Lower San Joaquin River Basin-Wide Water Temperature Modeling Project Data Collection Protocol

Prepared by S. Schubert, J. Guignard, D. Marston
California Department of Fish and Game
March 22, 2006

Table of Contents

1 Introduction

Several factors have been identified as potentially limiting populations of fall-run Chinook salmon (*Oncorhynchus tshawytscha)* and Steelhead Rainbow trout (*O. mykiss)* in the San Joaquin River Basin. Examples of such factors include: lack of suitable spawning habitat, insufficient flow and warm water temperatures. Water temperature is one of the most important physical properties in aquatic ecosystems affecting nearly all biological and chemical processes. Salmonid research has demonstrated that elevated water temperatures can affect growth rates, decrease egg viability, increase predation, and increase disease susceptibility and mortality (Myrick and Cech 2001).

Current restoration actions have focused on improving fishery habitat by replenishing spawning gravels and, providing increased minimum fishery habitat protection flows thru water purchases (e.g., VAMP and CVPIA-B2). In January 2005, the San Joaquin River Basin-Wide Water Temperature Modeling Project (SJR Model Project) began and is an extension of the Stanislaus – Lower San Joaquin River Water Temperature Modeling and Analysis Project (Stanislaus Model Project). The SJR Model Project seeks to improve fishery habitat quality on a SJR system wide basis by accurately characterizing the lower SJR hydrology, channel hydraulics, reservoir operations, meteorology, water temperature response, and salmonid temperature tolerance. Once the SJR Model is built and operable, and salmonid temperature response refined, it is anticipated that a water temperature management program for the lower SJR basin would be developed that may include elevated flows, changed reservoir operations, and/or conveyance infrastructure improvements (e.g., new release ports etc.). The primary purpose of the SJR Model Project is to identify a suite of restoration actions that would, if implemented, lead to suitable water temperatures for fall-run Chinook salmon (salmon) and Steelhead rainbow trout (steelhead) in the lower San Joaquin River Basin.

The SJR model is an extension of the Stanislaus HEC-5Q computer simulation model which is designed to simulate the thermal regime of mainstem reservoirs and river reaches. The SJR Model project focuses on understanding the relationship between air temperature, reservoir operations, river hydraulics, stream flow, and water temperature, both in-reservoir and in-river in an effort to decrease water temperatures to levels that optimize resident and migratory corridor habitat for salmon and steelhead in the lower SJR basin. The HEC-5Q model will analyze different water operation scenarios (e.g., reservoir storage and release patterns) that can optimize water temperatures and improve spawning and rearing habitats, and migration corridors for the steelhead and the fall-run Chinook salmon in the lower SJR Basin. Identification of an optimal thermal regime in response to upstream water management operations throughout these river reaches is critical to anadromous fish restoration measures in the San Joaquin River and its tributaries. The geographic boundaries of the model are (Figure 1) 1) the San Joaquin River from the Stevinson Bridge downstream to the Mossdale Bridge; 2) the Merced River from New Exchequer Reservoir downstream to the SJR confluence; 3) the Tuolumne River from New Don Pedro downstream to the SJR confluence; and 4) the Stanislaus River from New Melones Reservoir downstream to the SJR confluence.

2 Overview

2.1 Background

The Department has for a long time (e.g., since the 1970's) been concerned with the inadequacy of suitable water temperatures in the lower Stanislaus River for salmonids (Loudermilk 1996). This concern has been expressed to both the State Water Resources

Control Board and the Regional Water Quality Control Board who have the legally mandated responsibility to ensure adequate water quality exists for protection of fish beneficial use in the Stanislaus River is achieved and maintained.

In 1987, after New Melones Reservoir had been enlarged, the Department and the U.S. Bureau of Reclamation entered into a joint agreement to conduct studies to better understand the relationship of stream flow and salmon abundance trends. A key component was the collection of water temperature data and construction of a computer simulation model for the purpose of understanding how reservoir operations (e.g., inflow, storage, and release patterns) in combination with Stanislaus River hydrology (i.e., water year types) and meteorology influenced lower Stanislaus River water temperature response.

Additionally, in 1991 and 1992, in the fifth and sixth consecutive dry years, the Department and the USBR, Oakdale and South San Joaquin Irrigation Districts, and the Tri-Dam Project negotiated special water operations in the New Melones / Tulloch / Goodwin Reservoir Complex in an attempt to reduce water temperatures in salmon spawning reaches below Goodwin Dam to suitable (e.g., adult, egg, and juvenile temperature tolerant) levels. In the mid 1990's several temperature models were developed to define, and better understand, the thermal characteristics of the lower Stanislaus River, but none of these were able to link the Stanislaus River system components together to understand collectively how reservoir operations influence lower Stanislaus River temperature response and, how lower Stanislaus River flows influence both reservoir storage levels and reservoir temperature profiles over time.

Stanislaus stakeholders recognized the need to better define the relationship between water operations, water temperature regimes, and fish mortality in the Stanislaus River. In 1998 the Stanislaus Water Temperature Model Project was initiated as a joint venture project of the Stanislaus stakeholders group. Stakeholder members include: U.S. Bureau of Reclamation (USBR), U.S. Fish and Wildlife Service (USFWS), California Department of Fish and Game (CDFG), Tri-Dam Project, Oakdale Irrigation District (OID), South San Joaquin Irrigation District (SSJID) and Stockton East Water District (SEWD).

This cooperative effort started as a means of analyzing the relationship between water management operations and water temperatures in the Stanislaus River. An extensive program for water temperature and meteorological data collection throughout the Stanislaus Basin began. The extent of the model included the New Melones Reservoir, Tulloch Reservoir, Goodwin Pool, and approximately 60 miles of the Stanislaus River from Goodwin Dam down to the confluence with the San Joaquin River.

The objectives of this effort were to develop and calibrate a model capable of simulating the water temperature responses in the Stanislaus River system and to evaluate how New Melones Reservoir operations influence water temperatures in the lower Stanislaus River.

AD Consultants and Research Management Associates were retained to develop the HEC-5Q model. Historical and current air and water temperature data were used to calibrate and validate the model. Eleven different Stanislaus River operation simulations of New Melones, Tulloch and Goodwin Dams were run to assess the possibility of meeting water temperature objectives at identified critical areas of the river using existing dam structures and outlets. A key process of this assessment was the refinement and application of salmon and steelhead water temperature tolerance criteria.

To determine the water temperature objectives for the Stanislaus River the CDFG researched water temperature criteria for the Chinook salmon and Steelhead trout to establish water temperature range objectives for both species (Guignard 2001). The CDFG further refined these criteria in 2003 based upon new information (Marston 2003). These temperature objectives were used as a means of comparing the different model runs. Three zones of temperature ranges were identified: optimal, sub-lethal and critical. These zones vary by species, life stage and location on the Stanislaus River.

Also in 2001, the Stanislaus stakeholders recommended expanding the Stanislaus River temperature model to include the lower San Joaquin River from the confluence to the Mossdale Bridge. Extending the model to include the lower San Joaquin River allowed for an assessment of how Stanislaus river flows, and associated water temperatures, influence SJR flow and temperature rates. The Stanislaus Model Project proposal was accepted and funded by CALFED.

An additional component of the CALFED funded temperature model was the formation of an independent peer review panel that was charged with evaluating the biological merits, and application of thermal criteria to the Stanislaus River modeling applications. Assessing if the identified criteria are suitable to sufficiently differentiate water temperature benefits to the identified species in order to evaluate the various water operation scenarios (model simulations) being considered.

Temperature criteria, as presented to the Panel by both CDFG and local irrigation districts, were evaluated by the peer review panel that included John Bartholow (USGS), Chuck Hanson (Hanson Environmental), Chris Myrick (Colorado State University) and chaired by Michael Deas (Watercourse Engineering). The Panel concluded that although the use of a seven day average of the daily maximum in the form of a threshold, and three range (e.g., optimum, sub-optimum, and lethal) criteria has been successfully applied in other rivers, it was not successful in application to the Stanislaus because during many periods of the year water temperatures are marginal (ie, sub-optimal but not lethal). The Panel further concluded that although criteria could be selected that would detect differences among operational alternatives, the biological support for criteria values needed to justify their use was lacking (Deas et al, 2004).

The Panel suggested replacing the three tier threshold criteria with a non-linear continuous criterion that retains the seven day daily maximum average metric. The new criteria were based on the survival and mortality of juvenile Chinook salmon response to thermal conditions. A weight is assigned to temperatures above optimum levels according to an exponential function. There are differing optimum levels, and temperature sensitivity exponents, for each life history stage with the egg stage being the most sensitive to temperature change and the adult migration stage the least sensitive. The weights were normalized on a scale of 0 (no impact) to 100 (severe impact) for all life stages. The Panel ultimately concluded that the continuous criteria were a logical extension of multiple threshold criteria (Deas et al, 2004).

In 2004 upon learning that water temperature management in the SJR in both spring and fall transitional time periods is from the mass balance perspective dependent upon tributary flow and water temperature, the Stanislaus stakeholders in conjunction with both the Tuolumne and Merced River stakeholders expressed interest in expanding the Stanisluas-Lower SJR water temperature model project to include both the Tuolumne and Merced Rivers, including thr reach of the SJR from Stevinson down to the confluence with the Stanislaus.

At the end of 2004, an amendment to the original CALFED grant was proposed, approved, and funded to extend the Stanislaus-Lower San Joaquin River Modeling efforts to include temperature monitoring and modeling in the San Joaquin River upstream to Stevinson, in the Merced River up to Crocker Huffman Dam, and in the Tuolumne River up to La Grange Dam.

2.2 Project Description

The extent of this modeling and monitoring effort will include an extensive program of water temperature and meteorological data collection on the mainstem San Joaquin River from Stevinson Bridge downstream to Mossdale Bridge and its three major tributaries, the Stanislaus, Tuolumne and Merced Rivers. Figure 1 identifies the area of study in the lower San Joaquin Basin. This map indicates stream temperature, reservoir profile, and weather station sites. Also indicated, are monitoring sites maintained by the project stakeholders that have provided data for the model. Water temperature data collection occurs upstream of major reservoirs (e.g., New Melones, New Don Pedro, and Lake McClure), in major reservoirs, and downstream of these reservoirs.

The San Joaquin River watershed is located in the Central Valley of California. The San Joaquin River watershed area is 13,537 square miles and extends from the Delta to the Kings River. Total storage is 10,614,000 acre-feet (CVPIA-AFRP website). Only the lower 119 miles from the Merced River confluence to the Delta are presently available to anadromous fish and that will be the area of focus for this project on the San Joaquin River. Temperature monitoring upstream of the Merced River confluence to Stevinson will be carried out to determine boundary conditions (e.g., sources of thermal warming/cooling) allowing water management practices and thermal response to be better understood.

The Stanislaus River is the most downstream tributary to be monitored. It has a watershed area of 1,075 square miles, a total storage of 2,900,000 acre-feet, and an average annual unimpaired run-off of 1,200 taf/year (CVPIA-AFRP website). It flows from the Sierra Nevada Mountains to a confluence with the San Joaquin near the city of Vernalis.

The Tuolumne River, the largest tributary of the San Joaquin River, is located between the Stanislaus and Merced Rivers. Its watershed area is 1,540 square miles, a total storage area of 2,777,000 acre-feet, and an average unimpaired run-off of 1,950 taf/year (CVPIA-AFRP website). It flows from the Sierra Nevada Mountains to a SJR confluence near Shiloh.

The Merced River is the southern most tributary. Its watershed area is 1,273 square miles, a total storage of 1,024,000 acre-feet, and an average unimpaired run-off of 987 taf/year (CVPIA-AFRP website). The Merced River also originates in the Sierra Nevada Mountains and flows to it's SJR confluence near Hills Ferry.

2.3 Objectives

The objectives of this modeling study and temperature data collection protocols are to:

- develop and calibrate a model capable of simulating the water temperatures in reservoirs and river reaches of the lower San Joaquin River basin in response to water management operations
- investigate yet to be defined water management alternatives for improving habitat for salmon and steelhead by decreasing water temperatures
- collect reliable water temperature data in both reservoir and stream environments at time and space intervals that sufficiently document thermal response of lower SJR basin water operations in conjunction with local meteorological conditions
- collect reliable meteorological data at specified locations in the lower SJR basin at sufficient intervals to determine how meteorlogical conditions in concert with water operations influence water temperature response

3 Methods

3.1 Stream Sampling

Several water temperature monitoring stations were established for the Stanislaus River in 1998 and are still currently being used. Continuous monitoring stations were placed at identified spawning and rearing habitat areas (critical points) for fall-run Chinook salmon and steelhead. Figures 2 and 3 identify Stanislaus River thermograph sites below and above Tulloch Reservoir Dam respectively.

The CDFG, and other agencies, have been collecting water temperature data for several years on the Merced and Tuolumne Rivers. The sampling sites on these rivers are similar to the sites chosen for the Stanislaus monitoring sites (i.e. spawning and rearing sites). Figures 4 and 5 identify thermograph sites on the Tuolumne River below and above Don Pedro Reservoir Dam respectively. Turlock Irrigation District (TID) has thermograph sites on the Tuolumne River and has provided stream temperature data for the model. When TID provides coordinates for the site locations these sites will be displayed on the maps. Figures 6 and 7 identify thermograph sites on the Merced River below and above McSwain Reservoir Dam respectively.

Previous monitoring sites on the three tributaries were focused on representing average river conditions at critical points for the model. Several new monitoring sites have been established basin-wide to detect factors that may influence water temperatures such as major spillways, irrigation drains, tributary confluences, and cross-sectional differences. Decisions for the location of these new sites have been based on the input and approval of the stakeholders given at temperature TAC meetings, field inspections, and field tours.

Several monitoring sites on the San Joaquin River were established in 2005 (Figure 8). The CDFG currently has monitoring sites located upstream and downstream of tributary confluences, major inflows, diversions, and locations where substantial thermal warming/cooling is believed to occur. The California Data Exchange Center (CDEC) has 15 monitoring sites on the San Joaquin River that are also being utilized.

All current water temperature monitoring sites that provide data for the model are listed in Table 1. The site operator, CDFG database identifier (ID), river mile, CDEC code (where applicable), and a brief description of each monitoring site location are listed.

Onset thermographs (Stowaways, Tidbits and Hobo Temp Pros) are the data loggers being used by the CDFG for this project. The thermographs are calibrated using the Calibration and Standardization Procedure (Appendix 1) adopted and modified from Lewis et al. 2000. This procedure tests each thermograph logger at room air temperature, room temperature water and cold water temperature against a National Institute of Standards and Technology (NIST) thermometer for precision and accuracy. All thermographs are calibrated before deployment using this procedure unless the manufacturer sends a certification of accuracy for each unit (Onset's Hobo Temp Pro); however, 10% of these certified units are being double-checked for calibration accuracy prior to deployment. All thermographs are set to record data on a continuous, year round, basis rather than seasonal and will be calibrated on an annual basis unless questionable data is retrieved.

Most of the thermographs currently deployed record temperatures on an hourly interval. Previously, 2-hour intervals were used. The CDFG intends to replace all 2-hour interval units with units recording at 1-hour intervals. Sampling at 1.6-hour intervals or less captures more accurate daily maximum temperatures (FSP 1998).

Thermographs will be downloaded monthly when staffing and stream flow conditions permit but should not be less frequent than once every three months. A monthly check of each site will provide a timely opportunity to replace any missing or damaged thermographs due to vandalism, or to take corrective actions such as removing the thermograph from the sand if buried, or replacement of thermographs not working properly (i.e. battery dead or erroneous data). All data are downloaded into a palm pilot and uploaded later into a field computer.

Field auditing (e.g., data quality assurance and control) is done at each site visit. Field crews collecting the data take a water temperature reading at each sampling station using a thermometer. The thermometer should be placed in the stream near the thermograph. The water temperature and time is recorded in a field notebook and is used as a cross reference check for auditing the data. Comments are also recorded in the field and are used to help determine the validity of the data (i.e. thermograph out of the water or buried in sand) and or possibly a malfunctioning thermograph. If the latter is suspected, a second thermograph may be placed to cross reference the data, or the thermograph can be retrieved and recalibrated to find its accuracy using the same procedure listed in Appendix 1.

3.2 Reservoir Profiling

The CDFG has been profiling seven locations at New Melones Reservoir and two locations at Tulloch Reservoir on the Stanislaus River (Figure 3). Figure 5 identifies six profiling sites at Don Pedro Reservoir on the Tuolumne River and Figure 7 identifies five profiling sites at McClure Reservoir and two profiling sites at McSwain Reservoir on the Merced River. Table 2 also lists these sites and includes a brief description.

Reservoir water temperature profiles are collected on a monthly basis using a Hydrolab Datasonde 4. The Hydrolab unit is calibrated monthly using the manufacturer’s calibration procedure. The Hydrolab measures and records depth, temperature, dissolved oxygen, pH and conductivity as the unit is lowered into the water. Measurements are recorded approximately every meter unless a drop in temperature exceeding 0.5 C is encountered. The Hydrolab is then lowered and readings are recorded in smaller increments until the temperature change stabilizes. Decreasing the depth increments to record smaller temperature decreases, provides a better characterization of thermal stratification. Larger depth increments are covered until the Hydrolab reaches the bottom of the reservoir. Field crews record time, surface temperature and secci disk readings at each reservoir profiling site.

3.3 Weather Station Monitoring

Currently there are five weather stations that are maintained by the CDFG and are located throughout the Lower San Joaquin River Basin. The stations are located at:

- CDFG La Grange Field Office near the Tuolumne River (Figure 4)
- Merced River Fish Facility (Figure 6)
- Goodwin Pool on the Stanislaus River (Figure 2)
- Riverbank at the Stanislaus River weir (Figure 2)
- The confluence of the Stanislaus and San Joaquin Rivers near Vernalis (Figure 2)

These stations record continuous air temperature, relative humidity, wind speed and direction, and solar radiation. The meteorological data from these weather stations are manually collected once every three months. The data is downloaded directly from the station into WINDS (Weather Information Network Display Software) using a field computer.

There are also active weather stations at McClure Reservoir and a CIMIS station on the Merced River. As water and air temperature data collection progresses, and modeling commences, the need for additional weather stations, or re-deployment of existing stations may be required.

3.4 Safety

The SJR project requires frequent site visits for monitoring and data collection. Site visits can include hiking, wading, boating, and driving. Field crews are subjected to various environmental conditions (e.g. changing stream flows and inclement weather) that require good judgment when determining where, when, and how to place monitoring equipment and collect data. Several actions have been taken to improve field crew safety awareness and include:

- Field work is done by two or more crew members
- Monthly field safety meetings
- Cell phones are provided for all field crews
- American Red Cross First Aide/CPR training course conducted by the CDFG
- Defensive driver training conducted by the CDFG
- Boater Safety Education course offered by the California Department of Boating and Waterways
- Informal field boater training done by CDFG experienced boat operators.

4 Data Management and Reporting

The CDFG staff is responsible for the collection of water temperature and meteorological data from the above mentioned stations for use in model development and application. As previously mentioned the CDFG has collected several years of historical water temperature data for the Stanislaus River model and is currently collecting historical water temperature data for the San Joaquin River Basin model. Collected data are being stored in four databases:

- Stanislaus River Temperature Database – a local database designed specifically for the original Stanislaus project by AD Consultants. The database was developed on a Microsoft Access platform and stores both thermograph and profile data. Historical data is also stored in this database.

- San Joaquin River Tributaries Temperature Database - a second local database also designed by AD Consultants. This database is similar to the Stanislaus River Temperature Database but contains the data collected for the remainder of the basin. This second database was created because of the size constraints of the Access platform

- California Data Exchange Center (CDEC) Internet database - a global database operated and maintained by the California Department of Water Resources (CDWR). Approximately once a month, data from the Stanislaus River Temperature Database has been exported to CDEC for long-term storage and posting on the Internet for general public accessibility. Because of the project extension, the department is seeking to expand our sites available on CDEC to include basin-wide temperature data.

- Weather Information Network Display Software (WINDS) - a database and display software for remote data collection platforms, produced by the Weathernews Company. Meteorological data from the weather stations are downloaded and saved in this database.

An important aspect of data collection and reporting is to ensure data integrity and validity. The structure of the local database and the characteristics of Microsoft Access usually enforce the integrity of the data. However, it is the responsibility of the CDFG staff to ensure valid data. To aid the staff in this task, the database is equipped with a QA/QC Utility to detect questionable data. The QA/QC Utility is designed to flag any data points that have a value in excess of a certain tolerance when compared with adjacent points. To minimize the possibility that erroneous data will migrate to other applications, the database will not allow the user to generate any reports or graphs until a QA/QC check is performed and all the data points tagged with QA/QC codes are cleared.

The QA/QC Utility enables the user to see what data has been tagged and provides the user with an editor to fix the data. The data are also graphed and visually inspected. Data that appear to be erroneous are either modified (accepted) or nullified (deleted). These edits are done in a second data column. The original data is always retained for review. Professional judgment is required to determine whether or not to correct (for example, by interpolating with other points) or to nullify the data. This decision is made on a case by case basis by the CDFG staff in concert with the modeling team who assess the original and modified data.

Once processed, the data can be used for temperature model application purposes as well as to generate graphs and reports. An updated copy of the database is periodically sent to AD Consultants for immediate use with the HEC-5Q Model. Updates are also exported to CDEC for inclusion in the global database.

5 References

Deas, M., Bartholow, J., Hanson, C., Myrick, C. 2004. Peer review of water temperature objectives used as evaluation criteria for the Stanislaus – lower San Joaquin River water temperature modeling analysis.

FSP, 1998. Stream temperature sampling frequencies explored. Forest Science Project Technical Notes. Forest Science Project, Humboldt State University Foundation, Arcata, CA, Vol. 1, No. 2, April 1998, 4 pp.

Lewis, T.E., Lamphear, D.W., McCanne, D.R., Webb, A.S., Krieter, J.P., Conroy, W.D., 2000. Regional assessment of stream temperatures across Northern California and their relationship to various landscape-level and site-specific attributes. Forest Science Project Technical Report, 2000. p. A38-A39.

Guignard, J. 2001. Stanislaus river temperature monitoring/modeling project water temperature criteria development. California Department of Fish and Game, La Grange, CA.

Loudermilk, William E. 1996. Fall-run chinook salmon egg deposition and exposure to lethal water temperatures in the designated salmon spawning area of the lower Stanislaus River. DFG Exhibit 96-6 to the State Water Resources Control Board.

Marston, Dean D. 2003. Stanislaus river water temperature criteria development and application for chinook salmon and steelhead. DFG Publication to Cal-Fed Sponsored Stanislaus Water Temperature Objectives Peer Review Panel Proceedings.

Myrick, C.A., and J.J. Cech, Jr. 2001. Temperature effects on chinook salmon and steelhead: a review focusing on California’s Central Valley populations. Bay-Delta Modeling Forum Technical Publication 01-1

Table 1. Current Water Temperature Monitoring Sites Used in the Lower San Joaquin Basin-Wide Modeling Project.

