APPENDIX D

SUMMARY OF STATE WATER RESOURCES CONTROL BOARD EVALUATIONS

Table 1. The State Water Resource Control Board's 41 Water Temperature Control Measures Assessed before Level 1 in 2007

Measure	Description	Evaluation Method	Evaluation Result	Conclusion	Meets 20°C Objective?
1a	Increase release of cold water from Lake Almanor to Butt Valley Reservoir through closely controlled, selective withdrawal from the Prattville intake by installing a thermal curtain or other device. Also, dredge the lake bottom levees in the Prattville intake area, increase the inflow supply of cooler water into Lake Almanor (to prevent depletion of the hypolimnion), and raise the elevation of the dam/spillway and/or seasonal operating levels of the lake to raise the level of the top of the hypolimnion and increase its overall volume.	Hydraulic model (IIHR 2004) and Review of PG&E's Condition 4.D report	"The most effective elevation of the curtain bottom is 4,455 ft (USGS datum). This configuration (without dredging of the Prattville intake area) provides about 4.4°C and 3.6°C water temperature reduction at the Butt Valley Powerhouse during July and August respectively at its normal operating discharge of 1,600 cfs."	Consider this in further study, but eliminate some of the measures for increasing the inflow supply of cooler water into Lake Almanor and for raising Lake levels.	No
1b	Increase release of cold water from Lake Almanor to the Seneca Reach through selective withdrawal from the existing Canyon Dam outlet. Also, dredge the lake bottom levees in the Prattville intake area	Review of PG&E's Condition 4.D report	"Evaluation of selective operation of the high/low outlet gates by PG&E indicated only a slight benefit was achievable; about 0.1°C cooler in water temperatures in Lake Almanor at the Prattville intake. Such minor water temperature reduction at Prattville intake would not produce measurable water temperature benefits in the Belden, Rock Creek, Cresta and Poe reaches."	Eliminate	No
1c	Increase release of cold water from Lake Almanor to Butt Valley Reservoir through reduced withdrawal from the Prattville intake	PG&E data collected in August 1994 and Review of PG&E's Condition 4.D report	"It is expected that reducing Butt Valley Powerhouse flows to a point that allows selective cold-water withdrawal would result in measurable water temperature reduction to the Belden, Rock Creek, Cresta and Poe reaches. Data collected by PG&E in August 1994 suggests that reduced intake velocities at the Prattville intake and the resulting decrease of Butt Valley Powerhouse	Consider this in further study, but eliminate some of the measures for increasing the inflow supply of cooler water into Lake Almanor and for raising Lake levels.	No

Measure	Description	Evaluation Method	Evaluation Result	Conclusion	Meets 20°C Objective?
			discharge to below 800 cfs will result in selective withdrawal of colder water from Lake Almanor."		
1d	Increase release of cold water from Lake Almanor to the Seneca Reach through increased cold-water releases from Canyon Dam low-level outlet. Also, increase the inflow supply of cooler water into Lake Almanor (to prevent depletion of the hypolimnion) and raise the elevation of the dam/spillway and/or seasonal operating levels of the lake to raise the level of the top of the hypolimnion and increase its overall volume.	Review of PG&E's Condition 4.D report	"Increasing Canyon Dam releases would enhance water temperature reduction in Belden Reservoir, which would benefit all downstream reaches."	Consider this in further study, but eliminate some of the measures for increasing the inflow supply of cooler water into Lake Almanor and for raising Lake levels.	No
2a	Increase release of cold water from Butt Valley Reservoir to Belden Reservoir through preferential use of Caribou Powerhouse No. 1. Also, construct a "crossover" conduit connecting Caribou No. 1 to Caribou No. 2., install a thermal curtain across Butt Valley Reservoir near the Caribou intakes, and raise the elevation of the dam/spillway and/or seasonal operating levels of the reservoir to raise the top of the hypolimnion and its overall volume.	Special operations testing conducted in 2003 and PG&E's Condition 4.D report	"Decreasing water temperature in Belden Forebay from approximately 20°C to 17.5°C would have minimal benefit in water temperature reduction below Cresta Dam and Poe Dam."	Consider this in further study, but eliminate the measure of raising the reservoir water levels.	No
2b	Increase release of cold water from Butt Valley Reservoir to Lower Butt Creek through releases from a new low-level outlet at Butt Valley Dam. Also, install a thermal curtain across Butt Valley Reservoir near the Caribou intakes, and raise the elevation of the dam/spillway and/or seasonal operating levels of the reservoir to raise the top of the hypolimnion and its overall volume.	Exact source is unclear, as this alternative was not derived from PG&E's Condition 4.D report	"Constructing a new low-level outlet at the dam, which would be close to the Caribou No.1 intake, is not necessary because Caribou No.1 already provides a means for delivering cool Butt Valley Reservoir water to Belden Reservoir. This measure is not a necessary water temperature reduction measure."	Eliminate	No
2c	Increase release of cold water from Butt Valley Reservoir to Belden Reservoir by directly conveying Butt Valley	Exact source is unclear, as this alternative was not derived from	"Under this measure, outflow temperature from the Caribou Powerhouse would be the same as the discharge temperature at Butt Valley	Consider this in further study, but eliminate the measure of raising	No

