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March 9, 2010

Mr. Phillip Crader
Senior Environmental Scientist
State Water Resources Control Board
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VIA E-MAIL:

Subject: East Bay Municipal Utility District's Clarifying Questions on Written Testimony and Exhibits for the Public Informational Proceeding to Develop Flow Criteria for the Delta

Dear Mr. Crader,

The East Bay Municipal Utility District (EBMUD) has reviewed the exhibits submitted to the State Water Resources Control Board (SWRCB) in the Public Informational Proceeding to Develop Flow Criteria for the Delta Ecosystem and is submitting the attached clarifying questions. EBMUD did not submit exhibits/testimonies in February because the proceeding was limited to an evaluation of Delta Outflow with the goal of establishing criteria to inform future proceedings. However, in reviewing all the submissions, there were many references to the tributaries and inflow into the Delta. To assist the SWRCB in its review of these clarifying questions, EBMUD has also provided some supporting information which is also attached in PDF format.

The following overarching points that were noted during the review of the submitted exhibits are included in these clarifying questions:

> Need to Rely On the Best Available Scientific Information. The legislation states that the SWRCB should rely on the best available scientific information in setting new Delta outflow criteria. As noted in EBMUD's clarifying questions, several significant exhibits and testimony rely on information that is more than 15 years old or has been superceded by subsequent actions and further studies. We urge that the best scientific information be used and that any obsolete and/or inaccurate science be updated or be recognized to be of limited value. Our questions list numerous examples of the areas where the information is obsolete and seek to provide updates to assist the SWRCB.
>
> Need to Eliminate Reliance on Erroneous Data. Related to the point above, we have attempted to point out instances where erroneous data or statements were made in exhibits. Given the very short two-week time period provided to review the thousands of pages of exhibits, there are likely to still be instances of errors. We have indicated in our questions those instances we were able to uncover in our brief, abbreviated review.

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Need to be Cognizant of the Coequal Goals. The legislation that has led to this proceeding states that the outcome is intended to inform processes that further the "coequal goals" of (1) providing a more reliable water supply for California, and to (2) protecting, restoring, and enhancing the Delta ecosystem. Despite this, the methodologies outlined in some of the exhibit submittals and summaries urge that the SWRCB undertake this proceeding with a focus exclusively on the restoration or enhancement of the Delta ecosystem, ignoring the coequal goal of providing a more reliable water supply. We urge the SWRCB to approach this proceeding recognizing the two coequal goals, as required by the legislation.

Need to Focus Proceeding Scope on Delta Outflow. The SWRCB's December 16, 2009 notice stated that the focus of this proceeding is on Delta outflows. The legislation indicates that tributary instream flow issues should be addressed later, in the form of required studies on tributaries which are to occur in two phases in 2012 and 2018. In fact, it is necessary to defer addressing these issues if, as set forth in the notice, there is no intent in this proceeding to alter current regulatory requirements or impact permitting decisions. Extensive evidence has been submitted on tributary issues, but this information is beyond the legally noticed scope of this proceeding and has little applicability in this proceeding to develop Delta outflow criteria.

The SWRCB is tasked with completing the new Delta criteria by August of this year. Developing carefully considered criteria for Delta outflow will be a challenge given this short time frame, and the SWRCB should avoid unnecessarily diverting its attention to tributary issues. To be consistent with the proceeding notice, and to allow the most comprehensive consideration possible in a very short time frame, we believe the SWRCB must remain focused on outflow conditions in the Delta. As noted above, we have reviewed and submitted questions on some exhibits that address tributaries and inflow, but we have done so primarily in order to point out errors or inaccuracies. We believe that in order to carry forward with the proceeding as indicated in the notice, the tributary-focused exhibits that have been submitted are of limited value.

We appreciate the opportunity to submit the clarifying questions and we look forward to attending the proceeding on March 22-24, 2010.

Respectfully,

Karen Donovan

KD:PKJ:smc

State Water Resources Control Board

Informational Proceeding to Develop Flow Criteria for the Delta Ecosystem - Questions

Party submitting questions: East Bay Municipal Utility District

Priority[1]	Question	Witness	Panel #
1	Given the requirement to use the best available scientific information, can you clarify how proportioning inflow according to historic contributions as noted on Page 3, under Key Issue 3 in the Summary of Testimony, would be consistent with the approach Heritage recommends on page 2 in response to key issue 2 in the Summary of Testimony; specifically that (i) flows should be based on known relationships between flow and benefits to organisms, or (ii) by statistical correlations, or (ii) by flows that existed when species were in good condition?	American Rivers and Natural Heritage	Hydrology, #1
2	What is being asserted regarding which historic period(s) should be used to proportion flows, given existing conditions in the Delta? (Referring to page 3 in response to key issue 3 in the 'Summary of Testimony of American Rivers and Natural Heritage Institute')	American Rivers and Natural Heritage	Hydrology, #1

[1]Please identify the top 10 priority questions concerning each participant's testimony or exhibits, with 1 being the highest and 10 being the lowest priority.

State Water Resources Control Board

Informational Proceeding to Develop Flow Criteria for the Delta Ecosystem - Questions

Party submitting questions: East Bay Municipal Utility District

Priority[1]	Question	Witness	Panel #
1	In Exhibit 6, "Historical Fresh Water and Salinity Conditions in the Western Sacramento-San Joaquin Delta and Suisun Bay." why does Figure 3-9 omit ranges of time periods? Particularly because he earlier years could provide a perspective on seawater intrusion and especially how the past years (when reservoir storage use was more modest) compare with the more recent years.	Contra Costa Water District	Other Stressors, #4

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State Water Resources Control Board

Informational Proceeding to Develop Flow Criteria for the Delta Ecosystem - Questions

Party submitting questions: East Bay Municipal Utility District

Priority[1]	Question	Witness	Panel #
1	In Exhibit 15, Page 9-15, Has the Delta Pathway Model developed by Cramer Fish Science been updated to account for migratory pathways for Mokelumne origin salmon and steelhead? It should be noted that the original model omitted a key pathway through Little Potato and Little Connection Sloughs.	State and Federal Water Contractors	Anadromous Fish, #3

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State Water Resources Control Board

Informational Proceeding to Develop Flow Criteria for the Delta Ecosystem - Questions

Party submitting questions: East Bay Municipal Utility District

Priority[1]	Question	Witness	Panel #
1	Please explain what is meant by "equitable apportionment" as related to the following statements: (1) "Equitable apportionment of contributions allocated among tributary streams to determine inflows to the Delta sufficient to meet Delta outflow needs in all years" - Exhibit 1, Testimony of Bill Jennings, page 7; and (2) "Determine equitable shares of flow contributions allocated among names streams to determine inflow to the Delta sufficient to meet Delta outflow needs, to occur in all year" - Exhibit 6, California Sportfishing Protection Alliance Recommendations for Optimal Ecological Conditions, page 3.	California Sportfishing Protection Alliance	Hydrology, #1
2	Are the contributions, referred to in the statement from Exhibit 1, page 7, Testimony of Bill Jennings, ("Equitable apportionment of contributions allocated among tributary streams to determine inflows to the Delta sufficient to meet Delta outflow needs in all years") and from Exhibit 6, page 3("Determine equitable shares of flow contributions allocated among named streams to determine inflow to the Delta sufficient to meet Delta outflow needs, to occur in all years."), to be based on biological benefit, biological impact, fisheries of concern within the tributaries, or some other "equitable" consideration?	California Sportfishing Protection Alliance	Anadromous Fish, #3
3	What, if any, hydrologic, biologic, or temperature management modeling or study was relied upon to make the recommendations in Exhibit 1, Testimony of Bill Jennings, page 7 ("Equitable apportionment of contributions allocated among tributary streams to determine inflows to the Delta sufficient to meet Delta outflow needs in all years") and Exhibit 6, California Sportfishing Protection Alliance Recommendations for Optimal Ecological Conditions, page 3 ("Determine equitable shares of flow contributions allocated among named streams to determine inflow to the Delta sufficient to meet Delta outflow needs, to occur in all year.")?	California Sportfishing Protection Alliance	Hydrology, #1
4	In Exhibit 6, Recommendations for Optimal Ecological Conditions, p. 1, what is the scientific basis for setting a new daily mean water temperature requirement in each Delta tributary system when, for example, in the Mokelumne River, implementing the in-stream temperature requirements of >15 degrees Celsius during outmigration period as agreed upon by the Resources Agencies, has led to a successful outmigration and subsequent return?	California Sportfishing Protection Alliance	Other Stressors, #4
5	In Exhibit 12, estimating the total number of coded-wire-tagged adult fall-run chinook salmon (oncorhynchus tshawytscha) in California's central valley rivers, p. 40, recent data contradicts some of the speculative conclusions reached in this exhibit. Specifically, what data was used to support the conclusions referred to below, and did this incorporate the best available	California Sportfishing Protection Alliance	Anadromous Fish, #3

	information? 1. Results indicating that a greater proportion of hatchery fish return to the hatchery as adults when compared to other CV systems were discounted. (This seems to be based on the theory that MRFH Chinook CWT'd had a higher rate of adipose fin regeneration than those in other systems (the adipose fin clip indicates presence of a CWT). The potential for this to happen at a rate of 30% in 4 consecutive years is highly unlikely.) 2. Statements that for the Mokelumne River, the in-river recovery data from 2003 to 2007 was highly unusual because the results suggested that the mean percentage of Mokelumne River hatchery fish that homed to their natal hatchery was 2.6 times greater than the percentage that spawned in the river. (page 40) 3. Suggestions that 1980-2007 ad-clip survey results were inaccurate because they were based on an otolith microchemistry study. (page 49)		

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State Water Resources Control Board

Informational Proceeding to Develop Flow Criteria for the Delta Ecosystem - Questions

Party submitting questions: East Bay Municipal Utility District

Priority[1]	Question	Witness	Panel #
1	This testimony suggests that resident populations of Central Valley steelhead on many streams including Mokelumne River may be enticed to emigrate if there is more variability in releases (page 30). Have lower flows also been considered, since increasing temperatures also stimulate steelhead outmigration and if not, why is this not considered a viable option?	US Department of Interior	Anadromous Fish, #3
2	This testimony suggests that flow pulses from the San Joaquin and eastside tributaries may be needed so that some water from each of those areas reaches the lower delta to provide a homing mechanism for returning adults (page 30). What is known about factors that exist that offset any pulse flow benefits, such as the effect of the Delta Cross Channel Gate operations, in impacting the homing of adult salmon and steelhead to the eastside tributaries?	US Department of Interior	Anadromous Fish, #3

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State Water Resources Control Board

Informational Proceeding to Develop Flow Criteria for the Delta Ecosystem - Questions

Party submitting questions: East Bay Municipal Utility District

Priority[1]	Question	Witness	Panel #
1	In Exhibit 22, "Habitat Variability and Complexity in the San Francisco Estuary", on page 17 what is the basis and analysis for the conclusion that 'increasing floodplain areas along some rivers (e.g. Cosumnes and Mokelumne Rivers)' can be done 'fairly easily' with large benefits and production of large year classes of some species? In terms of the Mokelumne River, there is no data analyzing the relationship between floodplain and year class population numbers, and in addition, providing seasonally inundated floodplains in the lower reaches of the river will be difficult to achieve because of deeply incised river channel.	CA Department of Water Resources	Anadromous Fish, #2
2	Are you aware that Slide 6 in Exhibit 34 is based on Figure 7B from the Delta Vision Report and it is misleading regarding proportionate usage and that EBMUD with SFPUC sent a letter to clarify and submit correct data but no response or revised figure was published? The letter and updated figure, EBMUD Figure 1, that was sent in July, 2008 are attached, and because the misleading figure is already been referenced by other parties, it is critical to stress that data be reviewed and confirmed by relevant parties prior to publication so results are based on reality and therefore more achievable.	CA Department of Water Resources	Hydrology, #1
3	Exhibit 18 titled "Envisioning Futures for the Sacramento-San Joaquin Delta" Jay Lund et al, May 2007, on page 115 submitted by DWR, suggests economic reasons for expanding the Hayward –EBMUD intertie so that the Mokelumne River Aqueduct can be used for replacement of water storage and conveyance capacity that is lost Are you aware that EBMUD's existing Mokelumne Aqueducts are built to a capacity to divert only the 325 MGD maximum diversion rate allowed under EBMUD's existing rights, and that EBMUD has no plans to expand the capacity of the Mokelumne Aqueducts beyond the capacity need to convey its existing water entitlements?	CA Department of Water Resources	Hydrology, #1

State Water Resources Control Board

Informational Proceeding to Develop Flow Criteria for the Delta Ecosystem - Questions

Party submitting questions: East Bay Municipal Utility District

Priority[1]	Question	Witness	Panel #
1	Exhibit 1 cites Mokelumne River as an example of a reach where increased flows promote homing fidelity of returning salmon (page 48). Have the impacts of other factors, such as the effects of the Delta Cross Channel Gate operations been considered among the factors affecting the homing of adult salmon and steelhead to the Mokelumne River? For example, even with Fall pulse flows from the Mokelumne River in 2009, 57% of the coded wire tagged Chinook salmon from the Mokelumne River returned to the Nimbus Hatchery on the American River. That would imply the Delta Cross Channel Gate operations are contributing to the straying problem by attracting Mokelumne salmon into the Sacramento River and that pulse flows alone will not ensure homing fidelity.	Environmental Defense Fund	Anadromous Fish, #3

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State Water Resources Control Board

Informational Proceeding to Develop Flow Criteria for the Delta Ecosystem - Questions

Party submitting questions: East Bay Municipal Utility District

Priority[1]	Question	Witness	Panel #
1	In the written summary on page 3, the testimony recommends the suite of methodologies as presented in the SWRCB Staff Exhibit "On Developing Prescriptions for Freshwater Flows to Sustain Desirable Fishes" are recommended. Wouldn't basing Delta outflow criteria on a scenario that includes no current projects as suggested in #4 of the suite of methodologies result in inappropriate and unattainable criteria that fail to recognize the public interest in water supply appropriations?	The Nature Conservancy	Hydrology, #1
2	Do any of the methodologies that are referenced from the SWRCB Staff Exhibit and recommended by the Nature Conservancy assist in providing a more reliable water supply or promoting the public interest in providing water?	The Nature Conservancy	Hydrology, #1
3	Are you aware that Slide 6 in Exhibit 2 is based on Figure 7B from the Delta Vision Report and is misleading and does not reflect the most accurate information and that EBMUD with SFPUC sent a letter to clarify and submit correct data but no response or revised figure was published? The updated figure, EBMUD Figure 3 are attached, and because the misleading figure is already been referenced by other parties, it is critical to stress that data should be reviewed and confirmed by relevant parties prior to publication so results are meaningful and therefore more achievable.	The Nature Conservancy	Hydrology - #1

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State Water Resources Control Board

Informational Proceeding to Develop Flow Criteria for the Delta Ecosystem - Questions

Party submitting questions: **East Bay Municipal Utility District**

Priority[1]	Question	Witness	Panel #
1	On page 12 Appendix A of NMFS Exhibit 5, "Public Draft Recovery Plan for Central Valley Salmon and Steelhead (October 2009) in the section entitled "Hydrology", it is not clear whether this section is intended to refer to the entire Mokelumne River watershed or only that portion of the watershed that is below Highway 49 and above Camanche Dam. If this section is intended to refer to the entire Mokelumne watershed, then several of these statements cannot be verified by EBMUD and appear to be incorrect, and EBMUD would like to know whether the incorrect data/information will be revised so correct data will be referred to and used in any analysis. Specific corrections that EBMUD would like to request include: a. The statement that 90% of the precipitation occurs as rainfall and snowfall is rare because this may be true for the portion of the watershed below Highway 49, but is not true for the entire watershed. For the entire watershed up to roughly 65% of the precipitation falls as snow. b. The statement that the 100 year floodplain is permanently flooded by Pardee and Camanche Reservoirs is incorrect, because combined, these reservoirs only occupy a small portion of the Mokelumne River and the 100 year floodplain. c. The statement that EBMUD owns 44% of the watershed land from Camanche Dam to Highway 49 is true as EBMUD does not own 44% of the entire Mokelumne watershed. The entire Mokelumne watershed, above Camanche Dam, consists of an area *about* 623 square miles and EBMUD only owns about 43 square miles acres within that area – about 7%..	NMFS	Hydrology, #1
2	Are you aware that the NMFS 2009 Draft Recovery Plan, which is submitted by NMFS as Exhibit 5, relies in part upon obsolete data and analysis as to the Mokelumne River, and can NMFS provide clarification on why the most up-to-date scientific data provided	NMFS	Hydrology, #1

	was not incorporated? To assist in further explaining this question, EBMUD notes that specific details were provided in EBMUD's comment letter to NMFS on the 2009 Draft Recovery Plan, included in this submittal as EBMUD Attachment 1. The letter is attached to show the extent of the comments so they are not repeated as part of these clarifying questions. The comments provided to NFMS were not incorporated into the Exhibit that has been submitted by the agency. A list of references is provided to assist the Board in its efforts to use the most up-to-date scientific data is included in this submittal as EBMUD Attachment 2. We are appreciative of the Board's efforts to use the "best available scientific information" and request consideration of the data that was not used in the 2009 Draft Recovery Plan. To ease in obtaining the data, the references provided in EBMUD Attachment 2 are available through EBMUD's website (http://www.ebmud.com/our-water/water-supply).		
3	In reference to Exhibit 9, p. 3-Xc-60 - 3-Xc-79 of WORKING PAPER ON RESTORATION NEEDS HABITAT RESTORATION ACTIONS TO DOUBLE NATURAL PRODUCTION OF ANADROMOUS FISH IN THE CENTRAL VALLEY OF CALIFORNIA, Vol 3.: SB1 established co-equal goals of a more reliable water supply for California and to protect, restore, and enhance the Delta eco-system. How do conclusions made in this exhibit lead to supporting the co-equal goals?	NMFS	Anadromous Fish, #3
4	In Exhibit 9, the Working Paper on Restoration Needs relies on outdated information and was released on May 9, 1995 and has never been independently peer reviewed. How does the inclusion of the analysis in this testimony to determine Delta flow criteria and the conclusions reached follow the mandate of SB1 to "use the best available scientific information" in this effort? And shouldn't the paper either be updated and finalized or removed from consideration? Specific concerns with data and assumptions in the model which shows that the results are unproven and that assessments and conclusions should not be based on the model include: a. The analysis presented in this testimony is driven only by Freeport Temperature and export rates (page 3-Xe-3). No evidence of model validity or any information on predictive capability. b. Analysis in this testimony assumed temporal distributions, by percent, of fall-, late fall-, and winter-run chinook salmon for the Mokelumne. Distributions were input to survival models. Shows distribution for Mokelumne are only in Apr, May, June rates (page 3-Xe-3). Chinook salmon are present within the Mokelumne River from January through July. When flows increase above	NMFS	Anadromous Fish, #3

	500cfs the proportion of salmon outmigrating as fry increases. Flood flows typically occur January – April. c. The analysis in this testimony concludes that survival in the Delta cannot be doubled for Mokelumne River fall-run stocks of chinook salmon. However, the data and the modeling utilized to reach this conclusion is outdated and incomplete (page 3-Xe-3). d. Model output of Apr-Jun for the various races of juvenile salmon with the integration of recommended actions and their effects on the doubling goals for MOKELUMNE. Comparisons between survival associated with recommended actions, baseline historical smolt survival (DAYFLOW), and present smolt survival (OP STUDY) rates (page 3-Xe-27).		
5	In Exhibit 9, the data used to do the modeling is outdated and incomplete. Shouldn't analysis be based upon current and accurate information so results/conclusions are useful and applicable and shouldn't the paper either be updated and finalized or removed from consideration? Ex 9, Flow criteria for green and white sturgeon – NMFS summary and AFRP paper, NMFS, p. 3-Xh-44 of WORKING PAPER ON RESTORATION NEEDS HABITAT RESTORATION ACTIONS TO DOUBLE NATURAL PRODUCTION OF ANADROMOUS FISH IN THE CENTRAL VALLEY OF CALIFORNIA, Vol 3.	NMFS	Anadromous Fish, #3
6	Why has the "best available scientific information" on the assessment and development of recovery measures for the Mokelumne River available to the NFMS not been incorporated into the NFMS's Central Valley Salmon and Steelhead Draft Recovery Plan, and specifically, why were the General and Specific Comments outlined in EBMUD's December 4, 2009 comment letter on the NFMS's Central Valley Salmon and Steelhead Draft Recovery Plan not addressed or incorporated into this testimony? EBMUD is particularly concerned about this testimony's reliance on outdated materials. The bulk of this testimony's recommendations made for the Mokelumne River steelhead were based on a single 1991 CDFG publication, now almost 20 years old and scientifically obsolete due to the subsequent (a) implementation of the Joint Settlement Agreement and (b) development of a much more recent, comprehensive database on the current status of Mokelumne River fisheries ecosystem. Please see EBMUD Attachment 1, for EBMUD's December 4, 2009 comment letter to NMFS and EBMUD Attachment 2, for a list of supporting information provided to assist	NMFS	Anadromous Fish, #3

	the Board in its efforts to use the most up-to-date scientific data, as related to this Exhibit. Please note that the references provided in EBMUD Attachment 2 are available through EBMUD's website (http://www.ebmud.com/our-water/water-supply). In addition, the 1998 Joint Settlement Agreement's 10-Year Review is included as EBMUD Attachment 3. Exh 5: Public Draft Recovery Plan for Central Valley Salmon and Steelhead (October 2009).		