Operator	Database Site ID	Site Name	River Mile	CDEC Station Code
		Merced River		
CDFG	M59B	Merced River Hwy 59 Bridge	41	
CDFG	M99	Merced River at Highway 99 Bridge	22	
CDFG	MASTVSP	Merced River above Stevinson Spill	4	
CDFG	MBRAT	Merced River Below Ratzlaff	40	
CDFG	MBRICE	Merced River at Briceburg		
CDFG	MBSTVSP	Merced River below Stevinson Spill	4	
CDFG	MDRYCK	Dry Creek above confluence of Merced River		
CDFG	MEX	Merced River Below Exchequer Dam	61	
CDFG	MGAL	Merced River Gallo Ranch Bridge	39	
CDFG	MGST	Merced River G Street Bridge	46	
CDFG	MHAG	Merced River Hagaman Park	13	
CDFG	MHAG2	Merced River at Hagaman Park RST access (side)	13	
CDFG	MHFLD	Merced River Hatfield Park	1	
CDFG	MLIVING	Merced River above Livingston spill	21	
CDFG	MRAT	Merced River on the Ratzlaff property	40	
CDFG	MRH	Merced River Hatchery	52	
CDFG	MROB	Merced River on the Robinson property	43	
CDFG	MRSFB	Merced River near Santa Fe Bridge at Cressey Dairy	28	
CDFG	MRSHAF	Merced River at Shaffer Bridge	31	
CDFG	MRSJR	Merced River above San Joaquin River Confluence	0	
CDFG	MRSWAIN2	Merced River at McSwain Dam	56	
CDFG	MUROB	Merced River upper Robinson	44	
CDWR		Merced River near Cressey	27	CRS
CDWR		Merced River near Stevinson	4	MST
NRS	MRBAG	Merced River at Bagby		
NRS	MREXCH	Merced River at McClure's New Exchequer Dam	61	
NRS	MRRM1	Merced River at River Mile 1	1	
NRS	MRRM12	Merced River at River Mile 12	12	
NRS	MRRM31	Merced River at River Mile 31	31	
NRS	MRRM42	Merced River at River Mile 42	42	
NRS	MRRM47	Merced River at River Mile 47	47	
NRS	MRRM52	Merced River at River Mile 52	52	
NRS	MRSWAIN	Merced River at McSwain Dam	56	
		San Joaquin River		
CDFG	MUDSL	Mud Slough upstream of SJR confluence		
CDFG	SALTSL	Salt Slough upstream of SJR confluence		
CDFG	SJALAIRD	San Joaquin River above Laird Park	91	
CDFG	SJALAT5	San Joaquin River above Lateral #5 canal	102	
CDFG	SJAMUD	San Joaquin River above Mud Slough	121	
CDFG	SJANMW	San Joaquin River above Newman Wastewater canal	121	
CDFG	SJASALT	San Joaquin River above Salt Slough	128	
CDFG	SJATR	San Joaquin River above Tuolumne River	84	
CDFG	SJAWPD	San Joaquin River above Westport Drain	93	
CDFG	SJAWSLC	San Joaquin River above West Side Lift Canal	84	
CDFG	SJBLAIRD	San Joaquin River below Laird Park	89	

Operator	Database Site ID	Site Name	River Mile	CDEC Station Code
CDFG	SJBLAT5	San Joaquin River below Lateral #5 canal	102	
CDFG	SJBSALT	San Joaquin River below Salt Slough	128	
CDFG	SJBST1	San Joaquin River 1/2 mile below the Stanislaus River Confluence (River Left)	74	
CDFG	SJBST2	San Joaquin River 1/2 mile below the Stanislaus River Confluence (River Right)	74	
CDFG	SJDF1	San Joaquin River at Durham Ferry (4 miles downstream from the confluence)	71	
CDFG	SJFFB	San Joaquin River 1.5 miles d/s Freemont Ford Bridge	123	
CDFG	SJHF1	SJR at Hills Ferry u/s of Merced confluence	118	
CDFG	SJLAT5	San Joaquin River in Lateral #5 canal	102	
CDFG	SJMR1	SJR at Hills Ferry d/s of Merced confluence (RV park) River Left	117	
CDFG	SJMR2	SJR at Hills Ferry d/s of Merced confluence (RV park) River Right	117	
CDFG	SJOFC	San Joaquin River at the Old Fisherman's Club	81	
CDFG	SJSTV	San Joaquin River at Stevinson Bridge	132	
CDFG	SJTR1	San Joaquin River above Two Rivers (approx. 100 meters above the confluence)	73	
CDFG	SJTR2	San Joaquin River above Two Rivers (approx. 800 meters above the confluence)	75	
CDWR		San Joaquin River near Patterson	97	SJP
CDWR		Orestimba Creek at River Road near Crows Landing	108	OCL
CDWR		San Joaquin River at Ramona Lake		RML
CDWR		San Joaquin River at Moran Drain	105	MON
CDWR		San Joaquin River at Marshall Drain	105	MSR
CDWR		San Joaquin River at Spanish Land Grant Drain	105	SGD
CDWR		Del Puerto Creek		DPC
CDWR		Hospital Creek		HSP
CDWR		Ingram Creek		ING
CDWR		San Joaquin River at Jerusalem Drain	63	NJD
SJCO		San Joaquin River at Mossdale Bridge	56	MSD
TID	SJDR	San Joaquin River at Dos Rios	86.2	
TID	SJGC	San Joaquin River at Gardner Cove	80	
USBR		San Joaquin River at Vernalis	72	VER
USGS		San Joaquin River Mud Slough near Gustine		MSG
USGS		San Joaquin River Salt Slough at HWY 165 near Stevinson		SSH
USGS		San Joaquin River at Fremont Ford Bridge	125	FFB
USGS		San Joaquin River near Crows Landing	106	SCL
		Stanislaus River		
CDFG	AMCHSP	Stanislaus River above McHenry spill	29	
CDFG	AMIDSP	Stanislaus River above MID spill in Ripon	19	
CDFG	COLL1	Collierville Powerhouse Tailrace		CLP
CDFG	GMB1	Stanislaus River at Gambini Property d/s of pond at Oakdale Rec. Area	38	GMB
CDFG	GOOD1	Goodwin Canyon immediately downstream of Goodwin Dam	58	GDC
CDFG	GWNBTM	Goodwin Dam Log Boom (Bottom of the water column)	58	
CDFG	GWNMID	Goodwin Dam Log Boom (Middle of the water column)	58	
CDFG	GWNTOP	Goodwin Dam Log Boom (Top of the water column)	58	
CDFG	KF1	Stanislaus River at Knights Ferry at the Sonora Road Bridge	54	KFS
CDFG	MCH1	Stanislaus River at McHenry Access	29	
CDFG	NFMF1	Below the confluence of the North and Middle Forks u/s of the Collierville Powerhouse		TCN
CDFG	NMPH1	New Melones Powerhouse Tailrace		NMT
CDFG	OAKR1	Stanislaus River at Oakdale Rec. Area (1/4 mile d/s of Hwy 120 Bridge)	40	ORA
CDFG	OB1	Stanislaus River 1/4 mile downstream of Orange Blossom Bridge	46	OBS
CDFG	RB3	Stanislaus River at Riverbank (Army Corp of Engineers property at Stanislaus Weir)	31	JMP
CDFG	SFRK1	South Fork of the Stanislaus approximately 2 miles upstream of New Melones		SSF
CDFG	SPHF1	Stanislaus Powerhouse (In the Stanislaus canal immediately upstream of the forebay)		SSC
CDFG	ST99	Stanislaus River at Highway 99 in Ripon	15	
CDFG	STTR1	Stanislaus River above Two Rivers (approx. 100 meters above the SJR confluence)	0	TDP

Operator	Database Site ID	Site Name	River Mile	CDEC Station Code
CDFG	STTR2	Stanislaus River above Two Rivers (approx. 800 meters above the SJR confluence)	0	
CDFG	TULT1	Tulloch Powerhouse Tailrace	60	
CDWR		Stanislaus River at Orange Blossom Bridge	47	OBB
USBR		Stanislaus River at Ripon	15	RPN
USGS		Stanislaus River near Oakdale	41	SOK
		Tuolumne River		
CDFG	T7-11	Tuolumne River 7-11 Gravel Company	38	
CDFG	TAHCKSP	Tuolumne River above Hickman Spill	33	
CDFG	TASFRK	Tuolumne River above the South Fork		
CDFG	TBAS	Tuolumne River Basso Bridge	47.5	
CDFG	TBHCKSP	Tuolumne River below Hickman Spill	32	
CDFG	TBSFRK	Tuolumne River below the South Fork		
CDFG	TCKPH	Cherry Creek Power House		
CDFG	TDRYCK	Dry Creek above Tuolumne River		
CDFG	THB	Tuolumne River Hickman Bridge	31	
CDFG	TR9STB	Tuolumne River at 9th Street Bridge	16	
CDFG	TRA1	Tuolumne River Riffle A1	51.6	
CDFG	TRASFB	Tuolumne River above Santa Fe Bridge	21	
CDFG	TRC1	Tuolumne River Riffle C1	49.7	
CDFG	TRCRDB	Tuolumne River at Carpenter Road Bridge	12	
CDFG	TRD2	Tuolumne River Riffle D2	48.8	
CDFG	TREARLY	Tuolumne River at Early Intake		
CDFG	TRFGB	Tuolumne River near Fox Grove Bridge	26	
CDFG	TRG3	Tuolumne River Riffle G3	45	
CDFG	TRI2	Tuolumne River Riffle I2	43.2	
CDFG	TRK1	Tuolumne River Riffle K1	42.6	
CDFG	TRMRDB	Tuolumne River at Mitchell Road Bridge	19	
CDFG	TRQ3	Tuolumne River Riffle Q3	35	
CDFG	TRSHILO1	Tuolumne River at Shiloh Bridge	3.4	
CDFG	TRWARDS	Tuolumne River near Wards Ferry Bridge		
CDFG	TSF	Tuolumne River Santa Fe Gravel	36.5	
CDFG	TSFRK	South Fork of the Tuolumne River near confluence		
CDWR		Tuolumne River near Modesto	15	MOD
TID	TR13B	Tuolumne River at riffle 13B	45.5	
TID	TR19	Tuolumne River at riffle 19	43.4	
TID	TR21	Tuolumne River at riffle 21	42.9	
TID	TR3B	Tuolumne River at riffle 3B	49	
TID	TRA7	Tuolumne River at riffle A7	50.8	
TID	TRFG	Tuolumne River at Fox Grove	26	
TID	TRHUSN	Tuolumne River at Hughson Sewer	23.6	
TID	TRLGPH	Tuolumne River at LaGrange Powerhouse		
TID	TRRFB	Tuolumne River at Roberts Ferry Bridge	39.5	
TID	TRRG	Tuolumne River at Ruddy Gravel	36.7	
TID	TRSHILO2	Tuolumne River at Shiloh Bridge	3.4	

Table 2. Current CDFG Reservoir Profiling Sites Used In the Lower San Joaquin Basin-Wide Modeling Project

Database Site ID	Site Location	Position	
	Merced River		
MC49	McClure Reservoir at Highway 49 Bridge	N 37 39’ 40.9”	W 120 12’ 29.1”
MCCA	McClure Reservoir at Cotton Arm	N 37 34’ 59.0”	W 120 15’ 04.6”
MCDAM	McClure Reservoir at New Exchequer Dam	N 37 35’ 21.3”	W 120 16’ 01.1”
MCHSB	McClure Reservoir at Horseshoe Bend	N 37 40’ 03.2”	W 120 14’ 01.4”
MCPIN	McClure Reservoir at Piney Creek	N 37 39’ 26.7”	W 120 17’ 21.5”
MSDAM	McSwain Reservoir at McSwain Dam	N 37 31’ 14.9”	W 120 18’ 29.9”
MSEXC	McSwain Reservoir Below Exchequer Dam	N 37 33’ 12.8”	W 120 16’ 54.4”
	Stanislaus River		
NM49	New Melones Reservoir at Hwy 49 Bridge	N 38 00' 15.0"	W 120 29' 59.9"
NMC9	New Melones Reservoir at Camp 9 Bridge	N 38 07' 00.3"	W 120 23' 02.4"
NMNA	New Melones Reservoir at North Arm	N 37 59' 31.0"	W 120 32' 39.0"
NMND	New Melones Reservoir at the New Dam	N 37 57' 04.9"	W 120 31' 08.5"
NMOD	New Melones Reservoir at the Old Dam	N 37 57' 14.5"	W 120 30' 52.2"
NMPF	New Melones Reservoir at Parrots Ferry Bridge	N 38 02' 14.0"	W 120 27' 14.6"
NMSA	New Melones Reservoir at South Arm	N 37 56' 35.2"	W 120 29' 32.3"
TD	Tulloch Reservoir Dam	N 37 52' 35.8"	W 120 36' 06.2"
TOB	Tulloch Reservoir at O'Byrnes Ferry Bridge	N 37 53' 58.6"	W 120 34' 03.8"
	Tuolumne River		
DP49	Don Pedro Reservoir at Highway 49 Bridge	N 37 50’ 22.4”	W 120 22’ 41.9”
DPDAM	Don Pedro Reservoir Dam	N 37 42’ 09.5”	W 120 25’ 18.2”
DPJB	Don Pedro Reservoir at Jacksonville Bridge	N 37 50’ 14.4”	W 120 20’ 42.9”
DPMB	Don Pedro Reservoir at Middle Bay	N 37 46’ 04.6”	W 120 21’ 25.2”
DPWC	Don Pedro Reservoir at Woods Creek	N 37 52’ 52.6”	W 120 24’ 55.3”
DPWF	Don Pedro Reservoir at Wards Ferry Bridge	N 37 52’ 38.8”	W 120 17’ 42.0”

Lat/Lon hddd mm’ ss.s” (WGS 84)

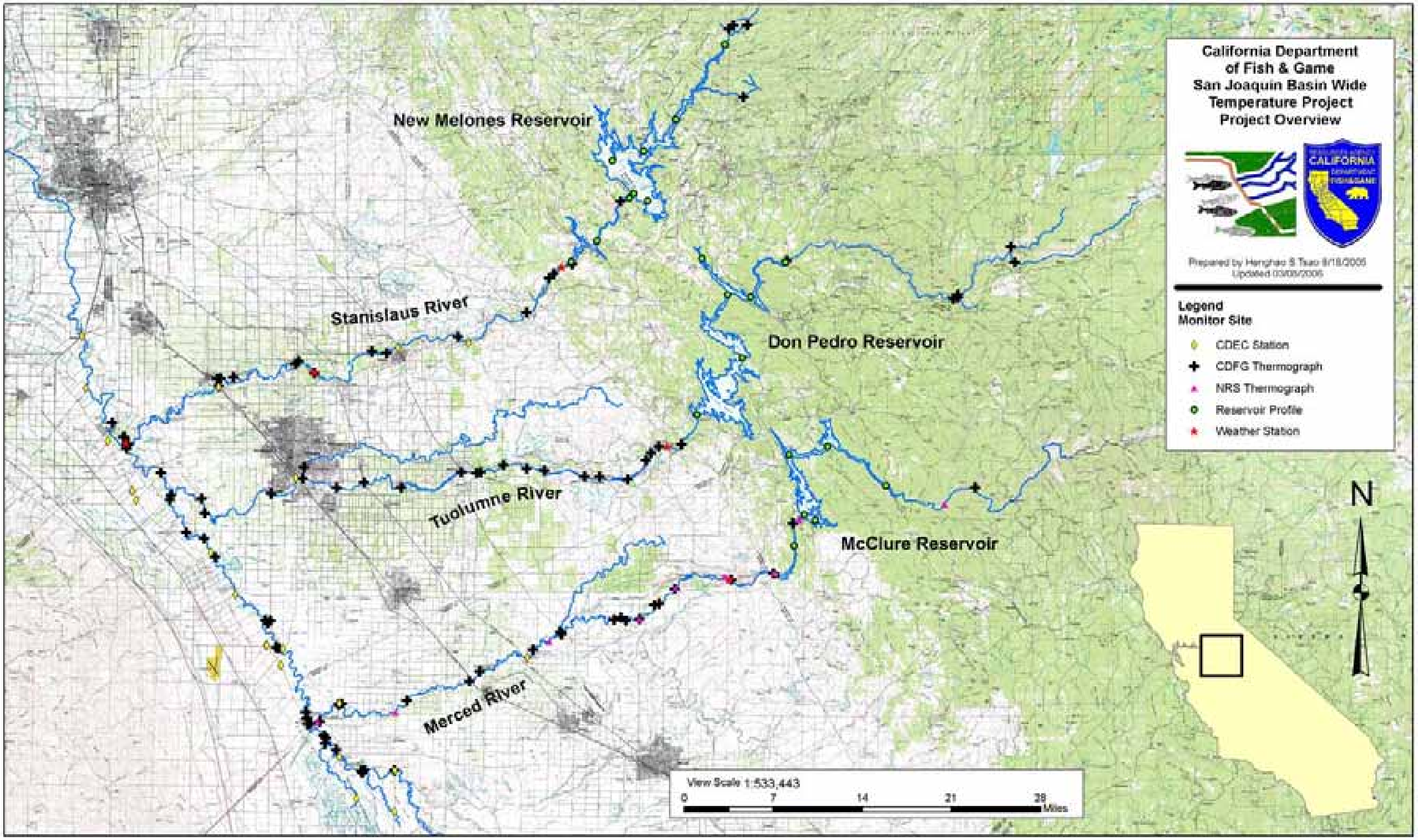


Figure 1. Lower San Joaquin Basin-Wide Water Temperature Modeling Project study area.

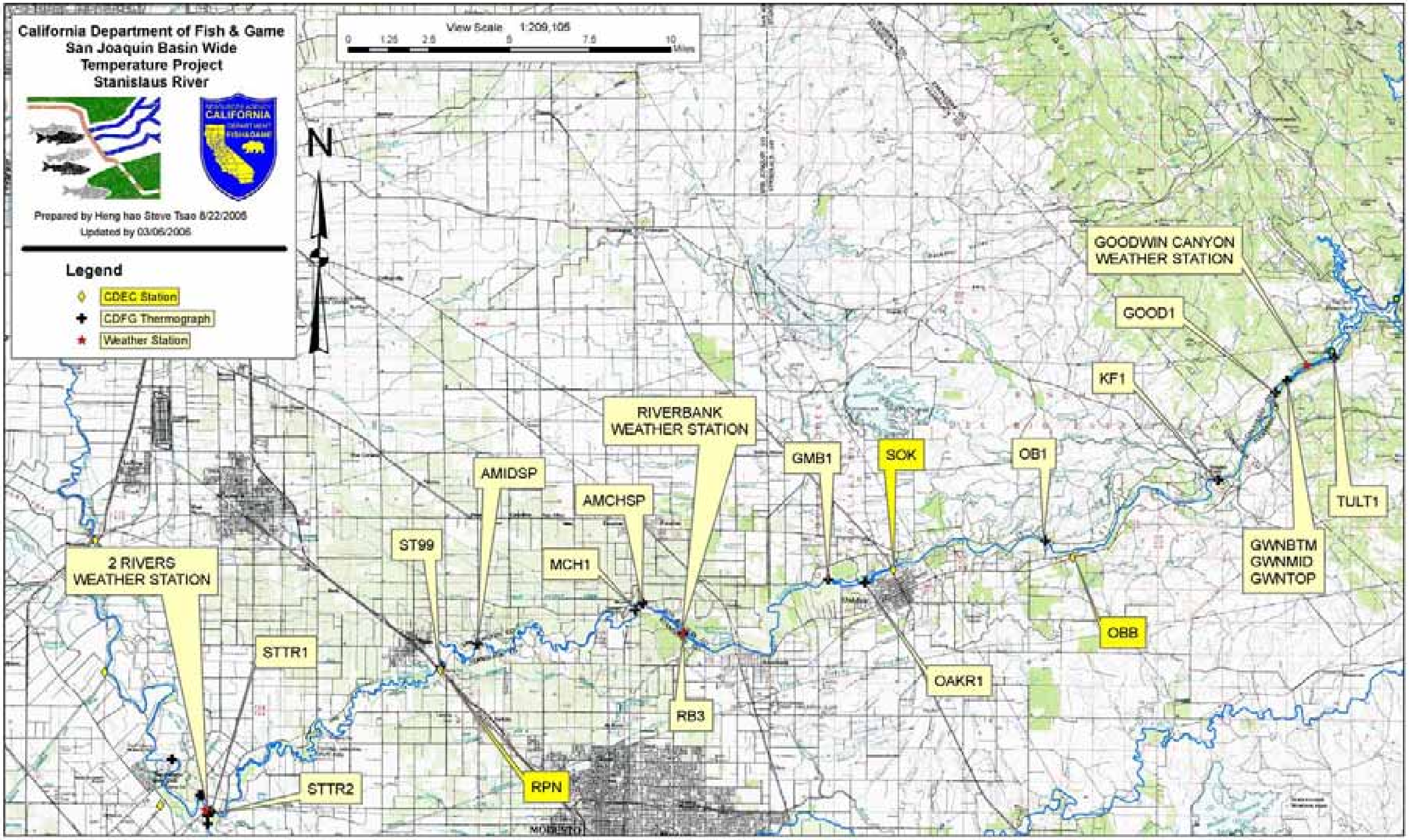


Figure 2. Project monitoring sites on the Stanislaus River below Tulloch Reservoir Dam.

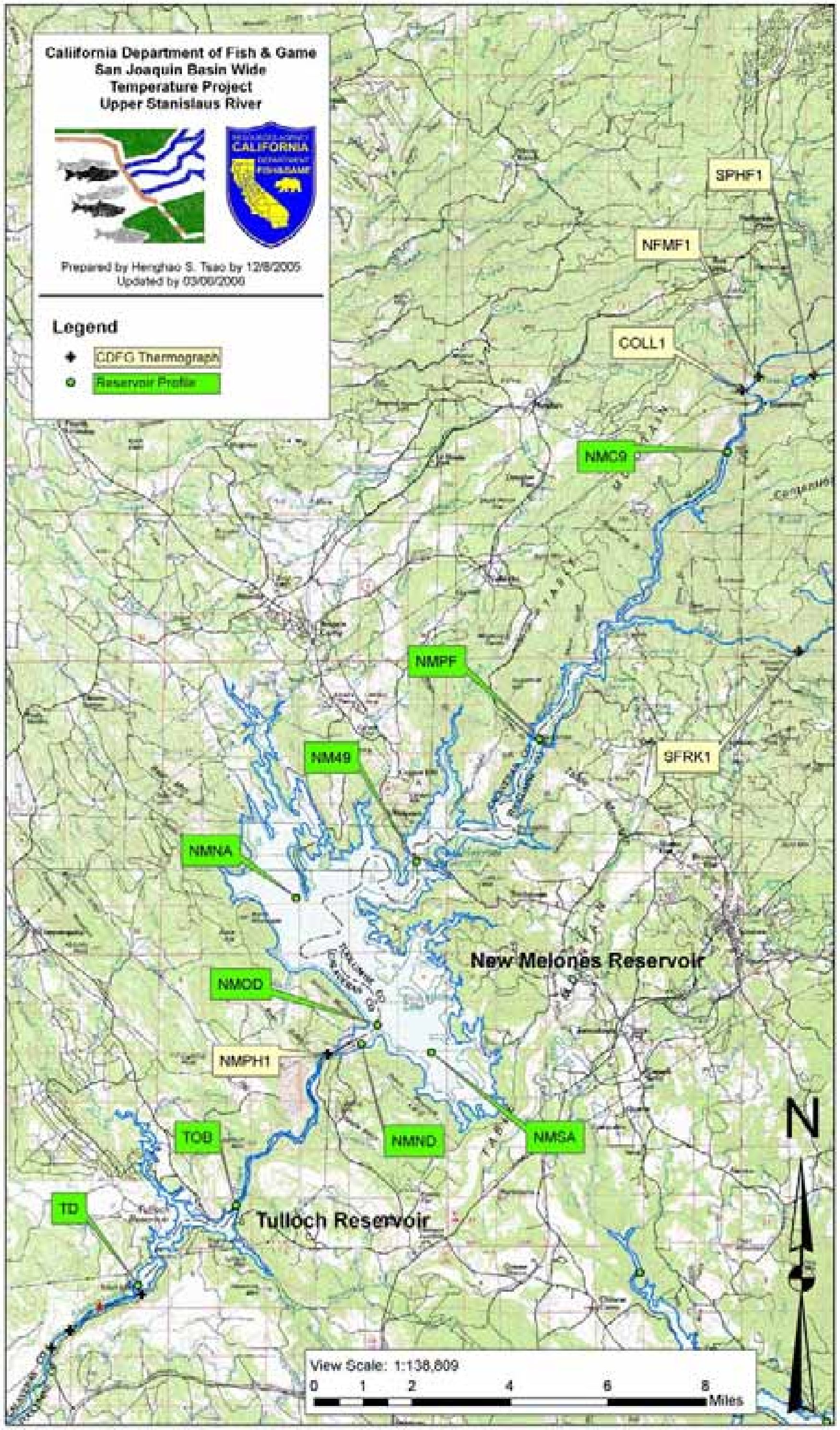


Figure 3. Project monitoring sites on the Stanislaus River above Tulloch Reservoir Dam.

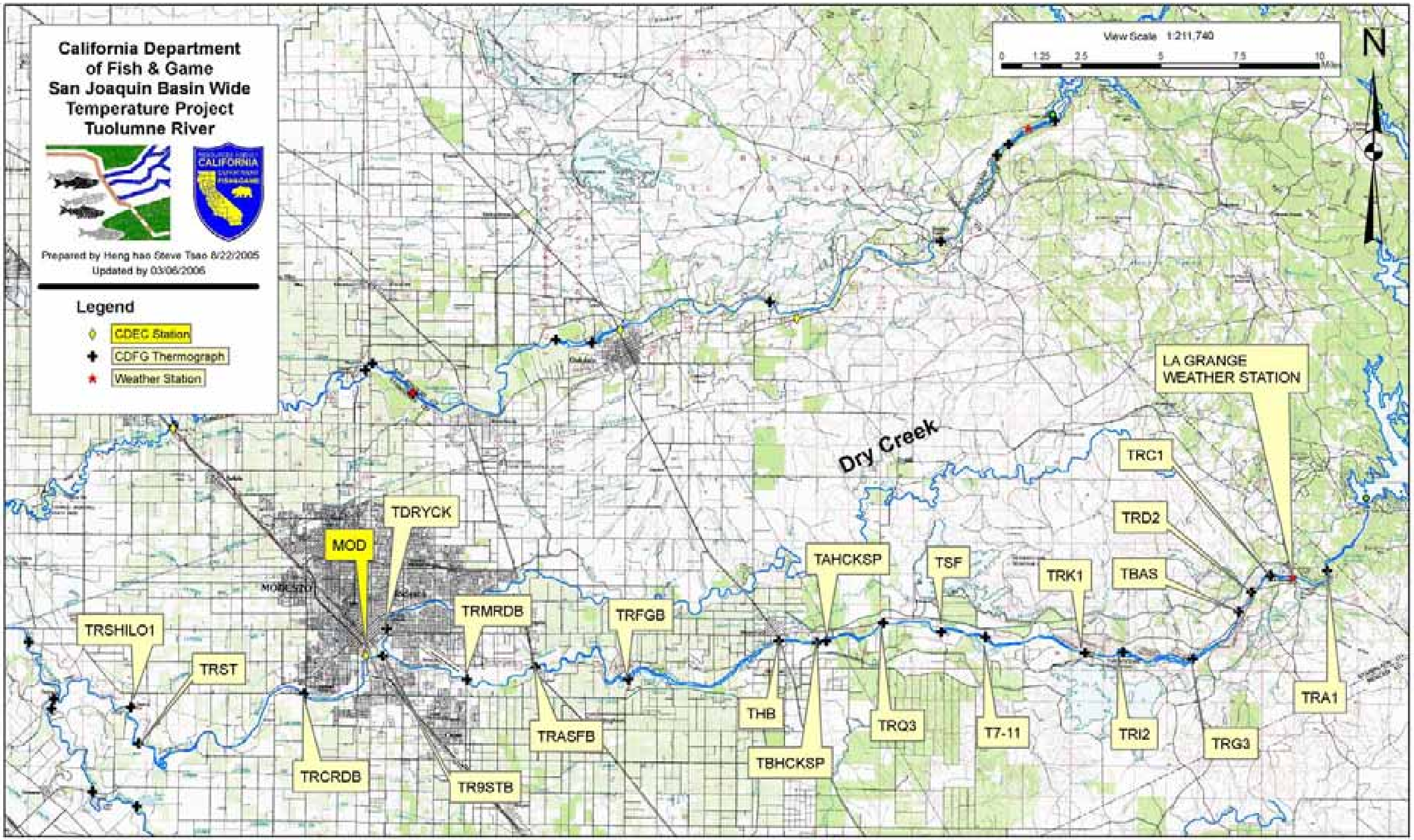


Figure 4. Project monitoring sites on the Tuolumne River below Don Pedro Reservoir Dam.

