RESPONSE TO FEBRUARY 16, 2018 REQUEST FOR ADDITIONAL INFORMATION, RESOURCE AGENCY LATE FILING, AND OTHER RELATED INFORMATION

ATTACHMENT S

REPLY COMMENT ON CDFW'S LATE-FILED TECHNICAL MEMORANDUM ON TEMPERATURE CRITERIA AND APPLICABILITY OF EPA (2003) TEMPERATURE GUIDANCE TO TUOLUMNE RIVER SALMONIDS

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Regulatory Review of CDFW Late-filed Technical Memorandum

Use of the EPA (2003) Temperature Guidelines

EPA Region 10 Guidance for Pacific Northwest State and Tribal Temperature Water Quality Standards (EPA 2003) is as titled a guidance document and not criteria. Resource agencies, such as California Department of Fish and Wildlife (CDFW; 2018), have suggested that the guidelines are criteria that must be met, but this is not correct. The 2011 Central Valley Regional Water Quality Control Board (CVRWQCB) Water Quality Control Plan (CVRWQCB 2011) for the Sacramento River and San Joaquin Basin (Basin Plan) provides a specific temperature objective for the San Joaquin Basin and its tributaries.

The Basin Plan states (pg III-8),

> *"The natural receiving water temperature of intrastate waters shall not be altered unless it can be demonstrated to the satisfaction of the Regional Water Board that such alteration in temperature does not adversely affect beneficial uses.*
>
> *At no time or place shall the temperature of COLD or WARM intrastate waters be increased more than 5°F above natural receiving water temperature. Temperature changes due to controllable factors shall be limited for the water bodies specified as described in Table III-4. To the extent of any conflict with the above, the more stringent objective applies.*
>
> *In determining compliance with the water quality objectives for temperature, appropriate averaging periods may be applied provided that beneficial uses will be fully protected."*

The Basin Plan temperature objective provides no specific direction to implement the EPA (2003) guidelines or that any temperature outside of EPA guidelines would "*adversely affect beneficial uses*" or result in impairment. The Basin Plan does state that, "…*objectives for temperature and appropriate averaging periods may be applied."* By operating within the bounds of the Basin Plan temperature objective above, it is appropriate to implement a site-specific study and determine scientifically supported water temperature indices for native species present in the study area that result in the protection of beneficial uses to comply with the Basin Plan temperature objective. In contrast, resource agencies have selectively applied the EPA (2003) guidelines, sometimes ignoring them altogether (NMFS 2018) and other times modifying suggested 'criteria' to their benefit (CDFW 2018).

The EPA 2008-2010 list of water quality segments that are impaired under the Clean Water Act (CWA), section 303(d), and 40 CFR 130.7(d)(2) identified the Tuolumne River as temperature impaired based on reduced salmon population numbers (EPA 2010). The EPA justified temperature as the direct mechanism for impairment from local water temperature exceeding EPA (2003) guidelines.

The Districts acknowledge the importance of maintaining a suitable thermal regime and conducted site-specific studies to identify a regime that supports the aquatic life beneficial use. However, it is not reasonable to draw a direct line between temperature and population dynamics, while ignoring all other limiting factors to salmonid populations in the Tuolumne River. For example, Dr. Sean Hayes of NOAA recently commented on the impact of predation in the Central Valley at the April 19, 2016 meeting of the State Water Resources Control Board[1]. He stated:

"Someone did a very elegant model and basically figured out how many pounds of fish the striped bass population needs to eat to survive every year, and that estimate was roughly on order of 25 million kilograms of fish that striped bass need to eat – crayfish, etc. to meet their energetic requirements every year. So working with juvenile salmon and having a rough estimate of the biomass of all the juvenile salmon in the Central Valley, I did a very conservatively high estimate and came up with a back of the envelope estimate of roughly 240,000 kilograms of juvenile salmon, which means that if striped bass were to eat every single salmon in the Central Valley, it would meet 1% of their diet. This isn't an accusation of the bass; it's just saying they could easily account for all missing salmon in the Central Valley."

In addition to ignoring the more complex landscape that impacts salmonids and other native fishes, it also is unreasonable to infer that meeting a guideline intended for Pacific Northwest states in a southwest Central Valley stream will result in the full recovery of local salmonid populations.

What is a TMDL?

An impaired water body is any water that is not meeting the water quality standards that have been established for that water after technology-based discharge limits on point sources are implemented.

EPA's decision to list the Tuolumne River as impaired for temperature is but a predicate step of a larger statutory process. The next step in the CWA is for California, through the State Water Resources Control Board (SWRCB) and Regional Water Quality Control Board (RWQCB) to develop TMDLs for the impaired waterways. 33 U.S.C. § 1313(d)(1). TMDLs are established at the level necessary to implement the applicable water quality standards. A TMDL requires that all sources of pollution and all aspects of a watershed's drainage system be reviewed, not just the pollution coming from discrete conveyances (known as point sources), such as a discharge pipe from a factory or a sewage treatment plant. The State then submits the TMDLs to EPA for approval or disapproval. 33 U.S.C. § 1313(d)(2). Ultimately, the State chooses "both if and how" it will implement the nonpoint sources provisions of any TMDL approved or promulgated by EPA. *Pronsolino v. Nastri*, 291 F.3d 1123, 1126-27 (9th Cir. 2002). EPA does not approve or disapprove a State's implementation plan.

In California, the SWRCB has interpreted state law (Porter-Cologne Water Quality Control Act, California Water Code Section 13000 et. seq.) to require that implementation be addressed when TMDLs are incorporated into Basin Plans (water quality control plans). The Porter-Cologne Act requires each Regional Board to formulate and adopt water quality control plans for all areas within

[1] https://mavensnotebook.com/2016/05/26/alien-vs-predator-factors-that-influence-salmon-predation-in-the-sacramento-san-joaquin-delta/

its region. It also requires that a program of implementation be developed that describes how water quality standards will be attained. TMDLs can be developed as a component of the program of implementation, thus triggering the need to describe the implementation features, or alternatively as a Water Quality Standard. When the TMDL is established as a standard, the program of implementation must be designed to implement the TMDL. Typically a revision to the program of implementation is needed whenever a new standard is adopted.

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 and provides a basis for taking actions needed to meet numeric targets, and implement water quality standards.

TMDLs in California are developed either by RWQCBs or by EPA. TMDLs developed by RWQCBs are designed as Basin Plan amendments and include implementation provisions. TMDLs developed by EPA typically contain the total load and load allocations required by Section 303(d), but do not contain comprehensive implementation provisions. This stems from the fact that EPA authorities related to implementation of nonpoint source pollution control measures are generally limited to education and outreach as provided by CWA Section 319. TMDLs are currently required for all waters and pollutants on the 303(d) list. TMDLs must consider and include allocations to both point sources and nonpoint sources of listed pollutants. Although the abbreviation stands for "Total Maximum Daily Load," the limitations contained in a TMDL may be other than "daily load" limits. There also can be multiple TMDLs on a particular water body, or there can be one TMDL that addresses numerous pollutants. The basis for grouping is whether or not there can be a common analytical approach to the assessment or a common management response to the impairment.

How are water quality standards or objectives established?

Federal regulations specify four components of water quality standards. These are: use designations, water quality criteria based upon those uses, an anti-degradation policy, and certain policies generally affecting the application and implementation of water quality standards. 40 C.F.R. §§ 131.6(a), (c), and (d). Water quality *criteria* are defined as "elements of State water quality standards, expressed as constituent concentrations, levels, or narrative statements, representing a quality of water that supports a particular use." 40 C.F.R. § 131.3(b).

