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January 27, 2010

This packet provides the following additional documents from NOAA's National Marine Fisheries Service (NMFS) to the National Research Council (NRC) Committee on Sustainable Water and Environmental Management in the California Bay-Delta, per request from individual panel members during its first meeting on January 25 and 26, 2010, at U.C. Davis:

- DVD of OCAP Biological Opinion Modeling Runs – 2009
- May 31, 2009, memorandum, from Rhonda Reed, for the record, Subject: Documentation on the Development of the Reasonable and Prudent Alternatives (RPA) to Avoid Jeopardy to CV Steelhead in the Stanislaus River, Specifically as Relates to Flow and Temperature (13 pages)
- Economic and technological feasibility:
    - June 2, 2009, memorandum, from Maria Rea, for the record, Subject: Review of Information Related to Economic and Technological Feasibility of NOAA's National Marine Fisheries Service's (NMFS) CVP/SWP Operations Reasonable and Prudent Alternatives (RPA)
    - April 28, 2009, letter from Katherine F. Kelly, California Department of Water Resources, to Ronald Milligan, U.S. Bureau of Reclamation, transmitting additional comments (specifically economic analyses) on NMFS' draft Salmonid Biological Opinion
- Alternative RPA actions considered, but rejected:
    - May 19, 2009, e-mail from Rod McInnis, Regarding trap and haul for Central Valley steelhead in the San Joaquin River
    - April 21, 2005, e-mail from Ron Ott, transmitting the South-Delta Fish Facilities Forum Co-Chair's Report on the feasibility of fish screens in the South Delta.

Additionally:

- NMFS refers the NRC Committee to the NMFS biological opinion (section 6.6.4, pp. 391-400; RPA Action IV.6, p.659) for the analysis regarding permanent operable gates within the Central Delta.
- NOAA General Counsel (GC) is currently reviewing NMFS' response to Tim O'Laughlin's presentation. If NOAA-GC determines that we can release the response, we will do so via an e-mail to David Policansky.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Sacramento Area Office
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May 31, 2009

MEMORANDUM FOR: ARN: 151422SWR04SA9116, (PCTS # 2008/09022)

FROM: Rhonda Reed, Section 7 Biologist, Southwest Region

REVIEWED BY: Maria Rea, Supervisor, Sacramento Area Office

SUBJECT: Documentation on the Development of the Reasonable and Prudent Alternatives (RPA) to Avoid Jeopardy to CV Steelhead in the Stanislaus River, Specifically as Relates to Flow and Temperature

I. Introduction

The overarching objectives of the RPA Actions to Avoid Jeopardy to CV Steelhead in the Stanislaus River are:

1) Maintain suitable conditions (temperature and flow) for steelhead survival year round below the East Side Division dams, to the greatest extent downstream that is used by *O.mykiss,* and create seasonally suitable conditions for adult and juvenile migration; and

2) Restore and maintain critical habitat for spawning, rearing, and passage that is adversely modified by operations and that also affects survival and reproductive success.

This technical memo primarily addresses investigations used to develop operational criteria of the East Side Division that affect Objective 1 above. The RPA actions for the Stanislaus River are based on information provided in the effects analysis of the opinion. Temperature guidance for steelhead life history stages is based on EPA (2003), and flow requirements are based on In-stream Flow Incremental Methodology (IFIM) by Aceituno (1993).

II. Information and Rationale Used in The Process of Developing Stanislaus River Flow Schedule For Central Valley (CV) Steelhead

The Project Description (PD) of the Biological Assessment (BA) describes that under the New Melones Transitional Plan (NMTP), New Melones operations will be based, in part, on annual allocations of water to various purposes or users, based on a three tier system: High-Allocation Years, Mid-Allocation Years, and Conference Years (BA Chapter 2, pg 2-65). Based on Aceituno (1993), CV steelhead habitat requirements may be met only in High-Allocation Years. Based on the 28-year history of New Melones operations, this condition has occurred in only 40 percent of years. The process for allocating water in Conference Years is basically that the parties will negotiate allotments. In Mid-Allocation years, the fishery allotment is less than what is needed for CV steelhead. However, under the past IPO operations, downstream water quality objectives frequently provide flows that are beneficial to salmonid needs, and these flows have not been attributed to the fishery allotment. Consequently, it is possible that flow conditions might be suitable for steelhead habitat, but the modeling tools and operational guidance do not provide sufficient information to determine that daily and seasonal flows are within optimum parameters for CV steelhead. Further, the models tend to use a variety of "look-up tables" in place of operational rules, so a look-up table for water quality needs may allocate 10 cfs daily for the month of May; and the look-up table for fishery needs may allocate 150 cfs daily for the month, but there are no definitions or rationale for these allocation levels and no interplay among these factors that would ensure that minimum flows are provided consistently for CV steelhead. Therefore, not only are the operational criteria for New Melones releases unclear, there are no operational parameters defined that would provide beneficial flows for CV steelhead. The most common examples of the problems with this approach under the present IPO occur in January and in September. Flows are typically dropped in January when regulated water quality standards change, resulting in decreasing the wetted spawning habitat and dewatering early-spawned eggs. In September when factors other than Stanislaus River flows cause Delta water quality standards to be met, Reclamation typically drops in-stream flows which reduces habitat for rearing CV Steelhead and causes more frequent temperature exceedances for rearing temperatures. Modeled results identify the same problem periods under the NMTP).

The task at hand was to identify operational criteria that would minimize or prevent flows below optimal levels as defined by the IFIM (Aceituno 1993) and presented as follows in the Opinion:

Table 6-16. Comparison by life stage of in-stream flows which would provide maximum weighted usable area of habitat for steelhead and Chinook salmon in the Stanislaus River, between Goodwin Dam and Riverbank, California (adapted from Aceituno 1993). No value for Chinook salmon adult migration flows was reported.

Life Stage	Steelhead Flow	Steelhead Timing	Fall-Run Flow	Fall-Run Timing
Spawning	200	Dec-Feb	300	Oct 15-Dec 31
Egg incubation/fry rearing	50	Jan - Mar	150	Jan. 1-Feb 15
Juvenile rearing	150	all year	200	Feb 15-Oct 15
Adult migration	500	Oct-April	-	

It is important to note that Aceituno (1993) made no analysis of flow needs for salmonid emigration in the spring.

Several approaches to define such operational criteria were deployed in the process of developing the final Stanislaus River Flow Schedule. These included: (1) a "look-up table"; (2) a fractional unimpaired flow approach; (3) flow schedules built with fall-run in mind which were then modified to address specific steelhead life history requirements; and finally, (4) adaptation of (3) to provide sufficient flows for CV steelhead as well as preventing excessive drawdown of New Melones Reservoir.

The Look-up Table

The initial attempt at defining such operational criteria was to propose a "look-up table" that would set minimum flows by month, as a minimum operational standard to be applied to within +_ 10 percent (Draft Opinion RPA, December 11, 2008). This was combined with additional flow management actions to create an adult attraction flow in October, augmented spring emigration flows, and periodic channel forming flows of 5,000cfs on a one to three-year schedule. Although the look-up table was an attempt to state fish flow needs in a format that appeared to be familiar to Reclamation, the comments we received from Reclamation and California Department of Water Resources about this action indicated general confusion in the presentation of the table and about how the flow-related actions would interact. This response prompted an evaluation of other approaches.

1) The Fractional Unimpaired Flow Approach

This approach considered devoting a set percentage of daily unimpaired flow as the release schedule for fish needs. This approach was abandoned because it was not clear how to define what the appropriate percentage allocation should be given that this schedule would mimic the natural hydrograph with which CV steelhead evolved. However, inflow into New Melones is not unimpaired, owing to many upstream dams for hydropower and other purposes, so it was not clear that such an operational approach could be implemented. Further, if the percentage were set incorrectly, the frequency of unsuitable flow conditions could be increased. Without a substantial level of time and modeling expertise, it did not appear feasible that NMFS could develop this approach, so it was abandoned from consideration in this RPA.

2) The Modified Fall-run Flow Schedules

In January 2009 I consulted with California Department of Fish and Game (CDFG) biologists (Dean Marston, Tim Heyne) and U.S. Fish and Wildlife Service (FWS) biologists (John Wikert, Roger Guinee), requesting their recommendations. The Anadromous Fish Restoration Program (AFRP) flows were discussed as an option. I did not actively pursue them because I felt that these recommendations were heavily focused on salmon and presented a set of priorities for flow allocation that balanced steelhead needs in the context of fall-run priority needs. Additionally, my understanding is that the AFRP flow recommendations are lower than what was recommended in the Working Papers, because the flow schedules ultimately recommended they had to meet the "reasonable-ness" criterion as implied by the Central Valley Project Improvement Act. More recent modeling studies by CDFG on spring outmigration flows for salmon provide further indication that the AFRP flows may not be inadequate for some life history stages (CDFG 2008).

The first flow schedule suggested by CDFG was a simple schedule, including a fall adult attraction flow and "table-shaped" spring emigration flows. These schedules would vary by water-year type, with higher flows in wetter years (Figure 1).

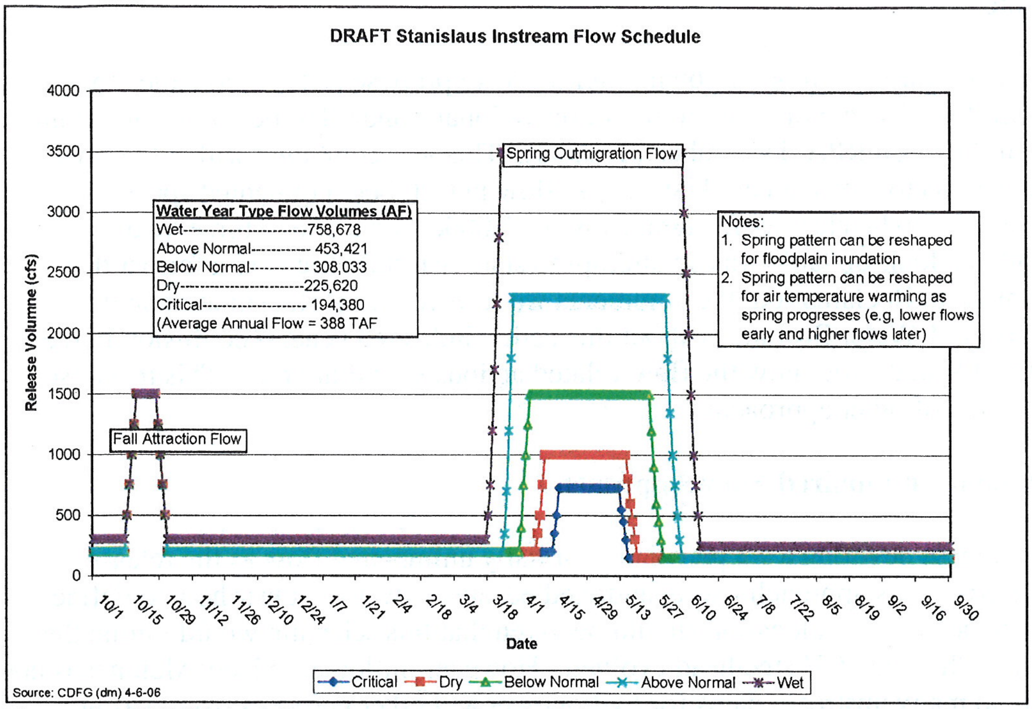

Figure 1. CDFG initial flows for salmonids schedule (rec'd. January 14, 2009)

Subsequent discussion continued by telephone among the parties about the relative needs for steelhead in such a flow schedule, compared to fall run. Topics discussed included:

- Did CV steelhead need a fall attraction pulse? (Yes, based on the fact that the counting weir detects adult CV steelhead at the same time [and not before]; that the fall attraction flows bring in adult fall-run; and based on the likely improvements of these flows on poor water quality conditions further downstream.)

- Variability in flow triggers appears to be important to promote anadromy in steelhead versus residualization.

- Variability in spring pulse flows tends to show elevated activity in out-migrants at rotary screw traps (RST).

- Do steelhead need spring pulse flows, or can they just swim out on their own? CV steelhead are captured at the RSTs before the pulse flows, so early smolts may not need a spring pulse. However, the spring pulse does improve downstream water quality conditions for smolts that are leaving later, and this may be more important than for swimming assistance.

- The unimpaired hydrograph showed elevated flows in the San Juaquin River at Vernalis, well into July in most years. So, would it be beneficial to extend the falling limb of the spring pulse to better replicate evolved conditions? Would there be added benefits to riparian tree recruitment?

