UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

Modesto Irrigation District	)	**Project No. 2299-065**
Turlock Irrigation District	)	**(New Don Pedro)**

MOTION TO CLARIFY RECORD OF MODESTO AND TURLOCK IRRIGATION DISTRICTS

Pursuant to Rule 212 of the Commission's Rules of Practice and Procedure (18 C.F.R. § 385.212), Modesto and Turlock Irrigation Districts ("Districts"), co-licensees of the New Don Pedro Project No. 199 ("Project"), hereby move to clarify the record in the above-captioned proceeding. The Districts are filing this motion to ensure that the record the Commission will rely upon in acting on the recently-filed requests for rehearing of the Commission's April 3, 2008 *Order On Ten-Year Summary Report Under Article 58* (123 FERC ¶ 62,012) ("Order) accurately reflects the results of -- and the conclusions that can be reasonably drawn from -- the recent studies submitted with and/or referenced in those requests for rehearing. Since this Motion will ensure an accurate record and thus assist the Commission's consideration of the requests for rehearing, the Districts respectfully request that the Commission grant this motion and consider the information contained herein in acting on the requests for rehearing.

DISCUSSION

Requests for rehearing of the Order were filed by: the National Marine Fisheries Service ("NMFS"); the United States Fish and Wildlife Service ("FWS"); the California Department of Fish and Game ("CDFG"); the Conservation Groups ("CGs"); and Friends of the Tuolumne, Inc. ("FOT"). These rehearing requests reference one or more of four recent studies and two prior studies that the authors of the requests for rehearing contend are relevant to

Commission action on the rehearing requests. The studies, and the entities referencing the studies in their requests for rehearing, are as follows:

- Dean Marston; September 2007. San Joaquin Fall-run Chinook salmon and Steelhead Rainbow Trout Historical Population Trend Summary (hereinafter "Marston 2007") (referenced by CDFG);

- Carl Mesick and Dean Marston; July 2007. Relationships between fall-run Chinook salmon recruitment to the major San Joaquin River tributaries and streamflow, Delta exports, the Head of the Old River Barrier, and tributary restoration projects from the early 1980s to 2003 (hereinafter "Mesick and Marston 2007a") (referenced by FWS);

- Carl Mesick and Dean Marston; July 2007. San Joaquin River East-side Tributary Fall-run Chinook Salmon Age Cohort Reconstruction (hereinafter "Mesick and Marston 2007b") (referenced by FWS);

- Carl Mesick; April 30, 2008. The High Risk of Extinction for the Natural Fall-Run Chinook Salmon Population in the Lower Tuolumne River due to Insufficient Instream Flow Releases (hereinafter "Mesick 2008") (referenced by NMFS, FWS, and CGs);

- Ken Newman; March 31, 2008. An evaluation of four Sacramento-San Joaquin River Delta juvenile salmon survival studies (hereinafter "Newman 2008") (referenced by CDFG); and

- Christian Zimmerman, *et al.*; March 6, 2008. Maternal Origin and Migratory History of *Oncorhynchus mykiss* captured in rivers of the Central Valley, California (hereinafter "Zimmerman 2008") (referenced by NMFS, FWS, and FOT);

Copies of Zimmerman 2008 and Mesick 2008 were appended to the requests for rehearing submitted by NMFS and the FWS; copies of Mesick and Marston 2007a and Mesick and Marston 2007b were appended to the FWS' request for rehearing; copies of Marston 2007 and Newman 2008 were appended to CDFG's request for rehearing.

The entities filing the requests for rehearing cite these studies as support for their positions on the status of fishery resources in the Tuolumne River and the actions they want the Commission to take in response to their requests for rehearing. However, as demonstrated in the attached Technical Memorandum prepared by the fishery biologists at Stillwater Sciences on behalf of the Districts that reviews these studies (Exhibit 1 hereto), there are conceptual and methodological errors both in these studies, some of which have been discussed in prior comments by the Districts, and in the conclusions the entities filing the requests for rehearing attempt to draw from those studies in their requests for rehearing. In summary:

- Marston 2007: The analyses in the Marston 2007 report are presented to support the proposition that adult salmon escapement abundance in the Tuolumne River began a sharp decline well before recent coast-wide population declines were attributed to poor ocean conditions. However, the accompanying population trends do not support a statistically-valid conclusion, appear to be fitted by hand, and show that periods of apparent long-term decline are accompanied by comparable periods of increase. A second focus of this submittal is the fact that the recent population decline has been accompanied by a reduction in spring flow magnitude and duration over the later part of the spring smolt out-migration season, which has resulted in unsuitably high water temperatures in the lower reaches of the Tuolumne River and other east side tributaries to the San Joaquin River. This analysis misrepresents historical peak flows as average flows. Further, the peak flows shown in the report have historically occurred during winter and thus at the wrong time of year to assist smolt outmigration or the maintenance of low water temperatures downstream of the Tuolumne River during May. Also, since the salmon shown in Table 1 of the report were identified after the end of the typical May 15 export reductions associated with the Vernalis Adaptive Management Program ("VAMP"), it is unlikely that these fish would have successfully outmigrated through the San Joaquin River and Delta after this date in the absence of an extension of Delta export restrictions.

- Mesick and Marston 2007a: This report appears to be a re-packaging of some earlier regression analyses used to validate the flow dependency used in the CDFG population model as discussed in earlier submittals by the Districts. In the current report, no analysis of the effects of tributary restoration projects was performed and the effects of management actions other than flow are ultimately discounted as in previous submittals. This report continues to exclude non-flow factors that may have significant impacts upon Chinook salmon recruitment.

- Mesick and Marston 2007b: The cohort reconstruction, referenced in Mesick and Marston 2007a and Mesick 2008, is included as the basis for additional analyses related to population and flow targets referenced by the FWS, NMFS, and the CGs. However, the analysis is not well detailed, ignores year-to-year variations in ocean life-history parameters, and predicted escapements fail to match observed escapements in recent years. It is clear from the analysis, however, that assumptions regarding consistent age-structure from year-to-year should be carefully re-examined. A more statistical approach would yield confidence bounds for the estimates, and formal goodness-of-fit tests of the conceptual model regarding harvest, hatchery and spawner returns from various geographic regions would be performed. A formal peer review of the methodology and supporting data should be conducted prior to using this report as the basis for agency policy recommendations regarding population levels and flow prescriptions.