Under State law, the RWQCBs establish water quality objectives that will ensure the reasonable protection of beneficial uses and the prevention of nuisance. Water Code § 13241. 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…." Water Code § 13241, § 13050, subd. (h). Beneficial uses include: domestic, municipal, agriculture, power generation, recreation, and preservation and enhancement of fish, wildlife, and other aquatic resources.
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 serve to (1) establish the water quality goals for a particular water segment, and (2) serve as the regulatory basis for establishing controls and strategies for meeting those goals.

Water quality objectives or *criteria* can be expressed in numeric or narrative terms. Where a narrative water quality objective has been established, to comply with TMDL requirements, the objective will need to be translated into another measure. While this new translation involves articulating a new number to express the existing numeric criteria, *selection of this new number does not establish a new water quality standard*. "[T]he basic purpose for which the § 303(d) list and TMDLs are compiled [is] the eventual attainment of state-defined water quality standards." 33 U.S.C. § 1313(d). TMDLS are therefore not themselves standards, but mechanisms to implement them.

Since TMDLs are not water quality objectives, the requirements for adopting such objectives do apply to TMDLs. 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. The same is true for a TMDL implementing a narrative standard.

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. TMDLs establish numeric targets for pollutants designed to achieve water quality standards in impaired water bodies. An impaired water body is any water body that is not meeting the water quality standards that have been established for that water body even after point sources discharge limits have been imposed.

EPA (2003) temperature guidelines are not water quality temperature criteria

EPA (2003) is quite clear that it is a guidance document intended to assist states and tribes in developing water quality standards. EPA (2003) "does not substitute for applicable legal requirements; nor is it a regulation itself. Thus, it does not impose binding requirements on any party, including EPA, other federal agencies, the states, or the regulated community." EPA (2003), p. iii.

CDFW asserts that water temperature criteria (EPA (2003)) "were adopted for the San Joaquin River and its tributaries by USEPA Region 9 pursuant to section 303(d) of the US Clean Water Act." Tech Memo, p. 1. This is in direct contradiction to both federal and state law. As explained above, water quality standards are adopted by the RWQCBs. Unlike a decision to list or not to list an impaired water body, the RWQCBs must balance a number of factors in setting water quality objectives. Furthermore, section 303(d) of the CWA requires states to establish a TMDL for waters within its boundaries for which effluent limitations are not stringent enough to implement applicable water quality standards. Section 303(d) does not authorize the EPA to adopt water quality *criteria.*

CDFW then applies these so-called water temperature *criteria* to the Tuolumne River in an attempt to extract additional flows from the Don Pedro Project. The Tuolumne River already has a water quality standard. It is a narrative standard, legally adopted by the Central Valley RWQCB and included in the Basin Plan, and applicable to the Tuolumne River.

While "natural receiving water temperature" may not have been available to the RWQCB in 2010 when the Tuolumne River was listed as impaired, the Districts have since developed Tuolumne River temperature models, including a "without project" model. These models show that (1) attempting to meet the EPA (2003) temperature guidelines results in draining Don Pedro Reservoir in some years and in many years, meeting the temperature guidelines is impossible, and (2) even under the "without project" condition, the EPA (2003) temperature guidelines would not have been met in all years. These findings have not been refuted by CDFW or any other relicensing participant.

The EPA (2003) temperature guidance was used by the RWQCB in the decision to list the Tuolumne as impaired in 2010. Because the documentation of the "natural receiving water temperature" was not readily available, the RWQCB conducted an assessment of whether the migration and spawning uses were being achieved by comparing existing temperature data to temperatures identified in EPA (2003) for salmonid species. It is one thing to use the EPA (2003) temperatures for comparative purposes; it is quite another thing to apply these numbers as if they were water quality standards.

Here, CDFW is essentially performing the duties of the RWQCB without such authority. Using a methodology previously used by the RWQCB in its decision to list the Tuolumne River as impaired, CDFW now applies that same process in an attempt to create a new water quality temperature *criteria* and bypass both the federal CWA and the state Porter-Cologne Water Quality Control Act.

Technical Review of CDFW Late-filed Technical Memorandum

Review of CDFW's Flow-Based Temperature Recommendation Memorandum

CDFW filed with the Federal Energy Regulatory Commission (FERC) a Technical Memorandum, "*Application of Water River Flows and Temperature Criteria for Fall-run Chinook Salmon (Oncorhynchus tshawytscha) and Steelhead Rainbow Trout (Oncorhynchus mykiss) in the Tuolumne River, California,"* (CDFW Memorandum or Memorandum) on March 8, 2018 regarding the Don Pedro Hydroelectric Project (Don Pedro Project) and La Grange Hydroelectric Project (La Grange Project). The Turlock Irrigation District (TID) and Modesto Irrigation District (MID) (collectively, the "Districts") conducted a technical review of the Memorandum that summarizes reviewer comments provided by subject area experts at the Districts' request. The following review addresses numerous issues and inconsistencies that casts doubt on the relevancy of the CDFW Memorandum in light of recent, site-specific research and other related studies.

CDFW Misapplies EPA (2003) and the FERC Record

The CDFW Memorandum attempts to use the 303(d) listing to invoke the EPA (2003) guidelines as legally binding "criteria". CDFW states that the purpose of the document is to, "*…apply the water temperature criteria that the USEPA approved and adopted at appropriate temporal levels within the lower Tuolumne River,"* (pg 3). The CDFW approach to this modified EPA (2003) application is a flow-based prescription by water year, "*…designed with the USEPA's water temperature criteria in mind,"* (pg 1). CDFW states the benefit of this water year influenced temperature management strategy is that there will be, "*…an expansion of the outmigration timeframe during wetter water years and a contraction of this timeframe during drier water years,"* (pg 2).

CDFW repeatedly refers to the EPA (2003) guideline as a criteria for California temperature management. CDFW attempts to use the EPA (2003) Guidance for Pacific Northwest State and Tribal Temperature Water Quality Standards as temperature "*criteria,"* which was not EPA's (2003) intent in developing its guidance. EPA (2003) clearly directs, "...States should: (1) establish numerical values...to reflect site-specific conditions, or other scientifically defensible methods..." EPA (2003) recommends that States "*establish numeric criteria based on an estimate of the natural background temperature conditions,"* which EPA views as "*protective of salmonid designated uses because river temperatures prior to human impacts clearly supported healthy salmonid populations."* CDFW ignored these critical elements and instead rebranded the EPA (2003) guidance as a California standard criteria for temperature management. CDFW then proceeded to adjust the EPA 'criteria' by changing multiple lifestage specific temperature recommendations (Table 4, pg 15). In lieu of more strictly following the suggested 'criteria', CDFW indicates it would suffice to keep the EPA (2003) information "*in mind"* (pg 1), while making their own flow-based determination.

