UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region
650 Capitol Mall, Suite 5-100
Sacramento, CA 95814-4700

MAR 28 2013

Jeanine Townsend
Clerk to the Board
State Water Resources Control Board
P.O. Box 100
Sacramento, California 95814-0100

Dear Ms. Townsend:

NOAA's National Marine Fisheries Service (NMFS) appreciates the opportunity to submit comments on the State Water Resources Control Board's (Board) Draft Substitute Environmental Document (SED) in support of potential changes to the 2006 Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary: San Joaquin River Flows and Southern Delta Water Quality (Bay-Delta Plan). NMFS is responsible for the administration of the Endangered Species Act of 1973, as amended [16 U.S.C. 1531 *et seq.*] with regard to listed salmonids and green sturgeon. Within the San Joaquin River watershed, NMFS has management authority over the threatened California Central Valley (CV) steelhead (*Oncorhynchus mykiss*). In addition, NMFS has the responsibility of administering the Magnuson-Stevens Conservation and Management Act for essential fish habitat (EFH) for Pacific Salmon. The San Joaquin River basin and its tributaries are designated EFH for Pacific salmon, which includes CV fall-run Chinook salmon (*O. tshawytscha*). The San Joaquin River Restoration Program (SJRRP) was established in late 2006 to implement the Stipulation of Settlement in *NDRC, et al., v. Kirk Rodgers, et al.* (Settlement). The SJRRP will re-introduce spring-run Chinook salmon (*O. tshawytscha*) to this historic range of the species and will provide flows to the restoration area. The San Joaquin River system is important to the viability and recovery of CV steelhead and CV spring-run Chinook salmon as a whole within the Central Valley.

Flow is undisputedly a key driver for survival in the San Joaquin River system. San Joaquin River flows must be augmented significantly from current levels in order to reverse the present trend of salmonid population declines in the basin. Survival rates in the San Joaquin River were only slightly greater than one percent in 2003 and 2004 and 12 percent in 2006, which was a very high flow year (VAMP 2010). We note that these survival rates are unlikely to support a viable salmonid population.

The purpose of the SED is to document the Board's analysis of the environmental impacts of potential changes to the 2006 Bay-Delta Plan that will establish new flow objectives for the lower San Joaquin River, new southern Delta salinity objectives, and a program of implementation for those objectives.

Below we have summarized NMFS' concerns on the SED. Enclosed with this letter are specific comments and supplemental attachments to support our concerns with the SED:

1) **Percent of Unimpaired Flow:** Percent of unimpaired flow is a useful approach to achieve a more natural flow pattern in the San Joaquin River system. However, the preferred alternative (35 percent of unimpaired flow) is not well justified in the SED and is not adequate to achieve a viable salmonid population in the San Joaquin River system. We recommend the Board begin at 45 percent of unimpaired flow (the upper end of the adaptive management range) and allow for adaptation to lesser levels if and when populations are trending towards recovery and survival rates have dramatically improved.

2) **14-day Running Average:** NMFS is concerned that a 14-day running average will lose the variability and peak flows necessary for environmental cues, floodplain inundation, and fluvial geomorphic processes to maintain habitat. NMFS recommends a shorter period of three to five days, with no limit on maximum flows, within approved flood management capacities, to achieve a more natural hydrograph that is needed for a healthy river ecosystem.

3) **Year-round Flow Schedule:** Flows are needed year-round, not just the February to June period, to support all CV steelhead life history stages and their habitat needs. Also, fall-run Chinook salmon have instream flow needs from October through June. We recommend assigning an annual flow schedule for each tributary based on water year type to support salmonids in the rivers, with flow criteria at Vernalis that will further support salmonid outmigration. The year-round flow schedules can be coordinated with 45 percent of unimpaired flow (the Board's upper end of the proposed adaptive management range).

4) **Economic Analysis:** The economic analysis, as presented in the SED, is a flawed basis for selecting the preferred alternative. The economic analysis does not include a sufficient range of economic sectors that may be affected. In particular, the analysis does not include consideration of economic effect of doubling salmonid populations on fisheries and recreation, nor does it consider the economic depression of these sectors that would continue or worsen under the status quo for San Joaquin River salmonid populations. Additionally, the economic analysis relies on models that have been shown to dramatically over-state agricultural impacts.

5) **Adaptive Management:** The Board needs to provide clearer direction in the adaptive management process. The decision making process is not well defined and the objectives are unclear. NMFS doesn't have the resources to participate in a new adaptive management process. We recommend that the Board staff and lead any adaptive management processes they think is necessary.

We thank you for the opportunity to provide comments on the SED. NMFS looks forward to continue working with the Board, Board staff, and other stakeholders involved in the Bay-Delta

Plan process. If you have any questions regarding this correspondence or if NMFS can provide further assistance, please contact Monica Gutierrez in our Central Valley Office at (916) 930-3657 or via email at Monica.Gutierrez@noaa.gov.