- How could, or should, this schedule accommodate geomorphic flows?

- Can we get a temperature model run of the proposed flow schedule?

In response to these discussions, the March 3, 2009, version of the Draft RPA proposed the flow schedule in Figure 2.

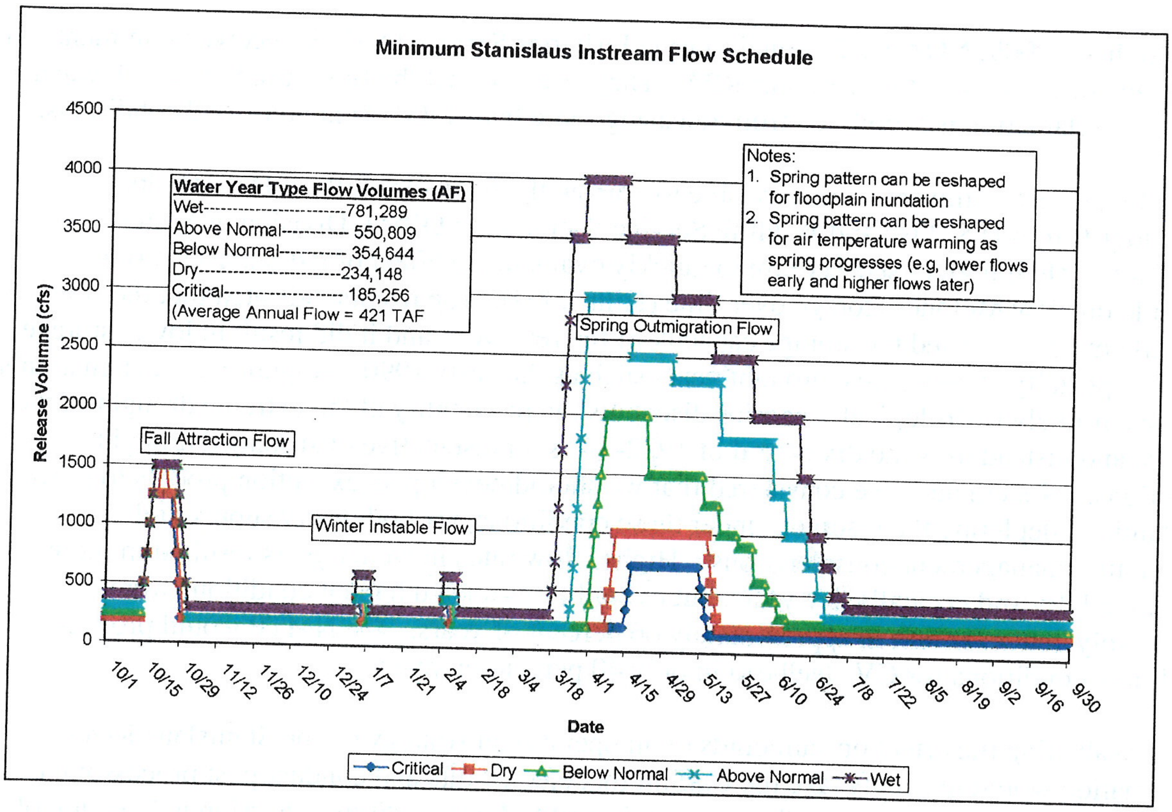

Figure 2. March 3, 2009, Draft RPA Stanislaus Minimum Flow Schedule.

The schedule was developed from: (1) the SJR salmon model (V.1.0) (output for doubling salmon and calculating the Stanislaus flow contribution (spring time); then (2) using other information (such as RST data, escapement patterns, and Aceituno [1993]) to fill in and shape the non-spring time periods. The basic approach was to take the standard salmon needs hydrograph and insert higher flows in time periods where the flow was not at least at the steelhead minimum based on the IFIM. In the dry years, we leaned toward meeting what was described in the IFIM as rainbow trout minimum flows, and in the wetter years the base is more the minimum flows recommendation for steelhead. The biggest change was in the summer where we added more minimum flow both to ensure that the IFIM need of 150 cfs is met for rearing, and, in wetter years, to provide better summer temperatures. The spring pulse flow was changed to have an extended recession limb to give smolts an extended invitation to leave. It also helps maintain a better riparian zone, particularly the large trees which germinate in spring and need a slow drop in water elevation to give their roots time to grow. Small pulse flows were inserted in the winter months to mimic unimpaired flow variability, which seems to be important in increasing the modeled frequency of anadromy in steelhead (Cramer Fish Sciences 2009).

CDFG recommended that these scenarios (especially the driest three scenarios) be run through the San Joaquin Basin temperature model to identify if there are any issues with temperature in summer and fall. This post processing of the proposed flows would likely identify a few corrections for hot spots. CDFG also expressed concern that fall pulse flows in the driest years should be considered on a real-time management basis to prevent drawing in fish only to leave them in the spawning reach at low flows during a time when the ambient air temperatures may remain high in late October and early November; causing warm water temperatures.

On March 20, 2009, NOAA's National Marine Fisheries Service (NMFS) received comments on Stanislaus flows in this March 3 Draft RPA. They asserted that the flows used too much water and that Reclamation is prohibited from releasing more than 1500 cfs in non-flood conditions.

To evaluate these comments, we were able to borrow the time and skills of Derek Hilts, Hydrologist from U.S. Fish and Wildlife Service Sacramento Office, Division of Water Operations. He initially used EcoSim to quickly evaluate the effect of the Stanislaus flow schedule on New Melones storage over time (Hilts 2009). The results indicated that the flow schedule more fully used the storage capacity of the reservoir, and it did result in lower storage levels; especially in successive drought years such as the early 1990's (Figure 3). Reclamation's analysis of likely hydrological scenarios discounts the probability of the extreme drought of the 1990's, and instead uses the dry period of 1922-34 as representative of sustained drought conditions. Nonetheless, we considered that we should develop an exception process to prevent substantially depleting the reservoir under these conditions, for both water supply and temperature management considerations. Higher flow rates in wetter years resulted in more operational dry and critically dry years, but overall flow-related habitat conditions were appreciably better for fish in approximately 66 percent of years. The NMTP would produce good flow conditions for CV steelhead in only 40 percent of years.

When evaluating the effect on salmonids of an operational strategy on the Stanislaus River, Reclamation would normally take the CalSim modeled results and conduct post processing to determine temperature effects. When we met in early March to discuss the March 3 version of the RPA with the action agencies, we requested help from Reclamation to do temperature modeling on these flows using their tools. In subsequent discussion with USFWS and CDFG, the need to perform temperature modeling on these flows was also identified, but NMFS and USFWS lacked internal expertise to perform the modeling. CDFG was unable to assist with running the San Joaquin River Basin temperature model because of funding freezes. Tetra Tech was hired by NMFS to assist with such activities under the guidance of Craig Anderson, Hydrologist, NMFS, Habitat Conservation Division, Southwest Region. Insufficient time was available for them to learn and apply the specifics of operating the model.

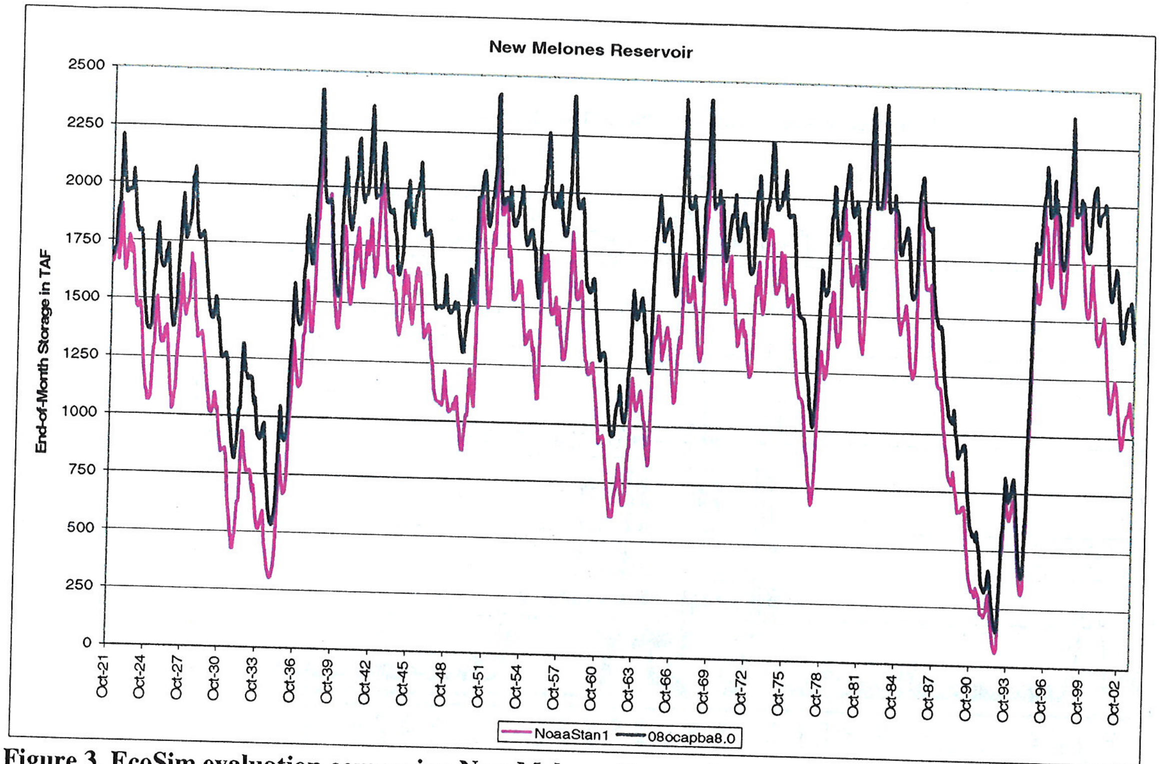

Figure 3. **EcoSim evaluation comparing New Melones Reservoir storage when operated under the March 3 proposed Stanislaus River flows (Pink-NoaaStan1) and when operated under Study 8.0 (full implementation of Proposed Action) from the BA.**

In an April 14 meeting with Ron Milligan, Reclamation, and others, Ron asked for something other than block allocations. I explained the Stanislaus River minimum flows graphic from the March 3 draft RPA. Issues raised were his understanding that Reclamation couldn't exceed 1500 cfs because of seepage. Roger Guinee pointed out that the 1500 cfs cap related to a ruling in a judgment that applied only to the period that New Melones reservoir was filling, and no longer applies (per Jim Monroe, FWS). Kaylee Allen (Reclamation) said she was researching the issue and wasn't sure of outcome. I asked how long it takes for high flows to cause seepage problems. Ron was not definite, but implied about ten days.

Ron also asked if it were possible to move channel-forming flows into their flood management period, as those would be easier to do without the seepage issues. I agreed to look into it, and John Hannon agreed to revisit the RST data for smolts and key migration times. Derek Hilts asked if Reclamation could run their temperature model on this flow schedule, and Ron indicated he would discuss that with his modeling staff.

3) CV Steelhead Modified Pulse Flow Schedule:

In response to the comments received in the meeting with Ron Milligan and others on April 14, I looked at how to modify the peak flows to achieve migration cueing, geomorphic flows, and minimize seepage issues. I did not limit flows to 1500 cfs, but decreased the duration of the flows in excess of that level. The changes were applied in the spring, with higher peak flows scaled to water-year type, repeated thru spring to give migration cues and facilitate geomorphic processes (Figure 4).

