SPRING RIVERS

ECOLOGICAL SCIENCES, LLC

Rock Creek-Cresta 2008 Water Temperature Monitoring Results

(ERC Review Draft)

Rock Creek-Cresta Hydroelectric Project

FERC Project No. 1962

February 2009

Prepared for:

PACIFIC GAS AND ELECTRIC COMPANY

Technical Project Support—Environmental Services

3401 Crow Canyon Road

San Ramon, California 94583

Prepared by:

Timothy Sagraves

14200 Deerwood Drive

Red Bluff, CA. 96080

(530) 529-2315

SPRING RIVERS ECOLOGICAL SCIENCES, LLC

Post Office Box 153

Cassel, California 96016

(530) 335–5446 ♦ fax (530) 335–4591

TABLE OF CONTENTS

	Page
1 INTRODUCTION	1-1
1.1 BACKGROUND	1-1
1.2 PROJECT SETTING	1-2
2 STUDY DESIGN	2-1
2.1 MONITORING PROGRAM	2-1
2.1.1 Monitoring Network	2-1
2.2 METHODOLOGY	2-1
2.2.1 Flow Monitoring	2-1
2.2.2 Meteorological Monitoring	2-6
2.2.3 Temperature Monitoring	2-6
3 2008 MONITORING RESULTS	3-1
3.1 HYDROLOGY AND METEOROLOGY	3-1
3.1.1 Stream Flow and Reservoir Operation	3-1
3.1.1.1 Lake Almanor and Tributaries	3-5
3.1.1.2 Butt Valley Reservoir and Tributaries	3-8
3.1.1.3 Seneca Reach of the NFFR and Tributaries	3-10
3.1.1.4 Belden Forebay and Caribou Powerhouse complex	3-12
3.1.1.5 Belden Reach of the NFFR and Tributaries	3-14
3.1.1.6 Rock Creek Reach of the NFFR and Tributaries	3-16
3.1.1.7 Cresta Reach of the NFFR and Tributaries	3-20
3.1.2 Meteorology	3-22
3.1.2.1 2008 Regional Precipitation	3-22
3.1.2.2 2008 Monitoring at Prattville Intake and Rock Creek Dam	3-23
3.2 WATER TEMPERATURE	3-26
3.2.1 2008 Monitoring	3-26
3.2.1.1 Lake Almanor and Tributaries	3-33
3.2.1.2 Butt Valley Reservoir and Tributaries	3-41
3.2.1.3 Seneca Reach of the NFFR	3-46
3.2.1.4 Lower Butt Creek	3-48
3.2.1.5 Belden Forebay and Caribou Powerhouse Complex	3-49

TABLE OF CONTENTS
(Continued)

Page

3.2.1.6 Belden Reach of the NFFR and Tributaries 3-52
3.2.1.7 Rock Creek Reach of the NFFR and Tributaries 3-56
3.2.1.8 Cresta Reach of the NFFR and Tributaries 3-63
3.2.1.9 Middle Fork of the Feather River at Milsap Bar 3-66
3.2.2 Special Evaluations 3-67
3.2.2.1 Temperature Mitigation Operations at Caribou Complex Powerhouses 3-67
3.2.2.2 Performance of Telemetry Station 3-68
3.2.3 Comparison of MWAT and MWMT Calculations 3-69
3.3 COMPARISON OF ANNUAL RESULTS 3-70
3.3.1 Comparative Summary of Monitoring Results 3-70
4 REFERENCE 4-1
5 APPENDIX A - SUMMARY OF FLOW MEASUREMENTS 5-1
6 APPENDIX B - SUMMARY OF HOURLY TEMPERATURE DATA 6-1
7 APPENDIX C – SUMMARY OF PROFILE DATA FROM LAKE ALMANOR AND BUTT VALLEY RESERVOIR 7-1
8 APPENDIX D – SUMMARY OF STAGE-FLOW RATINGS AND APPLIED SHIFTS 8-1

LIST OF FIGURES

Figure		Page
1-1	Regional Location of Study Area	1-4
2-1	Map of Station Locations Used During the 2008 Monitoring Program	2-9
3-1	Comparison of daily average flow at stations tributary to Lake Almanor – 2008	3-85
3-2	Lake Almanor average daily storage and elevation – 2008.	3-86
3-3	Comparison of daily average flow at select stations in the upper NFFR Project – 2008	3-87
3-4	Butt Valley Reservoir average daily storage and elevation – 2008.	3-89
3-5	Comparison of daily average flow at Rock Creek-Cresta Project powerhouses – 2008	3-90
3-6	Comparison of daily average temperature at stations tributary to Lake Almanor – 2008	3-91
3-7	Comparison of mean daily temperatures from two depths in Lake Almanor near the Canyon Dam Intake – 2008	3-92
3-8	Comparison of monthly profiles from Lake Almanor (LA1) for the period June through September 2008	3-93
3-9	Longitudinal thermal structure present at four stations in Lake Almanor – 2008.	3-94
3-10	Comparison of daily average temperature at stations tributary to Butt Valley Reservoir –2008.	3-97
3-11	Comparison of monthly profiles from Butt Valley Reservoir (BV2-A) for the period June through September 2008.	3-98
3-12	Longitudinal thermal structure present at three stations in Butt Valley Reservoir – 2008.	3-99
3-13	Comparison of mean daily temperatures from two depths in Butt Valley Reservoir near Caribou No. 1 Intake – 2008	3-102
3-14	Comparison of daily average temperatures in the Seneca Reach – 2008	3-103
3-15	Daily average temperatures in lower Butt Creek – 2008	3-104
3-16	Comparison of daily average temperatures from the Caribou Powerhouse/Belden Forebay complex – 2008.	3-105
3-17	Comparison of daily average temperatures in the upper Belden Reach – 2008	3-106
3-18	Comparison of daily average temperatures in the lower Belden Reach – 2008	3-107
3-19	Comparison of daily average temperatures from stations in the upper Rock Creek Reach – 2008	3-108

LIST OF FIGURES

Figure **Page**

3-20 Comparison of daily average temperatures from stations in the lower Rock Creek Reach – 2008..... 3-109

3-21 Comparison of daily average temperatures from river stations in the Cresta Reach – 2008..... 3-110

3-22 Comparison of daily average temperatures in streams tributary to the Cresta Reach – 2008..... 3-111

3-23 Comparison of daily average temperatures from Middle Fork Feather River at Milsap Bar with selected NFFR stations – 2008..... 3-112

LIST OF TABLES

Table **Page**

2-1. Description of water resource monitoring stations – 2008 2-2

3-1. Summary of June-September 2008 stream flow monitoring at permanent and temporary stations 3-2

3-2. Summary of 2008 precipitation data from meteorological stations in the NFFR watershed 3-24

3-3. Summary of 2008 meteorological data from Prattville Intake and Rock Creek Dam stations 3-27

3-4. Summary of daily average temperatures from the NFFR - 2008 temperature monitoring program 3-28

3-5. Comparison of 2008 daily average data with 20°C level 3-34

3-6. Comparison of three temperature indices from select stations in 2008 3-71

3-7. Comparison of 2008 temperature data with previous years monitoring information 3-72

1 INTRODUCTION

1.1 BACKGROUND

North Fork Feather River (NFFR) water temperatures in the Rock Creek and Cresta (RCC) reaches reflect a combination of the water temperature delivered from the upstream Upper NFFR Project (Federal Energy Regulatory Commission [FERC] 2105), flows from the unregulated East Branch of NFFR (EBNFFR) and other tributaries, flow released from Bucks Creek Project (FERC 619), and the diversions within the reaches of the Rock Creek-Cresta Project (Project). The temperature of water from FERC 2105 is primarily determined by conditions at the non-selective Prattville Intake in Lake Almanor. Pursuant to FERC Condition 4C of the Project License (issued October 24, 2001), temperature monitoring is required during the summer months to determine if and to what extent the 20°C daily mean temperature level can be met with reasonable control measures.

The RCC Hydroelectric Project FERC License No. 1962 required Pacific Gas and Electric Company (PG&E or Licensee) to file a water temperature monitoring plan with FERC, which described the implementation (including a schedule for implementation) of the water temperature monitoring program described in Condition No. 4C of the Project License. The RCC water temperature monitoring plan was prepared in consultation with the RCC Ecological Resource Committee (ERC) and the Forest Service (FS) and was

implemented in June 2002. The 2008 monitoring effort was the 7th year (or the second year as defined in the 2nd 5-year minimum flow period) after the issuance of FERC 1962 License (issued October 24, 2001).

The objective of the water temperature monitoring program is to:

1. *Document summer water temperatures and flows in the Rock Creek and Cresta reaches as well as in upstream drainages tributary to the Project.*
2. *Install and monitor continuous temperature recorders at two telemetry stations installed at flow gaging stations in the Rock Creek and Cresta reaches.*
3. *Determine if mean daily water temperatures of 20°C or less can be met in the Rock Creek and Cresta reaches to the extent that Licensee can reasonably control such temperatures, particularly if a modified Prattville Intake is implemented.*

This report documents the results and subsequent analysis of the 2008 monitoring program.

1.2 PROJECT SETTING

The Licensee's NFFR Projects (FERC 2105 and FERC 1962) are located on the NFFR watershed in northeastern California (see Figure 1-1). The monitoring area comprises the Upper NFFR and RCC Projects and is located in Plumas and Butte counties, approximately 90 miles northeast of Oroville, California, and encompasses approximately 30 river-miles of the upper NFFR. The Upper NFFR Project is located on lands owned by Licensee and the National Forest Service Lands and is currently operated by the Licensee under FERC License 2105.

The NFFR is part of the greater Sacramento River watershed and drains a large portion of the eastern Sierra-Cascade geomorphic area in California. The NFFR watershed extends from its headwater area on the southeastern slope of Mount Lassen to Lake Oroville, traversing lands in Lassen, Plumas, and Butte counties. The main stem of the Feather River is formed downstream of Lake Oroville; the North, Middle, and South forks of the Feather River are impounded behind Oroville Dam which was completed in 1967.

The monitoring program involved collecting data from facilities associated with the Licensee's Upper NFFR Project (FERC 2105) and RCC Project (FERC 1962). Both Projects are part of a series of major hydroelectric generation projects that utilize the water resources of the NFFR and its tributaries for hydroelectric power generation. Downstream of these Projects is the Poe Project (FERC 2107) operated by the Licensee, and the Oroville Project (FERC 2100) owned by the State of California Department of Water Resources (DWR). Delivering water to the NFFR upstream of Licensee's Rock Creek Powerhouse is the Licensee's Bucks Creek Project (FERC 619).

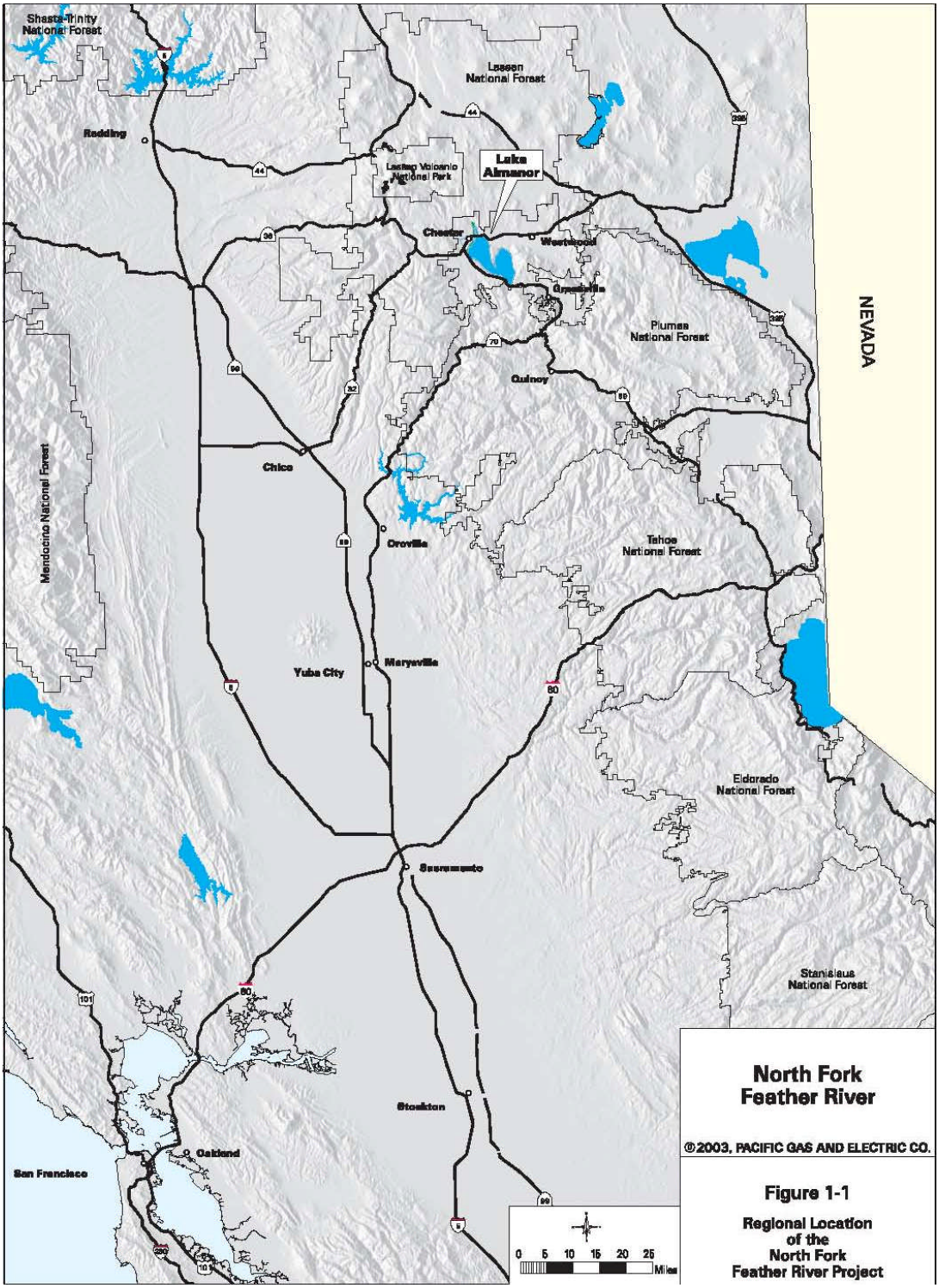


Figure 1-1. Regional location of study area.

2 STUDY DESIGN

2.1 MONITORING PROGRAM

2.1.1 Monitoring Network

A seventh year of compliance water resource monitoring was initiated in May 2008, and continued through September 2008. The monitoring program consisted of monitoring continuous stream flow, local meteorological, and water temperature data from selected locations. All monitoring activities were conducted by staff or contract personnel from the Licensee's Technical Project Support under Environmental Services Department.

A map of the system (Figure 2-1) depicts monitoring stations in relation to the major Project features such as powerhouses, reservoirs and bypass reaches. Station identification, location, and monitoring activity are shown in Table 2-1. Results of the 2008 water resource monitoring effort are discussed in Section 3.

2.2 METHODOLOGY

2.2.1 Flow Monitoring

Stream flow was monitored at eight stations (NF1, HB1, NF4, BC3, YC1, MR1, BUCK1, and GR1) located throughout the Project area in 2008. Flow data were also obtained from permanent stream flow gages and powerhouses associated with the Project through Pacific Gas and Electric Company's Hydroelectric Generation Department. Flow monitoring locations are shown on Figure 2-1 and described in Table 2-1.

Table 2-1

Upper NFFR Water Quality Sampling Locations

Station ID	Alternate Station Identification	Station Location	Monitoring Activity [1]
NF1	----	NFFR above Chester, CA.	F, TR
HB1	----	Hamilton Branch of NFFR at HWY bridge	TR, F
NF-83	----	Hamilton Branch Powerhouse	F
HB2	----	Hamilton Branch Powerhouse – canal head-works	TR
LA1-S	----	Lake Almanor near Canyon Dam - Epilimnion	TR - buoy
LA1-B	----	Lake Almanor near Canyon Dam - Hypolimnion	TR - buoy
LA – P1	----	Lake Almanor near Canyon Dam – near intake	IS-P
LA – P2	----	Lake Almanor - Offshore of Prattville Intake (LA2)	IS-P
LA – P3	----	Lake Almanor – middle of Eastern lobe (LA8)	IS-P
LA – P4	----	Lake Almanor – middle of Western lobe (LA6)	IS-P
LA-MET	----	Meteorological station on Prattville Intake	M
NF-1	11-399000	Lake Almanor near Prattville	Lake storage
NF2	----	NFFR below Canyon Dam	TR,
NF-2	11-399500	NFFR below Canyon Dam	F
NF3	----	NFFR at Seneca	TR
NF4	NF-47 (PG&E)	NFFR above Caribou No.1 Powerhouse	TR F
BV1		Butt Valley Powerhouse Tailrace	TR
NF-71	11-400600	Butt Valley Powerhouse	F
BV2_S	----	BVR near Caribou No.1 Intake - Epilimnion	TR - buoy
BV2_B	----	BVR near Caribou No.1 Intake - Hypolimnion	TR - buoy
BV-P1	----	BVR at Caribou No. 1 Intake	IS-P
BV-P2	----	BVR near Cool Springs Campground	IS-P
BV-P3	----	BVR near boat ramp	IS-P
BV-P4A	----	BVR near Caribou No.2 intake channel	IS-P (special)
BV-P4B	----	BVR at mouth of Caribou No.2 intake channel	IS-P (special)
NF-8	11-401050	Butt Valley Reservoir near Caribou (at dam)	Lake storage
CARB1	----	Caribou No. 1 Powerhouse (internal)	TR
NF-63	11-401110	Caribou No. 1 Powerhouse	F
CARB2	----	Caribou No. 2 Powerhouse tailrace (internal)	TR
CARB2B	----	Caribou No. 2 Intake channel bottom at structure	TR
NF-263	11-401109	Caribou No. 2 Powerhouse	F
BC1	----	Butt Creek upstream of Butt Valley Reservoir	TR
NF-4	11-400500	Butt Creek below ABC tunnel, near BVR	F
BC2	----	Butt Creek downstream of Butt Valley Reservoir	TR
BC3	----	Butt Creek near confluence with NFFR	TR, F
BD1	----	Belden Reservoir at powerhouse intake	TR
NF-67	11-403050	Belden Reservoir	Lake storage
NF-103	----	Oak Flat Powerhouse	F
NF5	---	NFFR below Belden Dam	TR
NF-70	11-401112	NFFR below Belden Dam	F
MC1	----	Mosquito Creek near mouth	TR, F
NF6	----	NFFR near Queen Lily Campground	TR

Table 2-1 Continued

Station ID	Alternate Station Identification	Station Location	Monitoring Activity [1]
NF7	----	NFFR near Gansner Bar	TR
EB1	----	East Branch of NFFR above confluence	TR
NF-51	11403000	East Branch of NFFR above confluence	F
NF8	----	NFFR at Belden Town Bridge	TR
BD2	----	Belden Powerhouse (internal)	TR
NF-74	11-403050	Belden Powerhouse	F
YC1	----	Yellow Creek near mouth	TR, F
RCK-MET	----	Meteorological station on Rock Creek Dam	M
CHIP	----	Chips Creek near mouth	TR, S
NF9	----	NFFR below Rock Creek Dam	TR
NF10	----	NFFR below Rock Creek Dam at NF-57	TR
NF-57	11-403200	NFFR downstream of Rock Creek Dam	F
MR1	----	Milk Ranch Creek near mouth	TR, F
CHAM	----	Chambers Creek near mouth	TR, S
NF11	----	NFFR below Granite Creek	TR
JC1	----	Jackass Creek near mouth	TR
NF12	----	NFFR above confluence with Bucks Creek	TR
BUCK1	11-403700	Bucks Creek near mouth	TR, F
NF-20	----	Bucks Creek Powerhouse	F
BUCK2	----	Bucks Creek Powerhouse tailrace	TR
NF13	----	NFFR above Rock Creek Powerhouse	TR
RC1	11-403800	Rock Creek Powerhouse (internal)	TR
NF-64	----	Rock Creek Powerhouse	F
RC2	----	Rock Creek near mouth	TR, S
NF14	----	NFFR below Cresta Dam	TR
GR1	----	Grizzly Creek near mouth	TR, F
NF15	----	NFFR downstream of Grizzly Creek	TR
NF-56	11-404330	NFFR downstream of Grizzly Creek	F
NF16	----	NFFR upstream of Cresta Powerhouse	TR
CR1	----	Cresta Powerhouse (internal)	TR
NF-62	11-404360	Cresta Powerhouse	F
MB1	----	Middle Fork Feather River at Milsap Bar	TR

F = Flow

TR = Temperature Recorder, TR-buoy = Temp Recorders attached to buoy

IS-P = *In Situ* Profile

S = Staff gage

M = Meteorological station data

Each of the temporary flow monitoring stations consisted of a Campbell CR510 digital recorder, associated Druck 5 psi pressure transducer and a stage-pin. The stage-pin and pressure transducer were placed in-stream, while the digital recorder was located on the stream bank in a locked enclosure. The digital recorders were set to record instantaneous readings every 15 minutes, and store these data as hourly average transducer values in non-volatile memory. During routine site visits, stream stage was recorded, and the stored hourly average transducer data were downloaded to computer.

A simple linear regression was used to define the relationship between transducer readings and the associated stream stage (stage pin readings) measurements at each station. Average hourly transducer readings were then converted into average hourly stream stage readings using the resultant regression equation. The conversion to a stage value based on a fixed reference (stage pin) facilitated year to year comparison of flow measurements and allowed for correction of errors associated with transducer drift or changes in stream channel morphology.

Stream flow measurements were made at each gaging station during routine site visits. Measurements were made at transects located near each station. Measurements were made using U. S. Geological Survey (USGS) approved stream flow measurement techniques (Buchanan 1980). All measurements were made using a Price AA-type flow meter and a 5-foot top-setting wading rod. The error associated with measurements was estimated to range from 5 to greater than 10% depending on the suitability of the transect.

The primary objective of the routine flow measurements was to cover the range of observed flows in order to develop a stage-flow rating equation.

The relationship of stream stage to stream flow (stage-flow rating) was developed using flow measurements and the associated stage pin readings collected during routine site visits. The resultant stage-flow rating was used to convert average hourly stage readings into average hourly flow. The rating is only applicable to flow within the defined range of stage and is also subject to changes in the hydraulic control (high flows, debris accumulation). All instrumentation installed *in situ* was removed during months when seasonal high flows could damage the equipment.

Daily flow at four secondary tributary streams (Mosquito, Chambers, Chips, and Rock creeks) was estimated based on periodic flow measurements. A linear decay between measurements was assumed to generate a daily flow value. A stage pin was installed at each of these stations to periodically measure stream stage. A total of at least four measurements were made at each station between June and September.

Stream flow and reservoir storage data from the permanent stations operated by the Licensee were collected, compiled, and provided by the Licensee's Hydro Generation Department.

2.2.2 Meteorological Monitoring

Local meteorology was monitored to define the climatic influence on water temperature in the Project area. Two temporary meteorological stations were placed in the Project area. One station was located on the Prattville Intake at Lake Almanor; another was located on Rock Creek Dam. These stations effectively represented conditions in the upper and middle portion of the Project. Parameters that were measured included average wind speed and direction, air temperature, relative humidity, and solar radiation. These parameters were monitored continuously using a Campbell Scientific Model CR10 data logger. Data were collected at 1-second intervals and were reduced to hourly average readings.

2.2.3 Temperature Monitoring

The temperature-monitoring program used recorders from three different manufactures to monitor temperature during the 2008 effort. The bulk of the data loggers deployed in the system were Vemco Model Minilog 12T recorders. These units recorded continuous temperature data based on readings taken at 20-minute intervals. Campbell Scientific Model CR510 recorders were used at eight stations to monitor temperature. These were also used to record continuous stream stage (flow) at the same locations (Table 2-1). The CR510 loggers recorded continuous temperature data as hourly averages based on readings taken at 15-minute intervals. A final type of recorder deployed during the monitoring program was the Campbell Scientific Model CR200 recorders. These units were used exclusively at five of the Project powerhouses (Caribou No. 1 and No. 2,

Belden, Rock Creek, and Cresta). The tailrace characteristics of these facilities dictated that the temperature sensors be installed internally in the powerhouse. The CR200 loggers recorded continuous temperature data as hourly averages based on readings taken at 15-minute intervals. All interval data were later reduced to hourly average.

Stream temperature sensors were typically deployed in well-mixed areas with elevated velocity and turbulent flow to ensure representative measurements. Various recorders were used depending on deployment conditions. In general, continuous monitoring of temperature covered the period from June 1 through September 30, 2008.

During the period May through September 2008, vertical temperature profiles were collected from four locations on Lake Almanor and from four locations on Butt Valley Reservoir to determine the magnitude and seasonal development of thermal gradients. Temperature profiles were defined using 1-meter vertical spacing from the surface to the bottom.

In addition to the synoptic profiles collected at the two primary Project reservoirs, vertical temperatures at two depths in Lake Almanor and Butt Valley were continuously monitored from June through September 2008. A thermistor array consisting of Vemco Model Minilog 12T recorders were positioned at two depths (near the surface [1.0 meter below surface] and near the bottom [2 meters above bottom to resting on bottom depending on lake elevation]) at each location. The thermistor array was suspended from

a buoy so that each recorder was maintained at a fixed depth below the surface. Continuous temperatures were monitored at a single station near the dam to define the temperature of the release from each reservoir (Figure 2-1).

To verify the operation and accuracy of the temperature recorders, the units were calibrated using an American Society for Testing and Materials (ASTM) reference thermometer, both prior to and following removal from the *in situ* deployment. Typical instrument error is approximately ±0.1°C.

Temperature records from instruments placed internally or in the tailrace of the various Project powerhouses were corrected to reflect periods of powerhouse operation. This process was done on an hourly basis by comparing powerhouse load records with temperature recorder data. This process helped eliminate periods when there was little or no flow through the powerhouse and temperatures would reflect stagnate conditions in the penstock.

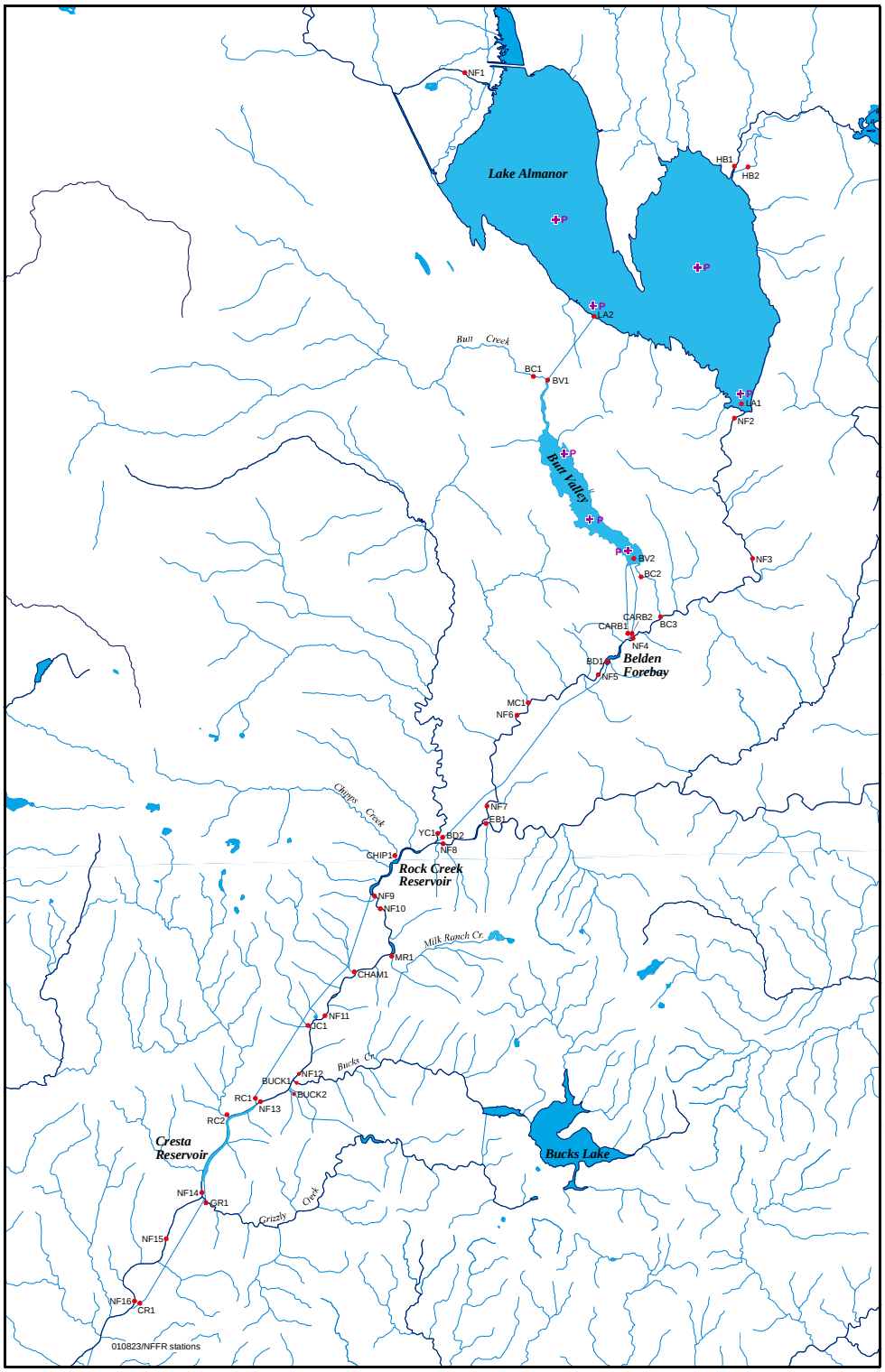


Figure 2-1. Map of station locations used during the 2008 monitoring program.

3 MONITORING RESULTS - 2008

3.1 HYDROLOGY AND METEOROLOGY

3.1.1 Stream-flow and Reservoir Operation

The Licensee's Upper NFFR Project (FERC 2105) encompasses the water resources and aquatic habitats of the upper NFFR drainage basin (from Lake Almanor to the NFFR confluence with Yellow Creek [headwaters of Rock Creek Reservoir]). The majority of flow entering the Project originates from water first stored in Lake Almanor. While Licensee operates and maintains the minimum instream flow as stipulated in the license for all by-passed reaches, majority of the water is passed downstream through a series of powerhouses and associated forebays. The Licensee's RCC Project (FERC 1962) encompasses the water resources of the middle portion of the NFFR basin, extending from the confluence of Yellow Creek to the headwaters of Poe Reservoir. In accordance with FERC 1962 License Condition 5 (River Flow Management), 2008 was classified as a Critical Dry Year, Licensee operated all minimum river flow releases in Rock Creek and Cresta reaches to meet required minimum flow conditions.

In addition to the permanent flow monitoring stations, the Licensee installed a series of temporary flow monitoring gages. These gages provided supplemental information in support of the temperature modeling effort. Table 3-1 summarizes stream flow data from all flow-monitoring stations. Stream discharge measurements that were collected in 2008 at each of the temporary stations are summarized in Appendix A. Data are discussed for

Table 3-1

Summary of 2008 stream flow monitoring at permanent and temporary stations.

Station	Year	Month	Daily Average Flow [1] (cfs) max	min	mean	Powerhouse Operation [2]	Data Days
NFFR near	2008	June	320	184	248	--	30
Chester (NF1)	2008	July	181	101	135	--	31
[Temporary]	2008	Aug	99.2	72.1	83.8	--	31
	2008	Sept	80.9	71.1	75.7	--	30
Hamilton Branch	2008	June	76.1	69.5	72.7	--	30
near Road A13	2008	July	70.9	68.9	69.9	--	31
Bridge (HB1)	2008	Aug	87.4	69.1	83.0	--	31
[Temporary]	2008	Sept	100	67.3	79.9	--	30
Hamilton Branch	2008	June	39.3	26.7	29.8	100%	30
Powerhouse	2008	July	29.8	0.0	5.36	20%	31
(NF-83) [3]	2008	Aug	28.2	0.0	2.68	10%	31
[Permanent]	2008	Sept	55.5	0.0	17.1	42%	30
Butt Valley	2008	June	0	0	0	0%	30
Powerhouse	2008	July	0	0	0	0%	31
(NF-71) [3]	2008	Aug	1,790	0	829	55%	31
[Permanent]	2008	Sept	1,810	867	1,728	94%	30
Butt Creek at ABC	2008	June	305	46.0	81.6	--	30
Tunnel (at BC1) [3]	2008	July	658	143	492	--	31
[NF-4 Permanent]	2008	Aug	616	40.0	270	--	31
	2008	Sept	41.0	39.0	39.5	--	30
NFFR below	2008	June	37.0	37.0	37.0	--	30
Canyon Dam	2008	July	38.0	37.0	37.6	--	31
(NF-2) [3]	2008	Aug	37.0	37.0	37.0	--	31
[Permanent]	2008	Sept	37.0	36.0	36.7	--	30
Butt Creek at	2008	June	11.7	11.5	11.6	--	30
Mouth	2008	July	11.4	11.4	11.4	--	31
(BC3)	2008	Aug	11.4	11.3	11.3	--	31
[Temporary]	2008	Sept	11.4	11.3	11.4	--	30
NFFR above	2008	June	63.1	59.8	61.5	--	30
Caribou PH	2008	July	60.2	58.4	59.3	--	31
(NF4)	2008	Aug	59.3	56.6	58.3	--	31
[Temporary]	2008	Sept	56.5	52.9	54.8	--	30
Caribou No. 1	2008	June	190	0	55	11%	30
Powerhouse	2008	July	72	0	23	1%	31
(NF-63) [3]	2008	Aug	349	5	113	18%	31
[Permanent]	2008	Sept	740	23	367	72%	30

Table 3-1 (Continued)

Station	Year	Month	Daily Average Flow [1] (cfs) max	min	mean	Powerhouse Operation [2]	Data Days
Caribou No. 2	2008	June	185	0.0	68.0	10%	30
Powerhouse	2008	July	592	102	294	49%	31
(NF-263) [3]	2008	Aug	1,440	272	837	80%	31
[Permanent]	2008	Sept	1,517	440	1,265	92%	30
Belden	2008	June	302	40.0	54.2	3%	30
Powerhouse	2008	July	541	40.0	226	27%	31
(NF-74) [3]	2008	Aug	1,400	196	826	73%	31
[Permanent]	2008	Sept	1,990	493	1,599	97%	30
Oak Flat	2008	June	117	0.0	96.6	93%	30
Powerhouse	2008	July	120	0.0	27.2	26%	31
(NF-103) [3]	2008	Aug	119	0.0	105	94%	31
[Permanent]	2008	Sept	104	0.0	49.1	90%	30
NFFR below	2008	June	161	145	148	--	30
Belden Dam	2008	July	156	147	152	--	31
(NF-70) [3]	2008	Aug	150	146	148	--	31
[Permanent]	2008	Sept	132	63.8	68.1	--	30
Mosquito Creek	2008	June	8.4	4.8	6.4	--	30
At mouth	2008	July	4.7	3.5	3.9	--	31
(MC1)	2008	Aug	3.5	3.3	3.4	--	31
[Estimate]	2008	Sept	3.3	3.3	3.3	--	30
East Branch	2008	June	348	103	188	--	30
NFFR near NFFR	2008	July	99.0	53.0	74.5	--	31
(NF-51) [3]	2008	Aug	59.0	45.0	51.5	--	31
[Permanent]	2008	Sept	58.2	45.0	50.4	--	30
Yellow Creek	2008	June	131	64.3	86.4	--	30
Near mouth	2008	July	64.1	54.5	58.0	--	31
(YC1)	2008	Aug	54.3	51.8	53.3	--	31
[Temporary]	2008	Sept	52.2	50.9	51.5	--	30
Chips Creek	2008	June	105.5	33.8	62.2	--	27
Near mouth	2008	July	32.5	15.6	21.7	--	31
(CHIP)	2008	Aug	15.5	13.3	14.0	--	31
[Estimate]	2008	Sept	13.3	13.1	13.2	--	30
NFFR below	2008	June	197	185	191	--	30
Rock Creek Dam	2008	July	255	179	222	--	31
(NF-57) [3]	2008	Aug	604	246	284	--	31
[Permanent]	2008	Sept	670	242	276	--	30

Table 3-1 (Continued)

Station	Year	Month	Daily Average Flow [1] (cfs) max	min	mean	Powerhouse Operation [2]	Data Days
Milk Ranch Creek	2008	June	16.7	6.26	10.0	--	30
Near mouth	2008	July	6.08	3.22	4.33	--	31
(MR1)	2008	Aug	3.19	2.44	2.74	--	31
[Temporary]	2008	Sept	2.60	2.43	2.50	--	30
Chambers Creek	2008	June	20.6	6.1	12.0	--	30
Near mouth	2008	July	5.8	2.5	3.7	--	31
(CHAM)	2008	Aug	2.5	2.1	2.2	--	31
[Estimate]	2008	Sept	2.1	2.1	2.1	--	30
Bucks Creek	2008	June	29.8	20.2	24.1	--	30
Near Mouth	2008	July	19.9	16.5	17.6	--	31
(BUCK1)	2008	Aug	16.5	14.2	15.5	--	31
[Temporary]	2008	Sept	16.2	12.3	14.0	--	30
Bucks Creek	2008	June	81.0	0.00	29.8	28%	30
Powerhouse	2008	July	196	0.00	84.2	50%	31
(NF-20) [3]	2008	Aug	159	4.10	96.9	61%	31
[Permanent]	2008	Sept	52.0	0.00	15.3	8%	30
Rock Creek	2008	June	714	189	387	53%	30
Powerhouse	2008	July	577	109	303	29%	31
(NF-64) [3]	2008	Aug	1,537	141	827	65%	31
[Permanent]	2008	Sept	1,996	546	1,587	95%	30
Rock Creek	2008	June	82.7	13.5	39.3	--	21
Near mouth	2008	July	12.3	2.4	5.1	--	31
(RC2)	2008	Aug	2.3	2.0	2.1	--	31
[Estimate]	2008	Sept	2.0	2.0	2.0	--	30
Grizzly Creek	2008	June	46.0	25.7	34.6	--	30
Near mouth	2008	July	25.3	14.4	19.4	--	31
(GR1)	2008	Aug	16.1	10.6	12.6	--	30
[Temporary]	2008	Sept	12.3	8.9	10.5	--	30
NFFR below	2008	June	177	162	170	--	30
Grizzly Creek	2008	July	237	163	198	--	31
(NF-56) [3]	2008	Aug	245	222	234	--	31
[Permanent]	2008	Sept	249	224	238	--	30
Cresta	2008	June	1,040	163	604	65%	30
Powerhouse	2008	July	888	283	530	40%	31
(NF-62) [3]	2008	Aug	1,720	280	1,010	60%	31
[Permanent]	2008	Sept	2,000	590	1,577	91%	30

1. Daily values are based on hourly average data, monthly statistics represent the maximum, minimum, and mean based on these hourly average flows.

2. Percent powerhouse operation is based on hourly generation data.

3. Source - Pacific Gas and Electric Company, 2008.

the period June 1 through September 30 (referred to as the monitoring period) unless stated otherwise.

3.1.1.1 Lake Almanor and tributaries

The major tributaries feeding into Lake Almanor are the NFFR at Chester with an historic average annual flow of approximately 335 cubic feet per second (cfs), the Hamilton Branch with an historic average flow of 190 cfs, and a number of minor tributaries including Benner, Last Chance, and Bailey creeks.

Flow in the NFFR upstream of Lake Almanor (which provides an estimated 50 percent of the annual inflow to Lake Almanor) is derived from headwaters on the slopes of Mount Lassen. During the 2008 monitoring program, flow in the NFFR upstream of Lake Almanor was measured at a temporary stream gage (NF1) located upstream of the city of Chester, California. The stream gaging system was installed on May 28th. Stream flow measurements at this location in 2008 recorded hourly average flows ranging from 88.4 to 328 cfs. These measurements indicated that the 2007 rating was adequate using small stage shifts (R2007-NF1). Based on this rating, flows over 361 cfs are beyond the 10 % range acceptable for extrapolating a rating and were not estimated (given a value of greater than 361). Based on the limits of this stage-discharge rating, daily average flow at NF1 for the period June 1 through September 30, 2008 ranged from 71.1 to 320 cfs, with an average of 136 cfs. A maximum hourly average flow of 332 cfs was calculated

based on the maximum hourly average stage. Figure 3.1 compares daily average flow from NF1 with two other stations tributary to Lake Almanor.

Flow in the Hamilton Branch (which provides 20 to 25 percent of the annual inflow to Lake Almanor) originates from the Licensee's Mountain Meadows Project. During the 2008 monitoring program, flow in the Hamilton Branch was measured upstream of Lake Almanor at a temporary stream gage (HB1). This station is located downstream of a series of small diversion facilities that diverts flow into a canal that supplies the Licensee's Hamilton Branch Powerhouse. Stream flow measurements at this location in 2008 recorded hourly average flows ranging from 64.6 to 85.8 cfs. These measurements supported the existing R2003-HB1 rating. Based on this rating, flows over 166 cfs are beyond the 10 % range acceptable for extrapolating a rating and were not estimated (given a value of greater than 166). Based on the limits of this stage-discharge rating, daily average flow at HB1 for the period June 1 through September 30, 2008 ranged from 67.3 to 100 cfs, with an average of 76.4 cfs. A maximum hourly average flow of 164 cfs was calculated based on the maximum recorded hourly average stage. Figure 3.1 compares daily average flow from HB1, with two other stations tributary to Lake Almanor.

