State of California - The Resources Agency ARNOLD SCHWARZENEGGER, Governor

DEPARTMENT OF FISH AND GAME

http://www.dfg.ca.gov

April 21, 2008

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, N.E.
Washington, DC 20426

Re: DeSabla-Centerville (FERC Project #803) Comments on Remaining Study Results

Dear Secretary Bose:

Thank you for the opportunity to comment on Pacific Gas and Electric Company's (Licensee) Final License Application (FLA) for the DeSabla-Centerville Hydroelectric Project (FERC Project No. 803). Although the Licensee filed the FLA with the Commission on October 2, 2007, many studies had not yet been completed. Since then, the Licensee has filed supplemental study information with the Commission.

The Commission issued a letter on February 22, 2008, amending the Project's Process Plan and set April 21, 2008 as the final date for submitting comments on the six "outstanding study results". These six studies are: 6.3.2-4 Develop Water Temperature Model..., 6.3.2-5 Measure and Evaluate Water Quality..., 6.3.3-4 Characterize Fish Populations..., 6.3.3-6 Assessment of Fish Entrainment and Upstream Fish Passage..., 6.3.3-3 Assessment of RT&E Amphibian and Aquatic Reptile Species..., and 6.3.8-2 Traditional Cultural Properties. The Department of Fish and Game is only filing comments on study 6.3.2-4 at this time; however, the Commission staff has stated at numerous meetings that they will accept comments on all aspects of the Project and associated studies until they reach a decision. The April 16, 2008 technical memorandum titled "DeSabla-Centerville Hydroelectric Project Water Temperature Modeling" (Enclosure) provides the Department's detailed comments on the water temperature modeling studies.

If you have any questions regarding this matter, please contact Beth Lawson, Associate Hydraulic Engineer, at (916) 358-2875.

Sincerely,

Sandra Morey
Regional Manager

Enclosures

Conserving California's Wildlife Since 1870

MEMORANDUM

To: MaryLisa Lynch
Senior Environmental Scientist
California Department of Fish and Game

Kathy Turner
Lassen & Shasta-Trinity National Forest Hydropower Coordinator
United States Forest Service

From: Robert W. Hughes, P.E.
Senior Hydraulic Engineer
California Department of Fish and Game

Elizabeth A. Lawson, P.E.
Associate Hydraulic Engineer
California Department of Fish and Game

Date: April 16, 2008

Re: DeSabla-Centerville Hydroelectric Project Water Temperature Modeling

On August 22, 2007 we filed a memo describing comments on our initial review of the CE-QUAL-W2 (W2) modeling that was prepared by Pacific Gas and Electric Company (Licensee) for the DeSabla-Centerville Project draft license application (DLA). Since that time, we have continued to work with the Licensee to review and modify the W2 stream and canal water temperature models. The purpose of this memorandum is to report our analysis of the calibration of stream and canal W2 models, and to provide recommendations for the use of these models within the relicensing process. In addition, we provide comments on the SNTEMP models developed by the Licensee for: Butte Creek below the Butte Creek Diversion Dam, Butte Canal below the Butte Creek Diversion Dam, and the Lower West Branch Feather River (WBFR) below the Hendricks Diversion Dam.

CE-QUAL-W2 Modeling

Background:

After filing the August 22, 2007 memo, we met with the Licensee and their consultant on August 31, 2007. In that meeting, the Licensee agreed to do an analysis of how the CE-QUAL-W2 modeled predications of travel time and wetted width compared to field measurements. The Licensee reported their findings in two memos dated October 23, 2007 and October 26, 2007. In these reports, the Licensee agreed that, based on the results of the travel time analysis, they should recalibrate the temperature models for the locations were travel time information existed. They also agreed to refine the geometry of the models where possible.

In late January of 2008, the Licensee released their recalibrated versions of the Hendricks Canal model, the Butte Creek model, the Philbrook Creek model, and the Centerville Canal model. Since that time, we have held regular modeling teleconferences with the Licensee and their modeling team to discuss the calibration of these models. As a result of working with the Licensee's modeling team, the Lower Centerville Canal model was refined two additional times. The refinements included reducing the maximum timestep to address model instabilities, and improving the cross section geometry to reduce model error at low flows.

Independent Review of CE-QUAL-W2 Models

In March we determined that it would be appropriate to get a third party expert to review the three primary models that would be used in the relicensing process (Hendricks and Centerville Canals, and lower Butte Creek). Working through the Forest Service, we contracted with Merlynn Bender, a Modeler/Hydraulic Engineer with the U.S. Bureau of Reclamation's Technical Service Center in Denver, CO. Mr. Bender specializes in riverine and reservoir flow and water quality modeling. Mr. Bender's comments regarding the Hendricks Canal, Lower Centerville Canal, and Lower Butte Creek CE-QUAL-W2 models are provided in a March 17, 2008 letter report. A copy of this report is included as Attachment 1.

The primary comments/recommendations from Mr. Bender's report are summarized below:

- More detailed channel geometry could improve model performance – particularly at low flows;
- The models should be used for comparative purposes only (i.e. evaluate the difference between operational alternatives);
- The models should be used to evaluate scenarios that are within the range of flow and temperature calibration conditions; however, the models should not be used for scenarios that extrapolate beyond the range of the calibration conditions
- The models should be used to evaluate scenarios that include flows above about 53 cfs (1.5 cms)
- Prior to implementing operational changes based on the models, the results should be verified through an empirical flow study.

CE-QUAL-W2 Model Analysis:

While Mr. Bender conducted his review of the CE-QUAL-W2 models, we continued our assessment of these tools. The sections that follow describe our comments on these models, and we include recommendations for their use in the relicensing process.

We generally concur with Mr. Bender's comments and recommendations. However, after considering Mr. Bender's comments, we evaluated each of the three models in more detail. Specifically, for each model, we evaluated the relationship between modeled temperature output data, observed temperature data, and flow data. The results of these comparisons are presented and discussed below.

Lower Centerville Canal

Figures 1 and 2 depict model[1] error vs. canal flow for the Lower Centerville Canal during the last half of the 2004 and 2005 calibration years, respectively. As can be seen for both the 2004 and 2005 calibration years, model error generally increases beyond +/- 1°C at flows below about 35 cfs. We also note that this pattern of increased model error seems to occur during the mid- to late-September period during both calibration years. The range of flows used in the calibration simulations was between about 28 cfs and 160 cfs. Therefore, we recommend that the Lower Centerville Canal model only be used to evaluate the differences in operational scenarios with flows between 35 cfs and about 160 cfs. In addition, the simulation period should be limited to early-June through mid-September.

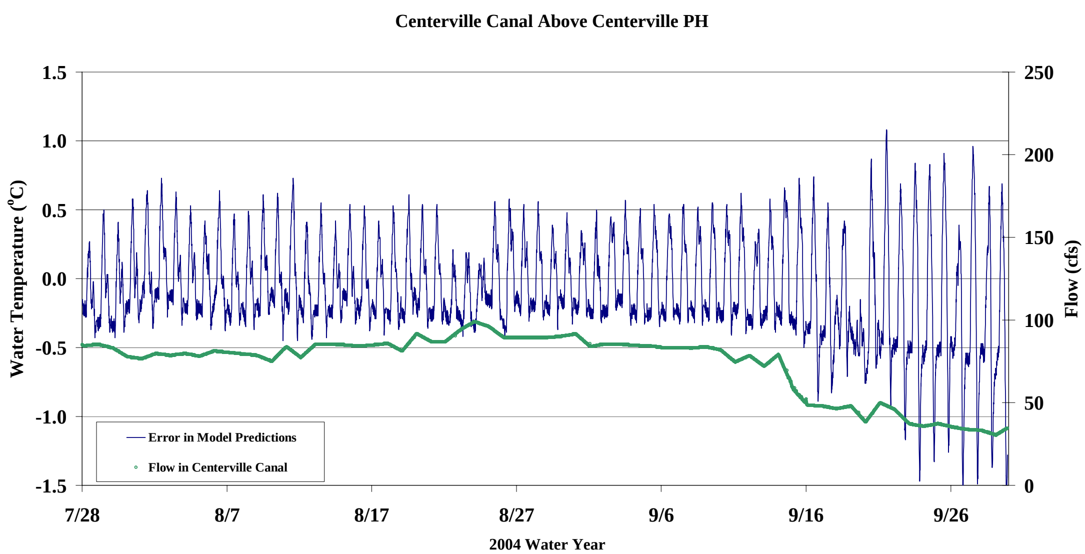


Figure 1. Centerville Canal W2 model error during the summer and early fall in the 2004 calibration simulation.