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State Water Resources Control Board

Informational Proceeding to Develop Flow Criteria for the Delta Ecosystem - Questions

Party submitting questions: East Bay Municipal Utility District

Priority[1]	Question	Witness	Panel #
1	In Exhibit 7, "Water Quality Control Plan for Salinity", October 1988, and elsewhere, two outdated pieces of information are presented on page 3-23: "As of 1987, about 242,000 acre-feet of water or about one-third of the average annual Mokelumne River flow were diverted into the Mokelumne Aqueduct for use in the east San Francisco Bay area;" and "CENTRAL SIERRA BASIN: unimpaired flow data from 1922-1978 for wet, above normal, below normal, dry, critical water years." Why was the information referenced in this exhibit based on outdated data, especially when more recent data that more accurately reflects the best available scientific information is readily available?	Pacific Coast Federation of Fishermen's Association and the Institute of Fisheries Resources	Hydrology, #1

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State Water Resources Control Board

Informational Proceeding to Develop Flow Criteria for the Delta Ecosystem – Questions

Party submitting questions: East Bay Municipal Utility District

Priority[1]	Question	Witness	Panel #
1	The authors of the staff exhibit "On Developing Prescriptions for Freshwater Flows to Sustain Desirable Fishes in the Sacramento-San Joaquin Delta" (Prescriptions Report) state that their work is exploratory and cannot be a finished product and therefore cannot be relied upon to provide specific flow prescriptions in this process. The authors also recognize that much work would need to be completed to rely upon this study as a source of methods to be used to establish flows, and that among other limitations of this work is the lack of recognition of the need to balance the needs of aquatic resources in the Delta and the needs of a reliable water supply for California. Recognizing that none of the methodologies outlined in the staff exhibit support the first of the co-equal goals the Delta Plan and the BDCP of providing a more reliable water supply for California, how will this product be further refined?	Staff Exhibits	Hydrology, #1
2	The Eastside streams are identified as primarily the Mokelumne and Cosumnes Rivers, but also include the Calaveras River, Bear Creek, Dry Creek, Stockton Diversion Channel, French Camp Slough, Marsh Creek, and Morrison Creek. Page 7 of this report contains Table 1 which shows annual unimpaired flow volumes and rates for major inflows to and outflow from the Delta, including inflow from the Eastside streams. Page 7 of this report also contains Figure 2 which shows seasonal variability for unimpaired flows including those of the Eastside streams. Among other things, Table 1 indicates that the average annual unimpaired outflow from the Eastside streams is 1.6 Maf annually or and average of 2200 cfs. This value is much higher than those for the Mokelumne River alone (for illustrative purposes, see attached EBMUD Figure 2 depicting Eastside Streams and Mokelumne River alone.) What Eastside streams and locations were used to develop the values used in Table 1 and Figure 1?	Staff Exhibits	Hydrology, #1

3	In light of the differences in hydrology among the identified Eastside streams, why was the Mokelumne River included in the Eastside streams, particularly because the Mokelumne River receives a considerable amount of snowmelt runoff and the other eastside streams do not receive as much due to difference in elevation of the watersheds? The Mokelumne River's hydrology varies from other eastside streams as can be seen in EBMUD Figure 1, attached for illustrative purposes.		
4	Pages 8 and 9 of the staff exhibit entitled "On Developing Prescriptions for Freshwater Flows to Sustain Desirable Fishes in the Sacramento-San Joaquin Delta" (Prescriptions Report) contain a discussion of Environmental Flows Based on Historical Flows. The discussion states that the period 1949 to 1968 is a period when native fish are known to be doing better than the 1986 to 2005 period. Given the available information for the Mokelumne River, and the requirement to use the best available scientific information, can it be clarified as to whether the statement regarding fish populations applies to all tributaries flowing in to the Delta or whether it is intended to refer primarily to fish populations on the Sacramento and San Joaquin Rivers and to pelagic fish within the Delta? Attached to assist in understanding this question is EBMUD Figure 2 which shows are Chinook salmon immigration data for the Mokelumne River for each of three time periods as shown on pages 8-9 of the exhibit, and shows that for the Mokelumne River salmon immigration for the 1986 to 2005 period is higher than either the 1949 to 1968 period or the 1968 to 1985 periods. In particular, these data show steadily improving returns since the in-stream flow requirements were implemented in 1996.	Staff Exhibits	Anadromous Fish, #3
5	The following is a 3-Part Question addressing the flow objectives recommendation for Eastside Streams: 1) Table 3 and Item 4b on page 19 of the Prescriptions Report contains a recommendation to provide a flow of 1060 cfs from the Eastside streams in all months in 90% of the years. DWR data indicates that for the Mokelumne River, the average annual unimpaired runoff is 735 TAF or about 1000 cfs, and thus this recommendation represents 100% of the average annual unimpaired runoff for the Mokelumne River. Is it possible to clarify in which Eastside streams in which quantities and in which locations this recommendation is meant to apply? 2) Figure 2 on Page 7 of the Prescriptions Report indicates that in almost all years, there is almost no unimpaired flow from the Eastside Streams during the months of July, August, September, and October. Given this absence of unimpaired flow during these months, is it possible to clarify how the 1060 cfs flow recommended in Table 3, page 19 is intended to be provided during these months? 3) Were any hydrologic, temperature, or any other modeling or studies relied upon to	Staff Exhibits	Hydrology, #1

	make the recommendations and to determine the ability to meet this recommendation on any particular eastside stream or to determine any impacts associated with the recommendation?		
6	The following is a 3-Part Question on Mokelumne River salmon pulse flow recommendation in the Prescription Report (Item 4a on page 19): 1) The Prescription Report reference was based on a 14-day pulse flow event in May/June, 2007 with the average flow of 1100 cfs. How was the recommendation derived when the unimpaired flow based on DWR's data only occurs 22 out of 83 years and cannot sustain the magnitude noted in the exhibit - monthly average of 1500 cfs? 2) The reasoning of the environmental benefit that would occur from the recommended pulse flow is invalid/incorrect. What study or data was relied on to make this recommendation and to determine the ability to meet this recommendation? 3) Method 4 basing flows solely on historical and estimated pre-development conditions only examines the environmental benefits that can come from using that methodology. How would the concept of co-equal goals be integrated into the method/be applied?	Staff Exhibits	Hydrology, #1

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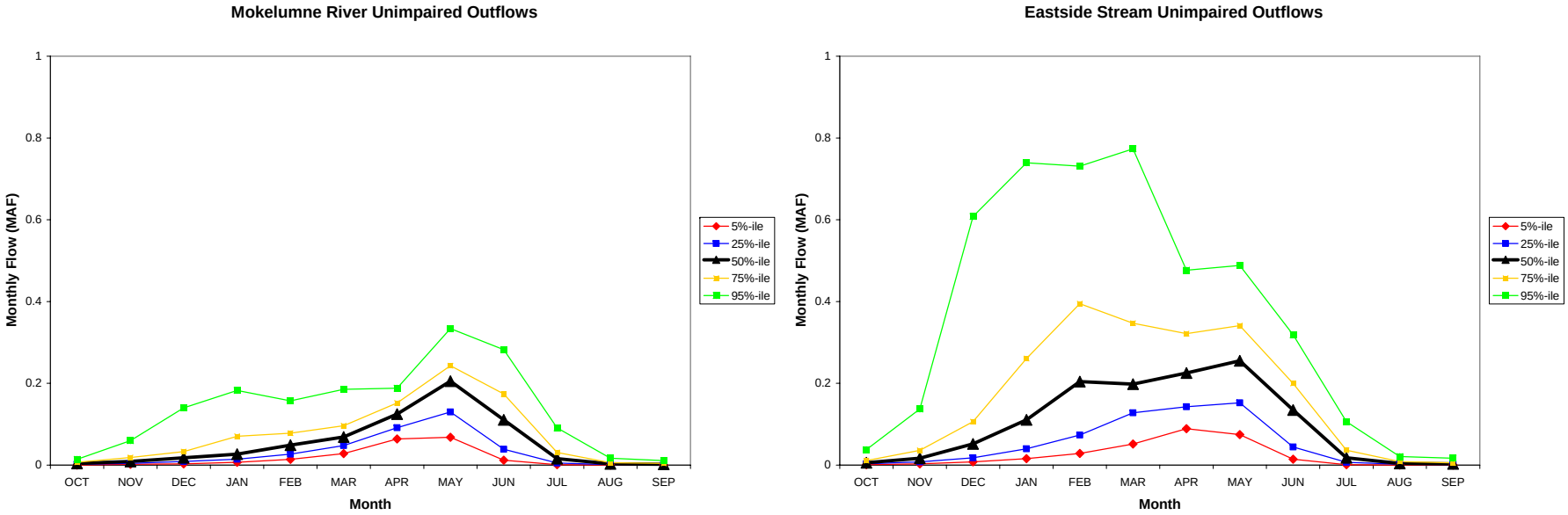
In reference to: Panel – Hydrology (#1); Witness – Staff Exhibits; Exhibit – "On Developing Prescriptions for Freshwater Flows to Sustain Desirable Fishes in the Sacramento – San Joaquin Delta"

EBMUD Figure 1: Seasonal and inter-annual flow variability for unimpaired Eastside Stream and Mokelumne River outflow. (These quartile plots have the 95th%-ile, 75th%-ile, 50th%-ile (median), 25th%-ile, and 5th%-ile from the unimpaired historical flow record.

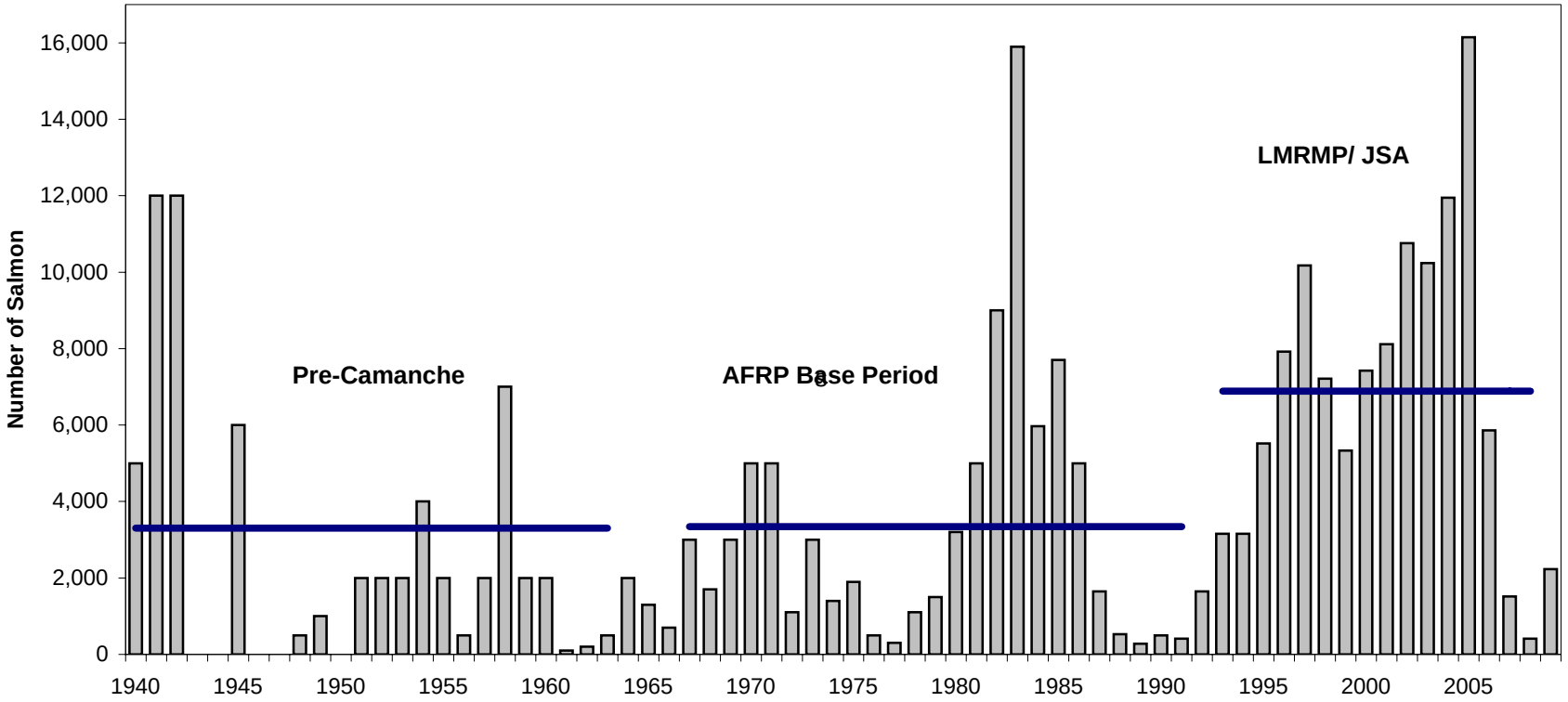


NOTE:

1. Source: "California Central Valley Unimpaired Flow Data 4th Edition", Bay Delta Office - California Department of Water Resources, May 2007

In reference to: Panel - Anadromous Fish (#3); Witness - Staff Exhibits; Exhibit - "On Developing Prescriptions for Freshwater Flows to Sustain Desirable Fishes in the Sacramento-San Joaquin Delta"

EBMUD Figure 2. Lower Mokelumne River Fall-Run Chinook Salmon Escapement (1940-2009)

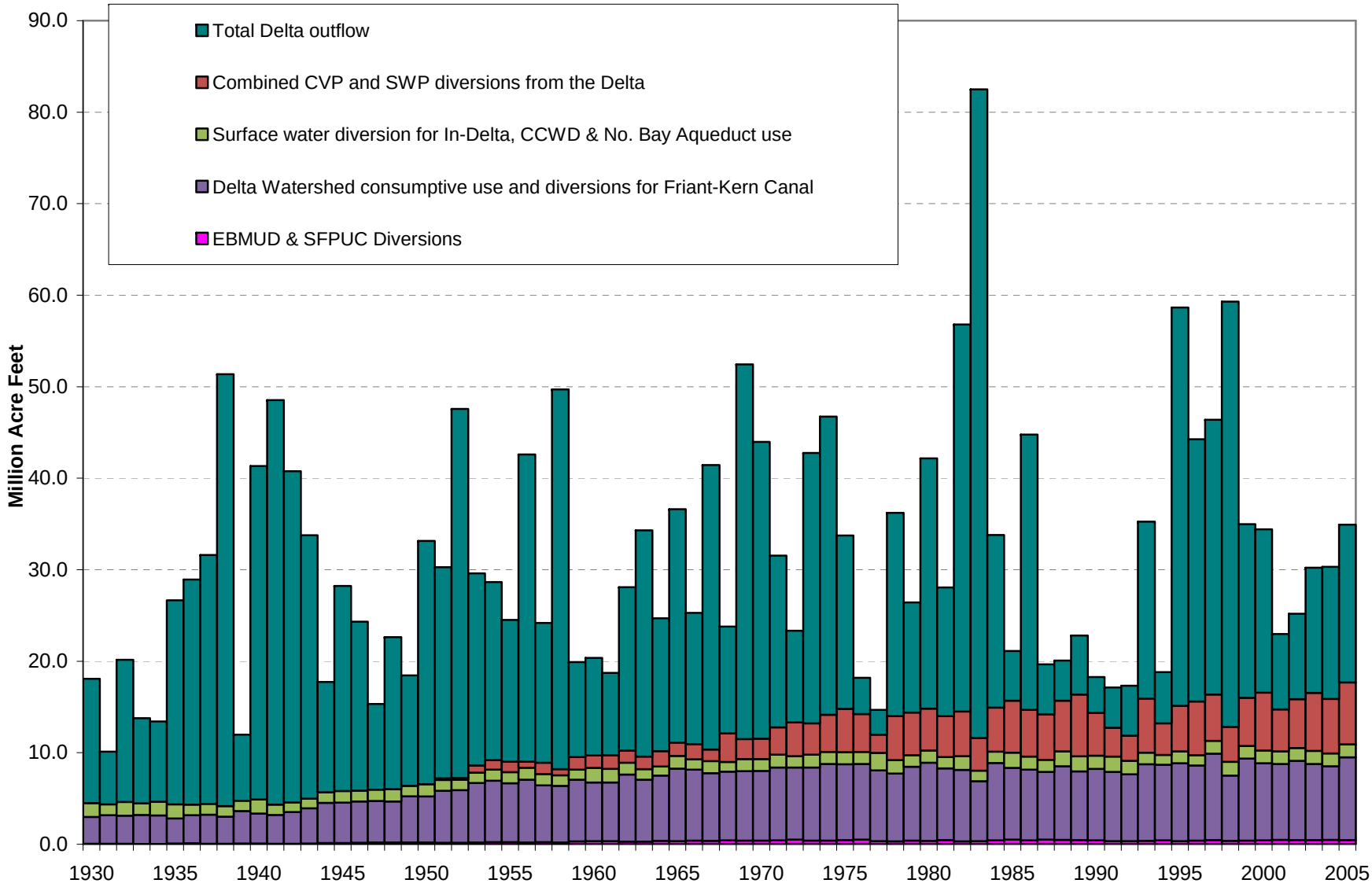


NOTES:

1. Source: 2009 Project Operations Report for the Lower Mokelumne River Project, FERC Project No. 2916, Feburary 2010.
2. (a) "Pre-Camanche" escapement (3305) is the average estimate at Woodbridge for the period of record beginning in 1940 through 1963 (excluding years when no data was recorded).
   (b) "AFRP Base Period" is defined as the 1967-1991 period. Mokelumne River average escapement estimate, at Woodbridge, for the AFRP base period is 3345.
   (c) "LMRMP/ JSA" escapement (6890) is the average estimate at Woodbridge since voluntary flow improvements were initiated in 1993.

In reference to: Panel – Hydrology (#1), Witness – The Nature Conservancy; Exhibit - Exhibit 2
and: Panel – Hydrology (#1), Witness – California Department of Water Resources;
Exhibit - Exhibit 34 "Introduction to the Presentations to the National Research Council Delta Issue"

EBMUD Figure 3: Historic Diversion from the Delta and Watershed Consumptive Uses



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December 4, 2009

Mr. Brian Ellrott
National Marine Fisheries Service
650 Capitol Mall, Suite 8-300
Sacramento, CA 95814

Subject: Comments on CV Salmon and Steelhead Draft Recovery Plan

Dear Mr. Ellrott:

The East Bay Municipal Utility District (EBMUD) appreciates the opportunity to review and provide comments on the public draft recovery plan for the Central Valley (CV) chinook salmon evolutionary significant units and the CV steelhead distinct population segment. EBMUD is very concerned that this recovery plan provide overarching strategies for recovery of the subject listed species and encompass the broad range of future actions needed regardless of whether or not they are included in biological opinions, environmental documentation or other documents or proceedings. This recovery plan should list all the potential recovery actions from the San Francisco Bay through the Delta and into the upper watersheds as necessary for recovery so that all parties can understand the scope of this effort and coordination can be maximized and conflicting actions can be minimized.

EBMUD's comments are provided in two areas. **General Comments** provide input on the overall approach and scope of the recovery plan. **Specific Comments** are focused on those recovery actions listed for the Mokelumne River and watershed and are made in the context of our FERC Joint Settlement Agreement (JSA) with the California Department of Fish and Game (CDFG) and the US Fish and Wildlife Service (USFWS). A brief **Background** section is provided so that you have context as to EBMUD's long term role in understanding and managing a CV river and our efforts to support a healthy salmonid fishery.