The second location used for monitoring flow from Mountain Meadows Reservoir as inflow to Lake Almanor was the Licensee's Hamilton Branch Powerhouse (NF-83). This facility is located at the mouth of the Hamilton Branch River and discharges directly into

Lake Almanor (Figure 2-1). During the June-September 2008 monitoring period, daily average flows at the Hamilton Branch Powerhouse averaged 13.8 cfs and ranged from 0 to 55.5 cfs (Pacific Gas and Electric Company 2008). The facility was shut down for a number of extended periods during the 2008 monitoring effort. Figure 3-1 compares daily average flow from HB2 with two other stations tributary to Lake Almanor.

Lake Almanor is the primary storage reservoir for the Upper NFFR Project. It is located about 90 miles upstream of the city of Oroville. Lake Almanor was created by the construction of a hydraulic fill dam now referred to as Canyon Dam. Canyon Dam was completed in various phases between 1913 and 1927. Lake Almanor has a normal maximum water surface elevation of 4504 ft (USGS datum) and a storage capacity of 1,142,00 acre-ft. The average residence time in Lake Almanor is approximately 291 days. Lake outlets are the Canyon Dam Intake, which releases water to the NFFR downstream of Lake Almanor, and the Prattville Intake that diverts water to Butt Valley Reservoir through Butt Valley Powerhouse. Figure 3-2 presents daily average reservoir storage and elevation for Lake Almanor for the monitoring period.

Releases from the Prattville Intake to Butt Valley Reservoir represent the greatest portion of water released from Lake Almanor. The maximum flow through the intake is 2200 cfs. The Prattville Intake is a high-Froude number structure; as a result, water is drawn from the entire water column regardless of thermal stratification conditions. The tunnel invert is situated at the bottom of a narrow steep-sided trough that connects the relatively

shallow intake channel with the deeper areas of the reservoir. The invert of the Prattville Intake is located at 4420 ft. (USGS datum). However, access to the deeper areas of Lake Almanor is restricted by the shallow approach channel that has a base elevation of 4,432 ft (USGS datum). Thus, the water withdrawn by the Prattville Intake is primarily from the warmer layers in the lake due to the restriction of the approach channel.

3.1.1.2 Butt Valley Reservoir and tributaries

The main source of inflow to Butt Valley Reservoir is the discharge from Butt Valley Powerhouse (NF-71), which draws water from Lake Almanor at Prattville Intake. During the June-September 2008 monitoring period, daily average flows in Butt Valley Powerhouse averaged 639 cfs and ranged from 0 to 1810 cfs (Pacific Gas and Electric Company 2008). The powerhouse did not operate between June 1 and August 11, 2008. Figure 3-3 compares daily average flow through Butt Valley Powerhouse with those from the other powerhouses associated with the Upper NFFR Project.

Butt Creek is the only significant natural tributary entering Butt Valley Reservoir. During the 2008 monitoring period, daily average flows in Butt Creek (BC1 at NF-4 gage) ranged from 39.0 to 658 cfs, with an average flow of 221 cfs (Pacific Gas and Electric Company 2008). Flows in Butt Creek were elevated from June 26 through August 18, 2008 related to a maintenance outage at Butt Valley Powerhouse (Figure 3-3A). The maximum flows measured at this station were recorded at this time.

On an annual basis, the Butt Valley Reservoir water surface elevations fluctuate by about 10 to 15 feet from the maximum water surface elevation of 4142 ft. (USGS datum). Under normal operating conditions, daily changes in elevation are typically less than 1 foot. The retention time for water traveling through the reservoir is 14 to 32 days depending on operating conditions. Figure 3-4 presents daily average storage and elevation for Butt Valley Reservoir for the June through September 2008 monitoring period.

The primary outflow from the Butt Valley Reservoir is through the intakes for Caribou No. 1 and No. 2 powerhouses. The Caribou No. 1 Intake has a capacity of about 1,100 cfs and is located in the deepest area of Butt Valley Reservoir near the dam. The Caribou No. 1 Intake tunnel invert elevation is at 4077 ft. (USGS datum). The actual Caribou No. 1 Intake structure is located in a small depression zone. The most recent bathymetric surveys (April 1996) indicated that the main approach channel has an elevation of 4095 ft. (USGS datum). Caribou No. 2 Intake has a larger capacity (1460 cfs) and is more efficient than the Caribou No. 1 Intake, and is located in a shallow channel with an entrance elevation (channel invert) of 4110 ft. (USGS datum). Because of the higher invert elevation, the Caribou No. 2 Intake withdraws warmer surface water from the reservoir.

No controlled minimum release is made from Butt Valley Dam to the Butt Creek channel downstream of the reservoir. The reservoir rarely spills due to the large combined

outflow capability of Caribou No. 1 and No. 2 powerhouses (2560 cfs). The Licensee has monitored leakage flows in Butt Creek below Butt Valley Dam since 1997 to ensure that leakage flows were not reduced after seismic restoration work on the dam was completed in 1997. The average annual leakage flow is about 0.07 cfs (32 gallons per minute). Flow conditions in Butt Creek below Butt Valley Dam will be discussed in the following Section.

3.1.1.3 Seneca Reach of the NFFR and tributaries

The Seneca bypass reach (Seneca Reach) consists of a 10.8-mile section of the NFFR extending from Canyon Dam to Caribou No. 1 Powerhouse. A seasonally constant minimum of 35 cfs is released from Canyon Dam to the NFFR in accordance with Article 26 of FERC License 2105. Flows are measured by the Licensee in cooperation with the USGS at a permanent gaging station (NF-2) located approximately 0.5 miles downstream of the release structure. During the 2008 monitoring period, daily average flows in NFFR below Canyon Dam (NF-2) ranged from 36.0 to 38.0 cfs, and averaged 37.1 cfs (Pacific Gas and Electric Company 2008).

Butt Creek enters the NFFR approximately 1.25 miles upstream of Belden Forebay. Butt Creek is the largest of the NFFR tributaries in the Seneca Reach. There are no minimum flow requirements for Butt Creek below Butt Valley Reservoir. Flows in Butt Creek downstream of Butt Valley Dam consist primarily of spring flow accretion, supplemented with leakage from the Butt Valley Dam, and tributary inflow from Benner Creek. The

temporary stream gage located near the mouth of Butt Creek (BC3) was installed on June 9, 2008. Stream flow measurements at this location in 2008 recorded hourly average flows ranging from 11.1 to 11.7 cfs. These measurements supported the existing R2008-BC3. Based on this rating, flows over 15.1 cfs are beyond the 10 % range acceptable for extrapolating a rating and were not estimated (given a value of greater than 15.1). Based on the limits of this stage-discharge rating, mean daily flow at BC3 for the period June 1 – September 30, 2008 ranged from 11.3 to 11.7 cfs, with an average of 11.4 cfs.

The monitoring station located on the NFFR above Caribou Powerhouse (NF4 temperature station) is also the site of a discontinued permanent gage (NF-47). This station captures the total flow entering Belden Forebay from the Seneca Reach. Stream flow measurements at NF4 in 2008 recorded hourly average flows ranging from 55.0 to 68.0 cfs. These measurements supported the existing R2005-NF4 rating. Based on this rating, flows over 148 cfs are beyond the 10 % range acceptable for extrapolating a rating and were not estimated (given a value of greater than 148). Based on the limits of this stage-discharge rating, daily average flow at NF4 for the period June 1 through September 30, 2008 ranged from 52.9 to 63.1 cfs, with an average of 58.5 cfs. A maximum hourly average flow of 64.7 cfs was calculated based on the maximum recorded hourly average stage.

The total mean daily tributary and lateral accretion flows were calculated for the entire Seneca Reach. For the June 1 through September 30, 2008 period, tributary flows ranged

from 16.6 to 26.1 cfs, and averaged 21.4 cfs. The measured range of accretion exclusive of Butt Creek ranged from 5.2 to 14.5 cfs, averaging 9.9 cfs.

3.1.1.4 Belden Forebay and Caribou Powerhouse complex

Belden Reservoir is located on the NFFR approximately 10.8 miles downstream of Canyon Dam. Belden Forebay forms the afterbay for the Caribou Powerhouses, and is the forebay for Belden Powerhouse. The forebay was created by a rock-filled dam in 1958 and has a maximum water surface elevation of 2985 ft. (USGS datum) and a theoretical usable storage capacity of 2477 acre-ft. Under normal operation, the water surface elevation fluctuates between 2960 ft. and 2973 ft (USGS datum) depending on power operations. Lake Almanor and Butt Valley Reservoir control the majority of upstream run-off; as a result, spill events at Belden Dam are rare. Belden Forebay has limited storage capability and therefore the operation of the Caribou powerhouses is closely coordinated with the operation of Belden Powerhouse as well as Licensee's other downstream powerhouses. The average residence time in Belden Reservoir is estimated at approximately 0.5 to 1.0 days.

The majority of flow entering Belden Forebay originates from Butt Valley Reservoir and is discharged through the Caribou No. 1 and No. 2 powerhouses. These powerhouses have average annual flow rates of 615 and 674 cfs, respectively (Pacific Gas and Electric Company 1999). Additional inflow is received from the Seneca Reach of the NFFR; the average annual inflow from this source is approximately 125 cfs (NF-47 1970-1988

PG&E archive). Caribou No. 1 was completed in 1921 and Caribou No. 2 was completed in 1958. Depending on water availability and power requirements, one or both powerhouses may be used. The generating units at Caribou No. 2 are more efficient than those at Caribou No. 1, and their operation is favored.

During the 2008 monitoring period, daily average flows at Caribou No. 1 Powerhouse (NF-63) ranged from 0 to 740 cfs, and averaged 139 cfs (Pacific Gas and Electric Company 2008). Flow through the Caribou No. 2 Powerhouse (NF-263) during 2008 ranged from 0 to 1517 cfs, and averaged 616 cfs (Pacific Gas and Electric Company 2008). Figure 3-3 compares daily average flow through the Caribou No. 1 and No. 2 powerhouses with those from the other powerhouses associated with the Upper NFFR Project.

The primary outflow from Belden Forebay is through an intake structure located on the left bank (looking downstream) near Belden Dam. This intake provides flows of up to 2610 cfs to Belden Powerhouse, which is located on Yellow Creek immediately upstream of the confluence of Yellow Creek with the NFFR. Water released from Belden Powerhouse enters the NFFR at its confluence with Yellow Creek; this flow enters the Licensee's Rock Creek Reservoir immediately downstream. During the 2008 monitoring period, daily average flow at Belden Powerhouse (NF-74) ranged from 40 to 1990 cfs, and averaged 676 cfs (Pacific Gas and Electric Company 2008). Figure 3-3 compares

daily average flow through Belden Powerhouse with those from the other powerhouses associated with the Upper NFFR Project.

3.1.1.5 Belden Reach of the NFFR and tributaries

The Belden bypass reach (Belden Reach) is a 9.3-mile section of the NFFR extending from Belden Dam to the confluence of the NFFR and Yellow Creek. Prior to July 1985, releases from Belden Forebay to the NFFR immediately downstream of the Belden Dam were made from a low-level release in the dam or its upper spillway gates. Oak Flat Powerhouse was completed in 1985 and operates on the instream flow release made at the base of Belden Forebay Dam. To accommodate the two flow rates, the turbine has a high flow and a low flow runner. These runners are changed in the spring and fall. This change-out takes a few days and during this time the instream flow is met by releasing water through the pressure release valve at the end of the outlet pipe so that a continuous release is maintained. During the 2008 monitoring period, daily average flows through Oak Flat Powerhouse (NF-103) ranged from 0 to 120 cfs, and averaged 69.4 cfs (Pacific Gas and Electric Company 2008).

Under the terms of FERC License 2105 and the California Department of Fish and Game (CDFG) agreement, the Licensee releases a minimum of 140 cfs from the last Saturday in April to Labor Day and 60 cfs during the rest of the year to the NFFR downstream of Belden Dam (Belden Reach of the NFFR) for the maintenance of fish life. The instream flow releases from Belden Dam are measured at a compliance stream gage located

approximately 0.5 miles downstream of the Belden Dam-Oak Flat Powerhouse complex. During the 2008 monitoring period, daily average flows in the NFFR below Belden Dam (NF-70) ranged from 63.8 to 161 cfs, and averaged 129 cfs (Pacific Gas and Electric Company 2008).

Mosquito Creek is the largest tributary to the NFFR between Belden Forebay and the NFFR confluence with the EBNFFR. Flows in Mosquito Creek (MC1) typically range from 2 to 10 cfs during the period June through September (Pacific Gas and Electric Company 1987). Flows in Mosquito Creek were estimated based on periodic flow measurements and a curvilinear regression estimating the runoff decay between measurements. Based on this estimation, daily average flows during the June 1 through September 30, 2008 period ranged from 3.3 to 8.4 cfs, averaging 4.2 cfs.

The EBNFFR is a large unregulated tributary of the NFFR with an average annual flow of 1,031 cfs (Pacific Gas and Electric Company 1999). The EBNFFR and the NFFR merge approximately 1.75 miles upstream of the confluence with Yellow Creek. Winter and spring flows in the EBNFFR are sufficient under most conditions to allow the Licensee to operate the Upper NFFR Project such that water is stored in Lake Almanor until required by the downstream production facilities. During the 2008 monitoring period, daily average flows in EBNFFR (NF-51) ranged from 45.0 to 348 cfs, with an average of 91.2 cfs (Pacific Gas and Electric Company 2008).

Yellow Creek is one of the larger tributary streams contributing to the NFFR downstream of the confluence with the EBNFFR. Typical flows in Yellow Creek (YC1) range from 40 to 170 cfs during the June through September period (Pacific Gas and Electric Company 1986, 1987). Flows were calculated based on hourly average stage data using a rating curve developed with periodic flow measurements. Stream flow measurements at this location in 2008 recorded hourly average flows ranging from 48.9 to 118 cfs. These measurements supported the existing R2006-YC1 rating. Based on this rating, flows over 248 cfs are beyond the 10 % range acceptable for extrapolating a rating and were not estimated (given of value of greater than 248). Based on the limits of this stage-discharge rating, daily average flow at YC1 for the period June 1 through September 30, 2008 ranged from 50.9 to 131 cfs, with an average of 62.3 cfs. A maximum hourly average flow of 140 cfs was calculated based on the maximum recorded hourly average stage.

3.1.1.6 Rock Creek Reach of the NFFR and tributaries

Rock Creek Dam is located on the NFFR approximately 3.0 miles downstream of Belden Powerhouse. Rock Creek Reservoir forms the afterbay for Belden Powerhouse, and is the forebay for Rock Creek Powerhouse. The forebay was created by a concrete dam in 1950 and has a maximum water surface elevation of 2216.2 ft. (USGS datum). Rock Creek Reservoir's original operating capacity of 4400 acre-feet at 2216.2 ft. has been significantly reduced (greater than 50%) by sediment accumulation (PG&E, 2004).

Chips Creek is a major tributary of the NFFR, discharging directly into Rock Creek Reservoir. Flows in Chips Creek (CHIP) were estimated based on periodic flow measurements and a curvilinear regression estimating the runoff decay between measurements. Based on this estimation, daily average flows during the June 1 through September 30, 2008 period ranged from 13.1 to 105 cfs, averaging 26.8 cfs.

The Rock Creek bypass reach (Rock Creek Reach) is an 8.4-mile section of the NFFR extending from Rock Creek Dam to the tailrace of Rock Creek Powerhouse. Under the terms of the FERC License (Dated October 24, 2001), the Licensee was required to release a minimum of 150 cfs in the June-September period of 2008 which was classified as a critical dry year. However, as footnoted under critical dry year conditions: "*the base flow of 150 cfs shall be increased to 200 cfs, …., to the extent necessary to contribute to the maintenance of mean daily temperatures of 20 degrees Celsius or less in the Rock Creek Reach*.". A more detailed discussion of the minimum release requirements is contained in Appendix A of the FERC License. Shown in Figure 3-5, when daily average water temperature at station NF-57 exceeded 20° C in two consecutive days, the Licensee increased from the minimum release from 150 cfs to 200 cfs in mid-July.

The instream flow releases from Rock Creek Dam to the Rock Creek Reach of the NFFR are measured at a stream gage located approximately 1.5 miles downstream of the dam. During the 2008 monitoring period, daily average flows in the NFFR below Rock Creek

Dam (NF-57) ranged from 179 to 670 cfs, and averaged 243 cfs (Pacific Gas and Electric Company 2008).

Milk Ranch Creek is one of several tributaries to the Rock Creek Reach of the NFFR. Flows in Milk Ranch Creek were monitored using a temporary flow monitoring gage installed near the mouth (MR1). Flows were calculated based on hourly average stage data, and a rating developed using periodic flow measurements. Stream flow measurements at this location in 2008 captured flows ranging from 2.09 to 24.6 cfs. These measurements indicated that a new rating was necessary; as a result rating R2008-MR1 was developed. Based on this rating, flows over 27.1 cfs are beyond the 10 % range acceptable for extrapolating a rating and were not estimated (given a value of greater than 27.1). Based on the limits of this stage-discharge rating, daily average flow at MR1 for the period June 1 through September 30, 2008 ranged from 2.43 to 16.7 cfs, with an average of 4.90 cfs. A maximum hourly average flow of 18.8 cfs was calculated based on the maximum recorded hourly average stage.

Chambers Creek is another tributary to the Rock Creek Reach of the NFFR. Flows in Chambers Creek (CHAM) were estimated based on periodic flow measurements and a curvilinear regression estimating the runoff decay between measurements. Based on this estimation, daily average flows during the June 1 through September 30, 2008 period ranged from 2.08 to 20.6 cfs, and averaged 4.97 cfs.

Flows in Bucks Creek were monitored using a temporary flow monitoring gage installed near the mouth (BUCK1). Flow in Bucks Creek originates from Lower Bucks Reservoir. Flows were calculated based on hourly average stage data, and a rating developed using periodic flow measurements. Stream flow measurements at this location in 2008 captured flows ranging from 12.5 to 45.3 cfs. These measurements indicated that a new rating was necessary; as a result rating R2008-BUCK1 was developed. Based on this rating, flows over 49.8 cfs are beyond the 10 % range acceptable for extrapolating a rating and were not estimated (given a value of greater than 49.8). Based on the limits of this stage-discharge rating, daily average flow at BUCK1 for the period June 1 through September 30, 2008 ranged from 12.3 to 29.8 cfs, an averaged 17.8 cfs. A maximum hourly average flow of 30.9 cfs was calculated based on the maximum recorded hourly average stage.

The source of flow to Bucks Powerhouse is Grizzly Forebay, which receives diversion flow from Bucks Lake through Lower Bucks Lake. Bucks Powerhouse has a maximum capacity of 340 cfs; flows are released to the NFFR immediately upstream of Rock Creek Powerhouse. During the 2008 monitoring period, daily average flow at Bucks Powerhouse (NF-20) ranged from 0 to 196 cfs, and averaged 56.5 cfs (Figure 3-5) (Pacific Gas and Electric Company 2008).

The primary outflow from Rock Creek Reservoir is through an intake structure located on the right bank (looking downstream) near Rock Creek Dam. This intake provides flows

of up to 2880 cfs to Rock Creek Powerhouse, which is located on the NFFR upstream Cresta Reservoir. During the 2008 monitoring period, daily average flow at Rock Creek Powerhouse (NF-64) ranged from 109 to 1996 cfs, and averaged 776 cfs (Pacific Gas and Electric Company 2008). Figure 3-5 compares daily average flow through Rock Creek Powerhouse with those from the other powerhouses associated with the RCC Project.

3.1.1.7 Cresta Reach of the NFFR and tributaries

Cresta Reservoir is located on the NFFR immediately downstream of Rock Creek Powerhouse. Cresta Reservoir forms the afterbay for Rock Creek Powerhouse, and is the forebay for Cresta Powerhouse. The forebay created by a concrete dam build in 1949 has a maximum water surface elevation of 1681.20 ft (USGS datum). The original capacity of 4410 acre-feet has been significantly reduced to half of the original capacity by accumulated sediments (PG&E, 2004).

Rock Creek flows enter the NFFR at the upper end of Cresta Reservoir. Flows in Rock Creek (RC2) were estimated based on periodic flow measurements and a curvilinear regression estimating the runoff decay between measurements. Based on this estimation, daily average flows during the June 1 through September 30, 2008 period ranged from 1.98 to 82.7 cfs, averaging 9.81 cfs.

The Cresta bypass reach (Cresta Reach) is a 4.9-mile section of the NFFR extending from Cresta Dam to the tailrace of Cresta Powerhouse. Under the terms of the FERC License

(Dated October 24, 2001), the Licensee was required to release a minimum of 140 cfs in the June-September period of 2008 which was classified as a critical dry year. However, as specified under critical dry year conditions: "*the base flow of 140 cfs shall be increased to 200 cfs, …., to the extent necessary to contribute to the maintenance of mean daily temperatures of 20 degrees Celsius or less in the Cresta Reach*.". A more detailed discussion of the minimum release requirements is contained in Appendix A of the FERC License. Similar to Rock Creek Reach as shown in Figure 3-5, when daily average water temperature at station NF-56 exceeded 20° C in two consecutive days, the Licensee increased from the minimum release from 140 cfs to 200 cfs in mid-July.

Flows in Grizzly Creek were monitored using a temporary flow monitoring gage installed near the mouth (GR1). Flows were calculated based on hourly average stage data, and a rating developed using periodic flow measurements. Stream flow measurements at this location in 2008 captured flows ranging from 13.1 to 92.9 cfs. These measurements indicated that a new rating was necessary; as a result rating R2008-GR1 was developed. Based on this new rating, flows over 102 cfs are beyond the 10 % range acceptable for extrapolating a rating and were not estimated (given a value of greater than 102). Based on the limits of this stage-discharge rating, daily average flow at GR1 for the period June 1 through September 30, 2008 ranged from 8.90 to 46.0 cfs, an averaged 19.3 cfs. A maximum hourly average flow of 61.4 cfs was calculated based on the maximum recorded hourly average stage.

The instream flow releases from Cresta Dam to the Cresta Reach of the NFFR are measured at a permanent stream gage located approximately 2.8 miles downstream of the dam, and 2.4 miles downstream of Grizzly Creek. During the 2008 monitoring period, daily average flows in the NFFR below Grizzly Creek (NF-56) ranged from 162 to 249 cfs, and averaged 210 cfs (PG&E, 2008).

The primary outflow from Cresta Reservoir is through an intake structure located on the left bank (looking downstream) near Cresta Dam. This intake provides flows of up to 3560 cfs to Cresta Powerhouse, which is located on the NFFR upstream of Poe Reservoir. During the 2008 monitoring period, daily average flow at Cresta Powerhouse (NF-62) ranged from 163 to 2000 cfs, and averaged 930 cfs (Pacific Gas and Electric Company 2008). Figure 3-5 compares daily average flow through Cresta Powerhouse with those from the other powerhouses associated with the RCC Project.

3.1.2 Meteorology

3.1.2.1 2008 Regional Precipitation

Mean annual precipitation in the upper NFFR watersheds ranges from a low of 20 inches (in eastern portions of the EBNFFR watershed) to a high of 90 inches in the northwestern part of the watershed near Mount Lassen (California Data Exchange Center [CDEC] 2008). Most of the precipitation in the basin occurs from October through May, with maximum storm intensities occurring December through March. Winter precipitation at higher elevations usually occurs as snow, although warm winter storms can produce rain

up to the 10,000-ft level. The typical April 1 snow accumulations range from 6 inches of water at an elevation of 5000 ft, to 27 inches of water at 7000 ft. (CDEC 2008). Larger snow accumulations occur on Mount Lassen, with an average April 1 snow-water-equivalent of 80 inches. The mean annual precipitation within the Project area ranges from about 30 to 40 inches (CDEC 2008). Table 3-2 summarizes precipitation data from the available stations in the Project vicinity.

The data from the four stations presented in Table 3-2 broadly define conditions in the upstream watersheds and immediate Project area. Total precipitation during the 2008 water year (October 2007 to September 2008) averaged 70% of normal for these four stations (CDEC 2008).

3.1.2.2 2008 Monitoring at Prattville Intake and Rock Creek Dam

Two temporary meteorological stations were installed in the Project vicinity during the 2008 monitoring period. One station was located at the Prattville Intake on Lake Almanor; another station was located on Rock Creek Dam. The data collected at these meteorological stations in 2008 are summarized in Table 3-3.

Table 3-2

Summary of Precipitation Data from Meteorological Stations in the Upper NFFR Project Vicinity.

		Water Year* (inches)												Annual
Station	**YEAR**	**Oct.**	**Nov.**	**Dec.**	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**	**Jun.**	**Jul.**	**Aug.**	**Sept.**	**Total**
Chester	2008	2.92	0.65	4.09	10.26	4.71	1.10	0.51	0.82	0.01	0.00	0.00	0.00	25.07
4525 ft.	% of Normal	145%	17%	78%	171%	90%	27%	23%	56%	1%	0%	0%	0%	79%
(CHS)	Average	2.01	3.73	5.24	6.00	5.24	4.02	2.18	1.46	0.93	0.23	0.28	0.60	31.92
Canyon Dam	2008	3.28	0.96	3.87	10.03	4.75	1.11	0.60	1.25	0.01	0.00	0.00	0.04	25.90
4560 ft.	% of Normal	144%	22%	60%	132%	75%	22%	22%	76%	1%	0%	0%	7%	67%
(CNY)	Average	2.28	4.44	6.49	7.58	6.30	5.11	2.76	1.65	0.78	0.18	0.29	0.58	38.44
Greenville	2008	1.92	0.72	3.96	11.05	5.12	1.07	0.71	0.95	0.00	0.00	--	--	25.50
3570 ft.	% of Normal	75%	13%	63%	153%	82%	20%	26%	61%	0%	0%	--	--	65%
(GNV)	Average	2.55	5.35	6.26	7.22	6.26	5.35	2.68	1.55	0.78	0.26	0.36	0.78	39.40
DeSabla	2008	4.49	1.59	9.64	16.64	8.35	1.24	0.91	0.38	0.06	0.00	0.00	--	43.30
3710 ft.	% of Normal	117%	21%	88%	135%	80%	15%	18%	18%	6%	0%	0%	--	69%
(DSB)	Average	3.85	7.61	10.94	12.29	10.47	8.39	5.11	2.16	0.95	0.10	0.23	0.73	62.83

Data Source – CDEC 2008.

* Water year is period October 1 through September 30

Table 3-2 Continued.

Snow Survey Data from the Greater NFFR Watershed Area

Station	Elevation (ft. USGS)	2008 April 1 Water Equivalents (inches)	Average April 1 Water Equivalents (inches)
Lower Lassen Peak	8250	58.3	80.2
Mount Dyer 1	7100	28.0	25.9
Mount Dyer 2	6050	18.6	16.6
Harkness Flat	6200	25.4	28.5
Mount Stover	5600	17.2	14.7
Feather River Meadows	5400	24.6	23.1
Warner Creek	5100	16.6	14.7
Humbug Summit 2	4850	18.2	14.3
Chester Flat	4600	8.4	6.1

Data Source – CDEC 2008

3.2 WATER TEMPERATURE

3.2.1 2008 Monitoring

As discussed in Section 2, water temperatures were continuously monitored during the summer of 2008. Due to the voluminous nature of these data, the information presented in the following section will summarize the data collected during the monitoring effort. Appendix B presents a summary of hourly average temperature data. Furthermore, in accordance with FERC 1962 License Condition 4C (Water Temperature Monitoring), ERC requested the weekly provision of temperature monitoring data at seven stations mainly because 2008 was the second consecutive critical dry year since the issuance of license. These seven stations consist of NFFR below Rock Creek Dam (NF9), NFFR at the NF 57 gage (telemetered station NF57 [water temp]), NFFR above Bucks Creek (NF12), NFFR above Rock Creek Powerhouse (NF13), NFFR below Cresta Dam (NF14), NFFR at the NF 56 gage (telemetered station NF56 [water temp]) and NFFR above Cresta Powerhouse (NF16). Licensee provided the weekly data for the entire June-September period.

For consistency with the temperature level specified for the Licensee's Rock Creek Cresta Project (FERC 1962), daily average data are used throughout this document unless otherwise specified. Table 3-4 summarizes the daily average water temperature data collected during the 2008 program.

Table 3-3

Summary of 2008 Meteorological Data from Project Area

Prattville Intake Station

Station	Units	Year	Month	Daily Average [1] Max	Min	Mean	Data Days
Air Temperature	(°C)	2008	June	21.7	9.2	15.4	30
			July	22.6	15.9	18.9	31
			Aug	23.3	14.0	19.5	31
			Sept	20.6	11.1	15.8	30
Relative Humidity	(%)	2008	June	62.9	35.9	48.0	30
			July	61.8	34.7	46.5	31
			Aug	54.6	33.4	42.3	31
			Sept	64.0	28.5	41.3	30
Solar Radiation	(watts/m^2)	2008	June	529	357	475	30
			July	495	298	430	31
			Aug	468	378	438	31
			Sept	445	238	374	30
Wind Speed	(m/s)	2008	June	2.95	0.91	1.38	30
			July	1.23	0.87	1.08	31
			Aug	2.49	0.98	1.20	31
			Sept	3.20	0.90	1.16	30

Rock Creek Dam Station

Station	Units	Year	Month	Daily Average [1] Max	Min	Mean	Data Days
Air Temperature	(°C)	2008	June	25.4	15.5	20.4	30
			July	27.5	20.9	23.7	31
			Aug	29.3	19.5	24.6	31
			Sept	25.7	16.6	21.3	30
Relative Humidity	(%)	2008	June	55.2	22.7	38.1	30
			July	50.1	28.2	37.4	31
			Aug	45.4	23.6	32.6	31
			Sept	51.3	20.4	30.4	30
Solar Radiation	(watts/m^2)	2008	June	485	213	407	30
			July	438	216	368	31
			Aug	440	371	411	31
			Sept	412	207	347	30
Wind Speed	(m/s)	2008	June	3.41	2.32	2.77	30
			July	3.26	2.24	2.61	31
			Aug	3.47	2.40	2.80	31
			Sept	3.32	1.93	2.77	30

1= Based on hourly average data.

Table 3-4

Summary of Daily Average Water Temperatures from UNFFR – 2008

Station	Year	Month	Daily Ave Temperatures [1] max	min	mean	Diel Fluctuation [2] max	min	mean	Data Days
NFFR at	2008	June	15.3	9.9	12.4	7.8	3.9	6.5	30
Chester	2008	July	15.6	12.8	14.5	7.6	3.9	5.9	31
(NF1)	2008	Aug	15.7	12.5	14.3	6.4	3.8	5.2	31
	2008	Sept	12.9	9.5	11.2	5.3	2.4	4.0	30
Hamilton	2008	June	12.1	10.4	11.2	5.8	3.5	4.9	30
Branch at	2008	July	12.3	11.0	11.5	5.3	3.0	4.4	31
Road bridge	2008	Aug	12.1	10.8	11.4	4.9	3.2	4.1	31
(HB1)	2008	Sept	11.1	9.8	10.5	4.2	2.0	3.5	30
Hamilton	2008	June	13.4	11.3	12.3	8.6	4.1	7.4	30
Branch	2008	July	13.3	12.1	12.7	8.2	6.3	7.2	6
Powerhouse	2008	Aug	12.6	12.2	12.4	7.6	6.8	7.1	3
(HB2)	2008	Sept	14.2	11.3	13.0	5.4	0.4	3.0	16
Lake Almanor	2008	June	22.0	15.7	18.2	2.9	0.5	1.5	30
at Canyon Dam	2008	July	23.4	20.5	22.1	2.3	0.6	1.2	31
near surface	2008	Aug	24.4	21.3	22.3	1.8	0.4	1.1	31
(LA1-S)	2008	Sept	21.9	18.4	20.1	2.0	0.4	1.2	30
Lake Almanor	2008	June	10.4	9.5	10.0	2.2	0.6	1.1	30
at Canyon Dam	2008	July	11.5	10.5	11.0	1.7	0.7	1.2	31
near bottom	2008	Aug	12.5	11.6	11.9	1.7	0.7	1.2	31
(LA1-B)	2008	Sept	12.6	12.1	12.3	1.6	0.6	1.0	30
Butt Valley	2008	June	--	--	--	--	--	--	0
Powerhouse	2008	July	--	--	--	--	--	--	0
[Corrected]	2008	Aug	22.1	19.9	21.4	1.9	0.4	0.9	19
(BV1)	2008	Sept	21.0	18.0	19.7	1.0	0.2	0.5	30
Butt Creek above	2008	June	15.6	11.4	13.0	7.2	1.6	5.5	30
Butt Valley	2008	July	18.5	14.7	17.0	3.1	1.0	1.5	31
Reservoir	2008	Aug	19.0	11.9	16.6	5.2	0.9	2.5	16
(BC1)	2008	Sept	12.3	9.6	11.0	5.2	2.3	4.2	30
Butt Valley Res.	2008	June	22.6	16.9	19.8	2.9	0.5	1.2	30
at Caribou Intake	2008	July	23.8	21.4	22.2	3.1	0.5	1.1	31
Near surface	2008	Aug	24.2	21.4	22.5	2.6	0.4	1.0	31
(BV2-S)	2008	Sept	21.9	18.4	20.1	2.1	0.4	0.9	30
Butt Valley Res.	2008	June	14.5	10.2	12.0	1.8	0.7	1.1	30
at Caribou Intake	2008	July	16.7	14.6	15.7	1.8	0.7	1.2	31
Near bottom	2008	Aug	18.8	16.8	17.6	1.5	0.4	1.1	31
(BV2-B)	2008	Sept	19.4	17.7	18.8	1.4	0.1	0.6	30

Table 3-4 (Continued)

Station	Year	Month	Daily Ave Temperatures [1] max	min	mean	Diel Fluctuation [2] max	min	mean	Data Days
NFFR below	2008	June	12.5	10.7	11.8	3.3	1.1	1.9	23
Canyon Dam	2008	July	13.4	12.5	13.0	2.6	1.0	1.8	31
(NF2)	2008	Aug	14.4	13.5	13.9	2.6	1.3	1.8	31
	2008	Sept	14.7	14.2	14.4	2.0	1.0	1.6	30
NFFR at	2008	June	14.7	11.7	13.2	4.8	2.2	3.8	30
Seneca Bridge	2008	July	14.9	14.0	14.4	4.0	2.5	3.3	31
(NF3)	2008	Aug	15.6	14.0	14.8	3.6	2.3	2.9	31
	2008	Sept	14.6	13.0	13.8	3.3	1.5	2.3	30
NFFR above	2008	June	15.1	11.8	13.3	4.0	1.8	3.1	30
Caribou PH	2008	July	15.4	14.3	14.7	3.1	1.7	2.5	31
(NF4)	2008	Aug	16.0	14.0	15.0	3.2	1.9	2.6	31
	2008	Sept	14.4	12.2	13.3	2.8	1.3	2.1	30
Butt Creek below	2008	June	Monitoring not required since 2007						
Butt Valley	2008	July	--	--	--	--	--	--	--
Reservoir	2008	Aug	--	--	--	--	--	--	--
(BC2)	2008	Sept	--	--	--	--	--	--	--
Butt Creek at	2008	June	12.0	10.3	11.1	3.1	1.6	2.4	30
Mouth	2008	July	12.2	11.6	11.9	2.4	1.4	2.0	31
(BC3)	2008	Aug	12.7	11.7	12.2	2.4	1.4	2.0	31
	2008	Sept	12.1	11.2	11.7	2.3	1.0	1.7	30
Caribou No. 1	2008	June	15.8	14.5	15.3	3.2	1.6	2.1	7
Powerhouse	2008	July	17.5	17.5	17.5	2.4	1.8	2.1	2
[corrected]	2008	Aug	20.7	18.8	19.9	1.8	0.5	1.1	14
(CARB1)	2008	Sept	20.0	17.4	19.0	1.4	0.0	1.0	30
Caribou No. 2	2008	June	22.0	19.4	20.9	1.8	0.3	0.9	9
Powerhouse	2008	July	23.0	20.9	21.9	1.6	0.3	0.9	31
[corrected]	2008	Aug	23.3	20.9	21.8	1.4	0.3	0.7	31
(CARB2)	2008	Sept	21.4	18.3	19.9	1.1	0.0	0.6	30
Belden Reservoir	2008	June	19.3	13.7	16.2	1.1	0.2	0.4	30
At Intake	2008	July	21.4	19.3	20.6	1.3	0.4	0.8	31
(BD1)	2008	Aug	22.5	20.4	21.3	1.2	0.3	0.6	31
	2008	Sept	20.9	18.0	19.7	0.7	0.1	0.4	30
Belden	2008	June	16.8	16.2	16.5	3.4	0.7	2.1	2
Powerhouse	2008	July	21.6	19.5	21.0	1.1	0.2	0.4	21
(BD2)	2008	Aug	22.6	20.5	21.4	0.7	0.1	0.4	31
	2008	Sept	21.1	18.1	19.8	0.5	0.1	0.3	30

Table 3-4 (Continued)

Station	Year	Month	Daily Ave Temperatures [1] max	min	mean	Diel Fluctuation [2] max	min	mean	Data Days
NFFR below	2008	June	17.1	13.4	15.4	1.3	0.2	0.5	30
Belden Dam	2008	July	19.7	17.5	18.8	1.4	0.2	0.8	31
(NF5)	2008	Aug	21.4	19.2	20.4	0.8	0.2	0.4	31
	2008	Sept	20.6	17.7	19.3	1.0	0.2	0.6	30
Mosquito Creek	2008	June	13.7	10.6	11.9	2.4	1.2	1.9	30
At mouth	2008	July	14.4	13.2	13.6	2.0	1.2	1.7	31
(MC1)	2008	Aug	14.6	13.0	13.7	2.0	1.1	1.7	31
	2008	Sept	12.9	11.0	12.0	1.7	0.8	1.4	30
NFFR near	2008	June	17.1	13.6	15.4	3.6	1.8	3.0	30
Queen Lily	2008	July	19.6	17.4	18.7	3.6	2.0	2.8	31
Campground	2008	Aug	20.9	18.9	20.1	3.0	1.3	2.6	31
(NF6)	2008	Sept	19.6	16.9	18.3	4.4	1.7	3.4	30
NFFR near	2008	June	17.3	13.9	15.7	5.7	2.9	4.6	30
Gansner Bar	2008	July	19.8	17.6	18.9	5.1	2.9	4.2	31
(NF7)	2008	Aug	21.2	19.2	20.3	4.9	2.7	4.1	31
	2008	Sept	19.3	16.3	17.9	5.4	2.4	4.3	30
NFFR at Belden	2008	June	19.6	15.9	17.7	5.1	2.2	4.1	30
Town Bridge	2008	July	21.5	19.2	20.4	5.0	2.6	4.0	31
(NF8)	2008	Aug	22.5	19.9	21.1	5.2	3.1	4.5	31
	2008	Sept	20.2	16.4	18.3	4.3	2.0	3.4	30
East Branch	2008	June	21.9	16.7	19.2	4.4	2.0	3.5	30
NFFR at mouth	2008	July	23.9	21.1	22.3	3.3	1.4	2.3	31
(EB1)	2008	Aug	24.5	21.3	22.4	3.3	2.0	2.6	31
	2008	Sept	20.8	16.3	18.6	3.1	1.5	2.3	30
Yellow Creek	2008	June	16.5	11.3	13.7	4.1	1.8	3.2	30
Near mouth	2008	July	17.1	14.8	15.8	4.0	1.8	3.3	31
(YC1)	2008	Aug	17.6	14.5	15.9	4.2	2.4	3.6	31
	2008	Sept	14.4	10.6	12.6	3.5	1.6	2.7	30
Chips Creek	2008	June	14.7	8.9	11.7	4.8	1.6	3.8	30
Near mouth	2008	July	16.3	13.6	15.1	4.8	2.1	3.8	31
(CHIP)	2008	Aug	17.7	15.1	16.2	4.8	3.3	4.3	31
	2008	Sept	14.9	11.9	13.5	4.3	2.2	3.6	30
NFFR below Rock	2008	June	18.9	14.2	16.6	1.6	0.6	1.1	30
Creek Dam	2008	July	21.5	18.7	20.2	1.4	0.6	0.8	31
(NF9)	2008	Aug	22.5	20.2	21.3	1.3	0.5	0.7	31
	2008	Sept	21.0	17.8	19.5	1.0	0.2	0.7	30

Table 3-4 (Continued)

Station	Year	Month	Daily Ave Temperatures [1] max	Min	mean	Diel Fluctuation [2] max	min	mean	Data Days
NFFR at NF-57	2008	June	18.8	14.5	16.8	3.1	1.1	2.3	28
Telemetered	2008	July	21.3	18.6	20.0	2.7	1.2	1.8	31
(NF57 [Water	2008	Aug	22.5	19.9	21.1	2.2	0.5	1.5	31
Temp])	2008	Sept	20.7	17.8	19.2	1.6	0.5	1.3	30
Milk Ranch Creek	2008	June	15.5	10.0	12.4	5.0	2.1	3.7	30
Near mouth	2008	July	16.7	14.4	15.3	3.9	2.5	3.2	31
(MR1)	2008	Aug	16.9	14.1	15.4	3.4	1.8	2.8	31
	2008	Sept	14.2	11.4	12.9	2.6	1.2	2.0	30
Chambers Creek	2008	June	16.9	9.0	12.5	6.3	2.1	4.1	30
Near mouth	2008	July	17.4	14.6	15.7	3.8	2.0	3.1	31
(CHAM)	2008	Aug	18.1	14.5	16.3	3.9	2.5	3.3	31
	2008	Sept	15.6	12.4	14.0	3.6	1.6	3.0	30
NFFR near Tobin	2008	June	19.0	14.7	16.8	4.3	1.5	3.2	30
below Granite	2008	July	21.4	18.6	20.0	3.7	1.9	2.9	31
Creek (NF11)	2008	Aug	22.5	19.9	21.1	3.6	2.0	3.0	31
	2008	Sept	20.4	17.4	19.0	3.0	1.3	2.5	30
Jackass Creek	2008	June	16.7	9.9	12.9	6.5	2.5	4.7	30
Near mouth	2008	July	17.9	15.1	16.2	4.0	1.8	3.0	31
(JC1)	2008	Aug	18.8	15.3	17.0	2.5	1.5	2.0	31
	2008	Sept	16.5	13.6	15.0	2.0	0.9	1.6	30
NFFR abv Bucks	2008	June	19.1	14.7	17.0	3.7	1.3	2.7	30
Creek	2008	July	21.5	18.8	20.2	3.3	1.5	2.5	31
(NF12)	2008	Aug	22.6	20.1	21.2	3.3	2.0	2.8	31
	2008	Sept	20.5	17.5	19.0	3.0	1.5	2.4	30
Bucks Creek	2008	June	16.8	11.6	13.9	6.3	2.3	4.8	30
Near Mouth	2008	July	18.2	15.5	16.6	5.0	2.7	4.2	31
(BUCK1)	2008	Aug	18.7	14.7	16.6	4.8	2.5	3.9	31
	2008	Sept	15.4	11.8	13.6	3.9	1.6	3.1	30
Bucks Creek	2008	June	16.1	10.7	13.0	2.8	0.1	0.9	20
Powerhouse	2008	July	18.5	14.6	16.7	2.5	0.2	0.7	25
(BUCK2)	2008	Aug	16.0	14.8	15.5	2.3	0.2	1.1	26
	2008	Sept	16.1	15.1	15.5	3.5	1.2	2.5	10
NFFR abv Rock	2008	June	19.0	13.8	16.7	3.6	1.0	2.3	30
Creek Powerhouse	2008	July	21.0	18.3	19.4	3.5	1.1	1.8	31
(NF13)	2008	Aug	21.3	19.0	20.0	3.2	1.5	2.3	31
	2008	Sept	20.2	17.3	18.6	2.9	1.5	2.2	30

Table 3-4 (Continued)

Station	Year	Month	Daily Ave Temperatures [1] max	Min	mean	Diel Fluctuation [2] max	min	mean	Data Days
Rock Creek	2008	June	16.6	9.9	13.3	3.4	1.2	2.1	30
Powerhouse	2008	July	18.4	15.9	16.9	2.1	1.2	1.7	31
(RC1)	2008	Aug	19.0	16.1	17.5	2.4	1.4	1.9	31
	2008	Sept	16.7	13.7	15.2	1.9	0.8	1.4	30
Rock Creek	2008	June	16.6	9.9	13.3	3.4	1.2	2.1	30
Near mouth	2008	July	18.4	15.9	16.9	2.1	1.2	1.7	31
(RC2)	2008	Aug	19.0	16.1	17.5	2.4	1.4	1.9	31
	2008	Sept	16.7	13.7	15.2	1.9	0.8	1.4	30
NFFR abv Grizzly	2008	June	18.6	13.5	16.3	1.8	0.7	1.4	30
Creek	2008	July	21.0	18.8	19.7	1.3	0.6	1.1	31
(NF14)	2008	Aug	22.0	20.0	20.9	1.4	0.5	0.9	31
	2008	Sept	20.8	17.9	19.3	1.6	0.5	1.0	30
Grizzly Creek	2008	June	17.1	11.9	14.4	4.1	1.8	3.1	30
Near mouth	2008	July	19.4	16.8	18.1	3.5	1.8	2.7	31
(GR1)	2008	Aug	20.7	17.5	18.8	3.2	1.6	2.6	31
	2008	Sept	16.9	13.3	15.1	2.5	1.1	1.9	30
NFFR at NF-56	2008	June	18.4	14.2	16.3	5.5	1.6	3.4	28
Telemetered	2008	July	20.8	18.5	19.6	3.3	1.9	2.7	31
(NF56 [Water	2008	Aug	21.6	19.7	20.6	3.2	2.0	2.7	31
Temp])	2008	Sept	20.3	17.3	18.8	3.3	1.2	2.5	30
NFFR abv Cresta	2008	June	19.0	14.5	16.9	3.2	1.0	2.4	30
Powerhouse	2008	July	21.6	19.1	20.3	3.3	1.4	2.3	31
(NF16)	2008	Aug	22.3	20.3	21.2	3.1	1.6	2.6	31
	2008	Sept	20.8	17.6	19.2	3.0	1.4	2.2	30
Cresta	2008	June	18.9	13.6	16.4	1.0	0.2	0.5	30
Powerhouse	2008	July	21.4	19.1	20.0	0.9	0.2	0.4	31
(CR1)	2008	Aug	22.0	20.1	21.0	1.3	0.2	0.6	31
	2008	Sept	20.8	17.9	19.4	1.3	0.2	0.6	30
Middle Fork	2008	June	20.1	14.3	17.2	3.1	0.7	2.2	30
Feather River	2008	July	21.9	19.8	20.5	3.4	0.9	2.4	31
At Milsap Bar	2008	Aug	22.9	20.3	21.2	3.2	2.2	2.9	31
(MB1)	2008	Sept	19.5	15.5	17.5	2.9	1.5	2.4	30

1. Daily values are based on hourly average data. Monthly statistics represent the maximum, minimum, and mean based on these daily average temperatures. For example, the maximum June temperature represents the maximum daily average measured in June. See Appendix B for a summary of hourly data.