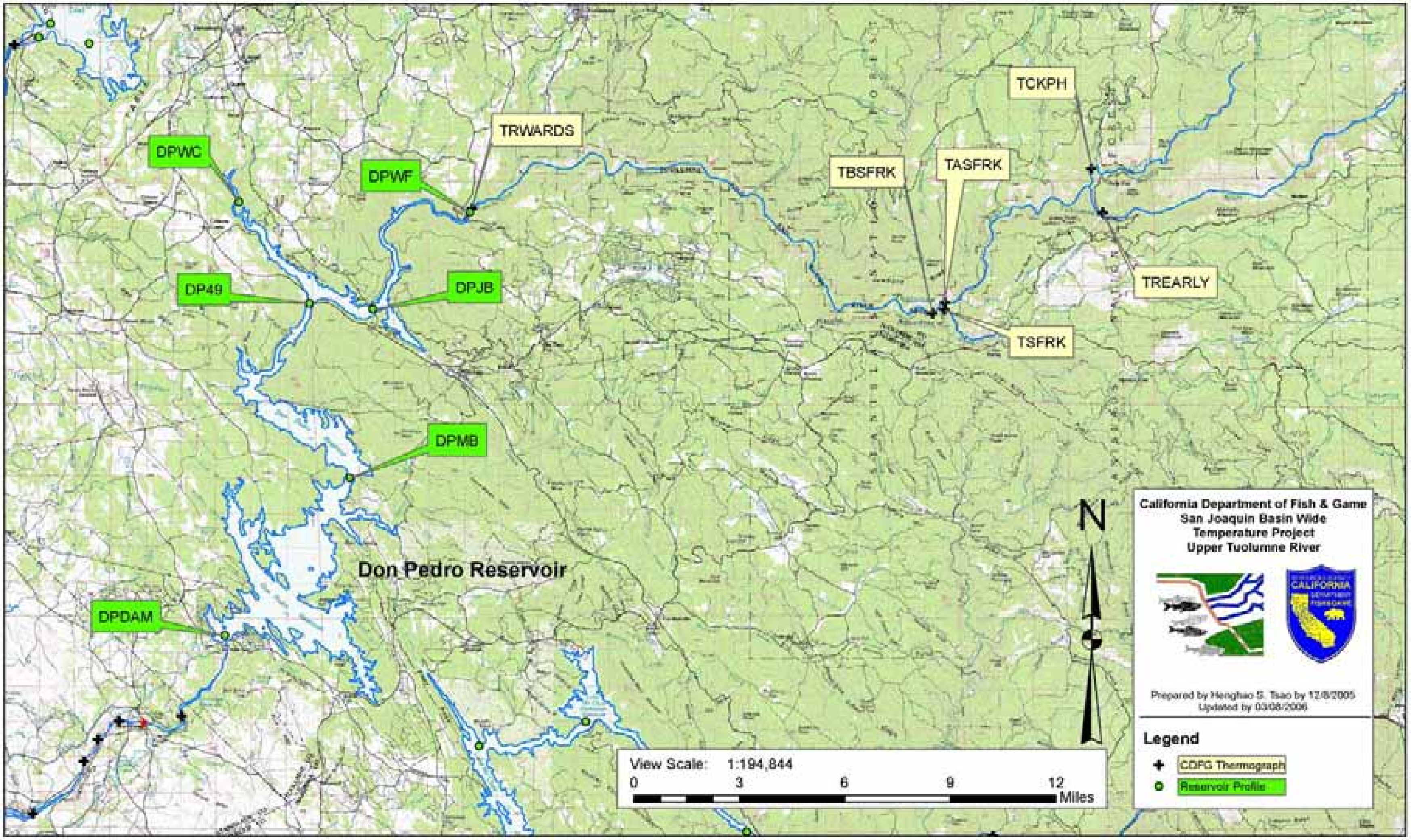


Figure 5. Project monitoring sites on the Tuolumne River above Don Pedro Reservoir Dam.

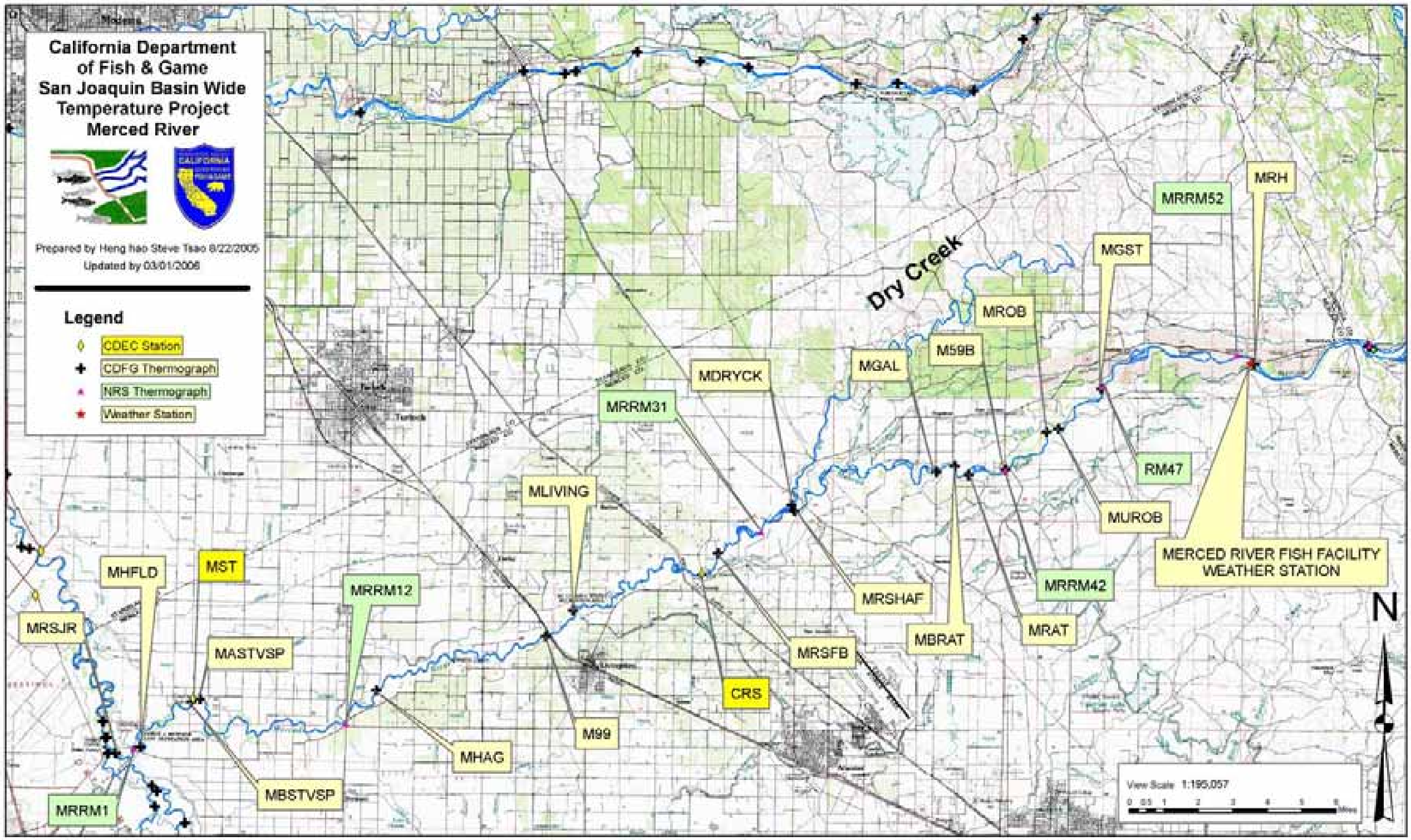


Figure 6. Project monitoring sites on the Merced River below McSwain Reservoir Dam.

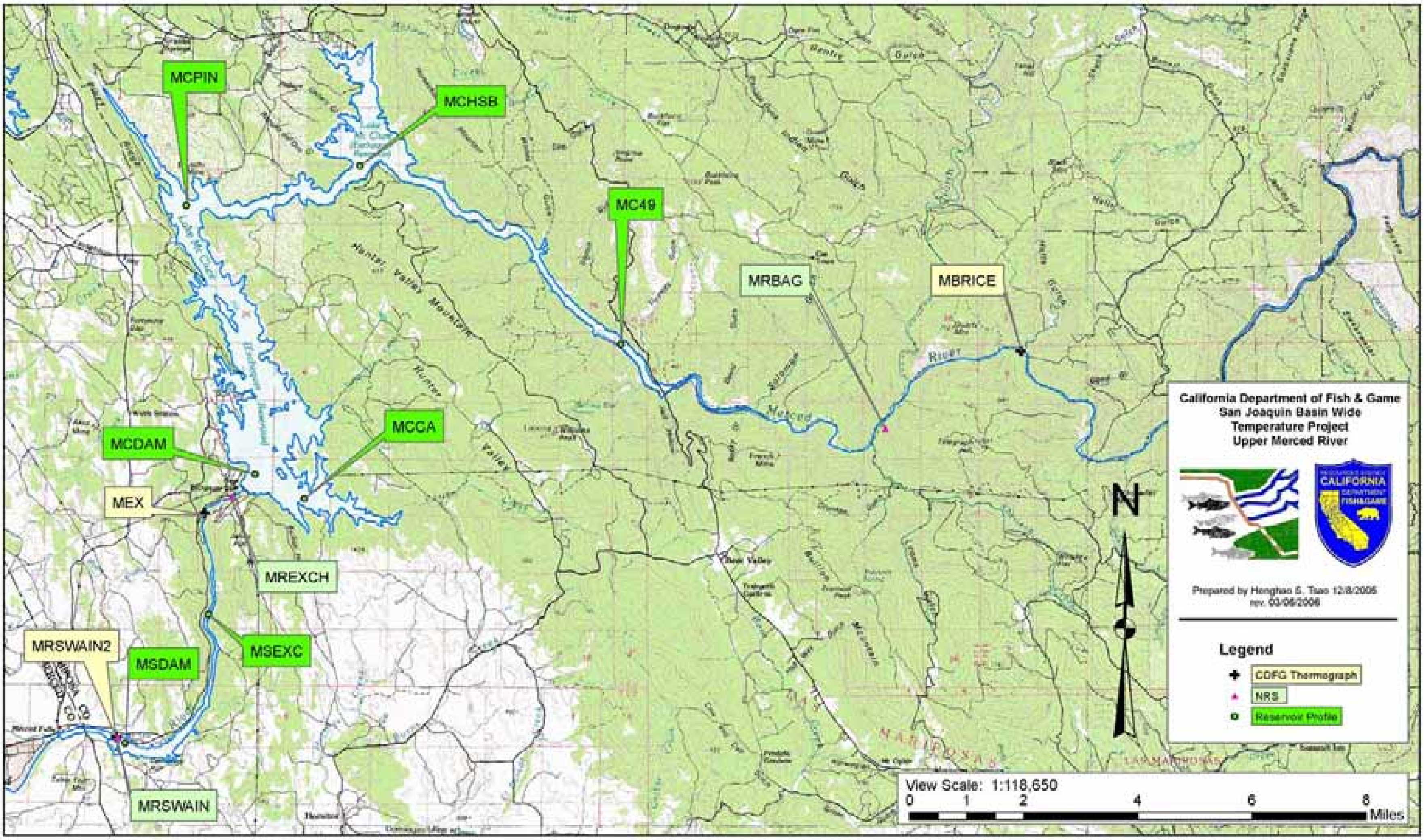


Figure 7. Project monitoring sites on the Merced River above McSwain Reservoir Dam.

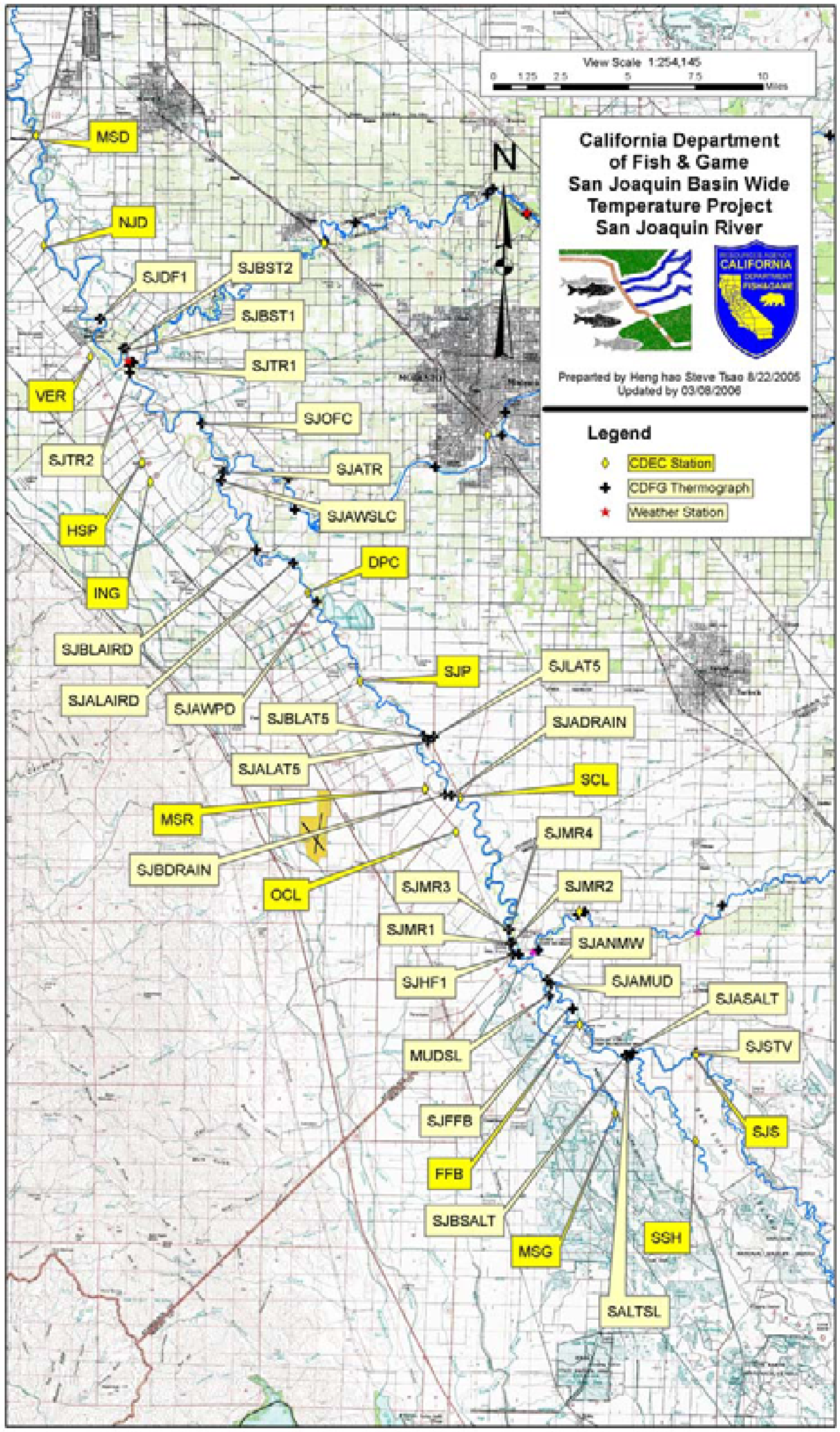


Figure 8. Project monitoring sites on the lower San Joaquin River.

APPENDIX F:

SAN JOAQUIN RIVER GROUP COMMENTS AND OTHER MATERIAL ASSOCIATED WITH THE SEPTEMBER 25, 2007 PUBLIC WORKSHOP ON ASSESSMENT OF POTENTIAL TEMPERATURE IMPAIRMENTS IN THE MERCED, TUOLUMNE, STANISLAUS, AND SAN JOAQUIN RIVERS

Item

1. Notice of a Public Workshop on Assessment of Potential Temperature Impairments in the Merced, Tuolumne, Stanislaus, and San Joaquin Rivers (June 4, 2007)

2. Postponement Notice of a Public Workshop on Assessment of Potential Temperature Impairments in The Merced, Tuolumne, Stanislaus, and San Joaquin Rivers (July 8, 2007)

3. Correspondence, electronic mail from Kenneth Petruzzelli, O'Laughlin& Paris LLP, counsel for the San Joaquin River Group Authority, to Daniel McClure, Central Valley Regional Water Quality Control Board, submitting temperature comments with exhibits (November 19, 2007).

4. Correspondence, electronic mail from Kenneth Petruzzelli, O'Laughlin& Paris LLP, counsel for the San Joaquin River Group Authority, to Daniel McClure, Central Valley Regional Water Quality Control Board, submitting temperature comments with corrected exhibits (November 19, 2007).

5. San Joaquin River Group Authority's Written Comments to Proposal by Central Valley Regional Water Quality Control Board to List The San Joaquin, Tuolumne, Merced And Stanislaus Rivers as Impaired Bodies of Water for Temperature Pursuant to Section 303(d) (Submitted November 19, 2007)

California Regional Water Quality Control Board
Central Valley Region
Karl E. Longley, ScD, P.E., Chair

Linda S. Adams
Secretary for Environmental Protection

Sacramento Main Office
11020 Sun Center Drive #200, Rancho Cordova, California 95670-6114
Phone (916) 464-3291 • FAX (916) 464-4645
http://www.waterboards.ca.gov/centralvalley

Arnold Schwarzenegger
Governor

NOTICE OF A PUBLIC WORKSHOP ON ASSESSMENT OF POTENTIAL TEMPERATURE IMPAIRMENTS IN THE MERCED, TUOLUMNE, STANISLAUS, AND SAN JOAQUIN RIVERS

Staff of the California Regional Water Quality Control Board, Central Valley Region (Central Valley Water Board) will hold a public workshop to provide information and receive comments on potential listing of the Merced, Tuolumne, Stanislaus and San Joaquin Rivers on the State's Clean Water Act Section 303(d) list as impaired by high temperatures.

Workshop topics include:

- California Department of Fish and Game's temperature data and analysis
- The approach the Central Valley Water Board staff plans to use to assess potential temperature impairments in these waterbodies
- Input from interested parties
    - If you would like to present information relevant to this issue, please contact Jennifer LaBay (916-464-4735) at least a week prior to the workshop.

The temperature data and analysis provided to the Central Valley Water Board by the California Department of Fish and Game, as well as background information on the 303(d) list will soon be available at the following location:
http://www.waterboards.ca.gov/centralvalley/programs/tmdl/index.htm.
If you would prefer a CD with the data please contact Central Valley Water Board staff.

Time and Location of Public Workshop:

Date: 20 July 2006
Time: 10 am to 3 pm
Place: Central Valley Water Board
Board Room
11020 Sun Center Drive, #200
Rancho Cordova, CA 95670

Map and directions to the Central Valley Water Board are available at:
http://www.waterboards.ca.gov/centralvalley/contact_us/index.html

The workshop facilities will be accessible to persons with disabilities. Individuals requiring special accommodation are requested to contact Jennifer LaBay at (916) 464-4735 at least 5 working days prior to the meeting. TTY users may contact the California Relay Service at (800) 735-2929 or voice line at (800) 735-2922.

We anticipate sending out notices during the 303(d) list update process for any public meetings that will be held and for any documents that will be made available to the public. In order to receive notices regarding the 303(d) list update process, interested parties should sign up for the Impaired Waterways 303(d) List email notification system at the following website: http://www.waterboards.ca.gov/lyrisforms/reg5_subscribe.html

For further information, contact Jennifer LaBay at JLaBay@waterboards.ca.gov or (916) 464-4735 or Danny McClure at dmcclure@waterboards.c.a.gov or (916) 464-4751.

*Original Signed By Jerry A. Bruns for* ______
Kenneth D. Landau, Assistant Executive Officer

4 June 2007

Linda S. Adams
Secretary for
Environmental Protection

California Regional Water Quality Control Board
Central Valley Region

Karl E. Longley, ScD, P.E., Chair

Sacramento Main Office
11020 Sun Center Drive #200, Rancho Cordova, California 95670-6114
Phone (916) 464-3291 • FAX (916) 464-4645
http://www.waterboards.ca.gov/centralvalley

Arnold Schwarzenegger
Governor

POSTPONEMENT NOTICE OF A PUBLIC WORKSHOP ON ASSESSMENT OF POTENTIAL TEMPERATURE IMPAIRMENTS IN THE MERCED, TUOLUMNE, STANISLAUS, AND SAN JOAQUIN RIVERS

The workshop previously scheduled for 20 July 2007 has been postponed until September.

Date: 25 September 2007
Time: 10:00 am to 3:00 pm
Place: Central Valley Regional Water Quality Control Board
11020 Sun Center Drive, Suite 200
Rancho Cordova, CA 95670

Staff of the California Regional Water Quality Control Board, Central Valley Region (Central Valley Water Board) will hold a public workshop to provide information and receive comments on potential listing of the Merced, Tuolumne, Stanislaus and San Joaquin Rivers on the State's Clean Water Act Section 303(d) list as impaired by high temperatures.

Workshop topics include:

- California Department of Fish and Game's temperature data and analysis
- The approach the Central Valley Water Board staff plans to use to assess potential temperature impairments in these waterbodies
- Input from interested parties
  - If you would like to present information relevant to this issue, please contact Jennifer LaBay (916-464-4735) at least a week prior to the workshop.

The temperature data and analysis provided to the Central Valley Water Board by the California Department of Fish and Game, as well as background information on the 303(d) list will soon be available at the following location:
http://www.waterboards.ca.gov/centralvalley/programs/tmdl/index.htm.
If you would prefer a CD with the data please contact Central Valley Water Board staff.

Map and directions to the Central Valley Water Board are available at:
http://www.waterboards.ca.gov/centralvalley/contact_us/index.html

The workshop facilities will be accessible to persons with disabilities. Individuals requiring special accommodation are requested to contact Jennifer LaBay at (916) 464-4735 at least 5 working days prior to the meeting. TTY users may contact the California Relay Service at (800) 735-2929 or voice line at (800) 735-2922.

We anticipate sending out notices during the 303(d) list update process for any public meetings that will be held and for any documents that will be made available to the public. In order to receive notices regarding the 303(d) list update process, interested parties should sign up for the Impaired Waterways 303(d) List email notification system at the following website: http://www.waterboards.ca.gov/lyrisforms/reg5_subscribe.html

For further information, contact Jennifer LaBay at JLaBay@waterboards.ca.gov or (916) 464-4735 or Danny McClure at dmcclure@waterboards.c.a.gov or (916) 464-4751.

_________*ORIGINAL SIGNED BY*_____________
Kenneth D. Landau, Assistant Executive Officer

3 July 2007

Kenneth Petruzzelli

From: Kenneth Petruzzelli

Sent: Monday, November 19, 2007 11:28 AM

To: 'dmcclure@waterboards.ca.gov'

Cc: Allen Short; Art Godwin; avry@aol.com; Bill Johnston; Chedester Steve (schedester@sjrecwa.net); Cory David; Debra Liebersbach; donn.w.furman@sfgov.org; Doug Demko; dvogel@resourcescientists.com; Fuller Andrea (andreafuller@fishbio.com); 'Jacobsma Ronald (rjacobsma@friantwater.org)'; Jeff Shields (jshields@ssjid.com); Jenniefer Buckman (Jennifer.Buckman@bbklaw.com); Ken Robbins; Kenneth Petruzzelli; lowellploss@aol.com; Noah Hume (noah@stillwatersci.com); Robert Nees; Roger K. Masuda (rmasuda@calwaterlaw.com); Ron Yoshiyama (rmyoshiyama@ucdavis.edu); steinerd@ix.netcom.com; Steve Emrick; Steve Knell; Ted Selb; Tim O'Laughlin (towater@olaughlinparis.com); Tim Ramirez; tjford@tid.org; Walter Ward; White Christopher (cwhite@ccidwater.org); William Luce

Subject: SJRGA Comments re Proposed 303(d) Listings for Temperature for the SJR, Stanislaus, Tuolumne, and Merced Rivers

Attachments: SJRGA Temperature Comments (11-19-07) Final with Exhibits.pdf

Danny -

Please see attached comments from the San Joaquin River Group Authority regarding the proposed Clean Water Act section 303(d) listings for the San Joaquin, Stanislaus, Tuolumne, and Merced Rivers for temperature. Exhibit E is a compact disc that will follow by mail with a paper copy and these comments. The paper copy and compact disc is being shipped today by Federal Express. You should receive it tomorrow.

Please contact me if you require anything further, if you have any questions regarding any of the comments, and, especially, if you have any difficulties with the pdf file or compact disc.

Ken Petruzzelli

O'Laughlin & Paris LLP
2580 Sierra Sunrise Terrace
Suite 210
Chico, CA 95928
530-899-9755 (tel)
530-899-1367 (fax)
www.olaughlinandparis.com

The information contained in this e-mail communication is privileged and/or confidential information intended only for the use of the individual or entity named above. If the reader of this communication is not the intended recipient, you are hereby notified that any dissemination, distribution or copying of this communication or the information contained herein is strictly prohibited. If you received this communication in error, please immediately notify me by return e-mail and then delete this e-mail from your system. Thank you.

Item 3

Kenneth Petruzzelli

From: Kenneth Petruzzelli
Sent: Monday, November 19, 2007 12:07 PM
To: 'dmcclure@waterboards.ca.gov'
Cc: Allen Short; Art Godwin; avry@aol.com; Bill Johnston; Chedester Steve (schedester@sjrecwa.net); Cory David; Debra Liebersbach; donn.w.furman@sfgov.org; Doug Demko; dvogel@resourcescientists.com; Fuller Andrea (andreafuller@fishbio.com); 'Jacobsma Ronald (rjacobsma@friantwater.org)'; Jeff Shields (jshields@ssjid.com); Jenniefer Buckman (Jennifer.Buckman@bbklaw.com); Ken Robbins; Kenneth Petruzzelli; lowellploss@aol.com; Noah Hume (noah@stillwatersci.com); Robert Nees; Roger K. Masuda (rmasuda@calwaterlaw.com); Ron Yoshiyama (rmyoshiyama@ucdavis.edu); steinerd@ix.netcom.com; Steve Emrick; Steve Knell; Ted Selb; Tim O'Laughlin (towater@olaughlinparis.com); Tim Ramirez; tjford@tid.org; Walter Ward; White Christopher (cwhite@ccidwater.org); William Luce
Subject: FW: SJRGA Comments re Proposed 303(d) Listings for Temperature for the SJR, Stanislaus, Tuolumne, and Merced Rivers
Attachments: SJRGA Temperature Comments (11-19-07) Final with Exhibits.pdf

Danny –

It came to my attention that some of the graphs and tables in our comments failed to correctly translate to pdf. The attached copy includes all of the correct tables and graphs. I apologize for any confusion this creates.

