prices of power, and the year-to-year volatility in prices is unlike anything ever seen by Ascend. All these factors lead to doubts on the trustworthiness of their analysis.	See Master Response 8.4, Non-Agricultural Economic Considerations, related to selection of price series.The commenter indicates that the influx of renewables is causing a "dramatic shift" in the energy market. Although wind and solar energy have experienced an increase in share of California's energy production, particularly in the last several years (U.S. Energy Information Administration, 2017), the two sources combined still represented only about 6 percent of the state's 2013 in-state source of electricity (California Energy Commission, 2015).Moreover, the commenter suggests that the anticipated increase in solar generation is responsible for anticipated lower prices in April through June, implying that the selected price series in the SED did not account for these changes. However, the price series selected does reflect a similar pattern with the low price occurring somewhat earlier. It is uncertain that the commenter's forecast is any more reflective of a long-run pattern than the one selected for the SED.
1169	127	[ATT7:ATT22: Figure 15. Forward Prices of Power 2017-2019.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1169	128	[ATT7:ATT23: Figure 16. The SED's depiction of monthly prices for power from 1998-2008 (Figure 20.3.4-1 in SED).]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1169	129	[From ATT7:] Changing Crop Distributions The SED does not capture current crop distributions in California. The SED derives crop distributions from 2010 data from the California Department of Water Resources (DWR). By 2015, however, crop distributions have undergone a significant shift, with permanent crops increasing statewide by 15%. [Footnote 1: Daniel A. Sumner, "Appendix G: Acreage Data and California Drought," in Economic Analysis of the 2016 California Drought on Agriculture, preparers Josue Medellin-Azuara, Duncan MacEwan, Richard E. Howitt, Daniel A. Sumner and Jay R. Lund, (UC Davis, 2016), https://watershed.ucdavis.edu/files/Drought_Report_2016_Appendix_Set_20160811.pdf.]As Figure 17 [ATT7:ATT24] shows, the acreage of nut trees has particularly increased, with a	State Water Board used the best available science throughout the SED. A variety of data were obtained for the water quality planning process, including quantitative data from peer-reviewed published literature on topics specific to the plan area; peer-reviewed published literature outside the plan area but on topics relevant to the plan amendments; unpublished quantitative data from within the plan area and from outside of the plan area; qualitative data or personal communication with topical experts; and expert opinion if no other sources were available. Please see Master Response 2.5, Baseline and No Project, regarding the CEQA requirements for establishing the baseline and a general description of the baseline. Please see Master Response 8.1, Local Agricultural Economic Effects and the SWAP Model, regarding the Statewide Agricultural Production Model, the acres used, why they are an accurate representative for baseline purposes and for the purposes of a comparative analysis. Please see Master Response 3.5, Agricultural Resources, regarding

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		percent increase ranging from 21 to 29%. Figure 18 [ATT7:ATT25] confirms that the growth in acreage of permanent crops includes the San Joaquin Valley. From 2010 to 2015, the harvested acreages of almonds for Stanislaus County increased by 19% from 144,700 acres to 177,700 acres, while for San Joaquin County the harvested acreage of almonds and pistachios increased by 26% from 48,200 acres to 65,300 acres. Without taking these factors into consideration, the SED overestimates the acreage that is available to fallow, which leads to results for water demand that are artificially low relative to actual conditions.	the geographic area, crop mix, and baseline acres used in Chapter 11, Agricultural Resources.
1169	130	[ATT7:ATT24: Figure 17. Acreage of Nut Crops in California.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1169	131	[ATT7:ATT25: Figure 18. Harvested Acreage of Permanent Crops for the Three Counties Affected by SED.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1169	132	[From ATT7:] Intensification of Groundwater Pumping The SED assumes increased groundwater pumping without adequately accounting for its negative effects. The SED proposes on average a 40% increase in groundwater pumping, from 260 TAF to 364 TAF (ES-4). Such a sustained intensification of groundwater pumping calls for the region to exceed sustainable levels of groundwater pumping at a time when local and state governments are pushing towards further regulations of groundwater.	Please see response to Comment 1169-4.
1169	133	[From ATT7:] Geographically Limited Impact Analysis Figure 19 [ATT7:ATT26] depicts the Detailed Analysis Units (DAUs) evaluated under the SED's economic impact analysis. The report, however, does not evaluate the economic impacts on the extended plan area (outlined in gray in Figure 20 [ATT7:ATT27]), rather circumscribing the analysis exclusively to the irrigation districts. Nevertheless, the SED states that the "reduction in availability of surface water could affect water users who obtain their water from diversions anywhere within the plan area and extended plan area--anywhere within the Stanislaus, Tuolumne, and Merced River Watershed" (ES-23). Thus, the agricultural and economic damages caused by the LSJR Alternatives would in reality extend further than the demarcated area in Figure 19.	Please see Master Response 8.0, Economic Analyses Framework and Assessment Tools, regarding the regulatory context of the economic analysis. Please see Master Response 8.1, Local Agricultural Economic Effects and the SWAP Model, regarding the use of DAUs and the geographic scope of the economic analysis. As described in Chapter 20, Section 20.2, Summary of Results, "the economic analyses in this chapter assess the potential economic effects of LSJR Alternatives 2, 3, and 4 and SDWQ Alternatives 2 and 3 based on how the use of certain resources may change. The economic analyses mostly rely on impacts presented in corresponding chapters and appendices in this SED. As described in Chapter 11, Agricultural Resources, Section, 11.2.3, Extended Plan Area, and Section 11.6, Impacts and Mitigation Measures: Extended Plan Area, there are limited agricultural resources in the extended plan area and no designated Prime, Unique, and Farmland of Statewide Importance. Much of the extended plan area is designated as nonagricultural with some acreage in grazing. Impacts are determined to be less than significant on agricultural resources in the extended plan area and as such are not evaluated in the economic analysis in Chapter 20. Please see Master Response 8.4, Non-Agricultural Economic Considerations, regarding potential recreation-related economic effects in the plan area and extended plan area and Master Response 8.5, Assessment of Potential Effects on the San Francisco Bay Area Regional Water System, regarding potential hydropower-related economic effects in the extended plan area.
1169	134	[ATT7:ATT26: Figure 19. Area analyzed for economic impacts of the 2016 SED.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1169	135	[ATT7:ATT27: Figure 20. Plan area and extended plan area.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1169	136	[From ATT7:] Limitations in the Presentation of Results The SED reports only the average annual reductions in agricultural revenues under the LSJR Alternatives. Given that the revenue losses are not normally distributed or symmetric, the average loss is not representative of the distribution of losses. Exclusively presenting the average economic impacts smooths out the volatility of the year-to-year water reductions and economic losses, and in turn does not inform the reader of the range of expected losses incurred by	Please see Master Response 2.3, Presentation of Data and Results in SED and Responses to Comments, for discussion of why average results were presented. In addition, please see Master Response 8.1, Local Agricultural Economics Effects and the SWAP Model, and Master Response 8.2, Regional Agricultural Economic Effects, for presentation of the results of the revised SWAP model run averaged by water year type.

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		the LSJR Alternatives. For example, the WSE model determines that the reduction in water supply relative to baseline under LSJR Alternative 3 would on average be 38% in critically dry years (ES-23), and that there would concomitantly be a 23% increase in unmet water demand during critically dry years (ES-26). On the other hand, the average reduction in water supply is 14%, while the average unmet demand is 11%. By not clearly presenting information on the economic impacts during drier years, the SED inadequately represents the extent of potential damages incurred by the LSJR Alternatives.	