- Mesick 2008: Through application of the criteria proposed by Lindley, *et al.* (2007) and the cohort reconstruction by Mesick and Marston (2007a), the analysis was included as an attachment to the rehearing requests of NMFS and the FWS to support the hypothesis that the Tuolumne River Chinook salmon are at a high risk of extinction due to insufficient instream flow releases and that increases of the current Article 37 flow regime will ensure long-term viability of the population. However, there are methodological inconsistencies in this report as well as the supporting analyses (Mesick and Marston 2007a) that reduce the credibility of the analysis presented and the development of population and flow targets. For example, the assumption that large numbers of hatchery fish from the Sacramento River basin released in the Bay and Delta should return to the Tuolumne River in recent years, at a time when few fish of any origin are returning to the Tuolumne River, is not tenable. The Districts have questioned the assumption of fry rearing habitat limitations, the availability of suitable floodplain habitat in the primary spawning reach of the Tuolumne River, and the impracticality of providing floodplain inundation while meeting obligations for flood control and water supply. This report should be peer-reviewed prior to being accepted as a basis of any conclusions regarding the population status of the Tuolumne River Fall-run Chinook salmon population.

- Newman 2008: This report re-analyzes paired release CWT data collected by the FWS in four studies conducted since the 1980s. Contrary to assertions by CDFG, the report makes no statements regarding the relative importance of in-tributary vs. delta or ocean conditions in controlling smolt survival or adult salmon populations. Although the report shows only weak relationships between export levels and smolt survival from re-analysis of the VAMP study data, reanalysis of two other studies ("Interior" and "Delta Action 8") suggests that export levels have a significant effect upon outmigrant survival, with the remaining two studies ("VAMP" and "Delta Cross Channel") showing significant relationships between smolt survival and barrier operations designed to prevent entrainment in the State and Federal export pumps. These analyses support conclusions in the Ten Year Summary Report and subsequent comments by the Districts that delta survival, including multiple factors outside of the Districts' control, other than simple export rates, are important determinants in the survival of juvenile salmon and subsequent adult returns to the Tuolumne River.

- Zimmerman 2008: This report was included as an attachment to the rehearing requests of NMFS and the FWS and cited by them and other parties as conclusive evidence of steelhead presence on the Tuolumne River. However, the low numbers of anadromous *O. mykiss* found in samples from the San Joaquin tributaries indicate little evidence of a successful ocean-type life history strategy, particularly south of the Stanislaus River. Further, it is unclear whether anadromous *O. mykiss* found in the Tuolumne River arrive from a self-sustaining

> population within the Central Valley Steelhead Distinct Population Segment ("DPS") or are from strays from nearby rivers such as the Mokelumne River, where the steelhead hatchery was stocked with fish from the Eel River in the Northern California steelhead DPS. The Eel River is geographically outside of the Central Valley steelhead DPS, and its fish are genetically distinct from native Central Valley steelhead. Genetic testing of any tissue samples from the confirmed steelhead and steelhead progeny identified in the report would be required to provide more conclusive evidence as to Central Valley steelhead presence in the Tuolumne River as opposed to genetically distinct out-of-DPS steelhead.

In other words, the Technical Memorandum clearly demonstrates that Commission reliance upon these studies and the conclusions reached therein and in the requests for rehearing without critical review of the data and analyses upon which the studies are based would be highly inappropriate and contrary to the requirement that the Commission base its actions on substantial evidence. More importantly, such uncritical reliance could lead to the imposition of unsupported and unsupportable changes to Project operations that could lead to adverse impacts to the very fishery resources the entities submitting the requests for rehearing purportedly want to assist.

Given the assistance the Technical Memorandum will provide the Commission in considering and acting on the requests for rehearing of the Order, the granting of this motion and consideration of the information contained in the Technical Report is clearly in the public interest. Such action is clearly supported by past Commission orders in similar situations. *See, e.g., Dominion Cove Point LNG*, 118 FERC ¶ 61,007 at ¶ 10 (2007) (allowing the filing of an answer to a rehearing request because the rehearing request contained new facts).

CONCLUSION

The Districts respectfully request that the Commission grant this motion and consider the information contained in the Technical Report attached hereto in acting on the requests for rehearing of the Order.

Respectfully submitted,

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ATTORNEY FOR MODESTO IRRIGATION DISTRICT AND TURLOCK IRRIGATION DISTRICT

Dated: July 7, 2008

EXHIBIT 1

Stillwater Sciences

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TECHNICAL MEMORANDUM

DATE: July 1, 2008

TO: Tim Ford

COMPANY: Turlock Irrigation District
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FROM: Noah Hume and Peter Baker

SUBJECT: Review of supplemental materials submitted with FERC rehearing requests of the April 3, 2008 Delegated Order on the Ten Year Summary Report

In their recent rehearing requests of the Delegated Order on the Districts' 2005 Ten Year Summary Report dated April 3, 2008,[1] the Agencies and NGOs submit and rely upon new analyses and other supporting materials regarding Chinook salmon and Central Valley steelhead (*O. mykiss*) population levels upon which the Districts have not previously commented. Our review of these new analyses and other supporting materials is provided below. However, the Agencies and NGOs in their rehearing requests also resubmit or reference several reports and analyses submitted in prior Agency and NGO filings that the Districts have previously commented on. In light of the resubmission and reference of these prior materials, we first provide a summary of these prior materials.

1 BACKGROUND

The Districts have previously responded to numerous comments filed by the Agencies and NGOs on the Ten Year Summary Report, including the Districts' August 23, 2005 (e-Library 20050823-5055) response to comments received prior to the July 25, 2005 comment deadline on the Ten Year Summary Report, the Districts' December 21, 2005 (e-Library 20051222-5001) response to additional comments of November 22, 2005, by CDFG and FOT, the Districts' June 6, 2006 (e-Library 20060613-5051) filing of independent technical review comments on the CDFG population model, the Districts' March 20, 2007 (e-Library 20070402-0040) filing of a Draft Study Plan along with responses to comments received on the February 2, 2007 draft, the Districts' June 15, 2007 (e-Library 20070702-0022) reply to CDFG's May 25, 2007 comments, the Districts' July 13, 2007 (e-Library 20070718-0082) response to FERC's Preliminary Staff Analysis and revisions of the March 20, 2007 Study Plan Draft, the Districts' October 26, 2007 (e-Library 20071107-0004) response to comments submitted by NMFS and others between September 18 and October 3, 2007, and most recently, the Districts' February 20, 2008 (e-Library 20080306-0107) reply to comments by the Golden West Women Flyfishers (GWWF) and Trout Unlimited on the July 2007 Study Plan.