BACKGROUND

EBMUD's Lower Mokelumne River Management Plan was implemented in 1993 to provide a reliable water supply while seeking to sustain and enhance the lower Mokelumne River fisheries, especially fall-run Chinook salmon and steelhead trout, and other aquatic and riparian resources. The 1998 Joint Settlement Agreement for FERC Project 2916 between EBMUD, the CDFG, and the USFWS built upon the Lower Mokelumne River Management Plan. The agreement provides even more protection for lower Mokelumne River resources in addition to those undertaken by EBMUD under the 1993 plan by specifying a schedule of flows by water year type and an adaptive management provision that includes concurrence from NOAA Fisheries for adaptive management flow changes. Water quality is protected through the management of the Camanche Reservoir coldwater pool using a network of temperature monitoring stations in both Pardee and Camanche reservoirs, a reservoir temperature model

and carefully timed releases of coldwater from Pardee into Camanche Reservoir. In spite of the recent poor returns in 2008, the average Mokelumne River salmon and steelhead escapement has increased dramatically since the JSA was implemented.

CDFG operates the Mokelumne River Fish Hatchery (MRFH) on behalf of EBMUD and is currently conducting reviews of draft Hatchery and Genetics Management plans for the fall-run Chinook salmon and steelhead programs. Measures have already been taken to change the steelhead hatchery broodstock to one that is more compatible with the distinct population segment of Central Valley steelhead.

GENERAL COMMENTS

Need to address interior Delta issues. While the actions of EBMUD, CDFG and USFWS on the Mokelumne River have improved recovery and will help promote further recovery of Mokelumne River salmonids, the major limiting factor and threat that needs to be addressed in the recovery plan is poor survival rates in the interior Delta. The mortality of winter-run, spring-run and CV juvenile steelhead diverted into the interior Delta ranges from 33 to 95 percent (Brandes and McClain 2001). This poor survival rate is likely due to longer migration routes, altered salinity gradient, reverse flows, entrainment in the through-Delta water conveyance corridor, losses to predation, and water quality impacts. Adult salmon have a difficult time locating the Mokelumne River in the fall because of the large volumes of water being transferred south through the Delta Cross Channel (DCC) across the point where the Mokelumne River enters the Delta. The constant fractional marking program is confirming that a high percentage of Mokelumne origin hatchery fish are straying to the Nimbus Hatchery on the American River. This straying occurred despite the release of substantial attraction flows from Camanche Dam and stormwater runoff indicating the likely culprit is the transfer of water through the DCC. The recovery plan should provide strategies and recovery actions to address Delta issues in the following areas (regardless of whether or not these actions show up in other documents): entrainment, migration route flow impacts due to DCC and other operations, predation by non-native species, and loss of Delta rearing habitat. In the BDCP proceedings, EBMUD has proposed recovery actions such as re-routing the Mokelumne River to the Sacramento River upstream of the DCC as an action to reduce straying and avoid the high mortality rates in the interior Delta. These types of actions could be considered in this recovery plan.

Need for including most recent CV salmonid studies. EBMUD is particularly concerned about the draft recovery plan's reliance on outdated materials in the assessment and development of recovery measures for the interior Delta, including the Mokelumne River. The bulk of the recommendations made for the Mokelumne River steelhead were based on a single 1991 CDFG publication, now over 18 years old and scientifically obsolete due to the subsequent (a) implementation of the Joint Settlement Agreement and (b) development of a much more recent, comprehensive database on the current status of Mokelumne River fisheries ecosystem. While the details will be provided in our specific comments, it appears that little data or published information since 1995 was used in the threats assessment. In the threats

assessment there is no mention of the JSA flows and monitoring, $1 million in spawning gravel enhancements, $13.5 Woodbridge Dam rebuild (including state of the art fish passage facilities), and $3.8 million for new state of the art fish screens at Woodbridge canal. In addition to over 100 District reports on all of the JSA monitoring, there are numerous data sources describing the salmonid resources of the Mokelumne River including CALFED reports, university studies, peer reviewed journal articles, and symposia presentations. A thorough review of data collected and reported since1991 should be initiated prior to developing recovery guidelines for the Mokelumne River so that the recovery guidelines are based on the best available, and most current, science and data. Please contact Jose Setka at jsetka@ebmud.com to obtain copies of the relevant studies and references to available online studies.

Need for cross-species balance between recovery plans, BOs, etc. EBMUD has observed that the actions in species-specific Biological Opinions and recovery plans from NMFS and USFWS, as well as the actions in this draft recovery plan will often aid one species at the expense of another. For example, using limited water supplies for steelhead over-summer rearing will come at the expense of using the same water to maintain colder temperatures for salmon spawning. Similarly, actions proposed for protection of Delta smelt will have negative impacts on migrating salmonids. NMFS must work within the broader group of entities engaged in CV and Delta recovery strategies so that a realistic and balanced plan is developed to effectively address all species of concern.

SPECIFIC COMMENTS

The following are EBMUD's detailed comments on the NMFS public draft recovery plan for CV listed salmonids. Each comment is preceded by information from the draft recovery plan which appears in bold italics.

The draft recovery plan lists four population diversity groups that salmonids historically inhabited in the Central Valley. The Sierra Nevada region is divided arbitrarily south of the Mokelumne River, but in places the draft recovery plan puts the Mokelumne River in the Northern Sierra Nevada diversity group (pp. 54, 65, 66, 101, 107 and 201) while in other places the Mokelumne River are referenced as being in the Southern Sierra Nevada diversity group (pp. 55, 123, and 145).

Comment: Mokelumne River steelhead should be listed in only one diversity group, the Northern Sierra Nevada diversity group since most of the recovery actions are made in context to that diversity group. In fact, steelhead life history patterns in the Mokelumne are not similar to those in the San Joaquin basin and the information used in grouping the Mokelumne population was not accurate and based on a 1991 report. Straying rates from cwt data indicates that the Mokelumne population is much more similar to the American River population than it is to the San Joaquin populations.

The current draft of the recovery plan has the following references to the Mokelumne River in the Southern Sierra Diversity Group: This inconsistency needs to be corrected.

Page 145: "*However, the steelhead conceptual recovery scenario for the Southern Sierra Diversity Group includes the maintenance and/or establishment of spawning steelhead populations in the Mokelumne River, Dry Creek and the Calaveras, Stanislaus, Tuolumne and Merced rivers.*"

Page 145: "*Extant populations of steelhead in the Southern Sierra Nevada Diversity Group are known or believed to occur in the Calaveras, Stanislaus, Tuolumne, and Merced rivers (NMFS 2009). In addition, a hatchery-dependent steelhead population is present on the Mokelumne River (Marsh 2007).*"

Page 55. Figure 3-3 shows the Mokelumne River in the Southern Sierra Nevada diversity group for CV steelhead.

Page 123. "These 26 steelhead populations were categorized into four Diversity Groups based on geographic structure described in Lindley et al. (2007), which listed below. Southern Sierra Nevada Diversity Group - Mokelumne River."

When listed with the Northern Sierra Nevada Diversity Group (Table 3-1, page 65), the lower Mokelumne River steelhead population is designated as Core 3.

Comment: Core 3 populations may be present on an intermittent basis and are dependent on nearby independent populations and in the case of the Mokelumne River the population is described as dependent on the hatchery. The populations in the lower Mokelumne River appear to be either hatchery origin, highly introgressed with hatchery fish or resident *O. mykiss*. The current hatchery broodstock should continue to be used since it should have the characteristics of Northern California DPS steelhead based on the most recent hatchery management practices. The last time Nimbus origin fish were used for the Mokelumne Hatchery program was in 1998-99. Feather River steelhead eggs were imported from 2001-02 through 2006-07. Increased protective actions in the Delta will be needed if the natural river production and hatchery program is to be self sustaining and changes to the DCC operations are needed to minimize straying of Mokelumne Hatchery steelhead to the American River.

The conceptual recovery scenario includes maintenance of steelhead spawning populations in the upper reach of the Mokelumne River below Camanche Reservoir and in upper Dry Creek and evaluation of the feasibility to reintroduce experimental populations of spring-run Chinook and steelhead above Pardee Dam into the North Fork Mokelumne River. The draft plan states that habitat conditions in the North Fork are likely suitable for steelhead spawning and juvenile rearing. Page 100 lists candidate areas for reintroduction of spring-run Chinook salmon include the Mokelumne River in the conceptual recovery scenario for the Northern Sierra Nevada Diversity Group. Page 146 includes the reintroduction of

steelhead to the North Fork Mokelumne River in the steelhead conceptual recovery scenario for the Southern Sierra Nevada Diversity Group.

Comment: The Upper Mokelumne River is listed as a secondary focus for steelhead recovery for the Northern Sierra Nevada Diversity Group (Table 3-2, page 66). Instead of reintroducing experimental populations of steelhead above Pardee Dam into the North Fork Mokelumne River, restoration efforts should focus on Dry and Sutter creeks and the upper Mokelumne River below Camanche Dam since PG&E diversions and natural barriers limit habitat restoration opportunities in the Upper Mokelumne River above Pardee Dam for both spring-run Chinook and steelhead. This position is supported on Page 10 of Appendix A which lists the potential for historic habitats to support spawning populations above Camanche Dam as low to moderate for both CV steelhead and spring-run Chinook salmon. The text on page 10 states: "*The upper Mokelumne River is characterized as having a low to moderate potential to support a spawning population of spring-run salmon and steelhead. Due to flow regulations at the Tiger Creek and West Point powerhouse, it is considered difficult to anticipated life history success for either of these species even if volitional passage or truck and haul programs were instigated because of low water quality as a result of these powerhouse facilities.*"

Bald Rock Falls on the North Fork and a geologic structure on the Middle Fork appear to be complete barriers to fish migration unless high spring flows make these structures passable. The structures are found at elevations below 1400 ft which is lower than the elevation that is considered to be suitable salmon habitat. CV spring-run Chinook typically hold over summer and spawn at elevations above 1500 ft (Yoshiyama et al 1996), and year round rearing habitat for CV steelhead in the Mokelumne River is predicted to be above elevation 820 ft (generated from figure 1 map in Lindley et al. 2006). Woodhull (1946) declared Bald Rock Falls to be a "complete barrier" to upstream migration of salmonids, and the presence of a similar structure has recently been documented on the Middle Fork at about 1200 ft elevation (Steve Boyd, personal communication). Figures 1 and 2, attached, show the locations of these barriers and provide a table showing elevation by river mile.

Page 146 states "Elevated water temperatures, low flow conditions, flow fluctuations, and limited supplies of instream gravel diminish the potential for a viable population of steelhead in the Mokelumne River."

Comment: Suitable river temperatures and flows in the lower Mokelumne River have been provided by EBMUD for steelhead through the JSA. On page 4-107 it states that temperatures within the Mokelumne River are as high as 68°F in August. This is not accurate given the JSA provisions and current river management. Within the reach between Camanche Dam and Lake Lodi water temperatures have not approached 68°F since at least 1992, prior to implementation of the joint settlement agreement flows in 1996.

As noted on page 17 of Appendix A, EBMUD, CDFG and USFWS work collaboratively to improve conditions for the Mokelumne River through the JSA. Restoration activities have focused on providing additional spawning gravel, improving inter-gravel conditions, increasing

floodplain connectivity through artificial side channels, restoration of riparian habitat and providing gravel cleansing flows to sustain river rehabilitation efforts. Except in emergencies or when flood control releases were being made, daily flow releases from Camanche Dam have not decreased by more than 50 cfs per day during the period October 16 through March 31, and by not more than 100 cfs per day at other times of the year since 1999. River temperatures in the reach between Woodbridge and Camanche dams are suitable for all life stages of steelhead. New state of the art fish screens and fish ladders at Woodbridge Dam provide safe passage conditions for both upstream and downstream migrating salmon and steelhead.

The major factor limiting the potential of the Mokelumne River to support a viable population of steelhead is poor conditions in the Delta. These conditions are the result of many factors as noted in the general comments, not the least of which is the routing large volumes of Sacramento River water across the Delta portion of the Mokelumne River via the Delta Cross Channel and reverse flows in the Lower San Joaquin River and south Delta channels. Page 17 of Appendix A states*: "Reverse flows caused by CVP and SWP export pumping in the south Delta contribute to poor survival of juvenile Chinook salmon and steelhead that enter the central Delta from the Mokelumne River or from the Sacramento River via the DCC or Georgianna Slough. Mark-recapture studies indicate that juvenile Chinook salmon released in the lower Mokelumne River experience higher mortality than those released in the Sacramento River below the DCC under dry year conditions (USFWS 1987 in USFWS 1995)...Estimated average survival is only 33 percent with a range of approximately 10 percent to 80 percent survival (NMFS 2009). Most of this loss is believed be associated with predation, but may also include prolonged exposure to adverse water quality conditions represented by temperatures or contaminants."*

Page 201 lists priority 1 recovery actions to address the threat of habitat degradation and loss for Mokelumne River spring-run and steelhead. These actions include evaluate and if feasible, develop and implement a fish passage program for Camanche and Pardee dams by conducting a feasibility study and habitat evaluations and then conduct a 3-5 year pilot testing program and implement long term fish passage program. The estimated five year cost to conduct the feasibility study and habitat evaluations is $2 million.

Comment: The listing of this priority 1 recovery action under economic analysis is inconsistent with Table 3-2 on page 66 which lists the Upper Mokelumne River as a secondary focus for recovery in the Northern Sierra Nevada Diversity Group for reintroduction priorities for Central Valley Watersheds.

PG&E should be included as a party in the habitat evaluations and fish passage assessment. The specific measures needed to assure successful spawning in the upper watershed would have to be identified and compared to PG&E operational limits to determine if PG&E even has the capability to meet these measures while complying with FERC or other regulatory requirements.

Although the draft recovery plan states the Mokelumne River watershed has a low potential to support a viable steelhead population and natural origin steelhead are reportedly extinct based on a 1998 USFWS reference, a number of restoration actions are listed to secure an extant (currently existing) population. These actions include evaluation of pulse flow benefits for steelhead attraction and passage, development and implementation of a spawning gravel augmentation plan, development of a HGMP to minimize adverse effects on wild stock, management of a coldwater pool in Pardee and Camanche reservoirs and development and implementation of an instream flow management plan that fully considers all steelhead life history stages.

Comment: Many of these actions are already being implemented under the JSA. Both Pardee and Camanche reservoirs are being managed to maintain the Camanche Reservoir hypolimnion in order to maintain suitable river temperatures until fall turnover. The JSA includes a schedule of flows by water year type. Adaptive management of the JSA flows is done with the concurrence of CDFG, USFWS and NOAA Fisheries. CDFG is currently conducting reviews of draft Hatchery and Genetics Management plans for the Mokelumne River Fish Hatchery fall-run Chinook salmon and steelhead programs.

Since 2001, EBMUD, in coordination with the University of California, Davis (UCD), has implemented the Spawning Habitat Integrated Rehabilitation Approach (SHIRA) on the LMR. SHIRA is a science-based methodology comprised of conceptual and numerical models developed to restore salmonid spawning habitat in regulated rivers. Between 2001 and 2009, EBMUD has placed approximately 28,395 cubic yards of spawning gravel in the LMR. Grain sizes purchased follow AFRP guidelines, which target spawning steelhead and salmon. From 1998 through 2009, EBMUD, USFWS, CDFG and Partnership have funded $921,000 for Gravel Enhancement.

- $614,000 USFWS AFRP funding
- $225,000 EBMUD funding
- $60,000 CDFG funding
- $22,000 Partnership funding

More recently EBMUD has teamed with UCD to develop and implement an enhancement model that not only provides spawning gravel, but also restores geomorphic processes. During the last two seasons 33% and 26% of steelhead redds were constructed in enhancement areas.

All flow events, whether flood or fisheries releases, are monitored and evaluated as to their effects on salmonid behavior. In addition to JSA required monitoring the District has worked with a number of agencies in using acoustic telemetry to track fish movements from the Mokelumne out to the Delta and beyond. Existing data not yet considered for this recovery plan may assist in determining the merits of pulse flows for steelhead. Moreover, the fact that over 90% of the steelhead population within the Mokelumne is of hatchery origin suggests that water for steelhead pulse flows would be better used to maintain cold water for all salmonids including steelhead and Chinook salmon.

The primary focus watersheds in the draft recovery plan are the Upper Yuba, Battle Creek, McCloud River, Little Sacramento River, and Upper American River, but under global climate change significant habitat will only remain in the Feather and Yuba rivers and remnants of habitat might be found in the upper Sacramento and McCloud rivers, Battle and Mill Creeks and Stanislaus River under a 5 C temperature rise.

Comment: If this is true why is the upper American River listed as a primary focus watershed while the Stanislaus is a secondary focus watershed?

The draft recovery plan includes several actions to increase floodplain habitat in the Delta, yet the closure of the DCC and placing barriers in Georgianna Slough would exclude a significant portion of the Delta as rearing habitat for Sacramento origin salmonid rearing.

Comment: If the Delta is fixed, then the habitat in the interior Delta should be suitable rearing habitat for juvenile salmonids and thus measures to restrict access might actually be detrimental to recovery.

Page 157: 1.5.6. Implement Actions IV.1 through IV.6 of the Reasonable and Prudent Alternative described in the NMFS biological opinion in the long-term operations of the CVP/SWP (NMFS 2009): Action IV.1: Modify DCC gate operations and evaluate methods to control access to Georgianna Slough and the Interior Delta to reduce diversion of listed fish from the Sacramento River into the southern or central Delta.

Comment: Any modifications of the DCC gate operations or controlling access to Georgianna Slough needs to consider how these actions will effect survival and migration of Mokelumne origin salmonids. The current operations of the DCC are causing a significant amount of salmon and steelhead to stray from the Mokelumne River Hatchery to the American River. Restricting access of salmon and steelhead from the Sacramento River through Georgianna Slough could exacerbate this problem.

Comments on Appendix A (Central Valley Watershed Profiles)

Page 9 states: "Anadromous hatchery programs that release out-of-ESU steelhead stocks into the CCVS ESU are operated at Nimbus Hatchery and Mokelumne River Hatchery."

Comment: The Mokelumne River Hatchery uses steelhead stocks that originated from the Feather and Mokelumne River hatcheries and naturally produced Mokelumne River steelhead that enter the fish trap. The last time Nimbus origin eggs were used for the Mokelumne Hatchery program was in 1999-2000. Feather River steelhead eggs were imported from 2001-02 through 2006-07.

Page 9 states: "It is likely that steelhead numbers could be restored to the lower Mokelumne River in better numbers if temperature and flow standards are established that would provide for juvenile rearing."

Comment: If juvenile rearing habitat were limiting, there would not be a large resident population of *O. mykiss* in the lower Mokelumne River. From January 2005 through February 2006, electrofishing surveys were conducted by EBMUD from Camanche Dam downstream to the Woodbridge Irrigation District dam. Based on a PIT tag mark and recapture study, the estimated population of *O. mykiss* greater than 100 mm was 9,215 (+/- 3,678).

Page 201 Appendix A states: "Thus, New Hogan Reservoir captures most of the rainfall into the watershed, and local runoff in the lower Mokelumne River below New Hogan Dam seeps quickly into the groundwater table (USFWS 2003)."

Comment: "lower Mokelumne River" should be Calaveras River.

Comments on Appendix B (Threats Assessment for Salmon ESUs and Steelhead DPS)

As previously mentioned the bulk of the material used to develop the threat assessment for the Mokelumne River populations was based on pre-1995 data with the majority coming from one 1991 CDFG report. In comparison, much of the literature used to complete the threats assessment for the American River is from the late 1990's to mid- 2000's. Therefore the assessment and recovery measures suggested for the Mokelumne River must be considered incomplete at best, and the final recovery plan should reflect measures based on using the most recent information.

Page 4-106: "All steelhead that comprise the Southern Sierra Nevada Diversity Group utilize the lower San Joaquin River as a migration corridor"

Comment: While there is evidence that Mokelumne steelhead use a short section of the San Joaquin for migration, the majority of the effects and influences related to flows originate from the Mokelumne River, Sacramento River via the Delta Cross Channel, and operations at the State and Federal water projects.

Page 4-107: Under the Passage/Impediments/Barriers section it states that a "potential (low flow) barrier extends over a 600-foot section" just upstream from Thornton. Moreover it states that Woodbridge Dam may present a barrier to upstream passage at low flows.

Comment: The data used for the statement is nearly 2 decades old and does not assess the effects of the JSA flows on improving conditions. Since 1996, salmon migration timing has varied with no correlation with flow timing or magnitude. Other than beaver dams and illegal fences there have been no blockages observed in the river reach below Woodbridge Dam. Fish passage has occurred during the months of August and September during dry years under JSA dry year flows.

Within the document there is no mention of the $13.5 million rebuild of Woodbridge Dam along with the $3.8 million for new state of the art fish screens. Both CDFG and NMFS were involved in the design and certification of these projects. Since the ladders went into operation there have been no data indicating that the ladders/dam impedes passage at low flows.

Page 4-107 "Water Quality" – Based on 1991 CDFG report there are statements regarding frequently occurring lethal levels of dissolved oxygen and hydrogen sulfide along with heavy metal that cause fish kills.