Sincerely,

Maria Rea

Maria Rea
Supervisor, Central Valley Office

Enclosure 1

Enclosure 1 to NMFS comment letter on the draft SED

Percent of Unimpaired Flow

The Board has proposed a 35 percent of unimpaired flow from February through June from the Stanislaus, Tuolumne, and Merced rivers on a 14-day running average. The Board's approach of an unimpaired flow to establish flow objectives on the lower San Joaquin River and its three eastside tributaries for the protection of fish and wildlife beneficial uses is a useful approach to achieve a more natural flow pattern in the system. However, the proposed standard of 35 percent is not well justified and falls short of what is needed to achieve viable salmonid populations in the San Joaquin River Basin. Current flow levels are not sustaining salmon and steelhead populations and their habitats in the San Joaquin River system. Documented returns in the San Joaquin River tributaries indicate that existing populations of salmonids are severely depressed (GrandTab 2012). We recommend the Board begin at 45 percent of unimpaired flow (the upper end of the adaptive management range) and allow for adaptation to lesser levels if and when populations are trending towards recovery and survival rates have dramatically improved.

NMFS is concerned that the Board is proposing a flow that is below current baseline conditions in the Stanislaus River. The Reasonable and Prudent Alternative (RPA) actions in the NMFS Biological Opinion on the long-term operations of the Central Valley Project and State Water Project (NMFS BiOp) flow schedules are the minimum necessary to avoid jeopardy and are implemented as part of a suite of actions to manage year-round conditions of temperature, flow, and habitat to avoid jeopardy. We understand that the preferred alternative will not preclude the NMFS RPA actions, but we note that setting a standard that merely avoids jeopardy is unlikely to achieve the doubling goal of the Bay-Delta Plan. Although the preferred alternative will improve flows in the Tuolumne and Merced rivers from baseline conditions, these flows are also still inadequate to achieve recovery.

The percent of unimpaired flow objective should provide geomorphic function and allow for inundation of floodplain habitat. Habitat restoration alone cannot make up for the lack of flow in these tributaries. The most significant improvement by salmonid populations in watersheds occurred when there were significant investments in habitat *and* flow. Butte Creek, Battle Creek, and Clear Creek are good examples where habitat improvements *combined with* flow augmentation have resulted in improvements in salmonid populations. Some of these investments include: completion of the water supply improvements for the Coleman Hatchery and dam removal that allowed access into 40 plus miles of habitat in Battle Creek; removal of Saeltzer Dam, channel structure improvements, and flow improvements in Clear Creek; and removal of passage barriers, construction of screens and ladders on diversions, and increased in-stream flows through diversion changes in Butte Creek.

In contrast, from the period 1998-2001 over $30 million in funds, from the CALFED Bay-Delta Program, the Anadromous Fish Restoration Program, and other sources, was invested in salmonid habitat restoration actions in the San Joaquin River watershed and three main tributaries, but the salmonid populations have continued to decline. This further underscores that current flow levels in the San Joaquin River Basin and tributaries remain inadequate and a 35 percent of unimpaired flow will not allow for already diminished salmonid populations to stabilize and recover. We urge the Board to consider a higher percent of unimpaired flow to achieve a viable salmonid population in the San Joaquin River Basin.

14-day running average
The San Joaquin River basin is a snowmelt driven system. Therefore, geomorphic flows are likely to occur in the springtime. However, a 14-day running average, combined with flow caps (see Appendix F.1, page 17) does not mimic the natural hydrograph that is needed for a healthy river ecosystem. A 14-day running average will lessen the peaks that are necessary for geomorphic flows and floodplain inundation. We are unclear as to why a 14-day running average was chosen. The Board should provide further analysis of other running average options in the SED. NMFS recommends a shorter period of three to five days, with no limit on maximum flows, within approved flood management capacities, to achieve a more natural hydrograph that is needed for a healthy river ecosystem.

Delta Outflow
In 2010, the Board issued a final report called the *Development of Flow Criteria for the Sacramento-San Joaquin Delta Ecosystem*. In the report, the Board determined that 60 percent of unimpaired flow from the San Joaquin River from February through June is needed in order to preserve the attributes of a natural variable Delta system to which native fish species are adapted to. It is unclear how the Board determined that 35 percent of unimpaired flow from the San Joaquin River would be appropriate inflow to the Delta. We ask the Board to explain or analyze in the SED why the large reduction from the 60 percent of unimpaired flow is required to achieve a healthy ecosystem is justified by the benefits to other beneficial uses.