CDFW also misconstrued FERC's guidance on the reliance on the EPA (2003) guidelines. The Memorandum states, "*On December 22, 2011, the Commission issued the study plan determination for the Don Pedro Hydroelectric Project relicensing. In that document, the Commission found that the Districts should follow USEPA's (2003) guidelines for temperature*

requirements for salmonids in the lower Tuolumne River. Additionally, the Commission ruled the study W&AR-14 (Temperature Criteria Assessment) was not required," (Pg 4). This is an incomplete characterization of what FERC directed. FERC stated, *"While the Districts' temperature criteria assessment may have the potential to inform W&AR-5 Salmonid Populations Information Integration and Synthesis Study, we will continue to rely upon the temperature criteria[2] in EPA (2003) for our evaluation of project effects, unless empirical evidence from the lower Tuolumne River is provided that suggests different criteria are appropriate for salmonids in the lower Tuolumne River,"* (pg 56 of the Study Plan Determination; FERC 2011). Based upon FERC's statement, the Districts conducted site-specific studies (listed in the next section) to provide scientifically rigorous, empirical evidence from the lower Tuolumne River to evaluate whether different temperature requirements should be applied to Tuolumne River salmonids. The recently available, site-specific empirical information on salmonids in the lower Tuolumne River collected and provided by the Districts during the relicensing process was apparently not considered in the CDFW Memorandum.

CDFW Ignores Critically Important Localized Data and Recent Research

The Districts acknowledge the importance of identifying an appropriate thermal regime for the lower Tuolumne River warmwater and coldwater fish populations. The Districts have invested considerable resources directly investigating local populations' thermal tolerances and working with resource agencies to conduct evaluations. Besides studies conducted by the Districts of wild *O. mykiss* in the Tuolumne River, there are also numerous recent studies evaluating the thermal plasticity of coldwater salmonids in other river systems.[3] Unfortunately, it appears that most of these activities and resources were ignored by CDFW and the resulting Memorandum reflects little consideration. The only localized data considered in the CDFW Memorandum were population data to depict salmonid lifestage periodicity (pg 4) and the Lower Tuolumne River Instream Flow Study (pg 14). These data are peripheral to the primary goal of evaluating an appropriate river-specific thermal regime for the Tuolumne River. Site specific temperature research in the Tuolumne River or California was not discussed. The CDFW Memorandum goes as far as to state that, *"Unfortunately, the datasets available for steelhead life stages in the lower Tuolumne River are much less comprehensive and not amenable to the same level of summary statistics as the Chinook information. As a consequence, the proposed temporal guidance specific to steelhead was taken from the literature and is not unique to the lower Tuolumne River,"* (pg 5). This statement is both inaccurate and dismissive of available key resources that provide direct relevance to determining an appropriate localized or site specific temperature regime. These products were developed as part of the Don Pedro and La Grange FERC ILP processes.

The Districts provided a total of 13 research products (studies or tools) that would benefit CDFW's review. Only the Lower Tuolumne River Instream Flow Study was cited in the Memorandum. The Districts also organized 12 meetings for collaborative development of a framework for

[2] It is unclear if FERC's usage of 'criteria' in this quote is of a general reference or if FERC also was misled based on agency recommendations to suggest that the EPA (2003) is an actual temperature criteria for California. The EPA (2003) document clearly is identified as a guideline developed for the Pacific Northwest.

[3] In fact there has developed a massive amount of research and literature on adaptation and acclimation of fishes to local temperature regimes. For numerous cites to this literature, see Poletto et al. (2017)

establishing water temperature indices that CDFW, even though a participant, never mentions in the Memorandum.

A list of relevant research and studies are provided for reference:

- W&AR-02 - Project Operations Water Balance Model
- W&AR-03 - Reservoir Temperature Model
- W&AR-05 - Salmonid Population Information Integration and Synthesis
- W&AR-06 - Tuolumne River Chinook Salmon Population Model
- W&AR-10 - *Oncorhynchus mykiss* Population Model
- W&AR-14 - Temperature Suitability for Tuolumne River *O. mykiss*
  - (1) Swim Tunnel Study Report
  - (2) Tailbeat Frequency Study
- W&AR-16 - Lower Tuolumne River Temperature Model
- Development of the Tuolumne River Flow and Water Temperature Without Dams Model
- Lower Tuolumne River Instream Flow Study
- Upper Tuolumne River Basin Water Temperature Monitoring and Modeling
- Upper Tuolumne River Reintroduction Assessment Framework and Voluntary Studies

In addition to the Districts' supported efforts, the scientific understanding of the thermal tolerance of salmonids has advanced considerably in recent years compared to the relatively dated EPA (2003) study. It is now widely accepted that a fish species' thermal sensitivity and tolerance can vary with life stage, age, and among populations (e.g., Hochachka and Somero 2002; Fangue et al., 2006; Schulte et al., 2011; Somero et al. 2017; Komoroske et al., 2014; Tepolt and Somero, 2014). Variation in performance traits (e.g., growth, metabolic rate, aerobic scope, and swimming speeds) has ecological and fitness implications, and adaptation to thermal regimes can occur in a few generations (Barrett et al., 2010). Lindley et al. (2006), a source document frequently cited by resource agencies, acknowledge the site-specific nature of such adaptation, stating that "*[The] wide distribution across diverse ecological conditions should have provided Central Valley O. mykiss with substantial opportunities for adaptation to local conditions....*"

Site-specific studies show that salmonids in the Central Valley, including *O. mykiss* in the lower Tuolumne River, have thermal tolerances that differ from populations in northern regions. Field measurements using swim tunnel respirometers (TID/MID 2017a) show that wild *O. mykiss* from the lower Tuolumne River maintained 95 percent of peak aerobic scope at temperatures ranging from 17.8–24.6°C, and all fish tested maintained sufficient aerobic capacity to digest a meal at temperatures up to 23°C. These results were published in the peer-reviewed journal, *Conservation Physiology* (Verhille et al. 2016), along with the conclusion that "*high thermal tolerance suggests that O. mykiss at the southern limit of their indigenous distribution may be locally adjusted relative to more northern populations.*"

In addition, video recordings of *O. mykiss* in the Tuolumne River show that tail-beat frequencies did not exceed maximum rates observed in the swim tunnel respirometer at the same temperatures (TID/MID 2017b). At temperatures ranging from 13.4–24.9°C, juvenile *O. mykiss* had metabolic capacity beyond that required to maintain position in typical summer water velocities in the lower Tuolumne River, and fish engaged in darting behaviors for feeding, defense of territory, or escape

from threats over the full range of river temperatures. Snorkeling observations conducted in the lower Tuolumne River confirm that *O. mykiss* are frequently observed in habitats where temperatures exceed 20°C (Ford and Kirihara 2010).

Recent studies of salmonid temperature tolerances elsewhere in the Central Valley show similar results. Poletto et al (2017) used swim tunnel respirometers to test the thermal performance of juvenile fall-run Chinook from CDFW's Mokelumne River Hatchery. Aerobic capacity in groups of Chinook acclimated to either 15°C or 19°C was unaffected by temperatures up to 23°C. The results support thermal plasticity in localized populations of salmonids.

CDFW Contends That the EPA (2003) Guidelines are Valid for the lower Tuolumne River, because Northwest and Southwest Climates are Not Significantly Different

The overwhelming body of scientific research identified above supports that salmonids exhibit localized thermal plasticity, but CDFW attempts to negate the impact of localized adaptation by suggesting that there is little difference between Northwest and Southwest climates (Appendix A, pg 2). In Appendix A of the CDFW Memorandum, a lengthy list of cities ranging from California to Washington is presented with associated ambient temperature (Appendix A, pgs 4-8). CDFW reports simple t-test (ANOVA) statistics of whether mean ambient temperature is significantly different amongst cities from August to September, 2007-2010 (pgs 6-8). The usage of a simplistic statistical test ignores numerous meteorological, geographic, and hydrological variables including total precipitation, humidity, atmospheric pressure, elevation, gradient, cover, and annual runoff volumes that influence stream conditions. California's north-to-south oriented geography and Mediterranean climate results in long warm summers and mild wet winters, which cannot be found elsewhere in the United States. There are only five places in the world that reflect the characteristics of a Mediterranean climate: central Chile, Cape region of South Africa, Western Australia, and the Mediterranean basin[4]. Assuming temperature was the only defining factor for fish populations, comparisons could be made to a wide range of streams, all with numerous biological and physical dissimilarities.