Comment: Since 1991 these condition have been alleviated by the District with the addition of a hypolimnetic oxygenation system for Camanche Reservoir and a multi-million project by the State of California and EBMUD to remediate the abandoned Penn Mine to prevent further leakage of heavy metals.

Page 4-107 "Flow Conditions" – States that in dry year conditions flows below Woodbridge can be well below 100cfs from August through beginning of November.

Comment: Under Dry year scenario minimum flows below Woodbridge in October when salmon spawning begins are 80 cfs.

Page 4-109: Gravel mining is implied to occur in various areas.

Comment: There is only one off channel gravel mining operation left on the lower Mokelumne River. The operation actually provides the gravel used for the spawning gravel enhancement project in the area below Camanche Dam.

Page 4-110: "Flow Conditions"- States that maintaining flow of about 300 cfs from mid-October through February provides maximum spawning habitat and that flow variation during embryo incubation may lead to redd dewatering.

Comment: As sated previously, the 1991 report cited is out of date and since implementation of JSA flows and changes to the steelhead program at the Mokelumne River Fish Hatchery there has been an overall increase in steelhead escapement to the river and hatchery. In the months of November through May flow variations are a natural occurrence to which steelhead have adapted.

Page 4-111: "Entrainment" – States that Woodbridge Canal was screened in 1968 and that they do not meet CDFG or NMFS standards. Furthermore it states that North San Joaquin Water Conservation District (NSJWCD) pumps are either unscreened or that the screens are in disrepair.

Comment: State of the art fish screens were installed and became operational in 2008 at the head of Woodbridge Canal. These screens were certified by CDFG and NMFS. Both of the NSJWCD intakes referenced have had new CDFG certified screens installed in the last 3 years.

Page 4-111: "HATCHERY EFFECTS – Because early attempts to create a natural run of steelhead in the Mokelumne River were unsuccessful, the fishery is currently managed by CDFG as a catchable rainbow trout fishery. Steelhead averaging three to a pound are released annually. These fish likely prey on juvenile salmonids in the lower river (EBMUD 1992)."

Comment: Except for one year of volitional release, this practice was discontinued a number of years ago and all hatchery yearling steelhead are released below Woodbridge Dam with most of the fish released at Thornton or the Delta.

Comments on Appendix C (Priority 2 Recovery Actions and Implementation Schedule)

Table 2-3. Sacramento-San Joaquin Delta Threats and Associated Recovery Actions on Page 195, Appendix C: Recovery actions for Mokelumne River steelhead to address the threat of flow conditions limiting juvenile rearing habitat availability in the Mokelumne River include: 1) "Assess salmonid need by life history stage and identify deficits in optimal flow; negotiate water right purchases and/or increase flow releases from Camanche Dam (AFRP website 2005") and 2) "Dedicate instream flow through the EBMUD Camanche water right extension process" (recovery actions 2.10.30.2 – 3).

Comment: The recommended recovery actions, particularly the use of the Camanche permit extension proceeding to dedicate instream flow, is not appropriate both because of the nature of the permit extension proceeding and the lack of existing data to support a need to dedicate additional flows for steelhead. .

As an initial point, it should be noted that NOAA Fisheries issued a conference opinion and concluded section 7 consultation for CV steelhead and winter-run Chinook salmon and conferencing for CV fall-run/late-fall run Chinook salmon for the JSA instream flows. In the April 21, 1997 letter from William T. Hogarth, NMFS to Kevin P. Madden, FERC; NMFS concluded the "settlement" flows would not adversely affect listed or proposed salmonid species or their critical habitat. The April 23, 1998 letter from William T. Hogarth, NMFS to Carol Sampson, FERC states: "*The conferencing previously done for CV steelhead is adequate and serves as the section 7 consultation for this species, now that it has been listed as threatened. Given our original analysis of the proposed action, which concluded that the proposed action should improve conditions for fall-run Chinook salmon, I also conclude that this action is not likely to adversely affect the proposed –threatened CV fall-run Chinook ESU. This concludes section 7 consultation for the threatened CV steelhead, and conferencing for the proposed-threatened CV fall-run chinook salmon. Although conferencing does not take the place of a section 7 consultation, no further consultation should be necessary in the event of a CV fall-run Chinook listing, provided that the project is implemented substantially as*

described in the November 1993 FEIS." Copies of the two NMFS conferencing letters (April 21, 1997 and April 23, 1998) are attached.

In addition, the Joint Settlement Agreement (JSA) flows are already required as a matter of federal and state law. As to federal law, the Federal Energy Regulatory Commission (FERC) issued an "Order Approving Settlement Agreement and Amending License" on November 27, 1998, amending the District's FERC License for its Mokelumne Project to require EBMUD to meet the JSA, including release of the JSA flows. As to state law, the California State Water Resources Control Board (SWRCB) incorporated the flow provisions of the JSA into the District's Pardee and Camanche water rights in Decision D-1641 in 2000. Thus, the JSA flows are essentially already dedicated, as they are required to be released by the District to the lower Mokelumne River under both federal and state law.

Finally, the inclusion of this recovery action is inconsistent with NMFS' own guidance regarding the development of recovery plans. This guidance notes that when identifying recovery actions, options should not be overly prescriptive or limiting and should leave sufficient flexibility to allow for creative or innovative solutions. The measure, which mentions both an action that is not necessarily appropriate at this stage and a proceeding that simply seeks to continue an existing authorization, fails to satisfy these criteria and should be removed from the recovery plan.

Table 2-3. Sacramento-San Joaquin Delta Threats and Associated Recovery Actions on Page 201, Appendix C: Recovery actions for Mokelumne River steelhead to address the threat of low flow conditions in the Mokelumne River affecting the adult immigration: 1) "Provide for flows that are protective of all steelhead life stages through FERC processes and Section 7 implementation", 2) "Work with State and Federal water acquisition programs to dedicate instream water in the Mokelumne River" and 3) "Dedicate instream flow from Camanche Dam water right extension process" (recovery actions 2.10.42.2 – 4).

Comment: The dedication of instream flows through Section 7 implementation or the Camanche permit extension process is not appropriate since NMFS previously concluded that Section 7 consultation for the JSA was complete for CV steelhead. As noted above, the recovery actions are also inconsistent with NMFS' recovery planning guidance because they are overly limiting and prescriptive. In addition, dedication of instream flow as part of an action seeking only to extend a state-issued authorization could hinder future adaptive management efforts. The recovery planning guidance supports the use of adaptive management as an effective tool, particularly when there is uncertainty with regard to threats to species and the effectiveness of management actions. With NMFS' consent, EBMUD has effectively used adaptive management efforts in the past and most recently this year to provide fall attraction flows and any recovery actions that could jeopardize these efforts in the future are inappropriate for inclusion in the recovery plan.

EBMUD appreciates the opportunity to provide comments on the public review draft recovery plan. We look forward to continue working with NMFS under the Joint Settlement Agreement

and HGMP process to sustain the long-term viability of the salmon and steelhead fishery while protecting the genetic diversity of naturally producing populations in the lower Mokelumne River. We strongly encourage NMFS to work with EBMUD and others engaged in CV salmonid restoration efforts to develop the best possible recovery plan.

Please contact Joe Miyamoto at (510) 287-2021 or by email at miyamoto@ebmud.com if you have questions regarding our comments or would like copies of our studies and research.

Very truly yours,

Richard Sykes
Manager of Natural Resources

RGS:kap:dec

W:\WNR\nr\Administration\Richard Sykes\Comments on NMFS public draft 120409

Attachments

cc: Sandy Morey, Kent Smith, Robert Vincik, CDFG
Kathy Wood, Donny Ratcliff, USFWS
Maria Rea, Shirley Witalis, Erin Strange, NMFS

References

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UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region
501 West Ocean Boulevard, Suite 4200
Long Beach, California 90802-4213
TEL (310) 980-4000; FAX (310) 980-4018

F/SW022:CTM

APR 21 1997

Mr. Kevin P. Madden
Acting Director
Office of Hydropower Licensing
Federal Energy Regulatory Commission
Washington, D.C. 20426

Dear Mr. Madden:

Thank you for your letter of March 3, 1997, requesting concurrence that implementation of the preferred action in the Final Environmental Impact Statement for Proposed Modifications to the Lower Mokelumne River Project, California (FERC Project 2916-004, licensee East Bay Municipal Utility District, FERC/FEIS-0067, November 1993) is not likely to affect listed or proposed salmonid species or their critical habitat.

In addition to your letter, I also reviewed the Final Environmental Impact Statement (FEIS) for the project, including comment letters from resource agencies such as the California Department of Fish and Game and U.S. Fish and Wildlife Service.

Based on this review, I concur with your finding that implementation of the preferred alternative, which would provide flow and non-flow improvements to fishery habitat conditions in the lower Mokelumne River, is not likely to adversely affect anadromous fisheries. This includes the endangered Sacramento River winter-run chinook salmon, and the proposed-endangered Central Valley steelhead. Conversely, this action should improve conditions for anadromous fish utilizing the lower Mokelumne River, particularly fall-run chinook salmon.

I also concur that implementation of proposed "Settlement" flows, which are slightly different from those identified in the FEIS, (22.5, 67.4, 125.1, and 165.4 thousand acre-feet in critical-dry, dry, below normal, and wet years, for the settlement; vs. 51, 108, and 160 thousand acre-feet for the FEIS in dry, below normal, and above normal years), is also not likely to adversely affect listed or proposed salmonid species or their critical habitat. (The Settlement flows have been signed by East Bay Municipal Utility District [EBMUD] and by the U.S. Fish and Wildlife Service. The California Department of Fish and Game is considering their formal agreement to the settlement flows, with a decision expected in early April.)

I noted that the FEIS concludes that improvements in fish passage conditions at Woodbridge Dam and Lake Lodi are critical to

successful fisheries mitigation efforts. The FEIS goes so far as to state that,

> "it is not likely that the natural reproduction of chinook salmon can be improved in the lower river without eliminating the serious barriers to migration that exist in the vicinity of Lake Lodi which lies between Camanche Dam and the Sacramento San-Joaquin Delta." (FEIS, p.xxiv)

The FEIS then states,

> "Improvements in the hydraulics of Lake Lodi are the most important non-flow action that can be taken. Staff encourages that EBMUD participate in a cooperative effort to resolve the fish passage problems at Woodbridge Dam and Lake Lodi. If improvements cannot be made in this area in the near future (e.g., within 5 years), the recommendations in the FEIS may have to be reconsidered." (FEIS, p. xxv)

My Santa Rosa field office engineering staff may be able to assist in any efforts to resolve fish passage and fish screen problems in the lower Mokelumne River. Given the importance of resolving the problem at Lake Lodi and Woodbridge Dam, I encourage you and any other interested parties to contact Mr. Marcin Whitman of my engineering staff to discuss this issue. Mr. Whitman can be reached at (707) 575-6055, or by e-mail at Marcin.Whitman@noaa.gov.

This concludes section 7 consultation for the endangered winter-run chinook salmon, and conferencing for the proposed endangered Central Valley steelhead. Although conferencing for steelhead does not take the place of a section 7 consultation, no further consultation should be necessary in the event of a steelhead listing, provided that the project is implemented substantially as described in the November 1993 FEIS. Should project plans change, or if additional information on the proposed species becomes available, this determination may be reconsidered.

If you have any questions please contact Mr. Chris Mobley of my staff at (707) 575-6056; e-mail Chris.Mobley@noaa.gov.

Sincerely,

William T. Hogarth, Ph.D.
Acting Regional Administrator

cc: Wayne White, USFWS
John Turner, DFG
Joel Medlin, EPA

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region
501 West Ocean Boulevard, Suite 4200
Long Beach, California 90802-4213

APR 23 1998

F/SW4:CTM

Ms. Carol L. Sampson
Director, Office of Hydropower Licensing
Federal Energy Regulatory Commission
Washington, D.C. 20426

Dear Ms. Sampson:

Thank you for your March 26, 1998, letter following up on our April 21, 1997, section 7 consultation/conference letter for proposed modifications to the Lower Mokelumne River Project (FERC project 2916-004). In your letter, you ask whether the subsequent listing of Central Valley steelhead requires any further consultation, and you also request initiation of consultation for the proposed-threatened Central Valley fall-run/late fall-run chinook salmon.

The conferencing previously done for Central Valley steelhead is adequate and serves as the section 7 consultation for this species, now that it has been listed as threatened. Given our original analysis of the proposed action, which concluded that the proposed action should improve conditions for fall-run chinook salmon, I also conclude that this action is not likely to adversely affect the proposed-threatened Central Valley fall-run/late-fall-run chinook salmon ESU.

This concludes section 7 consultation for the threatened Central Valley steelhead, and conferencing for the proposed-threatened Central Valley fall-run/late-fall run chinook salmon. Although conferencing does not take the place of a section 7 consultation, no further consultation should be necessary in the event of a Central Valley fall-run/late-fall run chinook listing, provided that the project is implemented substantially as described in the November 1993 Final Environmental Impact Statement. Should project plans change, or if additional information on the proposed species becomes available, this determination may be reconsidered.

If you have any questions please contact Mr. Chris Mobley of my staff at (707) 575-6056; e-mail Chris.Mobley@noaa.gov.

Sincerely,

William T. Hogarth, Ph.D.
Regional Administrator

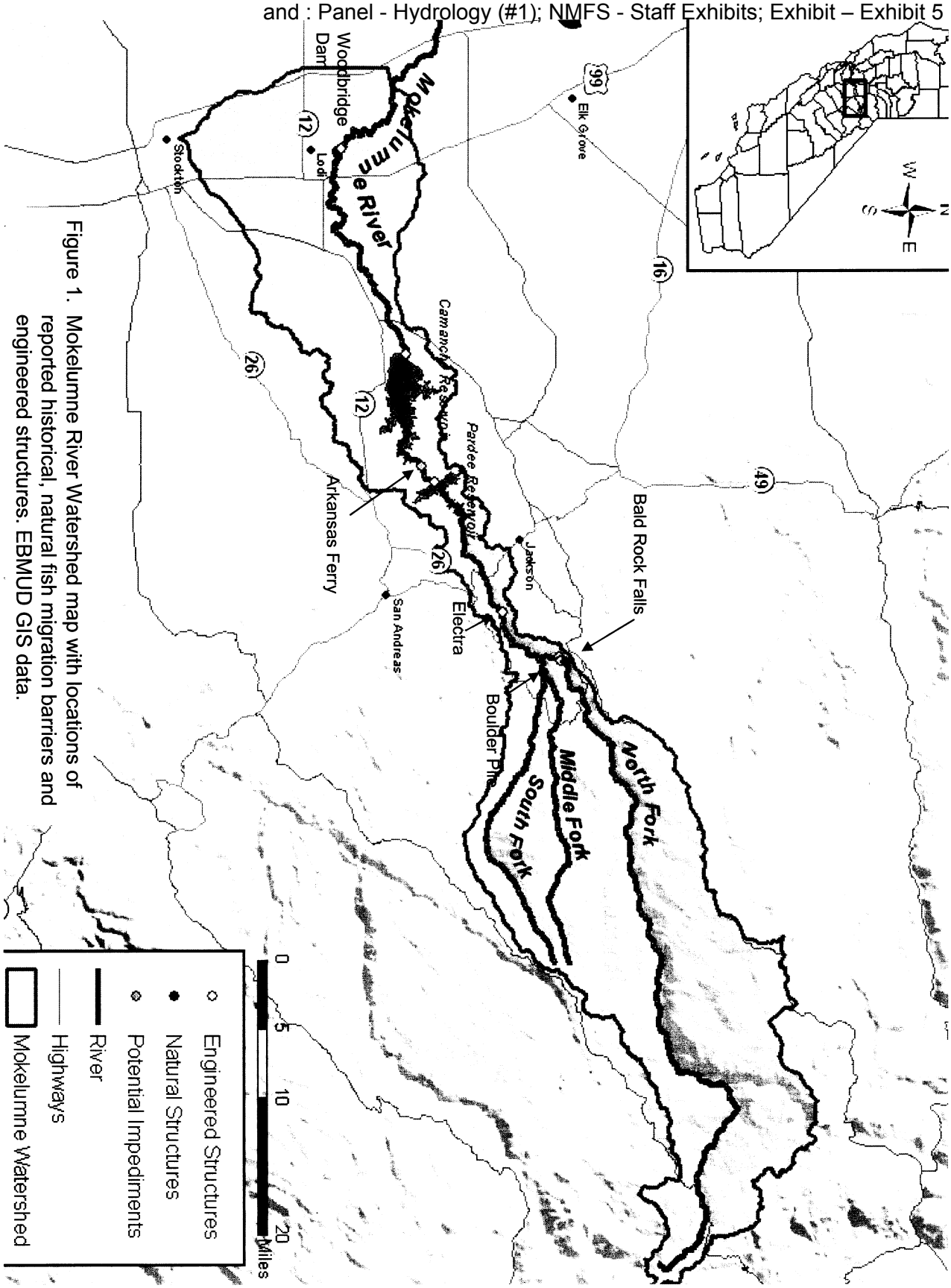

Figure 1. Mokelumne River Watershed map with locations of reported historical, natural fish migration barriers and engineered structures. EBMUD GIS data.

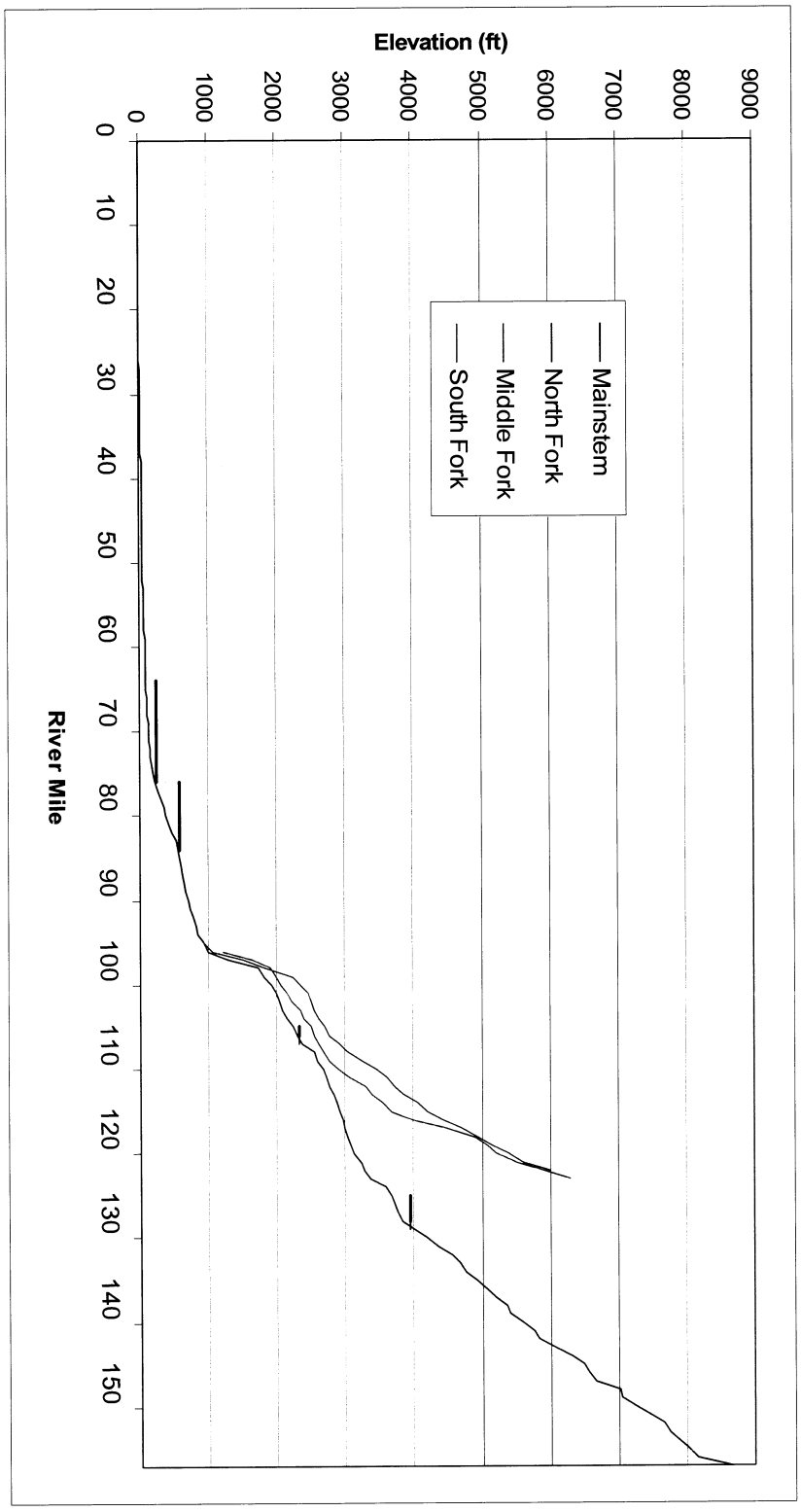

Figure 2. Mokelumne River Elevations by River Mile, starting at the confluence with the San Joaquin River; Sacramento, San Joaquin and Contra Costa Counties; showing streambed gradient at locations reported to be fish migration barriers (USGS data).