[1] Order on Ten-Year Summary Report Under Article 58 re Modesto Irrigation District and Turlock Irrigation District's Don Pedro Project under P-2299.
http://elibrary.FERC.gov/idmws/file_list.asp?accession_num=20080403-3004

1.1 Linkages between Project operations and long-term population trends

The rehearing requests submitted by CDFG, NMFS, the USFWS, and the NGOs repeat their prior assertions that Project operations are linked to apparent long-term population declines in the Tuolumne River. The Districts' previously commented that the analysis periods selected to support these assertions (e.g., pre-Project vs. post-Project) are only peripherally relevant to the evaluation of provisions of the 1996 FERC Order amending the license for the New Don Pedro Project (FERC No. 2299), include highly uncertain data and methodologies that disproportionately emphasize high estimates, and are missing escapement data corresponding to anecdotal reports in low escapement years (e-Library 20051222-5001). As noted in the Delegated Order, the recent population declines in all three San Joaquin tributaries (e-Library 20080331-5030) are part of a larger coast-wide population crisis that has been attributed by NMFS[2] to poor ocean conditions since 2003. In the Ten Year Summary Report, the Districts indicated that numerous out-of-Tuolumne-basin factors affect long-term population abundance, which is most recently supported by Vernalis Adaptive Management Program (VAMP) findings of low survival estimates through the delta over 2003-2006, including the 2005–2006 high flow periods (SJRGA 2008).

1.2 Linkages between Project operations and short-term population trends

Many comments have been filed with the Commission in the past asserting that the decline in the Tuolumne River fall-run Chinook salmon population since the adoption of the 1996 FERC Order, as well as changes in the relative contribution of the Stanislaus, Tuolumne, and Merced River populations to overall San Joaquin basin escapements, is due to the current Article 37 flow regime. The Districts' previous responses to these assertions have demonstrated that all San Joaquin Basin tributary runs (Stanislaus, Tuolumne, and Merced) continue to exhibit similar overall long-term cycles of varying high and low escapements following variations in hydrology and ocean conditions (e-Library 20050823-5055). The Districts continue to maintain that multiple factors other than the current flow regime are important determinants of salmonid populations in the Tuolumne River and San Joaquin River Basin (e-Library 20051222-5001 and 20070402-0040).

Most recently, Figure 2 of Mesick (2008) presents regression statistics of estimated recruitment against flow between February and mid-June for two time periods (1980–1990 and 1997–2003) as evidence of a 50% reduction in ocean recruitment at a given flow between the "pre-" and "post-Settlement Agreement period." These regressions were previously presented in the *Draft Limiting Factors Analysis* included in a prior submittal by the USFWS (20070314-0089) over slightly different averaging periods (1980–1990 and 1998–2003) and regressed against Vernalis flows. The reported significance levels of the regressions used in Mesick (2008) are not valid because they

[2] The House Natural Resources Committee, Subcommittee on Fisheries, Wildlife and Oceans: Oversight Hearing on the Management of West Coast Salmon Fisheries, Longworth House Office Building, Washington, D.C. May 15, 2008.

violate assumptions that the recruitment response "observations" [3] be independent and identically-distributed. Further, the regressions show potential model selection bias evident from the two versions of the Pre- vs. Post-Settlement Agreement analysis.[4] More importantly, the logic of these figures is flawed since they are presented simply to demonstrate that the number of adult Tuolumne River fall-run Chinook salmon produced *at a given spring flow* has significantly declined since the FSA was implemented; they do not, however, demonstrate that population declines *are due to variations in flow*. Even if the statement that the number of salmon had significantly declined at a given spring flow were accepted, it would essentially validate a hypothesis that any population decline since the implementation of the 1996 FERC Order is not due to the current Article 37 flow regime. Rather, apparent population declines would potentially be attributed to some other factor such as habitat availability, habitat quality, pulse flow timing, delta operations, or ocean conditions. This is essentially the position taken in the Ten Year Summary Report.

Claims that the Article 37 flow regime included in the 1996 FERC Order has resulted in *decreased* escapements are also at odds with the rationale for further flow increases. As stated in prior responses by the Districts to comments by the Agencies, numerous factors are at play in controlling adult population levels. For example, one peer reviewer of the CDFG population models questioned the assumption of excluding factors other than flow, stating that high abundance of Chinook salmon during the mid-1980s was a coast-wide phenomena seen from California to British Columbia and is acknowledged as a period of high-marine survival (e-Library 20070702-0022). It must be re-emphasized that the recent ocean fisheries collapse has occurred despite two high flow years (2005–2006) and that these population declines are not predicted by the CDFG population models, or even by the Districts' own models that are driven primarily or exclusively by flow. This provides further support that the linkages between the Article 37 flow regime and population levels repeatedly asserted by the Agencies are confounded by numerous out-of-basin factors.

2 REVIEW OF SUPPLEMENTAL MATERIALS SUBMITTED WITH THE REHEARING REQUESTS

Several of the rehearing requests of the April 3, 2008 Delegated Order cite new analyses and materials as well as materials submitted in advance of the August 8, 2007 hearing discussing fisheries study plan proposals. The CDFG rehearing request contains two attachments (Marston 2008, Newman 2008) to support the adoption of increased instream flow requirements under Article 37. The NMFS and USFWS rehearing requests include an analysis of flows necessary to meet various population targets (Mesick 2008) and a report by Zimmerman et al. (2008) indicating the presence of low numbers of anadromous *O. mykiss* in the Tuolumne River. The USFWS rehearing request also

[3] Another problem is that the "recruits" are not basic data, but are derived from the accompanying cohort reconstruction (Mesick and Marston 2007). This is an example of what Newman (2008) calls "indirect analysis" in Section 2.6 of his report.

[4] Statistical inferences from a model become less meaningful as the number of alternate models potentially under consideration increases. See Burnham and Anderson (1998) for a detailed discussion of this problem.

includes provisional drafts of agency reports (Mesick and Marston 2007a,b) discussing cohort reconstruction analyses and relationships between Chinook salmon recruitment and potential explanatory factors. Although the USFWS rehearing request also includes other supporting materials from peer reviewed literature (Lindley et al. 2007, Mesick 2001) that are not discussed in detail herein, we note below several inconsistencies in the conceptual models and conclusions drawn from these materials.