CDFW's narrow climactic summary ignores several important atmospheric and geographic factors in an attempt to draw an inappropriate correlation. Assuming that the entire West Coast is essentially the same, and a one-size-fits-all guideline is the best approach, is neither valid nor scientifically supportable.

CDFW States that the Upper Tuolumne Temperature Regime is Favorable and Infers that Historical Water Temperature Would Comply with EPA (2003) Temperature Guidelines.

CDFW states that the lower Tuolumne River temperature regime is impaired (pg 2). The Memorandum asserts that historically, accessible habitat in the upper Tuolumne River would have "favorable thermal conditions….throughout summer and fall" (pg 4). Specifically, CDFW states "*The temperature conditions which existed at those higher elevations on the Tuolumne River now need to be replicated in the accessible spawning, rearing, and migratory pathways that remain in the 52 miles of the lower Tuolumne River downstream of La Grange Dam at elevations of less than 300 feet*," (Pg 4). The Memorandum offers no specific analyses nor cites to any record of historical

[4] https://ucnrs.org/mediterranean-climate-ecosystems/

upper Tuolumne River thermal conditions to validate this assumption, while disregarding the "without dams" temperature model developed by Watercourse Engineering and available in the FERC record.

The upper Tuolumne River 'favorable conditions' that CDFW highlights do not achieve the recommended thermal criteria CDFW prescribes in Table 4 of its Memorandum (pg 15). Temperature modeling indicates that in the absence of dams, water temperatures in the lower (Jayasundara et al. 2017) and upper (TID/MID 2016) Tuolumne River would naturally exceed 25°C and 23°C, respectively, during late summer and early fall. If the temperature guidelines identified in EPA (2003) were to actually apply to the Tuolumne River, natural conditions would not have supported populations of spring-run Chinook or steelhead (TID/MID 2018) in the accessible reaches of the upper mainstem Tuolumne River and its tributaries[5].

The warmest thermal criteria CDFW recommends for the lower Tuolumne River is 18°C calculated as a seven-day average of the daily maximum (7DADM)[6] for juvenile steelhead rearing—all other CDFW recommended criteria are 13°C 7DADM (Table 4, pg 15). Figure 1 provides a series of modeled temperature metrics for accessible mainstem habitat in the upper Tuolumne River during several representative water-year types based on the 60-20-20 San Joaquin Index. Table 1 presents a summation of all days from July to October that exceed the warmest allowable criteria of 18°C 7DADM.

These upper Tuolumne River modeled temperature data highlight that the temperature guidelines the CDFW Memorandum recommends are frequently exceeded. The month of August only cools below 18°C 7DADM during the 2005 wet water year. For all other water year types, the *entire* month of August is warmer than 18°C 7DADM for all of the accessible mainstem (RM's 83-107). In addition, July and September only marginally improve during most water year types and often are not in compliance for over half of the month from July to September (Table 1 and Figure 1). The 13°C, 7DADM temperature recommendations would generally not have been met until October for all water year types throughout the entire reach. CDFW states that by moving the compliance point based on water year type, the prescribed temperature recommendations will be met in the lower Tuolumne River. However, the water year based spatial compliance adjustments would result in little change from July to September in the upper Tuolumne River due to the warm conditions reflected in Table 1 and Figure 1. The analysis shows that the historical thermal regime in the upper Tuolumne River would not comply with CDFW's temperature prescriptions and it can only be concluded that the recommended temperatures are inappropriate for the lower Tuolumne River as well.

Table 1. A summation of the number of days by select years (representing all water year types selected within recent years) that exceed the 18°C 7DADM by river mile and month in accessible mainstem reaches of the upper Tuolumne River. Red highlighted values

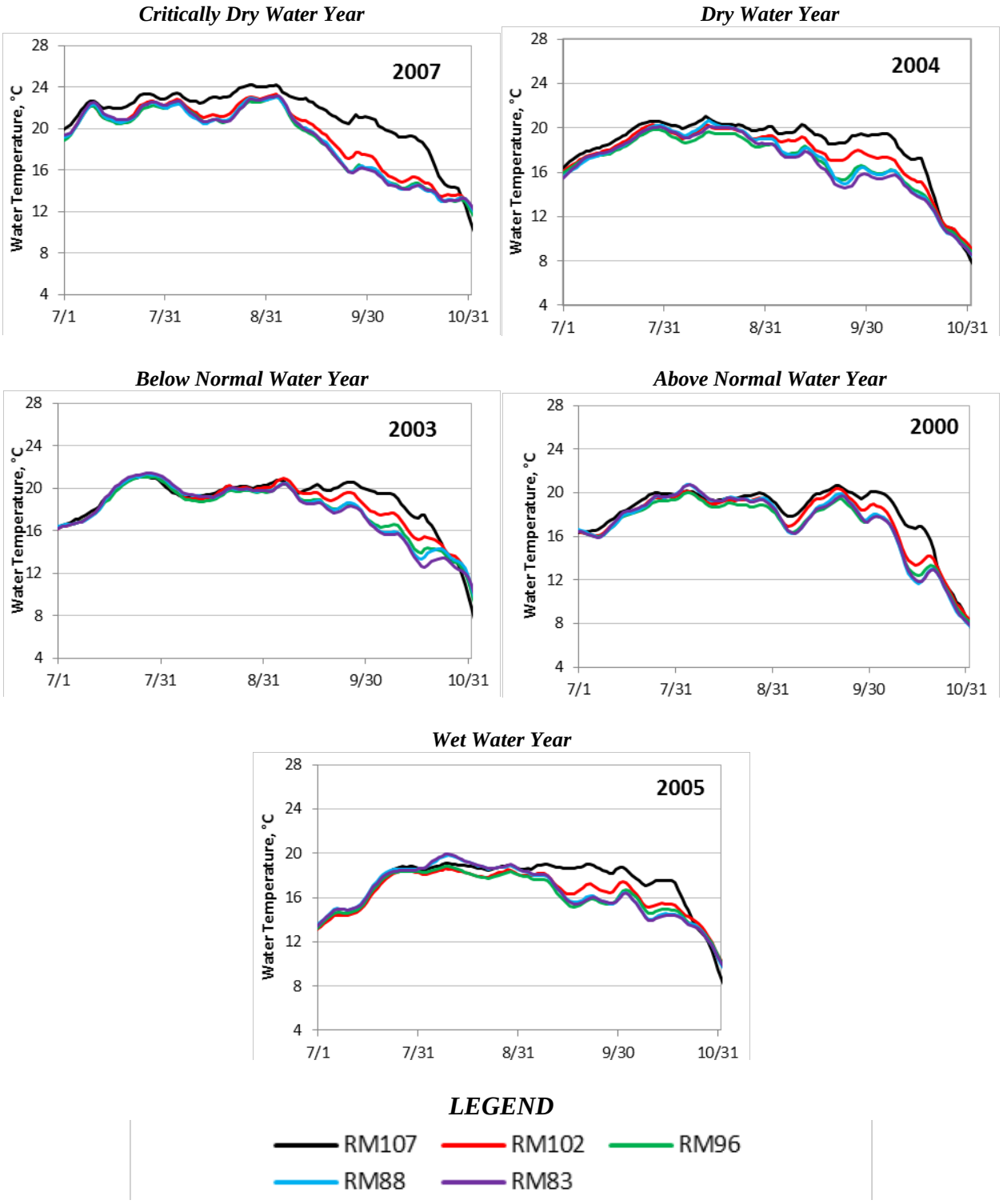
[5] Due to documented physical barriers, the mainstem Tuolumne River would be reliably accessible to anadromous fish from RM 80.8–97.3, and only the lower reaches of the major upper basin tributaries would be accessible, i.e., 1.69 miles of the North Fork Tuolumne River, 2.05 miles of the Clavey River, 1.9 miles of the South Fork Tuolumne River, 0 miles of the Middle Fork Tuolumne River, and 1.62 miles of Cherry Creek (TID/MID 2017c).