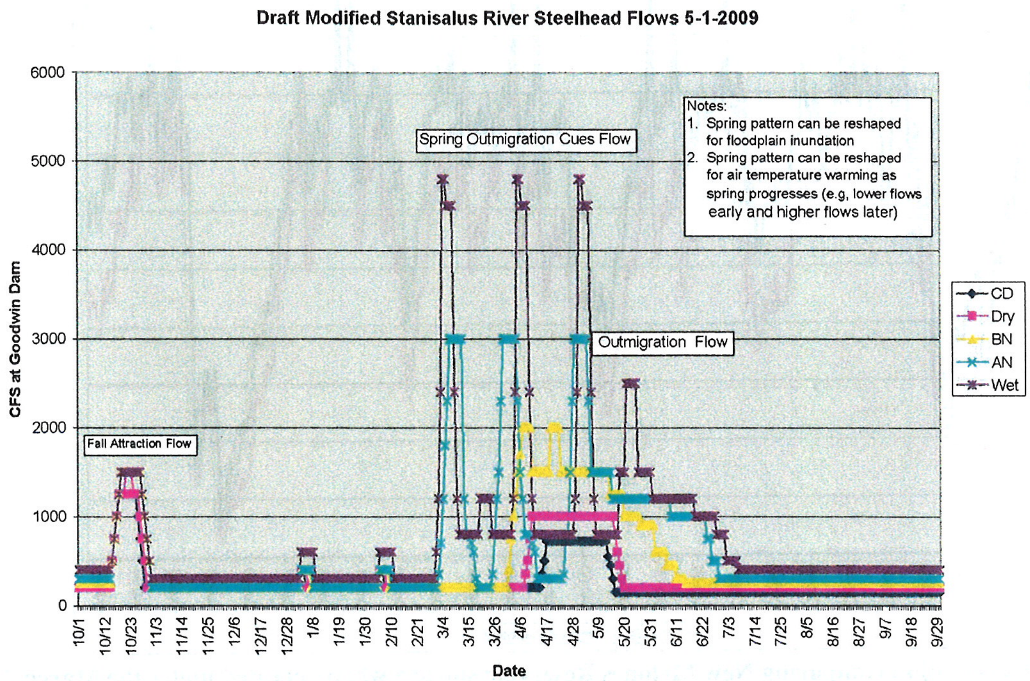

Figure 4. Modified Stanislaus flow schedule with Multiple Spring Pulses and ramp down to 800cfs. (Created May 1, 2009)

I evaluated whether it was possible to do channel-forming flows earlier, looking at John Hannon's steelhead emigration analysis (Hannon 2009). His analysis showed a median departure date of March 1, so an earlier pulse could assist earlier exiting smolts to cue their migration; but high flows in January through March risk scouring of both steelhead and fall-run redds. Hannon also included a historical presentation of monthly flows (Flow Charts Tab in Hannon 2009 spreadsheet), which showed that pre-New Melones Dam high flows would occur in February (peak ~5,000 cfs, median ~1,000 cfs), but were highest in May (peak ~8,000cfs, median ~ 2,300cfs). So, as a compromise to correlate geomorphic flows with flood releases, I proposed the first pulse in early March. This could cause some redd scouring, but it would be closer to the period when unimpaired flows would have produced similar high flows and would allow for some fry to have emerged. The EcoSim modeling (Hilts 2009a) showed less impact on New Melones storage with this schedule of multiple pulses of shorter duration, still scaled to water-year type. That said, an exception procedure should still be developed for the instances of multiple dry years as no action (even in the proposed BA PD) could seriously deplete reservoir levels.

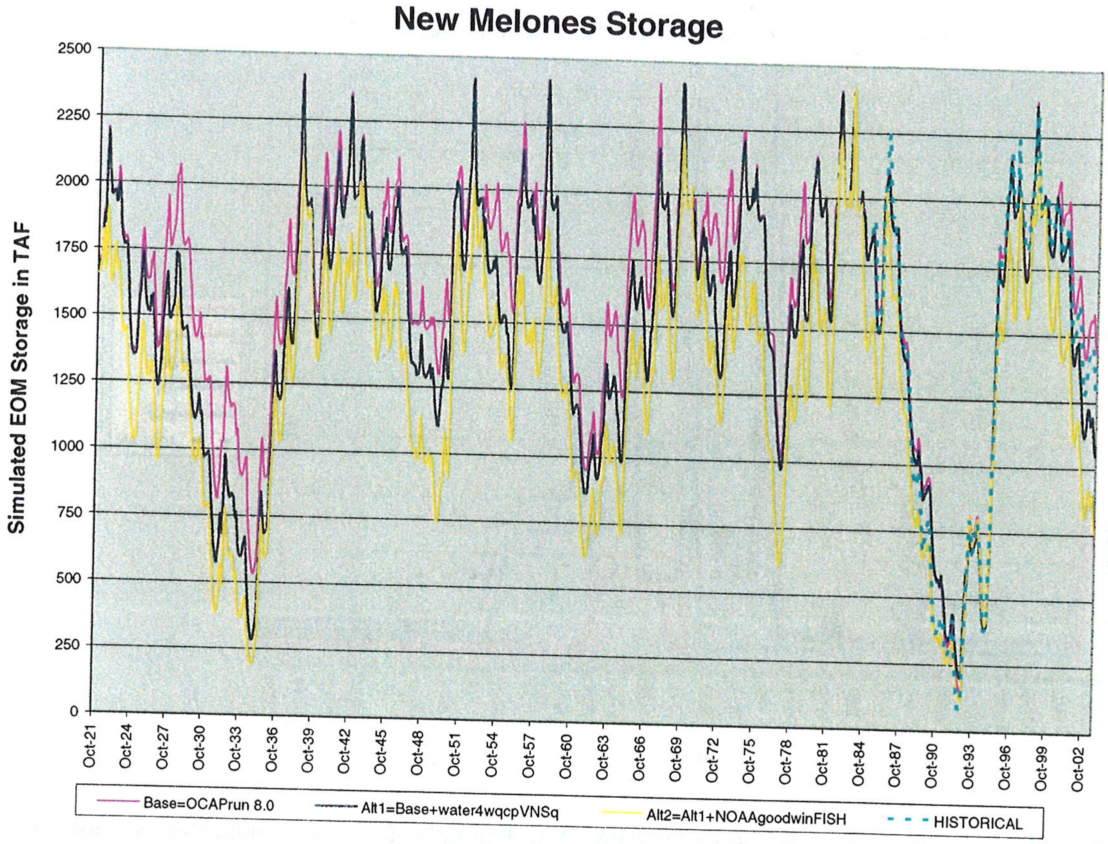

Figure 5. New Melones Storage Levels as Operated with CV Steelhead Modified Pulse Flow Schedule (Hilts 2009a)

The final flow schedule was adjusted to prevent pulse flow drops from falling below 800 cfs and prevent a known stranding problem (Roger Guinee 2009 pers comm.) and to slightly increase highest flows to 5,000 cfs in order to provide a minimum channel forming flow (Kondolf *et al.,* 2001). In practice, peak flows may get be higher in wetter years if 1999 is any indicator, but would require higher storage (Figure 6), starting the water year. These minor changes showed no ostensible difference in New Melones storage levels.

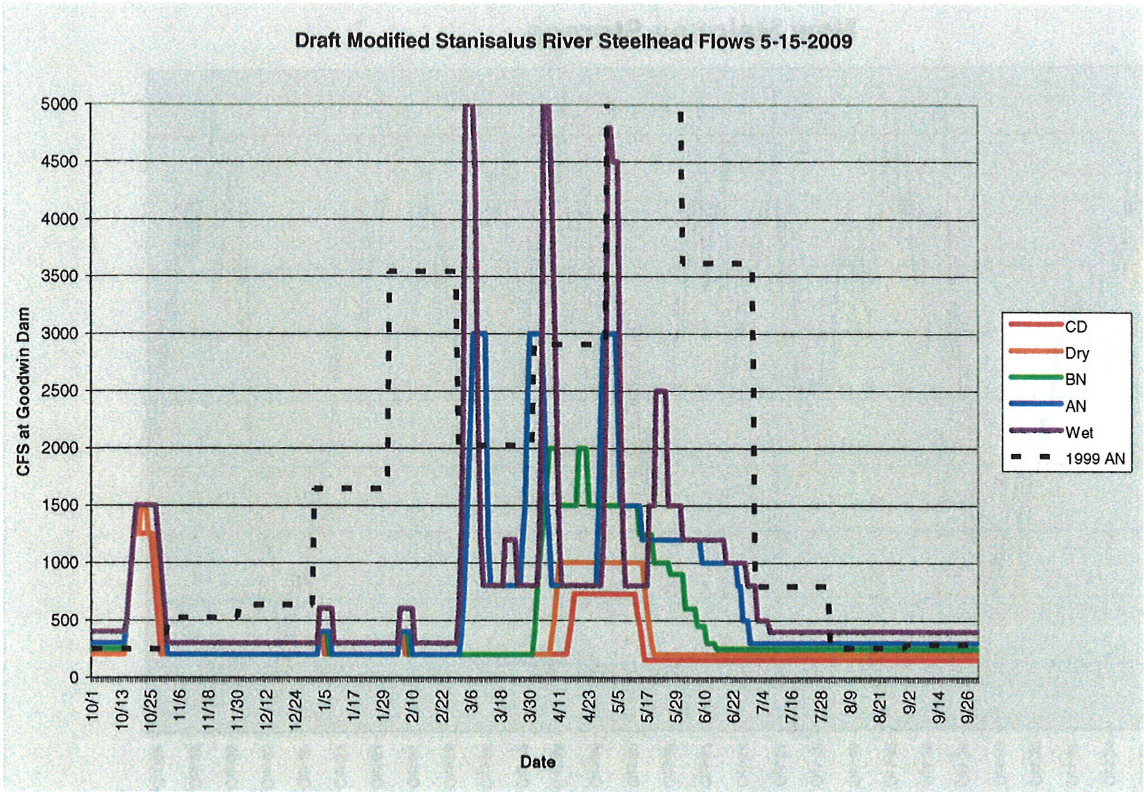

Figure 6. Final Stanislaus River Flow Schedule for RPA, With Example of Above Normal Release Pattern From 1999 (dotted line).

Upon seeing the applied release pattern from 1999, I am satisfied that the proposed minimum flow schedule provides a default minimum flow pattern that is a significant improvement for CV steelhead in all but driest of years and that can fall within the operational patterns conducted by Reclamation in recent years.

III. Interaction of San Joaquin River Inflow to Export Ratio Action and the Minimum Stanislaus River Flows Action

The Stanislaus River flow schedule for the RPA was developed from the initial perspective of providing appreciable benefits to CV steelhead as they inhabit the Stanislaus River, to avoid jeopardy from project operations. However, these flows and operations are an integral part of a larger migratory route and a larger water management system. Additional actions proposed in the RPA addressed the conditions encountered by CV steelhead further downstream in the San Joaquin River. Additional modeling was conducted to evaluate actions relating to the ratio of San Joaquin River inflow at Vernalis to export levels. For complete discussion of these analyses, see Craig Anderson's CVP/SWP operations biological opinion technical memorandum under the subject heading *Modeling Tools and Associated Analyses Utilized in Developing the San Joaquin River Inflow to Export Ratio Action and the Minimum Stanislaus River Flows Action for the 2009 NMFS OCAP BO* (Anderson 2009). This modeling was conducted in an exploratory manner; first looking at the inflow:export relationship, and ultimately uniting the analyses of these actions in their upstream to downstream relationship. The ability to achieve inflow:export ratios was determined to be related to available storage at upstream reservoirs, including New Melones; so the action evolved to include a relationship between the New Melones Index (NMI) and in-stream flows.. While the initial development of the Stanislaus River flow schedule considered the water-year classification system from a general perspective, such as the 60-20-20 index for the San Joaquin River, the rate of depletion of New Melones Reservoir in successive years of drought suggested that some mechanism, related to storage levels, should be developed to manage operations in these exceptional conditions. The integration of the NMI into that process appears to offer a useful planning tool.

The effect of dedicating Stanislaus water to purposes at Vernalis generally reduced the NMI for any given year. This increases the likelihood that for the same inflow, a water year will fall into a drier classification. As the annual flow pattern is determined by the water-year type and the NMI is expected to be lower, this will reduce the frequency of the highest final flow regimes and increase the frequency of the lowest flow regimes. This is illustrated in Figure 6 below. When the Vernalis RPA was imposed (yellow line), modeled as a minimum flow requirement at Vernalis April 1 through May 31, the frequency of each Goodwin minimum in-stream flow allocation generally shifted to the right as compared to the condition without the Vernalis RPA (blue line). This results in more years under the lower flow conditions and fewer under the higher conditions, but the flow patterns and peak magnitudes do not change for a given year type. The lower flow (drier year) patterns provide adequate conditions for the fish comparable or better than the Study 8 conditions, and the higher flows provide an appreciable benefit for survival conditions and habitat quality.