2. Diel Fluctuation is calculated based on the daily maximum temperature minus the daily minimum temperature. Monthly statistics are based on these daily range values.

3.2.1.1 Lake Almanor and Tributaries

Summer water temperatures in the NFFR upstream of Lake Almanor (near Chester) (NF1) were monitored in 2008 by the Licensee. This station was located in the NFFR upstream of the town of Chester and about 0.25 miles downstream of the Army Corp. of Engineers flood diversion dam. During the 2008 program, daily average temperatures at station NF1 ranged from 9.5 to 15.7°C, and averaged 13.1°C. The diel fluctuation in temperature ranged from 2.4 to 7.8°C, and averaged 5.4°C in 2008.

Under the Rock Creek-Cresta Relicensing Settlement Agreement (Pacific Gas and Electric Company 2008), a daily average water temperature of 20°C or less is specified as the desired water temperature level. As part of the license, to the extent that can reasonably be controlled, the Licensee shall try to maintain conditions at or below this temperature level. For this reason, a comparison to this level was made at applicable locations. At Station NF1, which defines the water temperature regime upstream of the PG&E project, the daily average temperatures were not above 20°C during the 2008 June through September period. The maximum hourly average temperature recorded at this station during the 2008 monitoring program was 19.3°C on July 7th (Appendix B). Table 3-5 compares daily average temperatures from each station with the 20°C level. Figure 3-6 compares the daily average temperature from the NFFR with other stations tributary to Lake Almanor.

Table 3-5

Summary of daily average temperature comparison with the 20°C level.

Station	Year	Month	Days Greater 20°C	Total Data Days	Percent Above 20°C Limit
NFFR at	2008	June	0	30	0%
Chester	2008	July	0	31	0%
(NF1)	2008	Aug	0	31	0%
	2008	Sept	0	30	0%
Hamilton	2008	June	0	30	0%
Branch at	2008	July	0	31	0%
Road bridge	2008	Aug	0	31	0%
(HB1)	2008	Sept	0	30	0%
Hamilton	2008	June	0	30	0%
Branch	2008	July	0	6	0%
Powerhouse	2008	Aug	0	3	0%
(HB2)	2008	Sept	0	16	0%
Lake Almanor	2008	June	4	30	13%
At Canyon Dam	2008	July	31	31	100%
near surface	2008	Aug	31	31	100%
(LA1-S)	2008	Sept	17	30	57%
Lake Almanor	2008	June	0	30	0%
At Canyon Dam	2008	July	0	31	0%
near bottom	2008	Aug	0	31	0%
(LA1-B)	2008	Sept	0	30	0%
Butt Valley	2008	June	--	--	--
Powerhouse	2008	July	--	--	--
[Corrected]	2008	Aug	18	19	95%
(BV1)	2008	Sept	16	30	53%
Butt Creek above	2008	June	0	30	0%
Butt Valley	2008	July	0	31	0%
Reservoir	2008	Aug	0	20	0%
(BC1)	2008	Sept	0	30	0%
Butt Valley Res.	2008	June	15	30	50%
at Caribou Intake	2008	July	31	31	100%
Near surface	2008	Aug	31	31	100%
(BV2-S)	2008	Sept	17	30	57%
Butt Valley Res.	2008	June	0	30	0%
at Caribou Intake	2008	July	0	31	0%
Near bottom	2008	Aug	0	31	0%
(BV2-B)	2008	Sept	0	30	0%

Table 3-5 (Continued)

Station	Year	Month	Days Greater 20°C	Total Data Days	Percent Above 20°C Limit
NFFR below	2008	June	0	23	0%
Canyon Dam	2008	July	0	31	0%
(NF2)	2008	Aug	0	31	0%
	2008	Sept	0	30	0%
NFFR at	2008	June	0	30	0%
Seneca Bridge	2008	July	0	31	0%
(NF3)	2008	Aug	0	31	0%
	2008	Sept	0	30	0%
NFFR above	2008	June	0	30	0%
Caribou PH	2008	July	0	31	0%
(NF4)	2008	Aug	0	31	0%
	2008	Sept	0	30	0%
Butt Creek below	2008	June	Monitoring not required since 2007		
Butt Valley	2008	July	--	--	--
Reservoir	2008	Aug	--	--	--
(BC2)	2008	Sept	--	--	--
Butt Creek at	2008	June	0	30	0%
Mouth	2008	July	0	31	0%
(BC3)	2008	Aug	0	31	0%
	2008	Sept	0	30	0%
Caribou No. 1	2008	June	0	7	0%
Powerhouse	2008	July	0	2	0%
[corrected]	2008	Aug	9	14	64%
(CARB1)	2008	Sept	1	30	3%
Caribou No. 2	2008	June	7	9	78%
Powerhouse	2008	July	31	31	100%
[corrected]	2008	Aug	31	31	100%
(CARB2)	2008	Sept	17	30	57%
Belden Reservoir	2008	June	0	30	0%
At Intake	2008	July	24	31	77%
(BD1)	2008	Aug	31	31	100%
	2008	Sept	15	30	50%
NFFR below	2008	June	0	30	0%
Belden Dam	2008	July	0	31	0%
(NF5)	2008	Aug	22	31	71%
	2008	Sept	6	30	20%

Table 3-5 (Continued)

Station	Year	Month	Days Greater 20°C	Total Data Days	Percent Above 20°C Limit
Mosquito Creek	2008	June	0	30	0%
At mouth	2008	July	0	31	0%
(MC1)	2008	Aug	0	31	0%
	2008	Sept	0	30	0%
NFFR near	2008	June	0	30	0%
Queen Lily	2008	July	0	31	0%
Campground	2008	Aug	19	31	61%
(NF6)	2008	Sept	0	30	0%
NFFR near	2008	June	0	30	0%
Gansner Bar	2008	July	0	31	0%
(NF7)	2008	Aug	21	31	68%
	2008	Sept	0	30	0%
East Branch	2008	June	8	30	27%
NFFR at mouth	2008	July	31	31	100%
(EB1)	2008	Aug	31	31	100%
	2008	Sept	4	30	13%
NFFR at Belden	2008	June	0	30	0%
Town Bridge	2008	July	24	31	77%
(NF8)	2008	Aug	30	31	97%
	2008	Sept	2	30	7%
Belden	2008	June	0	2	0%
Powerhouse	2008	July	20	21	95%
(BD2)	2008	Aug	31	31	100%
	2008	Sept	17	30	57%
Yellow Creek	2008	June	0	30	0%
Near mouth	2008	July	0	31	0%
(YC1)	2008	Aug	0	31	0%
	2008	Sept	0	30	0%
Chips Creek	2008	June	0	30	0%
Near mouth	2008	July	0	31	0%
(CHIP)	2008	Aug	0	31	0%
	2008	Sept	0	30	0%
NFFR below Rock	2008	June	0	30	0%
Creek Dam	2008	July	22	31	71%
(NF9)	2008	Aug	31	31	100%
	2008	Sept	9	30	30%

Table 3-5 (Continued)

Station	Year	Month	Days Greater 20°C	Total Data Days	Percent Above 20°C Limit
NFFR at NF-57	2008	June	0	30	0%
Telemetered	2008	July	7	31	23%
(NF57 [Water	2008	Aug	17	31	55%
Temp])	2008	Sept	2	30	7%
Milk Ranch Creek	2008	June	0	30	0%
Near mouth	2008	July	0	31	0%
(MR1)	2008	Aug	0	31	0%
	2008	Sept	0	30	0%
Chambers Creek	2008	June	0	30	0%
Near mouth	2008	July	0	31	0%
(CHAM)	2008	Aug	0	31	0%
	2008	Sept	0	30	0%
NFFR near Tobin	2008	June	0	30	0%
below Granite Crk	2008	July	20	31	65%
(NF11)	2008	Aug	30	31	97%
	2008	Sept	4	30	13%
Jackass Creek	2008	June	0	30	0%
Near mouth	2008	July	0	31	0%
(JC1)	2008	Aug	0	31	0%
	2008	Sept	0	30	0%
NFFR above	2008	June	0	30	0%
Bucks Creek	2008	July	22	31	71%
(NF12)	2008	Aug	31	31	100%
	2008	Sept	4	30	13%
Bucks Creek	2008	June	0	30	0%
Near Mouth	2008	July	0	31	0%
(BUCK1)	2008	Aug	0	31	0%
	2008	Sept	0	30	0%
Bucks Creek	2008	June	0	20	0%
Powerhouse	2008	July	0	25	0%
(BUCK2)	2008	Aug	0	26	0%
	2008	Sept	0	10	0%
NFFR abv Rock	2008	June	0	30	0%
Creek Powerhouse	2008	July	7	31	23%
(NF13)	2008	Aug	17	31	55%
	2008	Sept	2	30	7%
Rock Creek	2008	June	0	30	0%
Powerhouse	2008	July	18	31	58%
(RC1)	2008	Aug	30	31	97%
	2008	Sept	17	30	57%

Table 3-5 (Continued)

Station	Year	Month	Days Greater 20°C	Total Data Days	Percent Above 20°C Limit
Rock Creek	2008	June	0	30	0%
Near mouth	2008	July	0	31	0%
(RC2)	2008	Aug	0	31	0%
	2008	Sept	0	30	0%
NFFR abv Grizzly	2008	June	0	30	0%
Creek	2008	July	8	31	26%
(NF14)	2008	Aug	29	31	94%
	2008	Sept	6	30	20%
Grizzly Creek	2008	June	0	30	0%
Near mouth	2008	July	0	31	0%
(GR1)	2008	Aug	3	31	10%
	2008	Sept	0	30	0%
NFFR at NF-56	2008	June	0	28	0%
Telemetered	2008	July	8	31	26%
(NF56 [Water	2008	Aug	28	31	90%
Temp])	2008	Sept	2	30	7%
NFFR abv Cresta	2008	June	0	30	0%
Powerhouse	2008	July	24	31	77%
(NF16)	2008	Aug	31	31	100%
	2008	Sept	5	30	17%
Cresta	2008	June	0	30	0%
Powerhouse	2008	July	12	31	39%
(CR1)	2008	Aug	31	31	100%
	2008	Sept	6	30	20%
Middle Fork	2008	June	1	30	3%
Feather River	2008	July	24	31	77%
At Milsap Bar	2008	Aug	31	31	100%
(MB1)	2008	Sept	0	30	0%

Water temperatures in the Hamilton Branch of the NFFR (Hamilton Branch) are primarily a function of conditions in Mountain Meadows Reservoir and the significant accretion that occurs along its entire length. Temperatures in the Hamilton Branch tend to be less variable and slightly cooler than those measured in the NFFR upstream of Lake Almanor (NF1). The Hamilton Branch station (HB1) was located in the river below the Peninsula Road Bridge; this station was positioned to be upstream of any backwater effect associated with Lake Almanor.

During the 2008 program, daily average temperatures at station HB1 ranged from 9.8 to 12.3°C, and averaged 11.1°C. The diel fluctuation in temperature ranged from 2.0 to 5.8°C, and averaged 4.2°C in 2008. Figure 3-6 compares the daily average temperature from HB1 with other stations tributary to Lake Almanor. The maximum hourly average temperature recorded at this station during the 2008 monitoring program was 15.1°C on July 7 th (Appendix B). At station HB1, daily average temperatures were not above 20°C during the June-September 2008 period (Table 3-5).

Water temperatures associated with flow through Hamilton Branch Powerhouse are a function of conditions in Mountain Meadows Reservoir. The Hamilton Branch Powerhouse station (HB2) was located in the diversion canal immediately upstream of the head-works control structure. The powerhouse discharges directly into Lake Almanor from an elevated tailrace. During the 2008 program, daily average temperatures at station HB2 ranged from 11.3 to 14.2°C, and averaged 12.6°C. The diel fluctuation in

temperature ranged from 0.4 to 8.6°C, and averaged 6.2°C in 2008. Figure 3-6 compares the daily average temperature from HB2 with other stations tributary to Lake Almanor. The higher temperature values observed in the late part of the summer (August-September) were associated with higher instream releases from Mountain Meadows Reservoir. The maximum hourly average temperature recorded at this station during the 2008 monitoring program was 18.1°C on June 27 (Appendix B). Daily average temperatures did not exceed 20°C on any of the 55 operational days (0%) during the June-September 2008 period.

As discussed earlier, Lake Almanor is the primary storage reservoir on the NFFR. Lake Almanor has a very large surface area with relatively moderate depths. Resource monitoring indicates that near the Canyon Dam and Prattville intakes, Lake Almanor undergoes thermal stratification (CDFG 1988; DWR 1999; Pacific Gas and Electric Company 1982, 1984, 1986, 1987, 2002). Thermal gradients typically begin to develop relatively early in Lake Almanor (April-May). During June, the development of temperature stratification is well underway. By July, a fully developed thermal structure is present, including a well-developed epilimnion, thermocline, and hypolimnion. The stratification is persistent throughout the summer, with the epilimnion growing downward throughout the period and with turnover usually occurring during the period between late September and October.

The general pattern of temperature stratification near the Canyon Dam Intake was continuously measured by a submerged array of digital recorders deployed in 2008. The

temperature recorders were set up on a cable attached to a buoy. As a result, the top sensor remained approximately 0.5 meters below the surface, while the bottom sensor was typically 0 to 2 meters off of the bottom depending on lake elevation. Data from 2008 indicated that daily average temperatures at the lake surface (LA1-S) ranged from 15.7 to 24.4°C during the June through September period. Daily average temperatures near the bottom (LA1-B) ranged from 9.5 to 12.6°C during the same period. The daily average temperatures at station LA1-S were above 20°C on 83 of 122 days (68%) during the 2008 June through September period (Table 3-5). Figure 3-7 compares mean daily temperatures from the epilimnion and hypolimnion for 2008.

Summer temperature profiles in Lake Almanor show that a warm upper layer (epilimnion) extends to a depth of about 9 meters and that a colder bottom layer (hypolimnion) typically exists below a depth of 12 meters. The seasonal characteristics of the 2008 Lake Almanor thermocline were defined using monthly vertical profiles. Figure 3-8 compares monthly profiles from Lake Almanor near the Canyon Dam Intake (LA-P1) for the period May through September 2008. All profile data from Lake Almanor is presented in Appendix C.

Vertical temperature profiles were measured at four locations, covering the main body near Canyon Dam, the Prattville Intake area, and two longitudinal axes of Lake Almanor (see Figure 2-1). Figure 3-9 compares monthly profiles from each of the four profile stations. This figure illustrates the limited lateral thermal variation present in Lake Almanor in 2008. As illustrated by these figures, temperature profiles indicate that colder water is

present only in stations located in the deeper portions of the lake, particularly near Canyon Dam (Pacific Gas and Electric Company 2002).

3.2.1.2 Butt Valley Reservoir and tributaries

Butt Valley Reservoir is a long, narrow water body of moderate depth. The deepest areas of the reservoir occur near the dam. Water temperature in Butt Valley Reservoir is essentially driven by conditions in Lake Almanor and the physical configuration of the Prattville Intake. The operations of Butt Valley Powerhouse and the Caribou No. 1 and No. 2 powerhouses are the primary controlling influences on the water resources entering and leaving Butt Valley Reservoir. Under typical conditions, only a limited volume of cold water is available in Butt Valley Reservoir during the summer. Contributions from Butt Creek are seasonally variable, but typically remain a relatively small portion of the total inflow to the reservoir. The thermal structure of Butt Valley Reservoir is driven largely by the physical configuration of the reservoir and the location and operation of the two Caribou intakes.

Although perennial flow is present in Butt Creek upstream of Butt Valley Reservoir, the primary source of flow into the reservoir is through Butt Valley Powerhouse. Temperatures in the tailrace are representative of temperatures withdrawn from the Prattville Intake in Lake Almanor (Pacific Gas and Electric Company 1986). The Butt Valley Powerhouse station (BV1) was located in the tailrace estuary downstream of the powerhouse. The tailrace discharges directly into the original Butt Creek channel;

however, depending on lake elevation this area can exhibit flow characteristics ranging from riverine to lacustrine. The Butt Valley Powerhouse was shut down for maintenance during the period June 1 through August 12, 2008. During the 2008 program, daily average temperatures at station BV1 ranged from 18.0 to 22.1°C, and averaged 20.5°C. The diel fluctuation in temperature ranged from 0.2 to 1.9°C, and averaged 0.7°C in 2008. The maximum hourly average temperature recorded at this station during the 2008 monitoring program was 22.9°C on August 28 (Appendix B). The daily average temperatures at station BV1 exceeded 20°C on 34 of the 49 operational days (69%) during the 2008 June through September period. Figure 3-10 compares daily average temperatures from station BV1 with other stations tributary to Butt Valley Reservoir.

Temperatures in Butt Creek (BC1) were monitored upstream of the backwater effect from Butt Valley Reservoir during the 2008 period. Stream temperature regime was effected by high releases into the Butt Creek channel from the Lake Almanor-Butt Valley penstock as the result of the Butt Valley Powerhouse outage. The recorder was out of the water during the period August 11 through August 25, it is suspected that the recorder was left stranded following a period of high instream releases. During the 2008 program, daily average temperatures at station BC1 ranged from 9.6 to 19.0°C, and averaged 14.4°C. The diel fluctuation in temperature ranged from 0.9 to 7.2°C, and averaged 3.4°C in 2008. The maximum hourly average temperature recorded at this station during the 2008 monitoring program was 19.5°C on August 9 (Appendix B). The daily average temperatures at station BC1 did not exceed 20°C during the 2008 June through September period (Table 3-5).

A moderately pronounced thermal gradient does develop in Butt Valley Reservoir in the late spring and early summer. However, as a result of the relatively short retention time, and depending on the frequency of usage of the Caribou No. 1 Intake (located in the deeper portion of the lake), the limited cold water volume can be consumed in a few weeks. In general, an identifiable thermocline was present in June and persisted through July. By early August, after a few weeks of operation at Caribou No. 1 Powerhouse, a well-defined hypolimnion and epilimnion were no longer present (Pacific Gas and Electric Company 2002).

The seasonal characteristics of the Butt Valley Reservoir thermocline in 2008 were defined using monthly vertical profiles. Figure 3-11 compares monthly profiles from the Butt Valley Reservoir near Caribou No. 1 Intake (BV-P1) for the period May through September 2008. As indicated by these data Butt Valley Reservoir was essentially isothermal by August 2008. All profile data from Butt Valley Reservoir are presented in Appendix C.

Vertical temperature profiles were measured at three locations (BV-P1, BV-P2, BV-P3), covering the longitudinal axis of Butt Valley Reservoir. Profiles measured from June through September 2008 indicated little difference in thermal structure along the longitude of the reservoir. Figure 3-12 illustrates the longitudinal thermal structure present in Butt Valley Reservoir in 2008 by comparing monthly temperature profiles from the three

profile stations located in the reservoir. As illustrated by these figures, the general thermal structure is well established in the upper portion of the reservoir. The data also indicate that the only area with a cool-water zone is located near the dam.

The development of temperature stratification near the Caribou No. 1 Intake was measured continuously by a submerged array of digital recorders deployed in 2008. The temperature recorders were set up on a cable attached to a buoy. As a result, the top sensor remained approximately 0.5 meters below the surface, while the bottom sensor was typically 0.5 to 5 meters off the bottom. Daily average temperatures recorded in the epilimnion (BV2-S) of Butt Valley Reservoir near the Caribou No. 1 Intake averaged 21.1°C, and ranged from 16.9 to 24.2°C for the period June through September in 2008. The daily average temperatures at station BV2-S were above 20°C on 94 of 122 days (77%) during the 2008 June through September period (Table 3-5). Daily average temperatures from the hypolimnion (BV2-B) ranged from 10.2 to 19.4°C, with an average of 16.0°C during the same period (Table 3-4). The daily average temperatures at station BV2-B did not exceed 20°C during the 2008 June through September period (Table 3-5). Figure 3-13 compares mean daily temperatures from the epilimnion and hypolimnion of Butt Valley Reservoir for 2008. As indicated by the data in this figure, the reservoir became nearly isothermal (less than 3°C difference between top and bottom recorders) by late August.

3.2.1.3 Seneca Reach of NFFR

Water temperature in the NFFR below Canyon Dam is largely determined by the level at which water is released from the lake through the Canyon Dam Intake tower. At present, the Licensee preferentially utilizes the lower gates as the source of fishwater releases. The lower gates in combination with the upper gates are used during periods that require high flow releases. In 2008, the Licensee utilized the lower gate for fishwater release throughout the year.

Water temperatures in the NFFR downstream of Canyon Dam (NF2) were monitored approximately 0.25 miles downstream of the release structure during the 2008 monitoring effort. This station represents the initial conditions in the Seneca Reach and corresponded with the location of the Licensees NF-2 permanent flow monitoring station. During the 2008 program, daily average temperatures at station NF2 ranged from 10.7 to 14.7°C, and averaged 13.3°C. The diel fluctuation in temperature ranged from 1.0 to 3.3°C, and averaged 1.8°C in 2008. The maximum hourly average temperature recorded at this station during the 2008 monitoring program was 16.1°C on September 5th (Appendix B). The daily average temperatures at station NF2 did not exceed 20°C during the 2008 June through September period (Table 3-5).

Water temperatures in the NFFR at Seneca (NF3) were monitored approximately 60 meters downstream of the Seneca Road Bridge during the 2008 monitoring effort. This station represents conditions present in the middle of the Seneca Reach. During the 2008

program, daily average temperatures at station NF3 ranged from 11.7 to 15.6°C, and averaged 14.0°C. The diel fluctuation in temperature ranged from 1.5 to 4.8°C, and averaged 3.1°C in 2008. The maximum hourly average temperature recorded at this station during the 2008 monitoring program was 17.0°C on August 15 (Appendix B). The daily average temperatures at station NF3 did not exceed 20°C during the 2008 June through September period (Table 3-5).

Water temperatures were monitored in the NFFR approximately 0.5 miles upstream of Caribou Powerhouse (NF4) during the 2008 monitoring effort. This station represents conditions present at the end of the Seneca Reach. During the 2008 program, daily average temperatures at station NF4 ranged from 11.8 to 16.0°C, and averaged 14.1°C. The diel fluctuation in temperature ranged from 1.3 to 4.0°C, and averaged 2.6°C in 2008. The maximum hourly average temperature recorded at this station during the 2008 monitoring program was 17.5°C on August 15 (Appendix B). The daily average temperatures at station NF4 did not exceed 20°C during the 2008 June through September period (Table 3-5).

The magnitude of temperature changes that occur in the Seneca Reach depends on several factors including which release gates are used, the magnitude of the release flow, the magnitude of tributary inflows, physical characteristics of the stream channel, topographic and riparian shading and meteorological conditions. To compare the relative change in temperature occurring through the entire bypass reach, the daily average temperature from

station NF2 was compared with the daily average temperatures at station NF4. Temperatures were only evaluated for the period when releases were made from the low-level gate at the Canyon Dam Intake. Releases were made from the same gate for the entire period in 2008. For the period June through September, the daily average temperatures at station NF4 (upstream of Caribou Powerhouse) averaged 0.8°C warmer in 2008, than at station NF2 (below Canyon Dam). These values represent the average heating occurring through the entire Seneca Reach and calculate to a less than 0.1°C per mile increase in temperature for 2008. Figure 3-14 compares the daily average temperatures at the three stations located in the Seneca Reach in 2008.

3.2.1.4 Lower Butt Creek

No release is made from Butt Valley Reservoir to the lower Butt Creek channel. As a result, flows in lower Butt Creek are derived from various sources of tributary and accretion inflows. Water temperature was measured at two locations in Butt Creek downstream of Butt Valley Dam.

The first station in lower Butt Creek was located approximately 0.3 miles below the dam (BC2). This station captured inflow from Benner Creek, leakage flows from Butt Valley Dam, and the spring inflow that arises in the Butt Creek channel downstream of the Benner Creek confluence. Temperatures at this station typically exhibit constant value, varying from 10.6 to 10.8°C, based on the past 5 years monitoring results. Because of its relative constant value and extremely difficult and dangerous to access, this station was not

deployed since 2007 as per agreement with the Rock Creek-Cresta ERC (ERC meeting on April 18, 2007) decision.

The second station in lower Butt Creek was located near the mouth (BC3). This station was about 100 meters above the confluence with the NFFR. This station defines the quality of inflow to the NFFR from the largest tributary in the Seneca Reach. During the 2008 program, daily average temperatures at station BC3 ranged from 10.3 to 12.7°C, and averaged 11.7°C. The diel fluctuation in temperature ranged from 1.0 to 3.1°C, and averaged 2.0°C in 2008. The maximum hourly average temperature recorded at this station during the 2008 monitoring program was 13.9°C on August 16 (Appendix B). The daily average temperatures at station BC3 did not exceed 20°C during the 2008 June through September period (Table 3-5). Figure 3-15 presents the daily average water temperatures from this lower Butt Creek station in 2008.

3.2.1.5 Belden Forebay and Caribou Powerhouse complex

Water temperature in Belden Forebay is primarily the result of the combined flows from Caribou No. 1 and No. 2 powerhouses. Other inflows to Belden Forebay originate from the Seneca Reach of the NFFR. All three-inflow sources enter through the same channel in the upper portion of Belden Forebay.

Water temperatures at Caribou No. 1 Powerhouse (CARB1) were monitored at an internal location due to the configuration of the tailrace at this facility. Water temperature data

were processed to remove data for periods when the powerhouse was not operating and when water within the penstock was static and no discharge to the NFFR was being made. During the 2008 program, daily average temperatures at station CARB1 ranged from 14.5 to 20.7°C, and averaged 17.9°C. The diel fluctuation in temperature ranged from 0.0 to 3.2°C, and averaged 1.6°C in 2008. The maximum hourly average temperature recorded at this station during the 2008 monitoring program was 21.1°C on August 28 (Appendix B). The daily average temperatures at station CARB1 exceeded 20°C on 10 of 53 operational days (19%) in the 2008 June through September period (Table 3-5).

Water temperatures at Caribou No. 2 Powerhouse (CARB2) were monitored directly from the penstock at the main valve house. This location was chosen due to the configuration of the tailrace at this facility, which is submerged by Belden Forebay. Water temperature data were processed to remove data for periods when the powerhouse was not operating and when water within the penstock was static and no discharge to the NFFR was being made. During the 2008 program, daily average temperatures at station CARB2 ranged from 18.3 to 23.3°C, and averaged 21.1°C. The diel fluctuation in temperature ranged from 0.0 to 1.8°C, and averaged 0.8°C in 2008. The maximum hourly average temperature recorded at this station during the 2008 monitoring program was 23.6°C on August 16 (Appendix B). The daily average temperatures at station CARB2 were above 20°C on 86 of 101 operating days (85%) during the 2008.

Water temperature was monitored in Belden Forebay near the Belden Powerhouse Intake at a fixed depth. During the 2008 program, daily average temperatures at station BD1 ranged from 13.7 to 22.5°C, and averaged 19.4°C. The diel fluctuation in temperature ranged from 0.1 to 1.3°C, and averaged 0.6°C in 2008. The maximum hourly average temperature recorded at this station during the 2008 monitoring program was 23.0°C on August 16 (Appendix B). The daily average temperatures at station BD1 exceeded 20°C on 70 of 122 days (57%) during the 2008 June through September period (Table 3-5).

Temperatures at Belden Powerhouse (BD2) are essentially the same as those present in Belden Forebay as measured at the powerhouse intake (BD1) and primarily reflect the temperature of Butt Valley Reservoir water as released by the Caribou powerhouses, with some minor modification due to mixing and heat exchange in Belden Forebay. Water temperatures at Belden Powerhouse were monitored at an internal location due to the configuration of the tailrace at this facility. Water temperature data were then processed to remove data from periods when the powerhouse was not operating and when water within the penstock was static and no discharge to the NFFR was being made. During the 2008 program, daily average temperatures at station BD2 ranged from 16.2 to 22.6 °C, and averaged 19.7°C. The diel fluctuation in temperature ranged from 0.1 to 3.4°C, and averaged 0.8°C in 2008. The maximum hourly average temperature recorded at this station during the 2008 monitoring program was 22.9°C on August 16 (Appendix B). The daily average temperatures at station BD2 exceeded 20°C on 68 days during the 84 operational days (81%) in the 2008 June through September period (Table 3-5). Figure 3-

16 compares the daily average temperatures at the four stations associated with the Caribou Powerhouse-Belden Forebay complex in 2008.

3.2.1.6 Belden Reach of the NFFR and tributaries

Water temperatures were recorded in the NFFR downstream of Belden Dam (NF5) throughout the 2008 sampling season. This station represents initial conditions in the Belden Reach and corresponds with the location of the permanent flow monitoring station (NF-70). During the 2008 program, daily average temperatures at station NF5 ranged from 13.4 to 21.4°C, and averaged 18.5°C. The diel fluctuation in temperature ranged from 0.2 to 1.4°C, and averaged 0.6°C in 2008. The maximum hourly average temperature recorded at this station during the 2008 monitoring program was 21.7°C on August 29 (Appendix B). The daily average temperatures at station NF5 exceeded 20°C on 28 of 122 days (23%) during the 2008 June through September period (Table 3-5).

Water temperatures were recorded in Mosquito Creek near its confluence with the NFFR (MC1). Temperatures were comparatively cool with a relatively stable flow regime suggesting a strong groundwater supply during non-runoff periods. Mosquito Creek provides a cooling influence in the Belden Reach. Daily average temperatures at station MC1 ranged from 10.6 to 14.6°C, and averaged 12.8°C. The diel fluctuation in temperature ranged from 0.8 to 2.4°C, and averaged 1.6°C in 2008. The maximum hourly average temperature recorded at this station during the available 2008 monitoring period

was 15.5°C on August 16 (Appendix B). The daily average temperatures at station MC1 did not exceed 20°C during the 2008 June through September period (Table 3-5).

The station located near the Queen Lily Campground (NF6) represents conditions in the middle section of the Belden Reach and defines conditions downstream of the largest tributary in the reach. During the 2008 program, daily average temperatures at station NF6 ranged from 13.6 to 20.9°C, and averaged 18.1°C. The diel fluctuation in temperature ranged from 1.3 to 4.4°C, and averaged 2.9°C in 2008. The maximum hourly average temperature recorded at this station during the 2008 monitoring program was 22.7°C on August 29 (Appendix B). The daily average temperatures at station NF6 exceeded 20°C on 19 of 122 day (16%) during the 2008 June through September period (Table 3-5).

Station NF7 represents conditions in the NFFR at the end of the upper Belden Reach. This station is also upstream of the confluence with the EBNFFR. During the 2008 program, daily average temperatures at station NF7 ranged from 13.9 to 21.2°C, and averaged 18.2°C. The diel fluctuation in temperature ranged from 2.4 to 5.7°C, and averaged 4.3°C in 2008. The maximum hourly average temperature recorded at this station during the 2008 monitoring program was 23.9°C on August 16 (Appendix B). The daily average temperatures at station NF7 exceeded 20°C on 21 of 122 days (17%) during the 2008 June through September period (Table 3-5).

The total change in daily average temperature in the upper Belden Reach was measured as the difference between the NFFR at the confluence with the EBNFFR (NF7) and below Belden Dam (NF5). The change in temperature between stations NF5 and NF7 was evaluated for the period June-September. The total daily average temperature at station NF7 averaged 0.3°C cooler in 2008 than at station NF5. This value calculates to a 0.05°C per mile decrease in temperature in the upper Belden Reach. Figure 3-17 compares the daily average temperatures at the four stations located in the upper Belden Reach in 2008.

The temperature station in the NFFR upstream of Yellow Creek (NF8), was located immediately upstream of the Belden Town bridge. This station is approximately 1.75 miles downstream of the confluence of the EBNFFR with the NFFR. Temperatures at this location were warmer than those measured in the NFFR upstream of the EBNFFR (NF7), but cooler than in the EBNFFR. This station represents conditions in the NFFR at the end of the Belden bypass reach. During the 2008 program, daily average temperatures at station NF8 ranged from 15.9 to 22.5°C, and averaged 19.4°C. The diel fluctuation in temperature ranged from 2.0 to 5.2°C, and averaged 4.0°C in 2008. The maximum hourly average temperature recorded at this station during the 2008 monitoring program was 24.9°C on August 16 (Appendix B). The daily average temperatures at station NF8 were above 20°C on 56 of 122 days (46%) during the 2008 June through September period.

The daily average change in temperature in the NFFR between the NFFR at the confluence with the EBNFFR (NF7) and Belden Town Bridge (NF8) was evaluated for the period

June through September. The daily average temperatures at station NF8 in 2008 averaged 1.2°C warmer than at station NF7. This value calculates to a 0.6°C per mile increase in temperature in this section of the NFFR. This increase is attributable to the contribution from the EBNFFR.

Temperatures were recorded in the EBNFFR upstream of the confluence with the NFFR (EB1) during the 2008 sampling season. During the 2008 program, daily average temperatures at station EB1 ranged from 16.3 to 24.5°C, and averaged 20.6°C. The diel fluctuation in temperature ranged from 1.4 to 4.4°C, and averaged 2.7°C in 2008. The maximum hourly average temperature recorded at this station during the 2008 monitoring program was 25.6°C on August 16 (Appendix B). This was the highest hourly average temperature recorded during the 2008 monitoring program. The daily average temperatures at station EB1 were above 20°C on 74 of 122 days (61%) during the 2008 June through September period.

Temperatures were monitored in Yellow Creek (YC1) 0.5 miles upstream of its confluence with the NFFR during the 2008 sampling season. This station represents conditions at the mouth of Yellow Creek upstream of the confluence with the NFFR. During the 2008 program, daily average temperatures at station YC1 ranged from 10.6 to 17.6°C, and averaged 14.5°C. The diel fluctuation in temperature ranged from 1.6 to 4.2°C, and averaged 3.2°C in 2008. The maximum hourly average temperature recorded at this station during the 2008 monitoring program was 19.7°C on August 16 (Appendix B). The

daily average temperatures at Station YC1 did not exceed 20°C during the June through September period in 2008 (Table 3-5). Figure 3-18 compares the daily average temperatures from several stations in the lower Belden Reach.

Temperatures were monitored in Chips Creek (CHIP) 0.2 miles upstream of its confluence with the NFFR (Rock Creek Reservoir) during the 2008 sampling season. Chips Creek discharges directly into Rock Creek Reservoir. During the 2008 program, daily average temperatures at station CHIP ranged from 8.9 to 17.1°C, and averaged 14.1°C (Figure 3-19). The diel fluctuation in temperature ranged from 1.6 to 4.8°C, and averaged 3.9°C in 2008. The maximum hourly average temperature recorded at this station during the 2008 monitoring program was 20.2°C on August 16 (Appendix B). The daily average temperatures at station CHIP did not exceed 20°C during the June through September period in 2008 (Table 3-5).

3.2.1.7 Rock Creek Reach of the NFFR and tributaries

The first temperature station in the NFFR downstream of Rock Creek Dam (NF9) is located immediately below the dam. During the 2008 program, daily average temperatures at station NF9 ranged from 14.2 to 22.5°C, and averaged 19.4°C. The diel fluctuation in temperature ranged from 0.2 to 1.6°C, and averaged 0.8°C in 2008. The maximum hourly average temperature recorded at this station during the 2008 monitoring program was 22.8°C on August 17 (Appendix B). The daily average temperatures at Station NF9 exceeded 20°C on 62 of 121 days (51%) during the June through September period in 2008

(Table 3-5). Figure 3-19 compares the 2008 daily average temperatures from NF9 with five other river stations located in the Rock Creek Reach.