[1] For the purposes of this memo, model error is defined as model output data minus observed data.

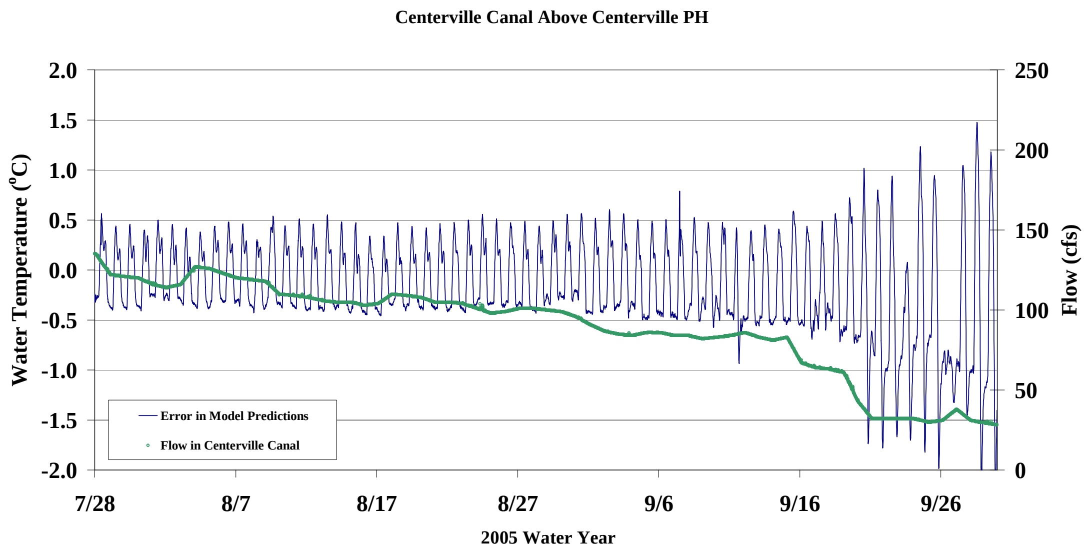


Figure 2. Centerville Canal W2 model error during the summer and early fall the 2005 validation simulation.

Lower Butte Creek

Figures 3 though 6 compare model output data, observed data, and flow data for lower Butte Creek during the 2004 and 2005 calibration years. As can be seen in both the 2004 and 2005 calibration years, the models appear to be specifically calibrated in an attempt to match maximum peak temperatures; however, the models appear to sacrifice accuracy with regard to the total amount of diurnal fluctuation and minimum temperatures. During the 2004 and 2005 calibration simulations, the flows in Butte Creek below the Centerville Diversion Dam ranged from about 43 cfs to about 236 cfs Therefore, we believe that the models should be used to evaluate the differences in operational scenarios with flows between 43 cfs and about 236 cfs.

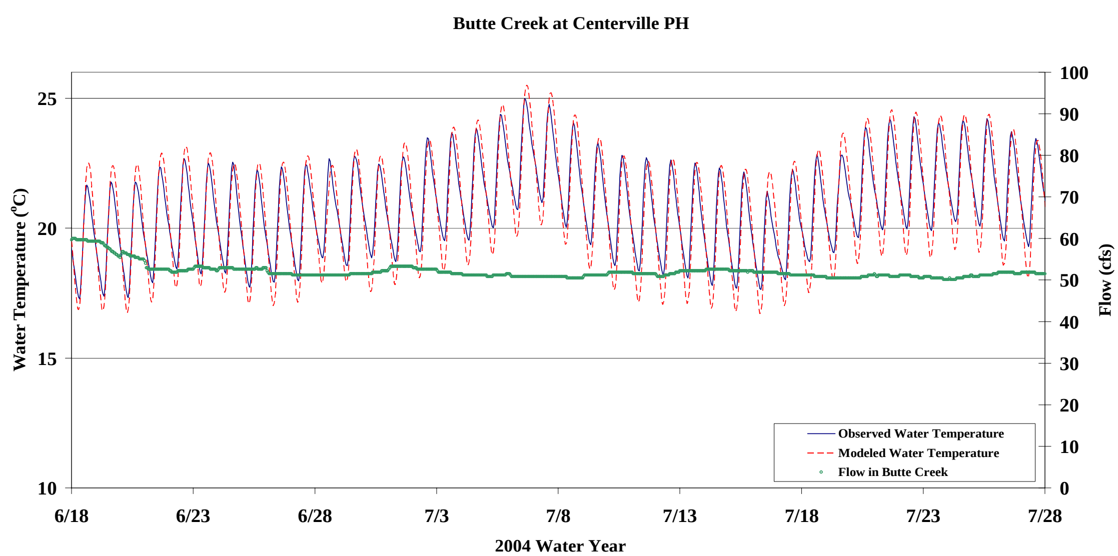


Figure 3. Butte Creek W2 model predictions and observed temperatures during early summer in the 2004 calibration simulation.

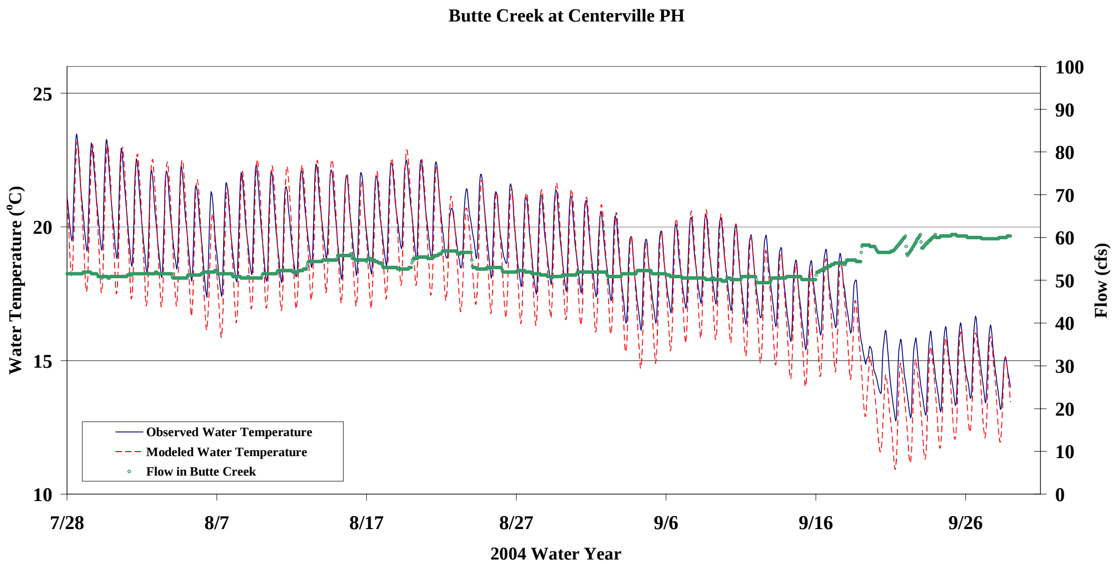


Figure 4. Butte Creek W2 model predictions and observed temperatures during summer and early fall in the 2004 calibration simulation.