2.1 Historical trends in San Joaquin River Fall-run Chinook salmon populations

The Marston (2007) report was included as an attachment to the CDFG rehearing request (e-Library 20080502-5043) to support the proposition that adult salmon escapement abundance in the Tuolumne River began to decline over several decades and well before recent coast-wide population declines were attributed to poor ocean conditions. Figures 1, 2, 8, and 12 of the Marston (2007) report all present long-term "trends" extending across many decades. Inspection of any of these figures reveals that the "trendlines" appear to have been added manually, suggesting that conventional statistical fitting methods were either not used or did not produce significant trends. Although Figures 3, 9, and 13 show escapements from 2000 through 2006, and while escapements do decrease over this period, this "trend" does not look very different from apparent declines of comparable duration in the past (1985–1991 and 1969–1974). We note that periods of population decline in the historical record have generally been accompanied by increasing population trends of comparable or longer duration (1991–2000, 1977–1985, and 1963–1969). Thus, the Marston (2007) analysis fails to present a statistically supported conclusion.

A second focus of the Marston (2007) paper is the fact that the recent population decline has been accompanied by a reduction in spring flow magnitude and duration over the later part of the spring smolt out-migration season, which has resulted in unsuitably high water temperatures in the lower reaches of the Tuolumne River and other east side tributaries to the San Joaquin River. Figure 10 of the report is described in the main text as showing "how annual flow releases into the lower Tuolumne River has lessened over time as water development has occurred" (p. 16). The figure itself, however, does not show total flow, average flow, or "Spring" totals or averages, but rather annual peak flow. This main text statement is clearly misleading. Further, it should be emphasized that the flow peaks shown in Figure 10 of the report have historically occurred during winter and thus at the wrong time of year to assist smolt outmigration or the maintenance of low temperatures downstream of the Tuolumne River during May. Also, these winter-time historical flow peaks would have moved many rearing fry from the current spawning reaches downstream into the lower river, San Joaquin River and Delta.

Spring flows have generally been higher in March and April from 1971 through 2007 (i.e., "post New Don Pedro era") than from 1940 through 1970, but do appear to be slightly lower during May over the latter period. However, since the salmon shown in Table 1 were identified after the end of the typical May 15 export reductions associated with VAMP,[5] it is unlikely that these fish would have successfully outmigrated through the San Joaquin River and Delta after this date in the absence of an extension of Delta export restrictions. As stated in prior comments by the Districts (e-Library 20051222-5001), because air temperatures increasingly influence river temperature warming rates as spring progresses, the Districts' temperature modeling results suggest that upstream flow management will be largely ineffective at meeting CDFG's temperature objectives without severely impacting the reliability of water supplies for both instream and consumptive uses.

2.2 Relationships between Fall-Run Chinook salmon Recruitment to the Major San Joaquin River Tributaries, in-Basin, and out-of-Basin Factors

Mesick and Marston (2007a) present a series of analyses examining the relationships between Fall-Run Chinook salmon recruitment and various explanatory factors, including tributary streamflow, Delta exports, barrier operations, and tributary restoration projects. The submittal appears to be a re-packaging of some earlier regression analyses used to validate the flow dependency of the CDFG population model discussed by the San Joaquin River Group (e-Library 20060613-5051).

In order to gain inferences upon population level responses to potential limiting factors, the analyses begin with a discussion of the age composition of the annual escapement data (Mesick and Marston 2007b), which is reviewed below (Section 2.3). Although the age structure methods in Mesick and Marston (2007b) can be questioned, these data are used in Mesick and Marston (2007a) to perform a series of regressions and correlation analyses with various spawner-recruit relationships and other explanatory variables. However, no analysis of the effects of tributary restoration projects was performed and the effects of management actions other than flow are ultimately discounted because of low correlation factors rather than examining more mechanistic connections beyond flow.

For example, Mesick and Marston (2007a) do not seem to consider the full implications of their conclusion that adult recruitment is not directly related to spawner abundance when there are more than 500 Age 3 equivalent spawners. If some dimension of spawning or rearing habitat is completely saturated at such modest escapement levels, habitat restoration and enhancement projects should have much greater potential for increasing population levels than previously acknowledged by CDFG and the USFWS in prior filings. In addition, the "population shift" variable developed in the analyses leads to a conclusion that there has been a downward shift in the relationship between Tuolumne River recruitment and mean spring flow at Vernalis "sometime between 1987 and 1995" (pp. 20–21). If the shift is real, it suggests that some dimension of habitat other than flow has undergone degradation over this period. After all, flows were generally higher since the late 1990s than the preceding decade and several restoration projects intended to benefit salmon survival in the tributaries were undertaken as well. On the Tuolumne River, the only potential explanatory factor would be related to spawning

[5] The VAMP provides for a 31-day pulse flow (target flow) at Vernalis on the San Joaquin River during the months of April and May, along with a corresponding reduction in State Water Project (SWP) and Central Valley Project (CVP) Sacramento-San Joaquin Delta exports (SJRGA 2008).

gravel losses attributed to the 1997 floods in the Ten Year Summary Report. But this conflicts with earlier positions by CDFG that spawning habitat is not limited on the Tuolumne River.

2.3 San Joaquin River Fall-Run Chinook salmon age cohort reconstruction

A cohort reconstruction (Mesick and Marston 2007b) of Chinook salmon from the San Joaquin River East-side tributaries, including the Tuolumne River, was referenced in CDFG's rehearing request (e-Library 20080502-5043) and included in the USFWS' rehearing request (e-Library 20080507-0168) as the basis for additional analyses related to population and flow targets. Because of their importance in these analyses, we are providing a brief review of the effects of hatchery contributions and the calibration of population models with historical data and also attach some of the underlying theory used to develop these estimates.

In typical cohort reconstructions, the annual estimation of run size at age (*i.e.,* 2, 3, and 4 year old fish) is derived from estimates of harvest, hatchery returns and spawning fish to the river of interest. In Mesick and Marston (2007b), the age structure of each of these run sizes is estimated through a combination of information gained from coded-wire tag (CWT) recoveries and scale analysis. The lack of aging data of this type in many years precludes accurate reconstruction of the numbers of individuals in each brood year. To address this, the "new method" described on p. 13 of the report consists of assuming that the ratios of returns at one age to returns of another age should be the same for all Central Valley fish of the same brood year. This is equivalent to assuming that all the populations concerned experience the same ocean conditions, and respond to ocean conditions in the same way. This is an attractive assumption, and could be the basis for rigorous cohort reconstruction. However, to the extent that the proposed method is correct, it is not clear that it really differs from the "deconvolution" method (Kope 1987) the authors critique on pages 12 and 13 of the report.[6] The principal merit of the approach of the report is that, in principle, it allows for variation in ocean conditions from year to year. In practice, however, Mesick and Marston (2007b) seem to use "average" values for the age-ratios (when the age-ratio method is used at all), negating this advantage. In particular, the reconstructed age compositions may be least reliable in precisely the most recent few years, when ocean conditions are most likely to be an issue.