The temperature station in the NFFR downstream of Rock Creek Dam (NF10) was located near the NF-57 gaging station. This station is approximately 1.5 miles downstream of the dam. The recorder deployed at this station used to serve as a backup for the telemetered station (NF57 [water Temp]) as discussed in Section 3.2.2.2. The telemetered unit has proven reliable over the past 5 years and therefore the data logger deployed at The NF10 was deemed no longer necessary as per discussions with the Rock Creek-Cresta ERC. NF10 recorder was removed since 2007. Figure 3-19 compares the 2008 daily average temperatures from Station NF57 [Water Temp] with five other river stations located in the Rock Creek Reach.

Temperatures were monitored in Milk Ranch Creek (MR1) 0.25 miles upstream of its confluence with the NFFR during the 2008 sampling season. This station represents conditions at the mouth upstream of the influence from the NFFR. During the 2008 program, daily average temperatures at station MR1 ranged from 10.0 to 16.9°C, and averaged 14.0°C. The diel fluctuation in temperature ranged from 1.2 to 5.0°C, and averaged 2.9°C in 2008. The maximum hourly average temperature recorded at this station during the 2008 monitoring program was 18.6°C on July 15 (Appendix B). The daily average temperatures at station MR1 did not exceed 20°C during the June through September period in 2008 (Table 3-5). Figure 3-19 compares 2008 daily average

temperatures from MR1 with other stations tributary to the NFFR in the Rock Creek Reach.

Temperatures were monitored in Chambers Creek (CHAM) 0.2 miles upstream of its confluence with the NFFR during the 2008 sampling season. This station represents conditions near the mouth upstream of any influence from the NFFR. During the 2008 program, daily average temperatures at station CHAM ranged from 9.0 to 18.1°C, and averaged 14.6°C. The diel fluctuation in temperature ranged from 1.6 to 6.3°C, and averaged 3.4°C in 2008. The maximum hourly average temperature recorded at this station during the 2008 monitoring program was 19.9°C on August 16 (Appendix B). The daily average temperatures at station CHAM did not exceed 20°C during the June through September period in 2008 (Table 3-5). Figure 3-19 compares 2008 daily average temperatures from CHAM with other stations tributary to the NFFR in the Rock Creek Reach.

The station located on the NFFR below Granite Creek (NF11) represents conditions in the middle section of the Rock Creek Reach and defines conditions downstream of several tributaries. During the 2008 program, daily average temperatures at station NF11 ranged from 14.7 to 22.5°C, and averaged 19.2°C. The diel fluctuation in temperature ranged from 1.3 to 4.3°C, and averaged 2.9°C in 2008. The maximum hourly average temperature recorded at this station during the 2008 monitoring program was 23.9°C on August 16 (Appendix B). The daily average temperatures at station NF11 were above 20°C on 54 of

122 days (44%) during the 2008 June through September period. Figure 3-19 compares the 2008 daily average temperatures from NF11 with four other river stations located in the Rock Creek Reach.

Temperatures were monitored in Jackass Creek (JC1) 0.2 miles upstream of its confluence with the NFFR during the 2008 sampling season. This station represents conditions near the mouth upstream of any influence from the NFFR. The data from this station for the period September 1 through September 30 were lost; as a result the data discussed covers the period June 1 to August 31. During the 2008 program, daily average temperatures at station JC1 ranged from 9.9 to 18.8°C, and averaged 15.3°C. The diel fluctuation in temperature ranged from 0.9 to 6.5°C, and averaged 2.8°C in 2008. The maximum hourly average temperature recorded at this station during the 2008 monitoring program was 19.7°C on July 15 (Appendix B). The daily average temperatures at station JC1 did not exceed 20°C during the June through August period in 2008 (Table 3-5). Figure 3-19 compares 2008 daily average temperatures from JC1 with other stations tributary to the NFFR in the Rock Creek Reach.

The NFFR station located upstream of the Bucks Creek confluence (NF12) represents conditions at the end of the Rock Creek Reach and defines conditions prior to inflow from Bucks Creek and Bucks Creek Powerhouse. During the 2008 program, daily average temperatures at station NF12 ranged from 14.7 to 22.6°C, and averaged 19.3°C. The diel fluctuation in temperature ranged from 1.3 to 3.7°C, and averaged 2.6°C in 2008. The

maximum hourly average temperature recorded at this station during the 2008 monitoring program was 23.8°C on August 16 (Appendix B). The daily average temperatures at station NF12 were above 20°C on 57 of 122 days (47%) during the 2008 June through September period. Figure 3-20 compares the 2008 daily average temperatures from NF12 with four other river stations located in the Rock Creek Reach.

The daily average change in temperature in the Rock Creek Reach (NFFR between Rock Creek Dam [NF9] and above Bucks Creek [NF12]) was evaluated for the period June 1 through September 30. The daily average temperatures at station NF12 in 2008 averaged 0.1°C cooler than at station NF9. This value calculates to a 0.01°C per mile decrease in temperature in this section of the NFFR.

Temperatures were monitored in Bucks Creek (BUCK1) 0.04 miles upstream of its confluence with the NFFR during the 2008 sampling season. During the 2008 program, daily average temperatures at station BUCK1 ranged from 11.6 to 18.7°C, and averaged 15.1°C. The diel fluctuation in temperature ranged from 1.6 to 6.3°C, and averaged 4.0°C in 2008. The maximum hourly average temperature recorded at this station during the 2008 monitoring program was 21.0°C on August 16 (Appendix B). The daily average temperatures at station BUCK1 did not exceed 20°C during the June through September period in 2008 (Table 3-5). Figure 3-20 compares 2008 daily average temperatures from BUCK1 with other stations tributary to the NFFR in the Rock Creek Reach.

Temperatures at Bucks Creek Powerhouse (BUCK2) are essentially the same as those present in Lower Bucks Creek Reservoir. Water temperatures at Bucks Creek Powerhouse were monitored in the tailrace at this facility. Water temperature data were then processed to remove data from periods when the powerhouse was not operating and when water within the penstock was static and no discharge to the NFFR was being made. During the 2008 program, daily average temperatures at station BUCK2 ranged from 10.7 to 18.5°C, and averaged 15.2°C. The diel fluctuation in temperature ranged from 0.1 to 3.5°C, and averaged 1.3°C in 2008. The maximum hourly average temperature recorded at this station during the 2008 monitoring program was 19.5°C on July 12 (Appendix B). The daily average temperatures at station BUCK2 did not exceed 20°C during the 81 operational days monitored in the 2008 June through September period. Figure 3-20 compares 2008 daily average temperatures from BUCK2 with other stations tributary to the NFFR in the Rock Creek Reach.

The NFFR station located upstream of Rock Creek Powerhouse (NF13) represents conditions at the end of the Rock Creek Reach and defines conditions prior to receiving diversion flow from Rock Creek Powerhouse. During the 2008 program, daily average temperatures at station NF13 ranged from 13.8 to 21.3°C, and averaged 18.7°C. The diel fluctuation in temperature ranged from 1.0 to 3.6°C, and averaged 2.2°C in 2008. The maximum hourly average temperature recorded at this station during the 2008 monitoring program was 23.0°C on August 17 (Appendix B). The daily average temperatures at station NF13 exceeded 20°C on 26 of 122 (21%) during the 2008 June through September

period. Figure 3-20 compares the 2008 daily average temperatures from NF13 with four other river stations located in the Rock Creek Reach.

The daily average change in temperature in the Rock Creek Reach (NFFR between Rock Creek Dam [NF9] and above Rock Creek Powerhouse [NF13]) was evaluated for the period June 1 through September 30. The daily average temperature at station NF13 averaged 0.7°C cooler in 2008 than at station NF9. The cooling occurs between stations NF12 and NF13 and is entirely related to the contribution from Bucks Creek and Bucks Creek Powerhouse.

Temperatures at Rock Creek Powerhouse (RC1) are essentially the same as those present in Rock Creek Reservoir. Water temperatures at Rock Creek Powerhouse were monitored at an internal location due to the configuration of the tailrace at this facility. Water temperature data were then processed to remove data from periods when the powerhouse was not operating and when water within the penstock was static and no discharge to the NFFR was being made. During the 2008 program, daily average temperatures at station RC1 ranged from 14.5 to 22.6°C, and averaged 19.4°C. The diel fluctuation in temperature ranged from 0.1 to 2.0°C, and averaged 0.8°C in 2008. The maximum hourly average temperature recorded at this station during the 2008 monitoring program was 22.8°C on August 17 (Appendix B). The daily average temperatures at station RC1 exceeded 20°C on 65 of 119 days (53%) during the 2008 June through September period.

Figure 3-20 compares the 2008 daily average temperatures from RC1 with four other river stations located in the Rock Creek Reach.

3.2.1.8 Cresta Reach of the NFFR and tributaries

Temperatures were monitored in Rock Creek (RC2) 0.2 miles upstream of its confluence with the NFFR during the 2008 sampling season. Rock Creek discharges directly into Cresta Reservoir approximately 0.75 miles downstream of Rock Creek Powerhouse. During the 2008 program, daily average temperatures at station RC2 ranged from 9.9 to 19.0°C, and averaged 15.7°C. The diel fluctuation in temperature ranged from 0.8 to 3.4°C, and averaged 1.8°C in 2008. The maximum hourly average temperature recorded at this station during the 2008 monitoring program was 20.0°C on August 16 (Appendix B). The daily average temperatures at station RC2 did not exceed 20°C during the 2008 June through September period. Figure 3-22 compares daily average temperatures from RC2 with another station tributary to the NFFR in the Cresta Reach in 2008.

The first temperature station in the NFFR downstream of Cresta Dam (NF14) was located upstream of the confluence with Grizzly Creek. This station is approximately 0.4 miles downstream of the dam. During the 2008 program, daily average temperatures at station NF14 ranged from 13.5 to 22.0°C, and averaged 19.1°C. The diel fluctuation in temperature ranged from 0.5 to 1.8°C, and averaged 1.1°C in 2008. The maximum hourly average temperature recorded at this station during the 2008 monitoring program was 22.4°C on August 16 (Appendix B). The daily average temperatures at station NF14 were

above 20°C on 43 of 122 days (35%) during the 2008 June through September period. Figure 3-21 compares the 2008 daily average temperatures at NF14 with three other river stations located in the Cresta Reach.

Temperatures were monitored in Grizzly Creek (GR1) 0.5 miles upstream of its confluence with the NFFR during the 2008 sampling season. During the 2008 program, daily average temperatures at station GR1 ranged from 11.9 to 20.7°C, and averaged 16.6°C. The diel fluctuation in temperature ranged from 1.1 to 4.1°C, and averaged 2.6°C in 2008. The maximum hourly average temperature recorded at this station during the 2008 monitoring program was 22.0°C on August 16 (Appendix B). The daily average temperatures at station GR1 were above 20°C on 3 of 122 days (2%) during the June through September period in 2008 (Table 3-5). Figure 3-22 compares daily average temperatures from GR1 with another station tributary to the NFFR in the Cresta Reach in 2008.

The temperature station in the NFFR downstream of Grizzly Creek (NF15) was located near the NF-56 gaging station. This station is approximately 2.5 miles downstream of the dam. The recorder deployed at this station used to serve as a backup for the telemetered station (NF56 [Water Temp] as discussed in Section 3.2.2.2. The telemetered unit has proven reliable over the past 5 years and therefore the data logger deployed at NF15 was deemed no longer necessary as per discussions with the Rock Creek-Cresta ERC. The NF15 recorder was not required since 2007 and is replaced with NF56 (water temp) data.

Figure 3-21 compares the 2008 daily average temperatures at Station NF56 [Water Temp] with three other river stations located in the Cresta Reach.

The NFFR station located upstream of Cresta Powerhouse (NF16) represents conditions at the end of the Cresta Reach and defines conditions prior to receiving diversion flow from Cresta Powerhouse. During the 2008 program, daily average temperatures at station NF16 ranged from 14.5 to 22.3°C, and averaged 19.4°C. The diel fluctuation in temperature ranged from 1.0 to 3.3°C, and averaged 2.4°C in 2008. The maximum hourly average temperature recorded at this station during the 2008 monitoring program was 23.5°C on August 16 (Appendix B). The daily average temperatures at station NF16 were above 20°C on 60 of 122 days (49%) during the 2008 June through September period. Figure 3-21 compares the 2008 daily average temperatures at NF16 with three other river stations located in the Cresta Reach.

The daily average change in temperature in the Cresta Reach (NFFR between Cresta Dam [NF14] and above Cresta Powerhouse [NF16]) was evaluated for the period June-September. The daily average temperature at station NF16 averaged 0.5°C warmer in 2008 than station NF14. This value calculates to a warming trend of 0.1°C per mile in this section of the Cresta Reach.

Temperatures at Cresta Powerhouse (CR1) are essentially the same as those present in Cresta Reservoir. Water temperatures at Cresta Powerhouse were monitored at an internal

location due to the configuration of the tailrace at this facility. Water temperature data were then processed to remove data from periods when the powerhouse was not operating and when water within the penstock was static and no discharge to the NFFR was being made. During the 2008 program, daily average temperatures at station CR1 ranged from 13.6 to 22.0°C, and averaged 19.2°C. The diel fluctuation in temperature ranged from 0.2 to 1.3°C, and averaged 0.5°C in 2008. The maximum hourly average temperature recorded at this station during the 2008 monitoring program was 22.5°C on August 19 (Appendix B). The daily average temperatures at station CR1 were above 20°C on 49 of 121 operational days (40%) during the 2008 June through September period. Figure 3-21 compares the 2008 daily average temperatures at CR1 with three other river stations located in the Cresta Reach.

3.2.1.9 Middle Fork Feather River

The Licensee collected temperature data in 2008 from a station in the Middle Fork of the Feather River (MFFR) at Milsap Bar (MB1). These data were collected in order to compare temperature conditions in the NFFR with those in the lower portion of the unregulated MFFR. During the 2008 program, daily average temperatures from station MB1 ranged from 14.3 to 22.9°C, and averaged 19.1°C. The diel fluctuation in temperature ranged from 0.7 to 3.4°C, and averaged 2.5°C in 2008. The maximum hourly average temperature recorded at this station during the 2008 monitoring program was 24.3°C on August 16 (Appendix B). The daily average temperatures at station MB1 were above 20°C on 56 of 122 days (46%) during the 2008 June through September period.

Figure 3-23 compares the 2008 daily average temperatures at MB1 with river stations located in the Rock Creek and Cresta reaches of the NFFR.

As indicated in Figure 3-23, temperatures in the NFFR were similar in value and trend to measured temperatures in the MFFR at Milsap Bar (unregulated) through August. From September through October, NFFR temperatures were similar in value and trend to those observed in the EBNFFR. Temperatures in the EBNFFR (unregulated) were warmer than those in the MFFR during the entire monitoring period. All stations were above the 20°C level from late June through early September 2008.

3.2.2 Special Evaluations

This section presents the results of various special field tests and data analyses conducted on the 2008 data. Typically this section contains the results of tests and evaluations conducted in response to specific requests by the ERC or implemented by the Licensee to improve monitoring methods or to identify potential mitigation sources.

3.2.2.1 Temperature mitigation Operations at Caribou Complex Powerhouses.

As part of the FERC license agreement, Licensee is required to monitor real time temperature in the NFFR below Rock Creek and Cresta Dams. During periods of sustained elevated temperature when the daily average temperatures at NF57 and NF56 exceeded 20°C consecutively for two days, Licensee is required to attempt temperature mitigation through operational changes. The Licensee was not able to conduct temperature

mitigation using operational manipulation of flow at Caribou Powerhouse complex in 2008 due to low water levels in Butt Valley Reservoir associated with the Butt Valley Powerhouse outage. It was anticipated that not much coldwater would exist in the hypolimnion of Butt Valley Reservoir and therefore provide little opportunity to reduce temperatures downstream. The decision was concurred by ERC prior to the start of summer season.

3.2.2.2 Performance of Telemetry Stations

Real-time temperature (telemetry) systems were installed in the gaging stations located at NF-56 and NF-57. To distinguish these stations from the corresponding flow stations, the temperature stations are termed NF-56 (water temp) and NF-57 (water temp). Temperatures were measured approximately at 5-minute intervals and stored locally on a data logger as well as being transmitted through SCADA to the Rock Creek and Caribou Powerhouse Switching Centers. The temperature data is processed for the daily average value, mid-night to mid-night, and if temperature levels are above 20°C on two consecutive days, a signal alerts operators and temperature conditions are reported to the ERC and USFS. An appropriate course of action is then developed in order to try and maintain daily average temperatures below 20°C at NF-56 [Water Temp] and/or NF-57 [Water Temp]. Both telemetry sensors are tested once a year before the monitoring season. In 2008, the calibration process indicated that both station had sensor errors over their range of less than 0.1 °C.

The performance of the telemetry systems have been demonstrated to provide water temperature data that is commensurate in accuracy with the standard digital thermistors used at the other monitoring stations. The installation is such that data from the telemetry sensors is conservative with regard to temperature trends and as a result the RCC ERC has decided to use this data in place of the in situ recorders for the remainder of the monitoring program.

Another stipulation of the FERC 4C Condition was that, "*Temperatures at NF57 and at NF56 are to be monitored and telemetered, from June 1 through October 31, for the term of the Project License. If temperatures from the telemetered stations demonstrate that mean daily water temperatures regularly exceed 20°C in October, the entire monitoring program will be expanded to include October*". This stipulation was incorporated into the monitoring program presented in the Water Temperature Monitoring Plan. The telemetered stations were continuously operated throughout the entire year. Recorded at five-minute intervals, the instantaneous water temperatures at NF-56 [Water Temp] and at NF-57 [Water Temp] never exceeded 20 °C in October.

3.2.3 Summary of MWAT and MWMT Calculations.

Three different indices were used to characterize the water temperature regime observed during the 2008 monitoring program. The first index value was simply the daily maximum (DM) temperature, and was derived from the maximum hourly average value. The second value utilized was the maximum weekly maximum temperature (MWMT) value. The MWMT is generated by evaluating the daily maximum temperatures from each

station averaged over a 7-day period (moving average for the entire period) and then selecting the maximum averaged value for the monitoring period. The third value is the maximum weekly average temperature (MWAT) value. The MWAT is generated by evaluating the daily average temperatures from each station averaged over a 7-day period (moving average for the entire period) and then selecting the maximum averaged value for the monitoring period. The DM, MWMT, and MWAT indices were selected to summarize the water temperature regime in the Project area at the request of the ERC.

Table 3-6 summarizes the three indices for the period June through September from six key stations in the lower NFFR (Rock Creek-Cresta and Poe projects) and one station from the Middle Fork Feather River. As indicated, the maximum value for each indices occurred in August at Station EB1, the East Branch Feather River. The coolest values for the three indices where observed in June at several stations (Station NF7, NF12, and NF16).

3.3 COMPARISON OF ANNUAL RESULTS

3.3.1 Comparative Summary of Monitoring Results

In order to facilitate evaluation of current results with previous year's data, a comparative summary of the data is presented in Table 3-7. Table 3-7A summarizes average water temperature conditions measured during the seven compliance monitoring years (2002-2008) for the July-August period. As indicated by these data, average 2008 water temperatures throughout the watershed were similar to or slightly warmer than those

Table 3-6

Comparison of three temperature indices from select stations in 2008

Station	June	July	August	Sept	Period (7/1-8/31)
Max Instantaneous Temperature (DM)[1]					
NF7	20.2	22.4	23.9	21.9	23.9
EB1	22.8	25.1	25.6	21.9	25.6
NF8	21.5	23.9	24.9	22.0	24.9
NF12	19.9	22.8	23.8	21.6	23.8
NF16	20.0	22.8	23.5	22.0	23.5
NFFR above Poe PH	22.3	24.7	25.3	22.9	25.3
Milsap	21.4	23.6	24.3	21.0	24.3
Max Weekly Average Temperature (MWAT)					
NF7	17.0	19.5	20.8	20.3	20.8
EB1	20.7	23.4	23.6	21.9	23.6
NF8	18.8	21.2	21.9	20.8	21.9
NF12	18.2	21.0	22.1	20.9	22.1
NF16	18.2	21.2	21.9	20.9	21.9
NFFR above Poe PH	19.9	22.4	23.2	21.9	23.2
Milsap	18.8	21.3	22.2	20.7	22.2
Max Weekly Maximum Temperature (MWMT)					
NF7	19.4	22.2	23.4	22.6	23.4
EB1	22.0	24.4	24.8	23.0	24.8
NF8	20.8	23.2	24.4	23.1	24.4
NF12	19.2	22.0	23.2	22.0	23.2
NF16	19.2	22.2	23.1	22.0	23.1
NFFR above Poe PH	21.8	23.9	24.8	23.3	24.8
Milsap	20.0	22.6	23.7	22.1	23.7

Table 3-7A

Comparison of 2008 temperature data with previous years monitoring information

Station	Year	Average Temperature (°C)	July 1 through August 31 Daily Average Exceedance of 20°C (% of days)	Maximum Hourly Temperature (°C)	Average Flow (cfs)
River Stations					
NF1	2002	14.9	0%	20.1	148
	2003	13.9	0%	19.9	225
	2004	14.3	0%	19.1	160
	2005	14.1	0%	19.3	200
	2006	12.8	0%	18.1	283
	2007	14.5	0%	20.4	95
	2008	14.4	0%	19.3	109
HB1	2002	11.9	0%	17.1	75
	2003	11.5	0%	14.9	89
	2004	11.9	0%	15.5	29
	2005	11.5	0%	14.7	84
	2006	11.6	0%	15.6	125
	2007	11.6	0%	15.6	80
	2008	11.5	0%	15.1	76
BC1	2002	13.9	0%	18.9	44
	2003	13.7	0%	19.0	65
	2004	13.4	0%	18.1	50
	2005	13.9	0%	18.4	58
	2006	15.7	0%	17.6	70
	2007	13.2	0%	18.1	75
	2008	16.9	0%	19.5	381
NF2	2002	12.9	0%	14.0	36
	2003	11.9	0%	12.8	36
	2004	21.1	98%	23.0	36
	2005	13.6	2%	21.5	37
	2006	9.2	0%	16.7	57
	2007	12.3	0%	14.3	40
	2008	13.4	0%	15.8	37

Table 3-7A

(Continued)

Station	Year	Average Temperature (°C)	July 1 through August 31 Daily Average Exceedance of 20°C (% of days)	Maximum Hourly Temperature (°C)	Average Flow (cfs)
River Stations					
NF3	2002	14.7	0%	17.4	--
	2003	13.9	0%	17.2	--
	2004	18.4	0%	21.4	--
	2005	14.9	0%	20.6	--
	2006	11.7	0%	18.3	--
	2007	14.0	0%	16.7	--
	2008	14.6	0%	17.0	--
NF4	2002	15.4	0%	18.4	75
	2003	14.8	0%	18.8	70
	2004	16.8	0%	20.1	64
	2005	15.1	0%	19.0	71
	2006	13.2	0%	18.6	101
	2007	14.6	0%	17.7	64
	2008	14.8	0%	17.5	59
BD1	2002	21.7	95%	23.0	--
	2003	20.0	65%	22.0	--
	2004	21.2	90%	22.4	--
	2005	20.6	79%	22.2	--
	2006	18.1	0%	19.8	--
	2007	20.5	85%	21.7	--
	2008	21.0	89%	23.0	--
NF5	2002	20.1	61%	21.5	143
	2003	19.1	23%	21.0	143
	2004	20.8	79%	22.1	145
	2005	19.8	55%	21.9	147
	2006	17.2	0%	19.6	143
	2007	19.9	66%	21.5	146
	2008	19.6	35%	21.7	150

Table 3-7A

(Continued)

Station	Year	Average Temperature (°C)	July 1 through August 31 Daily Average Exceedance of 20°C (% of days)	Maximum Hourly Temperature (°C)	Average Flow (cfs)
NF6	2002	19.9	48%	22.9	--
	2003	18.9	8%	22.4	--
	2004	20.4	77%	23.2	--
	2005	19.4	45%	22.9	--
	2006	17.2	0%	20.4	--
	2007	19.7	48%	22.7	--
	2008	19.4	31%	22.7	--
NF7	2002	19.9	50%	24.0	--
	2003	19.1	10%	23.6	--
	2004	20.3	76%	23.9	--
	2005	19.5	40%	23.3	--
	2006	17.5	0%	21.3	--
	2007	19.6	35%	23.5	--
	2008	19.6	34%	23.9	--
NF8	2002	21.1	87%	25.2	--
	2003	20.7	73%	25.4	--
	2004	21.3	100%	25.5	--
	2005	21.1	97%	25.3	--
	2006	19.9	37%	24.1	--
	2007	20.7	87%	24.8	--
	2008	20.8	87%	24.9	--
EB1	2002	22.8	97%	26.5	66
	2003	22.3	100%	27.4	128
	2004	22.3	100%	26.6	76
	2005	22.4	97%	26.6	147
	2006	21.4	82%	26.5	197
	2007	22.4	100%	26.0	72
	2008	22.6	100%	25.6	63

Table 3-7A

(Continued)

Station	Year	Average Temperature (°C)	July 1 through August 31 Daily Average Exceedance of 20°C (% of days)	Maximum Hourly Temperature (°C)	Average Flow (cfs)
NF9	2002	--	--	--	--
	2003	20.0	58%	22.2	--
	2004	21.1	92%	22.2	--
	2005	20.7	81%	22.0	--
	2006	18.7	0%	20.3	--
	2007	20.5	85%	21.6	--
	2008	20.7	85%	22.8	--
NF10	2002	21.3	97%	23.4	213
	2003	20.1	65%	22.8	214
	2004	21.1	92%	22.5	272
	2005	20.7	81%	22.6	265
	2006	18.7	3%	20.8	282
	2007	20.5	85%	22.4	248
	2008				253
NF11	2002	21.3	93%	24.0	--
	2003	20.3	68%	24.3	--
	2004	21.1	95%	23.9	--
	2005	20.7	82%	24.1	--
	2006	19.2	15%	22.9	--
	2007	20.8	92%	23.7	--
	2008	20.5	81%	23.9	
NF12	2002	21.3	95%	24.0	--
	2003	20.3	66%	23.9	--
	2004	21.2	97%	23.6	--
	2005	20.8	84%	23.9	--
	2006	19.4	23%	22.7	--
	2007	20.8	94%	23.4	--
	2008	20.7	85%	23.8	

Table 3-7A

(Continued)

Station	Year	Average Temperature (°C)	July 1 through August 31 Daily Average Exceedance of 20°C (% of days)	Maximum Hourly Temperature (°C)	Average Flow (cfs)
River Stations					
NF13	2002	20.0	58%	24.1	--
	2003	18.5	18%	24.2	--
	2004	18.8	10%	22.8	--
	2005	17.9	0%	22.7	--
	2006	16.6	0%	21.2	--
	2007	19.6	35%	23.6	--
	2008	19.7	39%	23.0	--
NF14	2002	20.9	94%	22.8	--
	2003	19.8	34%	22.9	--
	2004	20.7	87%	22.2	--
	2005	20.7	73%	22.1	--
	2006	18.4	3%	20.9	--
	2007	20.3	71%	22.5	--
	2008	20.3	60%	22.4	--
NF15	2002	20.9	92%	23.5	263
	2003	19.9	42%	23.9	291
	2004	20.7	85%	23.3	273
	2005	20.2	66%	23.3	301
	2006	18.5	6%	22.2	289
	2007	20.4	71%	23.6	242
	2008				216
NF16	2002	21.3	95%	23.9	--
	2003	20.1	50%	23.9	--
	2004	21.0	95%	23.4	--
	2005	20.5	77%	23.4	--
	2006	18.8	8%	22.2	--
	2007	20.8	87%	23.6	--
	2008	20.8	89%	23.5	--

Table 3-7A
(Continued)

Station	Year	Average Temperature (°C)	July 1 through August 31 Daily Average Exceedance of 20°C (% of days)	Maximum Hourly Temperature (°C)	Average Flow (cfs)
Tributary Stations					
BC2	2002	10.7	0%	11.2	--
	2003	10.8	0%	11.9	--
	2004	10.7	0%	11.2	--
	2005	10.8	0%	11.4	--
	2006	10.9	0%	11.7	--
	2007		Not Deployed in 2007		
	2008		Not Deployed in 2008		
BC3	2002	12.4	0%	14.0	14.0
	2003	12.3	0%	14.3	15.1
	2004	12.6	0%	14.5	15.1
	2005	12.4	0%	14.3	14.4
	2006	12.1	0%	14.2	14.8
	2007	12.1	0%	13.9	12.9
	2008	12.1	0%	13.9	11.4
MC1	2002	14.3	0%	16.7	4.3
	2003	13.5	0%	NA	6.4
	2004	14.0	0%	16.2	5.6
	2005	14.0	0%	16.4	6.7
	2006	13.5	0%	16.3	9.4
	2007	13.7	0%	15.8	4.7
	2008	13.7	0%	15.5	3.7
YC1	2002	16.4	0%	20.1	55
	2003	15.7	0%	20.1	81
	2004	15.7	0%	18.1	64
	2005	15.8	0%	19.1	105
	2006	15.0	0%	19.2	99
	2007	15.9	0%	20.3	55
	2008	15.9	0%	19.7	56

Table 3-7A
(Continued)

Station	Year	Average Temperature (°C)	July 1 through August 31 Daily Average Exceedance of 20°C (% of days)	Maximum Hourly Temperature (°C)	Average Flow (cfs)
Tributary Stations					
CHIP	2002	16.3	0%	21.0	21
	2003	15.4	0%	20.7	30
	2004	15.6	0%	19.5	21
	2005	15.1	0%	19.1	43
	2006	14.9	0%	19.7	33
	2007	16.1	0%	20.0	18
	2008	15.7	0%	20.2	18
MR1	2002	15.7	0%	20.4	4.3
	2003	15.4	0%	21.1	11.7
	2004	15.5	0%	20.2	6.1
	2005	15.5	0%	19.8	9.2
	2006	14.9	0%	19.9	8.3
	2007	15.5	0%	19.2	3.4
	2008	15.4	0%	18.6	3.5
CHAM	2002	16.3	0%	21.4	5.3
	2003	15.7	0%	22.2	10.1
	2004	16.0	0%	20.9	4.4
	2005	15.9	0%	21.4	11.9
	2006	15.2	0%	21.1	7.6
	2007	15.9	0%	20.4	2.8
	2008	16.0	0%	19.9	3.0
JC1	2002	16.5	0%	21.2	--
	2003	16.4	2%	22.8	--
	2004	16.5	0%	21.4	--
	2005	16.6	0%	21.9	--
	2006	16.1	0%	21.9	--
	2007	16.5	0%	20.2	--
	2008	16.6	0%	19.7	--

Table 3-7A
(Continued)

Station	Year	Average Temperature (°C)	July 1 through August 31 Daily Average Exceedance of 20°C (% of days)	Maximum Hourly Temperature (°C)	Average Flow (cfs)
Tributary Stations					
BUCK1	2002	17.7	3%	23.5	14
	2003	17.0	8%	23.5	25
	2004	17.3	0%	23.2	15
	2005	17.0	0%	22.7	20
	2006	16.4	0%	22.6	21
	2007	16.8	0%	22.5	13
	2008	16.6	0%	21.0	17
RC2	2002	17.6	0%	20.7	4
	2003	17.9	19%	22.7	5.5
	2004	17.4	0%	20.5	3.9
	2005	17.3	0%	20.9	16.3
	2006	16.8	3%	21.3	6.9
	2007	17.3	0%	20.3	3.5
	2008	17.2	0%	20.0	3.6
GR1	2002	18.7	19%	22.7	21
	2003	17.8	13%	22.7	27
	2004	18.4	3%	22.3	20
	2005	18.0	3%	22.3	30
	2006	17.5	8%	22.5	29
	2007	18.4	11%	22.1	16
	2008	18.4	5%	22.0	16
MB1	2002	21.1	76%	25.3	--
	2003	20.5	42%	24.6	--
	2004	20.7	76%	24.1	--
	2005	20.6	70%	23.4	--
	2006	19.9	39%	24.5	--
	2007	21.0	73%	24.8	--
	2008	20.9	89%	24.3	--

Table 3-7A

(Continued)

Station	Year	Average Temperature (°C)	July 1 through August 31 Daily Average Exceedance of 20°C (% of days)	Maximum Hourly Temperature (°C)	Average Flow (cfs)
Powerhouse Stations					
HB2	2002	15.4	0%	21.6	51
	2003	15.6	0%	21.2	89
	2004	14.7	0%	19.4	23
	2005	15.2	0%	19.8	18
	2006	15.4	0%	20.3	36
	2007	16.5	0%	20.9	21
	2008	12.6	0%	17.8	4
BV1	2002	20.7	85%	22.6	865
	2003	18.6	15%	20.8	1,281
	2004	20.4	69%	22.1	1,445
	2005	19.6	56%	21.6	1,547
	2006	15.7	0%	19.2	1,354
	2007	19.9	54%	21.5	1,126
	2008	21.4	95%	22.9	415
CARB1	2002	20.4	68%	22.2	401
	2003	18.8	0%	20.3	406
	2004	20.6	74%	22.1	542
	2005	19.2	50%	21.7	496
	2006	16.2	0%	18.8	398
	2007	19.3	45%	21.4	289
	2008	19.6	56%	21.1	68
CARB2	2002	22.9	100%	24.7	408
	2003	20.9	80%	24.1	873
	2004	22.0	100%	23.4	841
	2005	21.8	88%	23.9	996
	2006	19.2	6%	20.9	971
	2007	21.5	100%	22.9	842
	2008	21.9	100%	23.6	565

Table 3-7A

(Continued)

Station	Year	Average Temperature (°C)	July 1 through August 31 Daily Average Exceedance of 20°C (% of days)	Maximum Hourly Temperature (°C)	Average Flow (cfs)
Powerhouse Stations					
BD2	2002	21.5	93%	22.8	759
	2003	20.0	65%	21.8	1,195
	2004	21.3	92%	22.3	1,283
	2005	20.7	79%	22.2	1,435
	2006	18.4	0%	19.7	1,321
	2007	20.7	89%	21.8	1,082
	2008	21.3	98%	22.9	526
BUCK2	2002	15.5	0%	20.0	98
	2003	13.4	0%	20.1	125
	2004	13.6	0%	15.9	164
	2005	12.5	0%	18.6	190
	2006	11.8	0%	18.5	209
	2007	15.1	0%	21.2	106
	2008	16.1	0%	19.5	91
RC1	2002	21.5	97%	22.8	925
	2003	20.5	77%	22.7	1,478
	2004	21.6	97%	22.7	1,455
	2005	21.0	81%	22.5	1,687
	2006	18.5	0%	20.0	1,634
	2007	21.0	92%	22.3	1,191
	2008	20.6	77%	22.8	565
CR1	2002	21.2	100%	22.8	977
	2003	19.9	47%	22.7	1,581
	2004	20.7	89%	21.9	1,627
	2005	20.2	73%	21.6	1,852
	2006	18.5	2%	20.4	1,909
	2007	20.7	90%	22.3	1,290
	2008	20.5	69%	22.5	770

Table 3-7A

(Continued)

Station	Year	Elevation (ft PGE datum)	July 1 - August 31 Average Water Temperature Epilimnion (° C)		Hypolimnion (° C)
Lake	2002	4483.7	23.3		10.4
Almanor	2003	4487.6	23.0	Partial	10.1
	2004	4485.8	22.7		12.2
	2005	4486.8	23.3		10.8
	2006	4490.7	23.0		7.4
	2007	4494.0	22.0	Partial	10.3
	2008	4484.0	22.1		11.4
Butt	2002	4128.1	23.0		17.5
Valley	2003	4130.2	21.6		16.0
Reservoir	2004	4129.9	22.5		20.2
	2005	4130.2	22.3		16.9
	2006	4127.9	20.5		16.4
	2007	4135.1	22.0		17.3
	2008	4122.3	22.3		16.7

Table 3-7B

Comparison of rainfall and runoff in the NFFR Watershed

Classification	2002	2003	2004	2005	2006	2007	2008
Watershed Runoff							
Water Year classification	Dry	Above Norm	Below Norm	Above Norm	Wet	Dry	C Dry
State Runoff Index	6.4	8.2	7.5	8.5	13.1	6.2	5.4
Watershed Precipitation[1]	72%	110%	82%	104%	153%	66%	70%
Total Annual Inflow to Lake Oroville[2]	3,072,482	4,674,077	3,800,133	4,228,262	8,197,028	1,885,471	1,707,000
Water Year Type – Feather River[3]	Dry	Normal	Normal	Normal	Wet	C Dry	C Dry
Air Temperature Exceedance							
Canyon Dam June Ranking	16%	4%	18%	---	5%	40%	39%
Canyon Dam July Ranking	2%	5%	28%	3%	12%	20%	35%
Canyon Dam August Ranking	24%	38%	26%	21%	43%	29%	3%
Canyon Dam Sept. Ranking	23%	5%	49%	79%	---	---	---

1. Average based on four stations within the watershed.
2. CDEC – 2008.
3. Based on definition outlined in Rock Creek-Cresta Settlement Agreement.

measured in 2007, the first year with a critically dry year condition since the issuance of license. The exceedance of the 20°C objective also returned to levels similar to those measured in 2002-2005, 2007. Ambient meteorological and regional runoff conditions were most similar to those measured in 2007, with the exception that August 2008 air temperatures were warmer than normal (3% exceedance).

During the 2008 period, runoff into Lake Oroville was recorded as approximately 4 times less than the level observed in 2006, and significantly lower than the 2002-2005 and 2007 runoff levels (Table 3-7B). Precipitation in the watershed averaged 70% of normal (Table 3-7B). The available state indices all listed 2008 as critically dry with regard to precipitation and runoff. For the NFFR drainage, the 2008 water year was classified as Critically Dry based on annual inflow to Lake Oroville per FERC 1962 License Condition No. 5B. Air temperature conditions were comparatively mild, with only August exhibiting extreme temperature conditions (Table 3-7B).