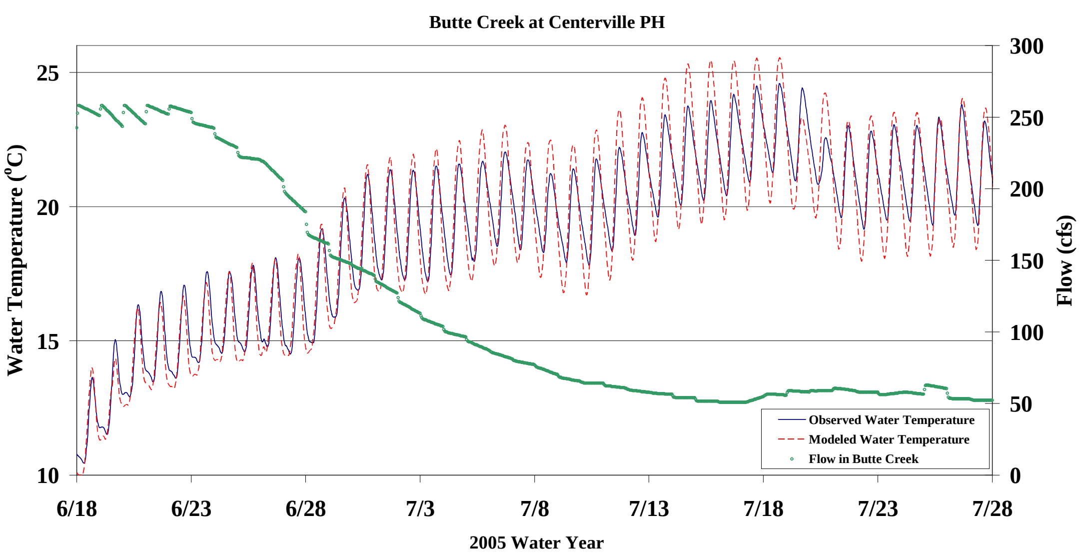


Figure 5. Butte Creek W2 model predictions and observed temperatures during the early summer in the 2005 validation simulation.

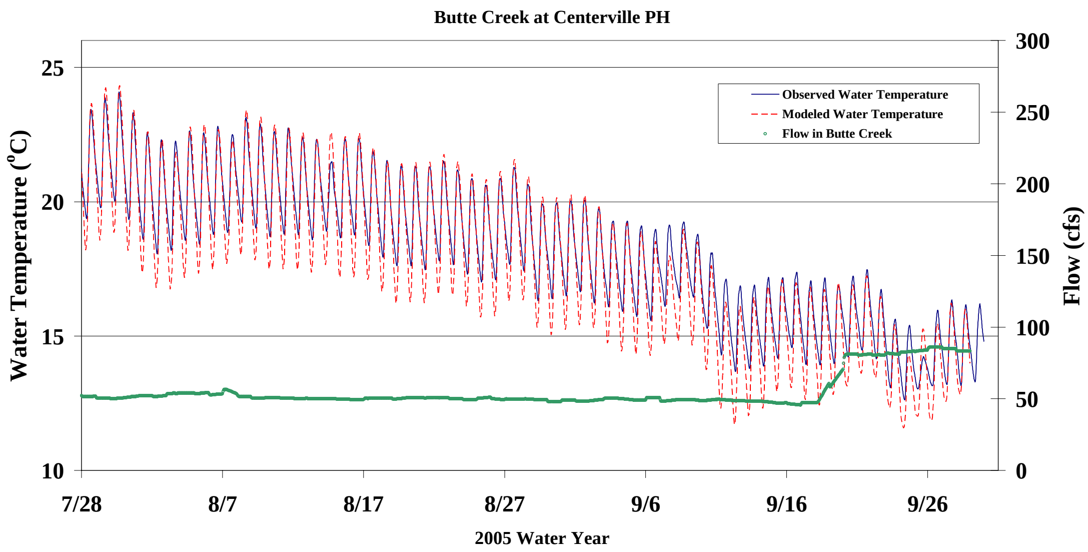


Figure 6. Butte Creek W2 model predictions and observed temperatures during the summer and early fall in the 2005 validation simulation.

Hendricks Canal

Figures 7 through 10 compare model output data, observed data, and flow data for the Hendricks Canal during the 2004 and 2005 calibration years. Similar to the lower Butte Creek models, the Hendricks Canal models appear to be specifically calibrated in an attempt to match maximum peak temperatures, and they appear to sacrifice accuracy relative to the total amount of diurnal fluctuation and minimum temperatures. During the 2004 and 2005 calibration simulations, the diverted flows ranged from about 24 cfs to about 118 cfs Therefore, we believe that the models should only be used to evaluate the differences in operational scenarios with flows between 24 cfs and about 118 cfs.

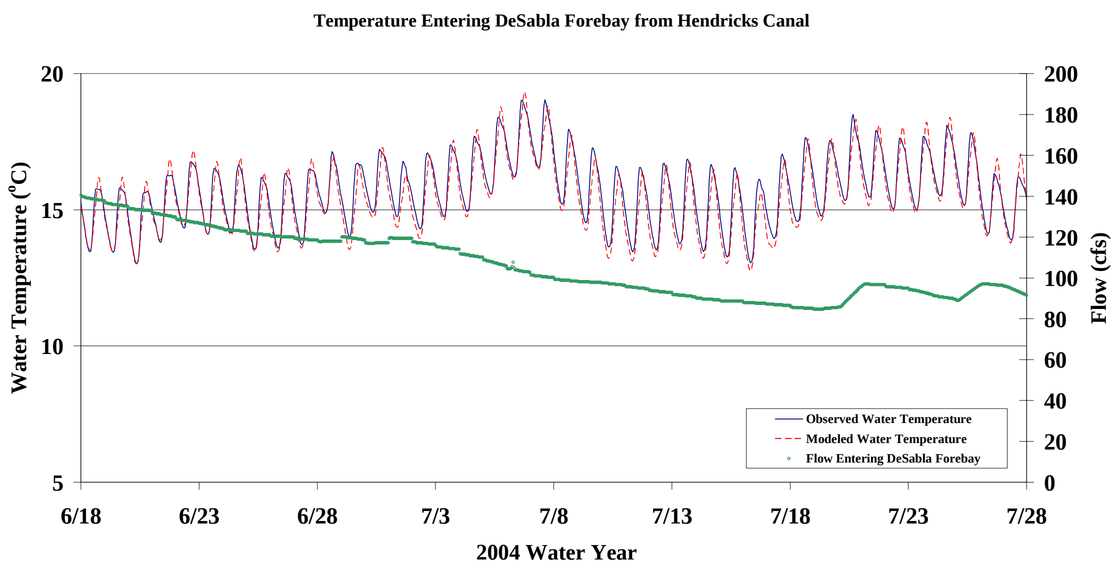


Figure 7. Hendricks Canal W2 model predictions and observed temperatures during the early summer in the 2004 calibration simulation.