Measure	Description	Evaluation Method	Evaluation Result	Conclusion	Meets 20°C Objective?
	Powerhouse discharge to Caribou No.2 and/or Caribou No.1.	PG&E's Condition 4.D report	Powerhouse. This measure would reduce outflow temperature from Caribou Powerhouse by 1°C to 2°C in July and August under existing intake configurations."	the reservoir water levels.	
3	Reduce warming along the Seneca Reach by increasing shading through planting of vegetation.	Exact source is unclear, as this alternative was not derived from PG&E's Condition 4.D report	"Water temperature modeling tests indicate that, if Canyon Dam release is increased to 80 cfs, by increasing shading by 20 percent (i.e., total shading increases to 64%) warming is only reduced by about 0.4°C. The warming reduction benefit for higher releases at Canyon Dam by increasing streamside shading of the Seneca Reach would be less. In addition, this marginal warming reduction benefit would be muted by relatively high discharges from Caribou Powerhouses. Therefore, this measure would not be an effective water temperature reduction measure."	Eliminate	No
4a	Increase release of cold water to the Belden Reach by increasing release of cold water from Belden Dam outlet/Oak Flat Powerhouse	Review of PG&E's Condition 4.D report	"Water temperature modeling indicates that increased magnitude of water releases from Belden Dam would reduce warming very slightly if the dam release temperature is higher than 19°C. Increasing the magnitude of water releases from Belden Dam from 80 cfs to 200 cfs would reduce warming by about 0.4°C and 0.6°C if dam release temperatures are 18°C and 17°C, respectively"	Consider for further study	No
4b	Increase release of cold water to the Belden Reach by constructing a bypass pipeline to convey cold Seneca Reach flows around Belden Reservoir to the Belden Reach.	Review of PG&E's Condition 4.D report	"Based on observed average mean daily flow and water temperature data in July and August 2002 (dry year), this measure would cool water below Belden Dam by approximately 1.9°C and 3.0°C in July and August, respectively."	Consider for further study	No
4c	Increase release of cold water to the Belden Reach by operating Caribou	July 2003 Caribou special test; 2006	"It is expected that increasing Canyon Dam releases, extending Caribou off-	Consider for further study	No