Despite persistent attempts, we have not been able to reproduce most of the numbers given in the tables of Mesick and Marston (2007b), which are not raw data. This is partly due to incomplete methods descriptions and partly to the lack of supporting data. In any case, there are problems with the estimates of two-year-olds in the historical data (discussed on page 10 of the report), and the analysis is non-statistical. While there is nothing fatally inappropriate about this, a more statistical approach would yield confidence bounds for the estimates, and formal goodness-of-fit tests of the conceptual model regarding harvest, hatchery and spawner returns from various geographic regions would be performed.

[6] See attachment A for a detailed discussion of this problem.

For example, the fact that the summation of the estimated year class contributions in Table 11 does not match the observed escapement data suggests that some kind of normalization step is needed, to ensure that the total escapements match up with observation (see Attachment A hereto). The most straightforward way to do this is to rescale the numbers of two-year-olds from each brood year (or equivalently, to rescale the total returns form the brood year by the same factor). But choosing the normalization factors as was done in Mesick and Marston (2007b) involves a system of equations with more unknowns than equations, effectively becoming a deconvolution problem of the kind criticized in their report.

In summary, the methodology of the report seems basically sound. However, the resulting estimates in the most recent years may be biased to an unknown degree. It is clear from the analysis, however, that assumptions regarding consistent age-structure from year-to-year must be carefully re-examined. The report should receive a formal peer review before being used in analyses regarding population levels and flow prescriptions. We would expect that a peer review would find more clarification of methods and supplementary data necessary.

2.4 Evaluation of four Sacramento-San Joaquin River Delta juvenile salmon survival studies

The Newman (2008) report was included as an attachment to the CDFG rehearing request (e-Library 20080502-5043) to support the assertion that the adult salmon population in the Tuolumne River is controlled by in-tributary limiting factors, rather than oceanic or other downstream controlling features. The Newman (2008) report carefully re-analyzes paired release CWT data collected by the USFWS in four studies conducted since the 1980s to examine the relationship between Delta smolt survival, exports, pumping facility barrier operations (*i.e.*, Delta Cross Channel Gate, Head of Old River Barrier), and San Joaquin River flows. The analyses are strictly confined to assessing factors affecting smolt survival through the delta. Contrary to assertions by CDFG in its rehearing request (p. 3); Newman (2008) makes *no* statements regarding the relative importance of in-tributary vs. delta or ocean conditions in controlling smolt survival or adult salmon populations. In his re-analysis of the VAMP studies, Newman (2008) does show the expected relationship between Vernalis flow and smolt survival from Dos Reis to Jersey Point and shows only weak relationships between export levels and smolt survival. However, results of the Newman (2008) reanalysis of two studies ("Interior" and "Delta Action 8") suggests that export levels have a significant effect upon outmigrant survival, with the two other studies ("VAMP" and "Delta Cross Channel") showing significant relationships between smolt survival and barrier operations. These analyses support conclusions in the Ten Year Summary Report and subsequent comments by the Districts (e-Library 20070402-0040 and 20070702-0022) that delta survival, including multiple factors outside of the Districts' control, other than simple export rates, are important determinants in the survival of juvenile salmon and subsequent adult returns to the Tuolumne River.

2.5 Risk of extinction for the natural fall-run Chinook salmon population in the lower Tuolumne River due to insufficient instream flow release

The Mesick (2008) report was included as an attachment to the rehearing requests submitted by NMFS (e-Library 20080505-5007) and the USFWS (e-Library 20080507-0168) to support the hypothesis that the Tuolumne River Chinook salmon are at a high risk of extinction due to insufficient instream flow releases and that increases of the current Article 37 flow regime will ensure long-term viability of the population. However, closer examination of the corresponding spawner data (Report 2007-2, e-Library 20080331-5030) and through application of the criteria of Lindley et al. (2007), the extension of the arguments presented in Mesick (2008) is that the naturally reproducing Chinook salmon population in the Tuolumne River may have already become extinct during one or more population crises in the past century and have been presumably replaced by a founding population of hatchery or stray salmon from other tributaries in the San Joaquin River basin. There are methodological inconsistencies that reduce the credibility of the analysis presented in Mesick (2008), and the development of population and flow targets, as discussed below.

2.5.1 Hatchery contributions to Tuolumne River spawning runs

In the process of evaluating the extinction risk criteria of Lindley et al. (2007) to the Tuolumne River, Mesick (2008) attempts to identify and separate hatchery contributions to the Tuolumne salmon runs. The Districts have previously expressed concerns regarding increases in hatchery contributions in recent spawning runs (e-Library 20050324-5063). Mesick (2008) shares this position and suggests that hatchery contributions now dominate the annual escapement with almost no contribution from wild populations. However, the estimates of hatchery contributions in the report appear to be excessively high, and require implausible levels of strays from outside the San Joaquin basin. For example, the natural escapement was estimated to be zero in six consecutive years (1990–1995), a time span exceeding the maximum generation time seen in Central Valley Chinook populations in recent decades. It might be argued that these estimates are consistent with some continuing low level of natural escapement during the 1990–1995 period. However, if "natural" fish in fact make up such a miniscule fraction of the run in so many years, the level of interbreeding between natural and hatchery spawners would necessarily be so high as to render the distinction between "natural" and "hatchery" populations meaningless.

Another indication that the Mesick (2008) analysis is incorrect is that Table 1 of the report also shows non-zero natural escapements from 1996–2004, and these fish presumably were progeny of natural and not hatchery fish. Further, the estimated numbers of hatchery spawners frequently exceeds the estimated total number of spawners, often by very large multiples.[7] One potential error we were able to identify is that the estimated numbers of "unmarked adults" from the different hatcheries in Table 1 of the report do not vary greatly from year to year when compared to the numbers of marked fish actually observed or estimated. The calculations of the report assume constant survival and straying rates for hatchery fish across all years, at a time which

[7] For example, Table 1 shows the hatchery contribution to the 1990 run is estimated at 741 spawners, out of an estimated total escapement of only 96 spawners.

non-hatchery populations and environmental conditions have been varying greatly from any long-term norms.

In short, we do not believe that it is reasonable to assume that large numbers of Sacramento Basin fish are returning to the Tuolumne River in the same years that fish of Tuolumne River origin are failing to return to the Tuolumne River. We see no reason why any conclusions "supported" by this report should be taken seriously when other clear and immediate implications of the same analysis are so questionable. The Mesick (2008) report should be carefully peer-reviewed prior to being accepted as a basis for *any* conclusions regarding the population status of the Tuolumne River Fall-run Chinook salmon population.