[6] While CDFW did not explicitly state what metric they were applying, it is assumed that they followed EPA's 7DADM temperature metric.

represent when 18°C (CDFW's highest temperature recommendation) is exceeded for the entire month.

Month	River Mile									
	RM107	RM105	RM102	RM99	RM99	RM96	RM93	RM93	RM88	RM83
CRITICALLY DRY WATER YEAR - 2007										
July	31	31	31	31	31	31	31	31	31	31
August	31	31	31	31	31	31	31	31	31	31
September	30	30	21	20	20	19	19	19	19	19
October	18	17	0	0	0	0	0	0	0	0
DRY WATER YEAR - 2004										
July	22	19	17	15	15	14	13	13	15	16
August	31	31	31	31	31	31	31	31	31	31
September	30	23	15	13	12	6	6	6	6	4
October	0	0	0	0	0	0	0	0	0	0
BELOW NORMAL WATER YEAR - 2003										
July	20	19	19	18	18	18	18	18	18	19
August	31	31	31	31	31	31	31	31	31	31
September	30	30	30	30	30	28	23	23	27	24
October	12	10	1	0	0	0	0	0	0	0
ABOVE NORMAL WATER YEAR - 2000										
July	18	17	17	14	14	15	12	12	16	17
August	31	31	31	31	31	31	31	31	31	31
September	27	25	22	20	20	15	11	11	16	16
October	10	8	6	5	5	0	0	0	2	0
WET WATER YEAR - 2005										
July	10	9	9	8	8	9	9	9	11	10
August	31	31	27	17	17	24	22	22	31	31
September	30	23	7	0	0	0	0	0	6	8
October	4	3	0	0	0	0	0	0	0	0

Figure 1. A series of modeled water temperature outputs using 7DADM metric from July through October (warmer months) in accessible mainstem reaches of the upper Tuolumne River, representing all water year types that recently occurred. Note that CDFW recommended a temperature criteria range from 13° and 18°C and EPA (2003) recommend temperature guidelines from 13° and 20°C based on lifestage.



CDFW Did Not Accurately Represent or Directly Follow the EPA (2003) Guidelines

Throughout the entire Memorandum, CDFW incorrectly contends that the EPA (2003) is a criteria and not guidelines as the original EPA document is titled. CDFW states that the "criteria" is a "key factor" that should be attained (pg 1), but then proceeds to modify the presumed criteria. To assume that the EPA (2003) guidelines were strict criteria would then logically require for those criteria to be followed. CDFW violated this basic logic.

CDFW incorrectly summarizes the EPA (2003) guidelines (Table 1, pg 2) and then is selective of which aspects of the guidelines to follow. Table 2 provides the actual EPA (2003) guidelines and the CDFW recommended values presented in Table 4 (pg 15). The CDFW Memorandum Table 1 (pg 2) incorrectly summarizes that the EPA (2003) adult migration guideline does not exceed 18°C, when it is actually 20°C for adult migration reaches outside of non-core rearing and 18°C in non-core rearing reaches with adult migration. The CDFW recommended temperature in Table 4 (pg 15) does not specify an adult migration compliance temperature, but on pg 7 CDFW states that by October 1, a compliance temperature of 18°C should be maintained for adult migration. The compliance point location for this temperature is not specified. CDFW also does not follow the EPA (2003) temperature guideline for steelhead smoltification of 14°C, but recommends 13°C (Table 4, pg 15) without justification or discussion of the change. Overall, CDFW's prescriptions are poorly organized, confusing, do not completely follow EPA (2003), and offer no justification or rationale for why deviations from the EPA temperature guidelines occurred.

Table 2. Comparison of the EPA (2003) guidelines and the CDFW recommended temperature criteria from the Memorandum. Temperature units for the EPA are 7DADM and are assumed to be the same for the CDFW recommendation (although not specified).

Lifestage	Species	Temperature (°C) 7DADM[1]	
		EPA (2003)	CDFW Recommendation
Adult migration (excludes non-core rearing areas)	Salmon/steelhead	20	18[2]
Adult migration (including non-core rearing areas)	Salmon/steelhead	18	18[2]
Spawning	Salmon/steelhead	13	13
Incubation	Salmon/steelhead	13	13
Juvenile rearing (early year)	Salmon	16	13
Smoltification	Steelhead	14	13
Juvenile Rearing (late year)	Salmon/steelhead	18	18

[1] 7DADM metric not specified in CDFW Table 4 used to populate the current table, but is assumed based on EPA (2003) usage of 7DADM.
[2] Value not specified in the Memorandum Table 4, but specified in earlier text as 18°C (pg 7)

CDFW Provides Flow Recommendations with No Evidence that Temperature Compliance Will Be Met and Lacks Analyses by Species and Lifestage

The CDFW Memorandum does not provide any evidence or support that the recommended flow schedule provided in Table 3 (pg 14) will meet their modified EPA (2003) temperature prescriptions presented in Table 4 (pg 15). CDFW states that the recommended flows in Table 3 result in relatively high weighted usable area (WUA): a modeled metric from Physical Habitat Simulation (PHABSIM) that did not include a water temperature parameter in the Stillwater Sciences (2013) report referenced. CDFW states that based on the quantity of discharge and timing of release that the resultant conditions will be "protective" of salmonids (pg 14), but offers no reasoning or support as to how that translates into suitable water temperature. CDFW does not provide any modeled temperature outputs to validate flows will meet EPA (2003) guidelines, but rather relies on "staff expertise" (pg 13).

Regardless of staff expertise, there is insufficient information in the Memorandum to reliably predict temperature or ensure that CDFW's flow schedule will meet its temperature criteria, but existing information suggests that the recommendation will not be met. In response to the July 16, 2009 FERC order (128 FERC ¶ 61,035), the Districts applied an existing water temperature simulation model (RMA 2008) to evaluate the downstream extent of thermally suitable habitat to meet temperature objectives recommended by the fishery resource agencies to be applied at specific locations and times of year (Stillwater Sciences 2011). Although this report indicated model calibration issues that led to the subsequent development of a HEC-RAS based water temperature model by the Districts (TID/MID 2017d), the relationship between flow and water temperature in the lower Tuolumne River shows that particular temperature objectives cannot be feasibly met at locations recommended by CDFW at certain times of year. This finding was verified by the HEC-RAS temperature model developed under Study W&AR-16, in response to a comment provided by FERC staff on the Don Pedro draft license applications (see Don Pedro Project AFLA, Attachment A, Appendix A).