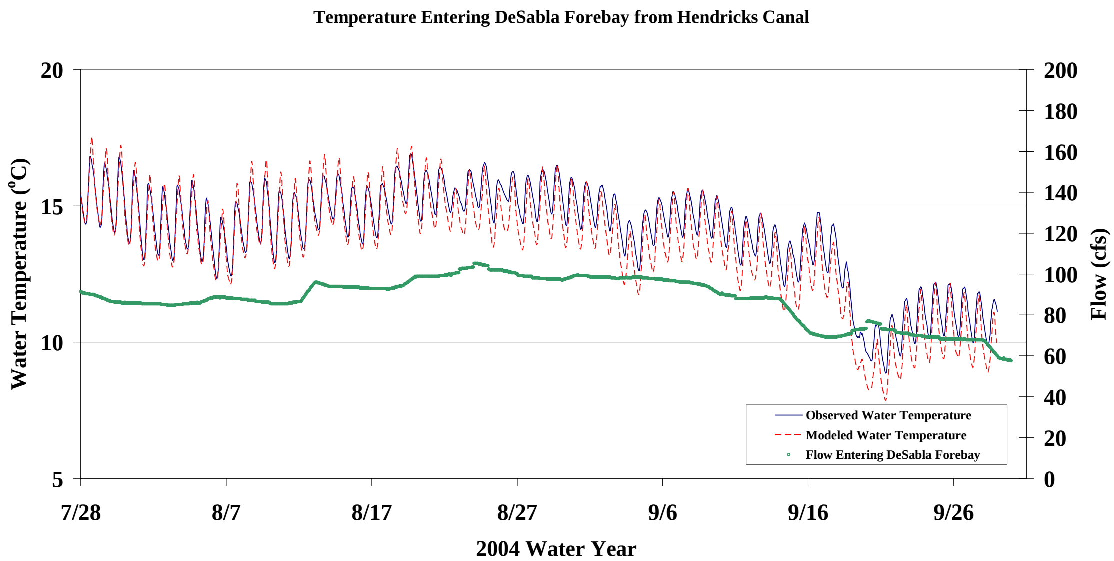


Figure 8. Hendricks Canal W2 model predictions and observed temperatures during the summer and early fall in the 2004 calibration simulation.

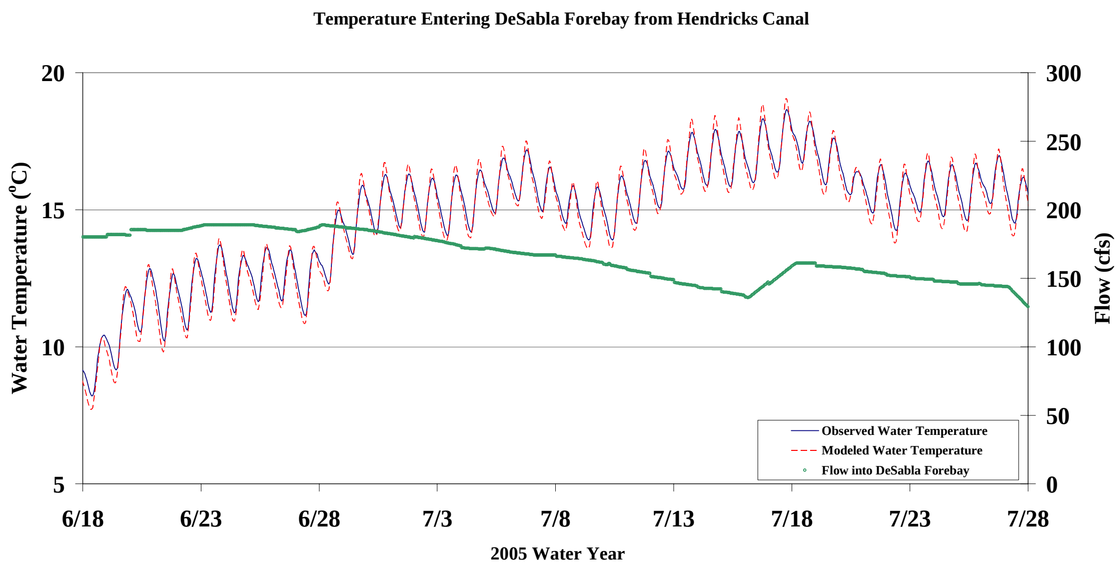


Figure 9. Hendricks Canal W2 model predictions and observed temperatures during the early summer in the 2005 validation simulation.

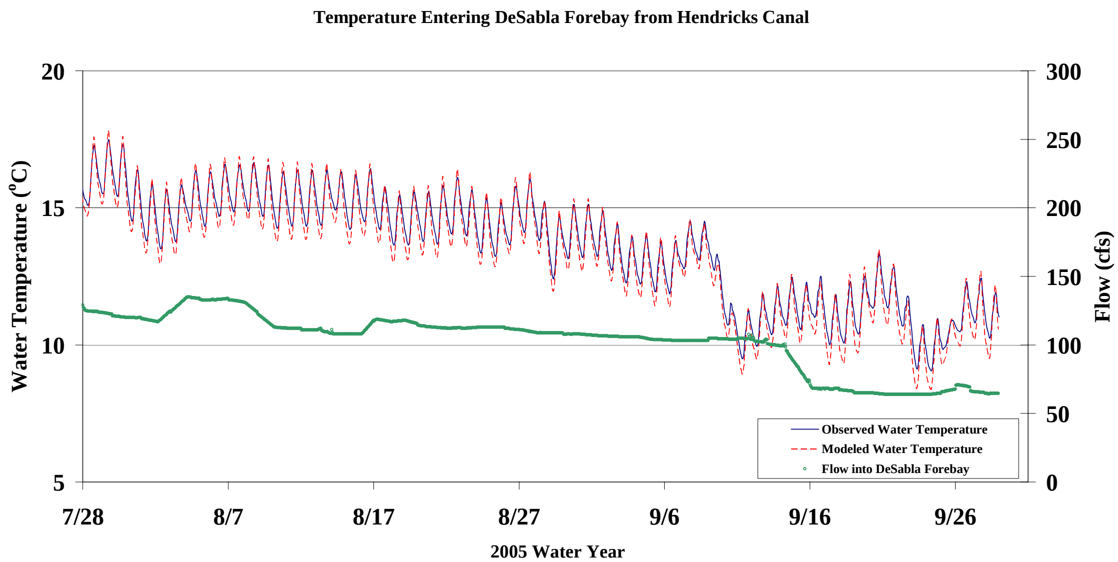


Figure 10. Hendricks Canal W2 model predictions and observed temperatures during the summer and early fall in the 2005 validation simulation.

<u>Recommendations:</u>
The models are suitable for use in the relicensing process with certain limitations. These limitations include:

- The models should be used for comparative purposes only (i.e. to compare the difference between operational alternatives);
- The Lower Centerville Canal model can be used to evaluate scenarios that include diversion flows between 35 cfs and 160 cfs. The simulation period should be limited to early-June through mid-September;
- The Hendricks Canal model can be used to evaluate scenarios that include diversion flows between 43 cfs and 236 cfs; and
- The lower Butte Creek model can be used to evaluate scenarios that include flows below the Centerville Diversion Dam between 24 cfs and 118 cfs.

In addition, prior to implementing operational changes based on the models, the results should be verified through an empirical flow and temperature study.

At this time, we have not reviewed in more detail the additional W2 models. It is our understanding they have not been modified since our initial memo on August 22, 2007. Based on what we have learned from the recalibration of the three models described above, we will continue to review and comment on the other W2 models if needed for the relicensing process.

SNTEMP Modeling

The Licensee prepared separate SNTEMP models for Upper Butte Creek, the Butte Canal, and the Lower West Branch Feather River (WBFR). We reviewed these three models and agree that the models are adequately calibrated for use in comparing results of different management scenarios. The models should not be used to predict absolute temperatures that will be achieved in the river in any one management scenario.

River Models:

As the Licensee describes in the February 15, 2008 Updates to the Final License Application (PG&E 2008), the SNTEMP models tend to overshoot the prediction of mean daily peaks and valleys in water temperature. The Licensee hypothesizes that models are exhibiting this “spiky” behavior because they are trying to model long travel times at low flows. They additionally note that SNTEMP does not account for the thermodynamic effects of residual pool volume. However, the Licensee felt that further calibration of the models was not warranted because the models mostly fell within calibration criteria specified in the Study Plan, with only a few minor exceptions.

The License did choose to revise the WBFR model in 2007. After the model was already calibrated/validated, the Licensee continued to collect data during 2007. When the field data for this dry year was input into the Lower WBFR model, the model did not meet the Licensee’s calibrations guidelines. The Licensee therefore developed a specific model for the WBFR during dry year conditions. In this model, the Licensee used a one-day lag in hydrology input conditions; this approach helped the Licensee bring the 2007 WBFR model’s performance to “near or within” their calibration criteria, however the model still continued to exhibit the exaggeration in temperature predictions. This trend is illustrated in Figure 11 below, which shows the measured and modeled temperatures at the Miocene diversion, on the downstream end of the Lower WBFR model.