Measure	Description	Evaluation Method	Evaluation Result	Conclusion	Meets 20°C Objective?
	Powerhouse in strict peaking mode with several hours shut down time to prevent mixing at the Caribou Powerhouse/Seneca confluence and thereby allow cold Seneca Reach flows (enhanced by increasing Canyon Dam releases to the Seneca Reach) to submerge in Belden Reservoir for release to downstream reaches.	North Fork Feather River Special Testing Data Report (Stetson and PG&E 2007)	peak hours, or conveying cold Seneca Reach flows directly to an appropriate plunging location in Belden Reservoir would strengthen the stratification and enhance the benefit. Cold water plunging during Caribou off-peak hours and resulting strengthening of the stratification in Belden Reservoir were verified in the 2006 special test (2006 North Fork Feather River Special Testing Data Report, Stetson and PG&E, March 2007)."		
4d	Increase release of cold water to the Belden Reach by constructing a pipeline to convey cold Seneca Reach flows (enhanced by increasing Canyon Dam releases to the Seneca Reach) to an appropriate plunging location in Belden Reservoir.	Exact source is unclear, as this alternative was not derived from PG&E's Condition 4.D report	"It is expected this measure would strengthen Belden Reservoir stratification and reduce the temperature of Belden Dam water releases to the Belden Reach."	Consider for further study	No
4e-Belden Dam	Increase release of cold water to the Belden Reach by constructing a mechanical water-cooling tower or chiller at a site below Belden Dam.	Review of PG&E's Condition 4.D report	"The amount of water temperature reduction below Belden Dam would depend on the amount of flow delivered to the cooling tower or chiller and the degree of cooling by the cooling tower or chiller."	Consider for further study	No
4e-Belden Adit	Increase release of cold water to the Belden Reach by constructing a mechanical water-cooling tower or chiller at the Belden Adit.	Review of PG&E's Condition 4.D report	"The amount of water temperature reduction below Belden Dam would depend on the amount of flow delivered to the cooling tower or chiller and the degree of cooling by the cooling tower or chiller."	Consider for further study	No
6	Reduce warming of Belden reach by increasing shading through planting of vegetation.	Exact source is unclear, as this alternative was not derived from PG&E's Condition 4.D report. However, water temperature modeling is noted.	"Water temperature modeling indicates that the benefit of increasing shading along the entire Belden Reach would be minimal. This measure would not be an effective water temperature reduction measure."	Eliminate	No

Measure	Description	Evaluation Method	Evaluation Result	Conclusion	Meets 20°C Objective?
7	Reduce warming along the East Branch by increasing shading through planting of vegetation.	Review of PG&E's Condition 4.D report	"Reducing water temperature by 1°C at the mouth of East Branch would reduce water temperature at the lower Belden Reach immediately below the East Branch confluence by about 0.3°C. Any water temperature benefits of streamside vegetation management along the East Branch or its tributaries would be beneficial mostly to the lower Belden Reach, because the much higher discharges from the Belden Powerhouse would mute this temperature benefit once these two discharges mix in Rock Creek Reservoir."	Consider for further study	No
8a	Replace discharge of warm water into the UNFFR from the East Branch with cooler water by collecting and discharging thermally stratified cold water to the NFFR by constructing a new reservoir on the upper East Branch.	Review of PG&E's Condition 4.D report	"PG&E evaluated three potential sites for a new dam and reservoir. However, given the very long travel distance (30 to 40 river miles) and significant warming effect of the East Branch Feather River, cold water released from a new dam would not be expected to result in measurable water temperature changes at the Rock Creek, Cresta and Poe reaches. This measure would not be an effective water temperature reduction measure."	Eliminate	No
8b	Replace discharge of warm water into the UNFFR from the East Branch with cooler water by collecting and discharging thermally stratified cold water to the NFFR by enlarging the existing reservoir on the upper East Branch	Review of PG&E's Condition 4.D report	"PG&E evaluated potential enlargement of the existing Round Valley Dam and Reservoir as the most promising dam for this measure. However, the evaluation concluded that the annual runoff for the Round Valley basin is not large enough to produce the water volume needed to sustain an enlarged reservoir. This finding combined with the finding in 9a leads to the conclusion that enlargement of an existing dam is not an effective water temperature reduction measure."	Eliminate	No