EBMUD Attachment 2 – List of References for the NMFS 2009 Draft Recovery Plan

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2. Lower Mokelumne River Upstream Migration Monitoring Conducted at Woodbridge Irrigation District Dam August 2000 though April 2001. Technical Report. August 2001.
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13. Downstream Migration Monitoring at Woodbridge Dam on the Lower Mokelumne River, CA. December 2005 through July 2006. Technical Report. September 2006.

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15. Lower Mokelumne River Fish Community Survey. 1 January 1997 through 30 June 2004. Technical Report.
16. Lower Mokelumne River Salmonid Spawning Habitat Improvement Project Monitoring. Technical Report. June 2004.

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1. Modification of Flood Flow Releases to Support Restoration of Ecological Processes. Technical Report.
2. Floodplain Restoration Potential on the Lower Mokelumne River, California. UCD Technical Report. June 2003.
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4. Riverine Habitat Characterization of the Lower Mokelumne River, California. Technical Report. July 2004.
5. Terrestrial Vegetation Communities along the Lower Mokelumne River, California. Technical Report. May 2004.
6. Use of Macroninvertebrates as an Indicator of Chinook Salmon Spawning Habitat Quality in the Lower Mokelumne River, California. M.S. Thesis. Spring 2003.
7. Lower Mokelumne River Fish Community Survey. 1 January 1997 through 30 June 2004. Technical Report.
8. Lower Mokelumne River Amphibian and Reptile Inventory. Technical Report. July 2004.
9. Lower Mokelumne River Small Mammal Inventory. Technical Report. July 2004.
10. Survey of Falcons, Kites, Hawks, and Owls in the Lower Mokelumne River Watershed, Sacramento and San Joaquin Counties, California. Technical Report. February 2004.
11. Lower Mokelumne River Riparian Bird Surveys. Technical Report. March 2004.
12. Non-Native Invasive Plant Communities Along the Lower Mokelumne River, California. May 2004.
13. Data Dictionary/Metadata for Oracle Fisheries Migration Database. Technical Document.
14. Summary of Fall-run Chinook Salmon and Steelhead Trout Spawning in the Lower Mokelumne River, California 1996-2003. Technical Report. October 2004.
15. Lower Mokelumne River Water Quality Monitoring Program December 1999-June 2004. Technical Report. August 2004.
16. Lower Mokelumne River Salmonid Spawning Habitat Improvement Project Monitoring. Technical Report. June 2004.
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18. Spawning Habitat Enhancement for Pacific Salmon in a Regulated River. Doctorate Thesis. 2004

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26. USFWS Comments on 6-year report RE: Water Quality Measurements. Memo.
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28. Lower Mokelumne River Project Water Quality and Resource Management Plan Status Report October 2004 "6-year review". Technical Report. October 2004.

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1. Lower Mokelumne River Project Joint Settlement Agreement Ten-Year Review. Technical Report. September 2008.

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2. Use of Otolith Microstructure to Discriminate Stocks of Juvenile Central Valley, California, Fall-Run Chinook Salmon. Published Literature. Transactions of the American Fisheries Society 2007.
3. An Evaluation of Treatments to Reduce Mortality from Coagulated Yolk Disease in Hatchery-Produced Chinook Salmon. Published Literature. North American Journal of Aquaculture 2001.
4. Evaluation of a Spawning Habitat Enhancement Site for Chinook Salmon in a Regulated California River. Published Literature. North American Journal of Fisheries Management 2004.
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7. Aquatic Macrophyte Encroachment in Chinook Salmon Spawning Beds: Lessons Learned from Gravel Enhancement Monitoring in the Lower Mokelumne River,

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8. Movement of Sacramento sucker, *Castostomus occidentalis,* and hitch, *Lavinia exilicauda*, during a spring release of water from Camanche Dam in the Mokelumne River, California. Published Literature. Environmental Biology of Fishes 2006.
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10. Homogenization of Fall-Run Chinook Salmon Gene Pools in the Central Valley of California, USA. Published Literature. North American Journal of Fisheries Management 2005.
11. Predicting benefits of spawning-habitat rehabilitation to salmonid (*Oncorhynchus spp*.) fry production in a regulated California river. Published Literature. Canadian Journal of Fisheries and Aquatic Sciences 2004
12. Use of habitat heterogeneity in salmonid spawning habitat rehabilitation design. Published Literature. Fifth International Symposium on Ecohydraulics 2004.

LOWER MOKELUMNE RIVER PROJECT
JOINT SETTLEMENT AGREEMENT
TEN-YEAR REVIEW

PARTNERSHIP STEERING COMMITTEE

East Bay Municipal Utility District
California Department of Fish and Game
U.S. Fish and Wildlife Service

2008

LOWER MOKELUMNE RIVER JOINT SETTLEMENT AGREEMENT TEN-YEAR REVIEW

1.0 BACKGROUND

The Federal Energy Regulatory Commission's (FERC) November 27, 1998 Order "Approving Settlement Agreement and Amending License for the East Bay Municipal Utility District's Lower Mokelumne River Project No. 2916" approved the Joint Settlement Agreement (JSA) entered into by East Bay Municipal Utility District (EBMUD), U.S. Fish and Wildlife Service (USFWS) and California Department of Fish and Game (CDFG). The JSA included flow and non-flow measures, and required EBMUD, USFWS, and CDFG to develop a plan Water Quality and Resource Management Program (WQRMP) for FERC approval.

The Partnership Steering Committee, composed of one representative each from CDFG, USFWS and EBMUD, developed WQRMP to define reasonable goals, measures, performance criteria and responsive actions associated with the implementation of the JSA. It includes a comprehensive monitoring and applied research program integrated with a well-coordinated program to adaptively manage water and power supply operations, flood control, hatchery operations and ecosystem rehabilitation actions. It was approved by FERC in 2001.

JSA Goals

- Provide, to the extent feasible, habitat quality and availability in the lower Mokelumne River to maintain fishery, wildlife and riparian resources in good condition
- Contribute towards the state and federal fishery restoration goals as defined in the California Salmon, Steelhead Trout and Anadromous Fisheries Program Act and the Central Valley Project Improvement Act
- Sustain the long-term viability of the salmon and steelhead fishery while protecting the genetic diversity of naturally producing populations in the lower Mokelumne River

This report summarizes the findings of the Partnership Steering Committee with respect to the progress and accomplishments resulting from the first ten years of JSA implementation as defined in the Water Quality and Resource Management Program and recommends strategies and measures for continued implementation.

Sandy Morey
California Department of Fish and Game

9-10-08
Date

Michael Hoover
U.S. Fish and Wildlife Service

9-10-08
Date

Alexander Coate
East Bay Municipal Utility District

9.10.08
Date

2.0 ACCOMPLISHMENTS

2.1 Flow Measures

The JSA specifies minimum flow releases from Camanche Dam and expected flow below the Woodbridge Irrigation District Dam (WIDD) based on time of year and water year types. Water year types are determined based on combined storage in Camanche and Pardee reservoirs (October through March) and the unimpaired runoff into Pardee Reservoir (April through September). Since 1998, there have been 6 Normal and Above, 2 Below Normal, and 2 Dry water year types from October through March; and, 2 Normal and Above, 4 Below Normal, and 4 Dry water year type from April through September. Although the minimum flow releases from Camanche Dam and the expected flows below WIDD are designed to protect the fish resources in the lower Mokelumne River, actual flows have always exceeded the required releases below Camanche Dam (Table 1) and the expected flows below WIDD (Table 2).

Table 1. Comparison of JSA required release and actual releases below Camanche Dam.

Year	Period	JSA Water Year Type	JSA Required Release (Acre-feet)	Actual Release (Acre-feet) [1]
1998/1999	Oct-Mar	Normal & Above	117,294	349,361
1999	Apr-Sep	Below Normal	63,357	320,530
1999/2000	Oct-Mar	Normal & Above	117,939	274,205
2000	Apr-Sep	Below Normal	63,357	200,664
2000/2001	Oct-Mar	Normal & Above	117,294	119,827
2001	Apr-Sep	Dry	50,804	113,937
2001/2002	Oct-Mar	Dry	79,399	87,062
2002	Apr-Sep	Below Normal	63,357	139,500
2002/2003	Oct-Mar	Below Normal	90,227	95,394
2003	Apr-Sep	Dry	50,804	231,018
2003/2004	Oct-Mar	Normal & Above	117,939	130,259
2004	Apr-Sep	Below Normal	84,476	170,839
2004/2005	Oct-Mar	Below Normal	90,227	190,733
2005	Apr-Sep	Normal & Above	107,033	546,981
2005/2006	Oct-Mar	Normal & Above	117,294	388,359
2006	Apr-Sep	Normal & Above	112,982	826,939
2006/2007	Oct-Mar	Normal & Above	117,294	132,694
2007	Apr-Sep	Dry	50,804	124,118
2007/2008	Oct-Mar	Dry	80,481	82,157 [2]
2008	Apr-Sep	Dry	50,804	190,268 [2]

[1] Actual Release from USGS published data for site 11323500
[2] Estimated

Table 2. Comparison of JSA expected flow and actual flow below Woodbridge Dam.

Year	Period	JSA Water Year Type	JSA Expected Flow (Acre-feet)	Actual Flow (Acre-feet) [1]
1998/1999	Oct-Mar	Normal & Above	36,091	313,161
1999	Apr-Sep	Below Normal	36,765	221,223
1999/2000	Oct-Mar	Normal & Above	36,289	249,674
2000	Apr-Sep	Below Normal	36,765	110,477
2000/2001	Oct-Mar	Normal & Above	36,091	97,219
2001	Apr-Sep	Dry	22,983	30,465
2001/2002	Oct-Mar	Dry	28,872	62,923
2002	Apr-Sep	Below Normal	36,765	44,927
2002/2003	Oct-Mar	Below Normal	36,091	71,503
2003	Apr-Sep	Dry	22,983	146,080
2003/2004	Oct-Mar	Normal & Above	36,289	94,034
2004	Apr-Sep	Below Normal	36,765	68,596
2004/2005	Oct-Mar	Below Normal	36,091	151,315
2005	Apr-Sep	Normal & Above	49,773	423,398
2005/2006	Oct-Mar	Normal & Above	36,091	360,198
2006	Apr-Sep	Normal & Above	49,773	726,760
2006/2007	Oct-Mar	Normal & Above	36,091	106,505
2007	Apr-Sep	Dry	22,983	34,054
2007/2008	Oct-Mar	Dry	29,031	66,074 [2]
2008	Apr-Sep	Dry	22,983	94,236 [2]

[1] Actual Release from USGS published data for site 11325500
[2] Estimated

2.2 Fall-run Chinook salmon

Since implementation of the JSA in 1998, the population of fall-run Chinook salmon as measured by total escapement to the lower Mokelumne River has increased (average 1964 through 1997 = 3,636; 1998 through 2007 = 8,455, Figure 1); and as measured by in-river escapement (average 1964 through 1997 = 2,503; 1998 through 2007 = 2,973, Figure 2). Total and in-river escapement, number of redds, and estimated number of outmigrating juvenile fall-run Chinook salmon through the period are shown in Table 3.

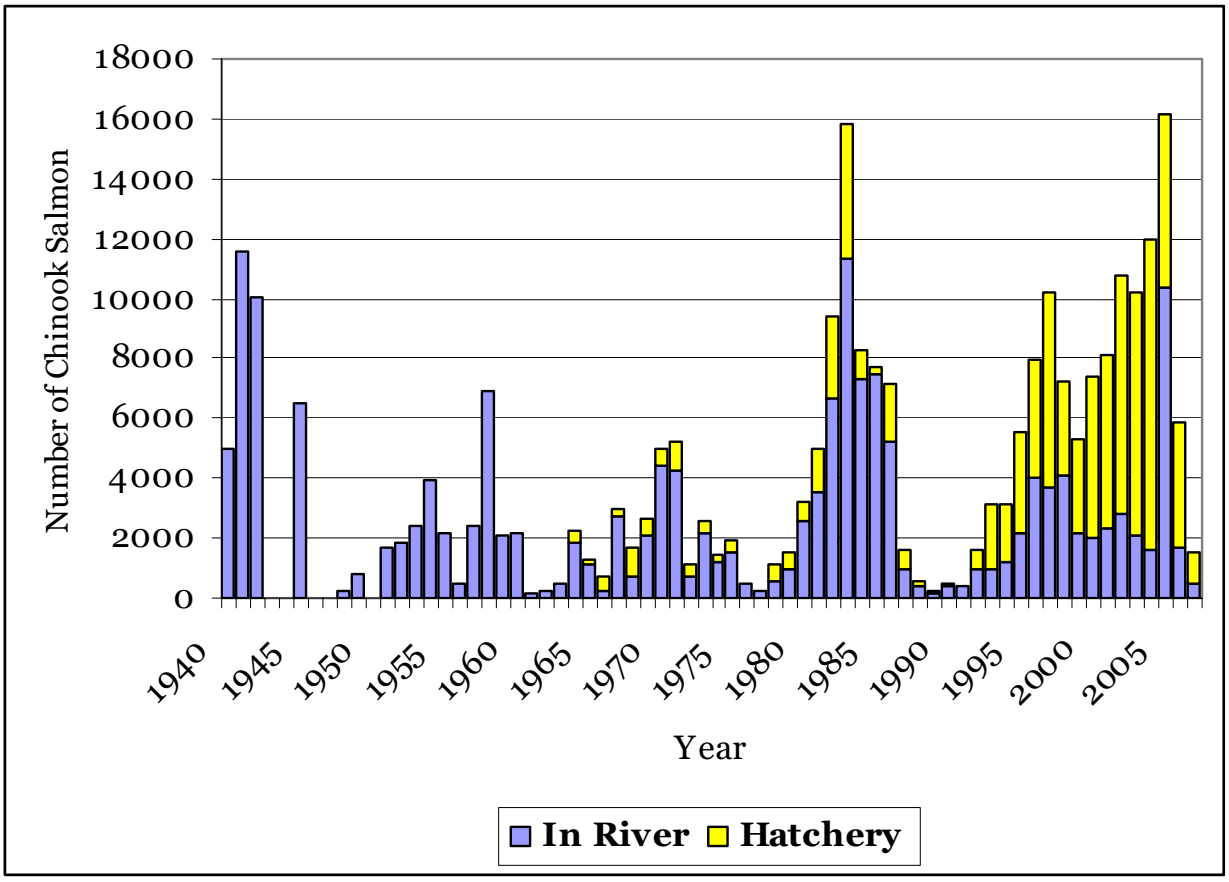

Figure 1. Mokelumne River Fall-run Chinook Salmon Escapement

Table 3. Fall-run Chinook salmon escapement, number of redds and outmigrants observed.

Year	Period	JSA Water Year Type	Preceding JSA Water Year Type	Total Escapement (In-river)	Number of Redds	Outmigrants
1998/1999	Oct-Mar	Normal & Above	Normal & Above	7,213 (4,122)	1,116	
1999	Apr-Sep	Below Normal	Normal & Above			1,535,439
1999/2000	Oct-Mar	Normal & Above	Below Normal	5,333 (2,183)	623	
2000	Apr-Sep	Below Normal	Normal & Above			168,525
2000/2001	Oct-Mar	Normal & Above	Below Normal	7,423 (1,973)	987	
2001	Apr-Sep	Dry	Normal & Above			119,334
2001/2002	Oct-Mar	Dry	Dry	8,116 (2,307)	843	
2002	Apr-Sep	Below Normal	Dry			77,923
2002/2003	Oct-Mar	Below Normal	Below Normal	10,759 (2,840)	848	
2003	Apr-Sep	Dry	Below Normal			140,471
2003/2004	Oct-Mar	Normal & Above	Dry	10,239 (2,122)	807	
2004	Apr-Sep	Below Normal	Normal & Above			87,654
2004/2005	Oct-Mar	Below Normal	Below Normal	11,944 (1,588)	835	
2005	Apr-Sep	Normal & Above	Below Normal			432,874
2005/2006	Oct-Mar	Normal & Above	Normal & Above	16,144 (10,406)	2,170	
2006	Apr-Sep	Normal & Above	Normal & Above			1,187,553
2006/2007	Oct-Mar	Normal & Above	Normal & Above	5,861 (1,723)	754	
2007	Apr-Sep	Dry	Normal & Above			39,627*
2007/2008	Oct-Mar	Dry	Dry	1,519 (470)	305	
2008	Apr-Sep	Dry	Dry			18,347*

* Sampling season abbreviated due to low flow conditions below WID dam

The lower Mokelumne River contributed about 2% (1.2-3.7%) to the total escapement of California Central Valley fall-run Chinook salmon and about 41% (16-77%) to total escapement of fall-run Chinook salmon in the San Joaquin River system. In-river escapement contributed about 1.1% (0.4-4.3%) to the total in-river escapement of California Central Valley fall-run Chinook salmon and about 22% (5-70%) to the total in-river escapement of fall-run Chinook salmon in the San Joaquin River system. Mokelumne River Fish Hatchery escapement contributed about 6.2% (3-9.3%) to the total hatchery escapement of California Central Valley fall-run Chinook salmon and about 83% (66-97%) to total hatchery escapement of fall-run Chinook salmon in the San Joaquin River system.

Table 4. California Central Valley fall-run Chinook salmon escapement.

YEAR	Sacramento River System		San Joaquin River System		Mokelumne River	
	Hatchery	In-river	Hatchery	In-river	Hatchery	In-river
1998/1999	75,028	151,732	3,890	19,711	3,091	4,122
1999/2000	49,657	341,693	4,787	17,893	3,150	2,183
2000/2001	50,965	385,593	7,396	39,474	5,450	1,973
2001/2002	61,702	528,472	7,391	27,303	5,809	2,307
2002/2003	96,471	739,537	9,753	26,666	7,919	2,840
2003/2004	118,144	451,208	8,666	12,717	8,117	2,122
2004/2005	115,929	246,508	13,626	8,637	10,356	1,588
2005/2006	186,833	226,888	6,159	14,835	5,738	10,406
2006/2007	78,326	203,568	4,266	7,245	4,138	1,723
2007/2008	21,638	70,494	1,128	1,450	1,049	470

2.3 Steelhead/Rainbow trout

Since implementation of the JSA, EBMUD has monitored *Oncorhynchus mykiss* populations in the lower Mokelumne River using video monitoring at the Woodbridge Irrigation District Dam fish ladder, rotary screw traps in the lower Mokelumne River below WIDD, and seasonal fish community surveys (electrofishing and seining) from Camanche Dam downstream to WIDD (Table 5).

Table 5. *O. mykiss* observed in the fisheries sampling conducted in the lower Mokelumne River from Camanche Dam downstream to Woodbridge Dam.

Year	Period	Community Surveys [1]		Rotary Screw Trap [2]		WID Fish Ladder [3]	
		Hatchery [4]	Wild [5]	Hatchery	Wild	Hatchery	Wild
1998/1999	Oct-Mar		347	620	22		555
1999	Apr-Sep		227	6	191		2
1999/2000	Oct-Mar		24	871	19		941
2000	Apr-Sep		205	31	148	8	3
2000/2001	Oct-Mar		274	487	77	3,067	89
2001	Apr-Sep		245	4	381	9	23
2001/2002	Oct-Mar		253	9	154	593	152
2002	Apr-Sep		213	1	50	357	400
2002/2003	Oct-Mar		196	82	78	1,017	117
2003	Apr-Sep		98	15	78	1,312	380
2003/2004	Oct-Mar		175	61	16	385	105
2004	Apr-Sep		131	9	43	749	439
2004/2005	Oct-Mar		410	28	7	265	70
2005	Apr-Sep		335	4	74	816	42
2005/2006	Oct-Mar		781	61	8	28	10
2006	Apr-Sep		189	6	51	108	22
2006/2007	Oct-Mar	2	324	75	15	337	16
2007	Apr-Sep	6	273	2	136	121	23
2007/2008	Oct-Mar		213	1	31	*	*

[1] Includes seasonal electrofishing and seining (Jan-Jun)
[2] Rotary screw trap(s) immediately below Woodbridge Irrigation District Dam (mid-Dec thru Jul)
[3] Includes video monitoring and trapping in old ladder
[4] Fish of hatchery origin (adipose fin clip)
[5] Fish of natural origin
* Monitoring system inoperable due to construction of fish screens at WID canal

The number of *O. mykiss* observed in the fish community surveys has varied (Figure 2). In 2005 EBMUD developed a population estimate of *O. mykiss* in the lower Mokelumne River from Camanche Dam downstream to the Woodbridge Irrigation District Dam using a mark/recapture study with PIT (passive integrated transponder) tags. That estimate was 9,215 ± 1,877.