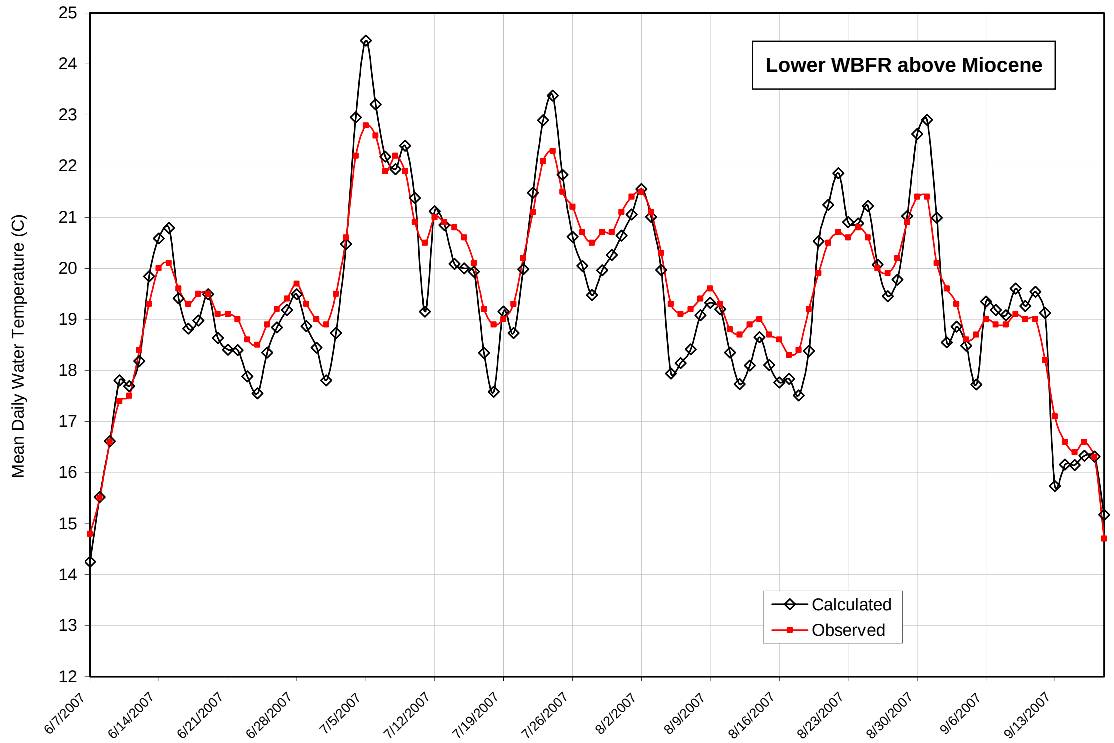


Figure 11. 2005 temperature model predictions at the downstream end of the WBFR model.

The hypothesis that the models perform poorly because of the low flow conditions is supported by consideration of the results of the one calibration model run that contains both high and low flows. Because releases are controlled at Butte Head dam and the Hendricks Head Dam, mostly only lower flow conditions were seen in the rivers during the simulation periods. However, during 2005 in the Upper Butte Creek model, higher flows were observed, and Figure 12 below shows that when flows at the top of the Upper Butte Creek reach were above about 50 cfs, the model performed well.

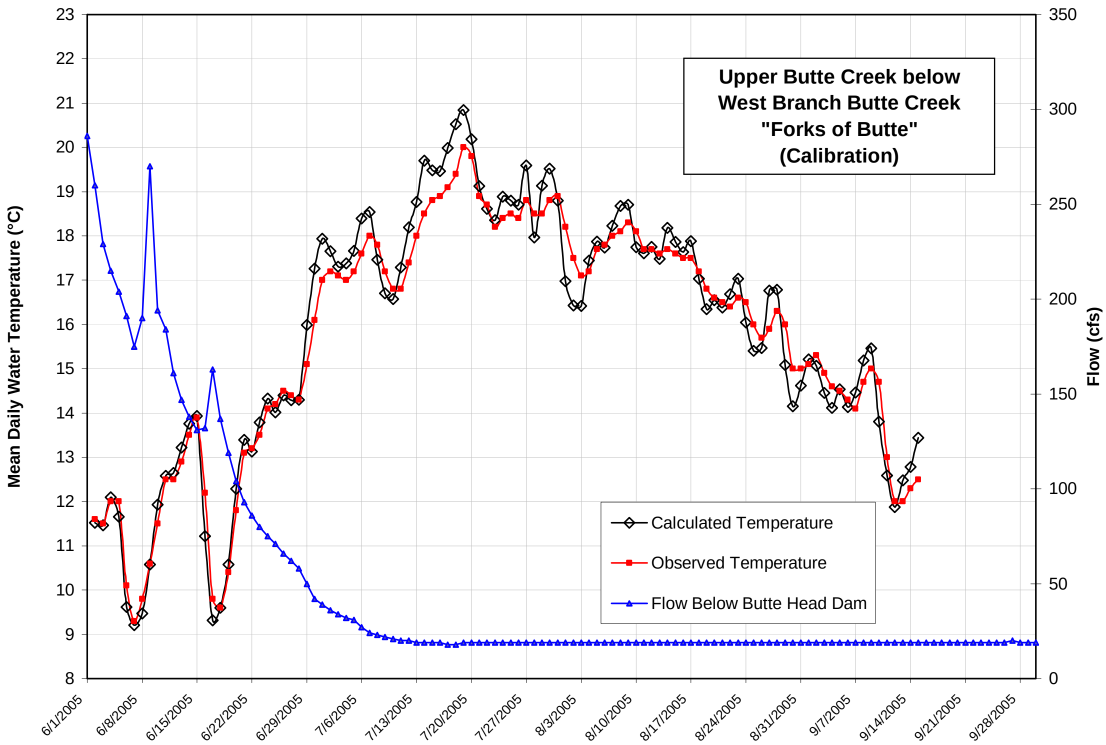


Figure 12. 2005 temperature model predictions at the downstream end of the Upper Butte Creek model compared to flow releases (and spill) from the Butte Head Dam.

After discussion with the Licensee's modeling team on March 26, 2008 we agree that the modelers have tried a variety of reasonable approaches to try to improve the model calibration, given the existing meterology and hydrology data. We agree that the geometry that is included in these river models is probably the cause of this "spiky" model behavior at lower flows. However, we also believe that there may be opportunities to further refine the model geometry, which will likely reduce the model error.

<u>Canal Model:</u>

We also reviewed the Butte Canal model. The geometry in this model was represented simply as a rectangular channel, and this is probably not accurate. A more appropriate width versus flow relationship could be developed. However, the Butte Canal model does a good job predicting water temperatures throughout the summer at Dam release flows of 40-75 cfs. We recognize that there may be a lower limit on the ability of the model to accurately predict temperatures at very low flows, but we have no way to determine a lower limit on the model's range. While we don't have any specific recommendations for changes or limits on this model, we would caution that using this model for predicting water temperatures at flows much below 40 cfs is outside of the range of calibration. The performance of the Butte Creek model during the calibration year, 2005, is shown in Figure 13 below.