Measure	Description	Evaluation Method	Evaluation Result	Conclusion	Meets 20°C Objective?
9	Replace discharge of warm water into the UNFFR from the East Branch with cooler water by purchasing water rights and transferring the water rights to instream use or changing the point of diversion to below Oroville thereby causing cooler inflows into the UNFFR by preventing the warming effect of diversions and return flows along the East Branch above the confluence.	Exact source is unclear, as this alternative was not derived from PG&E's Condition 4.D report	"Reducing 1°C of water temperature at the mouth of East Branch from this measure would reduce water temperature at the lower Belden Reach by 0.3°C. Little information is available on the effects of diversions and return flows on warming along the East Branch. Extensive study would be required to evaluate the effectiveness of this measure."	Eliminate	No
10	Reduce temperature of East Branch inflows to the NFFR by stream channel restoration efforts in the upper East Branch watershed.	Plumas County Project 2105 EIR Scoping Comments (Appendix D of the Levels 1 and 2 Report)	"Application of a simple mass balance equation to assess the preservation capability for flow and temperature contributions from treated headwater streams shows that benefits are overwhelmed by East Branch conditions with no measurable improvement at the confluence of the NFFR. This measure should be appreciated for its off-site potential, but removed from further evaluation in the NFFR alternatives screening."	Eliminate	No
11a	Increase release of cold water to the Rock Creek Reach by increasing release of cold water from Rock Creek Dam	Review of PG&E's Condition 4.D report	"Water temperature modeling tests indicate that the warming reduction benefit by increasing the magnitude of water releases at Rock Creek Dam is more measurable if the dam release temperature is lower than 20°C"	Consider for further study	No
11b	Increase release of cold water to the Rock Creek Reach by constructing a new reservoir on the upper Yellow Creek to collect and discharge thermally stratified cold water to the UNFFR/Rock Creek Reservoir.	Review of PG&E's Condition 4.D report	"Constructing a reservoir on the upper Yellow Creek or its tributaries to produce stratified cold water is not expected to improve temperature conditions beyond existing. This measure is not an effective water temperature reduction measure."	Eliminate	No
11c	Increase release of cold water to the Rock Creek Reach by constructing a bypass pipeline to convey cold Yellow Creek/Chips Creek flows around Rock Creek Reservoir to the Rock Creek Reach.	Review of PG&E's Condition 4.D report; water temperature data for July and August 2002	"Based on observed average mean daily flow and water temperature data in July and August 2002 (dry year), this measure would cool water below Rock Creek Dam by about 1.6°C and 1.8°C in July and August, respectively."	Consider for further study	No

Measure	Description	Evaluation Method	Evaluation Result	Conclusion	Meets 20°C Objective?
11d	Increase release of cold water to the Rock Creek Reach by constructing a mechanical water-cooling tower or chiller at the site of PG&E's Rogers Flat Station for discharge to the Rock Creek Reach	Review of PG&E's Condition 4.D report	"The amount of water temperature reduction below Rock Creek Dam depends on the amount of flow delivered to the cooling tower or chiller and the degree of cooling by the cooling tower or chiller"	Consider for further study	No
11e	Increase release of cold water to the Rock Creek Reach by constructing a bifurcation berm/wall/partition within Yellow Creek channel and upstream of Rock Creek Reservoir to separate Yellow Creek flows from Belden Powerhouse discharges and Belden Reach flows, thereby preventing mixing and thus allowing cooler Yellow Creek flows to submerge in Rock Creek Reservoir for release to downstream reaches. Also, dredge a submerged channel in Rock Creek Reservoir and construct low-level outlet at Rock Creek Dam.	Exact source is unclear, as this alternative was not derived from PG&E's Condition 4.D report	"It would be expected that the stratification in Rock Creek Reservoir could be strengthened by constructing a bifurcation berm/wall/partition within Yellow Creek channel and upstream of Rock Creek Reservoir to separate Yellow Creek flows from Belden Powerhouse discharges and Belden Reach flows...to prevent mixing and thereby allow cooler Yellow Creek flows to submerge in Rock Creek Reservoir."	Consider for further study	No
11f	Increase release of cold water to the Rock Creek Reach by constructing a bypass pipeline to convey cold Yellow Creek flows directly to an appropriate plunging location in Rock Creek Reservoir. Also, construct a low-level outlet at Rock Creek Dam.	2006 North Fork Feather River Special Testing Data Report (Stetson and PG&E 2007)	Similar evaluation as for 11e with the bifurcation	Consider for further study	No
12	Increase release of cold water to the lower Rock Creek Reach by increasing release of cold water to the Rock Creek Reach from Lower Bucks Lake/Bucks Creek.	Review of PG&E's Condition 4.D report	"Increasing release of cold water from either the Bucks Creek Powerhouse or Lower Bucks Lake/Bucks Creek would be beneficial primarily to the lower Rock Creek Reach, because much higher discharges from the Rock Creek Powerhouse would mute this temperature benefit once these two discharges mix in Cresta Reservoir."	Consider for further study	No
13	Reduce warming of Rock Creek reach by increasing shading through planting of vegetation.	Exact source is unclear, as this alternative was not derived from PG&E's Condition	"Water temperature modeling indicates that, if totalshading of the Rock Creek Reach was increased to 50%, warming would be reduced by about 0.5°C for the existing dam release temperature	Consider for further study	No