1169	137	[From ATT7:] Changing Climate Patterns The SED model does not adequately capture the changing variability in weather caused by climate change. As the California Department of Water Resources states, "Climate change is also expected to result in more variable weather patterns throughout California. More variability can lead to longer and more severe droughts." [Footnote 3: "Climate Change," California Department of Water Resources, http://www.water.ca.gov/climatechange/.]Relying on historical data ranging from 1922-2003, the SED does not factor into their model expectations for increased volatility in weather. An accurate representation of this volatility is key to understanding the risk of permanent damage to perennial crops and the associated economic losses. Increased likelihood of sequential dry years means more fruit and nut trees will die due to lack of water, and more acres of land will be converted to non-farming uses.	Please see Master Response 3.2, Surface Water Analyses and Modeling, for a discussion of climate change as it relates to the quantitative analysis. Please see Master Response 3.5, Agricultural Resources, for a discussion of consecutive dry years and potential effects on different crops.
1169	138	[From ATT7:] The Cost of Water and its Alternatives In Chapter 16 of the SED, SWRCB provides multiple alternatives for offsetting the losses in surface water supply induced by LSJR Alternative 3. Though at first glance these alternatives may seem to provide the necessary and adequate responses to the water supply reductions, none of the alternatives offer sustainable long-term solutions to the shortages that TID and the whole San Joaquin Valley would be facing.	As discussed in Chapter 16, Evaluation of Other Indirect and Additional Actions, the State Water Board does not mandate or require that any action evaluated in Chapter 16 be implemented. The State Water Board is only required to analyze reasonably foreseeable actions that entities could take. The fundamental purpose and goal of the LSJR flow objectives is to establish LSJR flow objectives during the February–June period and a program of implementation for the reasonable protection of fish and wildlife beneficial uses in the Lower San Joaquin River Watershed, including the three eastside, salmon-bearing tributaries, Stanislaus, Tuolumne, and Merced Rivers, as discussed in Chapter 3, Alternatives Description. The unsustainable use of surface water and/or groundwater that has occurred in the past in the plan area, cannot be attributed to the plan amendments or the goals of the plan amendments. For example, as discussed in Master Response 3.4, Groundwater and the Sustainable Groundwater Management Act, current groundwater overdraft is a legacy issue and is the result of over-pumping of ground water for irrigation, unstainable expansion of the agricultural land. In the San Joaquin River Hydrologic Region, the majority of groundwater supply is used for sustaining and expanding agriculture (see Master Response 3.4). The analysis in Chapter 16, Section 16.2, Lower San Joaquin River Alternatives—Other Indirect Actions, programmatically evaluates a suite of reasonably foreseeable actions affected entities may undertake to address possible surface water supply reductions anticipated under the proposed flow objectives and analyzes the indirect environmental impacts associated with those actions. These actions can be implemented as long-term or short-term solutions depending on the actual means by which affected entities choose to implement the projects. Feasibility and duration of an action or a combination of actions are functions of many factors, and should be assessed at the project level.
1169	139	[From ATT7:] Long-Term Water Transfers The SED puts forth the option of affected parties engaging in long-term water transfers in the face of a water shortage. The State Water Board, citing a 2006 report of US Bureau of Reclamation, indicates a reasonable average price for long-term water purchases to be $310 per acre foot (2010 USD) (16-7). However, these prices do not take into account TID's geographic location and the lack of preexisting infrastructure for implementing water transfers. As Turlock is not connected to any aqueducts and its neighbors downstream will also be facing water shortages under the new flow requirements, the possibility of water transfers are extremely limited. Furthermore,	Please see Master Response 1.1, General Comments, regarding the overall approach to the analyses contained in the SED and the programmatic nature of the plan amendments. The plan amendments do not mandate or require any action evaluated in Chapter 16 be implemented. Transfer and sale of surface water are included in Chapter 16, Evaluation of Other Indirect and Additional Actions, because these have occurred between different parties in California. As described in Chapter 16, actions entities might take depend on their circumstances and factors that may be external to them that influence their unique decision-making processes. Although entities may elect not to pursue certain other indirect or additional actions under some circumstances, it is reasonable to include them in a portfolio of possible actions because they were

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		Howitt et al. (2012) report that the only feasible inter-regional water transfers for TID or Modesto Irrigation District (MID) are with Merced Irrigation District. [Footnote 4: Richard E. Howitt, Josue Medellin-Azuara, Duncan MacEwan, and Jay R. Lund, "Calibrating disaggregate economic models of production and water management," Environmental Modelling & Software, 38 (2012), 244-258.] The historical data confirm Howitt et al.'s evaluation on the dearth of water transfers within region. The only water transfers recorded in the Western Water Transfer Data Set involving TID are two short-term transfers to the Bureau of Reclamation in 1990 and 2001. [Footnote 5: "California Water Transfer Records," Bren School of Environmental Science & Management, http://www.bren.ucsb.edu/news/water_transfers.htm.]Theoretically, TID could enter into water purchase agreement with the City and County of San Francisco, who owns and operates the Hetch Hetchy Reservoir, Cherry Lake and Lake Eleanor upstream. However, water transfers from urban to agricultural regions are extremely rare in California. Out of the 691 California water transfers recorded in Western Water Transfer Data Set, only 10 were urban to agriculture transfers. Moreover, San Francisco has not been looking to sell water to other irrigation districts, but buy water from them. Recently, SFPUC, attempting to secure backup water sources in response to the drought, was negotiating with Modesto Irrigation District (MID) for a long-term water transfer of 2,240 AF per year at a price of $700/AF. [Footnote 6: "MID Water Transfer FAQ," Modesto Irrigation District, http://www.mid.org/about/newsroom/projects/watertransfer/documents/MIDWaterTransferFAQ_5-17-12.pdf] (MID withdrew from negotiations due to local resistance against the transfer.) Additionally, SFPUC expects to experience exacerbated water shortages under SED's proposed flow requirements. Hetch Hetchy Regional Water System, suggest that the implementation of the proposed flows could cause a shortage of 52% under drought conditions. [Footnote 7: Ellen Levin, Donn Furman, Dan Steiner, David Sunding, "City and County of San Francisco Comments on the State Water Resources Control Board Substitute Environment Document," SFPUC, March 21, 2013, http://www.swrcb.ca.gov/waterrights/water_issues/programs/bay_delta/docs/dsedoc/sanfranciscocity.pdf.] Assistant General Manager Steven Ritchie of the San Francisco Water Enterprise states that, with the new flow requirements, the number of dry year shortages for San Francisco would double or triple. [Footnote 8: San Francisco Public Utilities Commission, "Minutes," January 10, 2017, http://www.sfwater.org/Modules/ShowDocument.aspx?documentID=10281.] As the SED notes, the LSJR Alternatives have the potential to negatively affect the CCSF's water supply, especially during a drought. It should be noted that the SED accounts for this, mentioning the potential for SFPUC to buy water from other irrigation districts at $1000/AF. However, they do not account for other irrigation districts, which, threatened by shortage, would also be in want of additional sources of water at this time. Moreover, growers in the region would have less flexibility than in the past because of the increase of permanent crop acreage within the region, which has hardened water demand. Sumner (2016) reports that permanent crops have increased statewide by 15% or 421,000 acres. [Footnote 9: Daniel A. Sumner, "Appendix G: Acreage Data and California Drought," in Economic Analysis of the 2016 California Drought on Agriculture, preparers Josue Medellin-Azuara, Duncan MacEwan, Richard E. Howitt, Daniel A. Sumner and Jay R. Lund, (UC Davis, 2016), https://watershed.ucdavis.edu/files/Drought_Report_2016_Appendix_Set_20160811.pdf.] Figure 21 [ATT7:ATT28] shows that the harvested acreage of almonds for Stanislaus County nearly doubles from 97,300 acres in 2010 to 177,700 acres in 2015. Unlike with low-value, annual crops, growers do not have incentive to fallow their permanent crops. Drought conditions would only increase the price of potential water purchases. For example, "Average prices in the [Central Valley] spot market soared in 2014, rising from an average of	considered in the past and may be appropriate for further consideration depending on how circumstances change. Furthermore, it is acknowledged in Chapter 16 and Appendix L, City and County of San Francisco Analyses, that a number of factors influence the price of a water transfer, including the amount of water and the demand for the water. The SED does not suggest that CCSF would transfer water to irrigation districts as theorized in the comment, because this action is unlikely or rare as stated in the comment. Purchasing water will reflect market values. The approach to evaluating the agricultural economic impacts is described in Master Response 8.1, Local Agricultural Economic Effects and the SWAP Model. The approach includes an evaluation of how the crop mix may change within the plan area or irrigation district based on a reduction in irrigation supply. That reduction is not offset in the analysis by water transfers. If an irrigation district chooses to supplement or offset the reduction in surface water supply with other water sources or with a water transfer, the cost to do so may be higher for the replacement water, and district-wide net revenue could be less as a result. Other factors would influence this decision, such as implementing irrigation efficiencies or other conservation measures to "create" additional water supply (see Master Response 3.5 for a discussion of these potential measures).Please see Master Response 8.5, Assessment of Potential Effects on the San Francisco Bay Area Regional Water System, for more information regarding the price of recent water transfers, as well as information related specifically to CCSF.Please see Master Response 3.6, Service Providers, for more information regarding municipal water use as compared to agricultural water use and municipal alternative water supply sources in the plan area as they relate to water transfers and also information regarding prices of recent water transfers. Please see Master Response 3.5 regarding the management of permanent crops and SWAP model results for permanent crops.