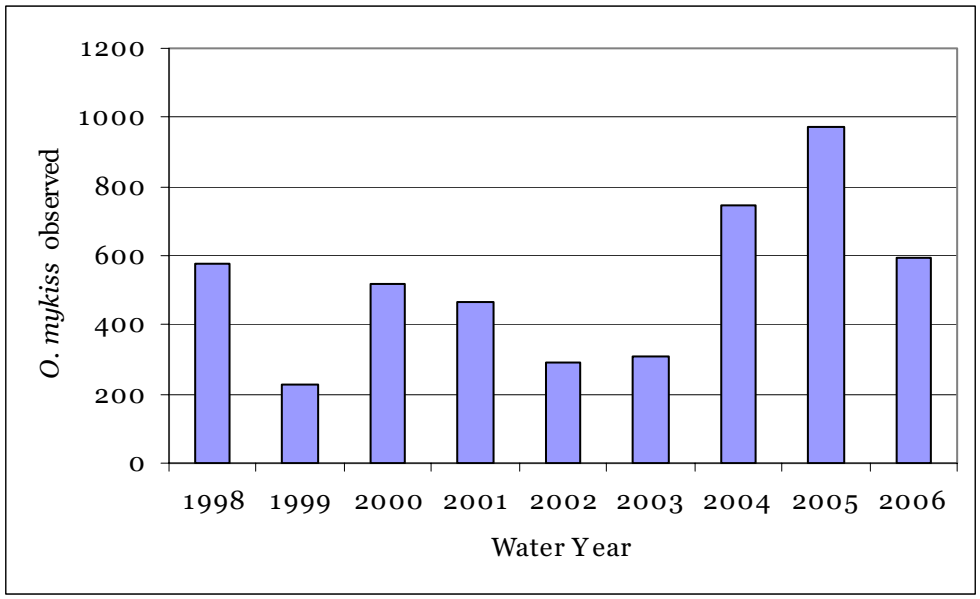

Figure 2. *O. mykiss* observed in the seasonal fish community surveys

Although the number of *O. mykiss* observed in the fish ladder videos and rotary screw traps (Figure 3) may give an impression of upstream (adults, Oct-Mar) and downstream (juveniles, Apr-Sep) movement of fish, it may not be an accurate representation of anadromy.

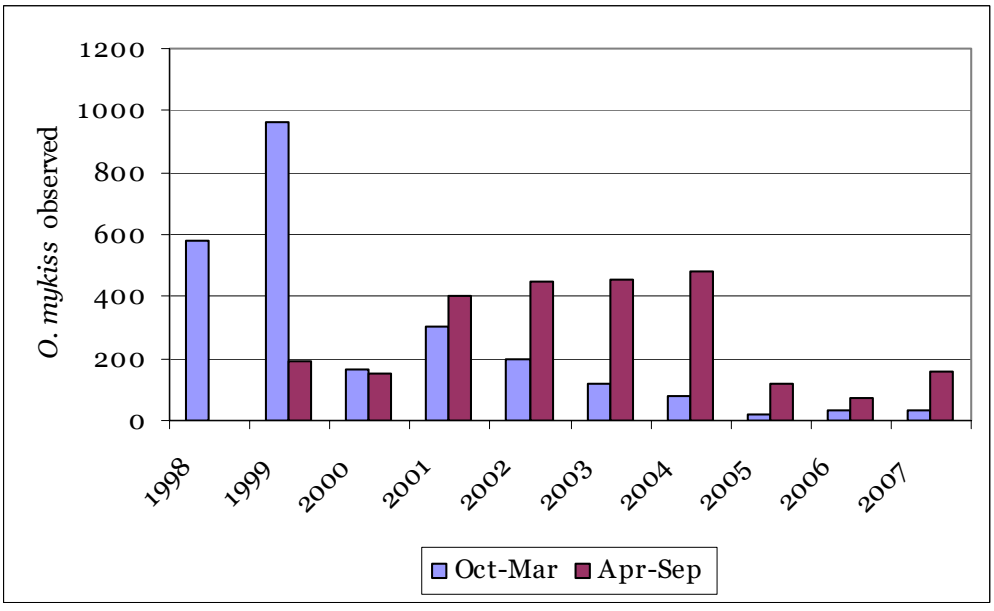

Figure 3. *O. mykiss* observations in the ladder videos and rotary screw traps.

Zimmerman et al. (2008) conducted an analysis of otolith strontium/calcium (Sr:Ca) ratios to determine maternal origin (anadromous v. non-anadromous) and migratory history (anadromous v. non-anadromous) of rainbow trout (*O. mykiss*) collected in tributaries of the Sacramento-San Joaquin River system in the Central Valley of California between 2001 and 2007. Of 964 otoliths examined, 224 were progeny of anadromous rainbow trout (i.e., steelhead) females and 740 were progeny of non-anadromous rainbow trout females. Of the 485 specimens examined from the Calaveras, Stanislaus, and Tuolumne rivers (similar to the Mokelumne river) , less than 1% (4) exhibited anadromous migratory history, and less than 16% (77) were progeny of anadromous females (Table 6).

Table 6. Maternal origin and migratory history of *O. mykiss* from the Calaveras, Stanislaus and Tuolumne rivers.

	AGE					TOTAL
	0	1	2	3	4	
MATERNAL ORIGIN						
Anadromous	6	12	30	17	12	77
Resident	10	72	168	109	49	408
MIGRATORY HISTORY						
Anadromous	0	0	0	0	4	4
Resident	16	84	198	126	55	479
Unknown	0	0	0	0	2	2

The number of *O. mykiss* that have entered the fish ladder and trap in the Mokelumne River Fish Hatchery has steadily increased since implementation of the JSA (Table 7). The proportion of these fish that are hatchery origin has increased from 77% in 2005 to 96% in 2007 and 93% in 2008.

Table 6. *O. mykiss* trapped at the Mokelumne River Fish Hatchery.

Year	Females	Males	Juveniles (<40.6 cm)
1999	0	0	
2000	9	23	
2001	17	15	
2002	18	25	
2003	29	23	29
2004	29	30	23
2005	25	22	13
2006	61	79	49
2007	113	132	167
2008	99	135	110

2.4 Non-Flow Measures

As specified in the JSA, East Bay Municipal Utility District, U.S. Fish and Wildlife Service and California Department of Fish and Game established the Lower Mokelumne River Partnership (Partnership) in 1998 and each agency representative has participated in an annual meeting to measure the success of the JSA flow requirements, non-flow measures and other actions pursuant to implementation of the JSA. The Partnership also established the Partnership Coordinating Committee consisting of technical representatives of each agency that meets semiannually to ensure timely implementation of the measures identified in the JSA and the WQRMP.

In January 1999, EBMUD established the $2 million Partnership fund, the interest from which is used to support Partnership programs to protect and enhance the lower Mokelumne River ecosystem. Since its inception, the Partnership fund has committed over $740,000 to approved projects (Table 7). Restoration activities comprised 61% of the expenditures and approximately 17% was committed to research, 16% to outreach, and 6% to law enforcement. Over 92% of the funds were leveraged with additional funding sources or in-kind services.

The Partnership has worked collaboratively with the Lower Mokelumne River Watershed Stewardship Steering Committee to 1) encourage the voluntary participation and cooperation of other stakeholders along the river, 2) recommend ecosystem protection and improvement priorities, and, 3) serve as a communications and coordination forum for stakeholders.

Representatives of the Partnership along with other resource agency staff and technical experts convene the Mokelumne River Technical Advisory Committee semiannually. This meeting provides a forum for sharing technical information about the fisheries, river operations, hatchery operations, and other issues related to ecosystem actions in the lower Mokelumne River.

The Partnership sponsored periodic symposia to present research findings related to ecological studies in the lower Mokelumne River, including the “State of the Rivers” symposia in 1999 and 2001, and the Salmonid Restoration Conferences in 2004 and 2008. Projects associated with implementation of the JSA resulted in completion of one Ph.D. and 6 M.S. degrees, 14 peer-reviewed scientific journal articles, and 18 scientific conference presentations.

The JSA states that a trap and truck program could have some benefit to the fishery resource and recommends that trapping and trucking of anadromous salmonids take place during critical years upon approval of the Partnership Steering Committee. Appendix A presents the trapping and trucking program conducted during the past 10 years.

Table 7. Approved Partnership Fund Projects.

PROJECT	SPONSOR	DESCRIPTION	COMPLETED	FUNDING
Farm Edges Handbook	East Bay Municipal Utility District	Purchase and distribution of resource handbook	10/10/2001	$760
2002 Enhanced Enforcement	California Department of Fish and Game	Increased warden surveillance & equipment	3/2/2002	$15,000
2002 Spawning Gravel Enhancement	East Bay Municipal Utility District	Install supplemental spawning gravel	9/3/2002	$24,685
Distribution, Abundance, and Habitat Association of Swainson's Hawks	San Joaquin County Resource Conservation District	Collect data for developing information to use raptors as ecosystem health indicator	12/9/2002	$15,965
2003 Spawning Gravel Enhancement	East Bay Municipal Utility District	Install supplemental spawning gravel	10/10/2003	$28,074
2004 Spawning Gravel Enhancement	East Bay Municipal Utility District	Install supplemental spawning gravel	9/17/2004	$29,324
Mokelumne River Day Use Area Restoration	East Bay Municipal Utility District	Wildlife habitat restoration	10/29/2004	$34,720
Riparian Area Restoration and Enhancement	San Joaquin County Resource Conservation District	Riparian restoration and invasive species removal	3/20/2005	$33,181
2003-2005 Enhanced Enforcement	California Department of Fish and Game	Increased warden surveillance	4/29/2005	$25,933
Salmonid Rearing Habitat Improvement	East Bay Municipal Utility District	Reestablishment of side channel habitat	9/29/2005	$93,600
2006 Watershed Open House	San Joaquin County Resource Conservation District	Sponsor SJRCD watershed open house event	3/31/2006	$500
2006 Spawning Gravel Enhancement	East Bay Municipal Utility District	Install supplemental spawning gravel	9/30/2006	$84,813
2006 Spawning Gravel Enhancement	East Bay Municipal Utility District	Install supplemental spawning gravel	11/7/2006	$28,797

Table 7. Approved Partnership Fund Projects (continued).

PROJECT	SPONSOR	DESCRIPTION	COMPLETED	FUNDING
Lower Mokelumne River Watershed Coordinator	San Joaquin County Resource Conservation District	Cash match for Dept of Conservation Watershed Coordinator Grant	7/15/2007	$30,000
Cosumnes-Mokelumne River Floodplain Resource Management	Southeast Sacramento County Agricultural Water Authority	Feasibility study of ecosystem restoration/flood hazard reduction	12/31/2007	$50,000
Large Woody Material	University of California, Davis	Develop large woody material budget for LMR	4/1/2008	$25,663
Gil Creek Riparian Improvement	Gil Creek Landowners	Riparian improvement on private land along Gil Creek	Ongoing	$11,191
Calvary Bible Church Riparian Restoration	Calvary Bible Church	Riparian restoration along LMR on church property	Ongoing	$21,408
Hoffman Riparian Restoration	Center for Land Based Learning	Riparian restoration on the Hoffman Farm	Ongoing	$14,988
2008-2010 Watershed Coordinator	San Joaquin County Resource Conservation District	Cash match for Dept of Conservation Watershed Coordinator Grant	Ongoing	$30,000
Watershed Education and Riparian Restoration	San Joaquin County Resource Conservation District	Cash match for Dept of Water Resources CALFED grant	Ongoing	$60,000
Invasive Species Removal - Murphy Creek	Murphy Creek Landowners	Removal of invasive species from Murphy Ck restoration site	Ongoing	$47,212
Steelhead Acoustic Telemetry Study	East Bay Municipal Utility District	Purchase acoustic tags for steelhead acoustic telemetry study	Ongoing	$35,000

The following table summarizes the accomplishments of JSA implementation as defined by the goals, measures, and performance criteria of the WQRMP. The measures and performance criteria were developed by the Partnership Steering Committee as a means to define specific methods to implement the goals of the JSA. The status of the performance criteria during the ten years since JSA implementation suggests that significant progress has been made towards the Partnership goals and that numerous successes and milestones have been achieved.

Goal: Provide, to the extent feasible, habitat quality and availability in the lower Mokelumne River to maintain fishery, wildlife and riparian resources in good condition

Measure	Performance Criterion	Status
Maintain water temperatures in the lower Mokelumne River to meet the life-history needs of aquatic organisms.	Use best efforts to maintain a minimum of 28,000 acre-feet of hypolimnetic volume (the volume of water colder than 16.4° C as determined by weekly hydro-lab at CAMD) in Camanche Reservoir through October whenever Pardee Reservoir total volume is in excess of 100,000 acre-feet.	Using best efforts, EBMUD managed the hypolimnetic volume in Camanche Reservoir so that at the end of October the volume has exceeded 28,000 acre-feet in every year except 2003 . The Mokelumne River watershed received uncharacteristically high precipitation in April and May 2003 and high flood control releases were required which diminished the cold-water pool during 2003 to 16,700 acre-feet. There was no significant difference in the number of juvenile outmigrating chinook salmon in spring 2004 (0.018/spawning adult) compared to the previous year (0.015/spawning adult) when the hypolimnetic volume was 63,500 acre-feet.
	Operate the upper and lower level outlets in Camanche Reservoir to maintain the best possible release temperatures to meet the life-history needs of aquatic organisms based on EBMUD's operation plan prepared annually in March	EBMUD opens the upper level outlet in Camanche Reservoir after lake turnover and closes the upper outlet when temperatures at Woodbridge Dam reach approximately 18°C to maintain the best possible release temperatures to meet the life-history needs of aquatic organisms
Maintain dissolved oxygen levels and reduce hydrogen sulfide levels in the Camanche Reservoir hypolimnion	Operate the Hypolimnetic Oxygenation System when dissolved oxygen levels in the Camanche Reservoir hypolimnion drop to 2 ppm (as measured at CAMC) during the period May through October	EBMUD operates the Hypolimnetic Oxygenation System (HOS) in Camanche Reservoir to maintain dissolved oxygen levels to prevent the formation of hydrogen sulfide. Since 1998 the system has operated typically from July/August through mid-November (108-143 days) and no hydrogen sulfide has developed.

Goal: Provide, to the extent feasible, habitat quality and availability in the lower Mokelumne River to maintain fishery, wildlife and riparian resources in good condition

Measure	Performance Criterion	Status
Increase summer and fall base flows in the lower Mokelumne River by developing new water supplies	Increase instream flows beyond the flows specified in Attachment 1 of the Agreement by an amount equal to 20% of the actual yield (up to 20,000 acre-feet) of additional water supplies developed by EBMUD from new facilities. Said gainsharing water shall be available in accord with Section F.2 of the Agreement	To date no additional water supplies have been developed by EBMUD. The Freeport Regional Water Project is a joint venture of the Sacramento County Water Agency and East Bay Municipal Utility District of Oakland to supply water from the Sacramento River to customers in Sacramento County and the East Bay. When operational in 2010, EBMUD will use up to 100 million gallons per day of water during dry years only as a supplemental water source to complement existing conservation programs.
Improve opportunities for the lower Mokelumne River from Camanche Dam downstream to the San Joaquin River to seasonally inundate the floodplain	Examine how revisions to the flood control requirements of the U.S. Army Corps of Engineers and the pattern of the flood flow releases could be modified to support restoration of ecological processes, and not create undue risk of flood damage	The existing agreement between the U.S. Army Corps of Engineers committed EBMUD to provide up to 200,000 acre-feet of flood space in Camanche and Pardee Reservoirs. Prior to the agreement, Mokelumne River flow records showed that True Natural Flow (TNF) had exceeded 100 Thousand Acre Feet (TAF) in every month from November through June, with TNF as high as 270 TAF in November. Since the agreement was signed, even greater runoff has occurred. To date, TNF has exceeded 220 TAF in every month from November through July. The Intergovernmental Panel on Climate Change projects a global temperature increase from 1990-2100. Precipitation is also expected to increase over the 21st century, particularly at northern mid-high latitudes. Based on this information, revisions to the flood control requirements of the U.S. Army Corps of Engineers at Camanche and Pardee reservoirs may change at some point to reflect changing climate conditions.

Goal: Provide, to the extent feasible, habitat quality and availability in the lower Mokelumne River to maintain fishery, wildlife and riparian resources in good condition

Measure	Performance Criterion	Status
Improve opportunities for the lower Mokelumne River from Camanche Dam downstream to the San Joaquin River to seasonally inundate the floodplain	Conduct a feasibility study to identify activities to minimize flood-related damage and improve flood plain habitats and processes. Activities considered for implementation will be those that respect private property rights, protect water rights and maintain economic viability of land owners and water users. The activities will be identified through a cooperative planning effort that will include landowners, local governments, land and water users, and interested public	Funded by the California Bay-Delta Authority ($1,007,800), EBMUD Partnership Fund ($50,000), Sacramento Area Flood Control Agency ($50,000) and Sacramento County Water Agency ($50,000) and with the Southeast Sacramento County Agricultural Water Authority as the lead agency, the feasibility study developed an Integrated Resource Management Plan (2007) to guide implementation of prioritized management actions to enhance floodplains and riparian habitat, flood management, and groundwater recharge. Additional study partners included The Nature Conservancy, University of California, Davis, San Joaquin County Resource Conservation District, and Reclamation District 800.

Goal: Provide, to the extent feasible, habitat quality and availability in the lower Mokelumne River to maintain fishery, wildlife and riparian resources in good condition

Measure	Performance Criterion	Status
Improve opportunities for the lower Mokelumne River from Camanche Dam downstream to the San Joaquin River to seasonally inundate the floodplain	Modify the minimum flow regime, in accord with Section F.1 of the Agreement, to optimize the conditions for ecosystem values provided the total quantity of water released in any given year will not be less than the quantity of water provided by the flow requirements specified in Attachment 1 of the Agreement	Minimum flow modification occurred in March 2004, when Woodbridge Irrigation District (WID) requested EBMUD delay planned April flow increases required by the JSA and release the deferred water in May to allow completion of the fish bypass pipeline component of their dam construction. The California Department of Fish and Game, U.S. Fish and Wildlife Service, NOAA Fisheries, and State Water Resources Control Board concurred and Camanche release was maintained at 330 cfs until mid-April, when WID completed the portion of the work that would be impacted by a higher release rate. The release increased to 515 cfs by the end of April as WID initiated their seasonal diversions. The deferred volume originally scheduled to be released during April was released in addition to JSA requirements in May to coincide with outmigration of juvenile Chinook salmon and the volitional release of juvenile Chinook salmon from the Mokelumne River Fish Hatchery.
Maintain and enhance high quality habitat conditions for terrestrial riparian communities and shaded riverine aquatic habitat	Identify and map the aquatic and terrestrial components of the riparian system from Camanche Dam downstream to tidewater and cooperate with others to identify and map these components downstream to the San Joaquin River	Aquatic habitat in the lower Mokelumne River from Camanche Dam downstream to the San Joaquin River was mapped using aerial photographs and global positioning system equipment (Merz and Setka 2004a). Terrestrial vegetation communities adjacent to the lower Mokelumne River from Camanche Dam downstream to the confluence of the San Joaquin River were classified and mapped using aerial photographs (Reeves and Jones 2004a).

Goal: Provide, to the extent feasible, habitat quality and availability in the lower Mokelumne River to maintain fishery, wildlife and riparian resources in good condition

Measure	Performance Criterion	Status
Maintain and enhance high quality habitat conditions for terrestrial riparian communities and shaded riverine aquatic habitat	Continue monitoring invertebrates, fish, amphibian, reptile, mammal, raptor and neotropical bird communities in the lower Mokelumne River from Camanche Dam downstream to tidewater and cooperate with others to monitor these communities downstream to the San Joaquin River.	Surveys were conducted for invertebrates (Ochikubo-Chan 2003), fish (Merz and Saldate 2004), amphibians and reptiles (Workman and Smith 2004), mammals (Reeves and Jones 2004b), raptors (Reeves and Smith 2004), and neotropical birds (Smith 2004).
	Develop a cooperative program with local interests to improve land management and livestock grazing practices along riparian zones to reduce streambank erosion and fine sediment input	Over $400,000 has been contributed by the Partnership Fund, AFRP, and California Bay-Delta Authority to fund 8 projects that incorporated fencing, streambank protection and riparian vegetation restoration along the lower Mokelumne River. Cooperative efforts on Murphy Creek resulted in the removal of a dam, restoration of riparian habitat and control of livestock grazing (fencing).
Reduce the adverse effects of invasive riparian plants on native species and ecosystem processes	Develop and implement a coordinated control program to reduce or eliminate invasive plant species from the riparian corridor along the lower Mokelumne River	Reeves and Jones (2004c) identified the extent of non-native invasive plant species in the lower Mokelumne River corridor, provided control measures and listed the ongoing management programs designed to reduce or eliminate invasive plant species in the area. The Lower Mokelumne River Watershed Stewardship Plan and the Lower Mokelumne River Conservation Handbook include recommendations to reduce invasive plant species along the lower Mokelumne River. In 2007, the Partnership sponsored removal of Himalayan blackberries in the Murphy Creek watershed.