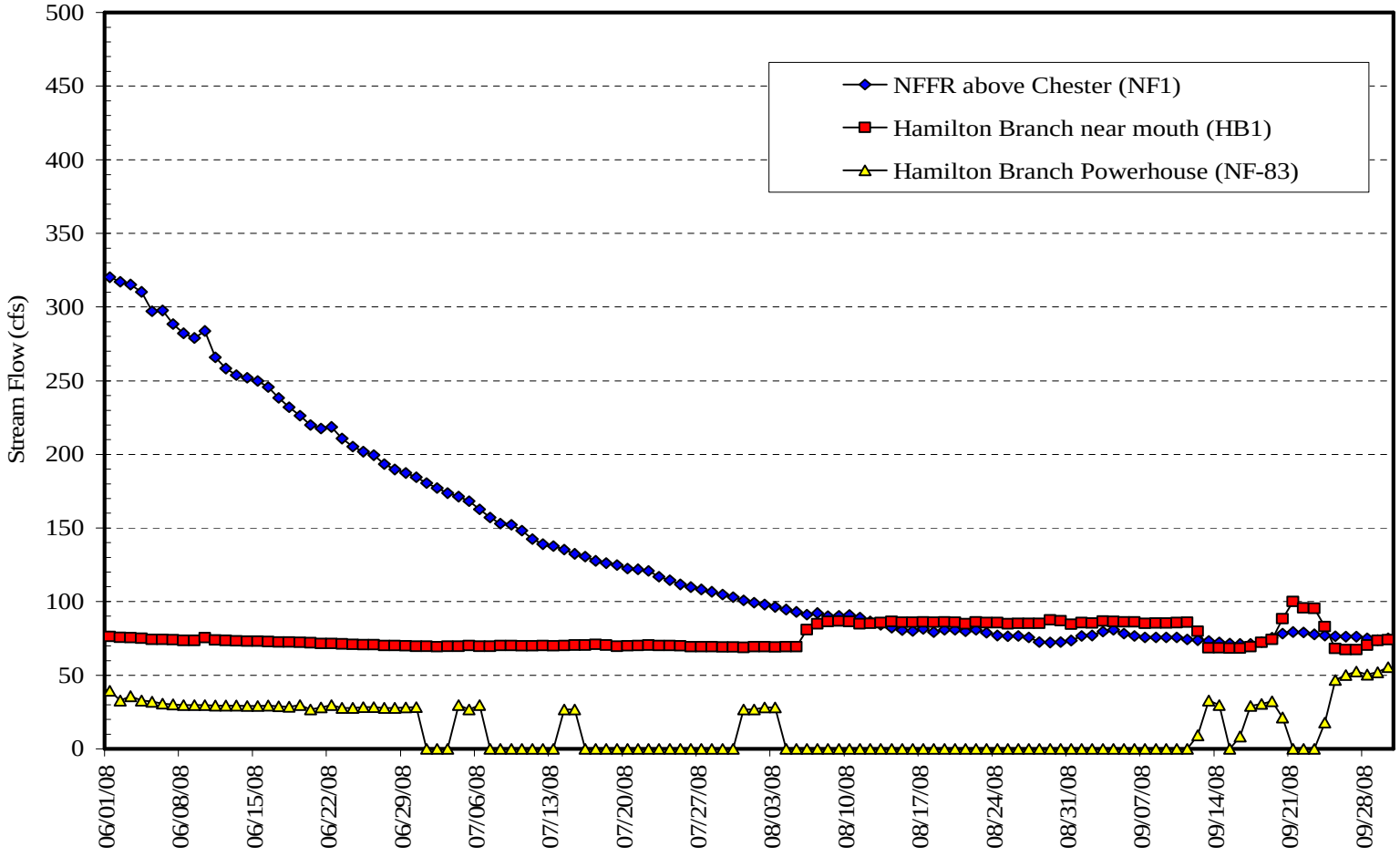


Figure 3-1. Comparison of daily average flow at stations tributary to Lake Almanor – 2008

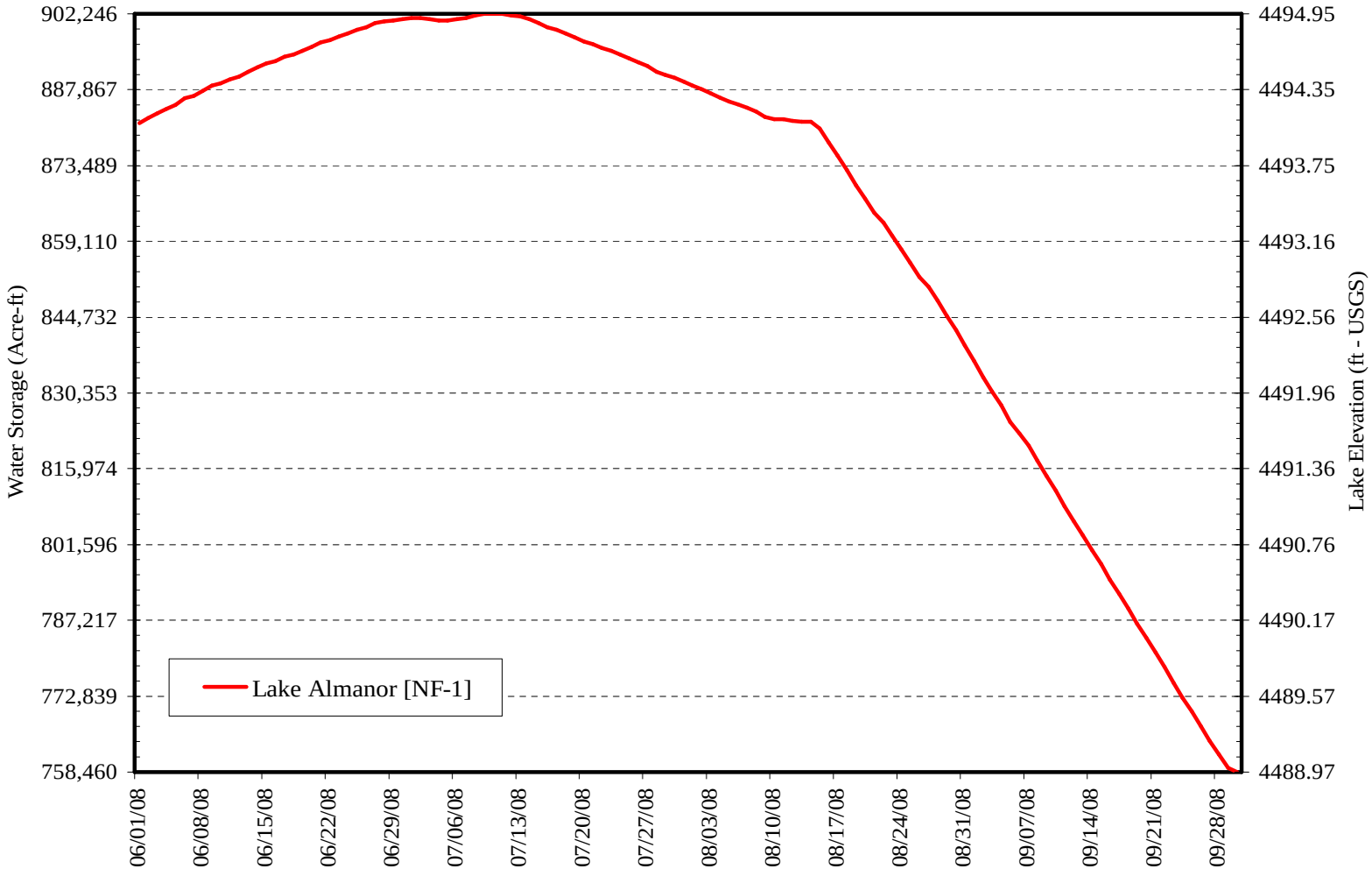
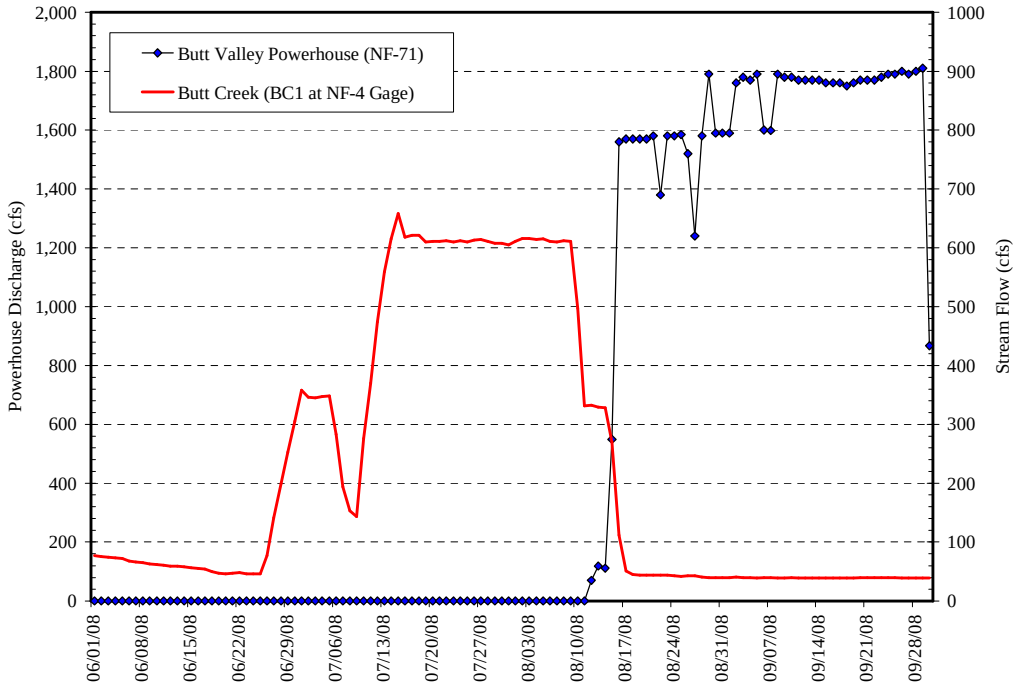
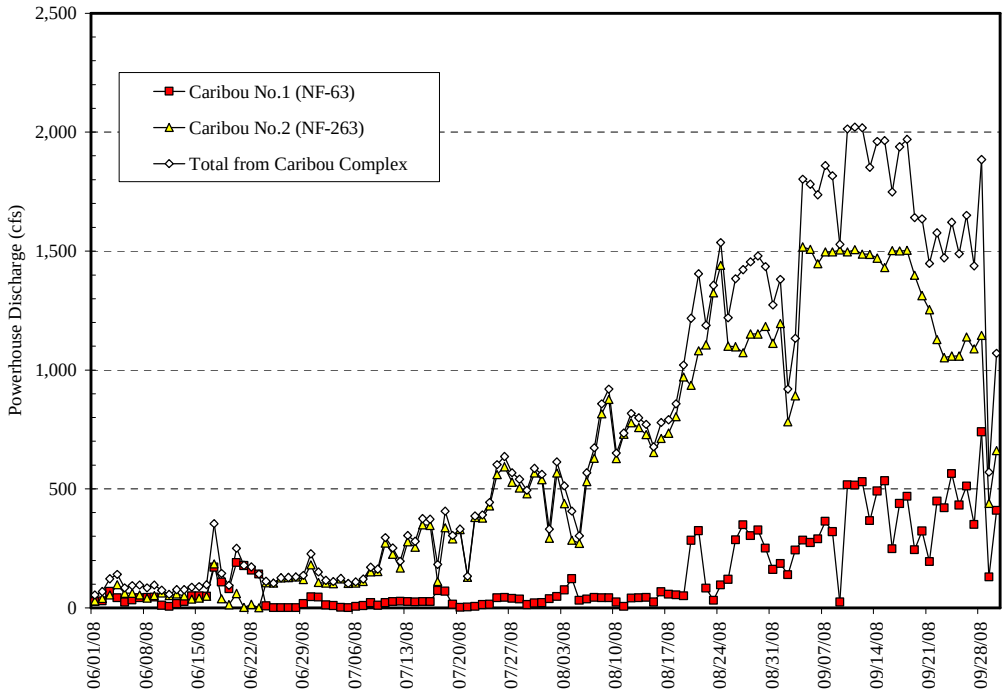


Figure 3-2. Lake Almanor Daily Average Storage and Elevation – 2008

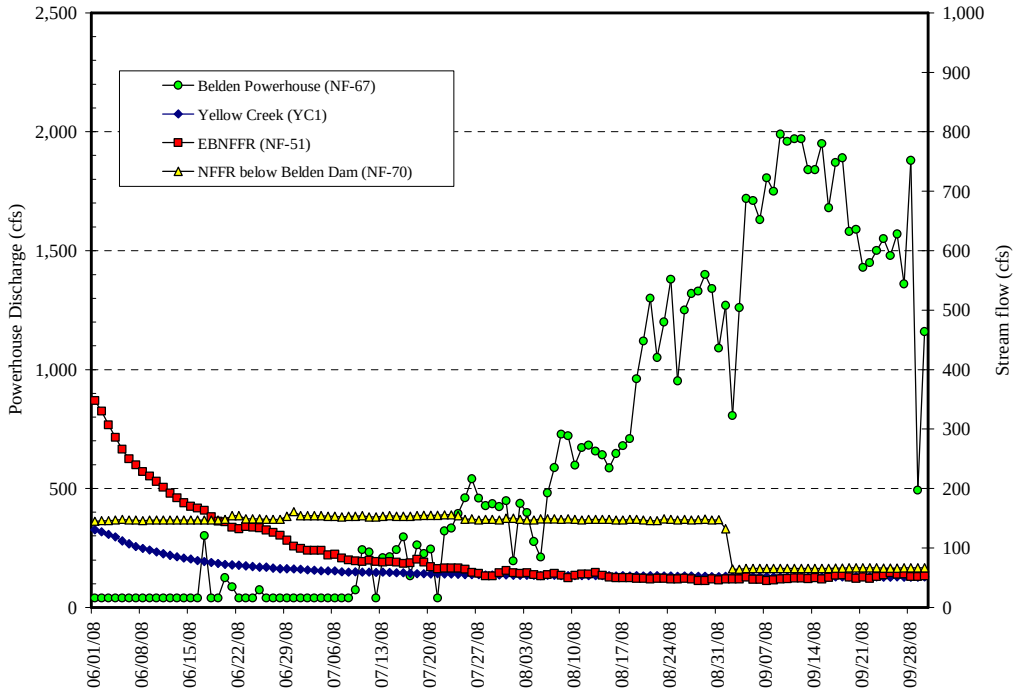


A. Butt Valley Powerhouse and Butt Creek.

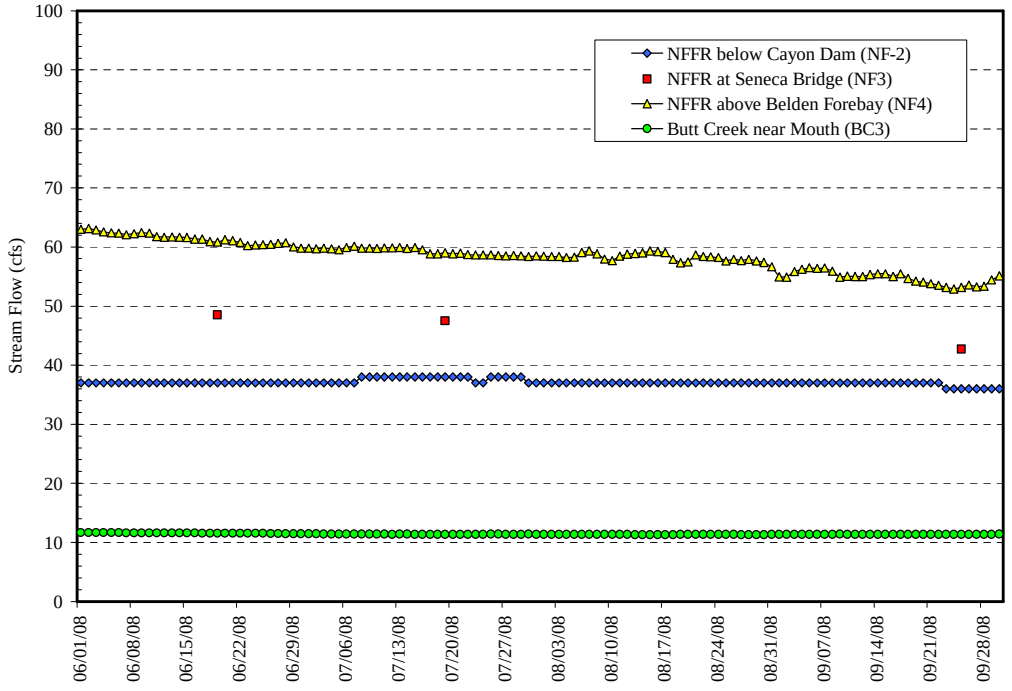


B. Caribou No.1 and Caribou No.2 powerhouses.

Figure 3-3. Comparison of daily average flow from select stations in the upper NFFR Project – 2008



C. Belden Reach.



D. Seneca Reach.

Figure 3-3 (continued). Comparison of daily average flow from select stations in the upper NFFR Project – 2008

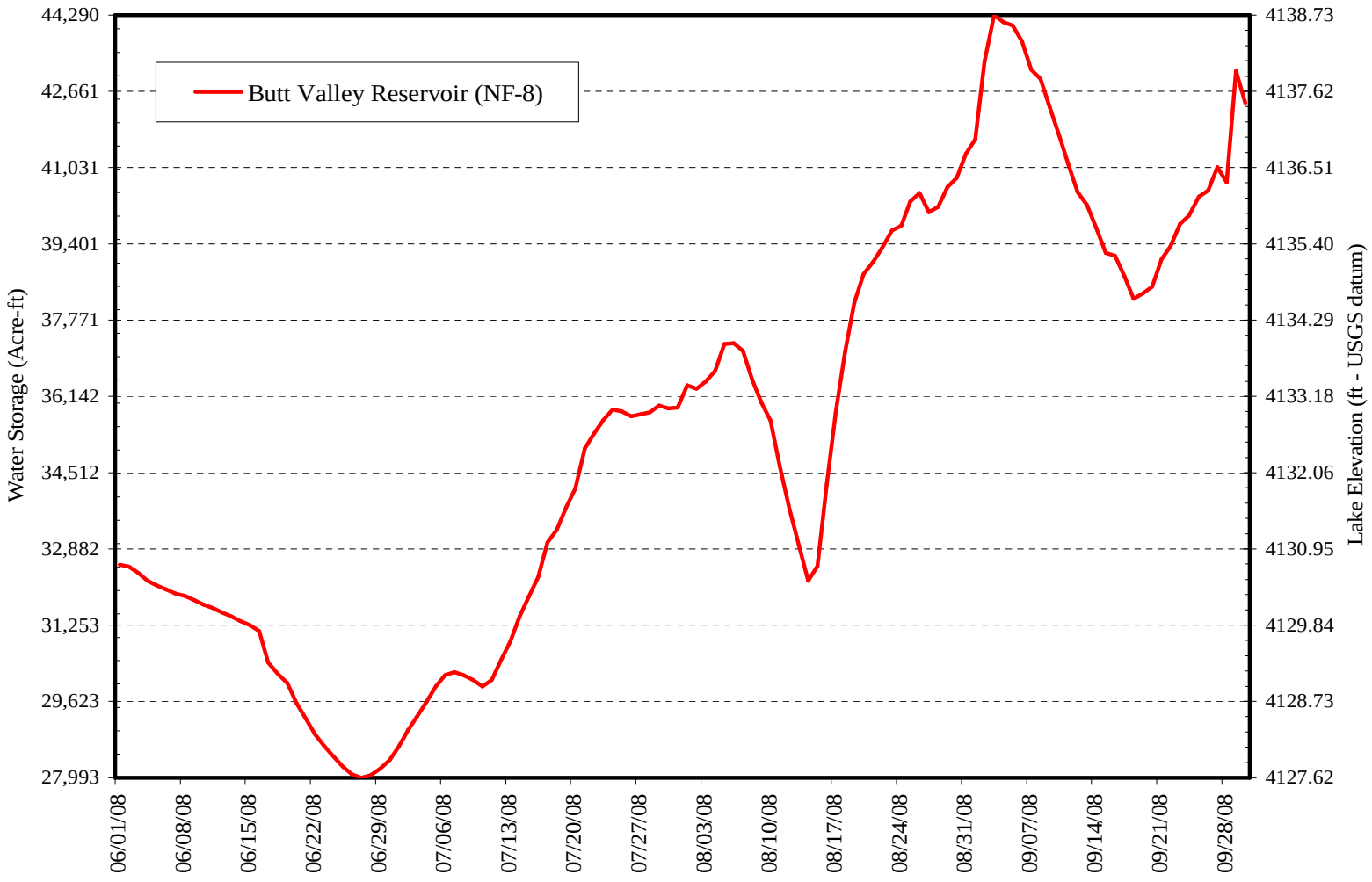
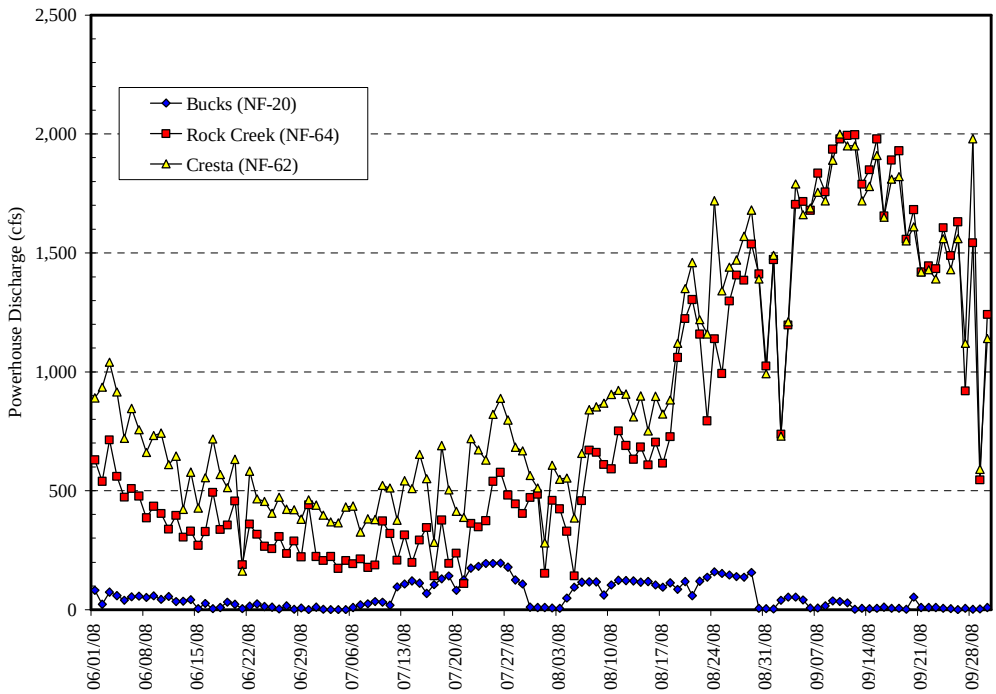
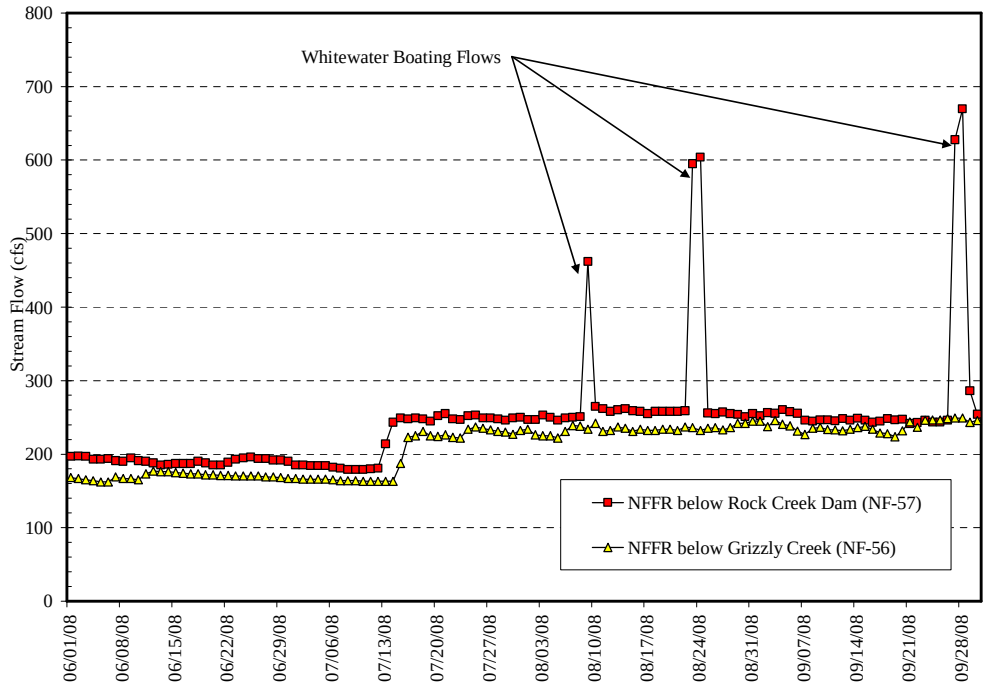


Figure 3-4. Butt Valley Reservoir Daily Average Storage and Elevation – 2008



A. Bucks, Rock Creek and Cresta Powerhouse.



B. Rock Creek and Cresta Reach.

Figure 3-5. Comparison of daily average flow at Rock Creek-Cresta Reaches – 2008

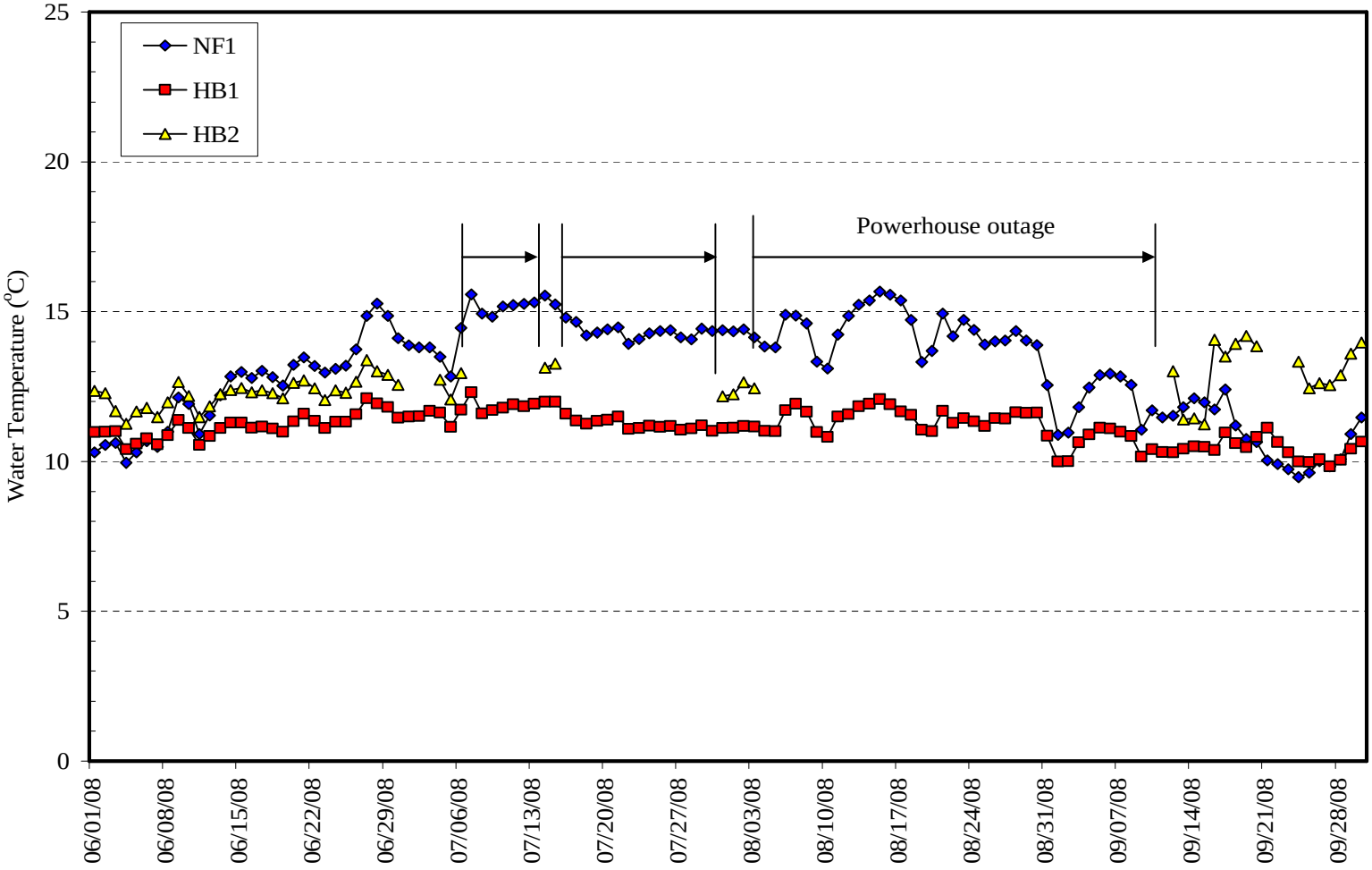


Figure 3-6. Comparison of daily average temperature at stations tributary to Lake Almanor – 2008

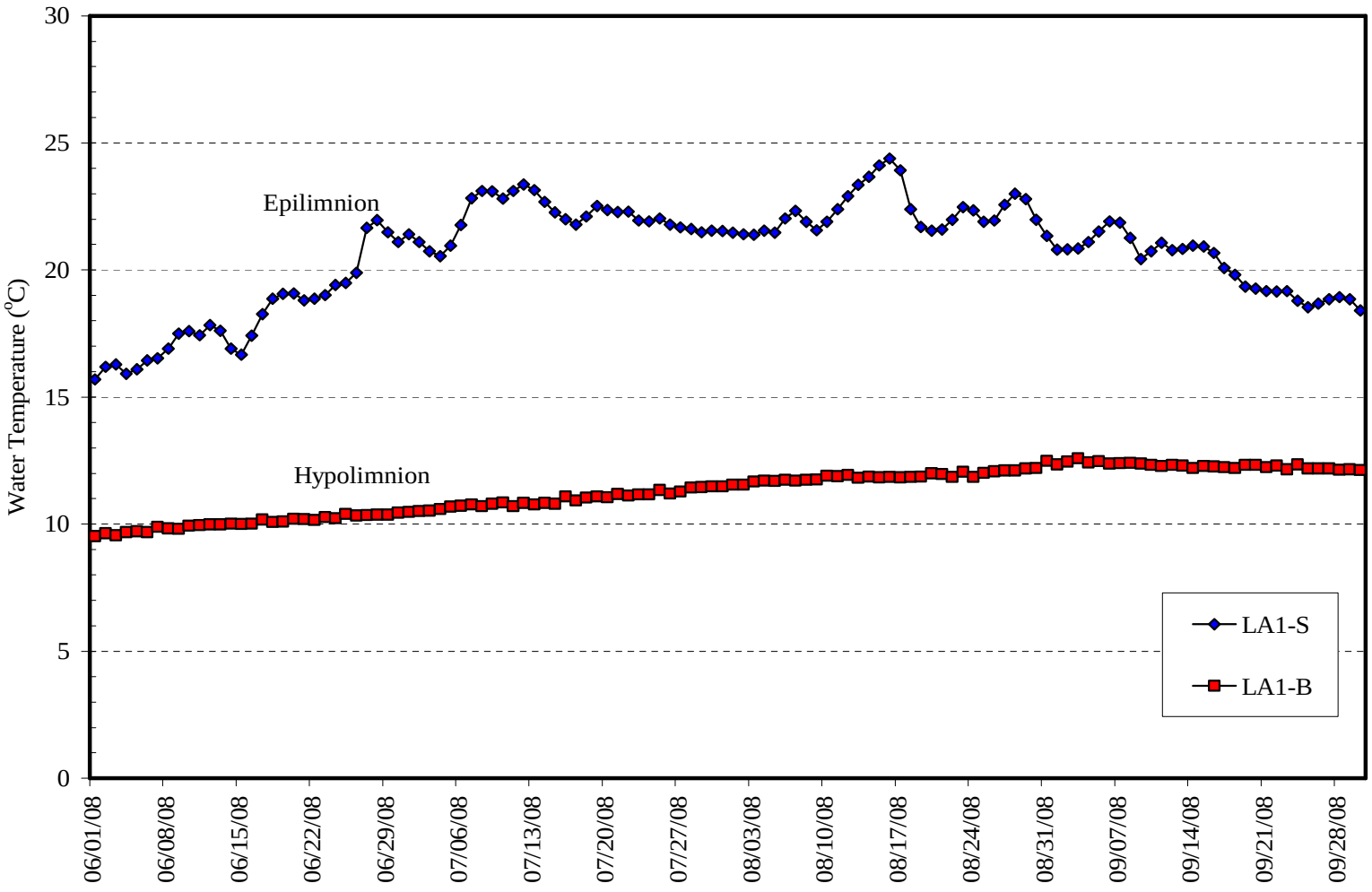


Figure 3-7. Comparison of mean daily temperatures from two depths in Lake Almanor near the Canyon Dam Intake – 2008

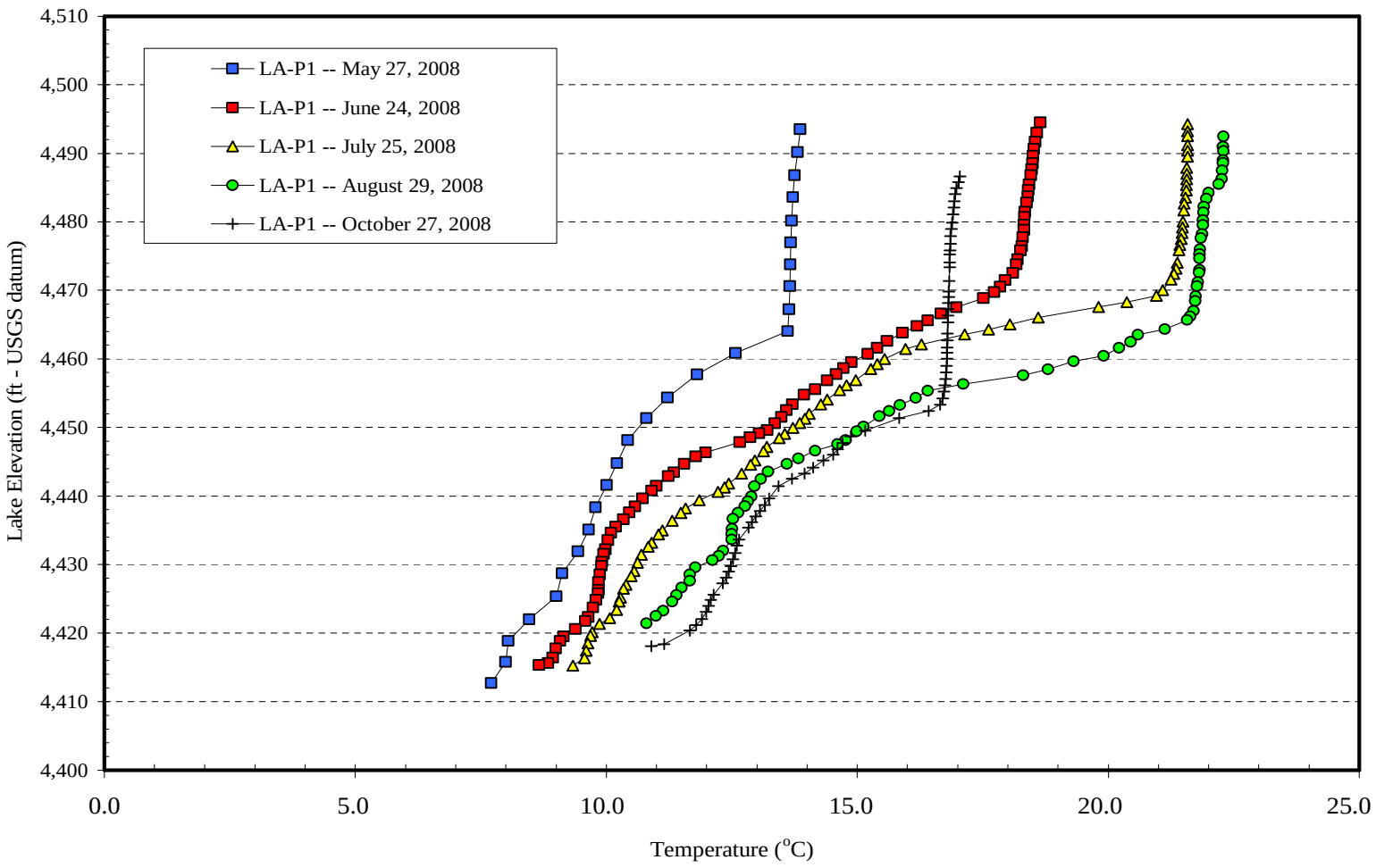
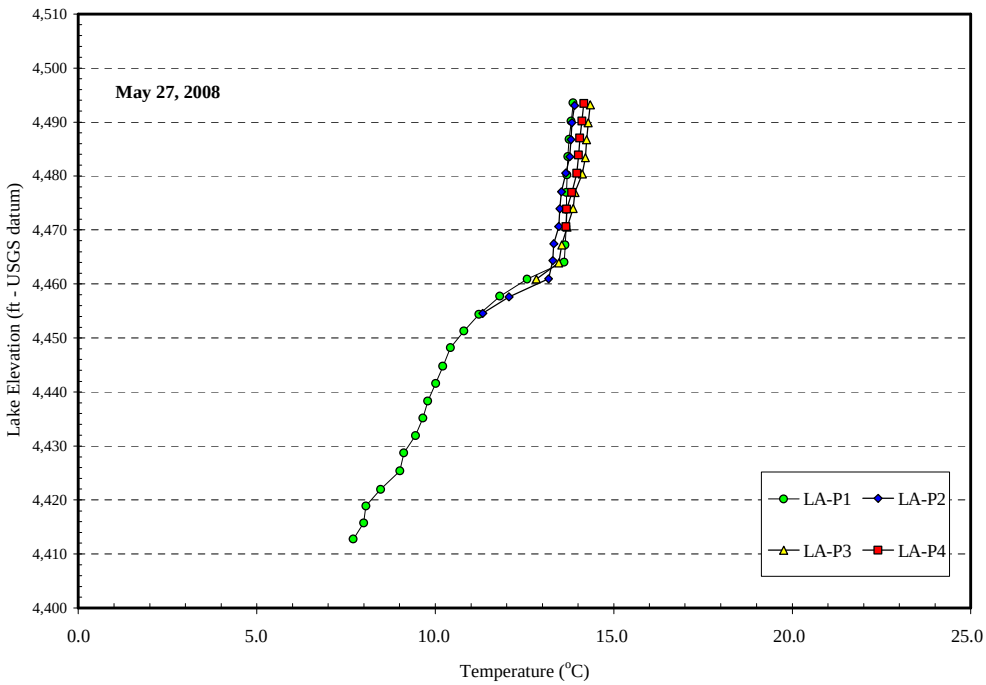
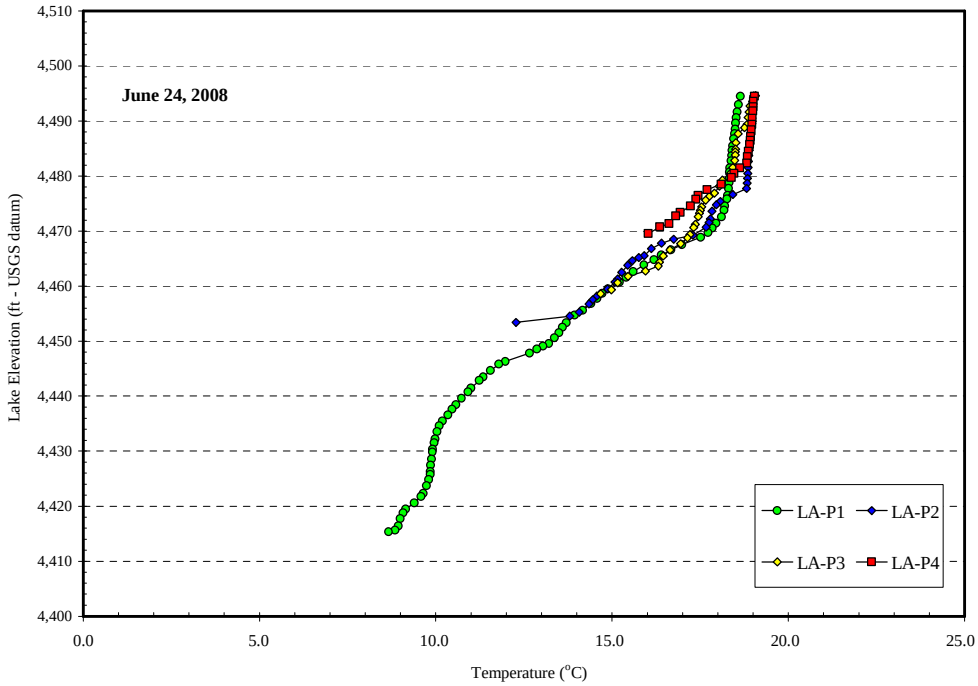


Figure 3-8. Comparison of monthly profiles from Lake Almanor (LA1) for the period June through September 2008

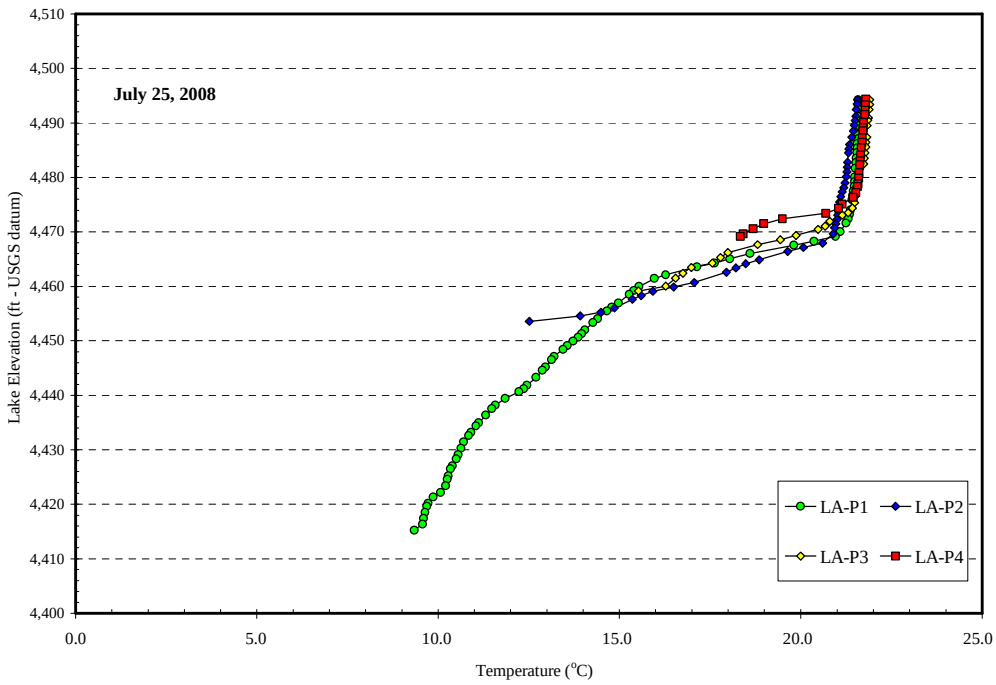


A. May 27, 2008 – Lake Almanor Profiles

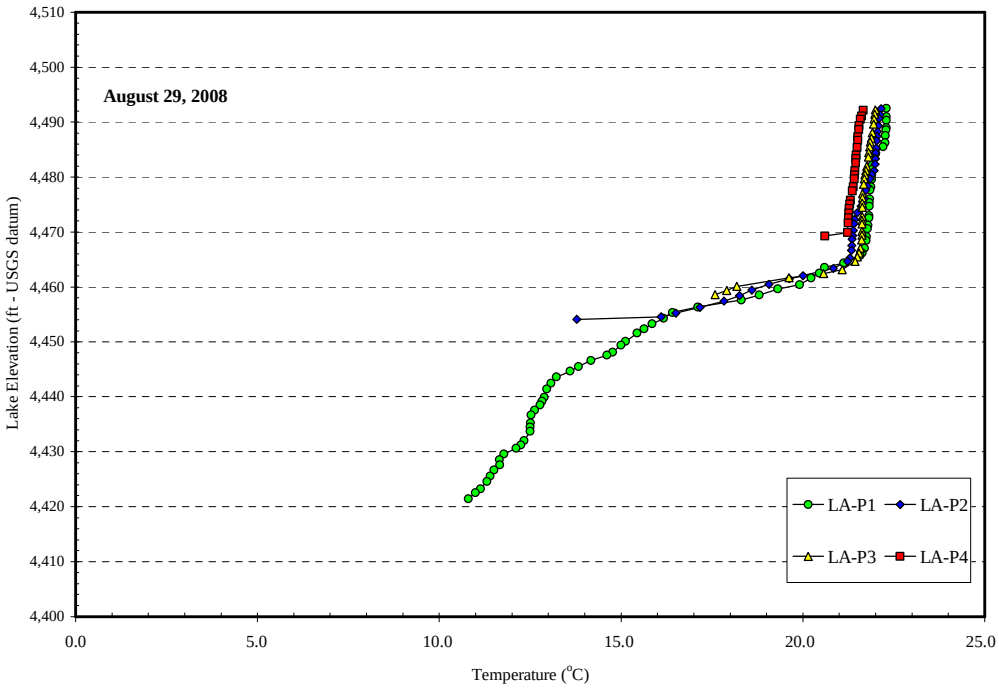


B. June 24, 2008 – Lake Almanor Profiles

Figure 3-9. Longitudinal thermal structure at four profile stations in Lake Almanor – 2008

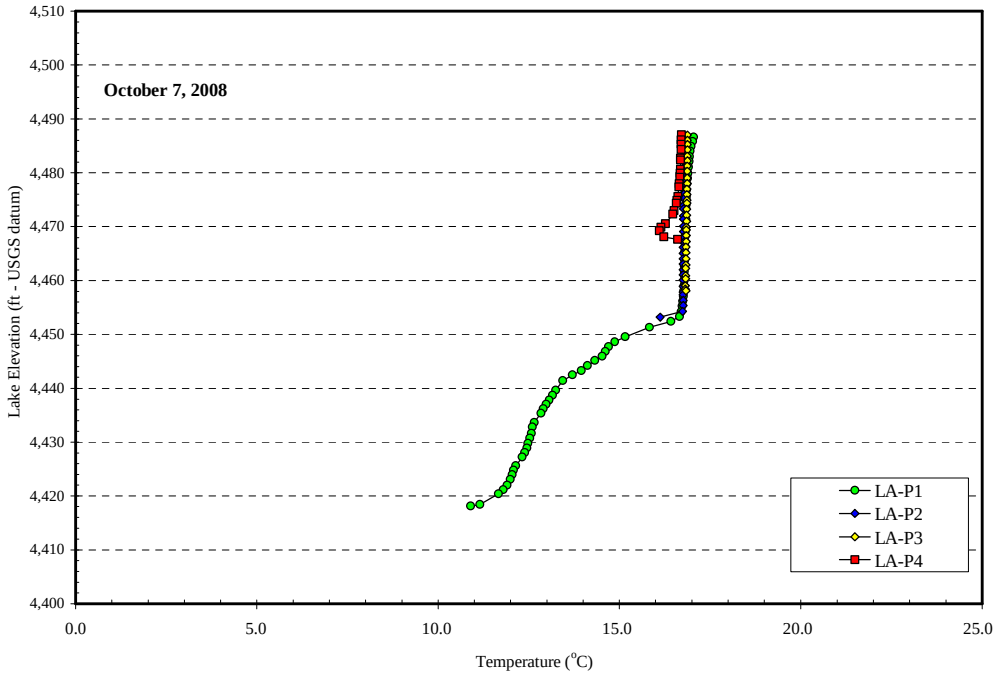


C. July 25, 2008 – Lake Almanor Profiles



D. August 29, 2008 – Lake Almanor Profiles

Figure 3-9. (Continued).