CDFW's Memorandum does not sufficiently address recommended temperature by lifestage or consider conditions within the Tuolumne River. Provided below is an assessment of each recommendation by species and lifestage.

<u>Adult Chinook Immigration</u>

CDFW applies the EPA 18°C (64.4°F) 7DADM criteria for adult salmon migration over the *entire* length of the lower Tuolumne River beginning October 1 (Table 4, pg 15). It is presumed, but not explicitly stated, that this threshold would apply to all WY Types. The document also states that fall pulse flow "window" (no pulse flow volumes stated) should also begin on October 1 (pg 7).

CDFW suggests implementing temperature compliance at the immediate onset of migration, when few fish occur. The CDFW rationale for the periodicity of adult migration is based on 7 years of Tuolumne River weir counts and supported by one table showing initial date of the first salmon counted along with a graph showing weir passage during 2015 and the average daily water temperature at the USGS Modesto gage (pg 6). Although recent weir reports suggest that October 1st is a reasonable date for the beginning of adult migration, overall early activity is relatively low

until late October. The document does not necessarily demonstrate a clear association of weir passage with the 18°C 7DADM. While the relationship between adult emigration and temperature is unclear, the relatively few adults present in mid-October that would potentially benefit from this recommendation is apparent. Establishing the thermal 'criteria' at the end of October when most fish begin to arrive would provide the best balance of water allocation and overall benefit to adults.

Providing 18°C by October 1 for the entire lower Tuolumne River is infeasible and likely will have unintended impacts to water supply uses. Examination of thermograph data compiled by the Districts (2000-2017) indicates that the 18°C 7DADM recommendation as far downstream as the San Joaquin River confluence (RM 0) is not met as early as October 1st in years with flood control releases extending into the fall (e.g., 2011, 2017).

CDFW ignores temperatures which occur downstream of the Tuolumne River, which would exceed CDFW's recommendations. Seasonal air temperatures in early October are high enough that the 18°C 7DADM 'criteria' is not met at temperature monitoring locations in the San Joaquin River and south Delta (both listed as temperature impaired by the EPA) until mid-to-late October in most years. Even if large flow releases were attempted to meet a lower Tuolumne River mouth compliance location in early October, up-migrating salmon would continue to encounter water in excess of the 18°C 7DADM for most of their journey from San Francisco Bay to the lower Tuolumne River. Any adverse effects purported to affect migration or subsequent spawning would continue to occur regardless of such measures.

For these reasons, the Districts consider the recommendation for adult Chinook salmon immigration to be practicably unattainable, while potentially resulting in the loss of needed reservoir storage in drought years following years with high autumn air temperatures. Furthermore, it will not avoid the adverse effects intended to be addressed. The Districts disagree with the requirement to meet the 18°C 7DADM for adult Chinook migration.

Chinook Spawning and Incubation

CDFW applies the EPA 13°C (55.4°F) 7DADM criteria to benefit spawning, egg incubation and fry emergence to various compliance points for achieving 13°C over the October 16 to December 31 time period by WY type (CDFW 2018, Table 4, pg 15). Table 4 of the document outlines compliance points for proposed temperature objectives and includes Turlock State Park (RM 42.8) as the compliance point for the 13°C 7DADM for spawning/incubation during Wet, Above Normal, and Below Normal water year types, and Basso Bridge (RM 47.4) as the compliance point during Dry and Critical water years. Based upon the Districts' review of historical spawning data there is no indication that spawning activity is related to attainment of the 13°C 7DADM recommendation.

Water temperatures typically do not fall below 13°C 7DADM until mid-November and salmon spawning use has been shown to be most heavily weighted at the farthest upstream gravel areas at all times of the spawning season. For example, approximately 50% of redds observed between 2010 through 2012 and mapped as part of the Salmonid Redd Mapping Study (TID/MID 2013a) were located within the 85% of the spawning gravels mapped downstream of approximately

RM 49. The other 50% of spawning occurring within the remaining 15% of the spawning gravels occurring between RM 49 and La Grange Dam (RM 52.2).

Although spawning habitats of the lower Tuolumne River typically reach the 13°C 7DADM criteria by mid-November in most years, any flow releases made to attain these criteria at locations proposed by CDFW would have to be maintained for the remainder of the spawning period (up to December 1st) to prevent redd dewatering. Because no biologically based evidence of reduced egg viability, fry mortally, or spawning habitat use has been demonstrated by CDFW, the Districts disagree with the requirement to meet the 13°C 7DADM recommendation for adult Chinook spawning at any location in the lower Tuolumne River.

Chinook Rearing/Emigration

CDFW applies the EPA 18°C (64.4°F) 7DADM criteria to benefit Chinook rearing and emigration downstream to the San Joaquin River confluence (RM 0) under "wetter" water year types (Table 4, pg 15). Although not specified by CDFW, the fall-run Chinook rearing/emigration period in the lower Tuolumne River generally occurs between January through June.

Results from annual seine surveys show the majority of fish have emigrated the lower Tuolumne River by the end of April, with an annual average of 2.5% of all seine captures of Chinook salmon occurring in May during the 1999 through 2017 period. However, results of annual RST operations show more variability. In Above Normal and Wet water year types, the percentage of captures during May at the Grayson rotary screwtrap typically is below 10% of season totals, with the exception of year 2005, when higher spring flows result in higher captures earlier in the emigration period. Consistent with patterns observed in data reviews conducted for the Chinook salmon population model report (TID/MID 2013b), these results indicate the majority of juvenile Chinook salmon have emigrated past the Grayson RST before May 1st and almost no captures occur by late May.

Because the majority of juvenile salmon have emigrated from the Tuolumne River before May and the large amounts of water needed to maintain cool water temperatures under high ambient air temperature, the Districts disagree with the requirement to meet the 18°C 7DADM recommendation for Chinook rearing and emigration after the initiation of schedule pulse flows and at no time after May 15th in Above Normal and Wet water year types.

Steelhead smoltification

CDFW applies the EPA 13°C (55.4°F) 7DADM criteria to benefit steelhead smoltification to various compliance points for achieving 13°C over the January 1 through May 31 time period by water year type (CDFW 2018, Table 4, pg 15). Although additional water temperature model results would be required, it is unlikely that the EPA 13°C (55.4°F) 7DADM would be met during May at the compliance points proposed by CDFW in years when flood control releases were not required. Because there are no records of any steelhead smolt emigration and no evidence of a self-maintaining steelhead population on the lower Tuolumne River, the Districts disagree with the application of the EPA 13°C (55.4°F) 7DADM recommendation to an idealized smoltification period extending to the end of May. Because very large amounts of water would be needed to

maintain these cool water temperatures under high ambient air temperatures the recommendation would be practically unattainable during spring outside of flood control periods.

Steelhead juvenile rearing

CDFW applies the EPA 18°C (64.4°F) 7DADM recommendation to benefit steelhead rearing downstream to TLSRA (RM 42.8) in all water year types (CDFW 2018, Table 4). As part of the instream flow study, various temperature metrics were considered in developing an effective weighted usable habitat analysis for rearing *O. mykiss* during summer in the lower Tuolumne River (Stillwater Sciences 2017). The report provides flows necessary at La Grange to achieve various modeled water temperature metrics, including 7DADM at selected downstream locations and then associates those flows with usable habitat based on the PHABSIM analysis for lower Tuolumne River (Stillwater 2013). These results indicate that flows ranging from approximately 700 cfs to approximately 1,200 cfs could be required to maintain an 18°C (64.4°F) 7DADM during August between RM 43.1 and RM 39.5, respectively, for *O. mykiss* fry and juvenile lifestages.