Ken Petruzzelli

O'Laughlin & Paris LLP
2580 Sierra Sunrise Terrace
Suite 210
Chico, CA 95928
530-899-9755 (tel)
530-899-1367 (fax)
www.olaughlinandparis.com

The information contained in this e-mail communication is privileged and/or confidential information intended only for the use of the individual or entity named above. If the reader of this communication is not the intended recipient, you are hereby notified that any dissemination, distribution or copying of this communication or the information contained herein is strictly prohibited. If you received this communication in error, please immediately notify me by return e-mail and then delete this e-mail from your system. Thank you.

From: Kenneth Petruzzelli
Sent: Monday, November 19, 2007 11:28 AM
To: 'dmcclure@waterboards.ca.gov'
Cc: Allen Short; Art Godwin; avry@aol.com; Bill Johnston; Chedester Steve (schedester@sjrecwa.net); Cory David; Debra Liebersbach; donn.w.furman@sfgov.org; Doug Demko; dvogel@resourcescientists.com; Fuller Andrea (andreafuller@fishbio.com); 'Jacobsma Ronald (rjacobsma@friantwater.org)'; Jeff Shields (jshields@ssjid.com); Jenniefer Buckman (Jennifer.Buckman@bbklaw.com); Ken Robbins; Kenneth Petruzzelli; lowellploss@aol.com; Noah Hume (noah@stillwatersci.com); Robert Nees; Roger K. Masuda (rmasuda@calwaterlaw.com); Ron Yoshiyama (rmyoshiyama@ucdavis.edu); steinerd@ix.netcom.com; Steve Emrick; Steve Knell; Ted Selb; Tim O'Laughlin (towater@olaughlinparis.com); Tim Ramirez; tjford@tid.org; Walter Ward; White Christopher (cwhite@ccidwater.org); William Luce
Subject: SJRGA Comments re Proposed 303(d) Listings for Temperature for the SJR, Stanislaus, Tuolumne, and Merced Rivers

Danny -

Please see attached comments from the San Joaquin River Group Authority regarding the proposed Clean Water

Act section 303(d) listings for the San Joaquin, Stanislaus, Tuolumne, and Merced Rivers for temperature. Exhibit E is a compact disc that will follow by mail with a paper copy and these comments. The paper copy and compact disc is being shipped today by Federal Express. You should receive it tomorrow.

Please contact me if you require anything further, if you have any questions regarding any of the comments, and, especially, if you have any difficulties with the pdf file or compact disc.

Ken Petruzzelli

O'Laughlin & Paris LLP
2580 Sierra Sunrise Terrace
Suite 210
Chico, CA 95928
530-899-9755 (tel)
530-899-1367 (fax)
www.olaughlinandparis.com

The information contained in this e-mail communication is privileged and/or confidential information intended only for the use of the individual or entity named above. If the reader of this communication is not the intended recipient, you are hereby notified that any dissemination, distribution or copying of this communication or the information contained herein is strictly prohibited. If you received this communication in error, please immediately notify me by return e-mail and then delete this e-mail from your system. Thank you.

SAN JOAQUIN RIVER GROUP AUTHORITY'S WRITTEN COMMENTS TO PROPOSAL BY CENTRAL VALLEY REGIONAL WATER QUALITY CONTROL BOARD TO LIST THE SAN JOAQUIN, TUOLUMNE, MERCED AND STANISLAUS RIVERS AS IMPAIRED BODIES OF WATER FOR TEMPERATURE PURSUANT TO SECTION 303(d)

Submitted November 19, 2007
By O'Laughlin & Paris LLP

2580 Sierra Sunrise Terrace
Suite 210
Chico, CA 95928
(530) 899-9755 (tel)
(530) 899-1367 (fax)

EXECUTIVE SUMMARY

The information provided to, and relied upon by, the staff of the Central Valley Regional Water Quality Control Board is not sufficient to support the proposed listing of the San Joaquin, Stanislaus, Tuolumne and Merced Rivers as impaired for temperature. If the CVRWQCB were to list these rivers as impaired for temperature, based upon the information received to date, such action would be arbitrary, capricious and contrary to the law.

The proposed listing is legally flawed. The CVRWQCB is relying upon the incorrect narrative standard, and has neither solicited nor received information which would support a listing under the applicable narrative standard which prohibits the increase of natural receiving water temperature by 5 degrees Fahrenheit or more. Further, the CVRWQCB's proposed use of Policy 6.1.5.9 to evaluate the available temperature data and information is improper, as such policy's efforts to utilize information on the health of fishery populations in lieu of actual temperature data expressly contradicts the SWRCB's Basin Plan and Thermal Plan.

The proposed listing is also factually flawed as it relies upon information submitted by the California Department of Fish and Game (CDFG) that is irrelevant, incorrect and incomplete. The EPA Region 10 temperature criteria, submitted by the CDFG as the "threshold" temperatures necessary for the survival of anadromous fish species are not applicable to the San Joaquin River Basin, and have been questioned by reputable biologists and scholars, including the CDFG itself. Further, the lifestage timing and reach location criteria identified by CDFG are not supported by the known data, but rather have been purposely manipulated by CDFG in an effort to support the proposed listing. Had CDFG presented accurate lifestage timing and reach location data, there would be no justification for the proposed listing. For example, CDFG contends that the adult upstream migration period begins on September 1 and ends on October 31. Relying upon this, the CVRWQCB staff is prepared to find that the number of temperature exceedances for this period supports a listing. However, the actual period for upstream migration is October 1 through December 20. If the data for this actual migration time period were to be examined, the SJRGA is confident that there would not be enough temperature exceedances to support a listing.

The CDFG made it clear at the September 25, 2007 staff workshop that it believes that reservoir releases can and must be used to reduce temperatures in the San Joaquin, Stanislaus, Tuolumne and Merced Rivers. Model runs demonstrate, however, that it will be virtually impossible to operate the existing reservoirs in such a way as to achieve the CDFG recommended temperature criteria for all time periods and locations. While improvements in temperatures can be achieved in portions of the rivers, such improvements are bought with tremendous costs to reservoir storage and, consequently, water deliveries for all existing beneficial uses. In 1991, the SWRCB concluded that it would be a waste and unreasonable use of water to use reservoir releases to control water temperatures at Vernalis. Current information and technology demonstrate that this conclusion is correct and circumstances have not changed, and further suggest that the use of reservoir storage for temperature control anywhere within the San Joaquin Basin will be a waste and unreasonable use of water.

Finally, the proposed listing is procedurally flawed. The SWRCB established February 28, 2007 as the deadline for the receipt and consideration of information and data as part of the 2008 listing cycle. The SWRCB expressly provided that information and data submitted after February 28, 2007 would be accepted, but would not be used in the 2008 listing cycle, but only in the 2010 listing cycle. The CVRWQCB has acknowledged that it did not receive sufficient information and data by the February 28, 2007 deadline concerning the current and historic state of the San Joaquin River Basin fishery necessary to support a listing. Nonetheless, and in contravention of the SWRCB's deadline, the CVRWQCB contacted the CDFG and asked it to provide the necessary information well after the February 28, 2007 deadline had come and gone. Since the CVRWQCB did not receive the information it needed to support a listing by the February 28, 2007 deadline, it cannot list the San Joaquin, Stanislaus, Tuolumne and Merced Rivers as part of the 2008 listing cycle.

I. INTRODUCTION

Having (1) reviewed the materials submitted to the Central Valley Regional Water Quality Control Board ("CVRWQCB") by the California Department of Fish and Game ("CDFG"), and (2) considered the methodology for determining impairment laid out by CVRWQCB staff at the September 25, 2007 workshop, the San Joaquin River Group Authority ("SJRGA") finds that the legal and factual bases asserted by the CDFG and CVRWQCB's staff in support of the proposed listing are faulty. As such, it is the SJRGA's position that the CVRWQCB cannot list the San Joaquin, Tuolumne, Merced or Stanislaus Rivers as impaired bodies of water for temperature during this listing cycle for numerous reasons described herein.

II. LEGAL OBJECTIONS

A. The "Narrative Objective" the CVRWQCB Claims to Be Complying With Is Not An Objective At All, And Cannot Be Used to Justify the Proposed Action.

In the materials and presentation the CVRWQCB staff gave as part of the September 25, 2007 workshop, RWQCB staff indicated that the first step in the Section 303(d) Listing Policy is to identify the relevant water quality objectives. (*See* Power Point Presentation of Danny McClure, Slide # 7). In this particular instance, the CVRWQCB identified the relevant water quality objective as

> "The natural receiving water temperature of intrastate waters shall not be altered unless it can be demonstrated to the Regional Water Board that such alteration in temperature does not adversely affect beneficial uses." (Id., Slide # 9; *see also* Preliminary Draft Example Assessment of Merced River, p. 1-2).

While the quoted language is contained in the *Water Quality Control Plan for the Sacramento River and San Joaquin River Basins (5A-5B)* ("the Basin Plan")(*see* Chapter III, p. 8.00), it does not constitute a "water quality objective" as defined by the Water Code.

A water quality objective is a standard that limits the levels of water quality constituents or characteristics. Specifically, the Water Code defines a "water quality objective" as "**the limits or levels** of water quality constituents or characteristics which are established for the reasonable protection of beneficial uses of water or the prevention of nuisance within a specific area."(*See* Wat. Code 13050(h)(emphasis added)). The language cited by the CVRWQCB as a "narrative objective" does not qualify as a water quality objective as defined by the Water Code as it does not contain any level, criteria, characteristic or other description or limitation regarding the temperature of an intrastate water. Rather, the language relied upon by the CVRWQCB merely provides that no alteration of temperature will be allowed unless expressly approved by the RWQCB. So, while the language relied upon by the CVRWQCB establishes that alterations of temperature are allowed, it provides for no such alterations unless prior approval is obtained from the CVRWQCB. The need to obtain prior RWQCB approval is not a description or identification of a limit or level of water quality constituents as required by Water Code Section 13050(h).

The language relied upon by the CVRWQCB similarly does not comply with federal requirements under the Clean Water Act. Pursuant to federal regulation, a water quality standard is comprised of both the designation of use to be made of the water, and the criteria necessary to protect such use. (*See* 40 C.F.R. § 131.2). In addition to not identifying any criteria, the language relied upon by the CVRWQCB fails to identify any beneficial use or uses which are to be protected. All that the language relied upon by the CVRWQCB says is that temperature cannot be altered, absent the permission of the CVRWQCB, if it will harm "beneficial uses." But, both the Water Code and the Clean Water Act require the CVRWQCB to evaluate, weigh and balance a host of factors before identifying the beneficial use or uses for a particular water (not to mention the criteria necessary to protect such beneficial use). (Wat. Code § 13241; *see* 33 U.S.C. § 1313(c)(2)(A); *see also* 40 C.F.R. §§ 131.10-131.13). In this case, the language relied upon by the CVRWQCB indicates that the type of weighing and balancing that the CVRWQCB is supposed to have engaged in did not occur, as the language does not identify any specific beneficial use or uses which are to be protected.

The inappropriateness of using the language relied upon by the CVRWQCB as a water quality objective becomes clearer when looked at in terms of implementing a total maximum daily load ("TMDL"). TMDLs are required to be established at a "level necessary to implement the applicable water quality standards…" (*See* CWA 303(d)(1)(C)). But, given that the language relied upon by the RWQCB does not set any limit or level of temperature, a TMDL cannot be devised which implements such language. Indeed, the only way that a TMDL can be developed in this case is if, after deciding to list the San Joaquin, Tuolumne, Merced and Stanislaus Rivers as impaired for temperature, the CVRWQCB then identifies the specific limits or levels of temperature that are appropriate as part of the TMDL itself. Such an effort would, however, be illegal, as the CVRWQCB does not have the authority to adopt "water quality objectives" as part of the development of a TMDL. (*See* June 12, 2002 memorandum from the SWRCB Office of Chief Counsel entitled *The Distinction Between A TMDL's Numeric Targets and Water Quality Standards*, attached hereto as Exhibit A).[1] Indeed, "TMDLs are not water quality objectives," but rather "serve as a means to an end. That end is the attainment and maintenance of existing water quality standards." (Id., p. 5, 6). In this instance, since the language relied upon by the CVRWQCB does not contain any limits, levels, characteristics or other description of the temperature objectives for the San Joaquin, Stanislaus, Merced and Tuolumne Rivers, nor does it identify the beneficial use or uses to be protected, a TMDL to attain such limits is impossible. Indeed, it is clear that to properly establish a TMDL in this case, a water quality objective, including both the

[1] The June 12, 2002 memorandum explains that a water quality objective is developed after consideration of a variety of policy considerations (*see* Wat. Code § 13241), whereas such policy considerations do not apply to the development of TMDLs. (Id., p. 3-9).

identification of the beneficial use and the temperature criteria necessary to protect such beneficial use, will need to be developed as part of the TMDL.

B. The Applicable Water Quality Objective is Identified in the Basin Plan for COLD Intrastate Waters.

If the CVRWQCB were interested in evaluating whether or not the San Joaquin, Tuolumne, Merced and Stanislaus Rivers were impaired for temperature, the water quality objective that would apply is the narrative objective identified for COLD intrastate waters, which is

> "At no time or place shall temperatures of COLD or WARM intrastate waters be increased more than 5ºF above natural receiving water temperature." (Basin Plan, Chapter III, p. 8.00).

The San Joaquin, Merced, Tuolumne, and Stanislaus Rivers have all been identified as COLD intrastate waters. (Basin Plan, Chapter II, p. 7.00-8.00).

Unlike the language relied upon by the CVRWQCB to date, narrative objective for COLD intrastate waters complies with State and federal law by including both a beneficial use designation and a temperature criteria designed to protect such designated beneficial use.[2] The designation "COLD" means that the recognized beneficial use of these rivers is "Cold Freshwater Habitat" that supports aquatic vegetation, fish and wildlife. (Basin Plan, Chapter II, p. 2.00). The criteria for protecting such designated beneficial uses is that natural receiving water temperatures cannot be increases by more than 5ºF.

None of the information solicited by nor made available to the CVRWQCB uses this water quality objective. As such, there is simply no information available upon which the CVRWQCB could rely to determine, as part of this listing cycle, if the San Joaquin, Merced, Tuolumne and Stanislaus Rivers are impaired for temperature.

C. The CVRWQCB's Proposed Use of Policy 6.1.5.9 Is Inappropriate.

The CVRWQCB indicated that it intends to rely upon the alternate approach to evaluating temperature data as set forth in Section 6.1.5.9 of the September 2004 *Water Quality Control Policy For Developing California's Clean Water Act Section 303(d)*

---

[2] This narrative objective would not be applicable in this case even if the language relied upon by the CVRWQCB is considered a "water quality objective." It is hornbook law that where a general regulation conflicts with a specific regulation, the specific controls. (People v. Weatherill (1989) 215 Cal.App.3d 1569, 1577-1578).Here, the CVRWQCB has adopted a general prohibition on alterations unless it gives prior approval. But, then the CVRWQCB actually approves of specific levels of alteration for COLD and WARM waters; ie, that any alteration that does not result in an increase of 5ºF above natural receiving water temperature is acceptable. Since the rivers at issue are designated COLD, this more specific objective would apply in lieu of the more general "objective" relied upon by the CVRWQCB.

List. ("the Listing Policy") (Power Point Presentation of Danny McClure, Slide # 11; *see* Preliminary Draft Example Assessment of Merced River, p. 1). The use of this alternate approach is inappropriate as it is contrary to the Basin Plan and the *Water Quality Control Plan for Control of Temperature in the Coastal and Interstate Waters and Enclosed Bays of California* ("the Thermal Plan") adopted by the SWRCB in 1975.[3] Further, even if alternate policy were to be found to be applicable generally, the factual predicates necessary to using the alternate policy do not exist in this case.

1. **The Alternate Policy is Contrary to the Basin Plan and Thermal Plan**.

The alternate policy expressed in Section 6.1.5.9 of the Listing Policy provides that, in the absence of "historical"[4] or "natural" temperature data, recent temperature data can be compared to the temperature requirements of aquatic life found in the water segment at issue. (Listing Policy, § 6.1.5.9, p. 25). This alternate policy is similarly described in the SWRCB's September 2004 *Final Functional Equivalent Document Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List* ("the Functional Equivalent Document").There, the SWRCB stated that the primary problem in assessing a body of water for temperature impairment is the lack of temperature data necessary to determine the "natural receiving water temperature" specified in the Basin Plan's temperature objectives. (Functional Equivalent Document, p. 132). The SWRCB explained that "Determining 'natural receiving water' temperature is limited by the availability of historic temperature monitoring data that is considered representative of unaltered and/or natural conditions in a water body." (Id., p. 132-133). The SWRCB went on to discuss two possible alternative methods of interpreting temperature data, including the one adopted in Section 6.1.5.9 of the Listing Policy. (Id., p. 133-135).

The SWRCB's discussion of the need for an alternate method of interpreting temperature data due to the lack of "historic" or "natural" temperature data representative of "unaltered" conditions is, however, severely wanting. There is simply nothing in the Basin Plan itself which suggests that the "natural receiving water temperature" refers to "unaltered conditions" justifying the SWRCB's development of an alternate policy. To the contrary, the SWRCB's definition of "natural receiving water temperature" expressly belies the SWRCB's stated need for temperatures indicative of the "unaltered" condition.

Both the language relied (inappropriately) upon by the CVRWQCB and the language establishing the narrative objective for COLD and WARM intrastate waters use the term "natural receiving water temperature." This term is expressly defined by the SWRCB in the Thermal Plan to mean "The temperature of the receiving water at locations, depths, and times which represent conditions unaffected by any elevated

---

[3] The Thermal Plan is expressly incorporated into and made part of the Basin Plan. (Basin Plan, Chapter III, p. 2.00; Chapter IV, p. 10.00, Appendix Item 11). Further, the Thermal Plan is expressly identified by the SWRCB as one of the policies with which all state agencies, including the CVRWQCB, must comply. (Basin Plan, Chapter IV, p. 8.00 (Policy #12)).

[4] The term "historical" is not defined in the Listing Policy.

temperature waste discharge or irrigation return waters." (Thermal Plan, p. 1).[5] The term "elevated temperature waste," used in the definition of "natural receiving water temperature" is likewise defined. That term refers expressly to "Liquid, solid, or gaseous material including thermal waste discharged at a temperature higher than the natural temperature of receiving water. Irrigation return water is not considered elevated temperature waste for the purposes of this plan." (Thermal Plan, p. 1).[6] Thus, "natural receiving water temperature" has nothing to do with "historic" or "unaltered" conditions, but rather is the temperature of the water before the addition of elevated temperature waste discharges and irrigation return waters.

To the extent that this conclusion was at all left in doubt based upon the definitions provided by the SWRCB itself, such doubt is utterly extinguished by the SWRCB when it provides that:

> "Natural water temperature will be compared with waste discharge temperature by near-simultaneous measurements accurate to within 1ºF. In lieu of near-simultaneous measurements, measurements may be made under calculated conditions of constant waste discharge and receiving water characteristics." (Thermal Plan, p. 6).

Given the SWRCB's insistence that temperature comparisons be made using "near-simultaneous measurements," it is clear that the SWRCB was not contemplating the need or use for data reflective of the "historic" or "unaltered" condition of the water body.

Although the definition of "natural receiving water temperature" is in the Thermal Plan and applies only to interstate waters, not intrastate waters such as are at issue in this case, the use of the same term in similar regulations is presumed to have the same meaning. (Boise Cascade Corp. v. USEPA, 942 F.2d 1427, 1432 (9th Cir. 1991)).[7] This is especially true when, as here, the agency has given a specific definition for a term. (Urban Renewal Agency v. Calif. Coastal Zone Conservation Co. (1975) 15 Cal.3d 577, 584-585). Since the SWRCB used the term "natural receiving water temperature" in regards to the interstate waters, coastal waters and enclosed bays covered expressly by the Thermal Plan, and in regards to the intrastate waters which are not discussed in the Thermal Plan, in the absence of some other manifestation of a differing intent, the two terms are to be treated as if they have the same meaning.

---

[5] This definition is misquoted in the Functional Equivalent Document on page 132 in such a way as to change the entire meaning of the definition. A comma is inappropriately added between the words "temperature" and "waste" which breaks up, avoids and negates the SWRCB's given definition for the term "elevated temperature waste" discharge.

[6] The term "thermal waste" as used in the definition of "elevated temperature waste" is also expressly defined as "Cooling water and industrial process water used for the purpose of transported waste heat." (Thermal Plan, p. 1).

[7] This standard of statutory interpretation also works in reverse. Where one statute uses a specific term, and another, similar statute omits the specific term, it is evidence that the promulgating body had a different intent in mind. (People v. Licas (2007) 41 Cal.4th 362, 367).

Further, there is no doubt that the SWRCB could have set up a different scheme for measuring temperatures in intrastate waters generally, or in the San Joaquin, Tuolumne, Merced and Stanislaus Rivers specifically. In the Basin Plan, on the very same page that the narrative objective for COLD and WARM waters is provided, the SWRCB identified specific temperatures for specific water bodies. (Basin Plan, Chapter III, p. 8.00, Table III-4 and Table III-4A). Moreover, these specific limitations on temperature changes are not related to "natural receiving water temperature," which is not mentioned at all, but rather are related to "temperature changes due to controllable factors." (Ibid.).

The Basin Plan and Thermal Plan make it clear that the alternate policy contained in Section 6.1.5.9 is inappropriate and unnecessary. To determine whether or not temperatures of a water body are in excess of the "natural receiving water temperature," the RWQCB must take nearly simultaneous temperature readings upstream and downstream of discharges of thermal waste and irrigation return flows. If the temperature of the water downstream of the discharge is more than 5ºF hotter than the temperature upstream of the discharge, then an exceedance exists. There is no reason or justification for the RWQCB to attempt to equate "natural receiving water temperature" with the "unaltered condition."

2. **Even Assuming Section 6.1.5.9 Applies, There Is No Information Justifying Its Use in this Case**.

Assuming, *arguendo*, that the alternate policy set forth in Section 6.1.5.9 does apply generally, there is not enough information justifying its application as to the San Joaquin, Tuolumne, Merced and Stanislaus Rivers in this instance. By its own terms, Section 6.1.5.9 applies only when "'historic' or 'natural' temperature data are not available…" (Listing Policy, § 6.1.5.9, p. 25). The submittal made to the CVRWQCB by the CDFG on February 28, 2007, and the information submitted by the CDFG at the workshop on September 25, 2007, did not show, and made no effort to show, that the "historic" or 'natural" temperatures are not available. Rather, the submittals by CDFG, as well as the Preliminary Draft Example Assessment of Merced River, assumed the unavailability of such "historic" or "natural" temperature data. The CVRWQCB must do more than rely upon this, as yet, unfounded assumption.

First, there is no indication that either the CDFG or the CVRWQCB looked to determine if "historic" or "natural" temperature data existed. Before applying, or attempting to apply, the alternate policy, it is incumbent on the CVRWQCB to determine if such "historic" or "natural" temperature data exist. (*See* EPA's 2004 Final Upper Main Eel River and Tributaries Total Maximum Daily Loads for Temperature and Sediment, p. 12 ["No information on pre-dam conditions was uncovered, nor general stream temperatures before the 1964 flood."]).

Second, "historic" or "natural" temperature data need not be generated solely from actual measurements taken, but may also come from modeling.[8] For example, in the Eel River TMDL, EPA used a computer model to calculate "natural stream temperatures" and also to evaluate the temperature affects of four additional riparian management scenarios. (Id., p. 20-24, 28-32). In so doing, EPA noted that "Modeling of stream temperature is a well developed area of inquiry and many models are available to assist policymakers in understanding the factors controlling stream temperatures." (Id., p. 20).

In this instance, even if data from actual temperature measurements taken at some point in the past are unavailable, "historic" or "natural" temperature can still be accurately calculated using the HEC-5Q model constructed for evaluating temperature in both the upper and lower San Joaquin River system, including the Stanislaus, Merced and Tuolumne Rivers, as part of the San Joaquin River Basin-Wide Water temperature Modeling Project ("the SJR Basin Model").[9] The SJR Basin Model, which is the model used by both the SJRGA and the CDFG for their respective presentations on September 25, 2007,

> "is designed to simulate the thermal regime of mainstem reservoirs and river reaches. The SJR [Basin] Model project focuses on understanding the relationship between air temperature, reservoir operations, river hydraulics, stream flow, and water temperature, both in-reservoir and in-river…the HEC-5Q model will analyze different water operation scenarios (e.g., reservoir storage and release patterns)…" (CDFG's March 22, 2006 *Lower San Joaquin River Basin-Wide Temperature Modeling Project Data Collection Protocol*, p. 4 (attached to CDFG's February 28, 2007 submittal as Exhibit E)).

Just as the SJR Basin Model is capable of predicting future water temperatures given a range of operation scenarios, it is likewise capable of accurately identifying "natural" or "historic" temperatures using the same principles. As an example, in the Case 1 run done for the SJRGA by AD Consultants, the model identified and compared "actual" temperatures with "historic" temperatures at varying locations in the Stanislaus River for the period 1967-1982. The "historic" temperatures were derived solely from the model by removing New Melones Dam and reservoir, installing the original Melones Dam and reservoir, and using historical flow and operation criteria for Melones Dam and reservoir. Similarly, the "actual" temperatures, which assumed the existence of New Melones Dam and reservoir and the Interim Plan of Operation as the operating criteria for the period 1967-1982, were derived solely from the model. Once the run was completed, the results were compared with temperature data collected at Vernalis and downstream of

---

[8] The SWRCB's December 4, 2006 data solicitation and the January 30, 2007 clarification notice expressly provided that there are no limits on the data and information that the public can provide. The SWRCB made it clear that the RWQCBs would accept any and all data.