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		$180/AF in 2013 to $830/AF in 2014 as a result of the drought and record low water allocation." [Footnote 10: "WestWater Research Announces 2014 Water Rights Price Index Results," WestWater Research, 2015, http://www.waterexchange.com/wp-content/uploads/2015/09/15-0916-Q3-WWInsider-fnl-LO.pdf.] Prices for water in the Central Valley for 2014 went as high as $1,350/AF. [Footnote 11: Lisa M. Krieger, "California Drought: High-bidding farmers battle in water auctions," The Mercury News, July 19, 2014, http://www.mercurynews.com/2014/07/19/california-drought-high-bidding-farmers-battle-in-waterauctions/.] The SED additionally provides prices on permanent water rights, indicating the average cost of permanent water rights to be $1,716/AF. However, their data is from 2002 to 2004, and the price of water is widely variable. Others sources provide the price for permanent water rights to be anywhere from $3,225/AF to $5,850/AF, increasing up to $8,663/AF when a reliability factor is incorporated. [Footnote 12: Indio Water Authority, "Supplemental Water Supply Program and Fee Study," http://www.indiowater.org/Modules/ShowDocument.aspx?documentid=2801.] [Footnote 13: Kavita Jain-Cocks, "California's Water Rights Controversy: Should farmers be Allowed to Transfer Water to Developers?" November 30, 2010, http://blogs.ei.columbia.edu/2010/11/30/california%E2%80%99s-water-rightscontroversy-should-farmers-be-allowed-to-transfer-water-to-developers/.] As explained above in regards to long-term water transfers, a purchase of permanent waters rights would be highly unlikely and prohibitively costly under the LSJR Alternatives, as other irrigation districts, utility companies and growers in the region will face water shortages and disincentives to permanently selling their water.	
1169	140	[ATT7:ATT28: Figure 21. Harvested Acreage of permanent crops for three affected counties, 2010-2015.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1169	141	[From ATT7:] Groundwater Groundwater seems to provide the simplest option for offsetting water losses associated with the implementation of LSJR Alternative 3. The SED presents typical groundwater costs for agriculture in the San Joaquin Valley in the range of $48-$64/AF for agriculture (16-18) and anywhere from $62-$1,937/AF for municipal groundwater production (16-19). Increased groundwater pumping, however, is an acceptable fallback option in periods of droughts, but not a long-term solution to meet the region's water needs under a structural water shortage. Groundwater essentially functions as a contingency reserve during drought. LSJR Alternative 3 would, according to the SED, increase groundwater pumping within the plan area by 40% on average, and increase groundwater pumping by 73% for the three driest water year types (below normal, dry, and critically dry), which make up 51% of the historical years analyzed. To ask the plan area to increase their groundwater pumping by 73% for over half the time would deplete the groundwater reserves significantly, leaving the region with no safety net to fall back on in the event of future droughts. Groundwater overdraft is already a major concern in California. Since 1962, the Central Valley has depleted groundwater reserves by nearly 80 MAF. [Footnote 14: Bettina Boxall, "Overpumping of Central Valley groundwater creating a crisis, experts say," Los Angeles Times, March 18, 2015, http://www.latimes.com/local/california/la-me-groundwater-20150318-story.html.] In 2014, certain areas in the San Joaquin Valley registered groundwater levels at more than 100 feet below historic levels. [Footnote 15: Janny Choy and Geoff McGhee, "Groundwater: Ignore It, and It Might Go Away," Water in the West (Stanford: 2014), http://waterinthewest.stanford.edu/groundwater/overview/index.html.]The Department of Water Resources states that the groundwater elevation in the Turlock-San Joaquin Valley has from 1971 to 2013 decreased by an average of 2.1 ft/yr. [Footnote 16: Department of	Please see responses to Comments 1169-4 and 1169-7. Water quality and subsidence impacts are evaluated in Chapter 9, Groundwater. Groundwater pumping as it relates to energy impacts is discussed in Chapter 14, Energy and Greenhouse Gases. Please see Master Response 3.4, Sustainable Groundwater Management Act and Groundwater, for responses to comments regarding groundwater dependent ecosystems.