Goal: Contribute towards the state and federal fishery restoration goals as defined in the California Salmon, Steelhead Trout and Anadromous Fisheries Program Act and the Central Valley Project Improvement Act

Measure	Performance Criterion	Status
Support the assessment of the overall effectiveness of actions implemented pursuant to the Central Valley Project Improvement Act in meeting Anadromous Fisheries Restoration Program production targets	Continue the daily enumeration of migrating adult chinook salmon and steelhead by video monitoring and trapping at Woodbridge Dam (or other appropriate methods). The enumeration begins in August and continues through March	EBMUD has monitored daily migration (escapement) of adult chinook salmon and steelhead at the fish ladders at Woodbridge Irrigation District Dam since 1990. Monitoring is currently conducted by video monitoring and carcass surveys. Data are stored in EBMUD's Oracle database and periodically submitted to the California Department of Water Resources Interagency Ecological Program (I.E.P.) database.
	Continue conducting weekly redd surveys in the lower Mokelumne River between Camanche Dam and the Elliott Road bridge from October through April	Systematic salmonid redd surveys have been conducted in the lower Mokelumne River since 1990. From September through December, surveys are conducted weekly, with bi-weekly surveys for the remainder of the season. The river is surveyed from the base of Camanche Dam to Elliott Road, with three individuals walking abreast down the river (water depths to 1.2 m) and searching for signs of redd construction (Setka 2004). Redd locations are recorded using a hand-held Global Positioning System (GPS) unit. Location of each redd is downloaded from the GPS unit into a Geographic Information System (GIS).

Goal: Contribute towards the state and federal fishery restoration goals as defined in the California Salmon, Steelhead Trout and Anadromous Fisheries Program Act and the Central Valley Project Improvement Act

Measure	Performance Criterion	Status
Support the assessment of the relative effectiveness of water management modifications, structural modifications, habitat restoration and fish screen installations to meet Anadromous Fisheries Restoration Program targets	Continue estimating the emigration of juvenile chinook salmon and steelhead by trapping at Woodbridge Dam and operation of the rotary screw traps below Woodbridge Dam (or other appropriate methods) and marking a portion of the natural outmigrants. The trapping begins in December and continues through July	EBMUD has monitored daily emigration of juvenile chinook salmon and steelhead at Woodbridge Irrigation District Dam since 1990. Monitoring is currently conducted by rotary screw trap(s) and trapping in the fish bypass system (when WID is diverting). Data are stored in EBMUD's Oracle database and periodically submitted to the California Department of Water Resources Interagency Ecological Program (I.E.P.) database. EBMUD has marked (coded-wire tag) over 230,000 juvenile fall-run Chinook salmon since 1994.
	Continue monitoring CAMC and CAMD in Camanche Reservoir to measure temperature, pH, dissolved oxygen, conductivity, oxidation-reduction potential, and turbidity. In addition, collect monthly water quality samples at CAMC and CAMD to analyze for volatile suspended solids (VSS), total suspended solids (TSS), nutrients (total and dissolved phosphorus and nitrogen), chlorophyll (corrected and uncorrected for phaeopigments), and phytoplankton and zooplankton abundance and taxonomic composition (to genus)	Monitoring of temperature, pH, dissolved oxygen, conductivity, oxidation-reduction potential, turbidity, volatile suspended solids (VSS), total suspended solids (TSS), nutrients (total and dissolved phosphorus and nitrogen), chlorophyll (corrected and uncorrected for phaeopigments), and phytoplankton and zooplankton abundance and taxonomic composition (to genus) at CAMC and CAMD was performed from December 1999 through May 2005. Based on the six-year review of the data collected, it was determined by the Partnership that this monitoring would be modified. Since May 2005 EBMUD has collected and analyzed monthly samples of temperature, pH, dissolved oxygen, conductivity and oxidation-reduction potential at CAMC and CAMD.

Goal: Contribute towards the state and federal fishery restoration goals as defined in the California Salmon, Steelhead Trout and Anadromous Fisheries Program Act and the Central Valley Project Improvement Act

Measure	Performance Criterion	Status
Support the assessment of the relative effectiveness of water management modifications, structural modifications, habitat restoration and fish screen installations to meet Anadromous Fisheries Restoration Program targets	Collect monthly water quality samples in the lower Mokelumne River at the Elliott Road Bridge to analyze for VSS, TSS, nutrients (total and dissolved phosphorus and nitrogen), chlorophyll (corrected and uncorrected for phaeopigments), and phytoplankton and zooplankton abundance and taxonomic composition (to genus). In addition, the samples are analyzed for hardness, Al, Cd, Cr, Cu, Fe, Ni, Pb, Zn, Hg, Ti, pH and turbidity	Monitoring of VSS, TSS, nutrients (total and dissolved phosphorus and nitrogen), chlorophyll (corrected and uncorrected for phaeopigments), and phytoplankton and zooplankton abundance and taxonomic composition (to genus), hardness, Al, Cd, Cr, Cu, Fe, Ni, Pb, Zn, Hg, Ti, pH and turbidity at the Elliott Road Bridge was performed from December 1999 through May 2005. Based on the six-year review of the data collected, it was determined by the Partnership that monitoring hardness, Cd, Cu, and Zn at the Elliott Road Bridge would continue and monitoring the other constituents would be discontinued.
	Collect monthly water quality samples at CAMA and PENN20 in Camanche Reservoir to analyze for TSS, hardness, Al, Cd, Cr, Cu, Fe, Ni, Pb, Zn, Hg, Ti, pH, and turbidity	Monitoring of TSS, hardness, Al, Cd, Cr, Cu, Fe, Ni, Pb, Zn, Hg, Ti, pH, and turbidity at CAMA and PENN20 was performed from December 1999 through May 2005. Based on the six-year review of the data collected, it was determined by the Partnership that monitoring hardness, Cd, Cu, and Zn would continue at PENN20 and monitoring the other constituents would be discontinued.
Maintain processes that provide for adequate sediment supply, channel meandering, and other fluvial geomorphologic attributes	When river flows allow it, provide average annual supplementation of approximately 1,200 cubic yards of suitably sized spawning gravel in the active stream channel to maintain and enhance spawning areas and to replace gravel that is transported downstream	Since fall 1998, EBMUD has placed 27,000 yds^3 of spawning gravel in the lower Mokelumne River. In addition, the Partnership restored two side channels to provide rearing habitat for salmonids adjacent to the spawning area below Camanche Dam.

Goal: Contribute towards the state and federal fishery restoration goals as defined in the California Salmon, Steelhead Trout and Anadromous Fisheries Program Act and the Central Valley Project Improvement Act

Measure	Performance Criterion	Status
Maintain processes that provide for adequate sediment supply, channel meandering, and other fluvial geomorphologic attributes	Continue monitoring spawning reach substrate characteristics, including channel configuration and gradient; substrate size; intergravel permeability, dissolved oxygen content, and temperature; and macroinvertebrate community structure (composition and abundance)	The extensive monitoring of salmonid substrate characteristics in the lower Mokelumne River that has been conducted (Merz 2004a, 2004b, Merz and Setka 2004c, Merz et al. 2004, Ochikubo-Chan 2003, Pasternak et al. 2004, Wheaton 2003, and Wheaton et al. 2004a, 2004b) demonstrated the substantial benefits of annual supplementation of spawning gravel in the active stream channel of the lower Mokelumne River.
Reduce entrainment of juvenile fish into water diversions to increase survival and contribute to restoration goals	Work cooperatively with the Woodbridge Irrigation District to install state-of-the-art fish screens and fish bypass system at Woodbridge Dam	EBMUD has worked cooperatively with the Woodbridge Irrigation District (WID) since 1998 to support WID's Lower Mokelumne River Restoration Program to improve fish passage at WID dam while maintaining WID's access to its water rights. In 2004-05, WID constructed a new bypass pipeline to transport fish migrating downstream from the existing fish screen to a location below the dam, and a smolt trap in the bypass pipeline. In addition, a new fish screen at the Woodbridge canal is currently under construction to meet Department of Fish and Game and NOAA Fisheries Service criteria. The new flat-plate "V"-shaped fish screen, head-gate structure, and enlarged bypass system will replace the existing diversion and will be complete in 2008.

Goal: Contribute towards the state and federal fishery restoration goals as defined in the California Salmon, Steelhead Trout and Anadromous Fisheries Program Act and the Central Valley Project Improvement Act

Measure	Performance Criterion	Status
Reduce entrainment of juvenile fish into water diversions to increase survival and contribute to restoration goals	Work cooperatively with riparian diverters to install state-of-the-art fish screens where appropriate in the lower Mokelumne River between Camanche Dam and the San Joaquin River	EBMUD completed a preliminary assessment of riparian diverters that indicates 62 riparian diverters from Camanche Dam downstream to river mile 10. Most of these diversions provide agricultural water diversion during the late spring, summer, and early fall and divert from 0.4 to 10.0 cfs. It is estimated that the intake velocities of these diversions range from 2.5 to 12 ft/sec when operating at full capacity. EBMUD provided a prioritized list of riparian diversions that could be screened to USFWS (AFRP) in 2007.
	Work cooperatively with the North San Joaquin Conservation District to evaluate the installation of permanent fish screens on their diversions	The North San Joaquin Conservation District diversions are currently under review by the State Water Resources Control Board.
Manage flow releases to prevent stranding of juvenile fish and exposure of redds	Except in case of emergencies or when flood control releases are being made, average daily flow releases from Camanche Dam will not decrease by more than 50 cfs per day during the period October 16 through March 31, and by not more than 100 cfs per day at other times of the year	Except in emergencies or when flood control releases were being made, daily flow releases from Camanche Dam have not decreased by more than 50 cfs per day during the period October 16 through March 31, and by not more than 100 cfs per day at other times of the year since 1999.

Goal: Contribute towards the state and federal fishery restoration goals as defined in the California Salmon, Steelhead Trout and Anadromous Fisheries Program Act and the Central Valley Project Improvement Act

Measure	Performance Criterion	Status
Improve anadromous fish passage at dams and diversions below Camanche Dam	Work cooperatively with the Woodbridge Irrigation District to improve fish passage at Woodbridge Dam	EBMUD has worked cooperatively with the Woodbridge Irrigation District (WID) since 1998 to support WID's Lower Mokelumne River Restoration Program to improve fish passage at WID dam while maintaining WID's access to its water rights. In 2004-05, WID replaced the existing Dam with a new adjustable weir dam immediately upstream. The new dam utilizes remotely operable Obermeyer gates, a downstream hydraulic control system to manage tailwater elevations at the entrances to the fish ladders, and a gated low-level outlet system. State-of-the-art fish passage facilities were also constructed at Woodbridge Dam, with improved design to attract fish to the ladder, fish ladders that operate when water levels in the lake are both high and low, and a fish-counting station and viewing area. Improvements to downstream fish-passage facilities included construction of a new bypass pipeline to transport fish migrating downstream from the existing fish screen to a location below the dam, and a smolt trap in the bypass pipeline.
	Work cooperatively with the Woodbridge Irrigation District and the City of Lodi to isolate the City of Lodi's Lake Lodi to improve salmon and steelhead passage and juvenile fish survival.	The predator isolation berm to isolate the City of Lodi's Lake Lodi was removed from the Woodbridge Irrigation District's Lower Mokelumne River Restoration Project due to a lack of data to justify its inclusion.

Goal: Contribute towards the state and federal fishery restoration goals as defined in the California Salmon, Steelhead Trout and Anadromous Fisheries Program Act and the Central Valley Project Improvement Act

Measure	Performance Criterion	Status
Reduce the loss of juvenile anadromous fish caused by hydraulic conditions created by man-made structures within or directly adjacent to the lower Mokelumne River	Modify and improve the fish bypass at the Woodbridge canal	In 2004-05, WID constructed improvements to downstream fish-passage facilities included construction of an 1,800 ft. long, 30-in diameter bypass pipeline to transport fish migrating downstream from the existing fish screen to a location below the dam, and a smolt trap in the bypass pipeline.
	Reduce the impact of predators on juvenile salmonids below Woodbridge Dam by modifying the stream channel below the dam and/or implementing a controlled recreational fishery	Woodbridge Irrigation District implemented predator-control measures below Woodbridge Dam to reduce predation on downstream-migrating smolts by regrading the riverbed below the dam to make the area less hospitable to predators and modifying the tailwater portion of the dam to help reduce the formation of a "hole" in the riverbed that would provide favorable habitat for predators.
	Construct a fish barrier separating recreational Lodi Lake from the river reach seasonally impounded behind Woodbridge Dam	The predator isolation berm to isolate the City of Lodi's Lake Lodi was removed from the Woodbridge Irrigation District's Lower Mokelumne River Restoration Project due to a lack of data to justify its inclusion.

Goal: Sustain the long-term viability of the salmon and steelhead fishery while protecting the genetic diversity of naturally producing populations in the lower Mokelumne River

Measure	Performance Criterion	Status
Continue operation of the Mokelumne River Fish Hatchery to meet the mitigation requirements to supplement natural production and sustain a viable commercial and recreational fishery	Reconstruct the hatchery in accordance with the 1996 Hatchery Master Plan and the final design in consultation with CDFG, USFWS and NMFS	The hatchery was reconstructed in accordance with the 1996 Hatchery Master Plan and the final design in consultation with CDFG, USFWS and NMFS. Reconstruction was completed in 2002.
	Operate the hatchery in accord with CDFG Best Management Practices	CDFG and EBMUD completed a new operation and maintenance agreement for the Mokelumne River Fish Hatchery in 2004. The new agreement clarifies and incorporates each party's roles and responsibilities into a single document (replacing several out-dated and obsolete agreements between the District and CDFG) and provides funding for operations and maintenance at the expanded hatchery. It will also ensure that operation of the hatchery meets EBMUD's Mokelumne River fishery mitigation requirements (for the Camanche Project) and provisions of the 1998 Mokelumne River Joint Settlement Agreement (JSA). Key elements of the new operations agreement include producing an annual report summarizing the adult salmon and steelhead returns, number of juvenile fish produced, the incidence of any diseases, water quality data, fish tagging and marking operations, and the number of visitors to the fish hatchery; and, developing an Annual Operations Plan that specifies the number of fish to be spawned, egg take goal, timing and release location of hatchery production, water quality monitoring, and operation of the fish ladder.

Goal: Sustain the long-term viability of the salmon and steelhead fishery while protecting the genetic diversity of naturally producing populations in the lower Mokelumne River

Measure	Performance Criterion	Status
Continue operation of the Mokelumne River Fish Hatchery to meet the mitigation requirements to supplement natural production and sustain a viable commercial and recreational fishery	Implement a protocol that will ensure notification of the parties of any abnormal losses and remedial actions taken	A protocol has been established to ensure notification of the parties of any abnormal losses and remedial actions taken at the Mokelumne River Fish Hatchery
	Monitor temperature, pH, dissolved oxygen, conductivity, oxidation-reduction potential, total and volitile suspended solids, total and dissolved phosphorous and nitrogen, and turbidity of the Mokelumne River Fish Hatchery water supply and effluent	Monitoring of temperature, pH, dissolved oxygen, conductivity, oxidation-reduction potential, total and volatile suspended solids, total and dissolved phosphorous and nitrogen, and turbidity at the Mokelumne River Fish Hatchery water supply and effluent was performed from December 1999 through May 2005. Based on the six-year review of the data collected, it was determined by the Partnership that monitoring temperature, pH, dissolved oxygen, conductivity, and oxidation-reduction potential of the Mokelumne River Fish Hatchery water supply and effluent would continue and monitoring the other constituents would be discontinued
	Operate the hatchery to provide the flexibility necessary to conduct focussed research to better integrate hatchery management practices with natural production	EBMUD has recommended that the Mokelumne River Fish Hatchery manager annually monitor the progress of the egg take and periodically during the run, determine the relationship between the projected egg take number, spawning guidelines established to ensure representation of the entire run, and the Goals and Constraints egg take target. If the projected number exceeds the target, the manager should, in order, (1) close the ladder on an interim basis, (2) return green fish to the river, or (3) truncate each egg lot by the percent exceeded

Goal: Sustain the long-term viability of the salmon and steelhead fishery while protecting the genetic diversity of naturally producing populations in the lower Mokelumne River

Measure	Performance Criterion	Status
Employ methods to limit straying of hatchery-produced fish and the possible reduction of the genetic integrity of naturally produced fish	Develop a cooperative program to evaluate the benefits of changing release locations in the Mokelumne River of salmon and steelhead produced at the Mokelumne River Fish Hatchery	EBMUD analyzed the efficacy of using coded-wire tags to evaluate various fall-run Chinook salmon hatchery release strategies such as changing release locations. Replicate groups of coded wire tagged (CWT) hatchery produced juvenile fall-run Chinook salmon were released in the lower Mokelumne River for nine years to evaluate relative survival and contribution to the ocean fishery from various release strategies. CWT recoveries for inland locations are incomplete to date. However, the recovery data associated with replicate experimental group recoveries in the ocean harvest suggests that CWT experiments lack the precision necessary to perform two-sample proportion comparison tests that would support hatchery management decisions such as changing release locations (Workman et al, 2005).
	Develop a plan to reduce the importation of eggs and fry from other hatcheries	The California Department of Fish and Game is working with NOAA Fisheries to develop a protocol for importation of eggs and fry from other hatcheries.

Goal: Sustain the long-term viability of the salmon and steelhead fishery while protecting the genetic diversity of naturally producing populations in the lower Mokelumne River

Measure	Performance Criterion	Status
Employ methods to limit straying of hatchery-produced fish and the possible reduction of the genetic integrity of naturally produced fish	Continue coded-wire tagging representative lots of chinook salmon released from the Mokelumne River Fish Hatchery and expand or modify the program if a statewide strategy is developed to constant fractional mark or coded-wire tag all salmon released from California fish hatcheries in cooperation with commercial salmon trawlers, the Resource Agencies and the California Fish and Game Commission	Over 5 million hatchery-produced fall-run Chinook salmon have been coded-wire tagged by EBMUD and released from the Mokelumne River Fish Hatchery since brood year 1992. In 2006, CALFED funded implementation of the Central Valley Constant Fractional Marking (CFM) program for marking/tagging production releases of fall-run Chinook salmon. The program is a cooperative effort of the California Department of Fish and Game, California Department of Water Resources, U.S. Fish and Wildlife Service, Pacific States Marine Fisheries Commission, U.S. Bureau of Reclamation and EBMUD. In spring 2007, 1,547,575 (24.98% of total production) fall-run Chinook salmon produced at the Mokelumne River Fish Hatchery were tagged and released.
	Develop a cooperative plan to reduce impacts of imported fish released in Camanche and Pardee reservoirs	Since 2005 EBMUD requires planting non-viable rainbow trout in Camanche Reservoir. CDFG continues to plant viable rainbow trout in Camanche Reservoir.
Develop harvest management strategies that allow naturally produced fish to increase their reproductive potential	Implement enforcement efforts to reduce or eliminate illegal salmon and steelhead harvest in the lower Mokelumne River	The Partnership funded $15,000 in FY01, $15,000 in FY03 and $10,933 in FY04 for increased CDFG enforcement patrols in the lower Mokelumne River. CDFG policy precluded expenditures of overtime enforcement in FY05. EBMUD also funds ($45K annually) enforcement efforts for watershed rules/regulations at the Mokelumne River Day Use Area

Goal: Sustain the long-term viability of the salmon and steelhead fishery while protecting the genetic diversity of naturally producing populations in the lower Mokelumne River

Measure	Performance Criterion	Status
Develop harvest management strategies that allow naturally produced fish to increase their reproductive potential	Mark and tag all hatchery-produced steelhead and establish a selective fishery in the lower Mokelumne River	Since 1998 CDFG is required to and does mark (adipose fin clip) all hatchery-produced steelhead.