While this may cool water temperature, there is the potential for unintended consequence. Meeting an 18°C (64.4°F) 7DADM threshold in 50% of years at RM 43.1 would require flows of 650 cfs during July, which corresponds to only 67% and 75% of the maximum usable habitat for juvenile steelhead. Although higher flows to meet lower water temperature thresholds at RM 43.1 and other locations would generally result in greater amounts of usable habitat for adult *O. mykiss* (See Figures D-33 through D-48 in Stillwater 2017), the corresponding increases in velocity at those flows result in reduced amounts of hydraulically suitable habitat for fry and juvenile life stages in all sub-reaches evaluated. *O. mykiss* fry WUA at 1,000 cfs is only 60% and Chinook fry is 50% (Figure 21-22, Stillwater 2013). In addition to lowered usable habitat, an increased risk of displacement, increased energetic demands, and other high-flow related issues on early lifestages would occur at these flows. The Districts see the minimal benefit and high cost of elevated flow releases to meet a poorly supported temperature recommendation as inappropriate and in most water years irresponsible.

Errors in the Memorandum Draw Speculation

The CDFW Memorandum reflects insufficient analyses to reach stated conclusions, which is compounded by issues found within the report. A few examples include:

- CDFW states that the purpose of the document is to apply the EPA (2003) 'criteria' at "*appropriate temporal levels*" and mentions nothing of modifying the actual temperature prescriptions (pg 3). CDFW then proceeds to recommend a 13°C steelhead smoltification criteria, when EPA (2003) recommends 14°C. Given this change was not addressed or justified, it appears as a potential error; however, it is not clear if this was an intentional revision or not.
- CDFW does not provide a temperature metric for its recommended criteria in Table 4 (pg 15). It can only be assumed that CDFW is using the EPA (2003) endorsed metric of 7DADM and not maximum weekly average temperature (MWAT) or daily average temperature. However, CDFW did modify the EPA (2003) temperature guidelines, so it is unclear as to what temperature metric they prefer without assumption.

- The premise of attempting to use t-tests to correlate complex climactic landscapes is flawed. The output of CDFW's analyses in Appendix A is presented in six tables (pgs 6-8), each labeled in degrees Celsius, but clearly reported in Fahrenheit (otherwise converted temperatures would start near 130°F for most major US cities listed). This error is repeated in all six tables presented.

Conclusion

The CDFW Memorandum does little to support usage of the EPA (2003) guidelines on the lower Tuolumne River. The Districts' acknowledge that historically these guidelines were considered for other California basins. However, after significant effort and investment of resources the Districts' provided the tools and data based on array of recent studies to collaboratively develop site-specific water temperature indices. Developing site-specific temperature indices required significantly more resources than deferring to past practice, but the potential result will maintain local warm- and coldwater fish populations, while protecting all beneficial uses. The Districts have overwhelmingly provided the burden of proof to move away from dated practices and information to endorse best available science.

Overall, the CDFW Memorandum provided few actual water temperature analyses. The Memorandum only provides two temperature figures reporting from monitoring stations at RM 26 and 52 (pg 11). In contrast, the Memorandum provides five figures (pgs 6, 9, 10, and 13) focused on salmonid population periodicity and distribution. Given the overall lack of local or site-specific temperature analyses throughout the CDFW Memorandum, it appears that the primary "staff expertise" and focus is in population monitoring results, not temperature management evaluations.

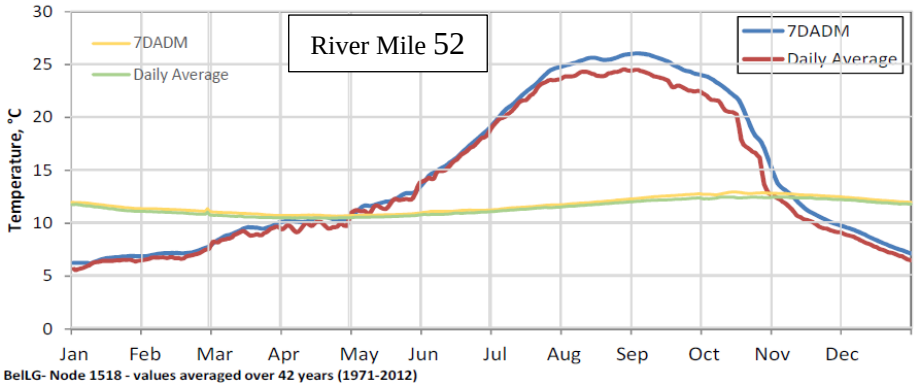
FERC should also consider more recent actions of resource agencies and the message that is depicted. NMFS and other resource agencies are applying a double standard, i.e., basing upper river habitat capacity estimates on Verhille et al. (2016), while for the same fish and same lifestage basing their lower river recommendations on EPA (2003). NMFS provides no rationale to justify the use of two sets of "criteria" for the same species of fish in the same river (NMFS 2018). Farrell (2018), a coauthor of the Verhille et al. (2016) study, points out the absurdity of attempting to apply EPA (2003) guidelines to the Tuolumne River rather than site-specific data, stating, "No study to date has refuted the data in Verhille et al. (2016), which tested in situ the local [rainbow trout] population inhabiting the [Tuolumne River]. Farrell goes on to note that in contrast, "the single study of Hokanson et al. [1977], performed 40 years ago, determined the optimal temperature for growth of a rainbow trout population living in a hatchery in Minnesota and these data were applied by EPA (2003) to set the 7 DADM [temperature guidelines] for the [Tuolumne River]," which is located about 2,000 miles from Minnesota at a significantly lower latitude.

One of the reasons the Districts have argued against use of the EPA (2003) has been its lack of applicability to the salmonids historically and currently present in Central Valley streams. To evaluate the likely historical temperature regime of the Tuolumne River below the natural migration barriers of the river, the Districts retained Watercourse Engineering to develop a temperature model of the Tuolumne River to evaluate temperature regimes under unimpaired flow

conditions in the river (Jayasundara et al. 2014, 2017)[7]. The model covers the Tuolumne River from the headwaters of the Hetch Hetchy Reservoir (RM 126) to the confluence with the San Joaquin River. The model is represented by two separate reaches – the upper reach from RM 126 to RM 79 and the lower reach from RM 79 to RM 0. As discussed previously in this report, if EPA (2003) temperatures actually represented temperatures needed to protect Chinook salmon and anadromous or resident *O. mykiss*, the Tuolumne River temperatures would not have supported sustained populations of anadromous salmonids based on the summer and early fall temperatures present under unimpaired conditions in the upper Tuolumne River.