E. October 7, 2008 – Lake Almanor Profiles

Left blank

Figure 3-9. (Continued)

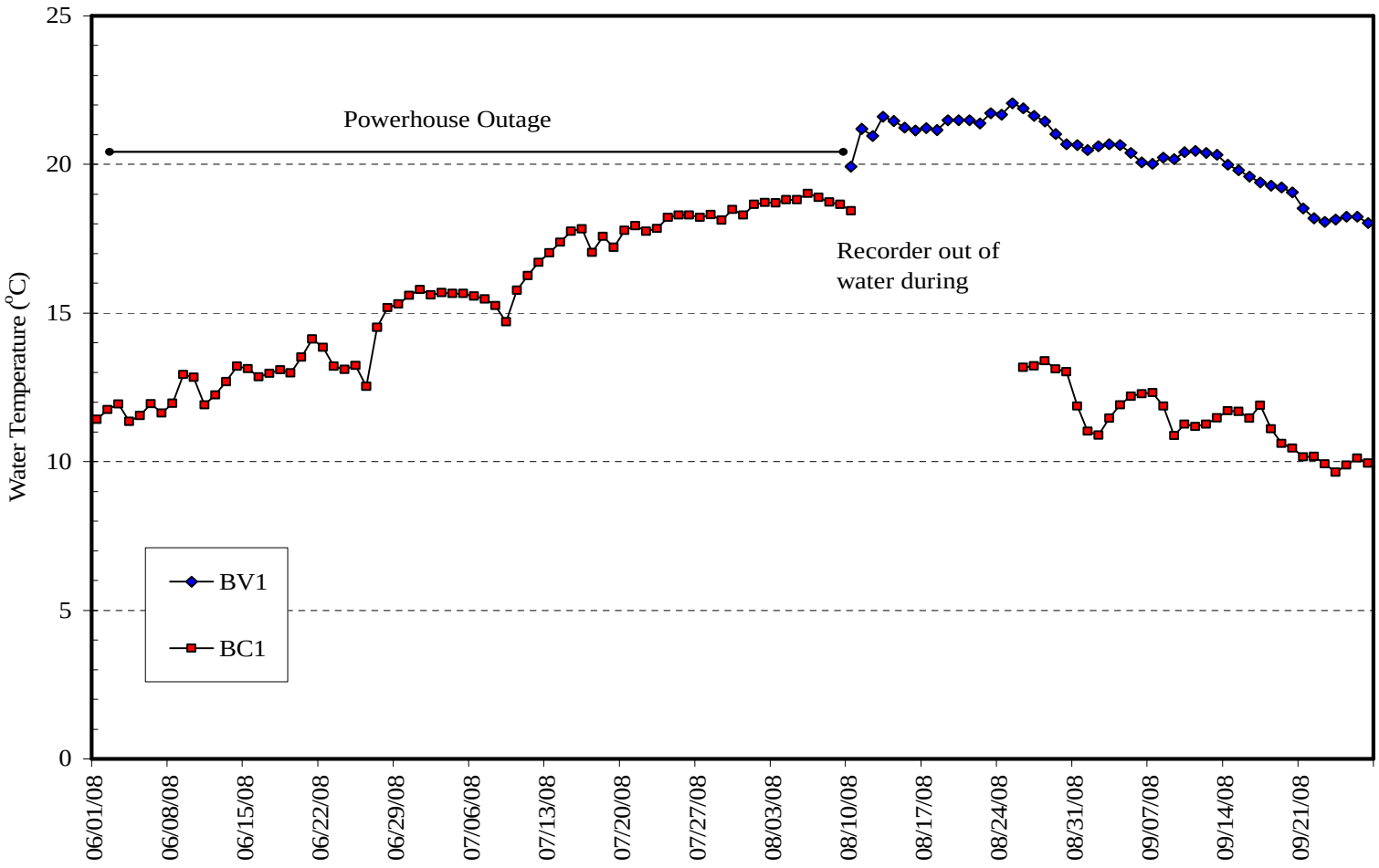


Figure 3-10. Comparison of daily average temperature at stations tributary to Butt Valley Reservoir – 2008

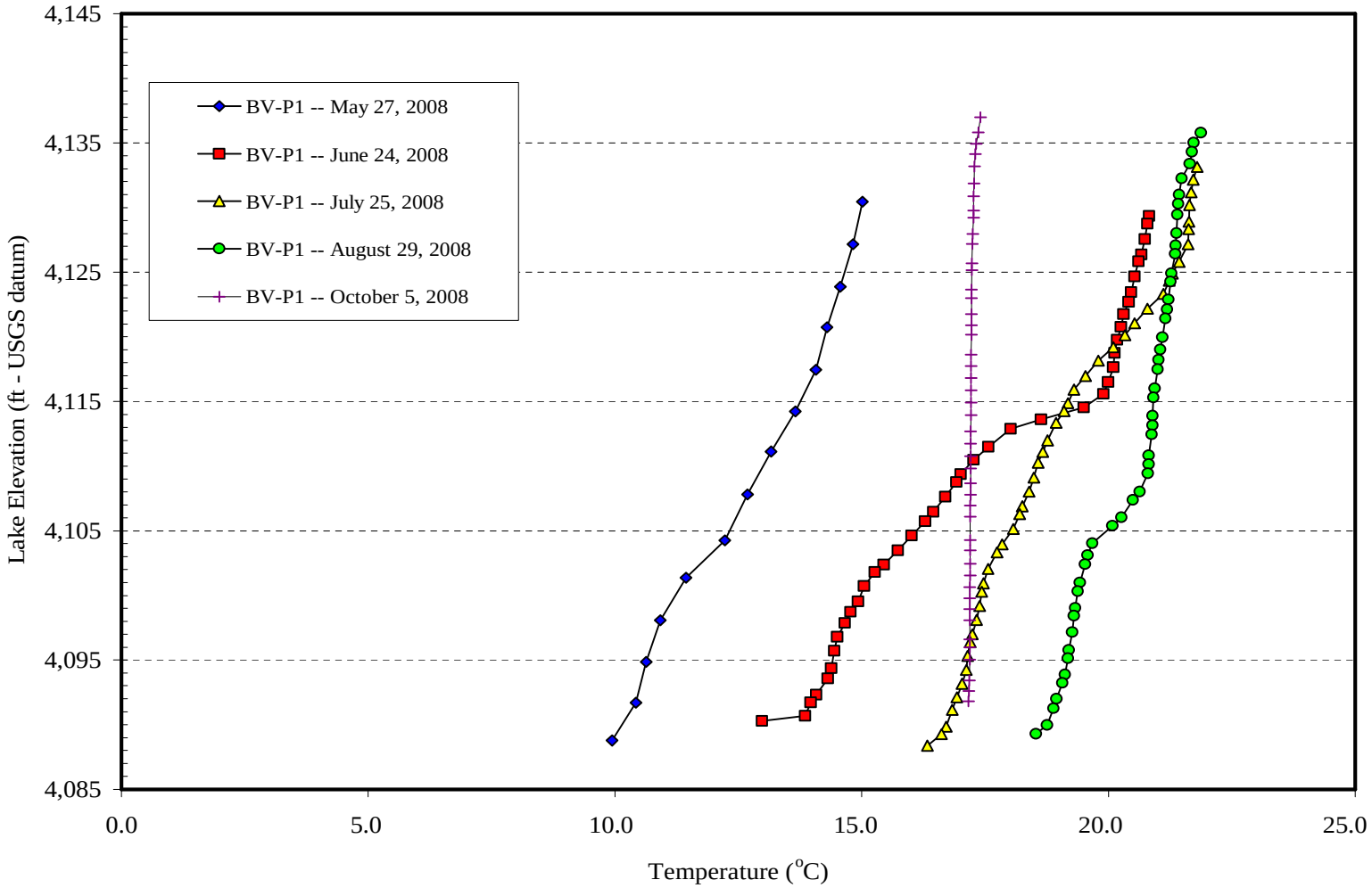
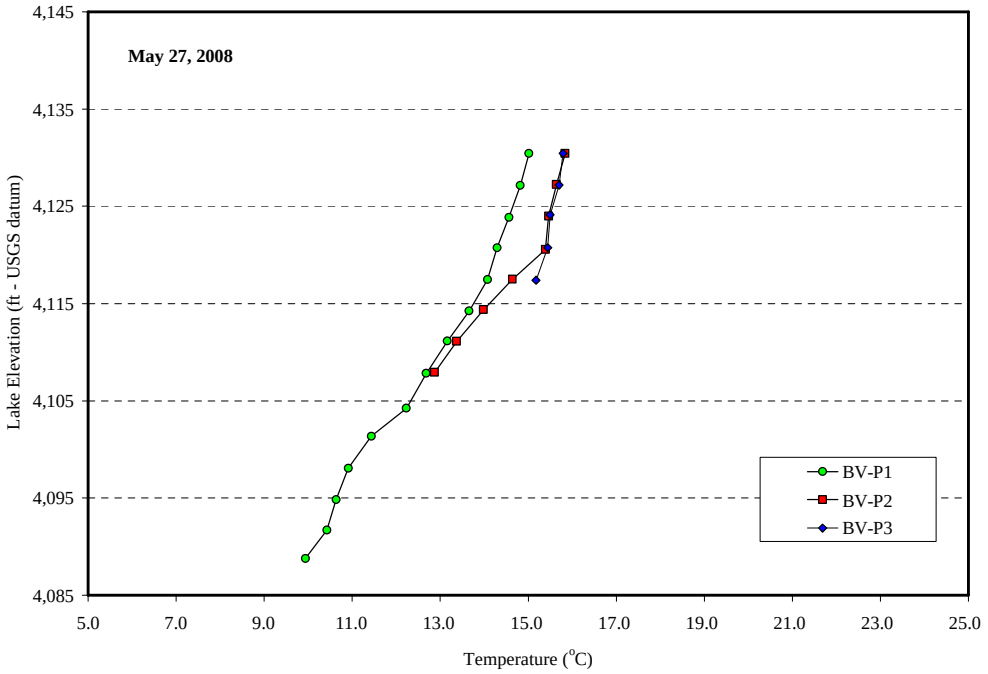
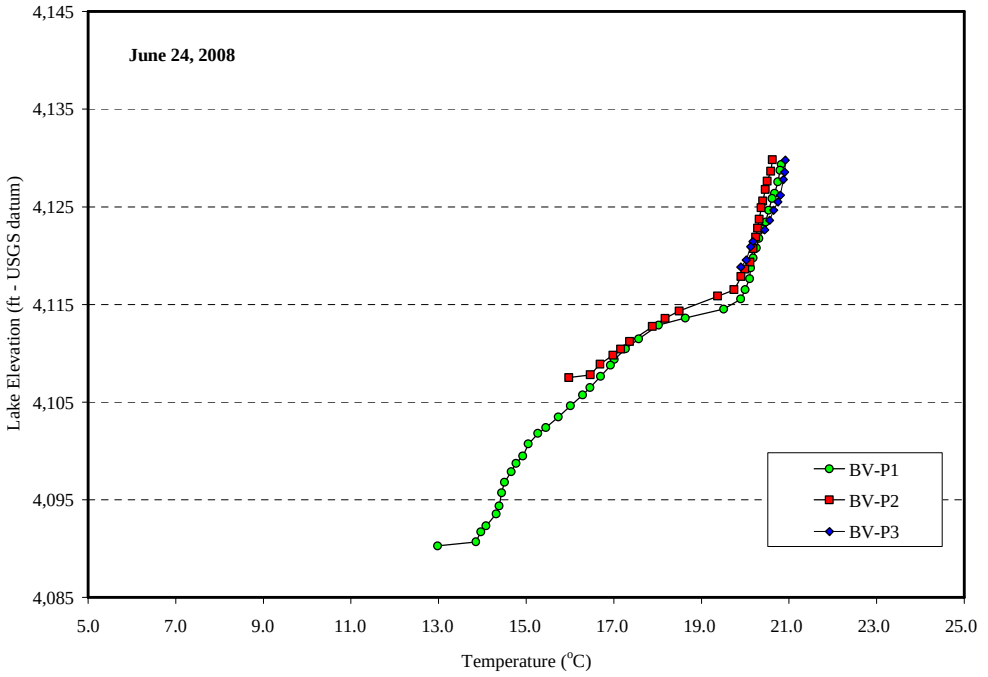


Figure 3-11. Comparison of monthly profiles from Butt Valley Reservoir (BV2-A) for the period May through September 2008

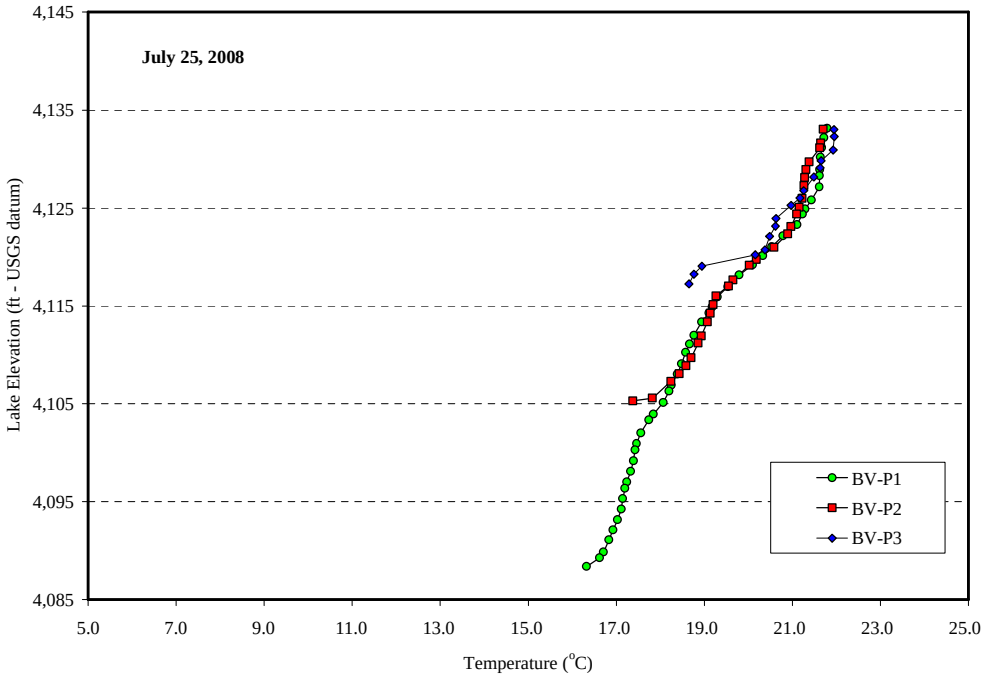


A. May 27, 2008 – Butt Valley Reservoir Profiles

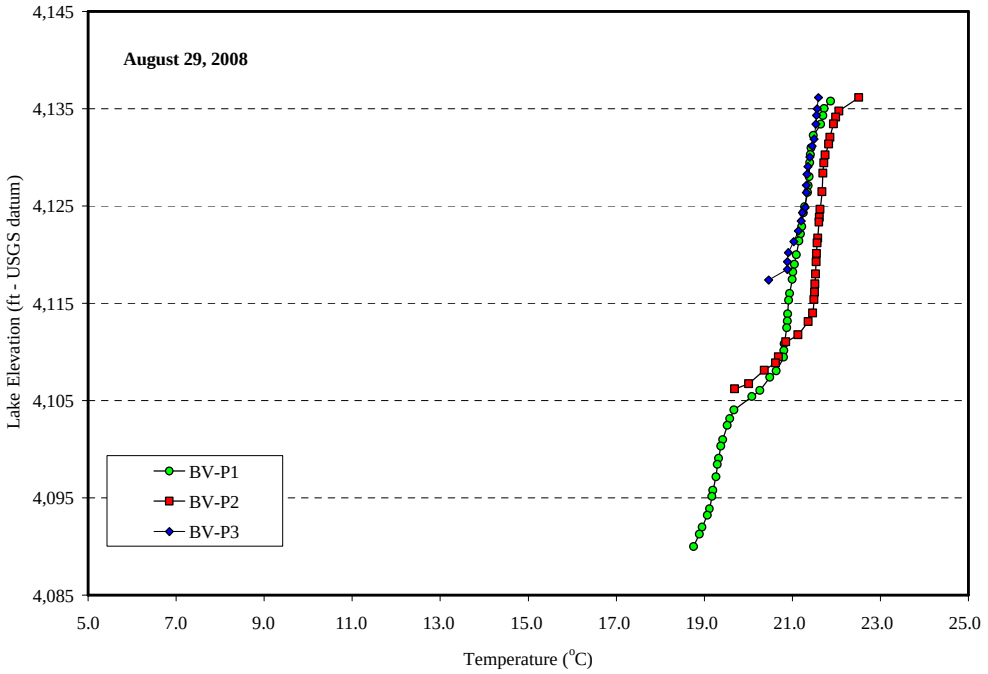


B. June 24, 2008 – Butt Valley Reservoir Profiles

Figure 3-12. Longitudinal thermal structure present at three stations in Butt Valley Reservoir – 2008

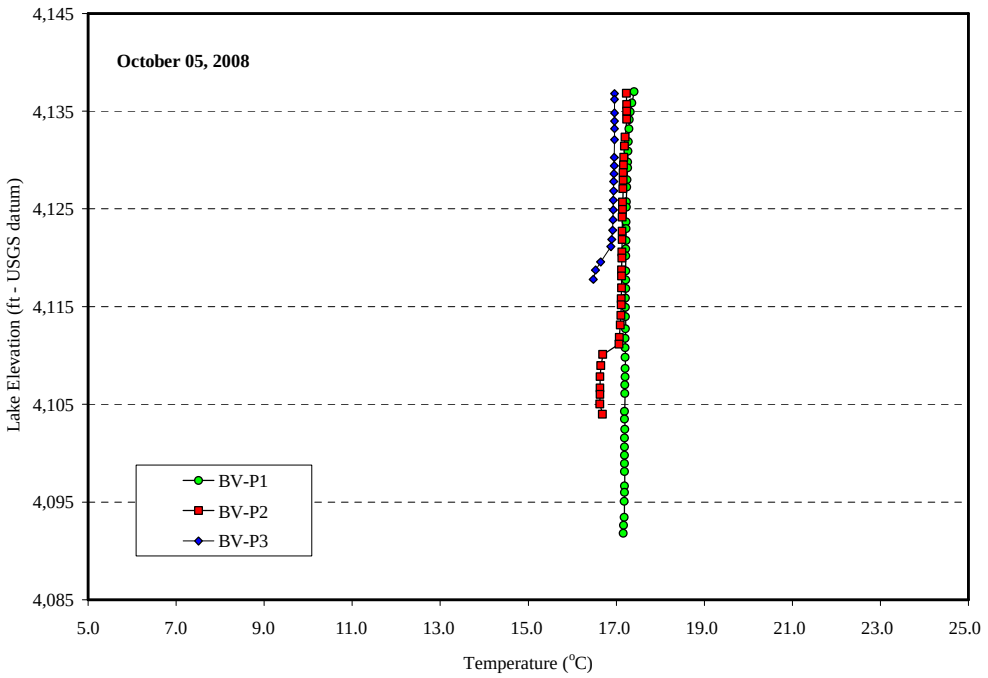


C. July 25, 2008 – Butt Valley Reservoir Profiles



D. August 29, 2008 – Butt Valley Reservoir Profiles

Figure 3-12 (continued).



E. October 5, 2008 – Butt Valley Reservoir Profiles

Left blank

Figure 3-12 (continued).

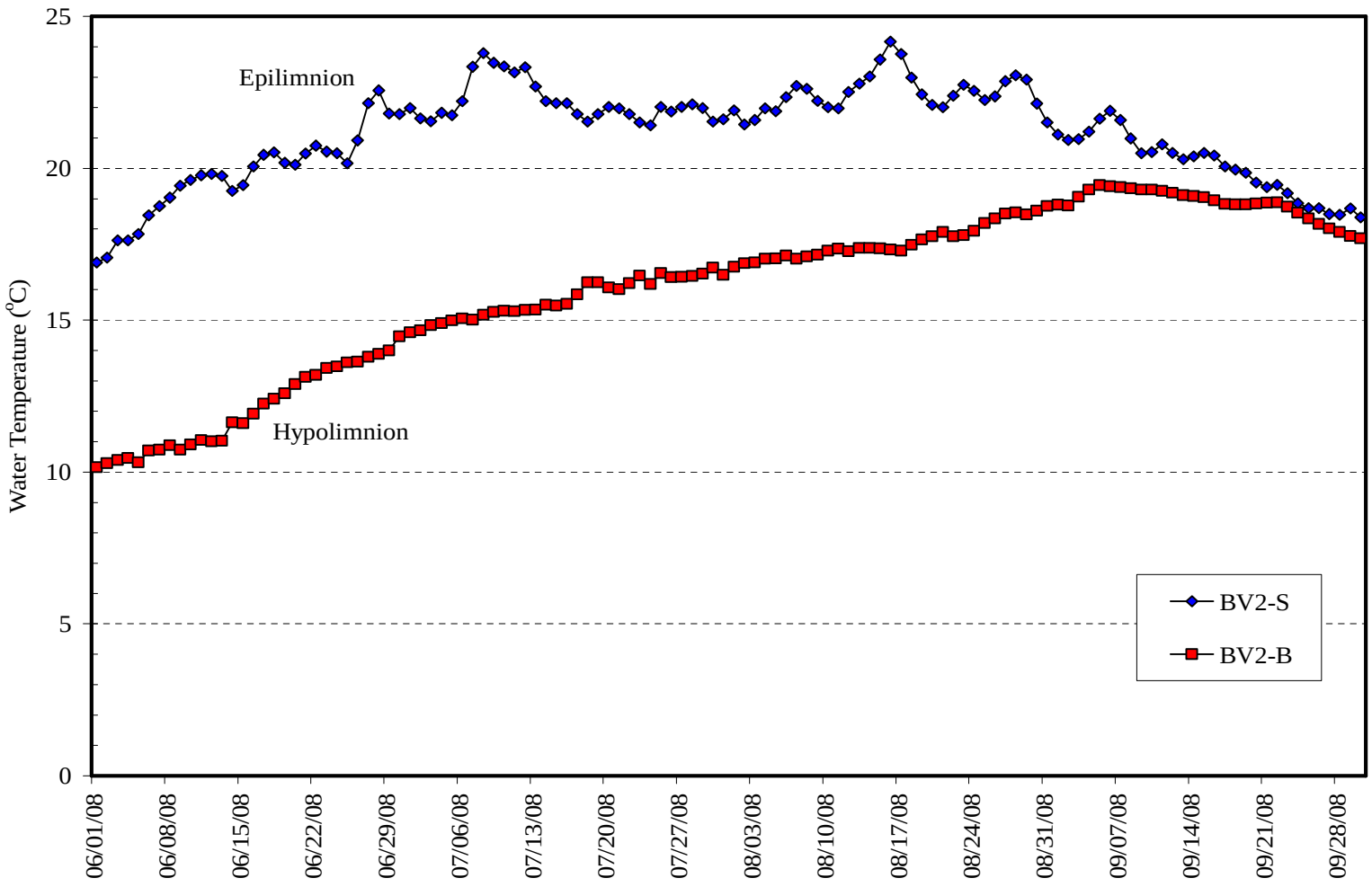


Figure 3-13. Comparison of mean daily temperatures from two depths in Butt Valley Reservoir near Caribou No. 1 Intake – 2008

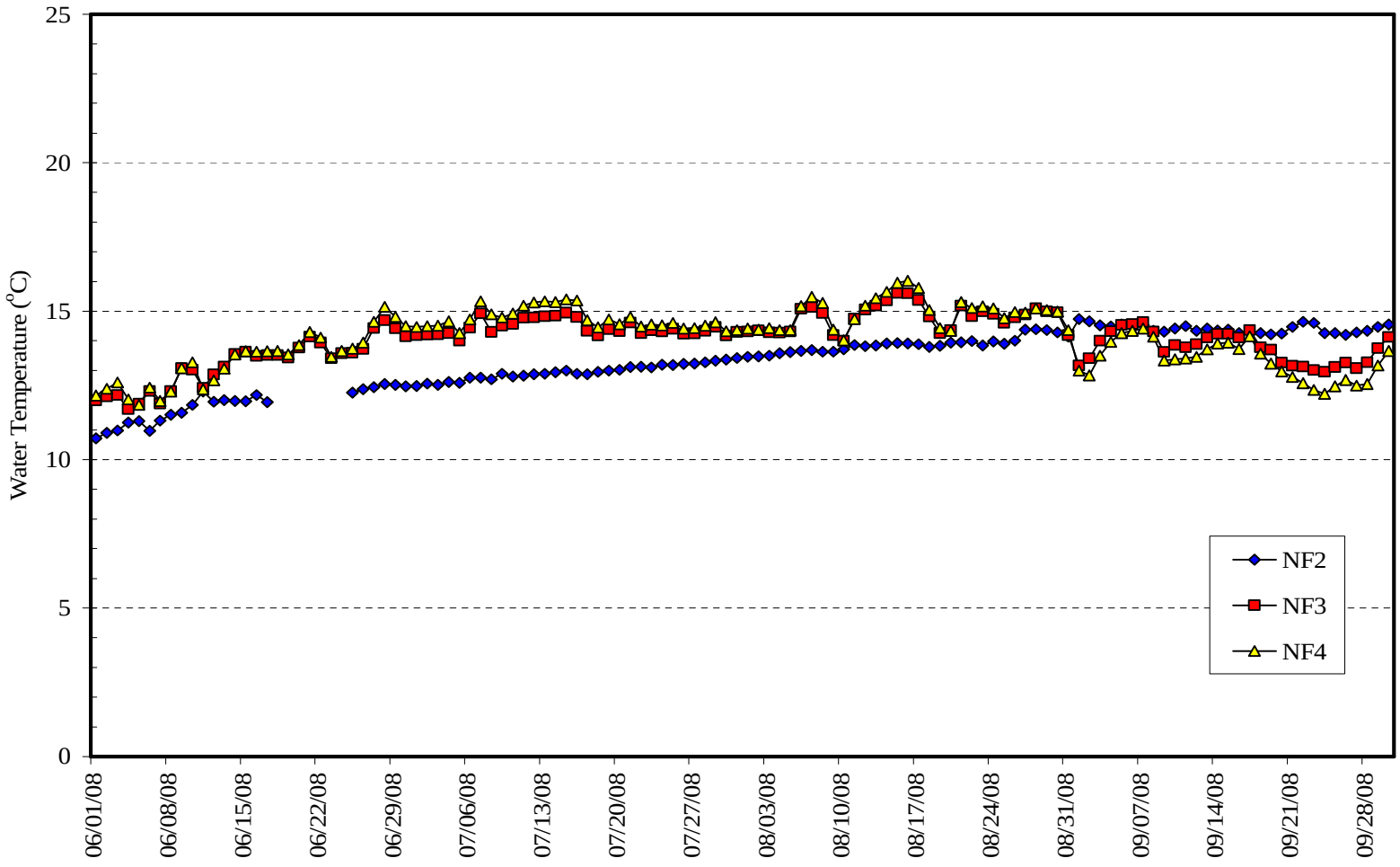


Figure 3-14. Comparison of daily average temperatures in the Seneca Reach – 2008

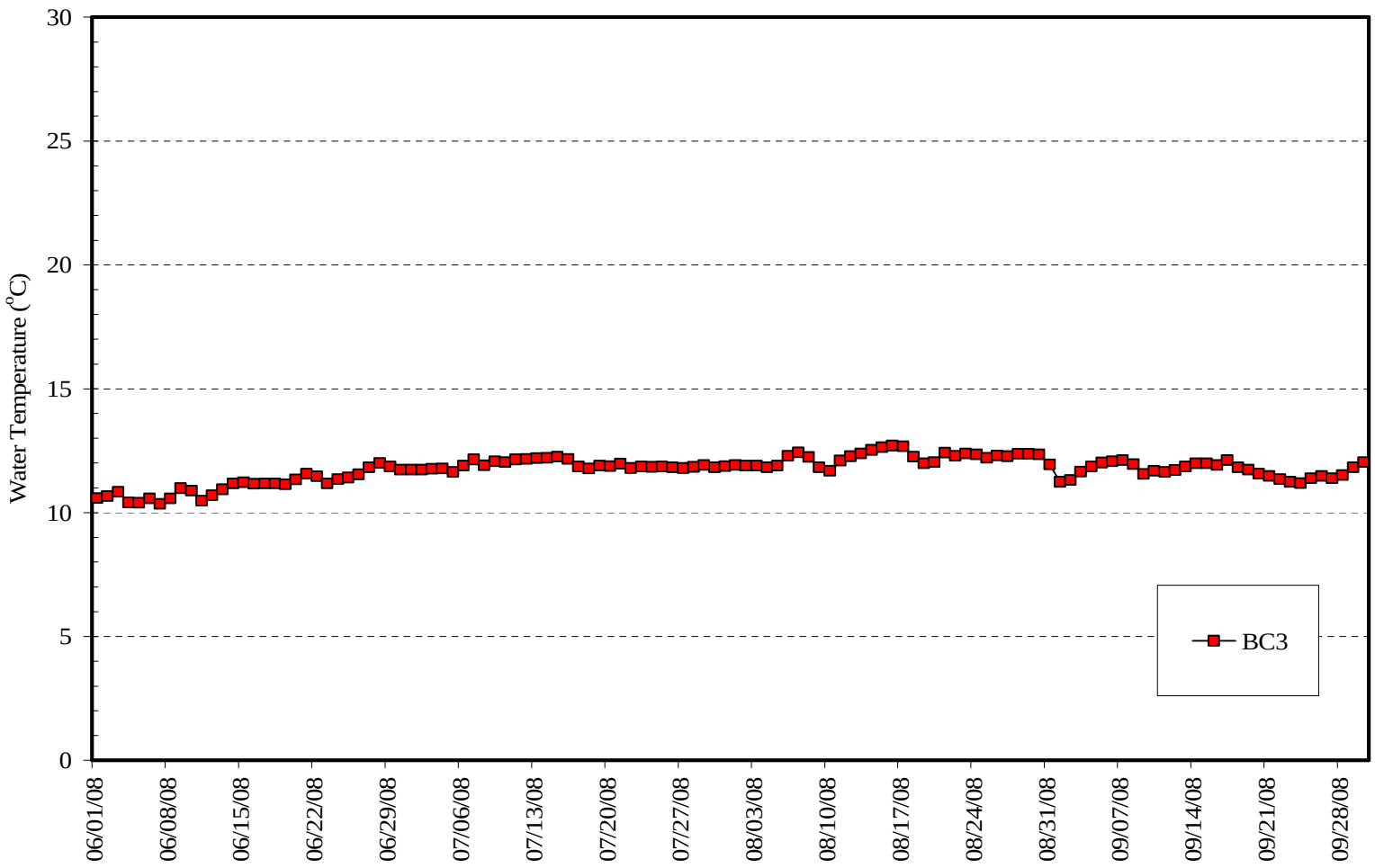


Figure 3-15. Daily average temperatures in lower Butt Creek – 2008

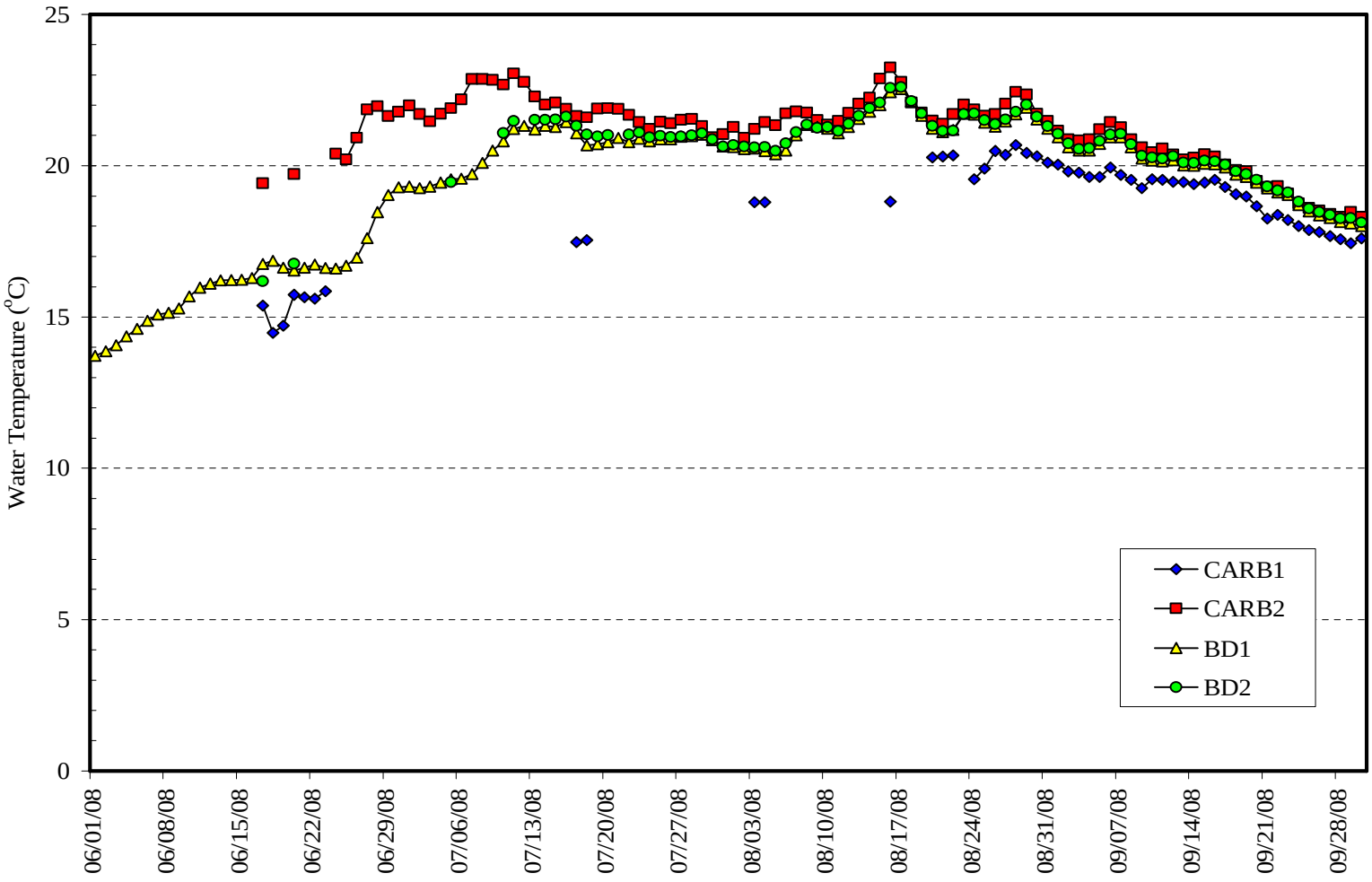


Figure 3-16. Comparison of daily average temperatures from the Caribou Powerhouse/Belden Forebay complex – 2008

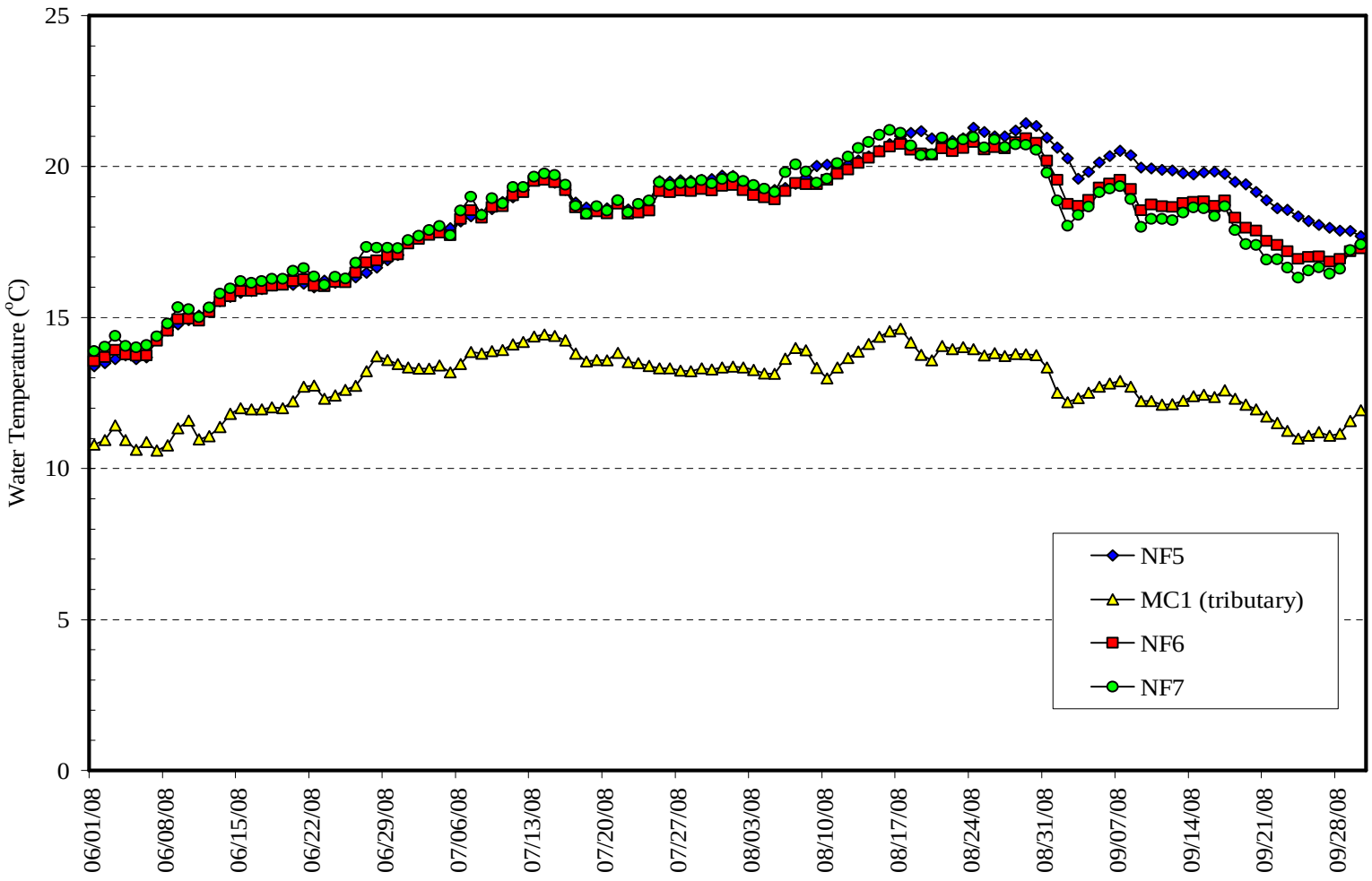


Figure 3-17. Comparison of daily average temperatures in the upper Belden Reach – 2008