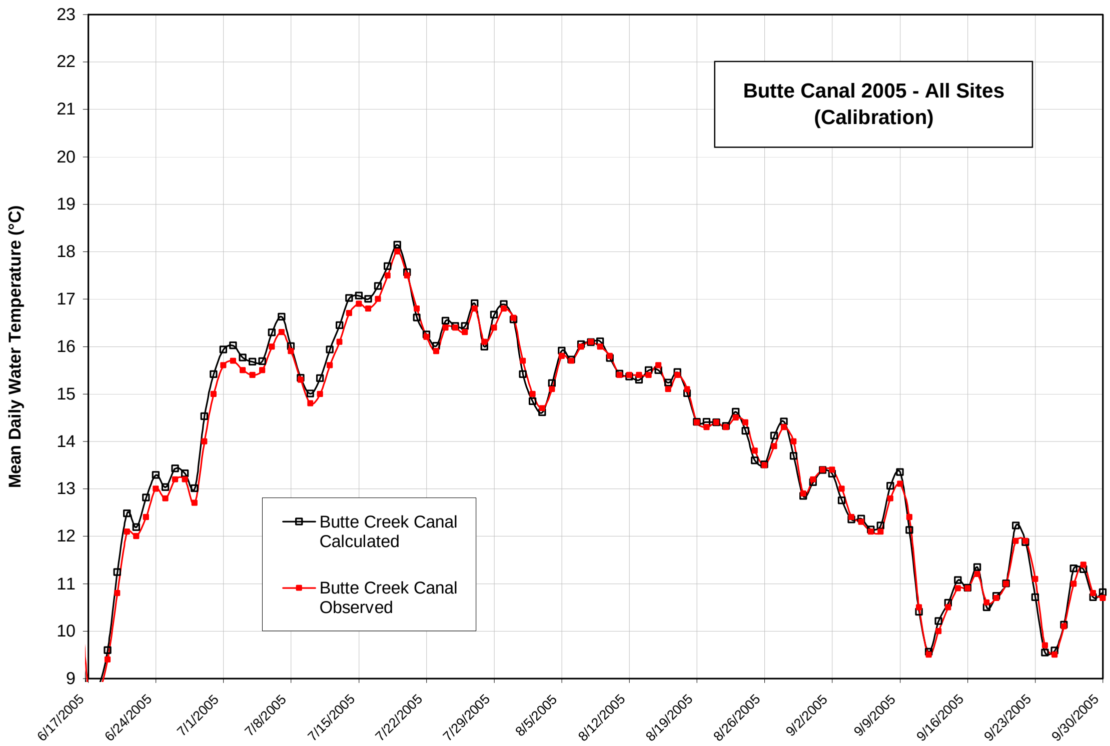


Figure 13. 2005 temperature model predictions at the downstream end of the Butte Canal model.

<u>Recommendations:</u>

Like the W2 models, these models are suitable for use in the relicensing process with certain limitations. These limitations include:

- The models should be used for comparative purposes only (i.e. to compare the difference between operational alternatives);
- The West Branch Feather River model can be used to evaluate scenarios that include Dam release flows above 8 cfs;
- The Upper Butte Creek model can be used to evaluate scenarios that include Dam release flows above 19 cfs.

REFERENCES:

Pacific Gas and Electric Company (PG&E), 2007. License Application, DeSabla-Centerville Hydroelectric Project, FERC Project No. 803, Volume IIA, Exhibit E, October, 2007.

Pacific Gas and Electric Company (PG&E), 2008. Updates to License Application, DeSabla-Centerville Hydroelectric Project, FERC Project No. 803, Volume IIE, Exhibit E, February, 2008.

Attachment 1

United States Department of the Interior

BUREAU OF RECLAMATION
PO Box 25007
Denver, Colorado 80225-0007

TAKE PRIDE® IN AMERICA

IN REPLY REFER TO:

March 17, 2008

86-68220
RES-3.10

Ms. Kathy Turner
Hydroelectric Coordinator, Lassen and Shasta-Trinity National Forest
USDA, Forest Service
Hat Creek Ranger District
P.O. Box 220
Fall River Mills, CA 96028

Subject: Review Comments on CE-QUAL-W2 Models for DeSabla Relicensing Project – Forest Service Agreement No. 08-IA-11050650-016

Dear Ms. Turner:

The staffs of the Denver Technical Service Center Water and Environmental Resources Division have reviewed the CE-QUAL-W2 (W2) flow and temperature models for the DeSable Centerville Relicensing Project provided by March 10, 2008 by Beth Lawson and Bob Hughes of California Department of Fish and Game. If appropriate, please share the enclosed comments with the modelers.

The DeSabla-Centerville Project W2 models are adequate for policy and planning, for defining data gaps and developing data collection plans, for appraisal level studies, and for screening purposes. However, modeling low flow conditions should be limited to sensitivity analysis.

If you have any questions, please call Merlynn Bender at 303-445-2460.

Enclosure

Sincerely,

Merlynn D. Bender

Merlynn D. Bender, P.E., Hydraulic Engineer
Environmental Applications and Research Group
Technical Service Center

cc: Robert W. Hughes, P.E.
Senior Hydraulic Engineer
California Department of Fish and Game
1701 Nimbus Road
Rancho Cordova, CA 95670
(w/encl)

cc: Beth Lawson, P.E.
Associate Hydraulic Engineer
California Department of Fish and Game
1701 Nimbus Road
Rancho Cordova, CA 95670
(w/encl)

Technical Reviewer: **Merlynn D. Bender, P.E., Modeler/Hydraulic Engineer**

Purpose

The primary goal of this independent technical review was to provide feedback on the adequacy of the draft Butte Creek, Centerville Canal, and Hendricks Canal CE-QUAl-W2 model calibrations in support of the DeSabla-Centerville Federal Energy Regulatory Committee (FERC) relicensing project in California.

This review provides recommendations about whether or not the physical representations of the streams are characterized in the models.

The review provides recommendations about which calibration parameters, if any, could be adjusted to improve the temperature model calibrations.

This review determines whether these models can be used for assessing a full range of operational changes to flow timing and magnitude.

This review provides recommendations about an appropriate range of flows (i.e. timing and magnitude) for which these models can be used if the models cannot be used in assessing a full range of operational changes.

Comments are as follows:

Comment 1: (Report organization, readability, and objectives). The January 2008 draft Butte Creek model calibration and scenario report is not complete. The Butte Creek report could use a stand-alone executive summary (or summary section). The modeling objectives and issues considered in calibrating the CE-QUAL-W2 (W2) model should be listed towards the front of the report. Reasons for selecting the CE-QUAL-W2 model over other modeling tools should be listed. For future model simulations, the confident calibration range of flows should be listed for each calibrated model. The primary model calibration objectives appear to be water temperature. Please clarify what this model calibration is to be used for or stress that the model is adequate for flow and temperature sensitivity scenarios for policy and planning decisions yet may need improvements for use in establishing other objectives or answering detailed questions regarding changes in operations at low flows.

Comment 2: (Model calibration). Overall, the Butte Creek CE-QUAL-W2 (W2) water quality model used on the DeSabla-Centerville System simulated measured values to within acceptable calibration tolerances for sensitivity analysis, planning purposes, and appraisal level studies. The models may need more data and calibration/verification for feasibility-level low-flow studies that would include cost estimates for structural or operational alternatives. Overall, water temperature calibrations for the various reaches range from excellent to below average (more than 1 degree C difference) for this difficult-to-model steep geometry. Therefore, the models can be used to predict effects of operational and structural alternatives on water temperature and to analyze flow and water temperature changes over the range of calibration conditions simulated. Simulating outside the calibration range of flows and temperatures or simulating low flow conditions is not recommended. The fully hydrodynamic unsteady flow W2 model is well suited for stratified reservoir dynamic systems that involve hourly variations in flow and water quality due to sharp changes in inflows/outflows caused by peaking power, rapidly changing meteorology, and diurnal variations. However, the W2 model, as well as other models, has difficulty simulating low flows in steep environments. Calibration may need to be improved with additional geometry, adjustments to geometry, and additional input data and minor coefficient adjustment to investigate low flow conditions, or to predict absolute values for potential feasibility studies. The model appears to be robust for all but low flow conditions and should provide a range of flexibility to analyze a range of operational and structural alternatives for investigating the relative differences between scenarios that fall within the calibration ranges. The model is useful for planning, however, all results should be reviewed with caution and carefully interpreted before operational or structural changes are proposed.