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		Water Resources, Public Update for Drought Response: Groundwater Basins with Potential Water Shortages and Gaps in Groundwater Monitoring, 2014, page 29, http://www.water.ca.gov/waterconditions/docs/Drought_Response-Groundwater_Basins_April30_Final_BC.pdf.] As UC Davis Professor Richard Howitt remarks, the current situation of groundwater in California is "a slow-moving train wreck." [Footnote 17: Kat Kerlin, "Drought impact study: California agriculture faces greatest water loss even seen," UC Davis News, Jul 15, 2014, https://www.ucdavis.edu/news/drought-impact-study-california-agriculture-faces-greatest-water-lossever-seen.] Unlike surface water in California, groundwater has largely been unregulated, and, until 2015, it was the only state that lacked a statewide framework for managing groundwater. [Footnote 19: Id.] In response to systemic overdrafts of groundwater, the state of California has moved towards developing groundwater regulations with the Sustainable Groundwater Management Act (SGMA). As noted in the SED, SGMA is supposed to protect California's groundwater from "undesirable results" such as the unreasonable reductions and chronic lowering of groundwater levels (9-33). Thus, the SED proposal places the affected districts in an impossible position, encouraging them increase groundwater pumping and move contrary to the direction that California's policy is moving in. Alongside depleting the region's drought reserve of water, there are multiple other deleterious effects associated with overpumping groundwater, none of which are rigorously evaluated in the SED. Ground water overdraft can lead to: -Diminished water quality and increased probabilities of water contamination. As groundwater levels decline, natural and manmade pollutants can concentrate in the remaining groundwater, rendering the water unsafe for irrigation or potable use. The potential for contamination is particularly a problem for agricultural areas, which have higher concentrations of nitrates. The concentration of nitrates are growing in agricultural areas, and the costs of removing nitrates are prohibitively high. [Footnote 20: Thomas Harter and Jay Lund, Addressing Nitrates in California's Drinking Water, (UC Davis, 2012), http://groundwaternitrate.ucdavis.edu/files/138956.pdf.]Professor Jay Lund of UC Davis states, "Most agricultural areas can expect nitrate contamination of drinking water supplies. Source control of nitrate discharge is only a partial long-term solution because of the large extent of contamination and its decades of travel in groundwater." [Footnote 21: Jay Lund and Thomas Harter, "California's groundwater problems and prospects," California WaterBlog, January 30, 2013, https://californiawaterblog.com/2013/01/30/californias-groundwater-problems-and-prospects/.] Turlock had 4 groundwater wells closed due to contamination of nitrates. In Modesto, where there are 12 active groundwater wells, four have been offline due to water quality issues. [Footnote 22: Turlock Irrigation District, Groundwater Management Plan, March, 2008, http://www.tid.org/sites/default/files/documents/tidweb_content/TID2015AWMPAttachments_Public%20Review.pdf.] Additionally, salt accumulation can result from overpumping. The cost of desalinating brackish water can range from $950-$1,800/AF. [Footnote 23: Heather Cooley and Rapichan Phurisamban, The Cost of Alternative Water Supply and Efficiency Options in California, (Pacific Institute, 2016), http://pacinst.org/app/uploads/2016/10/PI_TheCostofAlternativeWaterSupplyEfficiencyOptionsinCA.pdf.] A 2009 UC Davis study states that if salinity levels continue to increase in the Central Valley at current rates, there would be a $2.8 B to $5.3 B reduction in output in the Central Valley. [Footnote 24: Richard Howitt, Jonathan Kaplan, Douglas Larson, Duncan MacEwan, Josue Medellin-Azuara, Gerald Horner and Nancy S. Lee, The Economic Impacts of Central Valley Salinity, (UC Davis, 2009), http://www.waterboards.ca.gov/centralvalley/water_issues/salinity/library_reports_programs/econ_rpt_final.pdf.] -Increasing energy usage and cost of pumping groundwater, as aquifer levels decrease. -Land subsidence. In the San Joaquin Valley, subsidence	

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		necessitated by overdraft from 1955 to 1972 results in what would be $1.3 B in infrastructure repairs. Subsidence in Santa Clara Valley is estimated to have resulted in more than $756 million in costs. [Footnote 25: "Land Subsidence from Groundwater Use in California," (Luhdorff & Scalmanini Consulting Engineers, 2014), ES-2, http://waterfoundation.net/wp-content/uploads/PDF/1397858208-SUBSIDENCEFULLREPORT_FINAL.pdf.] -Deterioration of groundwater-dependent ecosystems, and species, some of which are endangered. Groundwater pumping also reduces water flow in many nearby rivers and wetlands. Scott River's average late-summer streamflow decreased by about 50% in the 1970s. The driving factor was farmers switching from surface water to groundwater to irrigate their fields. [Footnote26: Gus Tolley, "Scott Valley pioneers instream flow and groundwater management for reconciled water use," California WaterBlog, August 21, 2016, https://californiawaterblog.com/2016/08/21/scott-valley-pioneersinstream-flow-and-groundwater-management-for-reconciled-water-use/.]	
1169	142	[ATT7:ATT29: Table 8. Projected percent increase of average annual groundwater use under LSJR Alternative 3.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1169	143	[ATT7:ATT30: Figure 22. Change in Groundwater levels between 2013-2014 in California.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1169	144	[From ATT7:] Recycled Water The SED presents the average price for recycled water to be $400-$2,100/AF (2011 USD) for irrigation, and $700-$1,200/AF for direct potable use. The Pacific Institute (2016) conducted a survey of 13 water recycling facilities in California and found the total costs to recycle water to range from $1,500/AF to $2,100/AF for non-potable reuse, and $1,600/AF to $2,700/AF for the cost of indirect potable reuse. [Footnote 27: Heather Cooley and Rapichan Phurisamban, The Cost of Alternative Water Supply and Efficiency Options in California, (Pacific Institute, 2016), http://pacinst.org/app/uploads/2016/10/PI_TheCostofAlternativeWaterSupplyEfficiencyOptionsinCA.pdf.]The California Public Utilities Company's 2016 survey of California water recycling projects shows higher costs, with the average cost of recycled water being $2,869/AF. [Footnote 28: California Public Utilities Commission, What Will Be the Cost for Water?, January 12, 2016, http://www.cpuc.ca.gov/uploadedFiles/CPUC_Public_Website/Content/About_Us/Organization/Divisions/Policy_and_Planning/PPD_Work/PPD_Work_Products_(2014_forward)/PPD%20-%20Production%20costs%20for%20new%20water.pdf.] Such price levels are prohibitive for maintaining agricultural production in the area. Moreover, the plan area's districts are unable to supply sufficient quantities of recycled water at reasonable costs. Recycled water projects are most effective in urban areas, where there is a significant amount of wastewater produced, and in turn is significantly limited in less densely populated agricultural regions. [Footnote 29: Jeremy Cusimano, Jean E. McLain, Susanna Eden, and Channah Rock, "Agricultural Use of Recycled Water for Crop Production in Arizona," (College of Agriculture & Life Sciences, 2015), page 1.]	Please see Master Response 1.1, General Comments, for responses to comments that either make a general comment regarding the plan amendments or do not raise significant environmental issues. Additionally, please refer to Master Response 3.5, Agricultural Resources, for a discussion of the potential use of demand management techniques to reduce potentially significant impacts to agricultural land use. For information regarding agricultural economic effects, please see Master Response 8.0, Economic Analyses Framework and Assessment Tools, 8.1, Local Agricultural Economic Effects, and 8.2, Regional Economic Effects. In addition, Chapter 11, Agricultural Resources, does not suggest water recycling as a mitigation measure for agricultural effects.
1169	145	[From ATT7:] Aquifer Storage and Recovery Aquifer storage recovery is an important way to mitigate some of the water loss, and many of the irrigation districts in San Joaquin Valley are developing and expanding conjunctive use of surface water and groundwater. However, aquifers storage is unable to absorb and discharge large volumes of water in a short period of time. [Footnote 30: "Chapter 2" in Regional Issue in Aquifer Storage and Recovery for Everglades Restoration, (Washington, D.C.: National Academies Press, 2002),	Chapter 16, Evaluation of Other Indirect and Additional Actions, Section 16.2.3, Storage and Recovery, identifies aquifer storage and recovery as one the actions affected entities may take to develop alternative water supply sources to replace surface water that may no longer be available, if it is appropriate based on individual circumstance. Chapter 16 also provides an evaluation of the costs and potential environmental impacts associated with this action. The SED does not suggest aquifer storage and recovery is the only

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		https://www.nap.edu/read/10521/chapter/2.]Additionally there can be significant concerns, around water contamination in these wells. [Footnote 31: California State Water Board, Staff Report: General Information Regarding Potential Water Quality Impacts of Aquifer Storage and Recovery Projects, http://www.waterboards.ca.gov/rwqcb5/board_decisions/tentative_orders/0409/aquifer_storage/asr-issuepaper.pdf.] Thus aquifer storage and recovery, though beneficial, does not provide all the replacement water needed to meet the region's water needs. Though the SED provides a 20-year amortized cost of $158-238/AF (2009 USD) (16-40), they also mention that cost can be highly variable depending on local conditions (22-23). Water in the West puts forth the cost of groundwater recharge projects at $90-$1,100/AF (2014 USD), with the median price being $390/AF, or approximately 79% greater the SED's mean price, when inflation is accounted for.	option that affected entities can take.