Year-round flow schedule recommendation

Flows are needed year-round to support the needs of all Central Valley steelhead life history stages, not just a February through June period. Also, fall-run Chinook salmon have instream flow needs from October through June. As previously stated by NMFS, we recommend assigning an annual flow schedule for each tributary based on water year type with flow criteria at Vernalis. This approach will provide protection for anadromous fish if it were applied year-round to ensure beneficial flows for all fish life stages. A year-round flow schedule can also consider reservoir operations in balancing fish needs and other beneficial uses. In addition, a year-round flow schedule will be important for summer temperatures for rearing juvenile steelhead. We urge the Board to consider the following year-round flow schedules by tributary and at Vernalis as stated below. The year-round flow schedules can be coordinated with 45 percent of unimpaired flow (the Board's upper end of the proposed adaptive management range):

Stanislaus River
NMFS supports the year-round minimum flow schedules established in the RPA's in the NMFS Biological Opinion on the long-term operations of the Central Valley Project and State Water Project. These flow schedules are based on water year type for the Stanislaus River and are the *minimum* criteria for protecting steelhead. In addition, the RPA's are a suite of actions that not only include year-round minimum flow schedules but also include temperature, habitat restoration, and fish passage above the dams. The RPA actions also assume that the Bureau of Reclamation will operate to conditions required under D-1641. Please be advised that these RPA

actions are only to avoid jeopardy and are a minimum standard to protect salmon and steelhead flow and habitat. NMFS RPA actions are a good starting point but were not developed with the goal of recovery.

Tuolumne River

In addition to adopting a 45 percent of unimpaired flow, NMFS recommends adopting the NMFS and U.S. Fish and Wildlife Service interim protective flows developed for the New Don Pedro FERC relicensing 2009 Administrative Law Judge hearings as interim measures subject to the Board's adaptive management process. These interim flow measures are necessary to improve the quantity, suitability, and consistency of the aquatic habitat for all life stages of salmon and steelhead in the Tuolumne River. These interim measures also include floodplain inundation, flow migration cues, and temperature criterion. Please refer to Attachment 1 for the Tuolumne River interim measures. Please note that these interim measures are a minimum standard for protecting salmon and steelhead and should be reviewed periodically as restoration actions become effective.

Merced River

At this time, a year-round flow schedule has not been developed by NMFS for the Merced River. We still urge the Board to adopt a year-round flow schedule based on water year type that will address temperature, summer conditions, and habitat maintenance. However, if the Board decides to still use a percent of unimpaired flow, we recommend starting at a higher percent of unimpaired flow (45 percent) and revise as salmonid populations respond and habitat restoration actions become effective.

Vernalis

The preferred alternative includes a base flow requirement of 1,000 cfs at Vernalis. Biologically, this Vernalis base flow is extremely inadequate. It is important for there to be adequate flows down the San Joaquin River at Vernalis and through the Delta for out-migrating salmonid survival. NMFS recommends that the Board adopt the following base flows at Vernalis by water year type. These minimum flows at Vernalis can be found in the NMFS RPA actions (pages 642-643) and 2011 NMFS RPA Adjustments. Please note that these flow standards are an absolute minimum of flows. These flows were derived from an analysis on the Stanislaus River to avoid jeopardy of steelhead. That analysis did not include an analysis the effects on steelhead in the Tuolumne and Merced:

San Joaquin River Index (60-20-20)	Minimum long-term flow at Vernalis (cfs)
Critically dry	1,500
Dry	3,000
Below normal	4,500
Above normal	6,000
Wet	6,000

Economic Analysis

The selection of the preferred alternative appears to be driven by the economic analysis of the SED. In turn, this economic analysis in the SED is based heavily on potential agricultural impacts relating to reduction in surface water availability, and assumes no use of groundwater as an alternative to surface water. While the analysis uses models that are standard tools for such analyses, these tools are known to overestimate adverse impacts on agriculture. Attachment 2, *Review of Agricultural Economic Effects of Lower San Joaquin River Flow Alternatives,* prepared by Dr. Cameron Speir, an economist at NMFS' Southwest Fisheries Science Center, includes a summary of the publication by Howitt, *et al.* that shows how the predictions by these models resulted in an estimated impact 400 percent greater than actually occurred as a result of reductions of surface water availability in 2009 from the Central Valley Project and the State Water Project. We caution the Board that agricultural economics are not "absolute predictions" and that there is much uncertainty on how water supply actually affects agriculture economy.

The assumption that agriculture will not turn to other water supply alternatives is also unrealistic and denies the reality of existing programs funded by State and other entities to assist agriculture to diversify sources and methods for use and conservation of water in their practices. Consequently we believe that the analysis substantially overestimates economic losses for agriculture, and is a flawed basis for justifying lower instream flows for fish. We ask the Board to consider in their balancing of beneficial uses, that fish cannot diversify their water supply and are completely dependent on flow in the channel for their survival.