Comment 3: (Dry, average, and wet flow data availability). Much flow and temperature data exist for model calibration of the DeSabla-Centerville Project. There appears to be adequate flow, meteorological, and water temperature data to calibrate water temperature to stretch the range of the model for anticipated operational conditions under a range of hydrologic conditions. Hydrologically, 2004 and 2005 cover a range of dry to wet conditions. Therefore, the range of flow conditions is encompassed for all but low flow conditions. The models appear adequate for appraisal level or planning studies involving flows roughly above 1.5 cubic meters per second (cms) (53 cubic feet per second (cfs)). The models are still useful for sensitivity analysis for flows lower than 1.5 cms (53 cfs), however, the confidence is diminished and should be used with caution due to limited model geometry and model limitations for steep reaches.

Comment 4: (Adequacy of geometry). Accurate bathymetric data, riverine riffle-pool representation, and pool volume computations are critical modeling components. Some reaches have minimal or no cross- sectional channel geometry making model calibration difficult. The bathymetry and layout (water bodies, branches, and tributaries) for the system appear adequate. However, the W2 model does not appear to adequately characterize the steep reaches and some pool volumes in those steep reaches. Due to the way in which the geometry is handled with pools spilling into flat bottom reaches, it appears that not all flow conditions, such as low flow conditions, can be handled adequately "with confidence." The physical representations of the streams are not adequately characterized in the models due to a lack of geometric data. This will limit the usefulness of the model results at extreme ranges such as during low flow conditions. However, improving the CE-QUAL-W2 models will be difficult and is not recommended unless additional channel geometry is collected to better characterize the riffles and pools; such data should also improve water travel time predictions.

Comment 5: (Adequacy of input data). The 2004 and 2005 hourly or 15 minute input data sets appear adequate for this dynamic peaking power environment. Some input data which might be used to identify trends or problems with the input data were not included or plotted in the report.

Comment 6: (Water mass balance). The modelers might check the water mass balance for the pools by comparing to measured water surface elevations if that data is available. For relatively small reservoirs, computed water surface elevations should match to within acceptable tolerances (less than a foot difference). Daily inflow and outflow estimates based on a daily mass balance of water should be checked for reservoirs and reaches in the DeSabla-Centerville system.

Comment 7: (CE-QUAL-W2 Model version and changes). The W2 model version 3.2 used for this study appears to be stable without any major computational issues. CE-QUAL-W2 version 3.11a is a well-tested version of the model code that has been used extensively during the last couple of years on many reservoir and riverine calibrations. For the Desablo-Centerville project, a debugged and stable version 3.2 of the W2 model appears to have been used consistently for all the riverine and reservoir reaches. Older or initial 3.2 versions of the W2 model were not as tested and have been reported to have bugs or computational issues under some conditions. The lower Butte Creek model was tested on a recent version 3.5 of the CE-QUAL-W2 model and appears to be stable and produces realistic temperature modeling output. Model changes, such as any necessary modifications to enhance modeling steep reaches, should be documented in the modeling report for this project.

Comment 8: (Water temperature calibration). Overall modeled water temperatures tend to follow observed water temperature trends. However, in some cases the maximum temperatures are several degrees C higher than observed and minimums are several degrees C lower than observed. Timing of the heating peaks and troughs is also off in some cases. Observed heating and cooling patterns tend to lag modeled heating patterns by hours. Also, in some cases, modeled minimum water temperatures are several degrees cooler than observed minimum temperatures when maximum temperatures match. It appears that the model has been conservatively calibrated to maximum temperatures. Steeply modeled reaches tend to result in fast modeled water travel times due to modeled pools being too small resulting in over- and under-heating of passing water. Increasing channel friction may help model calibration during high flows and may minimally change model calibration at low flows. Channel friction tends to vary with depth and flow making it difficult to calibrate a model which does not allow variation in channel friction over the length of a flow-varying simulation. The simple formulation for bed heat transfer in the W2 model does not allow for a rigorous calibration of bed heat retention into the evening hours. However, increasing the sediment ground temperature (TBED) and/or increasing the coefficient of bottom heat exchange (CBHE) may improve the temperature calibration at lower flows. The W2 model coefficients may need to be pushed outside typical ranges to derive the desired temperature calibration.

Comment 9: (Audience): Overall, the report is technical and requires more discussion and explanation for a less technical audience. A summary and additional figures and tables might be beneficial.

Comment 10: (Closeness-of-fit statistics). Modeled water temperatures were compared to observed temperatures using closeness-of-fit statistics after damping out initial conditions providing confidence in the calibration. Calibrations varied seasonally and spatially and covered a range of conditions. The CE-QUAL W2 temperature calibration for this steep geometry will be difficult to improve upon.

Comment 11: (Warm overall temperatures): Due to the relatively warm overall temperatures for cold water species that can occur in this system, there is not much room for modeling error. Results need to be carefully examined at low flow conditions or conditions which could stress aquatic biota. Testing of proposed scenarios with data collection might be proposed before implementing or recommending changes in operations.

Comment 12: (Operational data). To cover extreme rages of flows, operational data or operational modeling output used for scenario development should incorporate many years of hydrologic data as well as recent operational conditions.

Comment 13: (Operational flexibility). Rapidly changing temperatures are likely to stress cold water fish in this relatively warm system. Ramping criteria will likely need to be factored into operational changes.

Comment 14: (W2 control files). The preliminary CE-QUAL-W2 control files for each calibration year modeled were provided electronically for this review. The control files were checked for major errors and compared electronically. No fatal flaws were found.

Comment 15: (Maintaining cool thermal refugia). With the warm temperatures (above 22°C (71.6°F)), cold water species likely are utilizing cooler areas (thermal refugia) and moving when conditions cool. Cold water fish holding in cool spring tributary inflow areas, deep pools, or hiding out on the shady side of a rock are likely already stressed. Changes in flow and temperature must be carefully analyzed. Increasing flow to improve downstream temperatures could blow fish out of a cold water refuge at a critical life stage or time of day. Ecosystems are complicated. Flow and temperature modeling requires a reality check by fishery managers and biologists that are familiar with the riffle/pool geometry, aquatic biota, and distribution of fisheries in the various reaches.

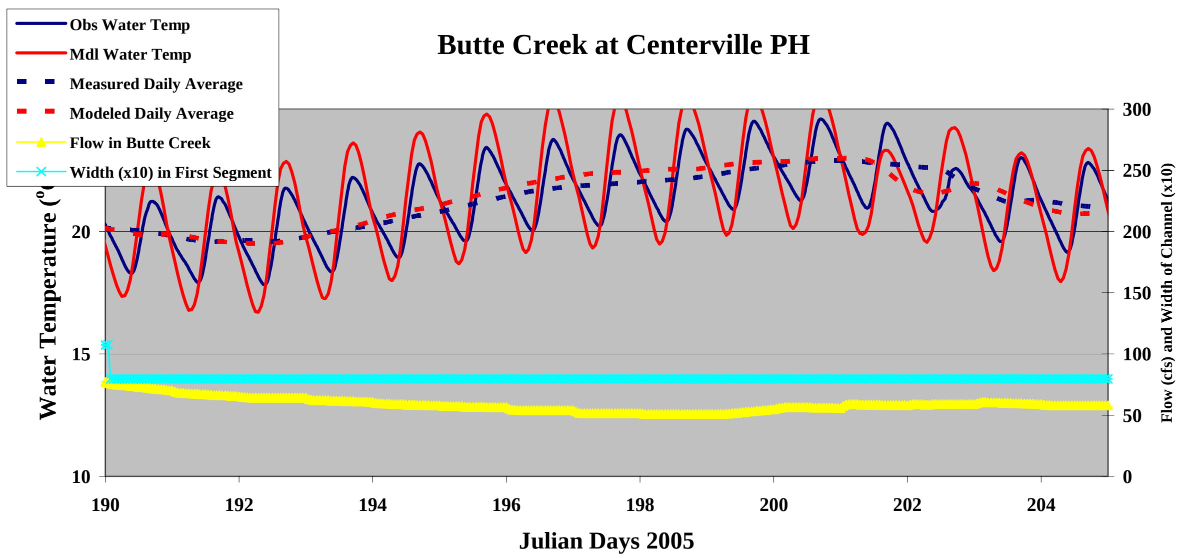
Comment 16: (Bottom line). The current W2 models are extremely useful for sensitivity analysis and planning. However, due to little room for error in this warm system used by anadromous fish, boundaries on the model results interpretation must be set to limit predicting water temperatures at low-flow warm conditions. The model conservatively over-predicts and under-predicts diurnal water temperature fluctuations likely due to limited geometric representation of the steep channel. Therefore, use the model for planning scenarios and test those scenarios in the field under controlled and carefully watched conditions. Also limit the amount of misinformation that can be released to the public due to incorrectly interpreting model results and limit overselling the absolute values predicted by the current models. A combined experience and modeling approach should be used for decision making. The modelers responsible for calibrating the model will need to carefully review recommendations. Fishery managers familiar with the anadromous fishery will need to provide a reality check on recommended operational changes suggested by the modeling.