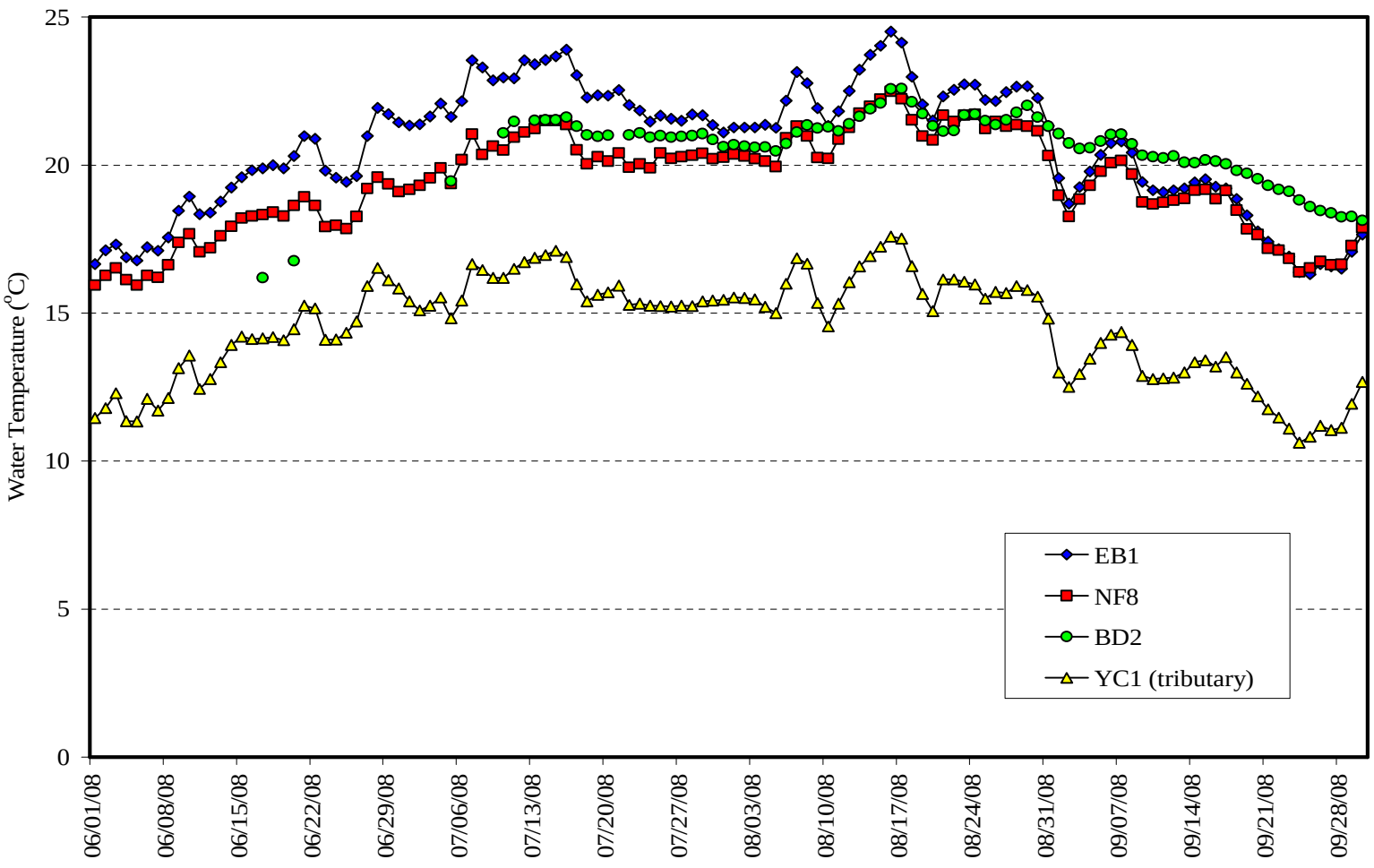


Figure 3-18. Comparison of daily average temperatures in the lower Belden Reach – 2008

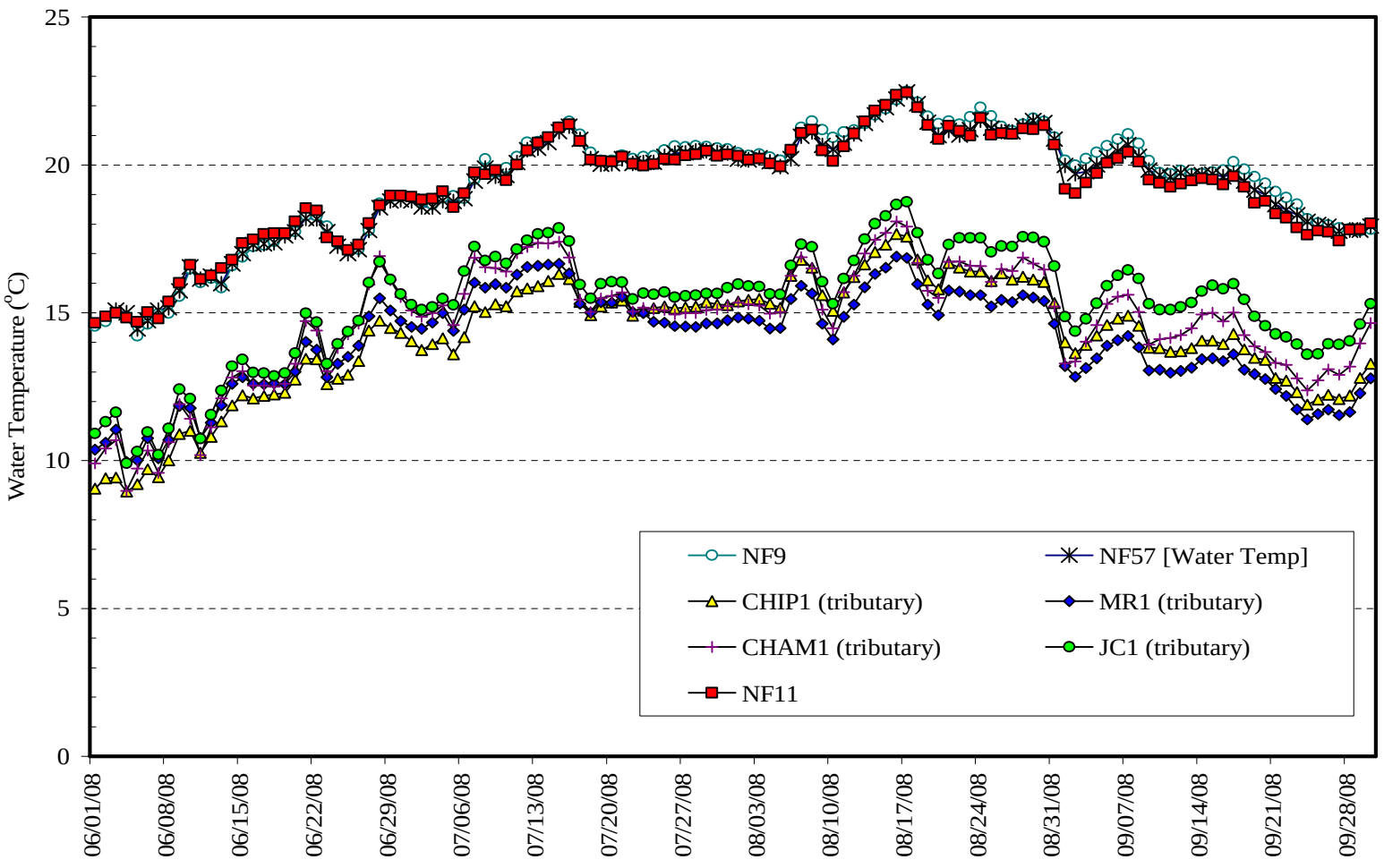


Figure 3-19. Comparison of daily average temperatures from stations in the upper Rock Creek Reach – 2008

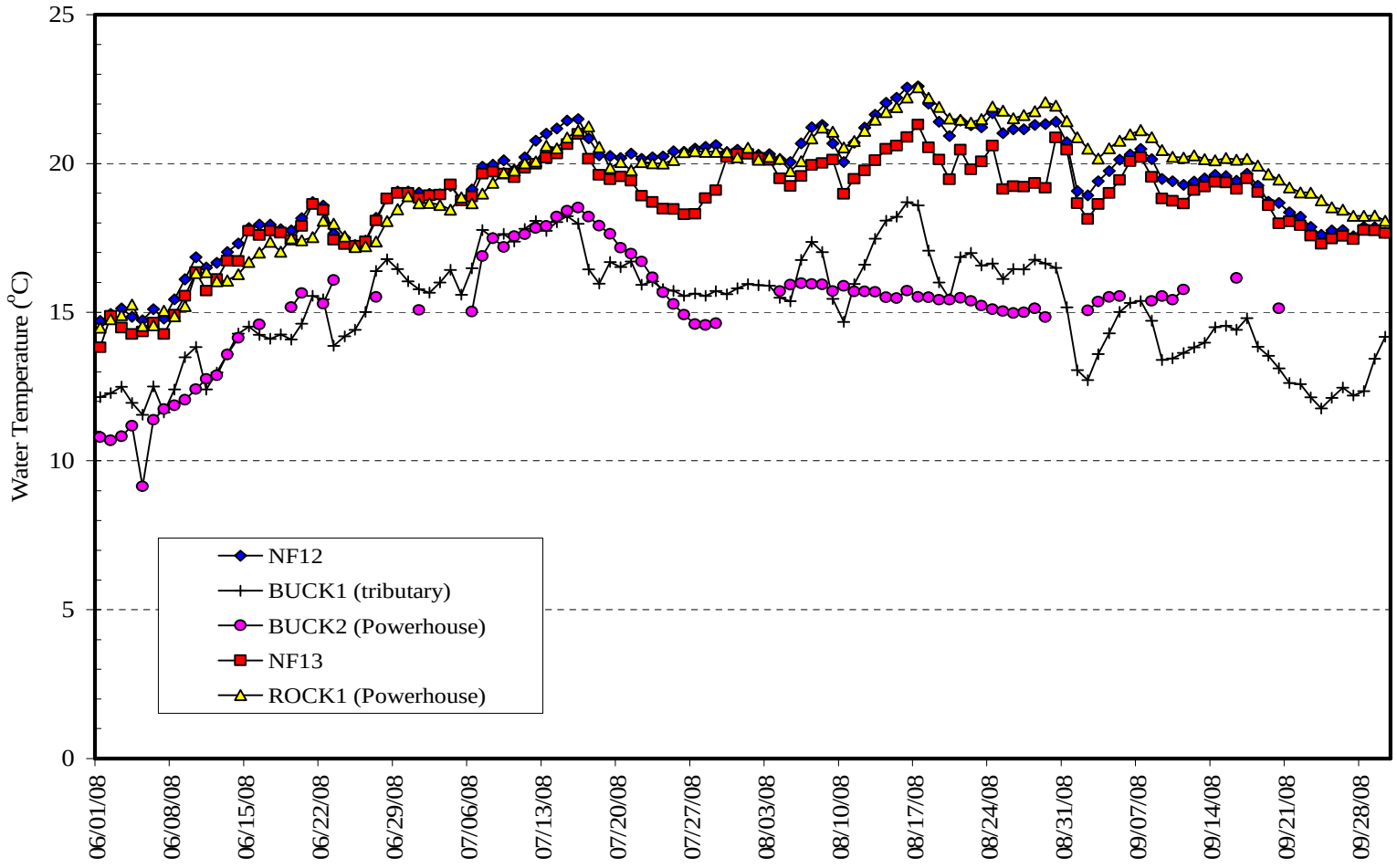


Figure 3-20. Comparison of daily average temperatures from stations in the lower Rock Creek Reach – 2008

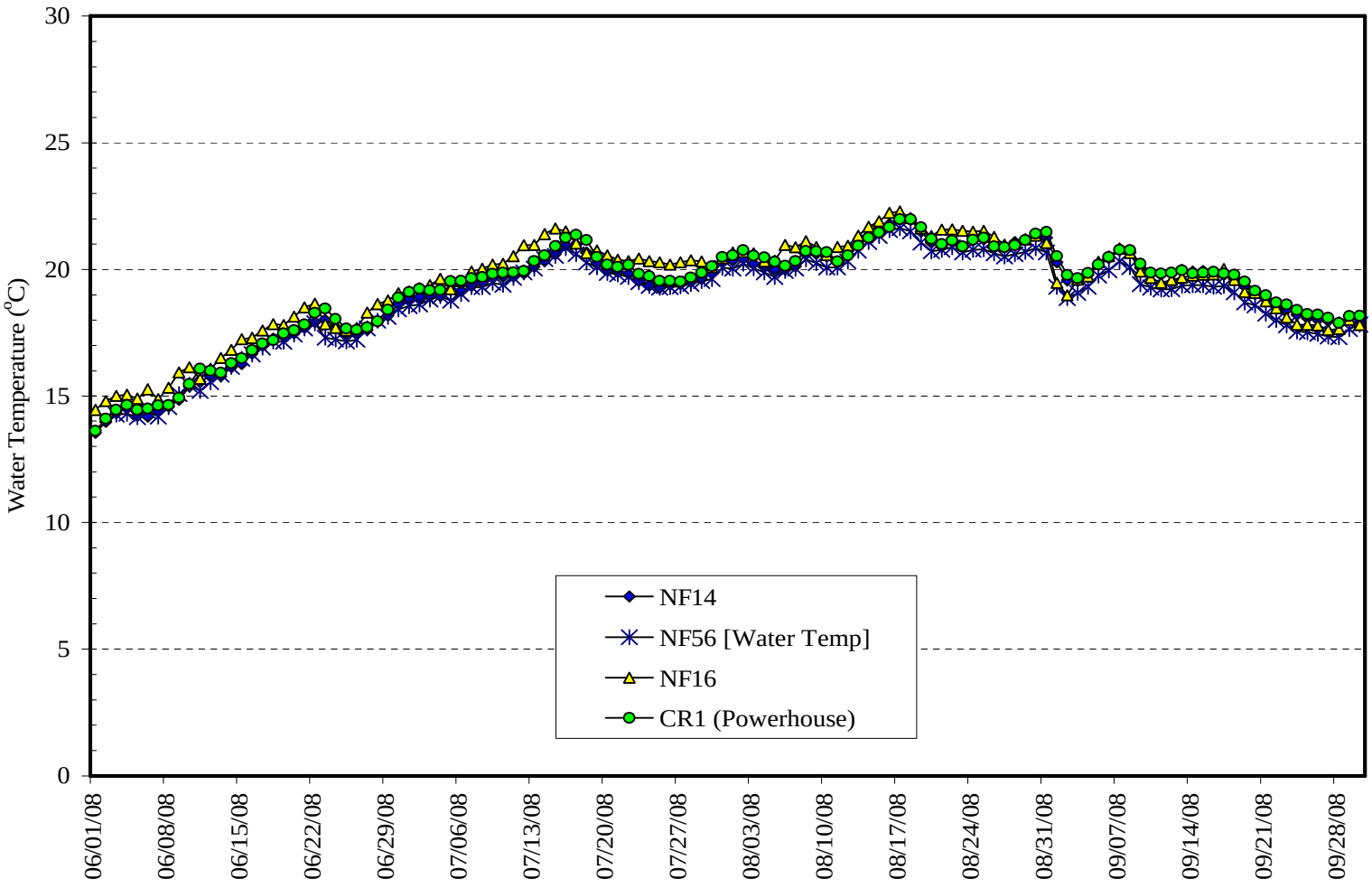


Figure 3-21. Comparison of daily average temperatures from river stations in the Cresta Reach – 2008

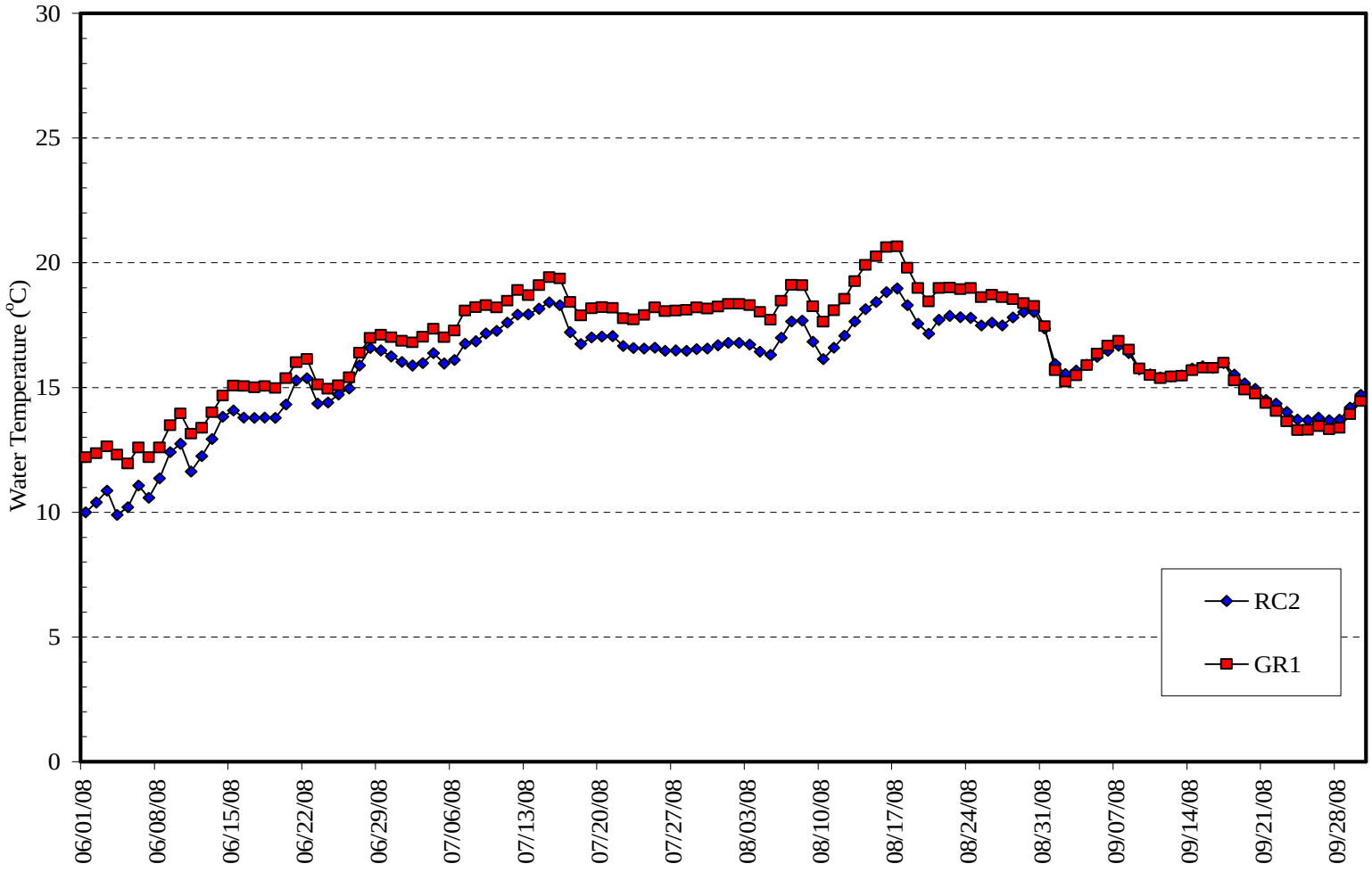


Figure 3-22. Comparison of daily average temperatures in streams tributary to the Cresta Reach – 2008

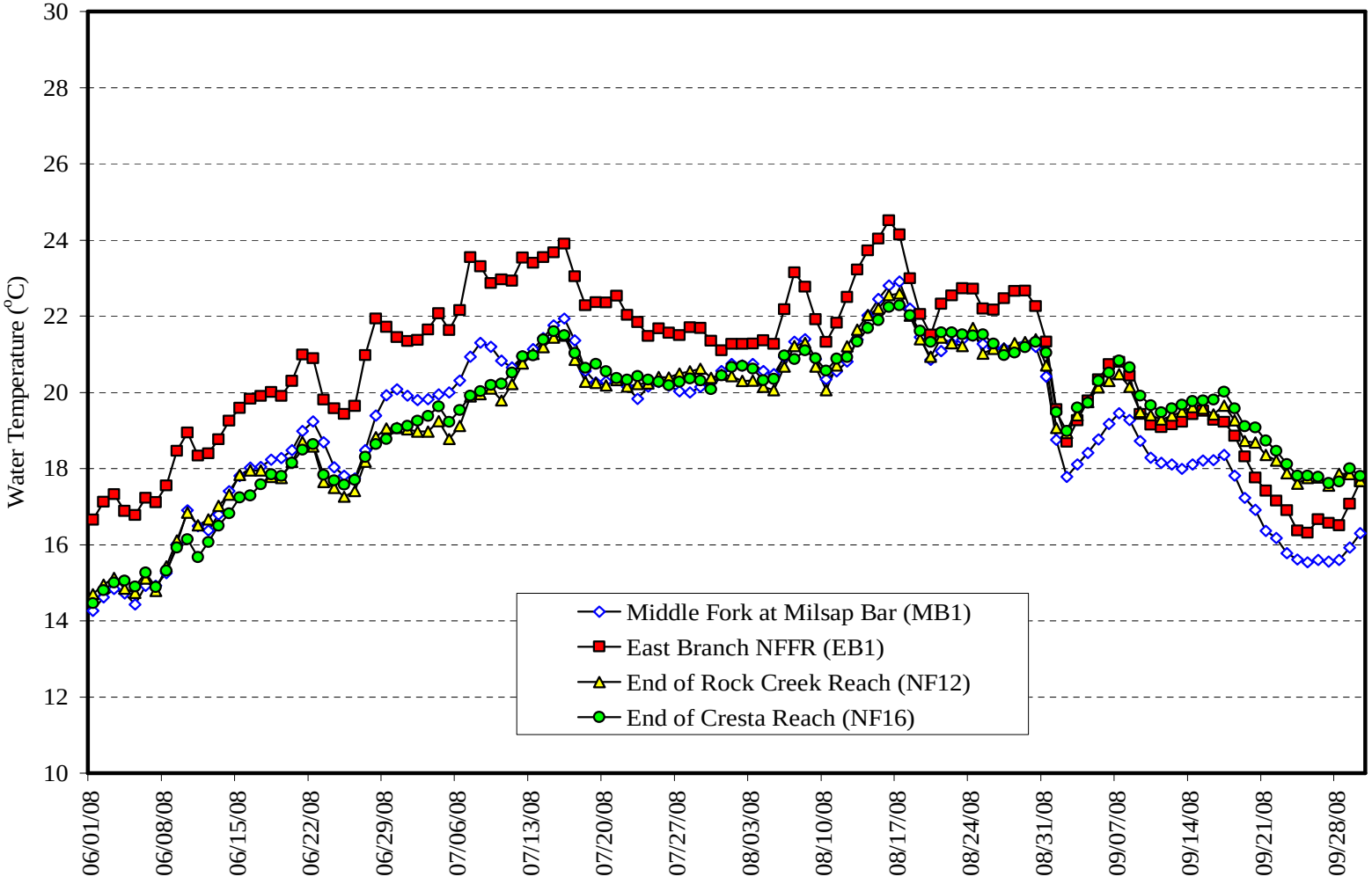


Figure 3-23. Comparison of daily average temperatures from MFFR at Milsap Bar with selected NFFR stations – 2008

4 REFERENCES

Buchanan, T.J., and W.P. Somers. 1980. *Discharge Measurements at Gaging Stations*. Tech. Water Resources Investigations. Book 3, Chapter A8.

CDEC. 2008. *California Data Exchange Center (http://cdec.water.ca.gov/).* Department of Water Resources.

California Department of Fish and Game (CDFG). 1988. *Rock Creek-Cresta Project (FERC 1962), Fisheries Management Study, North Fork Feather River, California.* CDFG Region 2, Environmental Services.

Department of Water Resources (DWR). 1999. Unpublished water quality data from DWR's Lake Almanor Water Quality Monitoring Program. Provided by Jerry Boles, DWR Red Bluff Office.

Pacific Gas and Electric Company. 1982. *Water Quality Impacts of Cold Water Releases on the Upper North Fork Feather River*. Pacific Gas and Electric Company. Report 026.11-82.7.

_____. 1984. *Lake Almanor Upper North Fork Feather River Temperature and Water Quality Investigation*. Pacific Gas and Electric Company. Report 026.11-83.1.

_____. 1986. *Rock Creek-Cresta Project Cold Water Feasibility Study. May 30, 1986* Prepared for Pacific Gas and Electric Company by Woodward Clyde Consultants.

_____. 1987. *Rock Creek-Cresta Project Cold Water Feasibility Study. July 23, 1987.* Prepared for Pacific Gas and Electric Company by Woodward Clyde Consultants.

_____. 1999. Hydrologic data from internal database.

_____. 2000. *Rock Creek-Cresta Project, FERC Project No. 1962, Rock Creek-Cresta Relicensing Settlement Agreement,* Pacific Gas and Electric Company. [September 18, 2000]

_____. 2002. Final Application for License – Upper North Fork Feather River.

_____. May 2004. Rock Creek-Cresta Sediment Management Monitoring Study, Interim Annual Data Report (FERC 1962-000 and 1962-082), prepared for Pacific Gas and Electric Company by ENTRIX, Inc, Walnut Creek, California

_____. 2008. *Hydrological database provided by Map-View Query Guided Map Interface,* Computer and Telecommunication Services, Pacific Gas and Electric Company.

5 APPENDIX A

SUMMARY OF DISCHARGE MEASUREMENTS

AT TEMPORARY FLOW STATIONS

Appendix A – Summary of discharge measurement data.

						Cross Section Statistics							
Station	Date	Time	Discharge (cfs)	GHT (ft)	Staff Ref.	Width (ft)	Area (square ft)	Average Depth (ft)	Average Velocity (ft/sec)	Maximum Velocity (ft/sec)	No. of Verticals	Measurement Rating	Measurement by
NF1	5/31/2008	11:30	328	2.29	-0.04	92.0	134.9	1.43	2.43	3.10	47	Good - 5%	M. Kossow
	6/20/2008	11:00	174	1.83	-0.50	88.5	118.3	1.28	1.47	2.35	47	Fair - 8%	M. Kossow
	7/20/2008	12:30	122	1.45	-0.88	65.2	92.7	1.39	1.31	2.13	45	Fair - 8%	M. Kossow
	9/25/2008	14:00	88.4	1.29	-1.04	64.5	79.9	1.20	1.11	1.69	34	Fair - 8%	M. Kossow
HB1	5/16/2008	12:30	85.8	2.42	-1.44	41.1	71.1	1.68	1.21	2.75	43	Fair - 8%	M. Kossow
	6/20/2008	14:00	69.7	2.22	-1.64	40.7	67.6	1.61	1.03	2.49	43	Fair - 8%	M. Kossow
	7/20/2008	10:00	70.5	2.21	-1.65	37.7	66.6	1.66	1.06	2.53	41	Fair - 8%	M. Kossow
	9/25/2008	16:00	64.6	2.19	-1.67	37.3	59.3	1.56	1.09	2.49	39	Fair - 8%	M. Kossow
BC3	5/14/2008	13:30	11.7	1.19	-1.31	22.8	17.8	0.75	0.66	0.99	32	Good - 5%	M. Kossow
	6/19/2008	11:30	11.7	1.18	-1.32	22.9	17.5	0.73	0.67	0.99	33	Good - 5%	M. Kossow
	7/19/2008	12:15	11.6	1.15	-1.35	22.8	17.3	0.73	0.67	0.90	32	Good - 5%	M. Kossow
	10/1/2008	15:00	11.1	1.15	-1.35	22.9	17.6	0.74	0.63	0.90	32	Good - 5%	M. Kossow
NF3	5/14/2008	11:00	48.3	1.30	-0.70	47.8	54.9	1.11	0.88	1.69	50	Fair - 8%	M. Kossow
	6/19/2008	09:15	48.5	1.31	-0.69	47.8	55.7	1.12	0.87	1.83	50	Fair - 8%	M. Kossow
	7/19/2008	09:45	47.5	1.30	-0.70	48.0	54.3	1.11	0.87	1.74	49	Fair - 8%	M. Kossow
	9/25/2008	10:30	42.7	1.25	-0.75	47.2	54.3	1.12	0.79	1.56	49	Fair - 8%	M. Kossow
NF4	5/15/2008	10:30	68.0	2.59	-1.13	45.3	78.9	1.73	0.86	1.38	32	Good - 5%	M. Kossow
	6/18/2008	10:45	60.3	2.54	-1.18	45.2	74.3	1.58	0.81	1.21	32	Good - 5%	M. Kossow
	7/18/2008	13:30	60.1	2.53	-1.19	45.3	74.9	1.59	0.80	1.25	32	Good - 5%	M. Kossow
	9/24/2008	13:30	55.0	2.49	-1.23	45.2	72.7	1.55	0.76	1.16	32	Good - 5%	M. Kossow
MC1	5/13/2008	12:00	10.9	2.57	-0.43	23.1	41.1	1.74	0.26	0.68	32	Poor - >10%	M. Kossow
	6/18/2008	09:30	5.98	2.42	-0.58	22.8	39.0	1.68	0.15	0.33	31	Poor - >10%	M. Kossow
	7/18/2008	12:00	3.78	2.35	-0.65	15.7	21.7	1.32	0.17	0.68	23	Poor - >10%	M. Kossow
	9/24/2008	11:30	3.32	2.25	-0.75	21.4	34.5	1.55	0.10	0.22	30	Poor - >10%	M. Kossow

						Cross Section Statistics							
Station	Date	Time	Discharge (cfs)	GHT (ft)	Staff Ref.	Width (ft)	Area (square ft)	Average Depth (ft)	Average Velocity (ft/sec)	Maximum Velocity (ft/sec)	No. of Verticals	Measurement Rating	Measurement by
YC1	6/4/2008	15:00	118	0.97	-0.53	35.8	69.0	1.78	1.71	3.72	26	Fair - 8%	M. Kossow
	6/18/2008	13:00	80.5	0.70	-0.8	35.1	58.1	1.50	1.39	2.58	26	Fair - 8%	M. Kossow
	7/18/2008	10:00	56.6	0.45	-1.05	34.5	49.5	1.27	1.14	2.18	27	Fair - 8%	M. Kossow
	9/24/2008	10:30	48.9	0.25	-1.25	31.9	48.5	1.42	1.01	2.13	24	Fair - 8%	M. Kossow

Appendix A – Summary of discharge measurement data.

						Cross Section Statistics							
Station	Date	Time	Discharge (cfs)	GHT (ft)	Staff Ref.	Width (ft)	Area (square ft)	Average Depth (ft)	Average Velocity (ft/sec)	Maximum Velocity (ft/sec)	No. of Verticals	Measurement Rating	Measurement by
CHIP	6/4/2008	16:30	106	17.4	-0.60	21.5	45.7	2.12	2.32	3.28	43	Fair - 8%	M. Kossow
	6/17/2008	13:30	56.7	16.9	-1.14	20.2	35.9	1.72	1.58	2.18	42	Fair - 8%	M. Kossow
	7/17/2008	09:15	22.6	16.4	-1.56	19.4	24.6	1.25	0.92	1.30	40	Fair - 8%	M. Kossow
	9/23/2008	13:30	11.4	16.2	-1.83	19.7	22.3	1.12	0.51	0.86	41	Fair - 8%	M. Kossow
MR1	5/13/2008	13:15	24.6	2.54	--	13.7	15.1	1.07	1.63	2.93	29	Poor - >10%	M. Kossow
	6/17/2008	11:00	8.54	2.30	--	13.7	10.2	0.72	0.84	1.69	28	Poor - >10%	M. Kossow
	7/17/2008	13:30	3.70	2.10	--	10.7	7.7	0.69	0.48	1.08	23	Poor - >10%	M. Kossow
	9/23/2008	10:30	2.09	1.97	--	10.7	6.6	0.59	0.32	0.90	23	Poor - >10%	M. Kossow
CHAM	5/16/2008	11:00	41.4	2.75	-0.25	17.5	29.5	1.72	1.40	2.84	34	Poor - >10%	M. Kossow
	6/17/2008	09:30	10.5	2.16	-0.84	13.8	15.3	1.06	0.69	1.34	29	Poor - >10%	M. Kossow
	7/17/2008	14:45	3.41	1.85	-1.15	12.2	9.6	0.74	0.36	0.94	26	Poor - >10%	M. Kossow
	9/23/2008	09:30	2.06	1.67	-1.33	11.6	7.0	0.57	0.30	0.77	25	Poor - >10%	M. Kossow
Buck2	05/12/08	13:00	43.5	1.35	-1.65	21.2	26.6	1.23	1.64	3.02	43	Fair - 8%	M. Kossow
	06/16/08	13:30	22.8	1.03	-1.97	20.5	21.0	1.01	1.09	2.00	28	Fair - 8%	M. Kossow
	07/16/08	13:30	19.1	0.93	-2.07	19.7	17.8	0.89	1.07	2.18	40	Fair - 8%	M. Kossow
	09/22/08	14:10	12.5	0.73	-2.27	19.4	14.9	0.75	0.84	1.78	41	Fair - 8%	M. Kossow
ROCK2	6/10/2008	12:00	82.7	1.51	-2.49	44.2	23.2	0.50	3.56	5.35	33	Fair - 8%	M. Kossow
	6/16/2008	13:00	49.4	1.33	-2.67	44.3	18.1	0.39	2.73	3.33	33	Fair - 8%	M. Kossow
	7/16/2008	11:45	4.04	1.00	-3.00	41.7	12.4	0.28	0.32	0.81	31	Fair - 8%	M. Kossow
	9/22/2008	12:30	1.98	0.90	-3.10	41.7	12.6	0.29	0.16	0.46	31	Fair - 8%	M. Kossow
GR1	5/12/2008	11:00	92.9	1.47	-2.39	42.7	84.5	1.93	1.10	2.00	44	Poor - >10%	M. Kossow
	6/16/2008	11:00	31.8	0.72	-3.14	41.3	54.6	1.28	0.58	0.99	43	Poor - >10%	M. Kossow
	7/16/2008	10:00	19.7	0.46	-3.40	40.9	46.2	1.10	0.43	0.81	43	Poor - >10%	M. Kossow
	9/22/2008	10:15	13.1	0.29	-3.57	40.6	38.7	0.93	0.34	0.77	42	Poor - >10%	M. Kossow

6 APPENDIX B

SUMMARY OF HOURLY TEMPERATURE DATA

Appendix B

Summary of Hourly Average Water Temperatures Data - UNFFR 2008

Station	Year	Month	Hourly Temperatures [1] max	min	mean	Data Days
NFFR at	2008	June	18.5	6.9	12.4	30
Chester	2008	July	19.3	10.4	14.5	31
(NF1)	2008	Aug	18.0	9.8	14.3	31
	2008	Sept	14.9	7.3	11.2	30
Hamilton	2008	June	14.9	8.2	11.2	30
Branch at	2008	July	15.1	8.8	11.5	31
Road bridge	2008	Aug	14.2	8.6	11.4	31
(HB1)	2008	Sept	13.1	8.0	10.5	30
Hamilton	2008	June	18.1	8.1	12.3	30
Branch	2008	July	17.8	8.9	12.7	6
Powerhouse	2008	Aug	16.6	8.9	12.4	3
(HB2)	2008	Sept	16.4	8.9	13.0	16
Lake Almanor	2008	June	23.0	15.2	18.2	30
at Canyon Dam	2008	July	24.3	20.1	22.1	31
near surface	2008	Aug	25.1	20.9	22.3	31
(LA1-S)	2008	Sept	22.6	18.0	20.1	30
Lake Almanor	2008	June	11.7	9.1	10.0	30
at Canyon Dam	2008	July	12.3	9.9	11.0	31
near bottom	2008	Aug	13.4	10.7	11.9	31
(LA1-B)	2008	Sept	13.2	11.4	12.3	30
NFFR below	2008	June	14.1	10.2	11.8	23
Canyon Dam	2008	July	14.8	11.7	13.0	31
(NF2)	2008	Aug	15.8	12.7	13.9	31
	2008	Sept	16.1	13.5	14.4	30
NFFR at	2008	June	16.2	9.5	13.2	30
Seneca Bridge	2008	July	16.7	12.2	14.4	31
(NF3)	2008	Aug	17.0	12.0	14.8	31
	2008	Sept	15.7	11.6	13.8	30
NFFR above	2008	June	16.4	9.9	13.3	30
Caribou PH	2008	July	17.0	12.9	14.7	31
(NF4)	2008	Aug	17.5	12.4	15.0	31
	2008	Sept	15.5	11.1	13.3	30
Butt Valley	2008	June	--	--	--	0
Powerhouse	2008	July	--	--	--	0
[Corrected]	2008	Aug	22.9	19.0	21.5	19
(BV1)	2008	Sept	21.4	17.8	19.7	30

Appendix B (Continued)

Station	Year	Month	Hourly Temperatures [1] max	min	mean	Data Days
Butt Valley Res.	2008	June	23.4	16.0	19.8	30
at Caribou Intake	2008	July	24.6	20.8	22.2	31
Near surface	2008	Aug	25.2	21.0	22.5	31
(BV2-S)	2008	Sept	22.7	18.0	20.1	30
Butt Valley Res.	2008	June	15.1	9.6	12.0	30
at Caribou Intake	2008	July	17.3	13.8	15.7	31
Near bottom	2008	Aug	19.5	10.1	16.5	16
(BV2-B)	2008	Sept	19.7	17.6	18.8	30
Butt Creek above	2008	June	17.0	8.1	13.0	30
Butt Valley	2008	July	19.0	13.0	17.0	31
Reservoir	2008	Aug	20.4	10.1	16.8	20
(BC1 @ NF-4 gage)	2008	Sept	14.7	7.5	11.0	30
Butt Creek below	2008	June	Not deployed since 2007			0
Butt Valley	2008	July	--	--	--	--
Reservoir	2008	Aug	--	--	--	--
(BC2)	2008	Sept	--	--	--	--
Butt Creek at	2008	June	13.3	9.2	11.1	30
Mouth	2008	July	13.7	10.8	11.9	31
(BC3)	2008	Aug	13.9	10.7	12.2	31
	2008	Sept	13.2	9.6	11.6	30
Caribou No. 1	2008	June	16.8	11.3	15.3	7
Powerhouse	2008	July	18.4	16.0	17.5	2
[corrected]	2008	Aug	21.1	18.0	20.1	14
(CARB1)	2008	Sept	20.4	17.0	19.0	30
Caribou No. 2	2008	June	22.7	17.0	20.9	9
Powerhouse	2008	July	23.5	20.3	21.8	31
[corrected]	2008	Aug	23.6	20.6	21.8	31
(CARB2A)	2008	Sept	22.0	18.0	19.9	30
Belden Reservoir	2008	June	19.7	13.6	16.2	30
At Intake	2008	July	21.8	19.0	20.6	31
(BD1)	2008	Aug	23.0	20.0	21.3	31
	2008	Sept	21.2	17.8	19.7	30
NFFR below	2008	June	17.6	12.8	15.4	30
Belden Dam	2008	July	20.0	17.0	18.8	31
(NF5)	2008	Aug	21.7	19.1	20.4	31
	2008	Sept	21.0	17.5	19.3	30

Appendix B (Continued)

Station	Year	Month	Hourly Temperatures [1] max	min	mean	Data Days
Mosquito Creek	2008	June	14.5	9.5	11.9	30
At mouth	2008	July	15.4	12.4	13.6	31
(MC1)	2008	Aug	15.5	12.0	13.7	31
	2008	Sept	13.7	10.3	12.0	30
NFFR near	2008	June	18.8	12.4	15.4	30
Queen Lily	2008	July	21.4	16.3	18.7	31
Campground	2008	Aug	22.7	17.9	20.1	31
(NF6)	2008	Sept	21.9	15.6	18.3	30
NFFR near	2008	June	20.2	12.0	15.7	30
Gansner Bar	2008	July	22.4	15.9	18.9	31
(NF7)	2008	Aug	23.9	17.3	20.3	31
	2008	Sept	21.9	14.2	17.9	30
East Branch	2008	June	22.8	14.9	19.2	30
NFFR at mouth	2008	July	25.1	19.8	22.3	31
(EB1)	2008	Aug	25.6	19.6	22.4	31
	2008	Sept	21.9	15.2	18.6	30
NFFR at Belden	2008	June	21.5	13.9	17.7	30
Town Bridge	2008	July	23.9	17.5	20.4	31
(NF8)	2008	Aug	24.9	17.7	21.1	31
	2008	Sept	22.0	14.6	18.3	30
Belden	2008	June	17.5	14.1	16.6	2
Powerhouse	2008	July	21.8	19.3	20.9	21
(BD2)	2008	Aug	22.9	20.3	21.5	31
	2008	Sept	21.3	18.0	19.8	30
Yellow Creek	2008	June	18.0	9.5	13.7	30
Near mouth	2008	July	19.3	13.4	15.8	31
(YC1)	2008	Aug	19.7	12.6	15.9	31
	2008	Sept	16.1	9.4	12.6	30
Chips Creek	2008	June	16.8	7.2	11.7	30
Near mouth	2008	July	18.9	12.1	15.1	31
(CHIP)	2008	Aug	20.2	13.0	16.2	31
	2008	Sept	17.3	10.4	13.5	30
NFFR below Rock	2008	June	19.4	13.9	16.6	30
Creek Dam	2008	July	21.9	18.4	20.2	31
(NF9)	2008	Aug	22.8	19.8	21.3	31
	2008	Sept	21.4	17.6	19.5	30
NFFR at NF-57	2008	June	19.8	13.6	16.8	28
Telemetered	2008	July	22.4	17.9	20.0	31
(NF57 [Water	2008	Aug	23.5	19.3	21.1	31
Temp])	2008	Sept	21.5	17.2	19.2	30

Appendix B (Continued)

Station	Year	Month	Hourly Temperatures [1] max	Min	mean	Data Days
Milk Ranch Creek	2008	June	16.9	7.7	12.4	30
Near mouth	2008	July	18.6	12.9	15.3	31
(MR1)	2008	Aug	18.4	12.5	15.4	31
	2008	Sept	15.5	10.4	12.9	30
Chambers Creek	2008	June	17.9	7.0	12.5	30
Near mouth	2008	July	19.4	13.2	15.7	31
(CHAM)	2008	Aug	19.9	12.6	16.3	31
	2008	Sept	17.4	10.8	14.0	30
NFFR near Tobin	2008	June	20.1	12.5	16.8	30
blw Granite Crk	2008	July	23.0	17.4	20.0	31
(NF11)	2008	Aug	23.9	18.1	21.1	31
	2008	Sept	21.8	16.2	19.0	30
Jackass Creek	2008	June	18.3	7.5	12.9	30
Near mouth	2008	July	19.7	13.4	16.2	31
(JC1)	2008	Aug	19.6	14.0	17.0	31
	2008	Sept	17.3	12.8	15.0	30
NFFR abv Bucks	2008	June	19.9	12.7	17.0	30
Creek	2008	July	22.8	17.7	20.2	31
(NF12)	2008	Aug	23.8	18.2	21.2	31
	2008	Sept	21.6	16.1	19.0	30
Bucks Creek	2008	June	19.0	8.9	13.9	30
Near Mouth	2008	July	20.9	13.4	16.6	31
(BUCK1)	2008	Aug	21.0	12.5	16.6	31
	2008	Sept	17.3	10.3	13.6	30
Bucks Creek	2008	June	16.5	10.3	12.3	20
Powerhouse	2008	July	19.5	14.4	16.5	25
(BUCK2)	2008	Aug	17.8	14.6	15.4	26
	2008	Sept	18.2	14.3	15.5	10
NFFR abv Rock	2008	June	19.8	12.3	16.7	30
Creek Powerhouse	2008	July	21.9	17.3	19.4	31
(NF13)	2008	Aug	23.0	18.2	20.0	31
	2008	Sept	21.2	15.9	18.6	30
Rock Creek	2008	June	19.2	13.8	16.3	30
Powerhouse	2008	July	21.4	18.2	19.9	31
(RC1)	2008	Aug	22.8	19.6	21.5	31
	2008	Sept	21.5	17.7	19.8	30

Appendix B (Continued)

Station	Year	Month	Hourly Temperatures [1] max	Min	mean	Data Days
Rock Creek	2008	June	17.2	8.3	13.3	30
Near mouth	2008	July	19.6	15.2	16.9	31
(RC2)	2008	Aug	20.0	15.1	17.5	31
	2008	Sept	17.6	13.0	15.2	30
NFFR abv Grizzly	2008	June	19.4	12.9	16.3	30
Creek	2008	July	21.6	18.3	19.7	31
(NF14)	2008	Aug	22.4	19.6	20.9	31
	2008	Sept	21.4	17.6	19.4	30
Grizzly Creek	2008	June	18.3	10.2	14.4	30
Near mouth	2008	July	21.1	15.5	18.1	31
(GR1)	2008	Aug	22.0	16.1	18.8	31
	2008	Sept	18.1	12.5	15.1	30
NFFR at NF-56	2008	June	19.9	12.5	16.3	28
Telemetered	2008	July	22.5	17.3	19.6	31
(NF56 [Water	2008	Aug	23.3	18.5	20.6	31
Temp])	2008	Sept	22.0	16.4	18.8	30
NFFR abov Cresta	2008	June	20.0	12.8	16.9	30
Powerhouse	2008	July	22.8	17.9	20.3	31
(NF16)	2008	Aug	23.5	18.7	21.2	31
	2008	Sept	22.0	16.4	19.2	30
Cresta	2008	June	19.1	13.4	16.0	30
Powerhouse	2008	July	21.7	18.9	20.0	31
(CR1)	2008	Aug	22.5	20.0	21.0	31
	2008	Sept	21.3	17.7	19.5	30
Middle Fork	2008	June	21.4	13.4	17.2	30
Feather River	2008	July	23.6	18.6	20.5	31
At Milsap Bar	2008	Aug	24.3	18.8	21.2	31
(MB1)	2008	Sept	21.0	14.6	17.5	30

1. Values are based on hourly average data, month statistics represent the maximum, minimum, and mean based on these hourly average temperatures. For example, the maximum June temperature represents the maximum hourly average temperature measured in June.