Furthermore, the SED economic analysis also does not analyze the economic effects that would occur when the doubling goal is achieved, nor the impact to fisheries, recreation and related economic sectors that would occur under the status quo of declining salmonid runs in the San Joaquin River basin. Impacts to economics of declining fisheries are important to consider for balancing. In 2004 (good salmon abundance year), salmon landings yielded $17,770,000 in California. However, in 2008 when the salmon fishery closures occurred, salmon landings yielded only $6,000 in California (NMFS 2012). California has previously estimated that the closure of the salmon fishery in California in 2008 and 2009, for the first time in the State's history, resulted in the loss of $534 million and 4,953 jobs (Press Release 2008 and 2009). We strongly urge the Board to assess the economic impacts to salmon fishery in their SED.

Specific comments by Chapter or Appendix

Chapter 20

In Chapter 20 of the SED, the Board summarizes the associated impacts analyses on the preferred Lower San Joaquin River flow alternative and southern Delta salinity alternatives. NMFS is unclear how the Board determined their thresholds for significance used in the analysis. For example, under "Water Quality Impacts" the analysis demonstrates that temperatures did not increase by more than two degrees under the preferred alternative. The Board deemed the temperature effects as a less-than-significant impact on water quality. It is unclear why 2 degrees (°) Fahrenheit (F) more was used as a threshold for significance in this analysis. If the impact assessment relates to salmonids, a 2°F threshold for significance would be relevant for a change temperature from 69°F to 71°F, but would have an insignificant effect on salmonids if the change was from 54°F to 56°F.

Appendix F.1
Monthly average temperature is a rather coarse review of the temperature regime under the different alternatives analyzed in the SED. In paragraph 2 on p. 5-64, it states "The temperature model was designed to provide a SJR basin-wide evaluation of temperature response at 6-hour intervals for alternative conditions, such as operational changes, physical changes, and combinations of the two." Yet, in Appendix F.1, figures and text refer to "simulated monthly average temperature" (see, for example, the first sentences in the descriptions for Figures F.1-19a-e on pages F.1-136 and F.1-138). Does each dot in those figures represent an average of all of the temperatures simulated at the 6-hr resolution in a given month? We ask the Board to please specify this section. According to *EPA Region 10 Guidance for Pacific Northwest State and Tribal Temperature Water Quality Standards* (2003), weekly maximum temperature is an important consideration to protect against acute effects (*e.g.* lethality or migration blockage) and sub-lethal and chronic effects (*e.g.* growth, disease, smoltification, and competition). Additional analysis which examines sub-monthly variation in temperature (*e.g.* daily max temperature) would provide a more effective evaluation of the effects of the different alternatives to the temperature regimes experienced by fish in the tributaries.

The temperature tables on pages F.1-155-165 could also use some additional explanation. Taking Table F.1-19 as an example, does the 48.9 value at the 50th percentile in January represent (a) that 50 percent of all monthly average temperatures (*i.e.* all Januarys from 1980-2003) were 48.9 degrees or cooler, or (b) that 50 percent of all 6-hour simulated temperatures (from all Januarys from 1980-2003) were 48.9 degrees or cooler? The latter sort of information is more informative about the distribution of temperatures experienced by fish in the three tributaries under different scenarios and provides a better assessment of the impacts to fish. NMFS is also interested in seeing simulations of maximum daily temperatures under different scenarios, or at least a discussion of the likely maximum temperatures that might be expected for a given average monthly temperature, as this is a better measure of sustained maximum temperature.

Maximum monthly flows are described as 2500, 3500, and 2000 cfs, for the Stanislaus, Tuolumne, and Merced, respectively (F.1-32). While we understand, and share, the Board's interest in avoiding flooding, it is possible to have daily flows greater than these maxima and still avoid flooding. We urge the Board to clarify that the maximum monthly flows are just that, maximum *monthly* flows, and not intended to represent maximum daily flows. The NMFS BiOp, for example, calls for spring flows greater than 2500 cfs on the Stanislaus in wetter year types. As mentioned above, floodplain inundation is an important ecological function for rearing juvenile salmonids. Therefore setting these flow caps may prohibit from achieving floodplain inundation and geomorphic processes in each of these tributaries.

Appendix K: Revised Water Quality Control Plan
The amendments to the 2006 Bay-Delta Plan proposed by the preferred alternative are presented in Appendix K, *Revised Water Quality Control Plan* of the SED. The narrative objective provides a good basic approach to the Board's goal however there is an inconsistency between

what is meant by the doubling goal and viable populations for salmonids. The Board should clearly define "viable population" and redefine the narrative objective to include the doubling goal for salmonid populations. It is unclear why the doubling goal language was omitted from the narrative objective and we recommend that the Board include the doubling goal language as it was originally applied in the 2006 Bay-Delta Plan. In addition, the narrative objective lacks quantitative measures. Including quantitative measures with the doubling goal, will provide appropriate measurable objectives to the narrative objective. Please note that the doubling goal is a policy of the State not only for salmon but for steelhead as well, as cited in the 1988 *Salmon, Steelhead Trout, and Anadromous Fisheries Program Act.* Also, the salmon doubling goal is a Federal mandate to the Central Valley Project Improvement Act of 1992. Therefore, it is important that the Board include the doubling goal in their narrative objective.