Additional general comments for Desabla-Centerville Project W2 modeling:

1) The modelers need to be complimented for their extra efforts. This is a difficult steep system to model.
2) If Reclamation review is acknowledged formally, the following could be used: Merlynn D. Bender, United States Department of Interior, Bureau of Reclamation, Technical Service Center, Water and Environmental Resources Division, Environmental Applications and Research Group (86-68220), Denver, Colorado. If that is too lengthy or Reclamation is acknowledged informally, use Merlynn D. Bender (Reclamation).
3) There are several W2 version 3.2 models. Indicate that a more recent and debugged version was used for the modeling. Correct or add an updated version of the following to the reference section:

> Cole, T. A and Wells, S.A., "CE-QUAL-W2: A Two-Dimensional, Laterally Averaged, Hydrodynamic and Water Quality Model, Version 3.2, User Manual," Instruction Report EL-2003-1, Prepared for the U.S. Army Corps of Engineers, US Army Engineering and Research Development Center, Vicksburg, MS, 2004. Legacy versions of the CE-QUAL-W2 model and manuals can be downloaded from the following internet website:
> http://www.ce.pdx.edu/w2/index.html?workshop.html

4) In general, title the tables and figures to stand alone outside the modeling report.
5) Modeling projects are rarely finished and are often abandoned once a desired usefulness is achieved. The DeSabla-Centerville project W2 models are extremely useful for answering questions and planning. Use the models and supplement with data and reality checks.
6) One of the concerns has been that the Butte Creek W2 model over-predicts warm maximum temperatures and under-predicts minimum temperatures as shown in the following draft figure of W2 model results plotted against observed data (received from Beth Lawson, CA F&G, EXCEL spreadsheet 2005 Butte Creek Temp recalibrated2.xls, based on two_95.opt file, March 13, 2008). Spot checking the w2 version 3.2 outputs with W2 vs. 3.5 model outputs showed similar warm maximum temperatures. If recent data and modeling shows a better calibration, similar figures should be produced. Much can potentially be discovered from the following figure that is titled Butte Creek at Centerville PH. More damping is seen in pools than on riffles suggesting that this W2 model is indicative of riffle conditions rather than more pool-like conditions observed in the field. More modeled riffles results in less water travel time in the pools. Diurnally, a riffle will warm and cool to a greater extent. A riffle bed exposed to solar radiation will trap bed heat and warm water flowing over the riffle into the evening hours creating a lag in water temperatures. Of greater concern on the following figure are water temperatures above 22°C (71.6°F) at roughly 1.5 (cms) (53 cfs). Such warm temperatures are too warm for anadromous or cold water fish. There is no room for error if operations under 1.5 cms (53 cfs) are anticipated. Most temperature modeling of steep reaches results in too much diurnal bounce due to modeled pool volumes being too small. The result almost always points to poor geometry used in a model resulting in not capturing the pool volume accurately. Adding pool volume to a steeply modeled reach that over- and under-predicts water temperature due to factors such as bed heat transfer and lag not being modeled accurately might be considered.



7) The following Figure 66 from the draft report, DeSabla-Centerville System Temperature Model: Model Update, by C. Berger, R. Annear, and S. Wells, January 2008 also shows some temperature differences and warm model results. However, overall the patterns track the observed warm temperatures sufficient enough for sensitivity analysis, planning, and appraisal level studies.

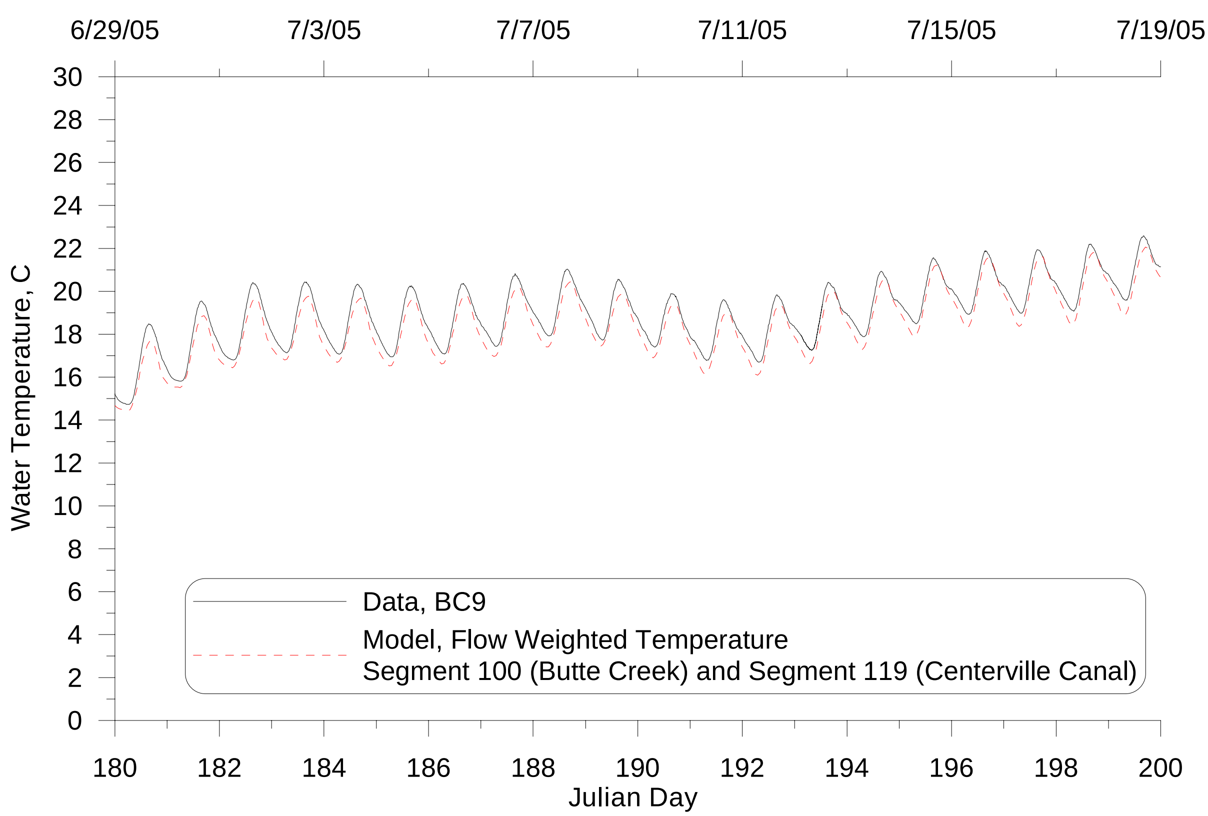


Figure 66: Model predicted water temperatures (flow weighted average from Models 9 and 10) compared with data measured at BC9, June 29th to July 19th, 2005.