Measure	Description	Evaluation Method	Evaluation Result	Conclusion	Meets 20°C Objective?
		4.D report. However, water temperature modeling is noted.	condition. Warming reduction would be more significant for lower release temperatures from Rock Creek Dam."		
14a	Increase release of cold water to the Cresta Reach by increasing release of cold water from Cresta Dam.	Review of PG&E's Condition 4.D report	"Water temperature modeling tests indicate that the warming reduction benefit by increasing the magnitude of water releases at Cresta Dam is more measurable if the dam release temperature is lower than 20°C."	Consider for further study	No
14b	Increase release of cold water to the Cresta Reach by increasing release of cold water to the Cresta Reach from Grizzly Forebay / Grizzly Creek.	Exact source is unclear, as this alternative was not derived from PG&E's Condition 4.D report	"Preliminary water temperature modeling indicates that this warming could be reduced by about 3.0°C if water releases at Grizzly Dam were increased to 100 cfs."	Consider for further study	No
14c	Increase release of cold water to the Cresta Reach by constructing a bypass pipeline to convey cold Buck Creek Powerhouse flows around Cresta Reservoir to the Cresta Reach.	Review of PG&E's Condition 4.D report	"Based on observed average mean daily flow and water temperature data in July and August 2002 (dry year), this measure would cool water below Cresta Dam by about 1.6°C and 3.0°C in July and August, respectively."	Consider for further study	No
14d	Increase release of cold water to the Cresta Reach by constructing a pipeline to convey all or a portion of the cold Buck Creek Powerhouse flows directly into Cresta Reservoir thereby avoiding mixing with Rock Creek flows thus allowing the cold Buck Creek Powerhouse flows to submerge in Cresta Reservoir for release to downstream reaches. Also, construct a submerged channel in Cresta Reservoir and construct a low-level outlet at Cresta Dam.	2006 North Fork Feather River Special Testing Data Report (Stetson and PG&E 2007)	With the additions implemented as noted, "constructing a low-level outlet at Cresta Dam would provide access to the cooler water in the reservoir bottom."	Consider for further study	No
14e	Increase release of cold water to the Cresta Reach by constructing a mechanical water-cooling tower or chiller below Cresta Dam	Review of PG&E's Condition 4.D report	"The amount of water temperature reduction below Cresta Dam would depend on the amount of flow delivered to the cooling tower or chiller and the degree of cooling by the cooling tower or chiller."	Consider for further study	No

Measure	Description	Evaluation Method	Evaluation Result	Conclusion	Meets 20°C Objective?
15	Reduce warming of Cresta reach by increasing shading by planting vegetation.	Exact source is unclear, as this alternative was not derived from PG&E's Condition 4.D report. However, water temperature modeling is noted.	"Water temperature modeling indicates that the benefit of increasing Cresta Reach shading from existing 30% to 60% would be a reduction in warming by about 0.5°C."	Consider for further study	No
16a	Increase release of cold water to the Poe Reach by increasing release of cold water from Poe Dam	Review of PG&E's Condition 4.D report	"The amount of reduction in warming is related to Poe Dam release water temperature and the rate of release."	Consider for further study	No
16b	Increase release of cold water to the Poe Reach by releasing water to the Poe Reach directly from the Poe Adit	Review of PG&E's Condition 4.D report	"This measure would provide water temperature benefits to the lower Poe Reach below Bardees Bar."	Consider for further study	No
16c	Increase release of cold water to the Poe Reach by constructing a mechanical water-cooling tower or chiller below Poe Dam	Review of PG&E's Condition 4.D report	"The amount of water temperature reduction below Poe Dam would depend on the amount of flow delivered to the cooling tower or chiller and the degree of cooling by the cooling tower or chiller."	Consider for further study	No
17	Reduce warming of Poe reach by increasing shading through planting of vegetation.	Exact source is unclear, as this alternative was not derived from PG&E's Condition 4.D report. However, water temperature modeling is noted.	"Water temperature modeling indicates that increasing total shading of the Poe Reach to 50% would reduce warming by about 0.8°C. Warming reduction would be more significant for lower release temperatures from Poe Dam."	Consider for further study	No
18	Increase release of cold water to all reaches by discharging cold water to the reaches from water wells that are drilled into adjacent rock and intercept and produce from fractures containing large volumes of cold water.	Review of PG&E's Condition 4.D report	"The cooling requirement would require numerous very productive cold-water wells at each dam. According to PG&E, existing geologic information and well driller's data demonstrate that it is not likely that an adequate aquifer exists near the dams. Extensive field investigation would be required to evaluate the feasibility of this measure."	Eliminate	No