2.5.2 Population and Flow Targets

The Districts have opposed the adoption of population targets for the Tuolumne River in the face of time-varying environmental conditions, ocean harvest, and other factors outside of the Districts' control (e-Library 20051222-5001). Mesick (2008) establishes a population target of 1,338 ocean recruits from an assumed average harvest rate of 40% (2000–2006) and the assumption that a three-year average escapement of 833 fish is necessary to ensure a low risk of extinction under the Lindley et al. (2007) criteria. This analysis uses an accompanying cohort reconstruction (Mesick and Marston 2007a), discussed in Section 2.3, that describes the age structure of returning adults over the period 1981–2002 to determine relationships between instream flows and adult recruitment.

The Mesick (2008) analysis argues that the primary benefit of spring flows in non-flood years is in improving smolt outmigration success. However, increasing the number of smolts produced in the first place (assuming no density-related effect), or increasing the survival of salmon in the Delta, Bay, and ocean, should have the same effect as increasing the survival of smolts in the Tuolumne River proper. The analyses in Mesick (2008) also argue that recruitment is effectively independent of parent stock size when the latter exceeds 650 "age 3 spawner equivalents."[8] Although no supporting analysis is provided in the report explaining the origin of the number 650, this independence logically requires that some dimension of spawning or fry-rearing habitat is saturated at some fairly modest escapement level. Contrary to prior assertions made by the USFWS and CDFG (e-Library 20070314-0089) that flow is the primary limiting factor for Tuolumne River salmonids, the conceptual model underlying the Mesick (2008) analyses is compatible with population increases by both flow and non-flow management measures as envisioned in the 1995 Settlement Agreement. It is for this reason the Districts (e-Library 20070702-0022) and others (e-Library 20070718-0036) have called for the support of CDFG, and other signatories to the 1995 Settlement Agreement, to assist in the implementation of currently funded gravel augmentation and channel restoration projects.

Lastly, we should note that the "natural recruits" shown in Figure 1 of the Mesick (2008) report are derived quantities lacking supporting data or method descriptions necessary to

[8] Prior analyses by the USFWS assert 500 spawners would be sufficient to saturate available rearing habitat were also unsupported in the Agencies Limiting Factor Analysis (e-Library 20070314-0089).

reproduce them. More importantly, the resulting quadratic equation between flow and recruits would not be validated as a management tool in isolation of accompanying flow increases throughout the San Joaquin Basin in wet water-year types. The quadratic form (not exponential as stated in Mesick (2008)) implies natural recruits would be produced at an ever increasing rate as spring flow increases. Further, the "inflection point" note added to Figure 1 in Mesick (2008) (not a possible feature of quadratic relationships) showing a flow corresponding to potential floodplain inundation appears to be included to indicate a juvenile rearing habitat limitation. The Districts have previously commented on the relative lack of floodplain habitat within the spawning reaches of the Tuolumne River and it should be noted that the current conceptual models presented in Mesick (2008) are inconsistent with those used to justify prior gravel augmentation projects implemented by CDFG (e-Library 20070402-0040).

2.6 Maternal origin and migratory history of *O. mykiss* recovered in the Tuolumne River

The Zimmerman et al. (2008) report was included as an attachment to the rehearing requests of NMFS (e-Library 20080505-5007) and the USFWS (e-Library 20080507-0168) and cited in the other rehearing requests as conclusive evidence of steelhead presence on the Tuolumne River. In all, some 964 otoliths were collected over six years (2001–2007) primarily in eight Central Valley rivers (Sacramento River, Deer Creek, Yuba River, Calaveras River, Stanislaus River, Tuolumne River, Merced River, San Joaquin River). Of all samples analyzed, 224 (23%) were classified as steelhead progeny and only five (0.5%) were classified as anadromous by elevated Strontium to Calcium (Sr:Ca) ratios in the older otolith growth regions. The Districts have documented the presence of *O. mykiss* in the Tuolumne River in the past. However, the Zimmerman (2008) results show that out of 148 otoliths analyzed from the Tuolumne River, only 10 (7%) were classified as steelhead progeny and only one (0.7%) was classified as anadromous. The results of the neighboring rivers also had a relatively low incidence. While prior comments by NMFS that steelhead may be present in the Tuolumne River were based on low captures of up-migrant trout at the trapping weir on the Stanislaus River (e-Library 20070730-5067), the low numbers of anadromous *O. mykiss* in these rivers indicate little evidence of a successful ocean-type life history strategy in the San Joaquin basin. Further, it is unclear whether anadromous *O. mykiss* found in the Tuolumne River arrive from a self-sustaining population within the Central Valley Steelhead DPS or are from strays from adjacent rivers such as the Stanislaus or Mokelumne.

For example, CDFG has stocked the Mokelumne steelhead hatchery with fish from the Eel River (CDFG 1994). The Eel River is geographically outside of the Central Valley steelhead DPS, and its fish are genetically distinct from native Central Valley steelhead. Because Mokelumne hatchery yearlings are released much lower in the Mokelumne River to reduce piscivory on rearing juvenile Chinook salmon, returning hatchery steelhead may be more likely to stray into San Joaquin basin tributaries.

The data presented in Zimmerman (2008) are an important contribution to the steelhead studies required by the Delegated Order and will be included in any study synthesis report preparation. However, because the fish analyzed in this study were collected opportunistically by CDFG, it is unknown whether the rates of anadromy are representative of the underlying *O. mykiss* population. The planned FERC studies required by the Delegated Order addressing *O. mykiss* may indicate whether the identified steelhead represent a substantial, self-sustaining population. Genetic testing of any tissue samples from the confirmed steelhead and steelhead progeny identified by Zimmerman et al. (2008) would be required to provide more conclusive evidence as to Central Valley steelhead presence in the Tuolumne River as opposed to genetically distinct out-of-DPS steelhead.