Some of the language used in the narrative objective is unclear to NMFS. For example, the narrative objective includes terms such as "reasonably controllable measures" and "reasonably contribute." These terms are very general and vague and we recommend that the Board clearly define these terms to eliminate ambiguity. The narrative objective also states to "maintain flow conditions from the San Joaquin River Watershed to the Delta at Vernalis" and "flow conditions that reasonably contribute toward maintaining viable native migratory San Joaquin River fish populations." However, under baseline conditions the San Joaquin River system does not have a viable salmonid population. Therefore using the term "maintain" is not appropriate use of language. If we continue to "maintain" conditions in the San Joaquin River system, fish populations will continue to decline. Therefore we advise the Board to reword their narrative objective to state that flow conditions in the San Joaquin River Watershed needs improvement and not maintenance. Lastly, we are unsure of the Board's use of viability in their narrative objective and recommend that the Board clearly define this term.

Adaptive Management

The adaptive management process will be an important component for the implementation of the narrative objective. In the adaptive management process, the Board will establish a Coordinated Operations Group (COG), which will comprise of the California Department of Fish and Wildlife, U.S. Fish and Wildlife Service, NMFS, representatives of water users from the three eastside tributaries, and any other representatives deemed appropriate by the Executive Director. However, the decision making process for this group is not well defined and the objectives are unclear. We recommend that the Board provide a specific framework which includes a quantitative approach and specific criteria standards to meet the Lower San Joaquin River flow objectives. The Board's adaptive management plan modification of flows over the entire February through June period that must be agreed to by all members of the COG seems unrealistic. We are concerned that this group will have difficulty in reaching consensus and we would like to see clearer guidance from the Board as to how these issues will be resolved when they emerge.

The connection between the Annual Adaptive Management process and the Long-term Adaptive Management is not well understood. The Board should explain why a floor of 25 percent of unimpaired flow is used instead of a higher floor for the Annual Adaptive Management process. The Long-term Adaptive Management process will use a range of 25 to 45 percent of unimpaired flow to be required from any one tributary over the entire February through June Period. In addition, the Board has chosen a range from 800 to 1200 cfs at Vernalis. It is unclear to NMFS the basis for these ranges. We recommend that the Board expand their percent of unimpaired flow range to include higher flows such as 60 percent of unimpaired flow and expand their ranges at Vernalis to include higher flows as well.

Lastly, it may be difficult for NMFS to participate in the Board's adaptive management process such as the COG. NMFS currently has limited staffing and our resources are already full, therefore it may be difficult to dedicate NMFS staff and resources to this adaptive management process. We strongly recommend that the Board provide the staffing and lead these adaptive management efforts in order to meet their narrative flow objectives in the Lower San Joaquin River and three eastside tributaries.

References:

California Department of Fish and Game. 2012. GrandTab: California Central Valley Sacramento and San Joaquin River Systems, Chinook salmon escapement, hatcheries and natural areas. April 23.

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Vernalis Adaptive Management Program (VAMP). 2010. The Vernalis Adaptive Management Program (VAMP): Report of the 2010 review panel. Prepared for the Delta Science Program. May 11, 2010.

National Marine Fisheries Service and U.S. Fish and Wildlife Service

Interim Measure Elements

(Source: New Don Pedro FERC relicensing 2009 Administrative Law Judge hearings)

The following are the National Marine Fisheries Service and the U.S. Fish and Wildlife Service's proposed *minimum* flows, in cubic feet per second (cfs), for the purpose of interim protection of anadromous fishes and habitats in the lower Tuolumne River. Flows are to be released from the Don Pedro Project, with discharges measured at the La Grange Bridge (river mile 50.5).

Element #1: Base flows to improve the quantity, suitability, and consistency (including thermal conditions) of the aquatic habitat for all stages of steelhead.

Action: Year-round minimum flow of 275 cfs, during all water year (WY) types.* In addition, release the greater of the year-round minimum flow (275 cfs) or the flow required to maintain stream water temperatures of 18° C or less** from the LaGrange Powerhouse (RM 52) downstream to Robert's Ferry Bridge (RM 40).

Monitoring: Fish health assessments, snorkeling to develop a quantitative index to abundance for *O.mykiss* (population estimate), investigations of habitat uses by adult and juvenile fish, continuous, 'real-time' temperature monitoring at locations spaced from the LaGrange Powerhouse downstream to Robert's Ferry Bridge, and refinement of a temperature model to predict release flow targets to meet the temperature requirement.