Measure	Description	Evaluation Method	Evaluation Result	Conclusion	Meets 20°C Objective?
19	Increase release of cold water to all reaches by discharging cold water to the reaches from a pipeline that conveys cold water pumped from Lake Oroville.	Review of PG&E's Condition 4.D report	"This measure would cool water by approximately 3°C below each dam. The cooling requirement would require a large diameter pipeline, several large pumping stations, and a substantial amount of electrical power to operate the pumping stations."	Consider for further study	No

Notes: cfs = cubic feet per second; NFFR = North Fork Feather River; UNFFR = Upper North Fork Feather River.
Source: Stetson's Levels 1 and 2 Report, Appendix C (2007)

Table 2. The State Water Resource Control Board's Water Temperature Control Measures Assessed in Level 1 and 2 in 2007

Measure	Description	Evaluation Method	Evaluation Result	Conclusion	Meets 20°C Objective?
1	Reduce the temperature in Belden Forebay to 12.5ºC by installing a thermal curtain at Prattville intake, pumping collected spring flows to the intake, and conveying Butt Valley Powerhouse discharges by pipeline to Butt Valley Reservoir near Caribou Powerhouse intake.	Level 1	SWB eliminated at Level 1 because this alternative involves pumping cold water from the Lake Almanor springs and insufficient hydrogeology information is available.	Eliminate at Level 1	NA
2a	Reduce the temperature in Belden Forebay to 14.5ºC by installing a thermal curtain at Prattville intake and conveying Butt Valley Powerhouse discharges by pipeline to Butt Valley Reservoir near Caribou Powerhouse intake, with one additional temperature reduction measure for the Poe Reach.	Level 1 and 2	SWB eliminated at Level 2 for constructability, cost, and logistical reasons.	Eliminate at Level 2	NA
2b	Reduce the temperature in Belden Forebay to 14.5ºC by installing a thermal curtain at Prattville intake and a thermal curtain near Caribou Powerhouse intake in Butt Valley Reservoir and pumping collected spring flows to the Prattville intake, with one additional temperature reduction measure for the Poe Reach.	Level 1	SWB eliminated at Level 1 because this alternative involves pumping cold water from the Lake Almanor springs and insufficient hydrogeology information is available.	Eliminate at Level 1	NA
2c	Reduce the temperature in Belden Forebay to 14.5ºC by significantly decreasing release of water from Lake Almanor to Butt Valley Reservoir through reduced withdrawal from the Prattville intake and	Level 1, 2, and 3	SWB eliminated at Level 3 because this alternative would restrict water delivery to the downstream powerhouses.	Eliminate at Level 3 (Stetson 2009 study)	NA