1169	146	[From ATT7:] Desalination [One] option [to mitigate water loss] would be desalination. TID could theoretically enter into an agreement with SFPUC, wherein a desalination plant is built in San Francisco, and SFPUC transfers water from Lake Eleanor to TID at the cost of desalinating the same amount of water in San Francisco. The State Water Board provides average cost to desalinate water between $1,000/AF to $3,000/AF (16-72). The California Public Utilities Commission (2016) presents the costs of water from three desalination plants to range from $2,367/AF to $5,100/AF [Footnote 32: California Public Utilities Commission, What Will Be the Cost for Water?, January 12, 2016, http://www.cpuc.ca.gov/uploadedFiles/CPUC_Public_Website/Content/About_Us/Organization/Divisions/Policy_and_Planning/PPD_Work/PPD_Work_Products_(2014_forward)/PPD%20-%20Production%20costs%20for%20new%20water.pdf.], while the Pacific Institute's survey of recently proposed desalination plants have costs ranging from $2,100/AF to $4,300/AF. [Footnote 33: Heather Cooley and Rapichan Phurisamban, The Cost of Alternative Water Supply and Efficiency Options in California, (Pacific Institute, 2016), http://pacinst.org/app/uploads/2016/10/PI_TheCostofAlternativeWaterSupplyEfficiencyOptionsinCA.pdf.] Such costs would be prohibitive to the agricultural region's future prospects.Moreover, TID expects their reductions of surface water diversions under LSJR Alternative 3 in the worst years to be above 100 TAF, which is more than any desalination plant could feasibly provide. The largest desalination plant in the US, the Carlsbad Desalination Plant, provides a maximum of 56 TAF per year. [Footnote 34: "Nation's Largest Seawater Desalination Plant Marks One-Year Anniversary," Carlsbad Desalination Plant, 2016, http://carlsbaddesal.com/nations-largest-seawater-desalination-plant-marks-one-year-anniversary.]	As noted in Chapter 16, Evaluation of Other Indirect and Additional Actions, the cost estimate provided for desalination is based on estimates of those projects under development in California at the time given the 2012 and 2015 documents referenced. The plan amendments do not mandate or require any action evaluated in Chapter 16 be implemented. Desalination was included in Chapter 16, because documents indicated that desalination had previously been under consideration. Although agencies may elect not to pursue certain actions under particular circumstances, it is reasonable to include them in a portfolio of possible actions because they were considered in the past and may be appropriate for further consideration depending on how circumstances change. Furthermore, if these actions do not occur, the potential environmental impacts and estimated costs associated with these actions, as disclosed in Chapter 16, would not occur. As indicated in Chapter 13, Service Providers, Chapter 16, and Appendix L, City and County of San Francisco Analyses, service providers may choose any approach described in Chapter 16, or a combination of approaches, or they may identify another as-yet unknown approach to meet their own unique needs. The analysis in the SED did not assume that any single action described in Chapter 16 would replace the entire reduction in surface water to a service provider due to implementation of the LSJR alternatives.
1169	147	[From ATT7:] Broader Societal Ramifications: The Issue of Social Justice The State Water Resources Control Board (SWRCB) explains that the objective of the SED proposal to increase flows upstream is to contribute to the improvement of the ecosystem along the San Francisco Bay/Sacramento-San Joaquin Estuary (Bay-Delta). The SED enumerates two central benefits of the LSJR Alternatives: -Increased attainment of beneficial water temperatures for salmonids. -Increased floodplain inundation for salmonids (ES-38). Yet the benefits of the SED proposal pale in significance to their costs, in particular to their human costs. LSJR Alternative 3 threatens San Joaquin, Stanislaus and Merced Counties with grave long-term economic losses, and, in turn, the effective devastation of the counties' economic and cultural livelihood. Moreover, when we start asking the question about distribution of these costs, it	The concerns of disadvantaged communities (DACs) and environmental justice issues are important to the State Water Board. As acknowledged in Chapter 22, Integrated Discussion of Potential Municipal Water Supply Management Options, the effects of reduced surface water supplies are not felt by communities equally, with "communities of color and low-income people living in tribal, rural, and farming communities often disproportionately [experiencing] impacts on drinking water." The recent drought highlighted this historical problem, which has been exacerbated by the unsustainable expansion of permanent crops and increased number of groundwater wells in the areas near these communities in the plan area. The plan amendments are not the cause of this legacy issue; rather, it is the local agricultural response to reduced water supplies that ultimately affects DACs. Please see Master Response 2.7, Disadvantaged Communities, regarding the consideration of and assistance for DACs. For further discussion regarding the requirements of CEQA as they pertain to a program-level analysis, please see Master Response 1.1, General Comments. Additionally, a cost-benefit analysis is not part of the requirements for environmental review required by CEQA. Consideration of economic impacts of the plan amendments on the plan area are in Chapter 20,

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		becomes clear that LSJR Alternative 3 creates a social justice issue. The SED does not emphasize that the burdens induced by the new requirements would be disproportionately placed on poorer regions of California. According to the Bureau of Economic Analysis, the 2011 income per capita of the San Joaquin, Stanislaus and Merced Counties ranges from $36,185 to $39,445. Income levels in the San Joaquin Valley are roughly 20% less than the average national income, and 29% less than California's average income. Not only are the affected counties in a less favorable economic position, but they are also beginning to regain their economic strength after the setbacks from the Great Recession and the droughts from 2007-2015. The three counties have just managed to creep past 2007 levels of income per capita in 2015. [Footnote 35: California County-Level Economic Forecast 2015-2040, (The California Economic Forecast, 2015), http://www.dot.ca.gov/hq/tpp/offices/eab/docs/Full%20Report%202015.pdf.] The unemployment rate for the counties, which is still over 80% higher than the national unemployment rate, has managed to reach 2007 levels by last year. LSJR Alternative 3 has the potential to dramatically setback these counties, just as they are beginning to recover their economic footing. One common complaint against the San Joaquin Valley is that the region consumes water at higher than average levels relative to the rest of the state. While the concern is understandable, it does not sufficiently take into consideration that the increased water consumption does not result from greediness or carelessness, but from the region's agricultural needs. As Zelezny et al. (2015) state, "It takes more water in the SJV to sustain the equivalent living conditions found in other parts of the state. Decreased water availability in the SJV could cause collapse of both the economy and government, forcing the balance of the state to support the remaining population that cannot leave" (117). [Footnote 36: Lynette Zelezny, Impact of the Drought in the San Joaquin Valley of California, (California State University, 2015), http://www.fresnostate.edu/academics/drought/documents/Fresno%20State_Drought%20Study%20Entire_FINAL.pdf.] In terms of human benefits of the plan, the additional flows would provide recreationists a richer natural habitat to enjoy, as mentioned in SWRCB's Summary of the Proposed Updates. [Footnote 37: State Water Resources Control Board, "Summary of Proposed Updates to the bay-Delta Water Quality Control Plan," 2016, http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/bay_delta_plan/water_quality_control_planning/2016_sed/docs/prp_update_sum.pdf.] However, SWRCB explains in its summary the environmental and human benefits of their proposal in relation to the San Francisco Bay/Sacramento-San Joaquin Delta Estuary, that is, in areas closer to or in wealthier pockets that would not be as damaged by the proposed flows. Thus, while the burden of the LSJR Alternatives is disproportionately placed on poorer regions, the human benefits of the SED proposal are not geared to the family growers, pickers and food processors of the San Joaquin Valley, but rather a select community of habitation restoration enthusiasts, who often will not have to suffer the costs of the proposal.	Economic Analyses. Further discussion of the economic considerations given are provided in Master Response 8.2, Regional Agricultural Economic Effects, 8.3, Fiscal Economics, and 8.4, Other Economic Considerations.