[9] The SJR Basin Model is still being reviewed by all of the stakeholders and some minor tweaking and improvements are expected.

Goodwin Dam. The comparison indicated that the model under-predicted the observed temperatures slightly, indicating that the model results are conservative from a temperature increment standpoint. (*See* Exhibit B, p. 6, p. 10 [Figure 7]).

Since the SJR Basin Model is capable of accurately depicting "historic" temperatures for the San Joaquin, Tuolumne, Merced and Stanislaus Rivers, there is no need for the CVRWQCB to rely upon the alternate policy set forth in Section 6.1.5.9 of the Listing Policy.

D. <u>Action Taken as Part of the 2008 Cycle Is Arbitrary and Capricious</u>.

1. **<u>CVRWQCB Does Not Have Sufficient Information About the Current and Historic State of the Fishery</u>**.

The SWRCB initiated the solicitation of data and information regarding water quality conditions from interested parties by public notice dated December 4, 2006. That notice provided, in bold type,

> "**To be considered in this review process, data and information must be submitted to the appropriate Regional Water Board no later than February 28, 2007.**" (SWRCB Notice of Public Solicitation of Water Quality data and Information for 2008 Integrated Report – List of Impaired Waters and Surface Water Quality Assessment [303(d)/305(b)], December 4, 2006, p. 2)(bold in original).

The notice also had attached to it a document entitled "Enclosure 3." Paragraph 4 of Enclosure 3 specifically provided that

> "All new information and data must be received by the respective Regional Water Board…by the close of business on February 28, 2007. Please note that any information received after February 28, 2007 will not be used for the 2008 section 303(d) List or for compiling the section 305(b) Report, but will be considered in developing the 2010 section 303(d) List and Section 305(b) Report." (Enclosure 3, p. 1, ¶ 4).

The SWRCB made it clear to everyone, including the RWQCBs tasked with compiling and assessing the water quality data and information submitted, that no extensions of the February 28, 2007 deadline were permitted or would be granted. Rather, the SWRCB specifically provided that data submitted after the close of the solicitation period would be considered only in the context of the development of the 2010 cycle.

As discussed above, the CVRWQCB is ostensibly relying on the alternate policy of Section 6.1.5.9 to support the proposed listing. This Policy, however, specifically provides that information "on current and historic conditions and distribution of sensitive beneficial uses (e.g., fishery resources) in the water segment **is necessary**…" (Listing Policy, § 6.1.5.9, p. 25-26). In this instance, as the September 12, 2007 Preliminary Draft Example Assessment submitted by CVRWQCB staff at the September 25, 2007 workshop demonstrates, information and data about the current and historic distribution of salmon is still needed.

For example, on page 1 under the heading "Decision," the document indicates "List – Pending information about the fishery." (Similar statements are provided elsewhere on page 1 ["Insert information about current and historic salmonid distribution"]). On page 9, the CVRWQB staff expressly acknowledges the lack of fishery information needed as it specifically admits

> "INFORMATION ABOUT THE HISTORICAL AND CURRENT STATE OF THE FISHERY WILL BE NEEDED TO COMPLETE THE ASSESSMENT." (September 12, 2007 Preliminary Draft Example Assessment, p. 9)(capitalization original).

Since it is clear that information and data regarding the historical and current state of the fishery was not submitted to the CVRWQCB by February 28, 2007 as required by the SWRCB, the CVRWQCB does not have enough information to list the San Joaquin, Tuolumne, Merced and Stanislaus Rivers as impaired for temperature using the alternate policy of Section 6.1.5.9.

2. **CVRWQCB's Apparent Effort to Solicit Information from CDFG After the February 28, 2007 Deadline Was Biased and Unfair, and Any Use of that Information in the 2008 Listing Cycle Will Be Arbitrary and Capricious**.

At the September 25, 2007 workshop, staff from CDFG gave a presentation which, among other things, discussed the current and historic status of the fishery. (*See*, *e.g.*, Marston slides entitled "Why List?" SJR Salmon Trend" and "Re-Cap Summary"). The SJRGA thought this presentation odd, as the CDFG had not submitted any such information as part of its February 28, 2007 submittal.

Further, Mr. Marston of CDFG indicated that CDFG was, as part of the workshop, submitting to the CVRWQCB a paper regarding the current and historic status of the fishery. This paper, dated September 2007 and entitled "San Joaquin River Fall-run Chinook Salmon and Steelhead Rainbow Trout Historical Population Trend Summary" was provided to the SJRGA on October 18, 2007 as the result of a Public Records Act request.[10] In this paper, Mr. Marston discloses that CDFG submitted information about historic fishery trends ***at the request of the CVRWQCB***. Mr. Marston writes

> "The Central Valley Regional Board asked the Department to submit information regarding the historical trends of salmon and steelhead in the San Joaquin River Basin (excluding the Mokelumne and Cosumnes Rivers)." (San Joaquin River Fall-run Chinook Salmon and Steelhead Rainbow Trout Historical Population Trend Summary, September 2007, p. 4).

Assuming that Mr. Marston's statement is accurate, the request by CVRWQCB that the CDFG submit additional evidence and data regarding current and historic fishery trends after the SWRCB's February 28, 2007 deadline is, at best, inappropriate, and at worst, evidence of prejudice and bias that calls into question the CVRWQCB's entire process.

Regardless of the propriety of the request itself, any effort by the CVRWQCB to use the information submitted by CDFG or any other party regarding current and historic fishery trends in the 2008 listing cycle will be arbitrary and capricious. The SWRCB established the February 28, 2007 deadline to insure that the various regional boards would have enough time to evaluate and assimilate the information submitted such that the Integrated Report could be completed and submitted to the USEPA by April 1, 2008. (*See* December 4, 2006 Notice, p. 2). The SWRCB made no provision for the change, relaxation or other extension of the February 28, 2007 deadline. To the contrary, the SWRCB flatly stated that any information submitted after February 28, 2007 "will not be used" as part of the 2008 listing cycle, but would instead be used in the 2010 listing cycle. (Id., Enclosure 3, p. 1, ¶ 4). The SWRCB expressly considered and resolved how information submitted after February 28, 2007 was to be treated and used. The fact that CDFG and/or other parties failed to submit sufficient information to the CVRWQCB by February 28, 2007 which will enable it to evaluate whether or not there is an impairment for temperature under the alternate policy of Section 6.1.5.9 is not sufficient reason for the CVRWQCB to unilaterally contact CDFG and request that it provide the missing information. (*See* Halaco Engineering Co. v. South Central Coast Regional Com. (1986) 42 Cal.3d 52, 79 [defining arbitrary and capricious conduct as that "not supported by a fair or substantial reason…"]).

Since it is clear from both the CVRWQCB's own September 12, 2007 Preliminary Draft Example Assessment and Mr. Marston's September 2007 paper "San Joaquin River Fall-run Chinook Salmon and Steelhead Rainbow Trout Historical Population Trend Summary" that the CVRWQCB did not receive the information it

[10] In addition to the September 2007 paper *San Joaquin River Fall-run Chinook Salmon and Steelhead Rainbow Trout Historical Population Trend Summary*, CDFG also furnished copies of two additional items that were submitted to the CVRWQCB after the February 28, 2007 deadline: a June 6, 2007 letter from Mr. John M. Bartolow, USGS (retired), and a September 24, 2007 report by Alice A. Rich, Ph.D., entitled *Impacts of Water Temperature on Fall-Run Chinook Salmon (Oncorhynchus tshawytscha) and Steelhead (O. mykiss) in the San Joaquin River System.*

needs regarding the current and historic state of the fishery to utilize the alternate policy of Section 6.1.5.9 by the SWRCB's February 28, 2007 deadline, the CVRWQCB cannot list the San Joaquin, Tuolumne, Merced and Stanislaus Rivers as impaired for temperature in the 2008 listing cycle.

E. The Use of Stored Water to Reduce Temperature At Vernalis is a Waste of Water In Violation of the California Constitution.

In its February 28, 2007 submittal, CDFG recommended that the San Joaquin River at Vernalis be declared impaired for temperature due to alleged exceedances of temperatures in the April 15-June 15 time frame, and again in the September 1-October 31 timeframe. (*See* February 28, 2007 letter, Table 1). During the September 25, 2007 workshop, staff from CDFG made it clear that the method of lowering temperatures at all proposed compliance points, including Vernalis, was by increasing flow through manipulation of reservoir storage. Mr. Marston submitted a slide entitled "Can H2O Be Cooled?" which specifically contemplates use of coldwater storage accounts in reservoirs as a method of cooling temperatures. (*see* Marston slide from the same presentation linking increased flows from reservoir storage and reduced temperatures, entitled "Flow Level & H2O Temp."). CDFG also contracted with AD Consultants to conduct two modeling runs using the SJR Basin Model to look at the impact of increased flow on temperatures at the confluence of the Tuolumne River and the San Joaquin River (Marston slide entitled "Tuolumne River Confluence (2001)") and Vernalis (Marston slide entitled "San Joaquin River at Vernalis (2001)").

CDFG's focus on the use of reservoir releases to cool temperatures, particularly at Vernalis, is of dubious value as the SWRCB has already concluded that the use of reservoir releases to control temperatures measured at Vernalis would be a waste and unreasonable use of water in contravention of the California Constitution. In the SWRCB's May 1991 Water Quality Control Plan for Salinity ("1991 Salinity Plan"), the SWRCB noted temperature objectives measured at Vernalis, but refused to implement them, stating controlling temperatures at Vernalis by "utilizing reservoir releases does not appear reasonable due to the distance of the [Vernalis] downstream of reservoirs and uncontrollable factors such as ambient air temperature, water temperature in the reservoir releases, etc. For these reasons, the State Board considers reservoir releases to control water temperatures [at Vernalis] a waste of water…" (1991 Salinity Plan, Table 1, p. 1-13).

There is no evidence that the CVRWQCB can rely upon to come to a different conclusion than that reached by the SWRCB in 1991. Mr. Marston admitted during the workshop that CDFG did not ask AD Consultants to evaluate the impact on reservoir storage that would result if CDFG's increased releases of reservoir storage were implemented. Further, the SJRGA did ask AD Consultants to evaluate impacts to reservoir storage as part of the model runs they commissioned, and in each case the increased releases not only were unable to achieve the temperature criteria at all times and in all locations, but had profound, detrimental impacts to reservoir storage. (*See*

Results of modeled Cases, attached hereto as Exhibit B, and complete discussion in Section III, *infra*.).

Article X, Section 2 of the California Constitution provides that waters of the state must be put to reasonable and beneficial use. Any use which is unreasonable or non-beneficial can be prohibited. (Gin S. Chow v. City of Santa Barbara (1933) 217 Cal. 673; Antioch v. Williams Irr. Dist. (1922) 188 Cal. 451; Joslin v. Marin Mun. Water Dist. (1967) 67 Cal.2d 132). Moreover, what constitutes a reasonable and beneficial use of water is a question of fact. (People v. Forni (1976) 54 Cal.App.3d 743, 750). As such, any evaluation of the propriety of a use of water must involve the examination of the proposed use and a determination of the proposed use justified the amount of water utilized. (Antioch, *supra*, 188 Cal. 451 (sought flows to prevent saltwater intrusion); Peabody v. City of Vallejo (1935) 2 Cal.2d 351, 375-376 (flows to flood land and to provide incidental recharge); Forni, *supra*, 54 Cal.App.3d 743 (sought water for frost protection); Imperial Irr. Dist. v. State Water Resources Control Bd. (1990) 225 Cal.App.3d 548 (examined irrigation and delivery practices which resulted in tailwater and drainage flowing into the Salton Sea); Erickson v. Queen Valley Ranch Co. (1971) 22 Cal.App.3d 578, 585 (determined method of diversion which resulted in loss of 5/6 of diverted water during transport); Joslin, *supra*, 67 Cal.2d at 141-145 (use of water to transport gravel not reasonable)).

In 1991, the SWRCB concluded that the use of reservoir releases to meet temperatures at Vernalis was a waste and unreasonable use of water "based upon the record in [the] proceedings" before it. (1991 Salinity Plan, p. 1-13). Further, the SWRCB stated that it "will require a test of reasonableness before consideration of reservoir releases" for the purpose of controlling water temperature at Vernalis. (Id.). Here, the information submitted by CDFG has done nothing to demonstrate that the use of reservoir releases to control temperatures at Vernalis is reasonable in contradiction to the findings of the SWRCB in 1991, particularly since the temperatures now cited by CDFG are even lower (*i.e.*, 64.4ºF [18ºC]) than those included in the 1991 Salinity Plan (*i.e.*, 68ºF [20ºC]) at Vernalis in April through June, September and November. Moreover, the information submitted by the SJRGA demonstrates that any attempt to use reservoir releases to achieve the recommended temperatures at Vernalis will (a) be unable to achieve such temperatures during the recommended time periods and (b) have a significant, detrimental impact on reservoir storage. The information submitted to date requires the CVRWQCB to conclude that the use of reservoir releases to meet the recommended temperatures at Vernalis continues to be a waste and unreasonable use of water.[11] Since the current proposed listing is dependent upon the use of reservoir releases, the CVRWQCB cannot list the San Joaquin River as impaired for temperature at this time.

[11] Given the SWRCB's prior findings, the CVRWQCB must also evaluate and determine whether the use of reservoir releases to meet the recommended temperatures in the other locations is a reasonable and beneficial use of water. The modeling data, discussed in Section IV, *infra*, certainly suggests that the use of reservoir releases to control water temperatures at the confluence of the San Joaquin River and its tributaries is not a reasonable and beneficial use of California's water resources.

III. BIOLOGICAL OBJECTIONS

The CDFG material is clearly selective and was presented to CVRWQCB staff with the sole purpose of obtaining an impairment determination. It is in fact astonishing, and of course extremely troubling to the SJRGA, that the staff did not evaluate the accuracy of that CDFG information as there are many obvious problems and biases with it as is revealed in detail in the following sections. The evaluation process consists of a formulaic assessment largely of "if this (CDFG claims), then this (impairment conclusion)" which in this case results in "Garbage in, garbage out".

The CDFG material and the staff's evaluation process makes little recognition of the inherent variability in the natural annual and seasonal hydrology and corresponding water management operations which are based on a purposeful (and often legally required) adaptive management approach that adjusts to changing conditions. Further variability exists within the fishery information and important exogenous factors such as weather and climate. The SJRGA contends that it is important for the staff to understand that such variability exists, that it is a dominant factor in the San Joaquin basin, and that it be reflected in the information and assessment under consideration in this process. The application of absolute temperature criteria to define impairment in the San Joaquin Basin rivers ignores the reality of year-to-year variability in temperature and flow conditions that have always naturally occurred in those rivers. The use of such inflexible, absolute criteria also discounts the adaptive capabilities, within certain limits, of the salmonids and other native biota to variable conditions.

Because there is inevitable natural cycling between warmer, low-flow years and cooler, high-flow years, it would be logical to apply different sets of temperature criteria to define degrees of impairment depending on the environmental/climate conditions prevailing in the San Joaquin Basin in given years. Thus, a river may be considered impaired if its temperature exceeded certain thresholds during normal years, but it would not necessarily be considered impaired if it exceeded the same thresholds during the drier years.

It should also be recognized this is a preliminary review of the information submitted by CDFG as some of it has only recently even been made available to the SJRGA. However this review is intended to bring to the CVRWQCB's attention many of the inconsistencies, inaccuracies, and inappropriate substitutions of data which invalidate CDFG's analysis of impairment and the subsequent staff assessment as well. For example, the CDFG analysis:

- uses temperature criteria that are not applicable to the San Joaquin Basin
- is not congruent with, or completely ignored, readily available fisheries information
- misrepresents conditions by substituting data from a distant (up to 28 miles away) thermograph location for a location where data was missing
- does not consider temperature records that are readily available for some locations in the Stanislaus and Tuolumne Rivers to expand the number of observations

- does not evaluate the biological significance of temperature conditions
- does not address other relevant issues.

Based on these issues, which are described in more detail below, the CDFG analysis cannot be used as the basis for a 303(d) listing.

A. Temperature Criteria Recommended By CDFG Are Not Appropriate.

CDFG chose to use EPA Region 10 criteria but did not provide adequate justification for their recommendation. In fact, the very report by A.A. Rich and Associates that was submitted to support their position clearly states that site-specific data are extremely important in ascertaining the effects of water temperature on Chinook salmon and steelhead populations in the San Joaquin River System and CDFG has admittedly performed no evaluation of the biological significance of temperature for these populations. EPA Region 10 temperature criteria are not consistent with other criteria previously cited by CDFG, are based on laboratory studies conducted in the Pacific Northwest, and do not apply to wild Central Valley fall Chinook salmon and steelhead at the southern extent of their range. . Discussion of some of these issues follows.

1. **The A.A. Rich and Associates Report Does Not Support Using the EPA Region 10 Criteria**.

The report from A.A. Rich and Associates recently submitted by CDFG does not provide adequate support for using the EPA Region 10 criteria to assess impairment. In fact, the report clearly states that site specific data are essential to ascertaining the effects of water temperature on Chinook salmon and steelhead populations in the San Joaquin River System and "knowledge of temperature tolerance and sublethal stress responses of Chinook salmon and steelhead are far from adequate to define safe thermal limits for Chinook salmon and steelhead in the San Joaquin River System". Despite this lack of critical information, Dr. Rich and CDFG assert that there has been a dramatic decrease in populations of these species as a result of temperature impairment. In addition to the paucity of site specific temperature criteria, the statement that decreased abundance is the result of in-stream thermal conditions completely ignores the influence of key factors such as ocean conditions on salmon abundance. Many scientists consider poor ocean conditions to potentially be the primary factor responsible for low returns to the Central Valley and along much of the West Coast during 2007. In addition, since most of the salmon life occurs in the ocean, Rich's statement: "…the Chinook salmon and steelhead are each exposed to higher than optimal water temperatures throughout their life cycle" is a misrepresentation.

The report also falsely asserts that Chinook salmon and steelhead are exposed to higher than optimal water temperatures throughout their freshwater lifecycle as a result of increased water temperatures associated with water impoundments and diversions, and the long-term result has been a dramatic decrease in populations of these species. However, recent analyses show that temperatures in the lower Stanislaus River were warmer prior to operation of New Melones Reservoir (*see* Section IV, *infra*), yet salmon abundance was higher during this time period. Again, temperature does not appear to be the limiting factor as reduced temperatures have not increased salmon escapement. The sweeping statement by Rich that "declining fish populations provide strong evidence the increased water temperatures have contributed overwhelmingly to cumulative physiological stress" is unsupported conjecture.

Numerous studies are provided in Tables 1-11 of the report and are supposedly organized to identify lethal, stressful, optimal temperatures ranges for the freshwater life stages of Chinook salmon. However, when compared to the ranges presented on pages 5-6, it is not clear, specifically, how the optimal ranges for each lifestage were established. They are not clearly derived from the tables. For example:

- The range presented for Chinook salmon egg and alevin incubation/fry emergence is 42.5°F (5.8°C) to <55°F (13°C) and no reference is cited for this range. However, Table 6 summarizes results of studies to determine the optimal water temperatures for this lifestage. Only one study is listed and the range was 39.8°F (4.3°C) to 59°F (15°C).
- Ranges are presented for various lifestages of steelhead yet no reference is cited and there are no tables that summarize the results of studies that have been conducted.

The criteria and tables presented in the report appear to be a repeat of testimony presented by Dr. Rich during hearings regarding the Delta Wetlands Project during 1997. These discrepancies were also identified during those proceedings and have clearly not been addressed.

With regard to steelhead, the report presents an optimal incubation temperature of <54°F which is warmer than the temperature reported for adult migration and spawning (<52°F). This does not make sense and in the absence of references there is no way of knowing where these numbers came from.

Perhaps many of the optimal temperatures cited in the report were taken from Dr. Rich's 1987 report. If so, the results are questionable as discussed in the following excerpt from Williams 2006.[12]

> "Rich (1987) reported maximum growth at 15.3°C (Figure 4-7a), and no survivors at 24°C, in contrast to Marine (1997), Cech and Myrick (1999), and Brett et al. (1982). Possible reasons for the difference are tank effects and disease. Marine (1997) used 400 L circular tanks with filtered surface water from Putah Creek and initial density of 550 fish per tank (0.73 L per fish). Cech and Myrick (1999) used 110 L circular tanks and pathogen-free well water and 30 fish per tank (3.67 L per fish). Both used

[12] The references cited in this Section III are attached hereto as Exhibit C.

directed sprays to maintain a current in the tanks. Brett et al. (1982) did not describe their experimental tanks, each of which held 25 fish. Rich (1987) used 57 L rectangular tanks with unfiltered surface water from the American River, and a high density of fish (initially 160 per tank, or 0.36 L per fish). The densities in both the Myrick and Rich experiments decreased over time as fish were sacrificed for various assays. Dr. Rich noted disease as an indicator of stress for the 19°C and higher treatments, and this, together with confinement in tanks with little current, may explain the difference between her results and those from other studies (there is evidence that confinement in aquaria without current causes stress (Milligan et al. 2000), and the unfiltered surface water probably introduced pathogens). Rich's results underscore the need to consider the extent to which higher temperatures increase the virulence of pathogens (Myrick and Cech 2001), but whether her experimental conditions reasonably reflect natural conditions is questionable."

2. **<u>Biological Significance of Temperature and Previous Criteria Cited by CDFG</u>**.

CDFG's analysis of impairment is also lacking in that it provides no evaluation of the biological significance of their chosen temperature criteria in the San Joaquin Basin – a point that they confirmed during the September 25, 2007 workshop. The approach used by CDFG presumes that there is no impact to the population if temperatures are below the EPA Region 10 criteria, but the population is reduced if temperatures exceed the criteria. The impairment analysis has no function to weight impact based on the proportion of the population affected which is a function of the proportion of the population experiencing a given condition, the severity of the condition (relationship of temperature to mortality rate), and the duration of exposure.

As cited from Moyle 2005 "the most productive spring-run Chinook salmon stream left in California, Butte Creek, can experience daily maxima up to 24ºC (75.2ºF) with minima of 18-20ºC (64.4-68.0ºF) for short periods of time in pools where juveniles are rearing and adults are holding. It is thus possible for Chinook salmon to maintain populations even when they experience periods of suboptimal or even near-lethal conditions. They are also capable of finding, through behavioral means, temperature refuges (where cooler water is present due to ground water seeps, shady areas, and other factors). The bottom line is that Chinook salmon do not have to experience (and usually do not) temperatures that are continuously in the temperature ranges specified by criteria. In fact, it is this flexibility that has made Chinook salmon so successful in the Central Valley and to thrive where less temperature tolerant salmonids (e.g., coho salmon) cannot."

If temperatures were a problem for adult migrants in the San Joaquin Basin, one might also expect to observe problems with pre-spawning mortality. However, studies conducted by CDFG (Guignard 2005, Guignard 2006) demonstrated that the incidence of pre-spawn mortality is quite low (i.e., 2%-4.5%) and appears to be density, not temperature, dependent.

a. *<u>CDFG Has Cited to Temperature Criteria In Other Reports</u>*.

Although CDFG has based its entire recommendation on the notion that the EPA Region 10 criteria are the temperature thresholds against which temperature impairment for anadromous fish beneficial uses, CDFG itself has not and does not rely on such criteria itself. To the contrary, CDFG has and does cite to a variety of temperature criteria. For example:

- CDFG uses <13ºC (<55.4ºF) maximum temperature in the impairment analysis for spawning/ incubation
    - <14.2ºC (<57.6ºF) is acceptable for egg incubation (CDFG 1987)
    - 13.3ºC (56ºF) average daily temperature, not maximum (CDFG 1987 to 2004; CDFG 1992).

- CDFG uses <15ºC for smolt outmigration in the tributaries and <18C (<64.4ºF) for oversummering and smolt outmigration in the San Joaquin River
    - In a previous document the criteria is defined as <20ºC (<68ºF) for fry, smolts, and yearlings (encompasses smolt outmigration and oversummering; CDFG 1987)

It is clear that, despite the impression left by CDFG, CDFG itself does not rely solely on the EPA Region 10 temperature criteria.

b. *<u>Other Sources Also Support the Conclusion that the EPA Region 10 Temperature Criteria Are Inapplicable Here</u>*.

In addition to CDFG, many scholars and scientists are also critical of the EPA Region 10 criteria. A preliminary review of some available sources identified indicates:

- considerable variation in thermal tolerance between stocks, with higher temperatures recommended for some populations;
- the need to consider other factors, such as acclimation conditions in thermal tolerance among populations;
- some evidence suggesting that San Joaquin Basin populations may be adapted to higher temperatures; and
- that local observations support other criteria that those for the Northwest by EPA are better suited to the San Joaquin Basin (SJB).

Specific information from some of the available sources regarding these issues is provided in the following bullets.

- In contrast with the EPA recommended threshold of 15°C (59.0ºF) for smoltification, Chinook salmon juveniles transform into smolts in the wild at temperatures in excess of 19°C (66.2ºF), and in a laboratory study highest growth and survival of smolts was found if they underwent transformation at temperatures of 13-17°C (55.4-62.6ºF; Marine and Cech 2004). Studies evaluating the relationship between growth and temperature of Central Valley Chinook found no difference in growth rates between 13-16°C (55.4-60.8ºF) and 17-20°C (62.6-68.0ºF) temperature treatments (Marine 1997); and found that growth rate increased up to 19°C (66.2ºF; Cech and Myrick 1999).