Measure	Description	Evaluation Method	Evaluation Result	Conclusion	Meets 20°C Objective?
	increased release from Canyon Dam, with one additional temperature reduction measure for the Poe Reach.				
3	Reduce the temperature in Belden Forebay to 16.0ºC by installing a thermal curtain at Prattville intake and a thermal curtain at Butt Valley Reservoir near Caribou Powerhouse intake and increasing Canyon Dam release as needed, with additional temperature reduction measures for the lower Belden, Cresta and Poe reaches.	Level 1, 2, and 3	Rock Creek reach temperatures reduced from baseline by approximately 0.8 to 2.7°C and Cresta water temperatures approximately 1.1 to 2.5°C (estimated from available data in the Level 3 report).	Viable option for UNFFR	No
4a	Reduce the temperature in Belden Forebay to 18.0ºC by installing a thermal curtain at Prattville intake and a thermal curtain at Butt Valley Reservoir near Caribou Powerhouse intake, with additional temperature reduction measures along the lower Belden, Rock Creek, Cresta, and Poe reaches.	Level 1, 2, and 3	Rock Creek reach water temperatures reduced from baseline by approximately 0.4 to 2.3°C and Cresta water temperatures approximately 0.6 to 1.9°C (estimated from available data in the Level 3 report).	Viable option for UNFFR	No
4b	Reduce the temperature in Belden Forebay to 18.0ºC by installing a thermal curtain at Prattville intake and preferentially operating Caribou Powerhouse No. 1 over No 2., with additional temperature reduction measures along the lower Belden, Rock Creek, Cresta, and Poe reaches.	Level 1, 2, and 3	Rock Creek reach water temperatures reduced from baseline by approximately 0.5 to 2.5°C and Cresta water temperatures approximately 0.6 to 2.3°C (estimated from available data in the Level 3 report).	Viable option for UNFFR	No
4c	Reduce the temperature in Belden Forebay to 18.0ºC by increasing Canyon Dan releases and preferentially operating Caribou Powerhouse No. 1 over No 2., with additional temperature reduction measures along the lower Belden, Rock Creek, Cresta, and Poe reaches.	Level 1, 2, and 3	Rock Creek reach water temperatures reduced from baseline by approximately 1 to 4.1°C and Cresta water temperatures approximately 1.6 to 3.9°C (estimated from available data in the Level 3 report).	Viable option for UNFFR	No
5a	Reduce the temperature in Belden Forebay to 19.5ºC by preferential use of Caribou Powerhouse No.1 plus any needed increased releases from Canyon Dam, and additional temperature reduction measures along all downstream reaches.	Level 1, 2, and 3	SWB eliminated at Level 3 because results showed limited water temperature reduction in Belden and “required intensive water temperature reduction measures in the Rock Creek, Cresta, and Poe reaches."	Eliminate at Level 3 (Stetson 2009 study)	NA
5b	This alternative is similar to 5a, except that the measure of preferential use of Caribou Powerhouse No. 1 is replaced by installing a thermal curtain near Caribou Powerhouse intake.	Level 1, 2, and 3	SWB eliminated at Level 3 because results showed limited water temperature reduction in Belden and “required intensive water temperature reduction measures in the Rock Creek, Cresta, and Poe reaches."	Eliminate at Level 3 (Stetson 2009 study)	NA

Measure	Description	Evaluation Method	Evaluation Result	Conclusion	Meets 20°C Objective?
5c	This alternative is similar to 5a, except that the measure of preferential use of Caribou Powerhouse No. 1 is replaced by conveying Butt Valley Powerhouse discharges by pipeline to Butt Valley Reservoir near Caribou Powerhouse intakes.	Level 1 and 2	SWB eliminated at Level 2 for constructability, cost, and logistical reasons.	Eliminate at Level 2	NA
6a	Reduce temperatures in all downstream reaches by increasing Canyon Dam cold water release from the low-level outlet and bypassing this cold water to all downstream reaches.	Level 1 and 2	SWB eliminated at Level 2 for constructability, cost, and logistical reasons.	Eliminate at Level 2	NA
6b	Reduce temperatures in all downstream reaches (except for the Belden Reach) by constructing a mechanical cooling tower/chiller at each dam.	Level 1 and 2	SWB eliminated at Level 2 for constructability, cost, and logistical reasons. This alternative also involved installing a chiller within a 100-year floodplain (logistical, scenic and safety issues).	Eliminate at Level 2	NA
6c	Reduce temperatures in all downstream reaches by discharging cold water to the reaches from a delivery system that conveys cold water pumped from Lake Oroville.	Level 1	SWB eliminated at Level 1 because this alternative involves pumping cold water up from Lake Oroville, and there are cost/logistical issues.	Eliminate at Level 1	NA

Notes: cfs = cubic feet per second; SWB = State Water Resources Control Board.
Source: Stetson's Level 1 and 2 Report (2007)

Table 3: The State Water Resource Control Board's Additional Water Temperature Control Measures Assessed in Level 3 in 2009