1169	148	[ATT7:ATT31: Figure 23. Per capita personal income (2011) of the affected counties in comparison to their neighbors due west.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1169	149	[ATT8: Appendix C. Technical Memorandum: Preliminary Review of the San Joaquin River SED Agricultural Economic Analysis. ERA Economics, March 15, 2017.]	The commenter provided this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1169	150	[From ATT8:] The agricultural economic model applied for this study is not the well-known Statewide Agricultural Production Model (SWAP) that is commonly applied in agricultural economic impact analyses of changes in irrigation water supply. This review refers to it as	Please see Master Response 1.1, General Comments, for an explanation of how amending the Bay-Delta Plan is a programmatic planning decision requiring a program-level document and program-level analysis. A detailed irrigation district-level model is neither appropriate nor required for a program-level analysis. The

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		the SED model. The SED model has different spatial scale, regions, assumptions, and underlying data which have not been described in the SED. Explanation: The SWAP model has a well-established history of being used, reviewed, and vetted by public agencies in the public process of analyzing the economic impacts of water (and agricultural) policies. All of the underlying data and code have been published in various formats and subject to public and peer review. The SED model does not have this history and it is misleading to suggest that the SED model has been subject to the same vigorous vetting process as SWAP. The technical appendix and supporting data provided in the SED (Appendix G) do not adequately describe the SED model. The SWAP model is developed specifically for statewide economic impact analyses of changes in water supply (and other factors) across distinct regions in California. As a statewide model, and not a detailed irrigation district-level model, studies that use SWAP will carefully interpret the results and note the limitations of this modeling approach. It is reasonable to apply the SWAP model methodology (i.e. calibrated optimization modeling) to more specific regions (e.g. the Study Area in the SED), but the model should be clearly defined and described. The SED model is developed for six irrigation districts in the Study Area, and as such, many of the generalizations that apply for the SWAP model do not apply to the Study Area. For example, the SWAP model explicitly assumes that irrigation water is perfectly substitutable within each model region. That is, the SWAP model is not able to differentiate between irrigation water supply (well, surface, etc.), and cost, applied to different service areas within any single region. While this is a reasonable assumption at the aggregate level of the state, it may not be appropriate within individual irrigation districts. Access to district surface water, groundwater quality, and cost all vary within an irrigation district. In turn, cropping patterns typically vary between service areas, and the assumption of substitutable water supplies may not be appropriate. Recommendation: The SED model is not the SWAP model so it must be carefully reviewed. As of March 9, 2017 the model code, data, and other underlying results are not available in the public SED documents.	model used in the SED is the Statewide Agricultural Production Model (SWAP). Please see Master Response 8.1, Local Agricultural Economic Effects and the SWAP Model, for a discussion of the Statewide Agricultural Production Model (SWAP) and SWAP input data. The SED analysis employs the same version of the SWAP model released in 2012 with some changes clearly described in the SED including: 1) use of district boundaries as opposed to CVPM areas of SWAP, and 2) updated land and water use based on 2010 estimates on DWR's DAU for the underlying districts. These modifications are appropriate because they 1) better represent the geographic areas that will be affected in response to implementation of the LJSR alternatives and 2) update land and water use to represent conditions reflective of the Baseline period of the SED. These modifications do not change the model equations or methodology used by the original SWAP model. The limitation of the statewide version of the SWAP model to model detail at the irrigation district level is avoided by using water supply estimates based on the results of WSE model and groundwater pumping capacities specific to each irrigation district. In summary, the SED analysis employs the same 2012 SED draft version of the SWAP model with the exception of land and water use information updated by district boundary and water availability assumptions from the SED water supply model. These assumptions have been described in the published version of the SED. In addition, see Master Response 8.1, Local Agricultural Economic Effects and the SWAP Model, for an additional explanation of SWAP model input data and a revised SWAP model run. The revised SWAP model run was performed in response to several comments that highlighted opportunities for refinement in the original model run.
1169	151	[From ATT8:] It is not clear what assumptions (see below) have gone into developing the SED model because Appendix G is incomplete. Assumptions can have significant effects on the estimated economic impacts. If assumptions are incorrectly applied, the resulting economic impacts will be incorrect. Explanation: The model description in Appendix G suggests that the SED model shares some similar code, data, and assumptions with the SWAP model. However, these assumptions and any supporting data have not been clearly described. Each modeling assumption needs to be considered carefully, clearly documented, and justified. Some examples from the SWAP model that could apply to the SED model and would affect the results of the SED agricultural economic analysis are presented below. The SWAP model includes a routine to estimate real increases in energy costs based on California Energy Commission (CEC) projections. Typically, energy costs are forecast to increase in real terms over the foreseeable future. This means that the cost of groundwater pumping will increase and the additional groundwater pumping cost (a typically component of the economic impacts) will increase. In the SED analysis, Table 20.2-1 shows additional groundwater pumping cost equals $12.67 million/year under Alternative 4. It is not clear how this was modeled in the SED analysis, what future point in time (year) the economic analysis is developed for, and if there is any real increase in energy cost. The SWAP model estimates the statewide market for crops, but it is not clear if the SED model does also. That is, the SWAP model estimates the market demand and supply for each of the crop categories using standard economic principles. This allows the analyst to consider two factors: (i) as the supply of a crop decreases, all else equal, the price for that crop will increase, and (ii) the demand for crops shifts over time. It is not clear what the SED analysis	Please see response to Comment 1169-150. For the SED analysis, assumptions regarding current market and growing conditions for crop production in the irrigation districts, such as the crop prices, yields, and production costs, are based on data already within the SWAP model database. Land and water use for the districts were updated based on DWR DAU data for 2010. Regarding calibration assumptions such as short- or long-run analysis: the SWAP model was calibrated for a long run analysis by using long run acreage response elasticities. An elasticity is the percent change in a variable, per unit of percent change in another variable or parameter (DWR 2012). SWAP includes an option to use either short or long run acreage response elasticities which represent the percent change in acreage of a crop from one percent change in crop price. The long run elasticities allow for a greater degree of adaptation in cropping decisions as these are larger in magnitude than short term elasticities, hence the expected changes in acreages are greater given a change in crop price. Please see Master Response 8.1, Local Agricultural Economic Effects and the SWAP Model, for additional explanation of the SWAP model setup, input data, and calibration.

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		assumed about current and future market conditions for the crops produced in the Study Area. It is not clear how the SED analysis calculates the gross and net return to farming for each crop included in the model. Typically, the SWAP model is based on aggregate crop categories and associated proxy crops as defined by DWR. However, these definitions are developed with the statewide market in mind. For example, the "other truck" category (miscellaneous vegetables) might have peppers or broccoli (fresh market) as the proxy crop. These crop budgets and corresponding proxy crops may not apply to the SED Study Area because they are not representative of agriculture in the region. In short, technical appendix G is incomplete. There are no details about the SED model, the underlying data, or the modeling assumptions. There is no way for affected stakeholders and the general public to assess the validity of the assumptions, data, and resulting impacts. The SED does not indicate what model version of the SWAP model the SED model is based on (if any). Typical inputs and outputs from the SWAP model that are summarized in every technical appendix for EIR/S analyses in California include, but are not limited to, the following: 1. Summary tables of the model calibration ("base year") data including acreage, prices, costs, yields, and water use, 2. Crop group definitions, corresponding proxy crop, and supporting crop budget data, 3. Current and future market conditions and assumptions about how they evolve, 4. With-project conditions point in time (year or "level of development"), 5. Current and future production technology assumptions, and 6. Calibration assumptions such as short- or long-run analysis. The references to the standard SWAP model are incorrect or incomplete. The SED cites various academic studies--where academic versions of the SWAP model have been applied--but offers no references where the SWAP model is applied for public policy/economic impact analyses, or how key data and assumptions are derived. Recommendation: The SED must provide additional details about the SED model so that the reader can understand if appropriate assumptions have been applied.	