3.0 RECOMMENDATIONS

Based on the review of the JSA flow and non-flow measures implemented since 1998 as described in the Water Quality and Resource Management Program (WQRMP), the Partnership Steering committee recommends implementing the following strategies and measures, designed to make significant progress towards meeting the JSA goals and measuring progress:

Strategy 1.0

Operate Camanche and Pardee reservoirs to maintain best available water temperatures in the lower Mokelumne River for salmonid spawning, incubation, rearing and over-summering based on temperature model simulations and water availability.

Measures

1.1 Develop an integrated reservoir/stream network temperature simulation model for the Mokelumne River to predict temporal water temperatures in the lower Mokelumne River.

1.2 Operate Camanche and Pardee reservoirs to maintain the best available water temperatures for all salmonid life stages in the lower Mokelumne River based on temperature model simulations and water availability.

Strategy 2.0

Provide flows in the lower Mokelumne River to enhance natural production of Chinook salmon and steelhead based on life history stage needs and water availability

Measures

2.1 Operate the Lower Mokelumne River Project in accordance with the flow requirements specified in Attachment 1 of the JSA.

2.2 Increase instream flows beyond the flows specified in Attachment 1 of the JSA by an amount equal to 20% of the actual yield (up to 20,000 acre-feet) of additional water supplies developed by EBMUD from new facilities. Said gainsharing water shall be available in accord with Section F.2 of the JSA.

Strategy 3.0

Replenish gravel suitable for salmonid spawning habitat.

Measure

3.1 Provide annual spawning gravel supplementation using the Spawning Habitat Integrated Rehabilitation Approach (SHIRA) developed by the University of California, Davis and EBMUD.

Strategy 4.0

Enhance and maintain the riparian corridor to improve streambank and channel rearing habitat for juvenile salmonids.

Measures

4.1 Work cooperatively with local landowners along the lower Mokelumne River to implement the conservation practices and restoration and enhancement projects identified in the San Joaquin County Resource Conservation District's Lower Mokelumne River Conservation Handbook.

4.2 Implement the Mokelumne River Day Use Area Recreation and Resource Management Plan as funding becomes available.

Strategy 5.0

Operate the Mokelumne River Fish Hatchery to maintain the genetic characteristics of the local, natural populations of fall-run Chinook salmon and California Central Valley steelhead and reduce the genetic risks that hatchery-origin fish may pose to naturally spawning populations.

Measures

5.1 Develop and implement a Hatchery and Genetics Management Plan for California Central Valley Steelhead and Fall-run Chinook salmon in cooperation with NOAA Fisheries.

5.2 Continue the Central Valley Constant Fractional Marking (CFM) program at the Mokelumne River Fish Hatchery.

Strategy 6.0

Evaluate the effects of the measures on Chinook salmon and steelhead in the lower Mokelumne River.

Measures

6.1 Continue the annual estimate of Chinook salmon and steelhead escapement by video monitoring at Woodbridge Dam, carcass surveys, or other appropriate methods.

6.2 Continue annual Chinook salmon and steelhead redd surveys in the lower Mokelumne River between Camanche Dam and the Elliott Road bridge.

6.3 Continue the annual estimate of juvenile Chinook salmon and steelhead outmigration by operation of the rotary screw traps or other appropriate methods.

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APPENDIX A

CHINOOK SALMON TRAP AND TRUCK PROGRAM: 1998-2007

Introduction

The Lower Mokelumne River Joint Settlement Agreement (JSA) parties agree that a trap and truck program could have some benefit to the fishery resource and recommends that trapping and trucking of anadromous salmonids take place during critical years upon approval of the Partnership Steering Committee. Outmigrating salmon smolts captured at the Woodbridge Irrigation District Dam were trapped and trucked in 2001, 2002 and 2007. Although 2003 was a dry water year type, instream temperatures did not warrant initiation of a trapping and trucking program.

2001 Operations

East Bay Municipal Utility District (EBMUD) operated under a dry water year type for the period of April through September of 2001. The JSA Partnership Coordinating Committee (PCC) developed operational criteria for the trap and truck program at it's April, 2001 meeting (the first dry water year type since JSA implementation). A temperature trigger of >18° C daily mean water temperature at the Frandy gauging station (RKM 46) was agreed upon to initiate trapping and trucking. The temperature trigger of >18° C was met on April 24, 2001. Trapping and trucking of juvenile fall-run Chinook salmon began on April 26, 2001. A transport tank with two 75-gallon compartments equipped with mechanical aerators was used to haul fish. Tanks were filled from the high stage fish ladder at Woodbridge Irrigation District Dam using a submersible pump. Water was treated with Novaqua®, ice made from Mokelumne River water, supplemental O_2, and salt to minimize stress to fish. A recommended concentration of salt for fish transport of a 0.1 to 0.3% salt solution was used in transport (Piper et al 1992). Oxygen levels in transport tanks were initially set at 9.00 ppm to accommodate high oxygen consumption associated with stress. Transport levels were kept at > 7.00 ppm. Each tank was supplied with a 1-gallon container of frozen Mokelumne River water to maintain constant temperatures during transport (Workman 2002a).

Fish were released at Wimpy's Marina, Lighthouse Marina, B&W Resort and Korth's Pirate's Lair. Release site determination was based on appropriate water temperatures, tides, predation activity and human activity at the site. All fish were acclimated to within 1.0° C of release water in the transport tanks by introducing release water into the tanks before release.

Trapping and trucking occurred from April 26, 2001 through July 24, 2001. During this period 56,229 fish were transported and released alive. A 1.2% mortality rate was attributed to handling and transport stress. Release location temperatures varied from within 0.1° C of trapping location to a high of 5.3° C. Average difference between release and trap temperatures was 3.0° C.

The average daily water temperatures at Frandy varied from 17.8 ° C (May 2nd) to 30.9 ° C (July 3rd). Water temperatures at capture (Woodbridge Irrigation District Dam) varied from 16.5 ° C (May 15th, 29th) to 22.8 ° C (July 3rd) and at the release sites from17.7 ° C (May 3rd) to 25.7 ° C (June 21st). There was no correlation between ΔT (° C), release temperatures, capture temperatures, or number of captures and mortalities.

2002 Operations
Although the April through September time period was not designated as a dry water year type, the temperature criteria developed by the PCC was reached in June and trapping and trucking was conducted from July1st through July 14th. The same transport protocols listed above for 2001 operations were again employed. Fish were released at Brannan Island State Park. Release site determination was based on appropriate water temperatures.

During the 2002 trap and truck operation, 577 smolt-sized fall-run Chinook salmon were trapped, and transported, with 575 released alive. The two mortalities were due to handling and transport stress. Release location temperatures were higher than trapping location temperatures by a range of 1.2° C - 3.3° C. Average difference in release and trap temperatures was 2.4° C. All fish were acclimated to within 1.0° C of release site water temperature in the transport tanks by introducing river water into the tanks.

2007 Operations
On April 6, 2007, the PCC agreed to the following revised criterion for trap and truck activities (mean average daily water temperature at Frandy gauge exceeds 24° C during April, May and June). The criterion change was based on recent published literature which indicates salmon growth and survival still occurs at 24° C (Marine and Cech 2004).

The trigger temperature of 24°C at Frandy was reached on June 4, 2007. Trap and truck operations were implemented on July 6, 2007 after approval from the Partnership Steering Committee, and amendment to scientific collector's permits were received on July 5, 2007. Trap and truck operations continued through July 11th at which time the agreed upon trigger to end the effort, < 50 fish per day for a 5 day period, was reached (Workman et al 2008).

During the 2007 operations, 295 fish were transported with 2 mortalities during transport (0.01% mortality rate). The two release locations were Lighthouse Marina and Korth's Pirate's Lair Marina on the Mokelumne River.

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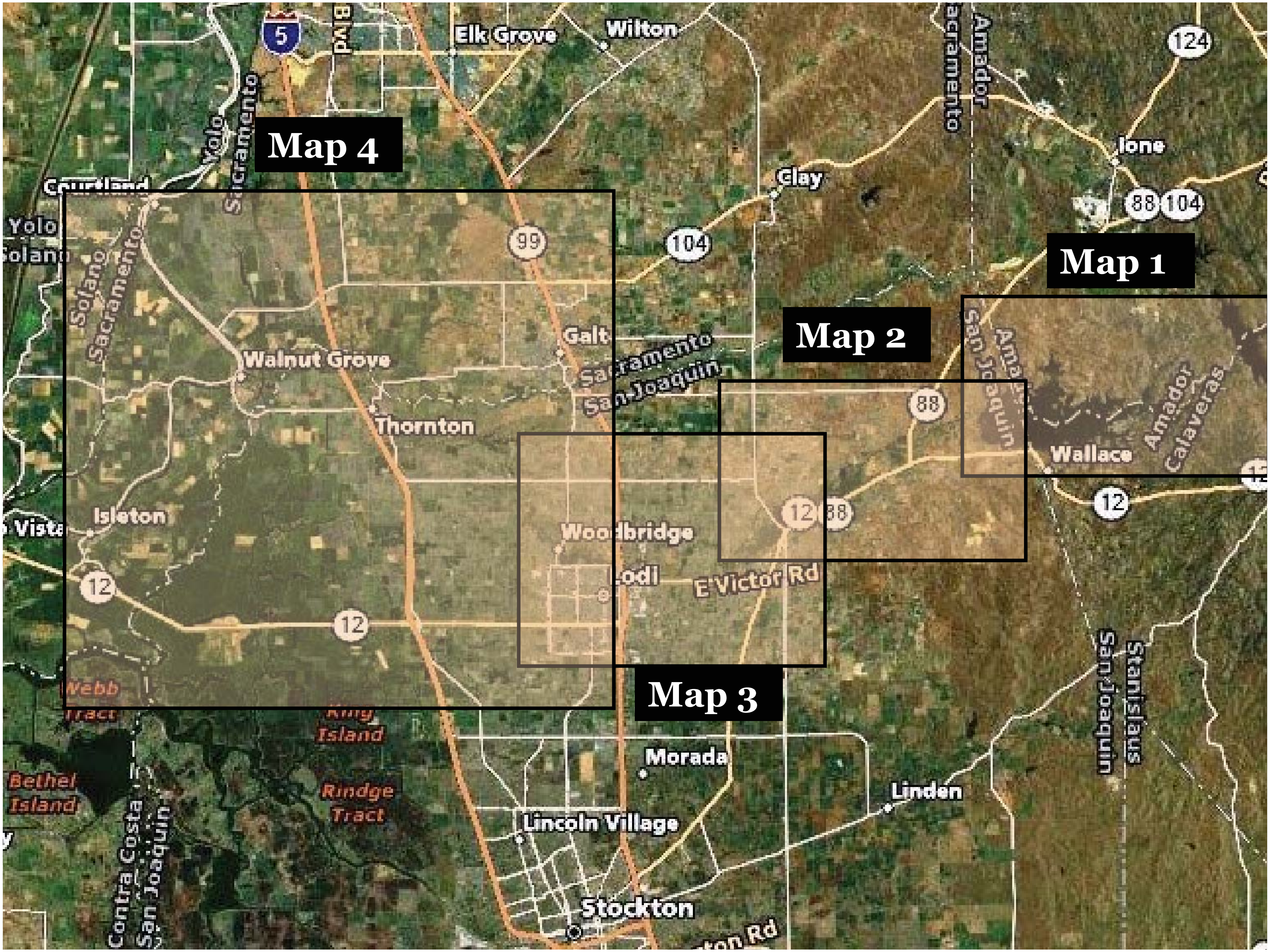
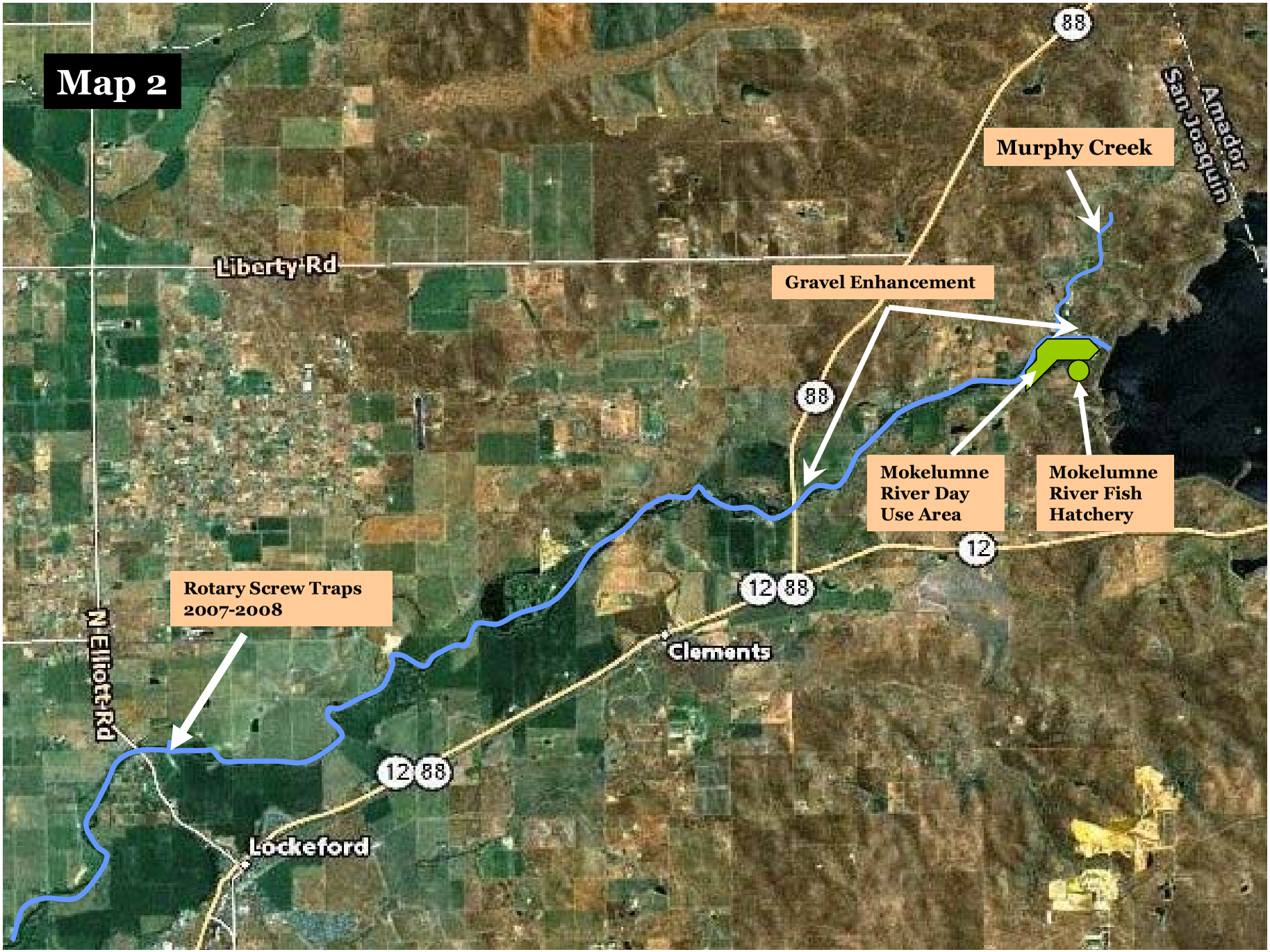
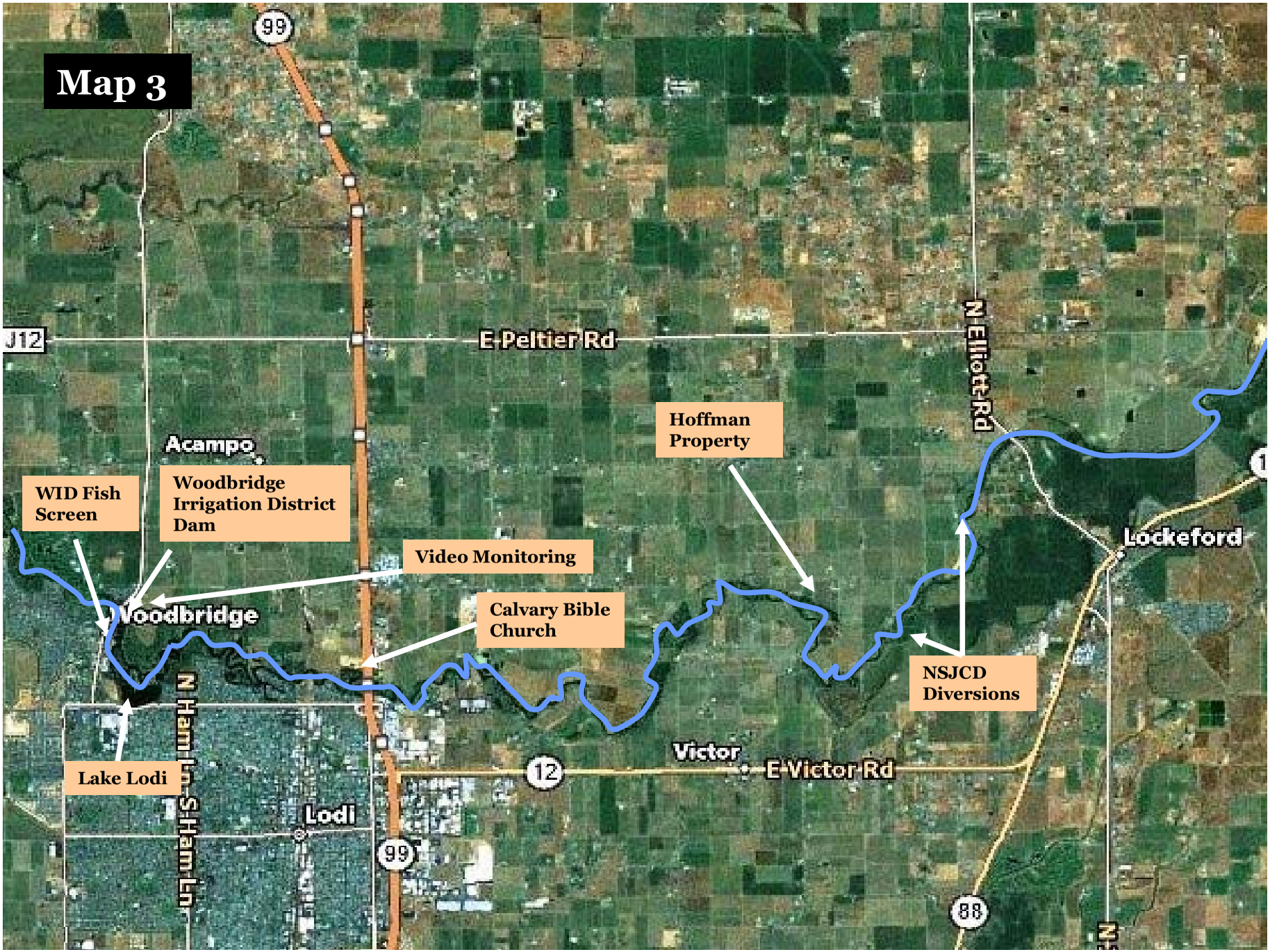

Map 1
Map 2
Map 3
Map 4
Elk Grove
Wilton
Ione
Clay
Amador
Sacramento
Galt
Walnut Grove
Thornton
Isleton
Courtland
Yolo
Solano
Woodbridge
Lodi
E Victor Rd
San Joaquin
Wallace
Calaveras
Stanislaus
Morada
Linden
Lincoln Village
Stockton
Contra Costa
Bethel Island
Rindge Tract
Webb
Island
12
88
99
104
124
5


Map 1
Pardee Reservoir
CAMA
CAMC
HOS
System
PENN20
Camanche Reservoir
CAMD


Map 2
Murphy Creek
Gravel Enhancement
Mokelumne River Day Use Area
Mokelumne River Fish Hatchery
Rotary Screw Traps 2007-2008
Liberty Rd
N Elliott Rd
Clements
Lockeford
88
12
Amador
San Joaquin


Map 3
99
J12
E Peltier Rd
N Elliott Rd
Acampo
WID Fish Screen
Woodbridge Irrigation District Dam
Hoffman Property
Video Monitoring
Calvary Bible Church
Woodbridge
Lockeford
NSJCD Diversions
Lake Lodi
N Ham Ln
S Ham Ln
Victor
E Victor Rd
12
Lodi
99
88


Map 4
Courtland
Paintersville
Sacramento
Vorden
Grand Island
Ryer Island
Solano
Sacramento
Walnut Grove
Andrus Island
Wimpy's Marina
Cosumnes River
Sacramento San Joaquin
Galt
Thornton
Gill Creek
99
220
Walker Landing
Eagle Tree
J8
Frandy Gage
J12
5
Grand Island
160
Tyler Island
Isleton
Acampo
Rotary Screw Traps 1990-2008
Woodbridge
B&W Marina
Lighthouse
Korth's
San Joaquin River Confluence
Terminous
Lodi
12
Bouldin