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Attachment A - Cohort Reconstruction Methodology

The mathematical formulation of cohort reconstruction can be summarized as follows. Consider the population dynamics in the ocean portion of the life-history of some particular Chinook salmon population such as the San Joaquin basin or Tuolumne River. Let O_y^a, H_y^a, E_y^a, and M_y^a be the ocean abundance of age-a fish at the start of year y, the harvest (and harvest-related mortality) of age-a fish during year y, the escapement of age-a fish during year y, and the mortality of age-a fish during year y, due to causes other than harvest. A simple basic conceptual model for the factors controlling ocean abundance is:

$$O_y^a = H_y^a + E_y^a + M_y^a + O_{y+1}^{a+1}$$

that is, for every fish of age a in the ocean at the start of year y will either be caught in the ocean harvest, escape, die of causes other than harvest, or survive to the following year. This can be elaborated in various ways. For example, we might decompose H_y^a into various components, such as sport vs. commercial harvest, and/or landings vs. shaker mortality; alternatively, we might simply lump all ocean mortality together into M_y^a. Setting statistical issues aside, and considering the evolution of ocean conditions deterministically, we can summarize the various mortality factors as $H_y^a = \eta_y^a O_y^a$, $E_y^a = \rho_y^a O_y^a$, $M_y^a = \mu_y^a O_y^a$, $O_{y+1}^{a+1} = q_y^a O_y^a$, where all the η, ρ, μ, q are in the interval $[0,1]$, and $\eta_y^a + \rho_y^a + \mu_y^a + q_y^a = 1$ for each year y and age a. We make the fundamental assumption that the η_y^a, ρ_y^a, μ_y^a, q_y^a depend only on y and a and *not* on the particular Central Valley population involved. That is, we assume that all Central Valley Chinook from a given brood year experience the same ocean conditions, and respond to these conditions in the same way.

In general, it will be arithmetically impossible for the same η_y^a, ρ_y^a, μ_y^a, q_y^a (which we henceforth refer to collectively as "the ocean parameters") to work for all populations, since all the O_y^a, H_y^a, E_y^a, and M_y^a must be whole numbers. In principle, the partition $O_y^a = H_y^a + E_y^a + M_y^a + O_{y+1}^{a+1}$ should be interpreted as a sample from some multivariate distribution parameterized by the ocean parameters.

In the Mesick and Marston (2007) cohort reconstruction, it is proposed that, for each year y and age a, the ratios E_{y+1}^{a+1} / E_y^a should be the same for all Central Valley populations. Call this ratio φ_y^a. Since $\varphi_y^a = \rho_{y+1}^{a+1} q_y^a / \rho_y^a$, this follows from the assumption that the ocean parameters are the same for all Central Valley stocks. The appeal of this approach is that these ratios can be calculated directly for any population for which the age-composition of escapements is known, and the ratios then applied to any other population of interest.

Given the φ_y^a, the total returns from the brood year y is

$$\begin{aligned} N_y &= E_{y+2}^2 + E_{y+3}^3 + E_{y+4}^4 + E_{y+5}^5 \\ &= E_{y+2}^2 (1 + \varphi_{y+2}^2 + \varphi_{y+2}^2 \varphi_{y+3}^3 + \varphi_{y+2}^2 \varphi_{y+3}^3 \varphi_{y+4}^4) \end{aligned}$$

That is, the total returns can be estimated if the number of two-year-old returns is known. Estimates of the latter have been made routinely in the historical spawning surveys. A problem with this approach is well illustrated in Table 4, of the Mesick and Marston (2007) report. If the E_y^a are calculated from the E_y^2 as suggested, the total estimated escapement for any particular year

$$\begin{aligned} E_y &= E_y^2 + E_y^3 + E_y^4 + E_y^5 \\ &= E_y^2 + \varphi_{y-1}^2 E_{y-1}^2 + \varphi_{y-1}^3 \varphi_{y-2}^2 E_{y-2}^2 + \varphi_{y-1}^4 \varphi_{y-2}^3 \varphi_{y-3}^2 E_{y-3}^2 + \varphi_{y-1}^5 \varphi_{y-2}^4 \varphi_{y-3}^3 \varphi_{y-4}^2 E_{y-4}^2 \end{aligned}$$

may differ noticeably from the escapement actually observed in that year. For example, notice how, in the "2- years after the flood" row for Table 4, Section B, the estimated escapement of two- and three-year olds alone, 840+11,543, already exceeds the observed escapement of 12,000.

The problem is likely with the 2-year old escapement estimate E_y^2. In the first place, there are problems with the estimates of two-year-olds in the historical data (discussed on page 10 of the report). In the second place, the assumption that the fraction of fish from a given brood year which return as two-year-olds is the same for all Central Valley populations is perhaps the shakiest of the uniform-across-populations assumptions—one might expect the number of two-year-old returns to depend on the sizes at which the smolts entered the ocean, for example. In any event, it seems that some kind of normalization step is needed, to ensure that the total escapements match up with observation.

Stillwater Sciences

Noah Hume P.E.,Ph.D.

Aquatic Ecologist/ Senior Scientist

EDUCATION

- **Ph.D.,** *Civil and Environmental Engineering,* U.C. Berkeley, 2000
- **M.S.,** *Civil and Environmental Engineering,* U.C. Berkeley, 1989
- **B.S.,** *Mechanical and Ocean Engineering,* University of Rhode Island, 1985

AREAS OF EXPERTISE

- Hydroelectric Relicensing
- Fisheries Biology
- Wetlands and Aquatic Ecology
- Environmental Engineering
- Mechanical Engineering

TRAINING

- California Mechanical Engineer, License M28919
- California Civil Engineer, License C45808
- Oregon Professional Engineer (ME/CE), License 67077PE

TEACHING EXPERIENCE

- **Lecturer** (2006): U.C. Berkeley Environmental Engineering. Introduction to Environmental Engineering.
- **Lecturer** (1994–2002): U.C. Extension. P.E. Review Courses in Water and Wastewater Treatment.
- **Graduate Student Instructor** (1995–2000): U.C. Berkeley Environmental Engineering, Limnology, Wetlands, Wastewater, Industrial and Hazardous Waste Management courses.

OVERVIEW

Originally trained in ocean engineering, Dr. Hume has over 20 years experience in aquatic sciences and engineering spanning ecology, water quality, water supply and treatment. Dr. Hume's areas of expertise include fisheries biology, aquatic and wetlands ecology, water quality management, as well as a range of environmental and process engineering applications. Dr. Hume is an experienced project manager that brings technical expertise to a variety of interdisciplinary projects, including habitat assessments, created wetland projects, river restoration and fisheries programs, and a number of engineering design projects.

PROJECT EXPERIENCE

Aquatic Ecologist.