Element #2: Fall flows to improve the migration habitat, including thermal conditions, for adult fall-run Chinook salmon and steelhead, and thereby promote successful immigration.

Action: During all WY types, from Oct. 15 through Dec 1, release the greater of the 275 cfs minimum base flow, or the flow required to maintain stream water temperatures of 18° C or less** from the LaGrange Powerhouse (RM 52) to the San Joaquin River confluence (RM 0). In addition, release a flow of 1,200 cfs for 10 days in mid-October, with the timing of release coordinated with releases from the Merced and Stanislaus Rivers, and the San Joaquin Restoration Program.

Monitoring: Counting weir, fish health assessments, carcass surveys, CWT recovery/analysis, tissue sampling, and continuous, 'real-time' temperature monitoring at locations spaced from the LaGrange Powerhouse downstream to the San Joaquin River confluence (RM 0), and refinement of a temperature model to predict release flow targets to meet the temperature requirement.

Element #3: Spawning flows to improve the habitat (including thermal conditions) for spawning, egg incubation, and alevin stages of fall-run Chinook salmon and steelhead.

Action: During all WY types, from Oct. 15 through Feb. 15, release the greater of the 275 cfs minimum base flow, the 1,200 cfs mid-October immigration flow, or the flow required to maintain stream water temperatures of 13 °C or less** from the LaGrange Powerhouse (RM 52) to Robert's Ferry Bridge (RM 40).

Monitoring: Spawning surveys, fish health assessments, carcass surveys, instream flow evaluation of spawning habitat, continuous, 'real-time' temperature monitoring at locations spaced from the LaGrange Powerhouse downstream to Waterford, and refinement of a temperature model to predict release flow targets to meet the temperature requirement.

Element #4: Winter flow releases to improve the migration habitat for adult steelhead, and to inundate floodplain habitats to promote the survival, growth, and development (rearing) of juvenile fall-run Chinook salmon and steelhead.

Action: Release 3,000 cfs between February 1 and March 15, with the frequency and duration of the releases defined by WY type as follows:

- Critical and Dry WYs: A single, 2-day release in late Feb.
- Below Normal and Above Normal WYs: A single, 14-day continuous release, or two continuous 7-day releases, one in Feb. and one in March;
- Wet WY: Releases in any multiples of continuous 7-day releases adding to 21 days.

Monitoring: Seining, rotary screw trapping, tagging, tracking, fish health assessments.

Element #5: Spring flow releases to improve the migration habitat for adult steelhead, and improve thermal conditions to promote rearing and downstream migrations of juvenile fall-run Chinook salmon and steelhead smolts.

Action:

- Critical and Dry WYs: From March 20 through April 20, release the greater of the 275 cfs minimum base flow or the flow required to maintain stream water temperatures of 15 °C or less** from the LaGrange Powerhouse (RM 52) to the San Joaquin River confluence (RM 0).
- Below Normal WY: From March 20 through April 30, release the greater of the 275 cfs minimum base flow or the flow required to maintain stream

water temperatures of 15 ˚C or less** from the LaGrange Powerhouse (RM 52) to the San Joaquin River confluence (RM 0).

- Above Normal and Wet WYs: From March 20 through May 15, release the greater of the 275 cfs minimum base flow or the flow required to maintain stream water temperatures of 15 ˚C or less** from the LaGrange Powerhouse (RM 52) to the San Joaquin River confluence (RM 0).

Monitoring: Rotary screw trapping, fish health assessments, radio/pit tagging, continuous, instantaneous 'real-time' temperature monitoring at locations spaced from the LaGrange Powerhouse downstream to the San Joaquin River confluence (RM 0), and refinement of a temperature model to predict release flow targets to meet the temperature requirement.

* Water year classifications are based on the San Joaquin Basin 60-20-20 Index, and the California Department of Water Resources' San Joaquin Valley unimpaired runoff forecasts.

**United States Environmental Protection Agency (USEPA). 2003. EPA Region 10 Guidance for Pacific Northwest State and Tribal Temperature Water Quality Standards. EPA 910-B-03-002. 49 pp.

Review of Agricultural Economic Effects of Lower San Joaquin River Flow Alternatives (Draft dated February 2012)
Cameron Speir
Southwest Fisheries Science Center, Fisheries Ecology Division
June 18, 2012

Summary
The draft appendix summarizes the results of a simulation analysis of the effects of reduced surface water diversions on agricultural production, revenue, and associated economic impacts (employment and regional output).

The analysis occurs in three steps.
(1) Generate estimates of allowable surface water diversions for each policy alternative and a baseline state (2009 is used as the base year). This done using the State Water Board's Water Supply Effects model (WSE).
(2) Estimate agricultural acreage and revenue by crop for each alternative. This is done using the UC-Davis group's Statewide Agricultural Production model (SWAP).
(3) Estimate regional economic impact (employment and output) for each alternative.