1169	152	[From ATT8:] The SED Appendix G provides a high-level overview of how the SWAP model allows for input substitution, but does not describe how these assumptions apply to (and are calibrated in) the SED model. The SED suggests that the ability to model input substitution is one reason why the SWAP model is superior to previous models of California agriculture and water, but the SED does not correctly describe how this economic substitution occurs and why it is important. The output results in the "Agricultural Economic Analysis" Excel Workbook indicate that there may be key errors in the SED model. Explanation: The SWAP model is specified with a series of mathematical relationships called "production functions" that translate production inputs (e.g., chemicals, land, fertilizer, water, etc) into the amount of a crop produced (e.g., yield). The parameters that describe each of these relationships are calculated ("calibrated") using economic theory and observed (historical) land use decisions. This specification correctly allows for some limited substitution between inputs, and these responses are consistent with statewide data. The SED model is specified with a similar production functions. However, it is not possible to evaluate how well these functions are calibrated--meaning, how well they reproduce what actually happens--and the resulting estimated impacts. There are errors in the SED model production function, calibration, or input substitutability. Without access to the SED model	The State Water Board reviewed the SWAP model and refined it based on comments received. The SWAP model now applies the appropriate stress irrigation for permanent crops. An updated "Agricultural Economic Analysis" spreadsheet is posted on the SWRCB website. Please see Master Response 8.1, Local Agricultural Economics Effects and the SWAP Model, for discussion of the revised SWAP model run. Using crop gross revenue as a proxy for crop yield, the results show that when there is a reduction in applied water per acre there is also a reduction in gross revenue per acre.Also, please see Master Response 8.1 regarding the long term economic effects of changes in water supply availability and reoptimization of cropping patterns and for discussion of the SWAP model and its input data.

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		code it is not possible to say how important these errors are and the effect on the economic impact analysis. For example, the table below reproduces the estimated applied water to almonds, other deciduous, and subtropical permanent crops in each of the irrigation districts, using the "Agricultural Economic Analysis 09142016" Excel Workbook provided with the SED. The baseline column shows the initial applied water per acre. These are plausibly within the range of standard irrigation requirements in the region. The "60 Pct Flow (Alt 4)" column shows the applied water per acre estimated by the SED model under the 60 percent scenario (SED Alternative 4) and "2009 groundwater replacement" levels. The SED model is estimating an impossible response to water shortage--over 30 percent deficit irrigation in some regions--and crops are being deficit irrigated significantly. For example, the SED model shows that under the 60 percent flow scenario almonds in Modesto ID are irrigated with 2.9 acre-feet per year, or nearly 19 percent below the average annual applied water. In other words, the SED model suggests that growers could apply 19 percent less water to almonds, relative to current use, and still produce a crop every year. Simply put, deficit irrigating crops at this rate is likely not feasible and it is not a reasonable long-run response to water shortage. Growers would instead fallow land or switch crops, resulting in lost revenues and economic activity in ancillary industries. The same general trend holds for other crops and other SED Alternative scenarios, but the issue is most pronounced for the permanent crops highlighted in Table 1 [ATT8:ATT1]. Recommendation: This is a shortcoming that warrants a significant revision of the analysis. The economic impact of water shortage is understated because the SED model allows implausible deficit irrigation.	
1169	153	[ATT8:ATT1: Table 1. Summary of crop irrigation water, baseline and 60 percent scenario with 2009 groundwater replacement assumption.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1169	154	[From ATT8:] The SED analysis assumes that fallowing a field is a costless activity. When a field is fallowed in response to water shortage in the short-run, the grower still must cover the costs to own and maintain the land. At minimum, there is a nominal charge to manage roads, dust, weeds, fences, and other structures. One cost estimate used by the U.S. Bureau of Reclamation for statewide planning studies is approximately $40 per acre in current dollars. This includes all short-run nominal maintenance costs for the fallow land. This would not include the full opportunity cost of the land if it must be permanently retired. Explanation: Economic impacts are understated because they do not include fallow land costs. This cost must be included in the direct economic impact analysis, and analysis of indirect and induced effects. There are over 70,000 acres estimated to be left fallow under the 60 percent flow scenario (Alternative 4). At $40 per acre nominal maintenance cost, this increases the direct economic cost of Alternative 4 by $2.8 million dollars annually. This cost would be borne by growers, resulting in a decrease in proprietor income in the regional economy. The cost of permanent land retirement is higher. Recommendation: The SED analysis must account for full land fallowing cost.	Please see Master Response 8.1, Local Agricultural Economic Effects and the SWAP Model, regarding Other Costs Associated with Crop Production, including discussion of maintenance costs for fallowed acres.
1169	155	[From ATT8:] It is not clear what method is used to calibrate the parameters of the SED model. There have been significant methodological improvements in calibration approaches in the last several years that could be incorporated into the SED model. It is unclear whether the SED model has incorporated these advanced methods. Explanation: Model calibration is the mathematical/statistical procedure used to calculate the parameters of an economic model. Calibration should ensure two things: (i) that the calibrated model reproduces observed conditions (e.g., cropping patterns, revenues, etc.) in the Study Area, and (ii) that the calibrated model accurately reproduces response to changes in key parameters (e.g.,	Calibration for the SED application follows the tests and guidelines in the published peer reviewed literature on SWAP and past research reports coauthored for the most part by SWAP users and developers. While no dedicated section on SWAP model calibration is provided in the SED documents, the released spreadsheet provides sufficient information to compare years with no water shortage to base conditions as a proxy to examine model calibration. Please see Master Response 8.1, Local Agricultural Economics Effects and the SWAP Model, for discussion of the SWAP model and its assumptions.

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		prices, water supply, costs, etc.) that are consistent with economic theory. Recent advances in calibration approaches that have been published in peer-reviewed economic journals allow for improved calibration of (ii), while still ensuring that condition (i) holds. SED Appendix G provides insufficient information about the SED model calibration procedure. It is not possible to review the calibration approach, and in turn how well the model calibrates to criteria (i) and (ii). Errors in calibration could invalidate the resulting economic impacts. Recommendation: The SED must provide additional technical details in Appendix G, and the associated SED model files so that the public can review the results of the analysis.	
1169	156	[From ATT8:] The SED analysis does not distinguish between short-run or long-run impacts. The ability to deficit irrigate crops and adjust other input use on the farm is a short-run response to changes in water supply. The SED is concerned with permanent, long-run, changes in SJR flows which would permanently (depending on water conditions) reduce access to surface water. Explanation: It is not a viable long-run strategy to deficit irrigate crops in response to water shortage, as indicated by the SED modeling. Growers' would fallow land or switch crops in the long run in response to water shortage, not irrigate a walnut orchard at 80 percent of full irrigation water requirements. The SED does not indicate whether the SED model is calibrated for short- or long-run conditions. These are important parameters that determine the response to changes in water supply. In general, growers' ability to respond to changes in the long-run is more flexible (more "elastic") than it is in the short run. Intuitively, growers' can make long-run decisions to remove or not plant orchards, whereas in the short-run there is a fixed capital investment (e.g., establishment, irrigation system, other capital costs) that cannot be avoided, thus limiting options and increasing costs of water shortage. Recommendation: The SED analysis must distinguish between short-run and long-run economic response and resulting economic impacts.	Short term agricultural responses to water shortage, such as deficit irrigation and fallowing of annual crops, are modeled for years with reduced irrigation water supplies. Potential long-term actions, such as changes in cropping pattern, are not modeled because cropping patterns will depend on many factors and it would be speculative to assume how they would change. Please see Master Response 8.1, Local Agricultural Economics Effects and the SWAP Model, for discussion of potential long term economic effects and for discussion of the SWAP model and its assumptions.