Dr. Hume has served as Project Manager and lead scientist for numerous ecological studies to assess hydro-electric impacts upon invertebrate and fish populations due to changes in flow regime, temperature, instream wood, sediment supply and transport. The purpose of these studies is to develop appropriate mitigation, restoration and management strategies to support land and water uses in balance with sensitive aquatic species uses. Projects include:

- Project Manager and lead scientist for numerous on-going ecological studies for the Don Pedro hydroelectric project related to Project impacts upon invertebrates and salmonid populations due to changes in flow regime, temperature, sediment supply and transport (Turlock Irrigation District, Turlock CA).
- Project Manager for *Sacramento River Standardized Assessment Methodology* to address habitat losses to life stages T & E fish species due to ongoing bank revetment by comparison of compensation and enhancement measures implemented in differing locations and times (U.S. Army Corps of Engineers, Sacramento, CA).
- Principal Investigator for *Upmigration and Straying Study* to examine the effect of fall attraction flows on the upmigration timing and straying of fall run Chinook salmon in tributaries the San Joaquin River basin, California (U.S. Fish and Wildlife Service, Stockton, CA).
- Lead Scientist in Surveys for *Toketee Wetland Habitat Enhancement Project*, North Umpqua River Oregon (PacifiCorp, Portland, OR).
- Project manager for *Merced River Ranch Mercury Bioaccumulation Study* related to methylation potential of residual mercury in mine tailings used for spawning gravel replenishment in the Merced River, CA (CALFED Bay Delta Authority, Sacramento, CA).

SELECTED PUBLICATIONS

- Hume, N.P, M. Fleming, A. Horne 2002. Denitrification Potential and Carbon Quality of Four Aquatic Plants in Wetland Microcosms. Soil Science Society of America Journal, 66:5.
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Permitting and design support for riparian, wetland, and creek restoration projects
In addition to Clean Water Act Section 401 and 404 permitting and design support, Dr. Hume has served as Project Manager and scientist on a number of habitat restoration and design projects by evaluating present day and future conditions as well as developing monitoring programs to ensure a balance of aquatic, terrestrial, and human uses. Projects include:

- Big Lagoon Creek and Wetland restoration (National Park Service, GGNRA, San Francisco, CA).
- Environmental Assessment and Design Support for the Sacramento River Bank Protection Project (US Army Corps of Engineers, Sacramento, CA).
- John Muir constructed wetland project (San Francisco Public utilities Commission, Lake Merced, San Francisco, CA).
- Port of Sacramento constructed wetland project (Port of Sacramento, West Sacramento, CA).
- Sherman Island Setback Levee Habitat Enhancement Project. (Subcontractor to Hanson Engineering, Sacramento, CA)

Water quality studies
Dr. Hume has served as Project Manager and lead scientist on numerous studies related to the impacts of water quality conditions upon designated beneficial uses including FERC relicensing, mercury bioaccumulation studies, and Clean Water Act Section 401 Certifications:

- Carmen Smith Hydroelectric Project relicensing (Eugene Water and Electric Board, Eugene, OR).
- DeSabla Centerville Hydroelectric Project relicensing (PG&E, San Francisco, CA).
- McCloud-Pit River Hydroelectric Project relicensing (PG&E, San Francisco, CA).
- Merced River Restoration Planning (CALFED Bay Delta Authority, Sacramento, CA).
- San Joaquin River Restoration Plan (Friant Water Users Authority, Fresno, CA).
- Radon Removal Feasibility Studies (American Water Works Association, Denver, CO).
- South Feather Water and Power Project relicensing (South Feather Water and Power, Oroville, CA).

Stillwater Sciences

Peter Fritz Baker, Ph.D.

Mathematical Biologist

EDUCATION

- **Ph.D.**, Mathematics, University of California at Berkeley, 1987
- **B.A.**, Mathematics, University of Kansas (summa cum laude, honors in mathematics), 1981

AREAS OF EXPERTISE

- Simulation Modeling
- Mathematical Biology and Statistics

PROFESSIONAL AFFILIATIONS

- Bay-Delta Modeling Forum
- American Mathematical Society
- Mathematical Association of America
- Association for Symbolic Logic

SELECTED PUBLICATIONS

- Workshop on Statistical Analysis of Coded-Wire-Tag Data, Sacramento, California, December 4, 1997.
- Morhardt, J.E and P.F. Baker. 1997. Downstream challenges to salmon restoration on the Tuolumne River salmon survival in the Sacramento-San Joaquin Delta. Presented at the 27th Congress of the International Association for Hydraulic Research, San Francisco, California, August 10-15, 1997.
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OVERVIEW

Dr. Baker has over 15 years experience in applications of mathematics and statistics to fisheries biology. He has extensive experience with Chinook salmon populations of Central California. Dr. Baker has been responsible for maintenance and continued development of the EACH simulation model for San Joaquin Chinook salmon populations since 1989, and has developed or assisted in the development of numerous other models for populations of various species of salmonid fishes in California, Oregon and Montana. He has developed individual-based models of spawning habitat usage by salmonid fishes. His expertise also includes experimental design and applied statistics. He is co-developer of Stillwater's BasinTemp model for predicting cumulative effects of watershed management actions on water temperature throughout a stream network. His current projects include refining the user interface for Stillwater's reference model, which is a computer modeling tool that links alterations in physical processes and habitats to salmonid population responses.

PROJECT EXPERIENCE

New Don Pedro Project Relicensing, Tuolumne River, California *(Client: Turlock and Modesto Irrigation Districts):*
As part of the New Don Pedro Project relicensing efforts, Dr. Baker has extended PHABSIM modeling of Chinook salmon habitat in the Tuolumne River to include water temperature considerations, and has prepared or assisted in the preparation of numerous reports.

San Joaquin River Restoration Plan, California *(Clients: Friant Water Users Authority and Natural Resources Defense Council):*
Dr. Baker has prepared or assisted in the preparation of numerous reports on the survival of Chinook salmon in the Sacramento-San Joaquin River Delta.

Sacramento River Standardized Assessment Methodology, California *(Client: U.S. Army Corps of Engineers)*
Dr. Baker developed the mathematical model for a standardized habitat assessment methodology that relates fish response of seven threatened and endangered fish species to bank revetment in the lower Sacramento River.

Sediment and Temp TMDL Support South Fork Eel River, *(Client: EPA):*
In support of a temperature TMDL that the EPA conducted in Northern California, Dr. Baker co-developed a basin-scale stream temperature model (BasinTemp) that predicts reach-based and cumulative stream temperatures throughout a stream channel network.

CERTIFICATE OF SERVICE

I hereby certify that I have this day served the foregoing document on the parties designated on the official service list compiled by the Secretary in this proceeding.

Dated at Washington, D.C., this 7th day of July 2008.

John A. Whittaker, IV

John A. Whittaker, IV

DC:561305.2