Their results predict that economic output in the region would be reduced by $193 million per year on average for the most stringent flow requirements. They also predict that this would result in 1,302 job losses on average for the most stringent flow requirements.

Overall, the methods used to generate the economic impact projects seem to be consistent with standard practice. There are 2 main points to make in my review.
1. The assumption of no groundwater substitution is unrealistic and affects the results of the analysis.
2. Predicted economic impacts estimated by the same methods proved to be too high relative to observed outcomes in the case of surface water supply reductions in 2009.

1. The assumption of no groundwater substitution is unrealistic and affects the results of the analysis.

A. There is evidence that groundwater substitution occurred during the drought of 2007 – 2009 in response to reduced surface water available for irrigation. Christian-Smith (2011) and Michael et al (2010) both report that groundwater use increased during this period of reduced surface water and, moreover, that groundwater substitution was in part responsible for mitigating the impacts of reduced surface water deliveries during that time period.

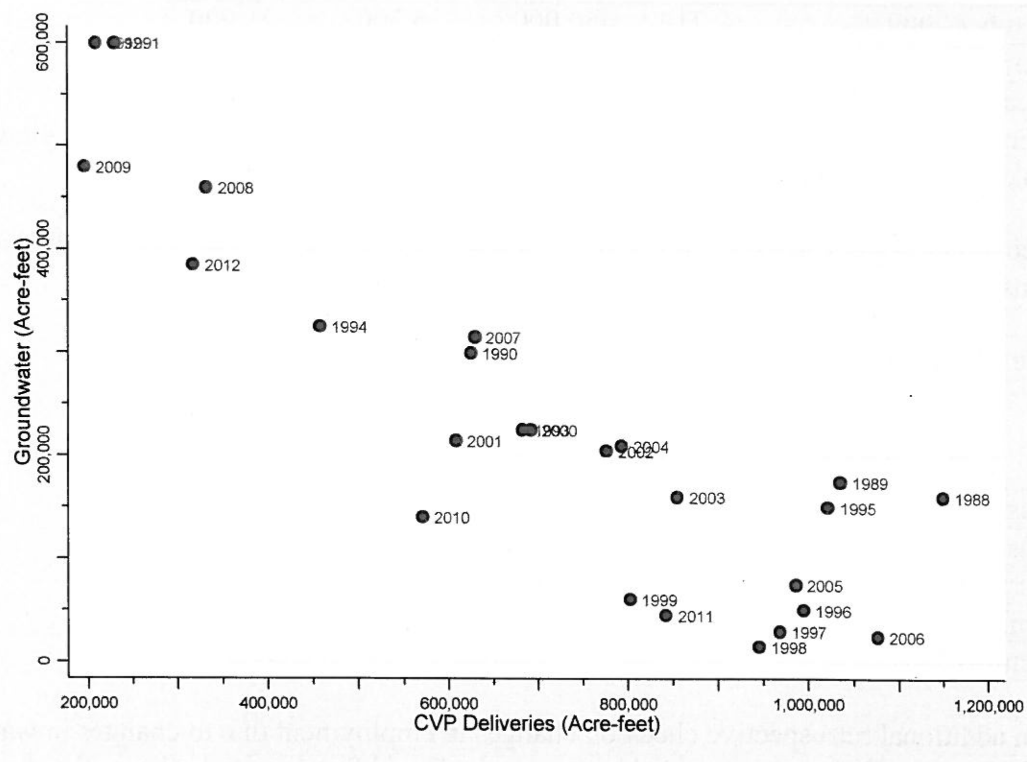
B. Previous applications of the SWAP model have incorporated changes in groundwater use in evaluating the impacts of changes in surface water availability. Two examples of this are below.

- Analysis of the impacts of the 2009 Delta export restrictions includes the effects of increased groundwater use. Howitt et al (2009b) include a brief discussion of the assumptions of the changes in groundwater pumping capacity. Table 1 of that report indicates that all three SWAP model regions analyzed in the LSJR flow alternatives appendix (11 – Stanislaus River, 12 – Tuolumne River, 13 – Merced River) had increased groundwater pumping capacity from 2000 to 2009.
- Reference to an analysis of South of Delta water transfers performed using SWAP notes that no increase in groundwater pumping is used as a constraint in the model (Howitt et al 2010).

These examples indicate that the SWAP model is capable of incorporating and estimating projected changes in groundwater use as a result of changes in surface water supply. The assumption of no changes in groundwater use as a result of the proposed flow objectives should either be relaxed or justified in detail.