Measure	Description	Evaluation Method	Evaluation Result	Conclusion	Meets 20°C Objective?
3x	Reduce the temperature in Belden Forebay to 16.0ºC by installing a thermal curtain at Prattville intake and preferentially operating Caribou No. 1 over Caribou No. 2, increasing Canyon Dam release to 600 cfs, with additional temperature reduction measures for the lower Belden, Cresta and Poe reaches.	Level 1, 2, and 3	In Rock Creek Reach and Cresta reaches, water temperatures are reduced from baseline by approximately 3.5°C (based on 50th percentile exceedance case). "The highest ranked alternative (Alternative 3x) could reduce the mean daily water temperature by about 5.9°C in July and 4.3°C in August on average at the upstream end of Belden Reach over the 19-year analysis period (1984–2002), and by about 2.0°C in July and 1.6°C in August at the downstream end of Poe Reach."	Viable option for UNFFR	No
3a	Reduce the temperature in Belden Forebay to 16.0ºC by installing a thermal curtain at Prattville intake and a thermal curtain at Butt Valley Reservoir near Caribou Powerhouse intake, with additional temperature reduction measures for the lower Belden, Cresta and Poe reaches.	Level 1, 2, and 3	In Rock Creek Reach and Cresta reaches, water temperatures are reduced from baseline by approximately 1-2°C.	Viable option for UNFFR	No
4d	Reduce the temperature in Belden Forebay to 18.0ºC by installing a thermal curtain near the Caribou Nos. 1 and 2 intakes in Butt Valley Reservoir, with additional temperature reduction measures along the lower Belden, Rock Creek, Cresta, and Poe reaches.	Level 1, 2, and 3	Rock Creek reach water temperatures reduced from baseline by approximately 1 to 3.6°C and Cresta water temperatures approximately 1.3 to 3.3°C (estimated from available data in the Level 3 report).	Viable option for UNFFR	No

Notes: cfs = cubic feet per second
Source: Stetson's Level 3 Report (2009)

Table 4. The State Water Resource Control Board's Additional Water Temperature Control Measures Assessed in the Supplemental Modeling Report in 2012

Measure	Description	Evaluation Method	Evaluation Result	Conclusion	Meets 20°C Objective?
Combination 1	Thermal curtains at both Prattville and Caribou intakes and modified Canyon Dam flows up to 250 cfs from June 16 through September 15 (without removal of submerged levees near Prattville intake).	Water temperature modeling assessments consistent with those in Level 3	Rock Creek reach water temperatures reduced from baseline by approximately 0.7 to 2.5°C and Cresta water temperatures approximately 1.1 to 2.3°C (*estimated from available data in the 2012 supplemental modeling study report*).	Viable option for UNFFR	No
Combination 2	Thermal curtains at both Prattville intake and Caribou intakes (without removal of submerged levees near Prattville intake).	Water temperature modeling assessments consistent with those in Level 3	Rock Creek reach water temperatures reduced from baseline by approximately 0.5 to 2.1°C and Cresta water temperatures approximately 0.7 to 2.0°C (*estimated from available data in the 2012 supplemental modeling study report*).	Viable option for UNFFR	No
Notes: cfs = cubic feet per second **Source:** Stetson's Supplemental Modeling Report (2012)					

Table 5. The State Water Resource Control Board's Additional Water Temperature Control Measures Assessed in the Supplemental Modeling Report in 2016

Measure	Description	Evaluation Method	Evaluation Result	Conclusion	Meets 20°C Objective?
Alternative 1	Proposed Project plus implementation of thermal curtains at both Prattville and Caribou intakes (without removal of submerged levees near Prattville intake) and release of 250 cfs from Canyon Dam from June 16 to September 15.	Water temperature modeling assessments consistent with those in Level 3	Rock Creek reach water temperatures reduced from baseline by approximately 0.3 to 2.5°C and Cresta water temperatures approximately 1.1 to 2.3°C (*estimated from available data in the 2016 supplemental modeling study report*).	Viable option for UNFFR	No
Alternative 2	Proposed Project plus implementation of thermal curtains at both Prattville and Caribou intakes (without removal of submerged levees near Prattville intake).	Water temperature modeling assessments consistent with those in Level 3	Rock Creek reach water temperatures reduced from baseline by up to approximately 2.0°C and Cresta water temperatures by approximately 0.6 to 1.9°C (*estimated from available data in the 2016 supplemental modeling study report*).	Viable option for UNFFR	No
Alternative 3	Proposed Project plus stand-alone release of 250 cfs from Canyon Dam from June 16 to September 15.	Water temperature modeling assessments consistent with those in Level 3	Rock Creek reach water temperatures reduced from baseline by approximately 0.4 to 1.2°C and Cresta water temperatures approximately 0.5 to 1.1°C (*estimated from available data in the 2016 supplemental modeling study report*).	Viable option for UNFFR	No

Notes: cfs = cubic feet per second
Source: Stetson's Supplemental Modeling Report (2016)