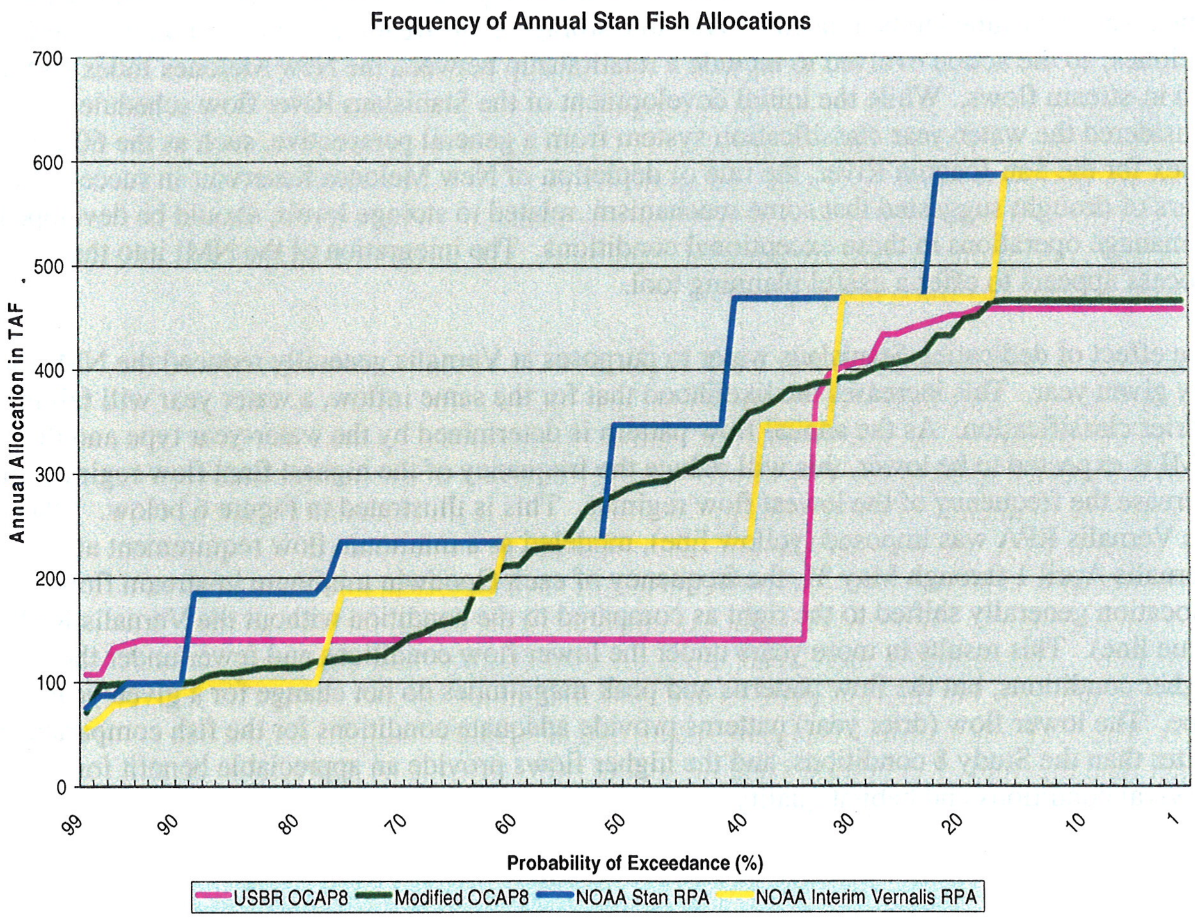

Figure 6. Probability of exceedance for simulated annual Stanislaus Fish flow allocations for OCAP study 8.0 simulation, the modified OCAP study 8.0 simulation, the minimum Stanislaus flows (Stan) RPA simulation, and the interim SJRI:export (Vernalis) RPA simulation.

IV. Temperature Modeling

Reclamation did conduct temperature modeling on the Modified Fall-run Flow Schedules presented in the March 3, 2009, draft RPA, and provided a copy of the results to NMFS on May 5 (Reclamation 2009). At that point in time, we had modified the March 3 Stanislaus flow schedule to the CV Steelhead Modified Pulse Flow Schedule. Nonetheless, the temperature analyses were informative. The results showed similar temperature exceedance problems as compared to Study 8.0 results in summer of dry and critically dry years, but the RPA action provides better flows for habitat quality and thus survivability. Given that these model runs were done on large continuous spring flow (March 3 version), I would expect that temperature evaluations for subsequent flow schedules would show no change or an improvement in temperature conditions. This expectation is based on the fact that Reclamation's temperature model didn't show much change in temperature as a result of the proposed fish-friendly flow pattern, and that the subsequent flow schedules required less water to be delivered from storage; which would preserve a larger coldwater pool.

V. Summary

The Stanislaus Flow pattern developed through this process is intended as default minimum flow schedule to avoid jeopardy on CV steelhead. The RPA identifies that this schedule shall be implemented in consideration of maintaining appropriate temperatures for CV steelhead life history requirements as identified in the RPA. NMFS recommends that additional temperature modeling runs be conducted to fine tune the precise flow schedule, within the constraints of the RPA as written. The action is written so that the flow schedule can be modified in real-time operations management process and can be improved with new information, such as from in-stream flow habitat evaluations underway or subsequent temperature modeling. A possible mechanism for an exception procedure to prevent extreme draw-down of New Melones Reservoir in extended drought conditions was to tie the flow schedule to the New Melones Index in Anderson (2009).

VI. References Cited

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Stanislaus flow patterns spreadsheet.

UNITED STATES DEPARTMENT OF COMMERCE
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June 2, 2009

MEMORANDUM TO: ARN: 151422SWR2004SA9116 (PCTS# 2008/09022)

FROM: Maria Rea
Supervisor, Sacramento Area Office

SUBJECT: Review of Information Related to Economic and Technological Feasibility of NOAA's National Marine Fisheries Service's (NMFS) CVP/SWP Operations Reasonable and Prudent Alternatives (RPA)

When developing an RPA, NMFS is required by regulation to devise an RPA that is "economically and technologically feasible", in addition to avoiding jeopardy and adverse modification.

Consultation Process

These feasibility concerns were discussed and addressed in many ways throughout the period of November 2008 through May 2009, during the course of the consultation. During this period, NMFS developed an initial RPA by December 11, revised that RPA in response to feedback from the two science panels and the California Department of Water Resources (DWR), U.S. Bureau of Reclamation (Reclamation), California Department of Fish and Game, and U. S. Fish and Wildlife Service (USFWS). NMFS developed a second draft RPA by March 3, and revised that draft in response to additional feedback from the agencies prior to providing the final action. Some of the more complex RPA actions, including Shasta Storage, Habitat Rearing Actions, Passage Program, Stanislaus Flows and the San Joaquin River Inflow Export Ratio, went through many iterations of review, re-drafting, and refinement, involving interagency staff and management expertise, including biology, ecology, hydrology, and operations, in order to ensure that the actions were based on best available science, would be effective in avoiding jeopardy, and would be feasible to implement. NMFS also secured outside contractual services to provide additional modeling expertise in evaluating draft RPA actions.

Examples of Feasibility Concerns in RPA Actions

As a result of this iterative consultation process, NMFS considered economic and technological feasibility in several ways when developing the CVP/SWP operations RPA. Examples include:

1) Providing reasonable time to develop technologically feasible alternatives where none are "ready to go" – *e.g.*, the Delta engineering action (Action IV.1.3) and lower Sacramento River rearing habitat action (Action I.6.1).

2) Calling for a stepped approach to fish passage at dams, including studies and pilot projects prior to a significant commitment of resources to build a ladder or invest in a permanent trap and haul program. A reinitiation trigger is built into this action in the event passage is not deemed feasible, prior to construction of permanent infrastructure.

3) Considering limitations of the overall capacity of CVP/SWP systems of reservoirs in determining feasibility of flow actions below reservoirs, and considering the hydrologic record and Calsim modeling results (Shasta/Sacramento River, Folsom/American River, New Melones/Stanislaus River, (see technical memo, Craig Anderson).

4) Tiering actions to wate- year type and/or storage in order to conserve storage at reservoirs and not unduly impact water supplies during drought (see technical memos Craig Anderson and Jeff Stuart).

5) Providing health and safety exceptions for export curtailments.

6) Using monitoring for species presence to initiate actions when biologically supported and most needed, in order to limit the duration of export curtailments.

7) Incorporating scientific uncertainty into the design of the action, when appropriate, in order to refine the action over time (*e.g.*, six-year acoustic tag study for San Joaquin steelhead).

8) Incorporating performance goals into more complex actions (for example, Shasta storage, rearing habitat, and San Joaquin acoustic tag study). A performance-goal approach will allow for adaptation of the action over time to incorporate the most up-to-date thinking on cost-effective technologies or operations.

9) Allowing for interim, further constrained water deliveries to Tehama Colusa Canal Authority through modified Red Bluff Diversion Dam operations for three years, while an alternative pumping plant is being built.

The RPA includes collaborative research to enhance scientific understanding of the species and ecosystem and to adapt actions to new scientific knowledge. This adaptive structure is important, given the long-term nature of the consultation and the scientific uncertainty inherent in a highly variable system. Monitoring and adaptive management are both built into many of the individual actions and are the subject of an annual program review. This annual program review will provide for additional opportunities to address any unforeseen concerns about RPA feasibility that may arise.

The rationale statements for individual actions explain more specific reasoning, and the administrative record contains specific hydrology and modeling results in support of the more complex actions (*e.g.*, Shasta and San Joaquin storage/flows).

Water Supply Costs and Projected Impacts

NMFS examined water supply costs of the RPA as one aspect of considering economic feasibility. While only costs to the action agency are considered in determining whether an RPA meets the regulatory requirement of economic feasibility, NMFS is mindful of potential social and economic costs to the people and communities that historically have depended on the Delta for their water supply. Any water supply impact is undesirable. NMFS made many attempts through the iterative consultation process to avoid developing RPA actions that would result in high water costs, while still providing for the survival and recovery of listed species.

NMFS estimates the water costs associated with the RPA to be 5-7 percent of average annual combined exports: 5 percent for CVP, or 130 TAF/year; and 7 percent for SWP, or 200 TAF/year[1]. The combined estimated annual average export curtailment is 330 TAF/year. NMFS' methodology and results for these estimates is contained in a technical a memo from Craig Anderson, (NMFS Hydrologist). These estimates are over and above export curtailments associated with the USFWS Smelt Opinion. The OMR restrictions in both Opinions tend to result in export curtailments of similar quantities at similar times of year. Therefore, in general, these 330 TAF export curtailments are associated with the NMFS San Joaquin River Ratio actions in the RPA.

NMFS also considered that there may be additional localized water costs not associated with South Delta exports. These may include, in some years, localized water shortages necessitating groundwater use, water conservation measures, or other infrastructure improvements in the New Melones service area, and localized impacts in the North of Delta in some years, associated with curtailments of fall deliveries used for rice decomposition. NMFS considered whether it was feasible to model and estimate any water costs associated with the Shasta or American River RPA actions, and discussed this issue with Reclamation. In general, it was decided that modeling tools were not available to assess these costs and/or that costs would be highly variable depending on adaptive management actions, and therefore, not meaningful to model.

To assess the economic feasibility associated with average annual water costs of 330 TAF, NMFS reviewed CVP/SWP project wide and statewide information regarding water availability. NMFS considered the following information as background to economic feasibility. This information is provided by the State Legislative Analyst's Office (California's Water: An LAO Primer, October 2008),

1) "The federal government has developed the most surface storage capacity in the state with over 17 MAF of capacity in ten reservoirs on multiple river systems. These reservoirs generally are part of the federal Central Valley Project (CVP), which serves about 3.1 million people, and provides irrigation water to over 2.6 million acres of land. The largest reservoir in the system is Shasta Lake with 4.6 MAF of capacity. The state, as part of the development of SWP, built Oroville Dam and reservoir on the Feather River system with a capacity of 3.5 MAF. The SWP provides all or part of the drinking

[1] The proportional share between the CVP and SWP is attributable to CalLite programming and may not represent the true share of export reductions that would be allocated to each facility under actual conditions.

water supply for 23 million people and provides irrigation water to about 755,000 acres of land."

2) "The federal government, through the Bureau of Reclamation, holds the most (in volume) water rights in the state with over 112 MAF of water held, mainly for delivery through the federal CVP. Second to this are the water rights held by the Imperial Irrigation District (44 MAF), serving mainly farms in the Colorado River region. Two private gas and electric companies hold rights to over 41 MAF of water collectively, mainly for hydroelectric power. The state, through DWR, holds rights to about 31 MAF of water."

3) "Water dedicated for environmental uses, including instream flows, wild and scenic flows, required Sacramento-San Joaquin River Delta (the Delta) outflow, and managed wetlands use, declines substantially between wet and dry years—a 62 percent reduction. Available water supplied to agricultural and urban users actually increases in dry years. From wet to dry years, urban use increases by 10 percent and agricultural use increases by 20 percent. The main reason for this increase is the need in dry years for more developed water for agricultural irrigation and residential landscaping."