1169	157	[From ATT8:] The SED economic analysis does not consider variability in irrigation water supplies. SJR flow requirements under each with-project Alternative simultaneously reduce the average annual irrigation water supply and increase the variability of that supply. The SED analysis has estimated the cost of a decrease in average annual water supply, but has not considered the additional cost of increased water supply variability. Explanation: The SED does not describe how changes in irrigation water supplies over time are modeled. Figures G.2-1A-G.2-1D [ATT8:ATT2-ATT8:ATT3] of SED Appendix G clearly show that average annual surface water supply decreases (the yellow shaded area gets smaller) and average annual variability increases (the yellow shaded area increases and decreases more from year-to-year). Figure 1 reproduces the Merced River plot from Figure G.2-1A [ATT8:ATT2] (the "baseline") and Figure G.2-1D [ATT8:ATT3] (SJR flows Alternative 4). It is clear that average supply and variability increase. Water supply variability is an important factor in planting decisions, and broader agricultural business decisions that is typically not included in a static SWAP-model-type analysis. In general, highly variability water supply discourages plantings perennial crops because it is less risky to plant annual crops that can be adjusted in response to changes in water supply (i.e., fallowed) much more easily. The SED model does not take these dynamic considerations into account. The model assumes that, even with highly variable surface supplies, irrigators are able to supply orchards with required demand (albeit, deficit irrigated). The SED economic impact analysis must consider year-to-year variability in water supply in a dynamic economic analysis. The static analysis applied in the SED quantifies the cost of a decreased average surface water supply, but does not quantify the cost of increased variability in water supply. Related to this point, the SED economic impacts should be summarized in terms of average annual economic impact (as	This evaluation appropriately addresses potential changes of agricultural production at a programmatic level. It is speculative to assume that growers will need to shift away from perennial crops in response to increase water supply variability. SWAP model results show that permanent crops can be maintained in production even under the water supply availability conditions estimated for the LSJR alternatives. Please see Master Response 8.1, Local Agricultural Economic Effects and the SWAP Model, regarding the scope of the agricultural economic analysis and long term economic effects of changes in water supply availability.Please see Master Response 2.3, Presentation of Data and Results in SED and Responses to Comments, for discussion of why average results were presented. In addition, please see Master Response 8.1, Local Agricultural Economic Effects and the SWAP Model and Master Response 8.2, Regional Agricultural Economic Effects, for presentation of the results of the revised SWAP model run averaged by water year type.

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		they are currently) in addition to dry and wet year impacts. This allows the reader to understand the average annual cost of the SJR flow requirements in addition to the impact in dry and wet conditions, when the natural water supply is changed separate from the SJR flow requirements. For example, a sequence of dry years, such as 2013-2016, will lead to significantly greater economic impacts than average water supply conditions. Recommendation: The static SED analysis should be revised to dynamically account for water supply variability. The current analysis understates economic impacts by omitting this factor.	
1169	158	[ATT8:ATT2: Figure G.1-1A. Partitioning of Baseline Diversions into End Uses.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1169	159	[ATT8:ATT3: Figure G.2-1D. Partitioning of LSJR Alternative 4 Diversions into End Uses.]	The commenter is providing this attachment for reference purposes in support of their comments. Those comments are addressed in these responses to comments; therefore, no additional response is required.
1169	160	[From ATT8:] It is not clear whether the SED agricultural economic analysis has correctly specified the "No Action Alternative." An economic impact analysis must compare the "with-project" to the "without-project" conditions. It would be incorrect to interpret the baseline (calibration data) as the without project conditions. Appendix G does not have sufficient information to determine whether this is the case. Explanation: This is a critical requirement for an economic impact analysis. Incorrectly comparing future conditions under SJR flow restrictions (Alternatives) to the current (baseline) conditions in each of the districts would generate incorrect impacts. It is essential to establish a correct "future without project" condition so that the future opportunity cost of irrigation water is correctly quantified. It is clear that the SED water supply modeling considers the no action and action alternatives, but it is not clear that these are carried this through the economic analysis. The no action alternative must specify all future (without project) economic conditions over the appropriate period of time. Then the incremental impact of the project is calculated as the difference between the no action and each with project alternative. The purpose of the No Action Alternative in an economic impact analysis is to establish this future value so that the reference point is correctly established. Recommendation: If the No Action Alternative is not properly specified in the economic model, then the analysis must be revised.	The comment is specifying conditions for a cost-benefit analysis. Please see Master Response 8.0 Economic Analyses Framework and Assessment Tools, and Chapter 20, Economic Analyses, Section 20.1, Introduction, regarding the regulatory context for considering economic effects and analyzing economic effects. The State Water Board is not required to prepare a cost-benefit analysis. In addition, forecasting what the economy would look like in the future (e.g., which sectors grow, which sectors remain unchanged, which sectors decline, and by how much), as seemingly implied by the comment, would be highly speculative since it requires predicting future demand and relative prices for virtually all goods and services. The Water Supply Effects model (WSE) considers the baseline and the LSJR alternatives (see Master Response 2.5, Baseline and No Project, for a description of the baseline and Master Response 3.2, Surface Water Analyses and Modeling regarding the modeled representation of baseline). This information is used to inform the economic analysis. The State Water Board presents a representation of the existing economy and its interrelationships through the use of different calibrated models (e.g., SWAP and IMPLAN), and evaluated how the LSJR alternatives would result in changes in the economy (e.g., which sectors are affected and by how much). The direct change comes from the SWAP model results, and IMPLAN measures indirect and induced effects on the regional economy. Please see Master Response 8.1, Local Agricultural Economic Effects and the SWAP Model and Master Response 8.2, Regional Economic Effects, for additional information regarding the economic effects model representation of baseline and conditions in response to implementation of the LSJR alternatives.
1169	161	[From ATT8:] The SED model does not include any forward-linkage to upstream industries that depend on the crops produced in the Study Area. For example, feed and fodder crops are inputs into the high-value dairy industry. As such, the marginal value of feed crops is understated in the SED model, and in turn the responsiveness of these crops to water shortage may be overstated. Explanation: It is likely that the SED model assumes that the inputs to the dairy sector (namely, hay, silage, and cereal-based concentrates) from the crop sector can be accurately modeled by perfectly competitive market prices and supply responses. Hay and cereal-based concentrates can be accurately modeled as economic inputs that have known market prices and responses, but silage cannot because it is produced and consumed locally. The structure of the dairy and feed sector in the Study Area means that silage and milk production are essentially joint products. It follows that the economic impact of water reductions on the production of silage cannot be measured by changes in the opportunity cost of silage production alone, since much of the economic impact will derive from the ability of the dairy sector to respond to changes in the cost of feed inputs. It is important to acknowledge that advances in economic calibration theory and methods over the last couple of years have made it theoretically possible to address	Please see Master Response 8.2, Regional Agricultural Economic Effects, regarding potential economic effects on dairies and discussion of silage.

Table 4-1. Responses to Comments			
Ltr#	**Cmt#**	**Comment**	**Response**
		upstream-linkages in a primary crop production model, such as the SED model. At a minimum, the SED analysis should be adjusted to account for these linkages and ensure that crop response, and resulting economic impacts, are correctly calculated. Recommendation: The analysis should be updated to acknowledge upstream linkages to dairy and other high-value industries.	
1169	162	[From ATT8:] It is not clear how the SED model calibrates to the sources of water supply in the Study Area (and by service area within any given district). The correct cost of water should equal the rate charged to growers including all fixed and volumetric charges, and acknowledge any variation by service area. Explanation: The value marginal product of water in part determines responsiveness to water shortage. Importantly, water must be specified in the SED model by source (and cost) within each district and service area. If the model does not calibrate (exactly) to water source and cost, then the response to changes in water supply will be incorrect. The SED materials available as of March 9, 2016, do not include any information about water supply costs and calibration to these supply sources. Recommendation: The SED must describe the water calibration approach and supporting data (model code).	Calibration to water use by source follows the same general approach as in past and current applications from SWAP, however for the SED each irrigation district is represented with its own surface water source with costs based on information contained in the SWAP database for the cost of local surface water in the region of each irrigation district. Total surface water availability for applied water in each district is determined based on output from the Water Supply Effects model. Please see Master Response 8.1, Local Agricultural Economics Effects and the SWAP Model, for discussion of the SWAP model and its input data.