C. As an example of the importance of including groundwater substitution in water supply projections, we analyze the case of Westlands Water District. Westlands may not be perfectly analogous to areas that may be affected by the Lower San Joaquin River flow objects (because of differences in groundwater quality/availability, crop mix, climate, alternative water sources, etc.), but it provides a useful illustration for two reasons. First, detailed data on surface water deliveries from the CVP and groundwater use are available for a long time series: 1988-2011. No such data are publicly available for the study area under consideration. Second, Westlands has been exposed to quantities of surface water deliveries that vary widely and thus allow us to analyze the degree of groundwater-surface water substitution over a range of values. Figure 1 plots the quantity of groundwater use and CVP deliveries to Westlands from 1988 to 2011. There appears to be a strong relationship between the two quantities: as CVP deliveries decline, groundwater use increases.

Figure 1. Westlands Water District: Groundwater Use and CVP Deliveries[1].



D. One obvious caveat to the inclusion of groundwater substitution effects is that groundwater availability may be limited in the future. Several reports have documented extreme aquifer depletion in the Central Valley (Christian-Smith 2010, Famiglietti 2011, Faunt 2009).

2. Predicted economic impacts estimated by the same methods proved to be too high relative to observed outcomes in the case of surface water supply reductions in 2009.

Initial estimates of the projected impacts of policy actions, including changes in water supply, are rarely checked for accuracy after the fact. However, in the case of the 2009 Delta export restrictions some retrospective analysis exists.

A. Table 1 summarizes successively updated estimates of revenue and job losses due to the export restrictions produced by the SWAP and IMPLAN models.

Table 1. UCD – SWAP (reproduced from Table 1 in Howitt et al 2011)

Date	Revenue (Million $)	Acres Fallowed	Agricultural Jobs Lost*	Jobs Lost
January 2009	$ 1,400	675,000	--	40,000

[1] Source: Westlands Water District "Annual Water Supply and Use." http://www.westlandswater.org/resources/watersupply/supply.asp

May 2009	710	450,000	--	21,000
September 2009	710	450,000	6,300	21,000
September 2010	370	270,000	2,100	7,500
"Actual"	$ 340	285,000	--	9,800

*Agricultural Jobs Lost column does not appear in Howitt et al 2011 Table 1, but figures are taken from the original studies.

B. Economist Jeffrey Michael provided alternative *ex ante* and *ex post* estimates that are summarized in Table 2.

Table 2. Alternative Employment Impact Estimates by Michael

Date	Farm Revenue Lost (Million $)	Agricultural Jobs Lost	Total Jobs Lost
August 2009	732	5,608 - 6,350	10,878 - 12,319
August 2009	627 - 710	5,755 - 6,518	11,324 - 12,823
August 2009	--	5,000 - 6,522	9,840 - 12,835
December 2009	--	4,410 - 6,300	7,000 - 10,000
September 2010	343	1,700	5,600

C. An additional retrospective check on changes in employment due to changes in water supply from the Delta was provided by economist David Sunding and others. Sunding et al (2011) estimate a very simple regression model with employment as function of CVP and SWP deliveries by county. Their results estimate 4,965 lost agricultural jobs due to Delta export restrictions in 2009[2].

D. Three conclusions can be drawn from the preceding figures. First, estimates, both *ex ante* and *ex post*, vary considerably. This is due to different assumptions, methods, and in some cases different data sources. Second, the SWAP-IMPLAN estimates are always higher than alternatives estimates by Michael. Third, as more information becomes available on observed employment outcomes estimated impacts decrease. The most updated *ex ante* projection by SWAP-IMPLAN of total job losses from May 2009 is 2.8 times greater than the retrospective analysis in 2010[3]. To their credit, the authors of the appendix alert the reader that IMPLAN estimates tend to overestimate indirect job and income losses (page X-29). However, they are unable to provide estimates of the magnitude of this potential error. They also are not able to quantify the uncertainty surrounding estimates provided by the SWAP model.

[2] Sunding et al (2011) report only the estimated job losses, not the full results of their simple regression, so the standard errors surrounding their point estimate are not available. They do indicate that the estimated coefficient used to generate the job loss figure is statistically significant at the 1% level.

[3] The line labeled "Actual" is somewhat misleading. Howitt et al (2011) derive this number by attributing the entire change in official employment statistics from 2008 to 2009 to changes in water supply. This approach seems to go against arguments for a more careful cause and effect analysis made in Howitt et al (2009c), Michael et al (2010), and Sunding et al (2011).

E. We do not intend to imply that the estimates of economic impacts from the SWAP and IMPLAN models are not useful. IMPLAN is widely used as a planning tool in many applications and is a standard method. The SWAP model has been used previously in water resources planning exercises in general. The positive math programming approach upon which is based is also frequently used and is grounded in accepted economic theory. It is important, however, to keep in mind that these tools predict outcomes of uncertain processes, but are not able to provide estimates of the degree of uncertainty surrounding those predictions.

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