4) "Agricultural use of water is significant. California agriculture uses roughly 30 MAF of water a year on 9.6 million acres. California's vast water infrastructure— including the development of the State Water Project, Central Valley Project, and Colorado River, as well as local and regional groundwater supply projects—was developed to provide water for irrigation (among other purposes), with agriculture using about 80 percent of California's developed water supply." (LAO, 2008)

NMFS also considered information on relative deliveries of water in the state, including Figure 8 from Blue Ribbon Task Force Delta Vision Report, and Figure 10 from the same report, showing the relative importance of Delta exports relative to other sources of water supplies (taken from DWR 2005 California Water Plan Update). To assess the relative impact of export reductions on Southern California urban uses, NMFS reviewed a presentation by Metropolitan Water District, entitled "Metropolitan's Water Supply Planning," January 31, 2009, and reviewed Figure 11 from the Delta Vision report showing the potential range of demand reductions and supply augmentations from different strategies (taken from DWR 2005 Water Plan Update).

NMFS considered the above water cost estimates in the context of the larger set of facts on California's water supply to determine whether the RPA is economically feasible. NMFS believes that a cost of 5-7 percent of the project capacity is not unreasonable for a multi-species ESA consultation, given the factual context of the Delta ecosystem and water delivery system. 330 taf reduction can be compared to 30 MAF for agriculture statewide, according to LAO. In addition, these amounts can be compared to the water rights held by the Federal and State governments (112 MAF, and 31 MAF respectively, according to LAO).

Most important, NMFS evaluated the 5-7 percent combined export reduction in the context of future water demand and supply in California. The Delta is only one source of water supply. According to other planning documents (DWR's California Water Plan Update, 2005), water agencies are already planning for and adjusting to reduced supplies from the Delta. Alternative supplies include: water transfers; demand reduction through conservation; conjunctive use/groundwater use during droughts; wastewater reclamation and water recycling; and desalination. For example, urban water use efficiency is estimated by DWR to potentially result in between 1.2 to 3.1 MAF annual water savings, and recycled municipal water is potentially estimated to result in .9 to 1.4 MAF annual water savings. The State of California has had an active Integrated Watershed Management Program for almost ten years. Projects funded through these local water infrastructure investments are coming on line and will help offset decreased water supply from the Delta.

Furthermore, NMFS considered RPA water costs in the context of (b)(2) water assets of 800 taf. As the Opinion explains, for purposes of the effects analysis, NMFS could not be reasonably certain that (b)(2) water would be available at a specific place and time needed to address adverse effects of the project on a listed species. Therefore, the Opinion analysis and RPA actions developed to avoid jeopardy and adverse modification of critical habitat are independent of the availability of (b)(2) assets, and are silent about how these assets should be used. The Secretary of Interior retains discretions over how (b)(2) assets are dedicated to eligible water actions throughout the water year. It is NMFS' understanding that water actions taken by Reclamation to implement the RPA are eligible actions. If the Secretary of Interior so chooses, dedication of (b)(2) water assets to the RPA actions could completely or significantly offset the projected water costs of the RPA. In addition, limited Environmental Water Account assets associated with the Yuba Accord may be available, in part, to offset water costs in the State Water Project. In the proposed project description these assets were dedicated to Vernalis Adoptive Management Program (VAMP) export curtailments. The VAMP export curtailments will be replaced, in part, by the new San Joaquin River Ratio action.

In evaluating economic feasibility, NMFS examined the direct costs of the modified operations to the Federal action agency; the U.S. Bureau of Reclamation. According to the LAO, 85 percent of Reclamation's costs are reimbursed by water users, and 95 percent of DWR's SWP costs are reimbursed:

> "Irrigation water users pay about 55 percent of CVP reimbursable costs ($1.6 billion), while municipal and industrial water users are responsible for the remaining 45 percent (or about $1.3 billion). These reimbursements are paid through long-term contracts with water agencies. The total capital cost to construct the CVP as of September 30, 2006, is about $3.4 billion. The federal Bureau of Reclamation calculates how much of the capital construction cost is reimbursable from water users. Currently, users pay about 85 percent of total costs. In contrast, more than 95 percent of SWP's costs are reimbursable from water users. The costs assigned to such CVP purposes as flood control, navigation, and fish and wildlife needs are not reimbursable and are paid by the federal government."

(LAO, 2008) Through this arrangement, costs to the action agency itself are minimized.

NMFS also reviewed and evaluated water cost information provided by DWR. In general, the DWR information reinforced NMFS' estimates of water costs. On March 20, 2009, DWR provided estimates of water costs associated with the March 3 draft of the RPA (letter from Kathy Kelly to Ronald Milligan). These modeled costs were discussed in several technical team meetings and remain the only modeled projections of water costs of the RPA that NMFS is aware of. DWR estimated that combined CVP/SWP costs, as compared to operations under D1641, are 800 taf to 1.0 MAF (or about 15-17 percent). However, because the salmon and smelt are near the export facilities during much of the same time of year (winter to spring), many export curtailments are multi-species in nature. Therefore, DWR estimates that, the average combined water supply impact of the NMFS RPA, layered on top of USFWS' smelt RPA, is an additional 150 taf to 750 taf, (or about 3 to 15 percent).

The San Joaquin river ratio action changed significantly between the March 3 draft of the RPA and the final RPA. Specifically, the duration of the period changed from 90 to 60 days, in order to better focus the action on the species' biological requirements, and the ratios were more closely refined to reflect water year type in order to reflect actual available water in the watershed and in acknowledgement that acquiring (or requiring, if the State Water Resources Control Board acts) additional flows on the Tuolumne and Merced rivers could be difficult or uncertain in the near term. Both of these refinements would reduce, perhaps substantially, DWR-projected water costs, and would most likely make them consistent with NMFS' estimates. On April 28, 2009, DWR provided an additional analysis of on the economic impacts of estimated water costs of the March 3 draft RPA (letter from Kathy Kelly to Ronald Milligan). DWR estimated that the impact of the RPA would range from $320 million to $390 million per year. The methodology used multipliers estimated indirect and well as direct impacts. Again, these costs were predicated on RPA actions that were modified after March 3, and would have reduced water costs.

Project Costs

In addition to water costs, Reclamation and DWR will incur project costs associated with certain RPA actions (*e.g.*, the fish passage program). The State of California has authorized $19.6 billion in water-related general obligation bonds since 2000, and these bonds often contain provisions for environmental conservation-related purposes (LAO, 2008). Over $3 billion has been spent through the Calfed Bay-Delta Program. The CALFED ROD contains a commitment to fund projects through the Ecosystem Restoration Program. Similarly, the Central Valley Program Impact Account Anadromous Fish Restoration Program funds eligible restoration projects, using Federal authorities. Some of the projects in the RPA may qualify for those sources of funds.

Summary

In summary, for all the above reasons, NMFS finds that the costs associated with the RPA, while not insignificant, do not render the RPA economically infeasible. Overall, the RPA is both technologically and economically feasible.

Cc: Garwin Yip, OCAP Project Manager

STATE OF CALIFORNIA -- THE RESOURCES AGENCY

ARNOLD SCHWARZENEGGER, *Governor*

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April 28, 2009

Mr. Ronald Milligan, Operations Manager
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Section 7 Consultation DWR's Additional comments on draft NMFS' Salmonid Biological Opinion

Dear Mr. Milligan:

The Department of Water Resources (DWR) provides the following additional comments on the National Marine Fisheries Services' (NMFS) revised draft Biological Opinion for effects of the CVP and SWP on salmonids and green sturgeon sent to DWR in March 2009 (March draft Bi Op).

The attachment to this letter contains two reports prepared by DWR which analyze the economic impacts of the March draft Bi Op as well as the United States Fish and Wildlife Service (USFWS) OCAP biological opinion issued in December 2008. The reports summarize the forecasted annual aggregated economic impact that would occur with the implementation of the two opinions compared to existing operational requirements under D-1641. The first report compares the two opinions against existing OCAP conditions at the 2030 level of development, and the second compares them at the 2004 level of development. It should be noted that the 2004 level is the latest scenario available under the CALFED Common Model Package, and that the current level of demand for the South Bay Area and South Coast Region is approximately 6.5% higher compared to 2004, so it logically follows that the associated impacts from the opinions would be proportionately larger. Further, the 2030 level estimate is based on long-term assumptions, including that cost-effective water conservation measures have been adopted and are in place by that time.

Table 1 of each report provides a summary of the annual impacts of the opinions. The first two sections show the cost of each opinion separately, with the third showing the impact from the two opinions combined. For the 2004 scenario, the NMFS draft RPA would have a net economic impact of about $320 million to $390 million per year while the combined costs of both the USFWS and NMFS opinions would be about $500 million to $670 million per year. For the 2030 scenario, the NMFS draft RPA in the Delta would have a net economic impact of about $320 million to $390 million per year while the combined costs of both the USFWS and NMFS opinions would be about $480 million to $620 million per year.

Again, the costs for the 2030 scenario include an assumption that a great deal of investment in water conservation and other improvements has been made. If these improvements are not made, the costs associated with the opinions would be proportionately greater. It should also be noted that the impacts set forth in the reports depend on the ability of agricultural users to pump additional groundwater. The bottom row in each table shows the amount of additional groundwater that would need to be pumped on an annual basis to keep the impacts at the cost level shown. If this additional amount of groundwater is unavailable, the economic impacts will be greater.

These are dramatic economic effects and any benefits to salmon from the proposed RPA must be considered against the costs of this action. In our earlier comments (January 13, 2009, February 2, 2009, March 20, 2009 and April 20, 2009) we pointed out inadequacies and uncertainties regarding NMFS' analysis related to the RPA actions, especially with regard to the pumping restrictions in Actions IV.2.1 and IV.2.2. As pointed out in our earlier comments, these actions are not likely to provide a clear benefit to salmonid survival, but will place a severe economic burden on the State, both in the near-term and the long-term. The economic cost of these proposed actions, when compared to the small and questionable benefit they may provide, shows that the proposed actions do not meet the standard for being economically feasible. The Department therefore requests that these actions be modified as proposed in our March and April, 2009 letters and our recent discussions with NMFS. Further, we ask that NMFS consider both the direct costs of implementing the proposed actions in the RPA as well as the economic costs associated with their implementation, and reassess whether the RPA is feasible as written.

Sincerely,

Original Signed by

Katherine F. Kelly
Chief, Bay-Delta Office
California Department of Water Resources

Enclosures:

Report (Parts A and B) on economic impacts

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Economic Impact Analysis of proposed NMFS BO
Part A: For the 2030 Level of Development
California Department of Water Resources
April 28, 2009

Results of Study

The results of comparing the existing (OCAP) conditions forecasted at the 2030 level of development with the forecasted 2030 conditions with the US Fish and Wildlife Service and the NOAA National Marine Fisheries Biological Opinions are shown in Table 1. These are expected annual impact numbers.

Urban economic impacts include increased costs and losses due to water supply shortages and the increased cost of regional water supply and conservation measures that are economically efficient to adopt. The urban economic impact results are based on studies that showed that the cost-effective level of adoption of regional water use efficiency and regional supply options would range from 0.7 to 1.0 million acre-feet above the 1.2 million acre-feet of conservation, water recycling, and ocean water desalting that could be reasonably foreseeable by 2030 per NEPA EIS criteria.

Urban economic impacts prior to 2030 and those after 2030 will depend upon water demand and the ability of the affected regions to mitigate the costs of unreliability with regional water supply and conservation measures. The initial economic costs associated with the biological opinions are expected to be very high. As regional water management projects and programs are developed to mitigate for the reduction in water supply, the annual costs will go down but they will increase with increasing demand as time progresses. Annual water demand is expected to continue to increase over time, and after 2030, the costs will be substantially higher because of the increasing costs of regional reliability management measures needed to manage growing urban demand. This is illustrated in Figure 2.

Agricultural economic impacts include reductions in farm product sales revenue and increased production costs. As shown in Table 1, the CVPM model results indicate substantially increased dependence on groundwater for maintaining agricultural production when exports are limited by the biological opinions. The FWS/NMFS High Restriction Scenario shows annual groundwater pumping in the Central Valley goes up over 600 TAF annually compared to the OCAP study. The question of long-term sustainability looms large, especially for groundwater in the San Joaquin Valley where the model shows an annual increase of about 715 TAF. (The Sacramento Valley groundwater pumping decreases by about 110 TAF annually.)