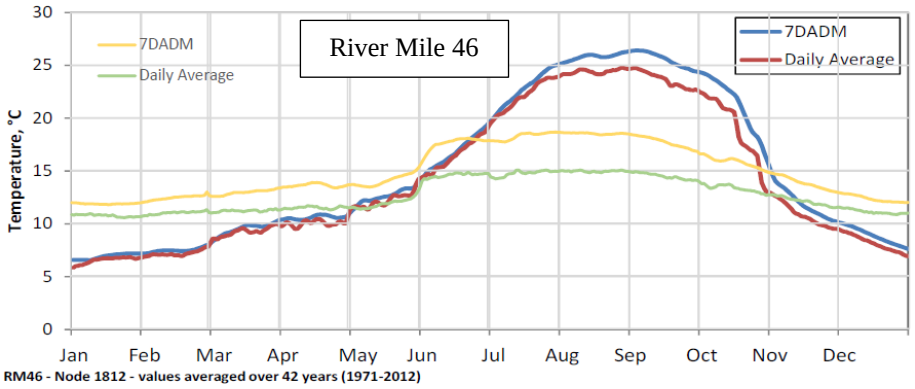
Examining the results of the lower river "without dams" model is also informative, especially when compared to the temperatures projected to occur under the Districts' Preferred Plan contained in the Don Pedro Project AFLA. In Figure 2, temperatures under "without dams" conditions are compared to temperatures under the Districts' Preferred Plan. The figures indicate that the Districts' Preferred Plan maintains suitable conditions for salmonids at least as far downstream as RM 34 year round, and at least as suitable, if not more so compared to "without dams" conditions for salmonids from July 1 through October 31.[8] The Districts' Preferred Plan generally improves or maintains cooler temperatures during critical species periodicities and at key locations (upper reaches) compared to unimpaired conditions

Figure 2. Daily average and 7DADM temperatures under "without dams" conditions (red/blue lines) and the Districts' Preferred Plan (green/yellow lines) at La Grange Diversion Dam (RM 52), RM 46, 40, 34, 24, and 2.

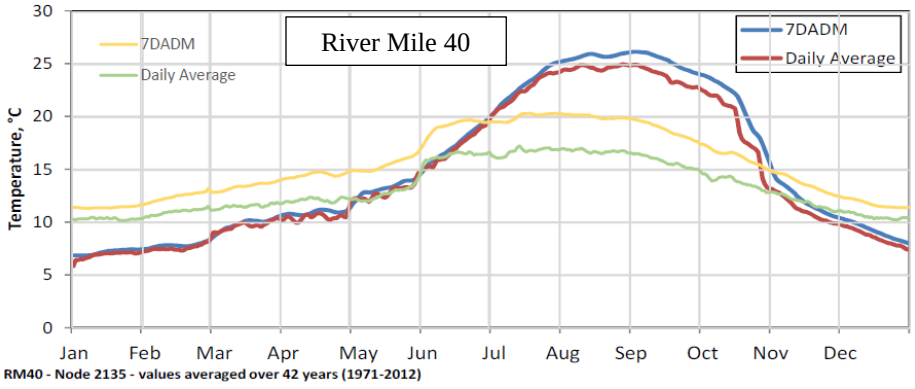


[7] See the Don Pedro Project AFLA, study entitled "Development of Tuolumne River Flow and Temperature Without Dams Model"; September 2017.

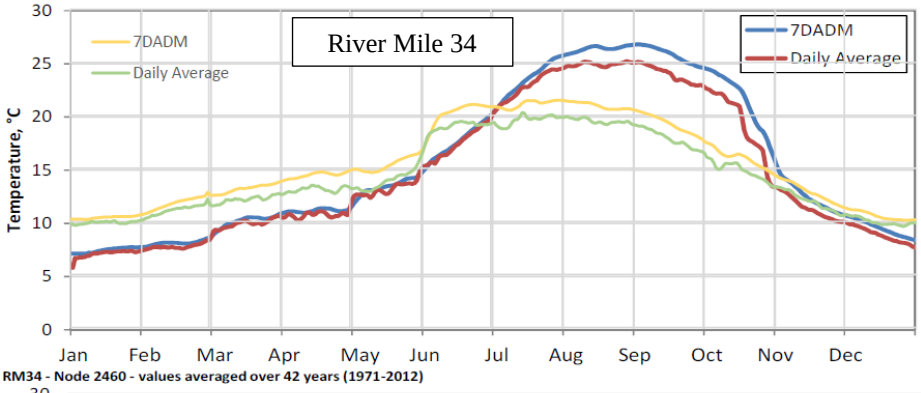
[8] The Districts' Preferred Plan gives preference to the *O. mykiss* fry life stage in the month of June, thereby keeping the minimum instream flow lower than in May and July. *O. mykiss* are generally found above RM 40 and June temperatures remain favorable for Tuolumne River *O. mykiss* throughout the June through October period. Except in Wet water years, juvenile Chinook salmon have left the Tuolumne River by the end of May (Don Pedro Project AFLA, Exhibit E, Section 5). In Wet years, high flows generally continue into June keeping temperatures cooler.



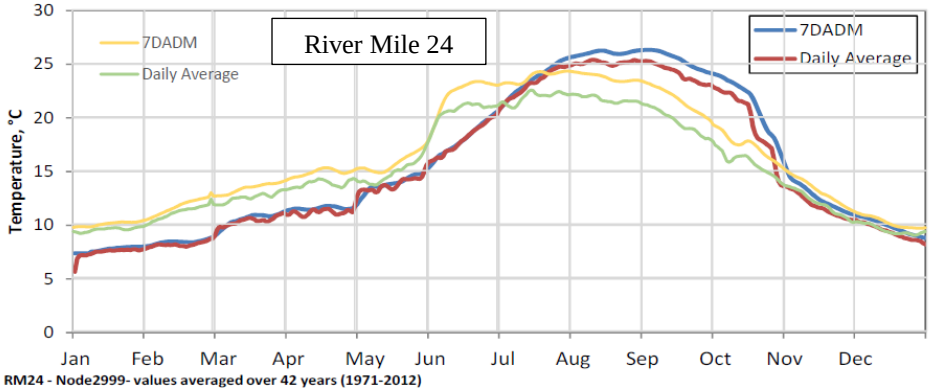
RM46 - Node 1812 - values averaged over 42 years (1971-2012)



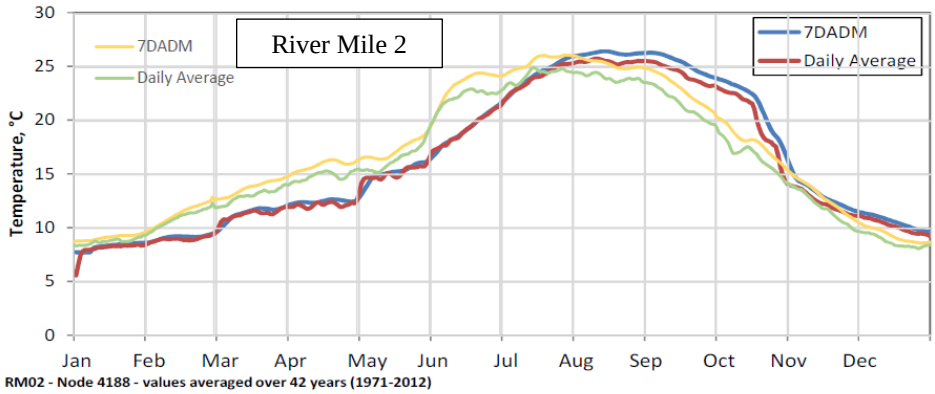
RM40 - Node 2135 - values averaged over 42 years (1971-2012)



RM34 - Node 2460 - values averaged over 42 years (1971-2012)



RM24 - Node2999- values averaged over 42 years (1971-2012)


River Mile 2
7DADM
Daily Average
7DADM
Daily Average
Temperature, °C
30
25
20
15
10
5
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
RM02 - Node 4188 - values averaged over 42 years (1971-2012)

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