- (McMahon 2006). The applicability of thermal criteria derived from the laboratory has long been debated, and unfortunately, there has been no confirmatory lab or field data for the growth vs. temperature relationship for any of the listed species in the Central Valley to assess if laboratory results are transferable to these southern stocks (Myrick and Cech 2004). Wurtsbaugh and Davis (1977, as cited in Myrick and Cech 2004) found 61.5ºF (16.4ºC) to be the optimum growth temperature for steelhead, whereas Myrick and Cech (2005) found that American River steelhead grew fastest at 66.2ºF (19.0ºC) over the range of 51.8-66.2ºF (11.0-19.0ºC). If optimal growth in the laboratory represents an upper temperature limit in the field, then the Wurtsbaugh and Davis laboratory results suggest that temperatures above 61.5ºF for prolonged periods may cause reduced growth and survival. As Myrick and Cech (2004) point out, however, these southerly steelhead stocks may have greater thermal tolerance, as perhaps evidenced by their results.

- (Moyle 2005). Optimal temperatures are typically defined under laboratory conditions as those in which physiological processes operate at the least energetic cost, so growth and survival are both high and predictable. The reality of wild Chinook salmon in the Central Valley is that they often experience temperatures higher than "optimal" yet still have high growth and survival. For example, Dr. Hanson indicates that for juvenile Chinook rearing "the seven day average of daily maximum temperatures should not exceed 16ºC (60.8ºF)" while I put optimal conditions for rearing in the range of 13-20ºC (55.4-68.0ºF), temperatures which are based on an exhaustive USEPA report (McCullough 1999). It would not at all be unusual to find juvenile Chinook salmon growing rapidly at daytime maxima of 20ºC (68.0ºF) with temperatures at night dropping to 15-16ºC (59.0-60.8ºF). I also point out that juvenile Chinook can survive exposure to temperatures of 24ºC (75.2ºF), depending on their thermal history, availability of refuges in cooler water, and night-time temperatures. While seven-day single temperature averages such as Dr. Hanson recommends as standards not-to-be-exceeded are often used because of the simplicity of doing so, they do not reflect the temperatures that juvenile Chinook salmon regularly experience in Central

Valley streams at some times of the year. For example, the most productive spring-run Chinook salmon stream left in California, Butte Creek, can experience daily maxima up to 24ºC (75.2ºF) with minima of 18-20ºC (64.4-68.0ºF) for short periods of time in pools where juveniles are rearing and adults are holding (Ward et al. 2003). It is thus possible for Chinook salmon to maintain populations even when they experience periods of suboptimal or even near-lethal conditions. They are also capable of finding, through behavioral means, temperature refuges (where cooler water is present due to ground water seeps, shady areas, and other factors). The bottom line is that Chinook salmon do not have to experience (and usually do not) temperatures that are continuously in the temperature ranges that the Hanson statement says are necessary. In fact, it is this flexibility that has made Chinook salmon so successful in the Central Valley and to thrive where less temperature tolerant salmonids (e.g., coho salmon) cannot.

- (Williams et al. 2007). While much information is available on lifestage-specific temperature ranges of Chinook salmon and steelhead little is known about the specific responses of Central Valley species to temperature. Anecdotal evidence suggests that some species of CV salmonids are heat tolerant: “the high temperature tolerance of San Joaquin River fall run salmon, which survived temperatures of 80°F (26.7ºC), inspired interest in introducing those salmon into the warm rivers of the eastern and southern US (Yoshiyama 1996).”

- (CALFED 1999). It is possible that populations southern range of the Central Valley including the Eastside rivers and San Joaquin tributaries have evolved to tolerate higher water temperatures. Laboratory studies indicate that mortality rates of juvenile Chinook salmon begin to increase at water temperatures above 65°F (18.3ºC). However, historically the San Joaquin basin has had higher water temperatures than all the other rivers that support Chinook salmon and so it is possible that the San Joaquin race has evolved to withstand higher temperatures than 65°F (18.3ºC).

- (Spina 2007). Oversummering Southern California steelhead accept an elevated body temperature in excess of the preference and heat tolerance information reported for the species and remain active and forage throughout the day, apparently as a means for coping with warm water at the southern extent of their range. The relatively high body temperatures that steelhead accept appear to represent a compromise in exchange for maintaining an expanded geographic (latitudinal) range.

- (Myrick and Cech 2001). Cherry et al. acclimated rainbow trout to temperatures of 6-24°C (42.8-75.2ºF; Cherry et al. 1975) and 12-24°C (53.6-75.2ºF; Cherry et al. 1977) in 3°C (37.4ºF) increments. They reported that the preferred or selected temperature changed with acclimation temperature in both studies. As acclimation temperatures increased from 6-18°C (42.8-64.4ºF), selected temperatures were higher than the acclimation temperature, but fish acclimated to temperatures higher than 18°C (64.4ºF) selected cooler temperatures. The overall mean preferred temperatures for the fish in the 6–24°C (42.8-75.2ºF) and 12–24°C (53.6-75.2ºF) experiments were 16.5(61.7ºF) and 18.4°C (65.1ºF), respectively. Myrick (1998) measured American River (Nimbus strain) steelhead thermal preference over the 11–19°C (51.8-66.2ºF) range. He reported a similar increase in thermal preference with acclimation temperature, but did not reach an acclimation temperature where juvenile steelhead began to select cooler temperatures. Myrick's (1998) results are interesting because (1) the steelhead selected higher temperatures than one might expect for a cold-water fish (Moyle 1976), and (2) because the selected temperatures closely match the temperature at which Myrick observed the highest growth rates. Myrick and Cech (2000) measured the thermal preference of hatchery Feather River steelhead acclimated to constant (16°C; 60.8ºF) and diel cycling temperature regimes (16 ± 2°C) (60.8 ± 3.6ºF) and that of wild-caught Feather R. steelhead that were fasted 24 h before testing and fed 24 h before testing. Hatchery fish acclimated to constant and cyclical thermal regimes had similar thermal preferences, selecting temperatures in the 18–19°C (64.4-66.2ºF) range. Wild fish, which probably were exposed to cooler temperatures in the Feather R. (Myrick and Cech 2000), selected slightly cooler temperatures (17°C; 62.6ºF) under both fed and food deprived conditions. Interestingly, the wild fish were collected from much cooler temperatures (< 15°C; <59.0ºF), yet selected warmer temperatures, as one might expect from the trends seen in Cherry et al.'s (1975; 1977) studies (Figure 1).

- Rob Titus of CDFG reported at the 2007 American River Conference on successful steelhead rearing in the lower American River at up to 18°C (64.4ºF) daily **average** [presumably daily maximum temperatures were higher] based on growth rates, condition factor, and absence of disease (Titus 2007).

B. Concerns With Lifestage Timing and Reach Location Criteria.

The critical importance of appropriately applying the temperature criteria with regard to the timing and location of different salmonid lifestages is well recognized by fisheries researchers. In a recent review of the temperature requirements of Pacific salmonid species, Richter and Kolmes (2005: p.38) stated:

> "For all these criteria, the significant challenge of defining the spatio-temporal range over which they should be applied remains. Those spaces occupied by threatened and endangered salmonids need to be regulated at the times of year that sensitive life stages are present, and defining the bodies of water involved and the times to apply the standards requires additional consideration and research. The complex life histories of salmonids, the variety of habitats used by their different life stages, and the spatially and temporally dynamic nature of the habitats involved, make this an enormous scientific undertaking. . . . Laboratory studies cannot fully substitute for field data, because of difficulties in replicating acclimation conditions, food availability, social interactions including territoriality, diurnal physiochemical periodicity, and the complexities of microhabitats accessible to fish in nature . . ."

Richter and Kolmes (2005:p.40) emphasized that the proper application of thermal tolerance information to effectively protect salmonids will require an adaptive and realistic management approach:

> "Definitive criteria for salmonid recovery should eventually define ways to incorporate spatio-temporal variability into them in a realistically complex fashion and have as their eventual goal a process that realigns the distribution of current environmental variables so that they overlay historic conditions rather than simply act as a floor or ceiling. . . . The challenge of this task is exacerbated by the multiple salmonid life stages whose distributions over space and time will need identification and monitoring."

In contrast to the ecologically-based approach recommended by Richter and Kolmes (2005), the information submitted by CDFG provides no justification for the seasons or reaches defined for the presence of each lifestage and used in their analysis of impairment. Information to assess the validity of the seasons and reaches defined by CDFG is readily available from several sources and according to listing policy RWQCBs and SWRCB shall actively solicit, assemble, and consider all readily available data and information. However, historical and current fisheries information was not solicited or considered prior to the September 25, 2007 workshop and a placeholder for current and historic salmonid distribution exists in the draft CVRWQCB assessment for the Merced River. It is impossible to assess potential impairment to a population without describing when a given lifestage is present, where they are located, and the relative proportion of the population that may be affected in a given location at a given time. Given serious flaws in the information submitted by CDFG and reviewed by the CVRWQCB re-analysis using lifestage timing and stream reach criteria supported by readily available scientific data is warranted. Concerns with CDFG's timing and stream reach criteria for each lifestage are provided in the following sections.

1. **Adult Upstream Migration**.

In their analysis submitted to the CVRWCB, CDFG defined the adult upstream migration period as occurring from September 1 through October 31. However, their submittal provided no justification for this assertion and such timing is not consistent with historical conditions, management actions taken by CDFG, and available data. Based on the evidence provided below, the primary adult upstream migration period occurs from October 1 through late December.

a. *Historical conditions and adult upstream migration timing*.

The lowest unimpaired (computed natural) flows of the year typically occur during the month of September. During 1922-1992, the average unimpaired flows during September were 117 cfs in the Stanislaus River, 185 cfs in the Tuolumne River, 84 cfs in the Merced River, and 808 cfs in the San Joaquin River (DWR 1994). Although not widely recognized, September unimpaired flows can be extremely low or nonexistent in dry years – for example, of the ten lowest September flows of the 1922-1992 period for the Tuolumne River (the largest of the three tributaries), five had zero average flow for the month and the other five averaged only 15 cfs. Average unimpaired flows in the San Joaquin River increase to just 933 cfs during October and then to 2,374 during November as average seasonal rainfall increases. The fall-run moved upstream in the fall or early winter after water temperatures had dropped and flows increased (CDFG 1987). Specifically, the Comprehensive Monitoring, Assessment, and Research Program report states that "adult San Joaquin fall-run Chinook salmon begin to enter the western Delta near Jersey Point in September and they migrate upstream slowly, typically entering the San Joaquin tributaries in late October or early November and continuing to migrate through December (Hallock et al. 1970; Department of Fish and Game annual reports; Carl Mesick Consultants 1998)".

b. *Management actions and adult upstream migration timing*.

The timing of management actions that directly involve CDFG for purposes of adult salmon migration in the San Joaquin Basin (i.e., Head of Old River Barrier operation and attraction flows) contradict the migration timing asserted by CDFG in their impairment analysis. This discrepancy has continued even since their analysis was submitted to the CVRWQCB in February 2007. Each year in the fall since 1968, CDFG determines whether and when to request that the temporary Head of Old River Barrier (HORB) be installed to improve conditions for migrating adult Chinook salmon in the San Joaquin River, in particular to address low dissolved oxygen conditions in the Deep Water Ship Channel at Stockton. As directed by CDFG, during 1968-2005 the average date that the HORB was completed is September 30 (Figure 2)[13]. During 2007 it was not until September 27 that CDFG even requested that DWR install the HORB and barrier installation was completed on October 18 (CDWR 2007).

CDFG's fall salmon attraction flow schedules also contradict the migration period used in their impairment analysis. Since the early 1990s, adult attraction flows that have been released from the Stanislaus, Tuolumne, and Merced rivers were scheduled during mid to late October, not September. During 2007, the attraction pulse flow on the Stanislaus River was scheduled for October 16-31 which corresponds to the last two weeks of the migration time period used by CDFG in the impairment analysis. Much of the 2007 attraction pulse flow on the Merced River, scheduled for October 24-November 9, occurred after the end of the migration period designated by CDFG and used in the impairment analysis (i.e., October 31).

In addition, long-standing base flow requirements for the tributaries were established to correspond with the typical timing of the run starting in October and have not included September. For example, the designated summer flow period for the Tuolumne River over the last 36 years has extended through September, with the higher base flow for salmon migration and spawning not starting until October 1 or as late as October 16.

[13] The Tables and Figures referenced in this Section III are attached hereto as Exhibit D.

c. *Available data on timing of adult upstream migration*.

CDFG provided no information to support using the September 1 through October 31 time period in their impairment analysis, and the available data from the Merced River Hatchery (MRH), the Stanislaus River Weir, tributary spawning surveys, and historical weir, trapping, and fish rescue operations provide the following evidence that most migration is much later than September and continues well after October.

i. *Merced River Hatchery*

CDFG annual reports state that "a standard measure of the timing of spawning runs in the San Joaquin Basin is the date on which the first salmon enter the MRH spawning trap each year" (CDFG 1987 to 2004). The average date that the first salmon arrived at the Merced River Hatchery from 1974 to 2003 is October 17 (CDFG 2004). CDFG reports do not present the average date that the last salmon arrived at MRH, however the date that trapping was terminated is reported in annual hatchery operations reports for the period 1996-2004 (CDFG 1997 to 2005). Based on this information the average date that trapping activities are terminated annually is December 20.

ii. *Stanislaus River Weir*

Operations at the Stanislaus River Weir have recorded that more than 97% of adult FRCS migrate after October 1 in recent years (Figure 3). Although temperatures were exceptionally cool during September 2006 (Figure 4), salmon did not migrate earlier than during 2003-2005 (Figure 5). During September 2006 temperatures on average were as much as 5 degrees cooler in the San Joaquin River at Rough and Ready Island (RM 37.9), Mossdale (RM 56.3), and Vernalis (RM 72.3), and as much as 9 degrees cooler in the Stanislaus River at Ripon (RM 15.7) as compared to monthly average temperatures at the same locations during 2003-2005 (Figure 6). September flows in the Stanislaus and San Joaquin Rivers exceeded average unimpaired flow conditions during all of these years (Figure 6, Figure 7).

iv. *Tributary Spawning Surveys*

During annual spawning surveys in the Stanislaus, Tuolumne and Merced rivers CDFG counts live fish observed in river reaches on a weekly schedule. This data provides a long-term measure of run timing and is available from annual CDFG escapement reports and in spreadsheet queries that they have provided from their database. CDFG has typically begun their spawning surveys in early to mid October. The following run timing has been observed based on live counts in the tributaries.

a. *Stanislaus River* live counts (CDFG 2007b) show that the earliest fall-run adult salmon observed in the Stanislaus River during 2000-2006 was September 25, and most of the run is from early October through mid-December (Figure 8).

b. *Tuolumne River* live counts demonstrate that relative numbers of adult salmon are generally very low in early October and after mid-December (Figure 9). Data provided by CDFG (CDFG 2007b) show that the earliest fall-run adult salmon observed in their surveys during 1992-2005 was September 27.

c. *Merced River* live counts (CDFG 2007b) show that the earliest fall-run adult salmon observed in their surveys during 1992-2006 was September 15, but again with most of the run being from early October to mid-December (Figure 10), much later than asserted by CDFG. Timing of first salmon arrival at Merced River Hatchery from 1974-2003 had a median date of October 17 with several years not occurring until November; the earliest date was September 24.

v. *Fish Barrier and Historical Weir Operations in the Tributaries*

a. *Weir counts during 1940s*

During 1940 and 1941 CDFG counted adult Chinook migrants entering each of the tributaries, and counts were also made on the Tuolumne River during 1942, 1944, and 1946 (Figure 11). Counts on the Stanislaus and Merced rivers were described as incomplete since sampling ended in November during both years. Sampling on the Tuolumne River was considered to be complete during 1940 and 98.6% of the run occurred during October through early December in that year. Counts continued through November 30th in 1942 and 1944. (Cloyd 1962; Hatton and Clark 1942).

b. ***Stanislaus River Egg Collection Station***

CDFG operated an egg collection station (trap) on the Stanislaus River at Orange Blossom Bridge (RM 46.9) during 1990 and 1991. In both years trap operation began on October 12 and continued until December 7 and December 10, respectively.

c. *Merced River Fish Guidance Project, Gallo Ranch Barriers*

In 1996, two fish barriers were built and installed by CDFG to prevent adult salmon from entering irrigation return channels on the Gallo Ranch. Dates of operation are provided in CDFG's annual job performance reports for the San Joaquin Drainage Chinook Salmon and Steelhead Habitat Restoration Program. During 1996-1998 the barriers were installed in October and during 2000-2001 the barriers were installed on September 20. The barriers continued to operate until December during all years.

//

//

//

vi. *San Joaquin River Fish Barrier and Trapping Operations*

a. *Trapping at Banta Carbona*

During 1977 a decision was made by CDFG to attempt to trap the entire run of migrating adult salmon bound for the Stanislaus, Tuolumne, and Merced rivers (CDFG 1978). Trapping was conducted from November 1 through December 15 and peak catches occurred on November 8 and November 26 (Figure 12). Clearly one may deduce from the stated objectives and timing of this effort that CDFG believed that the majority of salmon migration occurred during November 1 through December 15. However, this period does not even overlap with the September 1 through October 31 period recently designated by CDFG for use in their impairment analysis.

b. Trapping near Los Banos

Trapping near Los Banos was conducted during 1988-1991 to determine the number of adult salmon migrating in the San Joaquin River upstream of the confluence with the Merced River. Based on information from CDFG reports, trapping was initiated in November and terminated in mid-December each year.

c. Hills Ferry Barrier

Since 1992, CDFG personnel have constructed and operated a temporary fish barrier (Hills Ferry Fish Barrier) each fall on the San Joaquin River immediately upstream of its confluence with the Merced River. It is operated from September/October through December each year (CDFG 2003). Dates of operation are provided in CDFG's annual job performance reports for the San Joaquin Drainage Chinook Salmon and Steelhead Habitat Restoration Program. Based on information available from the reports, the barrier has been operated as early as September 17 and as late as December 23 during 1993-2002.

The available data show that the major portion of adult upstream migration occurs well after September 1, generally becoming substantial after the first week of October, and the adult migration period extends well into December. Hence, a much more representative period for most migration based on these many types of concurring and consistent evidence would be from about October 1 to December 20 (or about Julian weeks 40-51). Consequently, any impairment assessment should examine that period instead. We suspect the result would find only a small fraction of the initial flawed approach would be considered to be impaired, even under the biased temperature impairment criteria defined by CDFG.

d. <u>*Adult upstream migration location*</u>

During development of the CALFED temperature model for the Stanislaus River, CDFG proposed that compliance points for some adult migration dynamically change depending on hydrologic year type as follows: Adult migration= Confluence (Above Normal/Wet); Ripon (Below Normal); McHenry Bridge (Dry/Critical). In contrast to this proposal, CDFG now asserts that conditions are impaired if criteria are not met all the way down to Vernalis under all hydrologic conditions. In Dry/Critical years this is a shift of 32 miles from CDFG's previously proposed criteria.

2. **Spawning and Egg Incubation**

a. *Timing of spawning and egg incubation*

In the analysis of potential impairment submitted by CDFG the spawning (egg deposition) and egg incubation season is defined as October 1 through December 15 which is not supported by existing data. US EPA Region 10 recommends that the season be defined as the average date that spawning begins to the average date that incubation ends. The end of incubation is when fry emerge from the gravel. Based on available data from the Merced River Hatchery, tributary spawning surveys, and rotary screw trap monitoring provided below, the average date that spawning begins is October 10 on the Stanislaus River, October 9 on the Tuolumne River, and October 17 on the Merced River. Incubation extends into March on all three streams.

i. *Merced River Hatchery*

The average date that the first salmon arrived at the Merced River Hatchery from 1974 to 2003 is October 17 (CDFG 1987 to 2004). The average date that the spawning is terminated at MRH is December 20 (CDFG 1997 to 2005).

ii. *Tributary spawning surveys*

Average date of first redds observed during carcass surveys is October 10, October 9, and October 17 on the Stanislaus, Tuolumne and Merced, respectively (CDFG 2007b).

iii. *Rotary screw trap monitoring*

The capture of emergent fry in rotary screw traps provides an indication of emergence timing. Most emergent fry are typically captured by early to mid-March indicating that incubation extends into March. The truncated time period selected by CDFG skews the assessment of impairment by focusing on just a fraction of the time over which spawning and egg incubation actually occurs.

In addition to specific data, several agency documents describe spawn timing in the San Joaquin tributaries as beginning during October or later. For example:

- IFIM studies conducted by the USFWS (Aceituno 1993; USFWS 1995) describe the spawning period as beginning in mid-October and continuing through January.

- A 1987 Agreement between the US Bureau of Reclamation and CDFG states that spawning begins in mid-to-late October, reaches a peak in mid-November, and ends in January (CDFG and USBR 1987).
- A 1967 Davis-Grunsky Contract (Amendment #D-GGr17-A2) between the State of California Department of Water Resources and the Merced Irrigation District specifies that spawning/incubation flows shall be provided November 1 to April 1 on the Merced River (CDFG 1987).
- Emergence of fry increases mid-January to mid-March (CALFED 1999).

In summary, the available data show that the primary spawning and egg incubation season essentially begins about mid-October and extends into March —a substantially longer period than defined by CDFG. Hence, the putative impaired conditions as defined by the CDFG criteria would occur only for a fraction of the actual spawning and egg incubation period.

b. *Location of spawning and egg incubation*

Historically the spawning reaches of the Stanislaus and Tuolumne Rivers were described by G.H. Clark in the 1920s as extending from Knights Ferry to Oakdale and La Grange to Waterford (Clark 1929). These continue to be the reaches where most spawning activity occurs, although a small proportion of late-season spawning occurs on the Stanislaus down to Riverbank and on the Tuolumne down to Fox Grove. For example, less than 5% of spawning occurs below Oakdale and 95% of this activity occurs after November 30.

CDFG has advanced the hypothesis that a higher proportion of spawning would occur in the lower reaches if temperatures were made cooler earlier in the season. However, the spawning distribution on the Stanislaus River did not change during 2006 when temperatures were exceptionally cooler than average (Figure 13).

During development of the CALFED temperature model for the Stanislaus River, CDFG proposed that compliance points for incubation dynamically change depending on hydrologic year type as follows: Incubation= Riverbank (Above Normal/Wet); Oakdale (Below Normal); Valley Oak (Dry/Critical). In contrast to this proposal, CDFG now asserts that conditions are impaired if criteria are not met all the way down to Riverbank under all hydrologic conditions. In Dry/Critical years this is a shift of approximately 12 miles downstream from CDFG's previously proposed criteria.

Based on the temporal and geographic distribution of spawning and egg incubation, the downstream reach boundaries should be Oakdale on the Stanislaus River, Waterford on the Tuolumne River, and Shaffer Bridge on the Merced River from the beginning of the spawning period through November 30 (Table 1). After November 30 the boundaries should be Riverbank on the Stanislaus River, Fox Grove on the Tuolumne River, and Shaffer Bridge on the Merced River.

3. **Juvenile Outmigration and Smoltification**

In the analysis of potential impairment submitted by CDFG the smoltification and emigration season is defined as March 15 through June 15 which is not supported by existing information. Rotary screw trap data collected annually since 1995 indicate that emigration typically begins in January and about 97% of salmon juveniles migrate out of the Stanislaus River by May 15; therefore, temperatures at the confluence to protect smoltification after May 15 are not necessary for such a small portion (i.e., 3%) of the population. Less extensive rotary screw trap data from the Merced and Tuolumne suggest similar outmigration timing.

In particular, there is no evidence to support the June 15 ending being applicable for all years. Most management activities (flow operations and evaluations) have targeted about the April 15-May 15 period for primary smolt outmigration; monitoring data indicate almost all smolt outmigration from the tributaries has concluded by May 31 or earlier.

The period of years selected by CDFG was truncated for the Stanislaus (starting in 2000) and should be extended at least to 1998 to be consistent with the other tributaries. The same period should also be selected for Vernalis as there is no purpose in evaluating years back to 1973 which are not representative of current basin operational conditions.

4. **Oversummering**

CDFG asserts that steelhead are present and rearing in all three tributaries, yet it has not been conclusively established that steelhead exist in the Tuolumne and Merced Rivers. We do agree that rainbow trout are present in all three tributaries and the following discussion pertains to that population.

a. *Timing of oversummering*

CDFG defined the oversummering period as June 15 to September 15; however, National Marine Fisheries Service defines the oversummering period as June 1 to November 30 (NMFS 2004). Logical start and end-dates for the oversummering period would be June 1-September 30 as done by existing flow requirements, or some later date based on the onset of the fall rains. As described for the other lifestages the use of inappropriate time periods invalidates CDFG's assessment of impairment.

b. *Location of oversummering*

CDFG has here defined a 10-mile oversummering reach in the Tuolumne River with a lower boundary at Turlock Lake State Recreation Area (RM 42), yet provides no basis for that requirement. It is interesting to note that in the same month (February 2007) that CDFG filed their temperature impairment package with the Regional Board, CDFG also prepared a joint document with FWS and NMFS dated February 27 and filed with the Federal Energy Regulatory Commission on March 6, stating they wanted to "provide a minimum of 8 miles of habitat" for summer rearing in all but "wet" years (when 13 miles were recommended). Thus inconsistent criteria were identified by CDFG within the same month.

CDFG also agreed to increased flow schedules, including summer flows from June through September, until 2016 in a 1995 FERC Settlement. Those flows are reduced in the summer during the drier 50% of years, but the results have been the expected improvement in providing suitable oversummering conditions for several river miles in those dry years. In fact, it has been well documented that the summer flow regime since 1995 has routinely extended the trout distribution to include the upper 10 river miles. CDFG also is on record of not supporting any allocation of an optional portion of the existing required annual river flow volume to the June through September period. It is egregious for CDFG to even claim temperature impairment under the improved conditions they agreed to, to recommend differing target reaches in different venues, all while at the same time not supporting that existing flows be allocated to the period they have identified as impaired.