These results were produced using the models and procedures that are part of the CALFED Common Model Package. The CMP was developed to evaluate surface storage programs on a common basis. The methods used for each of the impact categories are as follows:

Economic Impacts related to Urban Water Supply

Most urban water supply is valued using LCPSIM. Some urban water supply is valued by extrapolating water supply values from LCPSIM, and some supply in dissimilar areas is valued based on costs of groundwater development.

LCPSIM is a yearly time-step simulation/optimization model developed by the California Department of Water Resources (DWR) to assess the economic benefits and costs of enhancing urban water service reliability at the regional level.

Table 1.
Forecasted Annual Impacts at the 2030 Level of Development

	FWS Low Restriction vs. OCAP Study 7.0	FWS High Restriction vs. OCAP Study 7.0	NMFS Low Restriction vs. OCAP Study 7.0	NMFS High Restriction vs. OCAP Study 7.0	NMFS/FWS Low Restriction vs. OCAP Study 7.0	NMFS/FWS High Restriction vs. OCAP Study 7.0
Annualized Net Revenue/Benefit/Reduced Cost (in 1,000's of $)						
Water Supply						
Urban (LCPSIM So Bay & So Coast; *note 2*)	-$269,351	-$489,506	-$279,920	-$329,944	-$407,444	-$514,659
Urban (Other)	-$14,436	-$69,542	-$20,095	-$32,754	-$50,366	-$75,141
Ag (CVPM Central Valley)	-$5,925	-$70,472	-$41,534	-$51,520	-$58,066	-$79,908
Water Supply Sub-total	-$289,711	-$629,520	-$341,549	-$414,218	-$515,876	-$669,709
Water Quality (TDS only)	-$11,786	-$57,142	-$26,973	-$39,535	-$43,728	-$60,754
Hydropower (system)	$40,141	$97,953	$49,361	$59,325	$77,209	$107,676
Total	-$261,356	-$588,709	-$319,161	-$394,427	-$482,394	-$622,787
Delivery/Delivery Impact (TAF/Yr) (CVP and SWP Ag and M&I service contracts)						
Long Term	-577	-1,523	-955	-1,128	-1,330	-1,671
Driest Periods	-511	-1,106	-663	-792	-864	-1,171
Ground Water Pumping (Central Valley Ag - CVPM)	75	519	280	361	453	605

Geographic Areas Considered

Shown in Figure 1 are the two regions within California were considered for the purposes of LCPSIM: San Francisco Bay Region–South, and South Coast Region. The South Coast Region corresponds to the DWR South Coast Hydrologic Study Area. The San Francisco Bay Region–South was expanded somewhat beyond the DWR South Bay Planning Study Area boundary to include all customers served by the Contra Costa Water District and the Santa Clara Valley Water District.

Figure 1. Urban Areas Modeled by LCPSIM

Conceptual Model

The primary objective of LCPSIM is to estimate water supply mix and costs based on the principle of least-cost planning, given that some water allocation, supply, and conservation decisions are predetermined. The total cost of reliability management is minimized given the following factors:

- Demand
- Available supplies

- Available reliability enhancement options
- This total cost is itself the sum of two costs:
    - The cost of reliability enhancement
    - The cost of unreliability

Provision of additional imported supplies results in a lower total water supply and management cost compared to the portfolio that could be developed without the proposed supply increase. LCPSIM can be used to identify this reduction in total water supply and management cost—the economic efficiency benefit. This benefit can be compared to the cost of the additional supplies for the purpose of establishing its economic justification.

The model accounts for the ability of shortage management (contingency) measures, including water transfers, to reduce regional costs and losses associated with shortage events, and for the ability of long-term demand reduction and supply augmentation measures to reduce the frequency, magnitude, and duration of those shortage events.

In LCPSIM, a linear programming solution is used to simulate regional water management operations on a yearly time-step, including the operation of surface and groundwater carryover storage capacity assumed to be available to the region. The system-operations context allows the evaluation of the reliability enhancement contribution of additional regional long-term water management measures, including increased carryover storage capacity. A quadratic-programming algorithm is used to minimize the cost of each incremental addition and, ultimately, total water supply and foregone use costs.

Foregone use (water shortage) is the most direct consequence of unreliability. Foregone use occurs when, for example, residential users or businesses have established a lifestyle or a level of economic production based on an expected level of water supply being available for use, but that expectation is not met (i.e., a "shortage event") in a particular year or sequence of years. Alternatively, foregone use means that some users are not able to obtain the quantity of water they want at the price at which it is being offered.

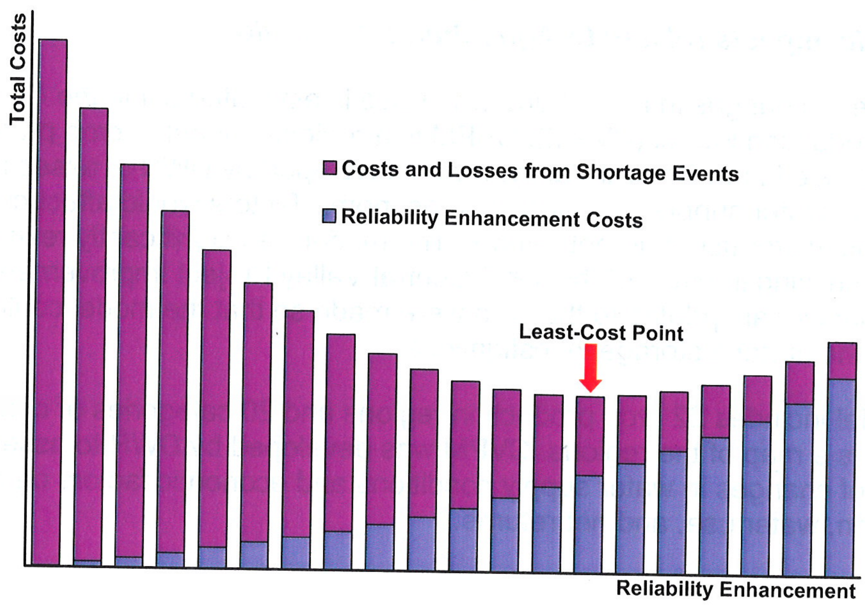
As regional reliability enhancement options are implemented, costs and losses associated with foregone use decrease. Reliability enhancement may be obtained through either of two measures:

- Supply augmentation
- Demand-reduction options (such as conservation)

The assumption is made that options will be adopted in an order inversely related to their unit cost; the least-expensive options are expected to be adopted first.

Total regional water management costs are the sum of reliability enhancement costs plus foregone use costs. Figure 2 shows the result of combining foregone use and reliability enhancement costs into total regional water management costs over a range of reliability enhancement option implementation.

Figure 2. The Effect of Increasing Reliability on Total Costs



The least-cost solution is economically efficient. Beyond the least-cost point, the cost of additional reliability enhancement exceeds the avoided costs and losses resulting from foregone use. At any lower level of reliability enhancement, the expected costs and losses from foregone use exceed the costs to enhance reliability, so more reliability enhancement is economical.

Urban Water Use not Covered by LCPSIM

There are four groups of urban water users who are not covered by LCPSIM. The total amount of delivery to these groups is about 40% of the amount delivered to the south coast. Two of the groups are similar to the south coast region. They are:

- SWP urban supplies provided by the central coast aqueduct
- SWP urban supplies provided to interior southern California

The interior southern California region accounts for more than half of the urban water delivered that is not covered by LCPSIM. Unit values per AF from LCPSIM for the driest periods are applied to the driest period water deliveries for these two groups.

Two other groups are located in the central valley;

- CVP central valley urban water use
- SWP central valley urban water use

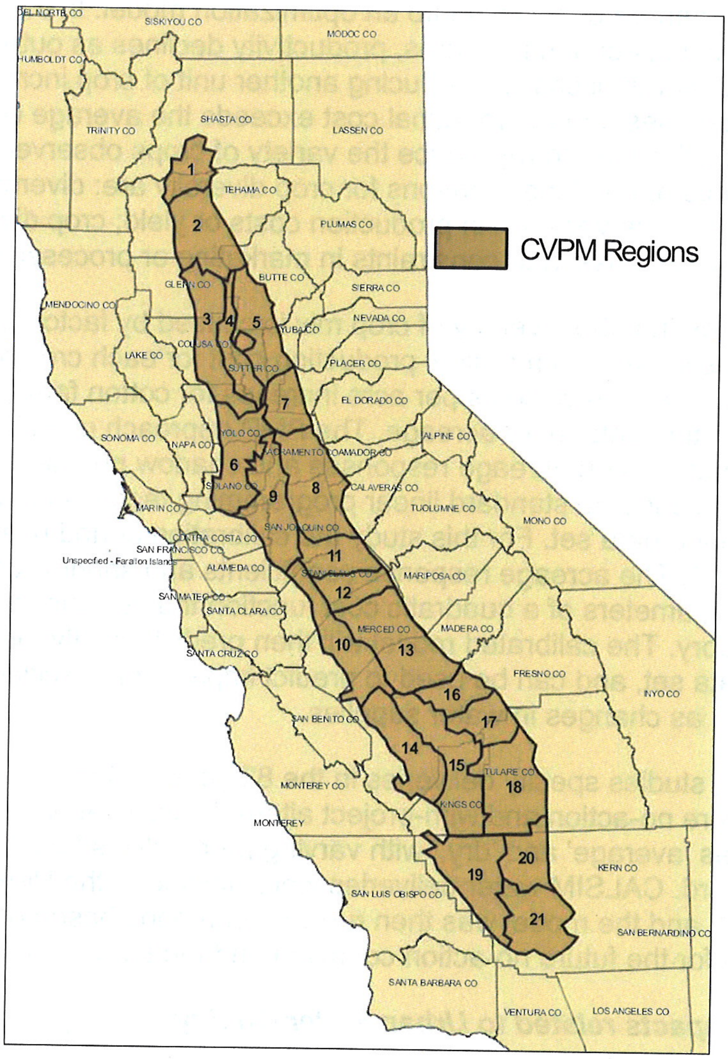
For both of these groups, supplies are valued at $250 per AF per year. These costs are similar to typical costs for urban groundwater development.

Economic Impacts related to Agricultural Production

The value of changes in agricultural water use is estimated using the Central Valley Production Model (CVPM). CVPM is a regional model of crop production and water use in the Central Valley. It was developed by DWR to assess how changes in water supply conditions and economic factors would affect crop production, water use, and net returns. The model was significantly revised for use in assessing impacts of the 1992 Central Valley Project Improvement Act. Recent additional updates to the data were made so that the model could be used for the surface storage investigations.

The model includes 22 crop production regions and 20 categories of crops. Figure 3 is a map of the regions. CVPM was developed by DWR to assess the impacts of changes in water supply conditions and economic factors on crop production, water use, and net returns.

Figure 3. CVPM Regions



A key assumption in CVPM is that agricultural water users make crop and irrigation decisions to optimize net returns, subject to the cost and availability of water supplies. If a water supply is reduced (for example, because growers sell the water to EWA) and no other water supply is used for replacement, CVPM estimates the mix of cropping and irrigation changes needed to adjust at minimal cost. Cost is defined as lost crop net revenue due to either acreage reductions or actual cost increases. If water supply is reduced, CVPM estimates the loss in crop net revenue, either because less acreage can be irrigated or, in most cases, because other more costly supplies such as groundwater are used.

Economic theory suggests that economic decisions are based on marginal conditions, and that these differ from the average conditions. Positive Mathematical Programming (PMP) is a technique developed to incorporate both marginal and average conditions into an optimization model. In the conventional case of diminishing economic returns, productivity declines as output increases. Therefore, the marginal cost of producing another unit of crop increases as production increases and the marginal cost exceeds the average cost. The PMP technique uses this idea to reproduce the variety of crops observed in the data. Several possible or combined reasons for crop diversity are: diverse growing conditions that cause variation in production costs or yield; crop diversity to manage and reduce risk; and constraints in marketing or processing capacity.

CVPM assumes that the diversity of crop mix is caused by factors that can be represented as increasing marginal production cost for each crop at a regional level. For example, CVPM costs per acre increase for cotton farmers as they expand production onto more acreage. The PMP approach used in CVPM uses empirical information on acreage responses and shadow prices—implicit prices of resources—based on standard linear programming techniques and a calibration period data set. For this study the calibration period used is 1998, 2000, and 2001. The acreage response coefficients and shadow prices are used to calculate parameters of a quadratic cost function that is consistent with economic theory. The calibrated model will then predict exactly the original calibration data set, and can be used to predict impacts of specified policy changes such as changes in water supplies.

The modeling studies specify deliveries in the 82 years of historical hydrology under the future no-action and with-project alternatives. Year types were categorized as 'average' and 'dry,' with varying probabilities based on the historical record. CALSIM water deliveries were applied to the PMP calibrated CVPM model, and the model was then run with demands based on 2030 level of development for the future no-action condition and the BO alternatives.

Economic Impacts related to Urban Water Quality

An urban economics salinity model was developed in a joint effort by the Metropolitan Water District of Southern California (MWD) and Reclamation (1998). The model includes the salinity of all available water supplies, such as the SWP and Colorado River Aqueduct, and relates salinity to economic damages in agricultural, residential, commercial, utility, industrial, groundwater, and recycled water.

Economic Impacts related to Energy

The models LTGEN (CVP facilities) and SWP_POWER (SWP facilities) were used to evaluate power impacts. The models have similar structure in that they both use a monthly time step from 1922 to 2003, utilize flow and storage output from CALSIM II, calculate power generation and use values for each facility in each month, and estimate economic benefits/costs from changes in energy generation and use.

Study Limitations

Although they were indexed to current dollar levels, the economic impacts were estimated using parameters that were developed in 2005, including forecasted regional population and water demand, the water quantities associated with regional water supply and conservation options and their expected future costs, and other parameters forecasted at that time. In addition, an evaluation of the impacts of the biological opinions on exported bromides and, consequently, regional water treatment costs was not part of this study.

Economic Impact Analysis of proposed NMFS BO
Part B: For the Existing Level of Development
California Department of Water Resources
April 28, 2009

The results of comparing the existing (OCAP) conditions at the existing level of development with the existing level of development conditions under the US Fish and Wildlife Service and the NOAA National Marine Fisheries Biological Opinions are shown in Table 1. Urban economic impacts include increased costs and losses due to water supply shortages and the increased cost of regional water supply and conservation measures that are economically efficient to adopt.

The data and assumptions used for the existing level analysis were generated for the most recently available existing level of development scenario that used the CMP, the 2004 level of development.

As with the previous results presented for the 2030 level of development (Part A), these results were produced using the models and procedures that are part of the CALFED Common Model Package (CMP). For the 2030 level of development, however, the LCPSIM model was optimized for economic efficiency by allowing the adoption of long-term urban water system reliability management options (e.g., conservation, recycling, and ocean water desalting) to balance against shortage-related costs and losses. By definition, the existing level of development simulation does not allow for this optimization.

Trending the water demand between the 2004 and the 2030 estimates made for the South Bay Area and the South Coast Region gives an estimated demand at the 2009 level about 6.5% higher compared to 2004. Bringing the net water demand (i.e., demand after reuse) back to the 2004 level from the estimated 2009 level would, therefore, have required the adoption of over 320 TAF of additional conservation and/or recycling measures in these areas by 2009.

If the level of adoption of additional conservation and/or recycling measures that can be assumed for the 2009 level of development is lower, the urban impacts shown in Table 1 for these areas will be an underestimate. If the level of adoption is higher, these impacts will be an overestimate. Conversely, if 2009 level demand is higher than the estimate produced by the trend analysis, the urban impacts shown in Table 1 for these areas will be an underestimate. If the 2009 level demand is lower, these impacts will be an overestimate.

The urban impacts for the 2030 level of development analysis for the South Lahontan Region were based on the South Coast Region results. Because current urban water supply conditions in that region are not as severe as those likely to exist in the future, a $250/AF groundwater pumping cost was used to determine urban impacts for the existing level of development analysis.

Agricultural economic impacts and groundwater pumping quantities were adjusted by factors developed by comparing the results of the FWS/NMFS High Restriction Scenario for the existing level of development with those obtained from the same scenario for the 2030 level of development. This was done in lieu of a full analysis of the existing level of development due to time constraints.

Because of the limited availability of modeling data and assumptions at this level of development, the water quality model was not run. Existing water quality costs are expected to be very substantial, however, if not as large as those shown for the 2030 level of development. Depending upon the scenario assumed for the biological opinions, those costs ranged from $11 million up to $58 million per year.

Table 1
Annual Impacts at the Existing Level of Development

	FWS Low Restriction vs. OCAP Study 7.0	FWS High Restriction vs. OCAP Study 7.0	NMFS Low Restriction vs. OCAP Study 7.0	NMFS High Restriction vs. OCAP Study 7.0	NMFS/FWS Low Restriction vs. OCAP Study 7.0	NMFS/FWS High Restriction vs. OCAP Study 7.0
Annualized Net Revenue/Benefit/Reduced Cost (in 1,000's of $)						
Water Supply						
Urban (LCPSIM So Bay & So Coast; *note 2*)	-$298,680	-$619,234	-$306,444	-$368,908	-$489,586	-$653,290
Urban (Other)	-$13,512	-$43,048	-$25,889	-$30,276	-$34,358	-$45,722
Ag (CVPM Central Valley)	-$5,879	-$69,929	-$41,214	-$51,123	-$57,618	-$79,292
Sub-total	-$318,071	-$732,211	-$373,548	-$450,307	-$581,563	-$778,305
Water Quality (modeling not available for existing analysis)						
Hydropower (system)	$40,141	$97,953	$49,361	$59,325	$77,209	$107,676
Total	-$277,930	-$634,258	-$324,186	-$390,982	-$504,353	-$670,629
Delivery/Delivery Impact (TAF/Yr) (CVP and SWP Ag and M&I service contracts)						
Long Term	-577	-1,523	-955	-1,128	-1,330	-1,671
Driest Periods	-511	-1,106	-663	-792	-864	-1,171
Ground Water Pumping (Central Valley Ag - CVPM)	80	557	300	387	486	649

maria.rea

From:	Rod Mcinnis [Rod.Mcinnis@noaa.gov]
Sent:	Tuesday, May 19, 2009 11:29 AM
To:	'maria.rea@noaa.gov'; 'rod.mcinnis@noaa.gov'
Cc:	'Russ.Strach@noaa.gov'; 'Garwin.Yip@noaa.gov'; 'Melanie.Rowland@noaa.gov'; 'Christopher.Keifer@noaa.gov'
Subject:	Re: Concerns re: trap and haul for San Joaquin

Thanks, Maria. This is exactly what I want clearly in the record that we have considered.
-- Rod

----- Original Message -----
From: maria.rea <maria.rea@noaa.gov>
To: 'Rod McInnis' <Rod.Mcinnis@noaa.gov>
Cc: 'Russ Strach' <Russ.Strach@noaa.gov>; 'Garwin Yip' <Garwin.Yip@noaa.gov>; Melanie.Rowland@noaa.gov <Melanie.Rowland@noaa.gov>; 'Keifer, Christopher' <Christopher.Keifer@noaa.gov>
Sent: Tue May 19 13:24:01 2009
Subject: Concerns re: trap and haul for San Joaquin

Rod -

Per your request yesterday for more information on our concerns regarding trap and haul - here is a summary.

As you know, there has not been any serious proposal for a trap and haul program for steelhead from Reclamation. Reclamation has one staff person who has mentioned this as a possibility a few times, but we have never seen a proposal in writing. Nor has Ron Milligan, Reclamation's lead for the consultation, ever indicated his desire to have a serious conversation about this approach. Nevertheless, here is a summary of some of the concerns my staff would have with a trap and haul proposal for steelhead in the San Joaquin River.

1) Trying to find and "trap" the steelhead would be like looking for a needle in a haystack. Due to the life history strategies of steelhead smolts, they emerge from the three tributaries at varied times and over a long period of months (about 120 days).

2) It is not technically feasible to place rotary screw traps across the entire channel of these tributaries - these are fairly large river systems in the spring. Also, steelhead smolts are good swimmers and are known to evade rotary screw traps.

3) There are very few of the steelhead smolts - therefore the consequences of missing any of them (i.e. not "tapping" them) are unacceptable from a biological standpoint. If there were no operational RPA that would improve the current likelihood of survival (1-9%) for those that evaded the trapping procedure - then we could not justify this RPA from a biological standpoint.

4) Fish that are trapped in the tributaries and released in the Delta will miss the imprinting cues from the San Joaquin River and Southern Delta, and therefore would not be likely to return to spawn in the San Joaquin tributaries, but rather stray into the larger flow systems in the Delta (Sacramento, American, etc.) - further jeopardizing the viability of the Southern Sierra Diversity group of CV Steelhead.

Please let me know if you have any questions.
- Maria

Maria Rea
Supervisor, Sacramento Area Office

National Marine Fisheries Service
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Subject: Final Version of the SDFF Forum Co-Chairs report.
From: "Ott, Ron@CalWater" <ronott@calwater.ca.gov>
Date: Thu, 21 Apr 2005 16:00:52 -0700
To: "Sommer Ted (tsommer@water.ca.gov)" <tsommer@water.ca.gov>, "Alan Oto (aoto@mp.usbr.gov)" <aoto@mp.usbr.gov>, Aondrea_Bartoo@fws.gov, "Bernice Sullivan (bsullivan@fwua.org)" <bsullivan@fwua.org>, "Bill O'Leary (william_oleary@FWS.gov)" <william_oleary@fws.gov>, "Bruce Oppenheim (bruce.oppenheim@noaa.gov)" <bruce.oppenheim@noaa.gov>, "Dale Flowers (LDFlowers@earthlink.net)" <LDFlowers@earthlink.net>, "Dan Odenweller (danodenweller@compuserve.com)" <danodenweller@compuserve.com>, "Diana F Jacobs (DfJacobs@dfg.ca.gov)" <DfJacobs@dfg.ca.gov>, "Heather Johnston (heatherj@calwater.ca.gov)" <heatherj@calwater.ca.gov>, "Jana Machula (JanaM@calwater.ca.gov)" <JanaM@calwater.ca.gov>, Jim Buell <buell@interserv.com>, "Joe Cech (jjcech@ucdavis.edu)" <jjcech@ucdavis.edu>, John Davis <JDAVIS@mp.usbr.gov>, "Jon Burau (jrburau@usgs.gov)" <jrburau@usgs.gov>, Kenneth Lentz <KLENTZ@mp.usbr.gov>, "Lev Kavvas (mlkavvas@ucdavis.edu)" <mlkavvas@ucdavis.edu>, Michael Kiparsky <kiparsky@socrates.Berkeley.EDU>, Mike Chotkowski <chotski@pacbell.net>, "Peggy Manza (PMANZA@mp.usbr.gov)" <PMANZA@mp.usbr.gov>, "Pete Smith (pesmith@usgs.gov)" <pesmith@usgs.gov>, "Randy Brown (brown.randall@comcast.net)" <brown.randall@comcast.net>, "Rick Wantuck (richard.wantuck@noaa.gov)" <richard.wantuck@noaa.gov>, "Rooks, Heidi" <hrooks@water.ca.gov>, schmutte <schmutte@water.ca.gov>, "Sitts,Rick" <rsitts@mwdh2o.com>, "Wright, Patrick@CalWater" <patrick@calwater.ca.gov>, "Alex Hildebrand (hildfarm@gte.net)" <hildfarm@gte.net>, "Ann Lubas-Williams (alubaswilliams@mp.usbr.gov)" <alubaswilliams@mp.usbr.gov>, "BJ Miller (bjmill@aol.com)" <bjmill@aol.com>, "Bob Fujimura (bfujimur@delta.dfg.ca.gov)" <bfujimur@delta.dfg.ca.gov>, "Bobker Gary (bobker@bay.org)" <bobker@bay.org>, "Bruce Herbold (Herbold.Bruce@epamail.epa.gov)" <Herbold.Bruce@epamail.epa.gov>, "Castleberry, Dan@CalWater" <dcastleb@calwater.ca.gov>, "Charles Liston (crlist@aol.com)" <crlist@aol.com>, "Chet Bowling (cbowling@mp.usbr.gov)" <cbowling@mp.usbr.gov>, Dan Nelson <dan.nelson@sldmwa.org>, "Dave Briggs (dbriggs@ccwater.com)" <dbriggs@ccwater.com>, "Dave Harlow (David_Harlow@fws.gov)" <David_Harlow@fws.gov>, "Dennis Majors (dmajors@mwdh2o.com)" <dmajors@mwdh2o.com>, "Don Kurosaka (donk@water.ca.gov)" <donk@water.ca.gov>, "Doug Lovell (Doug@FishFirst.com)" <Doug@FishFirst.com>, "Gartrell Gregory (ggartrell@ccwater.com)" <ggartrell@ccwater.com>, "Halverson-Martin, Wendy@CalWater" <wendyh@calwater.ca.gov>, "Hayes, Darryl@CalWater" <dhayes@calwater.ca.gov>, "Hymanson, Zachary@CalWater" <zachary@calwater.ca.gov>, "Ingrid Norgardd (inorgaard@jsanet.com)" <inorgaard@jsanet.com>, JBeuttler@aol.com, "Jim Lecky (jim.lecky@noaa.gov)" <jim.lecky@noaa.gov>, "John Winther (jwinther@deltawetlands.com)" <jwinther@deltawetlands.com>, "Kathy Kelly (kkelly@water.ca.gov)" <kkelly@water.ca.gov>, "Kirk Rodgers (krodgers@mp.usbr.gov)" <krodgers@mp.usbr.gov>, "Larry Smith (lhsmith@usgs.gov)" <lhsmith@usgs.gov>, "Laura King Moon (laurakingmoon@aol.com)" <laurakingmoon@aol.com>, "Martin JR, Daniel@etp.ca.gov" <dmartin@edd.ca.gov>, "Mcdonnell, Barbara" <bmcdonne@water.ca.gov>, "Mike Aceituno (michael.e.aceituno@noaa.gov)" <michael.e.aceituno@noaa.gov>, "Mike Thabault (michael_thabault@fws.gov)" <michael_thabault@fws.gov>, "Miles Croom (Miles.Croom@noaa.gov)" <Miles.Croom@noaa.gov>, "Ott, Ron@CalWater" <ronott@calwater.ca.gov>, "Pat Coulston (pcoulsto@delta.dfg.ca.gov)" <pcoulsto@delta.dfg.ca.gov>, "Perry Herrgesell (pherrges@delta.dfg.ca.gov)" <pherrges@delta.dfg.ca.gov>, "Ramirez, Tim@Calwater" <TimR@calwater.ca.gov>, "Rick Soehren (rsoehren@water.ca.gov)" <rsoehren@water.ca.gov>, "Roger Churchwell (Roger Churchwell