CDFG's impairment analysis designates the first 10 miles below Crocker-Huffman Dam as the oversummer rearing reach. However, there is no evidence to support this designation and oversummer rearing in the lower Merced River is generally known to occur within the first few miles downstream of Crocker-Huffman Dam.

c. *Years of assessment*

CDFG selected a biased set of years (2001-2006) for their Tuolumne River assessment that is dominated by dry years, even though CDFG began both the Stanislaus and Merced assessment periods in 1999; the Merced period was truncated at 2005 and should be extended. The first entire summer period under the present Tuolumne flow schedule criteria was in 1997 and it would be appropriate to begin the assessment period then.

C. Concerns With How The Criteria Are Applied

I. CDFG's use of criteria for smoltification is inconsistent between locations. Specifically, the CDFG assessment uses 15ºC as the criteria for the tributaries and 18ºC in the San Joaquin River.
II. CDFG substituted data from distant locations when data was missing for a particular station. For example in the assessment of Tuolumne River adult upstream migration, data are not available from Shiloh (RM 4) during 2002. Instead, data from Waterford (RM 32) is substituted to represent conditions near the confluence. This issue was found by chance while perusing the formulas and hyperlinks used in CDFG's Excel spreadsheets. Obviously the data was not presented properly which casts doubt on the accuracy of the rest of the analysis, especially in light of the other factors identified during this preliminary review.
III. The sub-set of available data used in CDFG's assessment focuses on a string of several dry years and the periods do not generally represent the distribution of

water year types. CDFG’s decision to only use some of the available data is clearly another bias that was purposefully introduced. Additional data has been provided to CDFG previously and is available from monitoring efforts conducted by TID/MID on the Tuolumne River since 1986 and by Tri-Dam on the Stanislaus River since 1998.

IV. The ability of individual salmon to survive, tolerate, or thrive at a particular temperature is the result of a combination of recent thermal history (i.e., acclimation), availability of thermal refuges, length of exposure time, daily temperature fluctuations, genetic background, life stage, interactions with other individuals and species, food availability, and stress from other factors (e.g., pollution). CDFG’s analysis ignores 8 out of the 9 factors.

V. Abundance of a given lifestage is not evenly distributed through time or space and CDFG’s analysis does not account for the proportion of the population that may be exposed to the conditions that they have defined as impaired. For example, if 5 out of 20 weeks are impaired, CDFG’s approach would calculate that the lifestage is 25% impaired. However, if only 5% of the population was present during that 5 week period, CDFG’s approach would have overestimated the impairment five-fold.

VI. The EPA criteria are based on constant laboratory conditions which are not directly comparable to diurnally fluctuating field conditions. Fish in the wild are acclimated to the mean of the average and maximum temperatures, and are not constantly exposed to the 7DADM temperatures. As such, the criteria assume a constant exposure to a given temperature rather than potentially brief exposure under diurnally fluctuating conditions.

VII. Adverse biological impacts associated with attempting to meet temperature criteria through increased flow have not been addressed. For example, increasing flows down the Stan during fall to meet temp criteria will result in negative consequences for spawning Chinook. Flood control releases on the Stanislaus during fall 2006 delayed spawning and very little spawning activity occurs during annual attraction pulses. Other biological issues may include de-watering and strandingand the relationships of these factors to instream flow will differ by stream.

VIII. The approach used by CDFG does not consider whether fish utilize potential areas of thermal refugia such as pools and areas of groundwater upwelling. During June 1989 a groundwater source in the Tuolumne River was identified where temperatures were about 5ºF (~3ºC) cooler than the surrounding water (EA Engineering 1992).

D. Sample Revised Assessment

Based on the corrected location and timing information described previously in the document and supported by actual fisheries information an example of a revised assessment was calculated using the EPA Region 10 criteria and the same basic impairment analysis structure used by CDFG (Table 2). Even with the use of the EPA temperatures which are overly conservative with regard to more heat tolerant stocks of the San Joaquin Basin, the number of exceedances was not adequate for listing adult upstream migration on the Tuolumne River.

E. Other Relevant Issues

Other relevant issues such as the relative benefits to the population that may be achieved through other types of restoration actions and global warming have not been addressed by CDFG. Although CDFG has stated that substantial restoration actions (in this case temperature reductions) must be taken because present average population trends are well short of targeted population levels (Marston 2007), they have failed to take several obvious and prudent actions to protect salmon and steelhead. For example:

- The California Fish and Game Commission establishes angling regulations in Title 14 of the California Code of Regulations. These are published annually in a booklet by CDFG as the California Freshwater Sport Fishing Regulations. Legal sport harvest of San Joaquin salmon has continued, with more liberalized regulations starting in 2004. The season was generally extended by two weeks to the end of October, thus exposing a much greater part of the runs to inland recreational harvest, and the daily limit was increased from zero to one salmon in part of the San Joaquin and Stanislaus Rivers (California Fish and Game Commission 2007). The extent of legal and illegal harvest is unknown and there is limited enforcement of existing regulations.

- CDFG has stymied implementation of collaboratively developed key spawning gravel additions, long recognized as an important habitat restoration need, and extensive monitoring efforts on the Tuolumne River, by withholding all funds from two grants approved by the CALFED Program.

- CDFG continues to support protection and restoration of striped bass, a non-native fish which preys on native salmon and steelhead.

Global warming is a serious concern that should not be ignored. Dettinger (2005) determined that the most likely projection of annual average warming over Northern California is about 5°C by 2100, together with a decrease in precipitation. Recent experience suggests that most climate models have been too conservative and the actual effects occurring are more accelerated than forecasted. Williams (2006) asserts that warming is already affecting Central Valley Chinook. The predicted increase in temperature begs the question whether Central Valley salmon are a lost cause, so that efforts to protect salmon are a waste of resources that should be applied elsewhere (Williams 2006).

//
//
//
//

IV. PRACTICAL OBJECTIONS

The SJRGA retained AD Consultants and Resource Management Associates, Inc. (hereinafter referred to as "AD Consultants") to run the SJR Basin Model in an effort to assess a variety of items, including whether or not (1) the model could accurately predict historic temperatures, (2) the construction and operation of New Melones dam and reservoir have made increased temperatures during the spring and fall time periods identified by CDFG, (3) the release of reservoir storage from new Melones could achieve the temperatures recommended by CDFG at Riverbank, the confluence of the Stanislaus and San Joaquin Rivers and Vernalis, and what the affect on reservoir storage would be as a result of such effort, (4) attainment of temperatures at the confluences of all three tributaries and the San Joaquin River would, in combination with additional reservoir releases in the tributaries, would result in achieving the recommended temperature criteria at Vernalis, (5) flows anticipated under the Friant Settlement will adversely affect water temperatures during the spring and fall time periods identified by CDFG, and (6) CDFG recommended temperatures can be met even if all water in the San Joaquin River Basin is allocated for temperature. The actual results of these cases run for the SJRGA by AD Consultants are attached hereto as Exhibit E. The results show that while the additional release of reservoir storage can reduce temperatures, the temperatures recommended by CDFG cannot be met at all times and in all locations and the impacts to reservoir storage are severe.

A. Case 1 Run Shows that the Construction and Operation of New Melones Have Improved Temperatures in the Stanislaus River and at Vernalis.

For Case 1, the SJRGA asked AD Consultants to analyze the time period from 1967-1982, which is the time period that provides the basis for the idea of doubling the natural production of salmon in the San Joaquin River Basin. During the 1967-1982 time period, the SJRGA asked AD Consultants to model temperatures at five times and locations identified by CDFG as critical in terms of evaluating impairment for temperature: the confluence of the Stanislaus River and San Joaquin River between September 1 and October 31, Vernalis between September 1 and October 31, Riverbank between October 1 and December 15, the confluence of the Stanislaus River and San Joaquin River between March 15 and June 15, and Vernalis between March 15 and June 15. As for the operational scenarios, the SJRGA asked AD Consultants to use actual hydrology, but model one scenario as if New Melones reservoir and dam were in place and operated under the terms of the Interim Plan of Operation ("IPO") currently used by the United States Bureau of Reclamation (referred to as the "Actual Temperature" or "IPO Scenario"), and model another scenario as if Old Melones dam and reservoir existed (referred to as the "Historic Temperature" or "Historic Scenario"). (A complete description of the Case 1 assumptions and instructions is found in Exhibit B, p. 2-3).

While we invite the CVRWQCB to review the entire set of results from this run, a few items need to be highlighted. First, the CDFG recommended temperatures were never met at all times and locations in the Historic Scenario. Typically, for each of the three locations – Riverbank, the confluence and Vernalis – the CDFG temperature criteria were achieved only on the shoulders of the recommended time periods. Second, in some instances, the recommended temperatures were barely achieved under the Historic Scenario. For example, in 1976, temperatures at Vernalis and the confluence were met only once in March and during the last 9 days of October. In 1977, the recommended temperatures at the confluence were met approximately the 1st six days of March and the last 10 days of October.[14] Under the Historic Scenario, even assuming that the CDFG recommended temperatures are appropriate, temperatures were hardly ideal for salmon and steelhead.

Things change slightly when the IPO Scenario is examined. In almost all instances, temperatures are improved compared to those identified in the Historic Scenario.[15] Sometimes, the improvement is dramatic. For example, at the confluence, in 1972 the IPO Scenario meets the recommended temperatures approximately 25 days in March and April, and approximately the last 27 days of October. In 1976, the IPO Scenario meets the recommended temperatures approximately 25 days in March and April and approximately the last 28 days of October. In 1977, the IPO Scenario meets the recommended temperatures approximately the 1st 18 days of the March-April time period, and approximately the last 20 days of October. Similar improvement can be found when comparing the results of the IPO Scenario and the Historic Scenario at Riverbank. Under the IPO Scenario, the recommended temperature criteria are met at all times in 1967, 1970 and 1982, as compared with such criteria not once being achieved at all times under the Historic Scenario.

Overall, the results of Case 1 refute the conventional wisdom that the construction and operation of dams and reservoirs generally, and in this case New Melones particularly, have made water temperatures during key times worse than they were before such construction and operation. Case 1 shows that the temperatures in the Stanislaus River and at Vernalis, in the absence of New Melones and the IPO were not met at all locations and time periods identified by CDFG as critical. This means that the construction and operation of New Melones is not the cause of any temperature problem that allegedly exists. Moreover, and to the contrary, the results of Case 1 show that temperatures are generally better, and sometimes significantly so, with the construction and operation of New Melones.

The results of Case 1 are not surprising, as actual data collected at the reservoirs on the Merced River show that the reservoirs dramatically cool the river water as compared to natural conditions during late spring, summer and early fall. During these time periods, water released from Lake McClure is almost always 55º F or less, whereas the temperature of the Merced River as it flows into Lake McClure during the same time period can be as hot as 80º F. (*See* Graphs attached hereto as Exhibit F).[16] Again, the

---

[14] Temperatures at Riverbank followed a consistent pattern throughout the 1967-1982 timeframe. In almost every year, CDFG recommended temperatures were achieved in mid-November through December 15. This pattern did not deviate, even in 1976 and 1977.

[15] Temperatures at Vernalis under the IPO Scenario are virtually unchanged from those of the Historic Scenario.

[16] This data also shows that the reservoirs improve winter-time temperatures for optimal salmon egg incubation and fry growth compared to inflow water temperatures. Inflow temperatures are cold enough to

existence and operation of the tributary reservoirs are not the cause of any perceived temperature impairment, but rather already dramatically improve temperature conditions as compared to the temperature of the natural condition.

B. Case 2 Runs Show That New Melones Operations Cannot Be Manipulated to Meet CDFG's Recommended Temperatures at All Times and At All Locations, and that Any Effort to Do So Will Have Dramatic, Negative Affects on Reservoir Storage and Future Operations.

For Case 2, the SJRGA asked AD Consultants to look at the time period of 1980-2003, and assume that the IPO controlled the operation of New Melones throughout that period. Then, AD Consultants was asked to increase releases from Goodwin Dam over and above what would have been released under the IPO such that the releases were equal to the following rates during the identified periods:

- 500 cfs between March 15 and April 15
- 1000 cfs between April 16 and May 15
- 1500 cfs between May 16 and June 15
- 1500 cfs between September 1 and September 31
- 1000 cfs between October 1 and October 15
- 500 cfs between October 16 and October 31 (*see* Ex B, p. 4).

AD Consultants was asked to determine (a) whether or not the identified flow releases would achieve CDFG's recommended temperatures at Riverbank, the confluence and Vernalis during the specified periods, and (b) what impacts, if any, accrued to New Melones storage as a result of making the increased releases. The results of Case 2 demonstrate that the increased releases from New Melones suggested by the SJRGA were not sufficient to meet CDFG's criteria at all specified times and locations. Moreover, making the suggested releases had a significant, detrimental impact on storage at New Melones, and hence on its ability to meet current and future water requirements.

1. **Increased Releases Insufficient to Meet CDFG's Recommended Temperatures**.

The results of Case 2 show that increasing the releases from New Melones as suggested by the SJRGA will not result in the achievement of the CDFG recommended temperature criteria at all times and locations during the modeled period of 1980-2003. Indeed, the percentage of time that the CDFG recommended temperature would be exceeded is virtually unchanged with the additional flow as compared to flow under the IPO.[17] Improvement can be seen in terms of meeting the recommended temperatures at the confluence, particularly in the Fall of some years during the modeled period.

---

retard fish growth during the Winter and delay salmon outmigration in the Spring which would not be beneficial to San Joaquin salmon.

[17] During the March 15 through June 15 time period, compliance with the IPO would meet the recommended temperatures at Vernalis approximately 6% of the time, which is almost exactly the same amount of time that the temperatures would be met with the additional releases. During the September 1

2. **Minor Benefits Purchased at Great Cost**

As part of Case 2, AD Consultants evaluated the affect that the additional releases specified by the SJRGA would have on storage at New Melones. The results are striking. Between 1980 and 1987, storage is generally less as a result of the additional releases than it would have been had the IPO been complied with. However, for a 9 ½ year period, from September 1986 through April 1997, the reduction in storage is significant.

Under both the IPO and additional release scenarios, storage in September 1986 is approximately 2 MAF. When the 1987-1992 drought hits, storage under the IPO drops to a low of approximately 200,000 AF in December 1992. Storage returns to approximately 2 MAF at the end of March 1996. However, with the additional releases, storage hits 200,000 AF in May of 1990 (as opposed to December 1992) and remains at or below 200,000 from May of 1990 until February of 1993. In fact, the reservoir is essentially at dead storage from July of 1990 through January of 1993 with the additional releases. Moreover, with the additional releases, storage drops below 200,000 AF again between August 1994 and January 1995 (it never drops below 200,000 AF with the IPO only after December 1992). Storage does not return to 2 MAF until April of 1997. Finally, the modeling shows a precipitous drop in storage begins anew in March of 2000. In that year with the IPO only, storage is at about 2 MAF and drops to approximately 1.2 MAF by November 2003. With the additional releases, storage in March of 2000 is approximately 1.9 MAF and drops to approximately 400,000 AF by November 2003.

The IPO is, of course, a set of operations criteria for New Melones designed to meet the majority of the demands on New Melones over time. (*See* Exhibit G). As a result, allocations and deliveries from New Melones in any given year are made based upon a combination of storage at the end of February plus forecasted inflow between March and September. Under the IPO, if storage plus inflow is between 0 and 1.4 MAF, no water is allocated or released to CVP contractors or for the Bay-Delta. Allocations for fishery are between 0 and 98,000 AF, and allocations for water quality at Vernalis are between 0 and 70,000 AF. These allocations rise as the combination of storage and inflow rises, although it is not until storage plus inflow is between 2.5 MAF and 3 MAF that all of these needs receive an allocation.

While the modeling runs do not show inflow in any given year, it is clear that the reductions in storage which result from the additional releases will mean that all of the needs dependent upon New Melones will get less water than if the increased releases did not occur. For example, storage on February 28, 1995 was 921,000 AF under the IPO, but only 354,000 AF with the additional releases. Assuming that anticipated inflow for that year was 750,000 AF (mean annual inflow is approximately 1.1 MAF). Under the "normal" IPO circumstances, the storage plus inflow would be in excess of 1.6 MAF (921,000 + 750,000). As such, the allocation for fisheries would be between 98,000 and

---

through October 31, compliance with the IPO would meet the recommended temperatures at Vernalis approximately 28% of the time, while the additional releases would meet such criteria approximately 33% of the time.

125,000 AF and for water quality at Vernalis would be between 70,000 and 80,000 AF. The Bay-Delta and CVP Contractors would not receive an allocation.

However, under the additional releases scenario, the storage plus inflow number would only be about 785,000 AF (35,000+ 750,000). As such, the allocation for fisheries would be between 0 and 98,000 AF and for water quality at Vernalis between 0 and 70,000 AF. Again, the Bay Delta and CVP Contractors would not receive an allocation.

C. Case No. 3 Shows That CDFG's Recommended Temperatures at Vernalis Cannot Be Met By Increasing Flows From the Tributaries.

The SJRGA asked AD Consultants to evaluate whether or not increasing flows from the tributaries would be an effective method for achieving CDFG's recommended temperatures at Vernalis. (Ex. B, p. 4). Recognizing that CDFG is recommending that certain temperatures be met at the confluence of the San Joaquin River and each of the three tributaries, Case No. 3 assumes that the CDFG recommended temperatures at each confluence is met for the time periods 9/1 – 10/15 and 3/15 – 6/15. (Id.). Flows are then increased from each of the tributaries to determine if CDFG's recommended temperature at Vernalis for these time periods can be met. (*See* Ex. B., p. 4 and p. 19, Table 3, for description of the flow increases).

What these Case No. 3 runs showed is that while it is theoretically possible to reduce temperatures at Vernalis by increasing releases from the tributaries if it is assumed that the CDFG recommended temperature at each confluence is met, the reduction is not sufficient to achieve the CDFG recommended temperature at Vernalis. (*See* Ex. B, p. 17, Figure 15). Moreover, as in Case No. 2, this runs shows that the benefit obtained by increasing releases from the tributaries is extremely slight and not worth the water cost. In the Spring absent the additional releases, the maximum average temperature is 62.8º F. The additional releases reduce the maximum average temperature by .7º F or less. (*See* Ex. B, p. 18, Table 3). The same phenomenon occurs in the Fall, when the additional releases reduce the maximum average temperature by 1.6º F or less. (Id.).

D. Anticipated Friant Restoration Flows Will Make It Harder to Achieve CDFG's Recommended Temperature Criteria.

The first three cases discussed above were each presented to the CVRWQCB staff at the September 25, 2007 workshop. At the workshop itself, CDFG staff indicated that temperatures could be improved by increased flows from the San Joaquin River's tributaries. However, CDFG staff admitted during the question and answer period that it had not looked at what impact, if any, the anticipated flows in the main stem of the San Joaquin River itself resulting from the Friant settlement would have on the ability to use additional tributary releases to meet CDFG's recommended temperature criteria. As a result, after the conclusion of the workshop, the SJRGA asked AD Consultants to evaluate the impact of the anticipated Friant settlement flows on temperatures in the San Joaquin River. The results, which were not presented at the workshop, are contained in full as part of Exhibit E.

The assumptions that went into this Case No. 4 are described on page 5 of Exhibit B. Essentially, the flows restoration flows that are anticipated once the settlement is approved, as well as operation of the Madera and Friant-Kern Canals were added to the 1980-2005 hydrology, and the Stanislaus River was added using both historical and IPO conditions. The relationship between releases from New Exchequer Dam and the new flow and temperature at the confluence of the San Joaquin and Merced Rivers was then developed.

The results of the run show two things. First, the additional water from Friant will not reduce temperatures by themselves. Temperatures at the confluence of the San Joaquin and Merced Rivers will remain essentially unchanged. Although the Friant settlement flows will add more water, the travel time is such that when the new water reaches the confluence, it approaches equilibrium with ambient temperature. (Ex. B., p. 18).

Second, the additional water actually makes it harder to achieve the CDFG recommended temperature at the confluence of the Merced and San Joaquin Rivers. Even though it is anticipated that the water temperature at the confluence of the Merced and San Joaquin Rivers will be the same with and without the anticipated Friant flows, the Friant flows themselves are of such a large volume that it will take a greater volume of water from the Merced River to reduce temperatures at the confluence. (*See* Ex. B, p. 18-19). Given the storage capacity of Lake McClure, the releases necessary to reduce temperatures at the confluence can only be made for limited duration before exhausting the available water supply. (Ex. B, p. 19, Figure 2).

E. The CDFG Recommended Criteria Cannot Be Met At All Times And Locations Even If All of the Water In The Basin Is Dedicated to That Purpose.

Again responding to CDFG staff's indication that its recommended temperature criteria could be met using reservoir releases, the SJRGA asked AD Consultants to evaluate whether or not such criteria could be met at all times and at all locations if all of the water within the basis was dedicated for that purpose. To make this determination, the SJRGA asked AD Consultants to (1) assume that all diversions in the three tributaries were eliminated and allowed to remain in the river, (2) re-shape all such rerouted diversions to maximize temperature reduction in the Spring and Fall time periods identified by CDFG, and (3) evaluate whether or not the additional water would achieve the CDFG recommended criteria. (*See* Ex. B, p. 5-6).

Consistent with all of the other runs performed by AD Consultants, this scenario again demonstrated that temperatures could be improved. However, as with all of the other runs, such temperature improvement was not enough to meet the CDFG recommended criteria at all times and at all locations. (*See* Ex. B, p. 20). Indeed, under the definition for impairment used by the CVRWQCB, dedication of all of the basin's water to meeting CDFG's recommended temperature criteria would still result in all locations during the Spring time frames being impaired, and all of the Fall locations impaired except for the Tuolumne and Stanislaus River confluences. (*See* Ex. B., p. 20, Table 4).

The inability of the system as a whole to meet the CDFG recommended temperature criteria at all times and locations, even assuming that all of the water was dedicated for that purpose, is a stunning indictment of the appropriateness of the CDFG recommendation. The CVRWQCB cannot justify a finding that the San Joaquin, Stanislaus, Tuolumne and Merced Rivers are impaired for temperature based upon the CDFG recommended criteria given that it is almost impossible for such criteria to ever be met.

Thank you for the opportunity to submit these written comments. Please let us know if there are any questions.

Very truly yours,

O'LAUGHLIN & PARIS LLP

By______________________________

TIM O'LAUGHLIN
Attorneys for the San Joaquin River Group Authority

EXHIBIT A

June 12, 2002 memorandum from Michael J. Levy, Office of the Chief Counsel, State Water Resources Control Board, to Ken Harris and Paul Lillebo, Department of Water Quality, regarding the distinction between a TMDL's numeric targets and water quality standards

Winston H. Hickox
Secretary for Environmental Protection

State Water Resources Control Board

Office of Chief Counsel
1001 I Street, 22nd Floor, Sacramento, California 95814
P.O. Box 100, Sacramento, California 95812-0100
(916) 341-5161 ♦ FAX (916) 341-5199 ♦ www.swrcb.ca.gov

Gray Davis
Governor

The energy challenge facing California is real. Every Californian needs to take immediate action to reduce energy consumption. For a list of simple ways you can reduce demand and cut your energy costs, see our website at www.swrcb.ca.gov.

TO: Ken Harris, DWQ
Paul Lillebo, DWQ

FROM: Michael J. Levy
Staff Counsel
OFFICE OF CHIEF COUNSEL

DATE: June 12, 2002

SUBJECT: THE DISTINCTION BETWEEN A TMDL'S NUMERIC TARGETS AND WATER QUALITY STANDARDS

This memorandum is intended to explain the distinction between numeric targets in a total maximum daily load (TMDL) and water quality standards. In general, section 303(d) of the Federal Clean Water Act (CWA)[1] requires each state to establish a TMDL for waters within its boundaries for which effluent limitations are not stringent enough to implement applicable water quality standards.[2] TMDLs, in turn, must be established at a level necessary to implement the applicable water quality standards.[3] In short:

1. TMDLs require a quantitative numeric target necessary to implement existing water quality standards;
2. While a TMDL's numeric target is an interpretation of existing water quality standards, it is not a water quality standard itself, and therefore, the processes required when adopting such standards do not apply;
3. Strategies to attain water quality standards, such as TMDLs, do not change the fact that enforcement of the Clean Water Act against point source dischargers is primarily through their NPDES permits; A TMDL's numeric target is not directly enforceable against dischargers absent a corresponding permit provision.

---

[1] The CWA is more accurately identified as the "Federal Water Pollution Control Act." (See 33 U.S.C. § 1251 et seq.) As used above, "section 303(d)" refers to the section number of the CWA as enacted by Congress. The same section is codified in title 33 of the United States Code in section 1313(d). Text in the body of this memorandum refers to the sections of the CWA as enacted by Congress. Corresponding citations to title 33 appear in footnotes.

[2] See generally 33 U.S.C. § 1313(d)(1)(A)-(D); see also 40 C.F.R. § 130.7.

[3] 33 U.S.C. § 1313(d)(1)(C); 40 C.F.R. § 130.7(c)(1).

I. TMDLs Require the Calculation of a Quantitative Numeric Target Necessary to Implement Water Quality Standards in Impaired Water Bodies

Section 303(d) contains two sentences regarding what a TMDL actually is. The first sentence requires establishment of the "total maximum daily load" for those pollutants suitable "for such calculation." The second sentence states that "[s]uch load shall be established at a level necessary to implement the applicable water quality standards with seasonal variations and a margin of safety which takes into account any lack of knowledge concerning the relationship between effluent limitations and water quality."[4] Based on these statements, a TMDL should be based on a quantitative value, or target,[5] designed to attain water quality standards in a particular water body.

The federal regulations corroborate that TMDLs require a quantitative numeric target. First, they repeat essentially the same statements from the statute.[6] Next, they define a TMDL as the "sum" of the individual waste load "allocations" for point sources and load "allocations" for nonpoint sources and natural background.[7] Both types of allocations are based on the concept of "loading capacity," which the regulations define as the greatest "amount" of loading (i.e., the introduction of matter or thermal energy) that a water body can receive without violating water quality standards.[8] Finally, the regulations provide that TMDLs can be expressed in terms of mass per time, toxicity, or other appropriate "measures."[9] Federal regulations, therefore, envision TMDLs (including the respective load and waste load allocations) as establishing a quantitative target for a particular water body that will assure attainment of water quality standards.