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CC: "'dcassidy@dfg.ca.gov'" <dcassidy@dfg.ca.gov>, " (rschlueter@mp.usbr.gov)" <rschlueter@mp.usbr.gov>, "'Culjis,Lisa M'" <lculjis@mwdh2o.com>

The South Delta Fish Facilities Forum met on Wednesday, April 20th, and had a open discussion on the March 23,2005 revised draft and the comments received on the Forums' Co-Chairs Report. With the revisions made at the meeting, it was decided to submit the Report to CALFED. At CALFED it will be reviewed at the Agency Coordination Team, BDPAC Ecosystem and Conveyance subcommittees, BDPAC and the Authority.

Before it is submitted to CALFED the Forum suggested that if anyone has comments on the Final Report submit then to me in writing before COB Friday, April 29th. All comments on the Final Report will be attached to it throughout the review process.

Thanks
Ron

<<SDFFF Co-Chairs FINAL Report.doc>>

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SDFFF Co-Chairs FINAL Report.doc	**Content-Type:**	application/msword
	Content-Encoding:	base64

SOUTH-DELTA FISH FACILITIES FORUM
CO-CHAIR'S REPORT:
SOME POLICY CONCLUSIONS
April 20, 2005

Preamble

The South Delta Fish Facilities Forum (Forum) was created in 2002 by CALFED to address questions regarding investments in fish screens in the South Delta as part of the CALFED Bay-Delta Program. The CALFED Record of Decision (ROD) directs the design and construction of new fish screens at the Clifton Court Forebay (CCF) and Tracy pumping plant to allow export facilities to pump at full capacity more often. A subsequent agreement between the state Department of Water Resources, Department of Fish and Game, U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, NOAA Fisheries, and CALFED Bay-Delta Program recommends a "modular" approach to South Delta fish screens intended to afford maximum protection to fisheries in the Delta. However, the costs of this approach could be as high as $1.7 billion. Because of concerns about the costs and effectiveness of such a strategy, the Forum has engaged in a participative process with stakeholders and outside experts to explore the ROD strategy as well as alternatives. The charge of the Forum is to make recommendations to the California Bay-Delta Authority and the state and federal agencies regarding the best direction in the future for pursuing investments in fish screens in the South Delta. The Forum Co-Chairs agree that this charge must be fulfilled in a manner consistent with ensuring maximum benefits for fish populations and habitat given available resources and, accordingly, that cost-effectiveness and binding assurances should be a central consideration in guiding future investment decisions. This white paper summarizes the conclusions of the Co-Chairs based on nearly two years of public meetings.

Overview of Conclusions

The Co-Chairs believe that investment decisions to protect and restore fish populations, including fish screens in the south Delta, should be guided by the overall goal of achieving existing federal and state population targets by using available financial resources in the most cost effective manner possible. Based on considerable dialogue and public input through the Forum process, we believe that the best strategy involves implementing immediate actions to remedy known facility deficiencies, completing investigations on alternative facility and operational strategies to assess future options, and developing a long term facility strategy in the context of implementing other actions that can achieve functionally equivalent estuary and fisheries benefits. This long-term strategy must be developed with agency and stakeholder involvement to ensure that it is both scientifically sound and backed with binding assurances. Based on available information, other alternatives exist that will be significantly more productive and cost-effective in meeting fishery objectives than the modular approach. However, pending the development and effective implementation of such alternatives, as determined through a sound monitoring and evaluation process, the Co-Chairs are not eliminating the possibility that future facility actions might include the modular screening approach.

Once developed, this strategy will be included in the appropriate CALFED program plans (Conveyance, Ecosystem Restoration, and Science programs) and integrated into the Environmental Water Account. Financing these assurances through CALFED's 10-Year Finance Plan must also be ensured before any alternatives are dropped from consideration.

Conclusions

1) **Phased Decision-Making:** Decisions about South Delta fish screens should be phased with earlier investments. Phased decision-making may provide incremental gains at modest cost.

2) **Science:** Additional science is necessary to support investment decisions in fish facilities, particularly regarding some significant issues related to long-term decisions. Focused and tactical investigations should be encouraged to address tradeoffs and action benefits. Focused investigations such as the proposed South Delta Hydrodynamic and Fisheries Investigations, and the Collection, Handling, Transportation, and Release (CHTR) studies outlined below are such examples. However, waiting for answers to these larger questions should not delay near-term actions to improve protections for fisheries in the South Delta. The Co-Chairs recognize that some long-term decisions may be based on the best available science at the time a decision is needed.

3) **Assurances:** Any portfolio of investments to protect and restore fisheries should be subject to binding commitments among the resource agencies, project operators, and interested parties to assure financing and effective implementation. These investments should be crafted to meet the restoration targets for Delta species identified in the Ecosystem Restoration Plan's Multi-Species Conservation Strategy (MSCS). Since these assurances and actions will involve commitments, participation, and cooperation of other CALFED programs and interest groups, the Co-Chairs propose that the CALFED agencies develop a thorough and transparent public process that addresses functionally equivalent actions and assurances. The Co-Chairs believe that functionally equivalent alternatives to major new screening facilities should be investigated for cost effectiveness of fisheries benefits. A comparative analysis between facility options and alternative operational strategies and additional habitat investments should be conducted. If there are more cost-effective strategies that can increase fish populations than the South Delta modular screening alternatives, they should be pursued. However, absent firm commitments to actually implement alternative strategies to protect and restore fish populations of concern with quantifiable improvements, the regulatory agencies must retain their commitment to the actions identified in the ROD and the state and federal endangered species acts and act in accordance to their public trust responsibilities.

4) **Adequate Funding:** Actions identified in any assurance agreement must be contingent on the availability of adequate funding to implement the alternative, including its monitoring and evaluation. The Co-Chairs recommend that such funding with firm commitments from public, water user, and other sources consistent with the beneficiaries-pay principle be included in the 10 year finance plan now under development by the CBDA. The 10-Year Finance Plan should also protect funds in Propositions 13 and 50 intended to improve fish facilities in the South Delta for that purpose.

5) **Immediate Actions:** The Co-Chairs strongly recommend that all necessary actions be taken to improve the function of the existing SWP and CVP fish facilities in the South Delta to assure effective fish protection despite changing Delta conditions. To improve fish protection relative to current conditions the fish facilities should be modified and/or operated to achieve to the maximum practical extent the original performance objectives required for the louver facilities. The SWP and CVP operators will seek regulatory agency review and approval for proposed modifications and changes in operations. Immediate facility actions include those identified in the Operations Criteria and Plan (OCAP) and its associated Biological Opinions, as well as those mandated through the Central Valley Project Improvement Act (CVPIA). Immediate actions also include initiating feasibility studies and continuing facility research activities that will assist in determining the feasibility and cost effectiveness of future actions and modifications.

Fish facility actions should be evaluated as they are implemented to assess fish protection improvements. This information, as well as results from the proposed feasibility investigations listed below, will be analyzed by the implementing and regulatory agencies to determine long-term cost effective strategies.

Improvement actions will be the responsibility of the implementing agencies. Schedules and budgets for action items will be integrated into the appropriate CALFED Program Plans consistent with the 10-Year Finance Plan. Immediate actions, some of which are ongoing, should include but are not limited to the following:

- Conducting a feasibility study to develop an approach to reduce predation losses in CCF. This study will examine the hydraulic and facility impacts of alternatives that reconfigure flows to the Skinner Fish Facility with the intent to reduce CCF predation losses. A predator study plan will be developed around technically feasible alternatives to investigate potential improvements in fish survival. The Co-Chairs agree that proposals to "bypass" CCF and screen water at the existing screening facilities at the Banks pumping plant before the water enters the CCF, essentially converting the forebay into an afterbay, have considerable merit.
- Improving debris-handling operations at the existing facilities to improve both fish protection and operational efficiency. Specific actions include

providing automated cleaning systems for the SWP and CVP trash racks, cleaning systems for the CVP's primary and secondary louver cleaning systems, and substantially reducing the debris that enters the fish trucks. New systems should minimize or eliminate salvage operation disruptions, including constructing redundant channels or holding systems if necessary. A phased improvement to the CVP's bypass and holding system, described below, is another immediate action that will reduce debris impacts.

- Completing the CHTR studies to identify facility or operational actions that will increase survival of delta smelt during collection, handling, transportation, and release. Recommendations on implementing these actions will be considered as information is available or upon study completion (2006).
- Completing the proposed South Delta hydrodynamics, water quality, and fish movement studies to identify better operational strategies that minimize fish entrainment at the export facilities. These studies will also be used to investigate future operations and facilities related to possible CCF reconfigurations.
- Phasing-in replacement of the CVP secondary louvers and fish holding facility to improve fish collection efficiency and protection by increasing bypass flows, improving debris management, and improving operational efficiency. This new system would connect the existing bypass pipes to "fish friendly" pumps (to provide higher bypass flows) and connect them to above-ground holding tanks. Lower bypass flows and low water levels have been identified as some of the major hydraulic deficiencies that impact fish collection efficiency. In addition, the above-ground holding tanks can reduce the debris impacts that cause fish injury and mortality in the CHTR process. Implementing these facility changes at the SWP facility may be considered after experience with this system.
- Improving water weed control measures for CCF.
- Reviewing and implementing, as appropriate, operations at the state and federal fish facilities to improve, as necessary, staffing, equipment and standard operating procedures.

6) **Long-Term Investments:** Long-term investment decisions should be consistent with CALFED Bay-Delta Program principles. Specifically, the basis for comparing facility actions with other actions should focus on its contribution to protecting Delta species as identified in the ERP's MSCS. Investments will be based on adaptive decision making strategies, progress on actions that meet fish population target objectives, evaluations of alternative facility investigations as described above and best available science. The Co-Chairs believe that the following considerations should guide long-term investment strategies in the South Delta:

- The modular screening strategy should not be pursued so long as a cost-effective alternative that provides increased abundance in fish populations and supporting habitat is adequately financed and its implementation is assured.
- Fish facility criteria should not be driven by delta smelt considerations but instead on cost effectiveness considerations so long as the alternative strategy meets the MSCS objectives for Delta species. Tradeoffs between South Delta screen costs and operational modifications and habitat investments elsewhere should be evaluated in the analysis.
- Operational strategies to protect and restore delta smelt are likely to be more productive and cost effective than large expenditures on South Delta screens. The Co-Chairs recommend that the CALFED Agencies develop specific operational strategies with comparable lifecycle cost estimates to determine functionally equivalent actions and assurances for protecting delta smelt.
- Long-term assurance agreements should be developed with agency and stakeholder input in a public process. Specific action items resulting from these assurances should be adopted in the CALFED 10-Year Finance Plan, and incorporated into the program plans of the Conveyance, Ecosystem Restoration, and Science programs and the Environmental Water Account.