The developing body of federal case law also views TMDLs in the same way. As was recently noted by the United States District Court for the Northern District of California, "[a] TMDL defines the specified maximum amount of a pollutant which can be discharged or 'loaded' into

---

[4] 33 U.S.C. § 1313(d)(1)(C).

[5] Although the term "numeric target" does not appear in the CWA, use of the phrase is a matter of convenience due to a peculiarity in the CWA vernacular. The term "TMDL" has come to have two meanings, the first of which is the numeric target, or the literal "load" referenced in section 303(d). The term "TMDL" is also used to reference not merely the load, but the allocations of the load and the implementation plan as well. For clarity, in this document the term "target" or "numeric target" refers to the "load", and the term "TMDL" is reserved to describe the culmination of the state's responsibilities under section 303(d), i.e., the load, allocations, and implementation plan.

[6] 40 C.F.R. § 130.7(c)(1).

[7] *Id.*, § 130.2(i).

[8] *Id.*, §§ 130.2(e) and (f).

[9] *Id.*, § 130.2(i).

the waters at issue from all combined sources."[10] Federal courts outside of California and the Ninth Circuit share the same view.[11]

The U.S. Environmental Protection Agency, Region IX (EPA) also views TMDLs as containing water body-specific targets necessary to attain water quality standards. According to a recent publication from EPA:

> "[a] TMDL is a written, quantitative assessment of water quality problems and contributing pollutant sources. It identifies one or more numeric targets based on applicable water quality standards, specifies the maximum amount of a pollutant that can be discharged (or the amount of a pollutant that needs to be reduced) to meet water quality standards, allocates pollutant loads among sources in the watershed, and provides a basis for taking actions needed to meet numeric target(s) and implement water quality standards."[12]

Numerous pages of that publication are devoted to explaining how TMDL targets are used to interpret narrative or numeric water quality standards and to explaining the requirement to quantify the loading capacity and allocations.[13]

In short, the Clean Water Act, federal regulations, case law, and interpretive guidance from EPA all describe TMDLs as requiring numeric pollutant targets that are established at levels necessary to achieve water quality standards in impaired waters.

II. A TMDL Implements Existing Water Quality Standards; It Does Not Create New Standards

The federal regulations specify essentially four components of water quality standards. These are use designations, water quality criteria based upon those uses, an antidegradation policy, and certain policies generally affecting the application and implementation of water quality standards.[14] Water quality criteria are defined as "elements of State water quality standards,

---

[10] *Pronsolino v. Nastri* (9th Cir., 2002) --- F.3d ----, 2002 WL 1082428, p. 3, quoting *Dioxin/Organochlorine Center v. Clarke* (9th Cir. 1995) 57 F.3d 1517, 1520.

[11] See, e.g., *American Iron and Steel Institute v. EPA* (D.C.Cir. 1997) 115 F.3d 979, 1002, citing 40 C.F.R. § 132.2; *Manasota-88, Inc. v. Tidwell* (11th Cir. 1990) 896 F.2d 1318, 1321; *Scott v. City of Hammond* (7th Cir. 1984) 741 F.2d 1318, 1321.

[12] U.S. Environmental Protection Agency, Region IX, Guidance for Developing TMDLs in California (January 7, 2000), p. 1, which is available at: www.epa.gov/region09/water/tmdl.

[13] *Id.*, pp. 2-6.

[14] 40 C.F.R. §§ 131.6(a), (c), and (d); 40 C.F.R. § 131.13. Unlike TMDLs, which are specific plans to attain standards in a specific water body, section 131.13 policies are generally applicable policies, e.g., mixing zones, low flows, and variances. See Memorandum to Paul Lillebo, Basin Planning Unit Chief, Division of Water Quality,

expressed as constituent concentrations, levels, or narrative statements, representing a quality of water that supports a particular use."[15] Federal law contemplates, "[w]hen criteria are met, water quality will generally protect the designated use."[16]

Similar to federal requirements, under state law, each Regional Board must establish water quality objectives that will ensure the reasonable protection of beneficial uses and the prevention of nuisance.[17] Water quality objectives are "the limits or levels of water quality constituents or characteristics which are established for the reasonable protection of beneficial uses of water or the prevention of nuisance within a specific area."[18] The Water Code provides that such beneficial uses include, but are not limited to: domestic, municipal, agricultural, and industrial supply; power generation; recreation; aesthetic enjoyment; navigation; and preservation and enhancement of fish, wildlife, and other aquatic resources or preserves.[19]

Under state and federal law, therefore, water quality standards designate the uses to be made of the water and set criteria necessary to protect the uses. These standards have two functions: (1) they establish the water quality goals for a specific water body; and (2) they serve as the regulatory basis for establishing water quality-based treatment controls and strategies (such as TMDLs) beyond the required technology-based levels of treatment.[20]

Water quality objectives or criteria can be expressed in numeric terms (i.e., concentration or mass per time), or narrative terms (e.g., "no toxics in toxic amounts").[21] When adopting a TMDL for an impaired water body, sometimes the numeric criteria can be used as the TMDL target (e.g., mass-per-time criteria). More typically, however, to comply with TMDL requirements, the objective will need to be translated into another measure amenable to allocating the total load (e.g., concentration-based numeric criteria, or narrative criteria). While this translation involves articulating a new number to express the existing criteria for the purposes of section 303(d), selection of this new number does not establish a new water quality standard.

---

from Michael J. Levy, Staff Counsel, Office of Chief Counsel, re: *The Extent to Which TMDLs are Subject to the Alaska Rule* (January 28, 2002) (hereinafter "*TMDLs and the Alaska Rule*").

[15] 40 C.F.R. § 131.3(b).

[16] *Ibid.;* 33 U.S.C. § 1313(c)(2)(A).

[17] Wat. Code, § 13241.

[18] *Id.*, § 13050, subd. (h).

[19] *Id.*, § 13050, subd. (f).

[20] 40 C.F.R. § 131.2.

[21] 40 C.F.R. § 131.11.

Although the assignment of a numeric value that ultimately must be implemented in NPDES permits may at first glace appear similar to establishment of a water quality standard, a comparison of the statutory requirements for TMDLs and water quality standards demonstrates they are quite distinct: section 303(c) of the Clean Water Act requires creation of the water quality standards; section 303(d) requires TMDLs to implement those standards when technology-based limits are insufficient.[22] "[T]he basic purpose for which the § 303(d) list and TMDLs are compiled [is] the eventual attainment of state-defined water quality standards."[23] TMDLs are therefore not themselves standards, but mechanisms to implement them. Unlike water quality standards, TMDLs do not designate existing or potential uses. They do not establish new criteria necessary to protect uses, but rather, interpret existing criteria. They do not establish policy guiding the circumstances under which water quality must be protected against degradation. TMDLs merely create an enforceable strategy to attain those standards (with seasonal variations and a margin of safety) that were already established but which are not yet attained in a specific water body.[24] TMDLs thus serve as a means to an end. That end is the attainment and maintenance of existing water quality standards.[25]

III. Water Code Section 13241 Does Not Apply When Establishing the Numeric Targets in a TMDL

Water Code Section 13241 establishes the requirements attendant to the Regional Boards' adoption of water quality objectives. Because "it may be possible for the quality of water to be changed to some degree without unreasonably affecting beneficial uses," the section requires the Regional Boards to consider a number of factors when establishing objectives. These include:

a. Past, present, and probable future beneficial uses of water;

b. Environmental characteristics of the hydrographic unit, including the quality of water available to it;

c. Water quality conditions that could reasonably be achieved through the coordinated control of all factors which affect water quality in the area;

d. Economic considerations;

e. The need to develop housing within the region; and

---

[22] 33 U.S.C. § 1313(d).

[23] *Pronsolino v. Nastri* (9th Cir., 2002) --- F.3d ----, 2002 WL 1082428, p. 13.

[24] 33 U.S.C. § 1313(d)(1); 40 C.F.R. §§ 130.7(b)(1) and (c)(1).

[25] For a detailed analysis of how the process of creating a TMDL is distinct from and incompatible with the process of adopting a water quality standard, see *TMDLs and the Alaska Rule*, *supra* note 14.

f. The need to develop and use recycled water.[26]

The Clean Water Act similarly provides that water quality standards "shall be established taking into consideration their use and value for public water supplies, propagation of fish and wildlife, recreational purposes, and agricultural, industrial, and other purposes, and also taking into consideration their use and value for navigation."[27] Considering these factors is appropriate because assignment of the appropriate level of water quality properly involves a balance between appropriate "designated" or "beneficial" uses of water, numeric or narrative water quality "objectives" or "criteria," and a host of sometimes-competing policy considerations, including economic and environmental interests.

Since TMDLs are not water quality objectives, the requirements for adopting such objectives do not apply to TMDLs. Nor should they. Numeric targets used by TMDLs to implement standards are not designed to re-balance the policy interests underlying those standards. Although the state must consider a variety of factors in establishing the different elements of a TMDL, considering the economic impact of the required level of water quality, for example, is not among them; that impact was already determined when the standard was adopted. This conclusion is not altered when a TMDL is established to implement a narrative water quality objective. The economic impact associated with maintaining ambient water quality at the level described by the narrative statement was considered when the narrative objective was adopted.[28]

While policy considerations are important in developing water quality standards, they play a smaller role in the formulation of the TMDLs that implement them. The statutory directive to adopt TMDLs to "implement the applicable water quality standards with seasonal variations and a margin of safety,"[29] is not qualified by the predicate "so long as it is economically desirable to do so." Therefore, not only would an in-depth economic analysis be redundant, it would be inconsistent with federal law.

[26] Wat. Code, § 13241, subds. (a)-(f). Notably, section 13241 contains no dictate as to the weight the Regional Board must afford to any particular factor, only that these factors be considered.

[27] 33 U.S.C. § 1313(c)(2)(A). See also 40 C.F.R. §§ 131.10-13.

[28] That is not to say that no economic analysis is required when adopting a TMDL. Indeed, depending on the specific activity under consideration, different parts of a TMDL may require differing levels of economic considerations. Section 13241 analysis, however, is not among them. For a detailed discussion of economic analysis requirements, see Memorandum to Stefan Lorenzato, TMDL Coordinator, Division of Water Quality, from Sheila K. Vassey, Senior Staff Counsel, Office of Chief Counsel, re: *Economic Considerations in TMDL Development and Basin Planning* (October 27, 1999).

[29] 33 U.S.C. § 1313(d)(1)(C).

In short, a water quality standard defines the water quality goals of a water body by designating the use or uses to be made of the water and by setting criteria necessary to protect the uses.[30] TMDLs, in contrast, establish numeric targets for pollutants—targets that are designed to achieve water quality standards in impaired waterbodies. TMDLs implement the existing objectives that are designed to protect designated beneficial uses and, therefore, serve as a water quality-based treatment control or strategy that necessarily rests on the established goals and balanced policy considerations embodied by water quality standards. As stated in a recent Ninth Circuit decision:

> "TMDLs serve as a link in an implementation chain that includes federally-regulated point source controls, state or local plans for point and nonpoint source pollution reduction, and assessment of the impact of such measures on water quality, all to the end of attaining water quality goals for the nation's waters."[31]

IV. Numeric Targets in a TMDL are not Directly Enforceable Against Dischargers

The difference between water quality standards and TMDLs is highlighted in the context of the "citizen suits", which are authorized by section 505 to enforce the CWA.[32] In pertinent part, section 505 authorizes "any person" to commence a "civil action" against any person who has allegedly violated "*an effluent standard or limitation*" or "an order" issued by the EPA or a "State with respect to such a standard or limitation[.]"[33] The Clean Water Act language does not support the notion that third parties can invoke the effluent provision in section 505 to directly enforce TMDL numeric targets against dischargers.

In contrast to the broad definition of "effluent limits" in section 502 of the Clean Water Act, section 505 limits citizen suits specifically to a narrower subset of effluent standards and limitations. Section 505 states, in particular, that "[f]or purposes of this section," the term "effluent standard or limitation" is limited to seven instances. Citizen suits are permitted to enforce:

a. An unlawful act, under section 301(a);

b. An effluent limitation or other limitation, under section 301 or 302;

c. A "standard of performance" under section 306;

d. A prohibition, effluent standard or pretreatment standards, under section 307;

---

30 40 C.F.R. § 131.2.

31 *Pronsolino v. Nastri* (9th Cir., 2002) --- F.3d ----, 2002 WL 1082428, p. 4.

32 33 U.S.C. § 1365.

33 33 U.S.C. § 1365(a)(1) (Italics added).

e. A certification, under section 401;

f. A permit or condition thereof, issued under section 402; or

g. A regulation under section 405(d).[34]

A TMDL's numeric targets do not fall within any of these provisions. Although the regulations refer to a waste load allocation as a "type of water quality-based effluent limitation,"[35] TMDLs are required by section 303(d), not sections 301, 302, or 307. Nor, for that matter, does a TMDL that establishes a total load or waste load allocation of "zero" establish a directly enforceable prohibition, unlawful act, regulation, or performance standard under sections 301, 306, 307, or 405. Again, the target is established under section 303(d). No section 303(d) limit is enumerated in section 505. Accordingly, a plain reading of the effluent limits that may be directly enforced by way of a citizen suit under the Clean Water Act does not include waste load allocations required by section 303(d).

The federal regulations reveal at least one obvious explanation for the exclusion of TMDLs from matters that can be directly enforced against dischargers. Those regulations contemplate flexibility in translating waste load allocations into permit conditions. The NPDES permitting provisions require that water quality-based effluent limits must be "consistent with the assumptions and requirements of any available wasteload allocation."[36] The provisions do not require the limit to be "identical to the wasteload allocation." This language leaves open the possibility that the Regional Board could determine that fact-specific circumstances render something other than literal incorporation of the waste load allocation to be consistent with its assumptions and requirements.[37] The regulations thus contemplate the additional step of revising applicable NPDES permits to make them "consistent with the assumptions" of the TMDL.[38]

Thereafter, it is the effluent limit set forth in the permit, and not the TMDL, that provides the potential vehicle for citizen suit enforcement under the Clean Water Act.[39] These requirements

---

[34] 33 U.S.C. § 1365(f).

[35] 40 C.F.R. § 130.2(h).

[36] 40 C.F.R. § 122.44(d)(1)(vii).

[37] The rationale for such a finding could include a trade amongst dischargers of portions of their load or waste load allocations, performance of an offset program that is approved by the Regional Board, or any number of other considerations bearing on facts applicable to the circumstances of the specific discharger.

[38] Of course, if a permit is already consistent with a newly adopted TMDL, the permit need not be amended to render its terms enforceable. The permit conditions are already enforceable, including by a citizens suit. (33 U.S.C. §§ 1365(a)(1)(B), 1365(f)(6).)

[39] *Id.*

are consistent with section 402(k)'s requirement that compliance with an NPDES permit is deemed compliance that bars most enforcement actions and citizen suits.[40]

CONCLUSION

Section 303(c) of the Clean Water Act obligates the State and Regional Boards to establish water quality standards to protect appropriate designated uses of waters. Section 303(d) requires the states to establish TMDLs at levels necessary to implement those water quality standards in waters that are not attaining them. While extensive policy considerations are evaluated when adopting standards, those considerations are generally not relevant when adopting TMDLs, whose purpose is to cause the compromised waters to attain those policy-based standards.

The distinction between water quality standards and TMDLs is significant both for the manner in which they are adopted, and the manner in which they are enforced. First, because TMDLs are not water quality standards, neither federal nor state law obligates the State and Regional Boards to establish and adopt TMDLs as water quality standards. Second, the provisions of a TMDL, including its numeric targets, are not directly enforceable against dischargers by way of a citizen suit under the Clean Water Act. In general, section 505 permits such suits to directly enforce an effluent limit or standard. Because TMDLs are neither water quality standards nor a type of effluent limit addressed in section 505, TMDLs, including the respective waste load allocations, are not directly enforceable under the citizen suit provision of the Clean Water Act. The NPDES permits implementing the TMDL provide the vehicles for enforcement. The TMDL does not.

Should you have any questions about this memorandum, feel free to contact me at (916) 341-5193 or mlevy@swrcb.ca.gov.

cc: Tom Howard, EXEC
Stan Martinson, DWQ
John Ladd, DWQ
David Leland, TMDL Coordinator, RB1
Thomas Mumley, TMDL Coordinator, RB2
Lisa McCann, TMDL Coordinator, RB3
Jonathan Bishop, TMDL Coordinator, RB4
Jerry Bruns, TMDL Coordinator, RB5(S)
Chuck Curtis, TMDL Coordinator, RB6(SLT)
Teresa Newkirk, TMDL Coordinator, RB7
Hope Smythe, TMDL Coordinator, RB8
Deborah Jayne, TMDL Coordinator, RB9
Craig M. Wilson, OCC
Andy Sawyer, OCC
All WQ Attorneys

[40] 33 U.S.C. § 1342(k).

EXHIBIT B

Temperature Modeling and Analysis for the San Joaquin River

Requested by the San Joaquin River Group Authority
in Connection with the 303(d) Proceedings

Prepared by

AD Consultants
RMA, Inc.

November 19, 2007

Temperature Modeling and Analysis for the San Joaquin River

Requested by the SJRGA in Connection with the 303(d) Proceedings

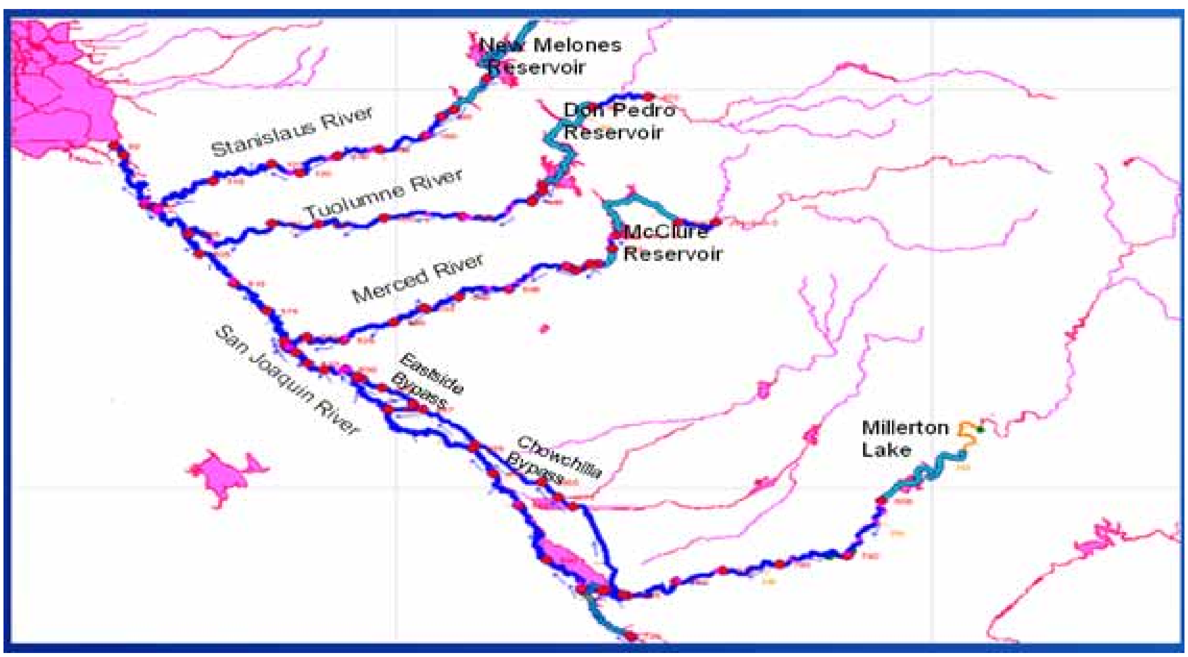
I. General

This report presents the results of water temperature modeling and analysis for the San Joaquin River (SJR) performed by AD Consultants and Resources Management Associates, Inc (RMA) as requested by the San Joaquin River Group Authority (SJRGA). The work was done to address issues in connection with the 303(d) Proceedings.

Most of the modeling results were presented to the Regional Water Quality Control Board (RWQCB) in the September 25 Temperature Workshop in Sacramento, California. Nevertheless, the report provides a more in-depth review of the results, as well as follow up analyses, specifically for the potential impact of the Friant Restoration on temperatures in the SJR in relation to the temperature objectives recommended by the CDFG and a broad view about the possibility to achieve these objectives given all the water physically available in the basin.

The modeling was performed using the CALFED sponsored San Joaquin River Basin-Wide Water Temperature Model. This HEC-5Q model encompasses the Stanislaus, Tuolumne, Merced and the main-stem and upper San Joaquin rivers, including Friant (Millerton Lake), as shown in Figure 1.

Figure 1 - HEC-5Q Model Representation of the San Joaquin Basin



The model has the capabilities to simulate various scenarios of system operation and then compute temperature response at any location throughout the system on a sub-daily basis (6-hour time increments). Using the model, it is possible to assess whether or not certain temperature objectives can be achieved given a prescribed operation scenario and what is the ramification of such operation on system storage.

II. Objective:

The objective of this analysis was to perform simulations with the HEC-5Q model and evaluate thermal conditions in the Stanislaus, main-stem SJR and lower SJR at Vernalis for different operation scenarios in connection with the Impaired Waters and Surface Water Quality Assessment 303(d) initiated by CDFG.

In the letter to the RWQCB on February 28, 2007, the CDFG proposed certain objectives (criteria) for temperatures at discrete locations on the Stanislaus, Tuolumne, Merced and the main-stem SJR at Vernalis. These objectives are summarized in Figure 2 below:

Figure 2 – Table 1 from CDFG letter to Regional Water Quality Control Board, February 28, 2007.

CDFG Proposed Temperature Criteria

River	Location	River Mile	Season	Life Phase	Threshold (ºF)	Affected River Miles	Threshold (ºC)
San Joaquin	Vernalis	72	9/1 - 10/31	Adult/Egg	64.4	118	18
	Vernalis	72	3/15 - 6/15	Smolt	59.0	118	15
Stanislaus	Mouth	0	9/1 - 10/31	Adult/Egg	64.4	58	18
	Riverbank	33	10/1 - 12/15	Egg	55.4	33	13
	Mouth	0	3/15 - 6/15	Smolt	59.0	58	15
Tuolumne	Mouth	0	9/1 - 10/31	Adult/Egg	64.4	52	18
	Waterford	28	10/1 - 12/15	Egg	55.4	24	13
	Mouth	0	3/15 - 6/15	Smolt	59.0	52	15
Merced	Mouth	0	9/1 - 10/31	Adult/Egg	64.4	52	18
	River Mile 28	28	10/1 - 12/15	Egg	55.4	24	13
	Mouth	0	3/15 - 6/15	Smolt	59.0	52	15

As such, all the results for the modeling runs (labeled "tasks" in this report) were evaluated with respect to the above objectives.

III. Tasks:

The following tasks were prepared for the September 25 staff workshop on temperature:

1. How "Actual" Temperatures Compare with "Historic" Conditions?

Model the "Historic" and "Actual" (1967-1982) temperatures for the following locations and times:

- Confluence of the Stanislaus River 9/1 – 10/31
- Vernalis 9/1 – 10/31
- Riverbank 10/1 – 12/15
- Confluence of the Stanislaus River 3/15 – 6/15
- Vernalis 3/15 – 6/15

For the purpose of this analysis, "Historic" temperatures were defined as pre-new storage development and "Actual" as post-new storage development on the Stanislaus River.

Concepts and assumptions:

The existing Stanislaus component of the Temperature Model was modified as follows:

- Removed New Melones and replaced with Old Melones.
- Extended stream section between Old Melones and Tulloch.
- Assumed same river cross sections above Old Melones to Stanislaus PH

- Removed Collierville PH
- Meteorology – extended based on Modesto max/min temperatures
- Hydrology – assumed historical flow and operation for Old Melones and Tulloch

Assess the following:

1) What were the “Historic” temperatures at the above mentioned locations and periods?
2) What were the “Actual” temperatures at the above mentioned locations and periods?
3) How do the “Historic” and “Actual” temperatures compare?
4) Did “Historic” temperatures meet the temperature objectives proposed by CDFG?

2. Can the IPO and Augmented IPO Meet CDFG Criteria?

Model temperatures in the Stanislaus and Lower SJR at Vernalis for the period 1980-2003 under the current IPO. Then, increase New Melones releases (Augmented IPO) and check if CDFG recommended criteria can be met.

Concepts and Assumptions:

Convert the IPO flows to daily time steps. Then run the IPO with the 5Q and track temperatures on a sub-daily basis at three locations: Riverbank, Confluence and Vernalis. Assume historical flows and temperature inflows for the main-stem SJR at the confluence. Increase releases from Goodwin for two periods: Spring and Fall as follows:

$Q_{Goodwin} = \max(Q_{IPO}, Q_{Schedule})$

Where:

Q_{IPO} = minimum flow per the IPO for fish, water quality, etc. (not including spills), and

$Q_{Schedule}$ varies (linearly) as follows:

Period	From	To	Flow Rate (cfs)
Spring	3/15	4/15	500
Spring	4/16	5/15	1000
Spring	5/16	6/15	1500
Fall	9/1	9/31	1500
Fall	10/1	10/15	1000
Fall	10/16	10/31	500

Assess the following:

1) Can the CDFG recommended criteria be met at all times and under all conditions?
2) If not, when and how often does New Melones Reservoir run out of water?

3. Can CDFG Criteria at Vernalis Be Met by Increasing Flows from the Tributaries?

Assume that the CDFG recommended temperatures at the confluences of all three tributaries are met for the time periods 9/1 – 10/31 and 3/15 – 6/15. Then, increase releases from the tributaries and check if CDFG criteria are met at Vernalis.

Concepts and Assumptions:

Use 1995-2006 for an example. First, assume historical flows from the Stanislaus, Tuolumne and Merced for the above periods. Assume temperatures are met (per CDFG criteria) at the confluence of each river with the SJR. Then:

- Route historical flows from the three rivers and check temperatures at Vernalis.
- Set Tuolumne and Merced flows (to equal historical) and increase Stanislaus. Compute temperatures at Vernalis.