7 APPENDIX C

SUMMARY OF PROFILE DATA FROM LAKE ALMANOR

AND BUTT VALLEY RESERVOIR

APPENDIX C1 – ROUTINE LAKE PROFILE DATA – LA1-P1

LA1-P1 - Lake Almanor near Canyon Dam

Latitude 40° 10.636'N Longitude 121° 05.256'W

Date	Time	Date	Time	Date	Time	Date	Time	Date	Time
05/27/08	07:50	06/24/08	09:23	07/25/08	08:48	08/29/08	09:10	10/27/08	11:01
Elevation		Elevation		Elevation		Elevation		Elevation	
(USGS)	(PG&E)	(USGS)	(PG&E)	(USGS)	(PG&E)	(USGS)	(PG&E)	(USGS)	(PG&E)
4493.7	4483.5	4494.8	4484.6	4494.8	4484.6	4492.7	4482.5	4487.4	4477.2

Elevation (ft.)	Temp. (°C)	Elevation (ft.)	Temp. (°C)	Elevation (ft.)	Temp. (°C)	Elevation (ft.)	Temp. (°C)	Elevation (ft.)	Temp. (°C)
4493.5	13.9	4494.5	18.6	4494.3	21.6	4492.5	22.3	4486.6	17.0
4490.2	13.8	4493.0	18.6	4493.3	21.6	4491.0	22.3	4485.8	17.0
4486.8	13.8	4491.7	18.5	4492.6	21.6	4490.3	22.3	4484.9	17.0
4483.6	13.7	4490.6	18.5	4491.2	21.6	4489.0	22.3	4484.1	17.0
4480.2	13.7	4489.6	18.5	4490.4	21.6	4488.6	22.3	4483.1	16.9
4477.0	13.7	4488.5	18.5	4489.5	21.6	4487.5	22.3	4482.1	16.9
4473.8	13.7	4487.7	18.5	4487.9	21.6	4486.3	22.3	4481.1	16.9
4470.6	13.7	4486.8	18.5	4487.0	21.6	4485.5	22.2	4479.9	16.9
4467.2	13.6	4485.5	18.4	4486.2	21.6	4484.2	22.0	4479.0	16.9
4464.1	13.6	4484.6	18.4	4485.4	21.6	4483.4	22.0	4477.9	16.9
4460.9	12.6	4483.7	18.4	4484.6	21.6	4482.2	21.9	4476.8	16.9
4457.7	11.8	4482.8	18.4	4483.6	21.5	4481.4	21.9	4475.8	16.8
4454.4	11.2	4481.5	18.3	4482.7	21.5	4480.2	21.9	4475.3	16.8
4451.3	10.8	4480.7	18.3	4481.7	21.5	4479.5	21.9	4474.1	16.8
4448.2	10.4	4479.6	18.3	4480.1	21.5	4478.2	21.9	4473.4	16.8
4444.8	10.2	4478.8	18.3	4479.2	21.5	4477.6	21.8	4471.3	16.8
4441.6	10.0	4477.7	18.3	4478.4	21.5	4476.0	21.8	4469.9	16.8
4438.3	9.8	4476.5	18.3	4477.5	21.5	4475.3	21.8	4469.1	16.8
4435.1	9.7	4475.8	18.3	4476.7	21.4	4474.7	21.8	4468.2	16.8
4431.9	9.4	4474.5	18.2	4475.9	21.4	4473.0	21.8	4467.3	16.8
4428.7	9.1	4473.8	18.2	4474.0	21.4	4472.6	21.8	4466.3	16.8
4425.4	9.0	4472.5	18.1	4473.2	21.4	4471.2	21.8	4465.3	16.8
4422.0	8.5	4471.5	17.9	4472.4	21.3	4470.6	21.8	4463.7	16.8
4418.9	8.1	4470.6	17.8	4471.6	21.2	4469.1	21.7	4462.7	16.8
4415.8	8.0	4469.7	17.7	4470.0	21.1	4468.4	21.7	4461.7	16.8

LA1-P1 - Lake Almanor near Canyon Dam

Latitude	Longitude
40° 10.636'N	121° 05.256'W

Date	Time	Date	Time	Date	Time	Date	Time	Date	Time
05/27/08	07:50	06/24/08	09:23	07/25/08	08:48	08/29/08	09:10	10/27/08	11:01
Elevation		Elevation		Elevation		Elevation		Elevation	
(USGS)	(PG&E)	(USGS)	(PG&E)	(USGS)	(PG&E)	(USGS)	(PG&E)	(USGS)	(PG&E)
4493.7	4483.5	4494.8	4484.6	4494.8	4484.6	4492.7	4482.5	4487.4	4477.2

Elevation (ft.)	Temp. (°C)	Elevation (ft.)	Temp. (°C)	Elevation (ft.)	Temp. (°C)	Elevation (ft.)	Temp. (°C)	Elevation (ft.)	Temp. (°C)
4412.7	7.7	4468.8	17.5	4469.2	21.0	4467.0	21.7	4460.9	16.8
		4467.5	17.0	4468.3	20.4	4466.2	21.6	4460.0	16.8
		4466.6	16.7	4467.6	19.8	4465.7	21.6	4459.0	16.8
		4465.6	16.4	4466.0	18.6	4464.3	21.1	4458.0	16.8
		4464.8	16.2	4465.1	18.0	4463.6	20.6	4457.1	16.8
		4463.8	15.9	4464.3	17.6	4462.5	20.4	4456.2	16.7
		4462.6	15.6	4463.6	17.1	4461.6	20.2	4455.3	16.7
		4461.6	15.4	4462.1	16.3	4460.4	19.9	4454.2	16.7
		4460.7	15.2	4461.4	16.0	4459.6	19.3	4453.3	16.7
		4459.5	14.9	4460.0	15.5	4458.5	18.8	4452.4	16.4
		4458.7	14.7	4459.2	15.4	4457.6	18.3	4451.3	15.8
		4457.8	14.6	4458.5	15.3	4456.3	17.1	4449.6	15.2
		4456.8	14.4	4456.9	15.0	4455.4	16.4	4448.7	14.9
		4455.6	14.2	4456.2	14.8	4454.3	16.2	4447.7	14.7
		4454.8	13.9	4455.5	14.6	4453.2	15.9	4446.8	14.6
		4453.4	13.7	4454.0	14.4	4452.4	15.6	4446.0	14.5
		4452.5	13.6	4453.3	14.3	4451.6	15.4	4445.2	14.3
		4451.5	13.5	4452.0	14.0	4450.1	15.1	4444.2	14.1
		4450.6	13.4	4451.3	14.0	4449.4	15.0	4443.3	13.9
		4449.6	13.2	4450.6	13.9	4448.1	14.8	4442.5	13.7
		4449.1	13.0	4450.0	13.7	4447.6	14.6	4441.4	13.4
		4448.6	12.9	4449.1	13.6	4446.6	14.2	4439.6	13.2
		4447.8	12.7	4448.4	13.4	4445.5	13.8	4438.7	13.2
		4446.3	12.0	4447.2	13.2	4444.6	13.6	4437.8	13.1
		4445.8	11.8	4446.5	13.1	4443.6	13.2	4437.0	13.0
		4444.7	11.6	4445.2	13.0	4442.5	13.1	4436.2	12.9

LA1-P1 - Lake Almanor near Canyon Dam

Latitude 40° 10.636'N

Longitude 121° 05.256'W

Date	Time	Date	Time	Date	Time	Date	Time	Date	Time
05/27/08	07:50	06/24/08	09:23	07/25/08	08:48	08/29/08	09:10	10/27/08	11:01
Elevation		Elevation		Elevation		Elevation		Elevation	
(USGS)	(PG&E)	(USGS)	(PG&E)	(USGS)	(PG&E)	(USGS)	(PG&E)	(USGS)	(PG&E)
4493.7	4483.5	4494.8	4484.6	4494.8	4484.6	4492.7	4482.5	4487.4	4477.2

Elevation (ft.)	Temp. (°C)	Elevation (ft.)	Temp. (°C)	Elevation (ft.)	Temp. (°C)	Elevation (ft.)	Temp. (°C)	Elevation (ft.)	Temp. (°C)
		4443.5	11.3	4444.6	12.9	4441.4	13.0	4435.4	12.8
		4442.9	11.2	4443.3	12.7	4439.9	12.9	4433.6	12.6
		4441.5	11.0	4441.8	12.4	4439.2	12.8	4432.8	12.6
		4440.8	10.9	4441.2	12.4	4438.5	12.8	4431.7	12.6
		4439.6	10.7	4440.6	12.2	4437.6	12.6	4430.8	12.5
		4438.4	10.6	4439.4	11.8	4436.7	12.5	4429.8	12.5
		4437.6	10.5	4438.2	11.6	4435.2	12.5	4428.9	12.4
		4436.6	10.3	4437.6	11.5	4434.5	12.5	4428.1	12.4
		4435.5	10.2	4436.4	11.3	4433.7	12.5	4427.3	12.3
		4434.6	10.1	4435.0	11.1	4432.0	12.3	4425.6	12.1
		4433.5	10.0	4434.4	11.0	4431.3	12.2	4424.8	12.1
		4432.2	10.0	4433.2	10.9	4430.6	12.1	4424.0	12.0
		4431.5	10.0	4432.6	10.8	4429.6	11.8	4423.1	12.0
		4430.4	9.9	4431.4	10.7	4428.6	11.7	4422.0	11.9
		4429.8	9.9	4430.3	10.6	4427.6	11.7	4421.2	11.8
		4428.6	9.9	4429.1	10.6	4426.7	11.5	4420.4	11.7
		4427.4	9.8	4428.3	10.5	4425.5	11.4	4418.4	11.2
		4426.3	9.8	4427.1	10.4	4424.6	11.3	4418.1	10.9
		4425.8	9.8	4426.5	10.3	4423.3	11.1		
		4424.8	9.8	4425.2	10.3	4422.5	11.0		
		4423.7	9.7	4424.6	10.3	4421.4	10.8		
		4422.3	9.6	4423.4	10.2				
		4421.7	9.6	4422.1	10.1				
		4420.6	9.4	4421.3	9.9				
		4419.5	9.2	4420.2	9.7				
		4418.8	9.1	4419.6	9.7				

LA1-P1 - Lake Almanor near Canyon Dam

Latitude	Longitude
40° 10.636'N	121° 05.256'W

Date	Time	Date	Time	Date	Time	Date	Time	Date	Time
05/27/08	07:50	06/24/08	09:23	07/25/08	08:48	08/29/08	09:10	10/27/08	11:01
Elevation		Elevation		Elevation		Elevation		Elevation	
(USGS)	(PG&E)	(USGS)	(PG&E)	(USGS)	(PG&E)	(USGS)	(PG&E)	(USGS)	(PG&E)
4493.7	4483.5	4494.8	4484.6	4494.8	4484.6	4492.7	4482.5	4487.4	4477.2

Elevation (ft.)	Temp. (°C)	Elevation (ft.)	Temp. (°C)	Elevation (ft.)	Temp. (°C)	Elevation (ft.)	Temp. (°C)	Elevation (ft.)	Temp. (°C)
		4417.7	9.0	4418.5	9.6				
		4416.4	8.9	4417.4	9.6				
		4415.6	8.8	4416.3	9.6				
		4415.3	8.7	4415.2	9.3				

APPENDIX C1 – ROUTINE LAKE PROFILE DATA – LA-P2

LA-P2 - Prattville Intake

Latitude 40° 12.794'N Longitude 121° 09.745'W

Date	Time	Date	Time	Date	Time	Date	Time	Date	Time
05/27/08	09:13	06/24/08	11:07	07/25/08	10:40	08/29/08	11:11	10/27/08	10:22
Elevation		Elevation		Elevation		Elevation		Elevation	
(USGS)	(PG&E)	(USGS)	(PG&E)	(USGS)	(PG&E)	(USGS)	(PG&E)	(USGS)	(PG&E)
4493.7	4483.5	4494.8	4484.6	4494.6	4484.4	4492.7	4482.5	4487.4	4477.2

Elevation (ft.)	Temp. (°C)	Elevation (ft.)	Temp. (°C)	Elevation (ft.)	Temp. (°C)	Elevation (ft.)	Temp. (°C)	Elevation (ft.)	Temp. (°C)
4493.1	13.9	4494.5	19.0	4494.3	21.6	4492.5	22.1	4486.8	16.8
4489.9	13.8	4493.6	19.0	4493.5	21.6	4491.4	22.1	4486.0	16.8
4486.7	13.8	4492.6	19.0	4492.5	21.5	4490.7	22.1	4485.0	16.8
4483.5	13.8	4491.7	19.0	4491.2	21.5	4489.3	22.1	4484.0	16.8
4480.6	13.7	4490.5	19.0	4490.4	21.5	4488.2	22.0	4483.0	16.8
4477.1	13.5	4489.5	19.0	4489.6	21.5	4487.4	22.0	4482.0	16.8
4473.9	13.5	4488.7	19.0	4488.5	21.5	4486.6	22.0	4481.0	16.8
4470.7	13.5	4487.6	18.9	4487.4	21.4	4485.2	22.0	4480.2	16.8
4467.4	13.3	4486.7	18.9	4486.0	21.4	4484.4	22.0	4479.3	16.8
4464.3	13.3	4485.8	18.9	4485.3	21.3	4483.3	22.0	4478.4	16.8
4461.0	13.2	4484.7	18.9	4484.5	21.3	4482.4	22.0	4477.6	16.8
4457.6	12.1	4483.7	18.9	4482.8	21.3	4481.1	22.0	4476.8	16.8
4454.6	11.3	4482.7	18.9	4481.9	21.3	4480.5	21.9	4476.1	16.8
		4481.6	18.9	4481.0	21.3	4479.7	21.8	4475.2	16.8
		4480.5	18.9	4480.1	21.3	4478.3	21.8	4474.0	16.8
		4479.6	18.8	4479.0	21.2	4477.6	21.7	4473.3	16.8
		4478.7	18.8	4478.2	21.2	4476.1	21.7	4472.0	16.8
		4477.7	18.8	4477.3	21.1	4475.3	21.7	4471.4	16.8
		4476.6	18.4	4476.5	21.1	4474.7	21.6	4470.1	16.8
		4475.4	18.1	4475.5	21.1	4473.5	21.5	4469.1	16.8
		4474.8	18.0	4473.9	21.0	4472.2	21.4	4468.1	16.8
		4473.6	17.8	4473.1	21.0	4471.5	21.4	4467.1	16.8
		4472.2	17.8	4472.3	21.0	4470.2	21.4	4466.1	16.8
		4471.6	17.8	4471.5	21.0	4469.3	21.4	4465.1	16.8
		4470.7	17.7	4470.7	20.9	4468.7	21.4	4464.0	16.8
		4469.3	17.3	4469.6	20.9	4467.5	21.3	4463.0	16.8

4468.5	16.7	4468.0	20.6	4466.7	21.3	4462.0	16.8
4467.8	16.4	4467.2	20.1	4465.3	21.3	4461.1	16.8
4466.8	16.1	4466.4	19.6	4464.7	21.2	4460.1	16.8
4465.5	15.9	4464.9	18.9	4463.4	20.8	4458.9	16.8
4465.2	15.8	4464.2	18.5	4462.0	20.0	4457.9	16.8
4464.6	15.6	4463.4	18.2	4461.5	19.6	4457.4	16.8
4463.8	15.4	4462.6	18.0	4460.5	19.1	4456.4	16.8
4462.5	15.3	4460.7	17.1	4459.4	18.6	4455.4	16.8
4461.3	15.2	4459.9	16.5	4458.4	18.3	4454.3	16.7
4460.7	15.1	4459.1	15.9	4457.4	17.8	4453.2	16.1
4459.5	14.9	4458.3	15.6	4456.3	17.2		
4458.2	14.6	4457.6	15.4	4455.2	16.5		
4457.5	14.4	4456.1	14.9	4454.6	16.1		
4456.7	14.3	4455.3	14.5	4454.1	13.8		
4455.3	14.1	4454.6	13.9				
4454.5	13.8	4453.6	12.5				
4453.4	12.3						

APPENDIX C1 – ROUTINE LAKE PROFILE DATA – LA-P6

LA1-P6 - Almanor West Latitude 40°15.445'N Longitude 121°10.807'W

Date	Time	Date	Time	Date	Time	Date	Time	Date	Time
05/27/08	08:54	06/24/08	10:54	07/25/08	10:21	08/29/08	09:55	10/27/08	10:05
Elevation		Elevation		Elevation		Elevation		Elevation	
(USGS)	(PG&E)	(USGS)	(PG&E)	(USGS)	(PG&E)	(USGS)	(PG&E)	(USGS)	(PG&E)
4493.7	4483.5	4494.8	4484.6	4494.6	4484.4	4492.7	4482.5	4487.4	4477.2
Elevation (ft.)	Temp. (°C)	Elevation (ft.)	Temp. (°C)	Elevation (ft.)	Temp. (°C)	Elevation (ft.)	Temp. (°C)	Elevation (ft.)	Temp. (°C)
4493.5	14.2	4494.5	19.0	4494.4	21.8	4492.1	21.7	4487.1	16.7
4490.1	14.1	4493.6	19.0	4493.3	21.8	4491.1	21.6	4486.1	16.7
4487.0	14.1	4492.6	19.0	4492.3	21.8	4490.5	21.6	4485.3	16.7
4483.9	14.0	4491.8	19.0	4491.6	21.8	4489.3	21.5	4484.3	16.7
4480.5	14.0	4490.5	19.0	4490.1	21.7	4488.6	21.5	4482.7	16.7
4477.0	13.8	4489.4	19.0	4489.1	21.7	4487.3	21.5	4482.3	16.7
4473.9	13.7	4488.4	18.9	4488.5	21.7	4486.6	21.5	4480.6	16.7
4470.6	13.7	4487.2	18.9	4487.3	21.7	4485.4	21.5	4480.0	16.7
		4486.5	18.9	4486.4	21.7	4484.0	21.5	4479.1	16.7
		4485.7	18.9	4485.4	21.7	4483.4	21.5	4478.0	16.6
		4484.5	18.9	4484.1	21.7	4482.6	21.4	4477.4	16.6
		4483.5	18.8	4483.1	21.6	4481.1	21.4	4475.6	16.6
		4482.4	18.8	4482.3	21.6	4480.4	21.4	4474.9	16.6
		4481.5	18.6	4480.8	21.6	4479.6	21.4	4474.4	16.6
		4480.5	18.5	4479.8	21.6	4478.2	21.4	4473.0	16.5
		4479.8	18.4	4478.8	21.6	4477.5	21.4	4472.3	16.5
		4478.6	18.1	4478.3	21.6	4475.8	21.3	4470.5	16.3
		4477.5	17.7	4477.2	21.5	4475.1	21.3	4469.9	16.2
		4476.5	17.4	4476.4	21.5	4474.3	21.3	4469.2	16.1
		4475.8	17.4	4475.1	21.1	4473.5	21.3	4468.1	16.2
		4474.5	17.2	4474.3	21.0	4472.6	21.3	4467.6	16.6
		4473.4	16.9	4473.4	20.7	4471.7	21.2		
		4472.8	16.8	4472.4	19.5	4469.9	21.2		
		4471.4	16.6	4471.5	19.0	4469.2	20.6		
		4470.8	16.4	4470.6	18.7				
		4469.5	16.0	4469.6	18.4				
				4469.2	18.3				

APPENDIX C1 – ROUTINE LAKE PROFILE DATA – LA-P3

LA1-P8 - Green Roof (P3) Latitude 40° 8404'N Longitude 121° 06.8098'W

Date	Time	Date	Time	Date	Time	Date	Time	Date	Time
05/27/08	08:31	06/24/08	10:29	07/25/08	08:42	08/24/07	09:10	10/06/07	09:01
Elevation		Elevation		Elevation		Elevation		Elevation	
(USGS)	(PG&E)	(USGS)	(PG&E)	(USGS)	(PG&E)	(USGS)	(PG&E)	(USGS)	(PG&E)
4493.7	4483.5	4494.8	4484.6	4494.4	4484.2	4492.0	4481.8	4490.0	4479.8
Elevation (ft.)	Temp. (°C)	Elevation (ft.)	Temp. (°C)	Elevation (ft.)	Temp. (°C)	Elevation (ft.)	Temp. (°C)	Elevation (ft.)	Temp. (°C)
4493.1	14.3	4494.6	19.1	4494.3	21.9	4492.2	22.0	4487.0	16.9
4489.9	14.3	4493.5	19.0	4493.4	21.9	4491.4	22.0	4486.1	16.9
4486.7	14.2	4492.7	18.9	4492.5	21.9	4490.5	22.0	4485.2	16.9
4483.4	14.2	4491.6	18.9	4490.9	21.9	4489.7	21.9	4484.3	16.9
4480.4	14.1	4490.7	18.9	4490.5	21.8	4488.0	21.9	4483.1	16.9
4477.0	13.9	4489.4	18.8	4489.5	21.8	4487.1	21.9	4482.2	16.9
4474.0	13.9	4488.8	18.8	4487.4	21.8	4486.3	21.9	4481.3	16.9
4470.5	13.7	4487.7	18.6	4486.4	21.8	4485.5	21.8	4480.3	16.9
4467.2	13.5	4486.1	18.5	4485.6	21.8	4484.5	21.8	4479.0	16.9
4463.9	13.5	4484.9	18.5	4484.5	21.8	4483.6	21.8	4478.0	16.9
4460.9	12.8	4484.4	18.5	4483.5	21.8	4482.0	21.8	4477.0	16.9
		4483.8	18.5	4482.5	21.7	4481.2	21.7	4476.0	16.9
		4482.8	18.5	4481.5	21.6	4480.4	21.7	4474.9	16.9
		4481.6	18.4	4480.1	21.6	4479.6	21.7	4474.4	16.9
		4480.4	18.3	4479.3	21.6	4478.7	21.7	4473.2	16.8
		4479.3	18.1	4478.4	21.5	4477.0	21.6	4472.1	16.8
		4478.1	18.0	4476.7	21.5	4476.3	21.6	4471.0	16.8
		4476.9	17.9	4476.5	21.5	4475.3	21.6	4469.9	16.8
		4476.3	17.8	4475.4	21.5	4474.5	21.6	4469.4	16.8
		4475.6	17.7	4474.4	21.4	4472.9	21.6	4468.4	16.8
		4474.4	17.5	4473.5	21.3	4472.1	21.6	4467.2	16.8
		4473.8	17.5	4473.1	21.1	4471.5	21.6	4466.2	16.8
		4473.2	17.5	4471.9	20.8	4470.1	21.6	4465.2	16.8
		4472.6	17.4	4471.0	20.7	4469.4	21.6	4464.0	16.8
		4471.2	17.4	4470.5	20.5	4468.5	21.6	4462.9	16.8
		4470.7	17.3	4469.4	19.9	4467.0	21.6	4462.2	16.8
		4469.4	17.2	4468.5	19.4	4466.2	21.5	4460.9	16.8

LA1-P8 - Green Roof (P3) Latitude 40° 8404'N Longitude 121° 06.8098'W

Date	Time	Date	Time	Date	Time	Date	Time	Date	Time
05/27/08	08:31	06/24/08	10:29	07/25/08	08:42	08/24/07	09:10	10/06/07	09:01
Elevation		Elevation		Elevation		Elevation		Elevation	
(USGS)	(PG&E)	(USGS)	(PG&E)	(USGS)	(PG&E)	(USGS)	(PG&E)	(USGS)	(PG&E)
4493.7	4483.5	4494.8	4484.6	4494.4	4484.2	4492.0	4481.8	4490.0	4479.8
Elevation (ft.)	Temp. (°C)	Elevation (ft.)	Temp. (°C)	Elevation (ft.)	Temp. (°C)	Elevation (ft.)	Temp. (°C)	Elevation (ft.)	Temp. (°C)
		4468.8	17.1	4467.6	18.8	4465.4	21.5	4460.3	16.8
		4467.7	17.0	4466.2	18.0	4464.7	21.4	4459.0	16.8
		4466.6	16.6	4465.3	17.8	4463.1	21.1	4458.4	16.8
		4465.5	16.5	4464.3	17.6	4462.4	20.6	4458.1	16.8
		4464.3	16.3	4463.5	17.0	4461.6	19.6		
		4463.6	16.3	4462.4	16.8	4460.1	18.2		
		4462.7	16.0	4461.5	16.5	4459.3	17.9		
		4461.8	15.5	4460.1	16.3	4458.6	17.6		
		4460.6	15.2	4459.2	15.5				
		4459.3	15.0						
		4458.6	14.7						

APPENDIX C2 – ROUTINE LAKE PROFILE DATA – BV1-P1

BV1-P1 Butt Valley Reservoir near Caribou 1 intake Latitude 40° 07.032 Longitude 121° 08.694

Date	Time	Date	Time	Date	Time	Date	Time	Date	Time
05/27/08	11:31	06/24/08	13:46	07/25/08	12:47	08/29/08	12:56	10/05/08	14:51
Elevation		Elevation		Elevation		Elevation		Elevation	
(USGS)	(PG&E)	(USGS)	(PG&E)	(USGS)	(PG&E)	(USGS)	(PG&E)	(USGS)	(PG&E)
4130.94	4120.74	4129.92	4119.72	4129.92	4119.72	4136.48	4126.28	4137.20	4127.00

Elevation (ft.)	Temp. (°C)	Elevation (ft.)	Temp. (°C)	Elevation (ft.)	Temp. (°C)	Elevation (ft.)	Temp. (°C)	Elevation (ft.)	Temp. (°C)
4130.4	15.0	4129.4	20.8	4133.1	21.8	4135.8	21.9	4137.0	17.4
4127.2	14.8	4128.7	20.8	4132.2	21.7	4135.0	21.7	4135.8	17.4
4123.9	14.6	4127.5	20.7	4131.2	21.7	4134.3	21.7	4134.9	17.3
4120.7	14.3	4126.4	20.7	4130.2	21.6	4133.4	21.6	4134.1	17.3
4117.5	14.1	4125.8	20.6	4128.9	21.6	4132.3	21.5	4133.2	17.3
4114.2	13.7	4124.7	20.5	4128.3	21.6	4131.0	21.4	4131.8	17.3
4111.1	13.2	4123.4	20.5	4127.2	21.6	4130.3	21.4	4130.9	17.3
4107.8	12.7	4122.7	20.4	4125.8	21.4	4129.5	21.4	4129.8	17.3
4104.2	12.2	4121.8	20.3	4124.9	21.3	4128.0	21.4	4129.2	17.3
4101.4	11.4	4120.8	20.3	4124.3	21.2	4127.1	21.4	4128.0	17.3
4098.1	10.9	4119.7	20.2	4123.3	21.1	4126.4	21.4	4127.2	17.2
4094.8	10.6	4118.7	20.1	4122.2	20.8	4124.9	21.3	4125.7	17.2
4091.7	10.4	4117.6	20.1	4121.0	20.5	4124.3	21.3	4125.2	17.2
4088.8	9.9	4116.5	20.0	4120.1	20.3	4122.9	21.2	4123.7	17.2
		4115.6	19.9	4119.2	20.1	4122.1	21.2	4123.0	17.2
		4114.5	19.5	4118.2	19.8	4121.4	21.2	4121.7	17.2
		4113.6	18.6	4117.0	19.5	4120.0	21.1	4120.9	17.2
		4112.9	18.0	4115.9	19.3	4119.0	21.0	4120.2	17.2
		4111.5	17.6	4114.9	19.2	4118.2	21.0	4118.6	17.2
		4110.5	17.3	4114.3	19.1	4117.5	21.0	4117.7	17.2
		4109.4	17.0	4113.3	18.9	4116.0	20.9	4116.8	17.2
		4108.8	16.9	4112.0	18.8	4115.3	20.9	4115.9	17.2
		4107.6	16.7	4111.1	18.7	4113.9	20.9	4114.9	17.2
		4106.5	16.5	4110.3	18.6	4113.2	20.9	4113.9	17.2
		4105.7	16.3	4109.1	18.5	4112.5	20.9	4112.7	17.2
		4104.6	16.0	4108.0	18.4	4110.8	20.8	4111.7	17.2

BV1-P1 Butt Valley Reservoir near Caribou 1 intake Latitude 40° 07.032 Longitude 121° 08.694

Date	Time	Date	Time	Date	Time	Date	Time	Date	Time
05/27/08	11:31	06/24/08	13:46	07/25/08	12:47	08/29/08	12:56	10/05/08	14:51
Elevation		Elevation		Elevation		Elevation		Elevation	
(USGS)	(PG&E)	(USGS)	(PG&E)	(USGS)	(PG&E)	(USGS)	(PG&E)	(USGS)	(PG&E)
4130.94	4120.74	4129.92	4119.72	4129.92	4119.72	4136.48	4126.28	4137.20	4127.00

Elevation (ft.)	Temp. (°C)	Elevation (ft.)	Temp. (°C)	Elevation (ft.)	Temp. (°C)	Elevation (ft.)	Temp. (°C)	Elevation (ft.)	Temp. (°C)
		4103.5	15.7	4106.9	18.3	4110.2	20.8	4110.8	17.2
		4102.4	15.4	4106.3	18.2	4109.4	20.8	4109.8	17.2
		4101.8	15.3	4105.1	18.1	4108.0	20.6	4108.7	17.2
		4100.7	15.0	4103.9	17.8	4107.4	20.5	4107.8	17.2
		4099.5	14.9	4103.3	17.7	4106.0	20.3	4107.0	17.2
		4098.7	14.8	4102.0	17.6	4105.4	20.1	4106.1	17.2
		4097.9	14.7	4100.9	17.5	4104.0	19.7	4104.3	17.2
		4096.8	14.5	4100.3	17.4	4103.1	19.6	4103.5	17.2
		4095.7	14.4	4099.2	17.4	4102.4	19.5	4102.4	17.2
		4094.4	14.4	4098.1	17.3	4101.0	19.4	4101.5	17.2
		4093.6	14.3	4097.0	17.2	4100.3	19.4	4100.6	17.2
		4092.3	14.1	4096.4	17.2	4099.0	19.3	4099.8	17.2
		4091.7	14.0	4095.3	17.1	4098.4	19.3	4098.9	17.2
		4090.7	13.9	4094.2	17.1	4097.2	19.3	4098.1	17.2
		4090.3	13.0	4093.2	17.0	4095.8	19.2	4096.6	17.2
				4092.1	16.9	4095.1	19.2	4096.0	17.2
				4091.1	16.8	4093.9	19.1	4095.0	17.2
				4089.9	16.7	4093.2	19.1	4093.4	17.2
				4089.3	16.6	4092.0	19.0	4092.6	17.2
				4088.4	16.3	4091.2	18.9	4091.8	17.2
						4090.0	18.8		
						4089.3	18.5		

APPENDIX C2 – ROUTINE LAKE PROFILE DATA – BV-P2

BV1-P2 Butt Valley Reservoir near Cool Springs Campground Latitude 40° 07.032 Longitude 121° 08.694

Date	Time	Date	Time	Date	Time	Date	Time	Date	Time
05/27/08	10:46	06/24/08	13:26	07/25/08	12:55	08/29/08	13:37	10/05/08	13:57
Elevation		Elevation		Elevation		Elevation		Elevation	
(USGS)	(PG&E)	(USGS)	(PG&E)	(USGS)	(PG&E)	(USGS)	(PG&E)	(USGS)	(PG&E)
4130.94	4120.74	4129.92	4119.72	4133.38	4123.18	4136.48	4126.28	4137.20	4127.00

Elevation (ft.)	Temp. (°C)	Elevation (ft.)	Temp. (°C)	Elevation (ft.)	Temp. (°C)	Elevation (ft.)	Temp. (°C)	Elevation (ft.)	Temp. (°C)
4130.4	15.8	4129.8	20.6	4133.0	21.7	4136.1	22.5	4136.8	17.2
4127.3	15.6	4128.6	20.6	4131.6	21.7	4134.8	22.1	4135.7	17.2
4124.0	15.5	4127.6	20.5	4131.1	21.6	4134.1	22.0	4135.0	17.2
4120.6	15.4	4126.8	20.5	4129.7	21.4	4133.4	21.9	4134.2	17.2
4117.5	14.6	4125.6	20.4	4128.9	21.3	4132.1	21.9	4132.3	17.2
4114.4	14.0	4124.9	20.4	4128.1	21.3	4131.4	21.8	4131.4	17.2
4111.1	13.4	4123.7	20.3	4127.3	21.3	4130.3	21.7	4130.3	17.2
4107.9	12.9	4122.8	20.3	4126.0	21.2	4129.4	21.7	4129.5	17.2
		4121.9	20.2	4125.0	21.2	4128.4	21.7	4128.7	17.2
		4120.7	20.2	4124.3	21.1	4126.5	21.7	4127.9	17.2
		4119.3	20.1	4123.1	21.0	4124.7	21.6	4127.1	17.2
		4118.6	20.0	4122.3	20.9	4123.8	21.6	4125.7	17.2
		4117.9	19.9	4121.0	20.6	4123.3	21.6	4124.9	17.1
		4116.5	19.7	4119.7	20.2	4121.7	21.6	4124.1	17.1
		4115.8	19.4	4119.2	20.0	4121.2	21.6	4122.7	17.1
		4114.3	18.5	4117.7	19.7	4120.1	21.6	4121.8	17.1
		4113.6	18.2	4117.0	19.5	4119.3	21.5	4120.6	17.1
		4112.7	17.9	4116.0	19.3	4118.0	21.5	4119.9	17.1
		4111.2	17.4	4115.1	19.2	4117.0	21.5	4118.8	17.1
		4110.4	17.2	4114.2	19.1	4116.1	21.5	4118.1	17.1
		4109.8	17.0	4113.3	19.1	4115.4	21.5	4116.9	17.1
		4108.9	16.7	4111.9	18.9	4114.0	21.5	4115.8	17.1
		4107.8	16.5	4111.2	18.9	4113.1	21.4	4115.2	17.1
		4107.5	16.0	4109.7	18.7	4111.8	21.1	4114.1	17.1
				4108.9	18.6	4111.0	20.9	4113.1	17.1
				4108.1	18.4	4109.5	20.7	4111.8	17.1
				4107.3	18.2	4108.9	20.6	4111.1	17.1
				4105.6	17.8	4108.1	20.4	4110.1	16.7
				4105.3	17.4	4106.7	20.0	4109.0	16.7

BV1-P2 Butt Valley Reservoir near Cool Springs Campground Latitude 40° 07.032 Longitude 121° 08.694

Date	Time	Date	Time	Date	Time	Date	Time	Date	Time
05/27/08	10:46	06/24/08	13:26	07/25/08	12:55	08/29/08	13:37	10/05/08	13:57
Elevation		Elevation		Elevation		Elevation		Elevation	
(USGS)	(PG&E)	(USGS)	(PG&E)	(USGS)	(PG&E)	(USGS)	(PG&E)	(USGS)	(PG&E)
4130.94	4120.74	4129.92	4119.72	4133.38	4123.18	4136.48	4126.28	4137.20	4127.00

Elevation (ft.)	Temp. (°C)	Elevation (ft.)	Temp. (°C)	Elevation (ft.)	Temp. (°C)	Elevation (ft.)	Temp. (°C)	Elevation (ft.)	Temp. (°C)
						4106.2	19.7	4107.8	16.6
								4106.7	16.6
								4106.0	16.6
								4105.0	16.6
								4104.0	16.7

APPENDIX C2 – ROUTINE LAKE PROFILE DATA – BV-P3

BV1-P3 Butt Valley Reservoir near Alder Creek Boat Ramp

Latitude						Longitude					
Date	Time	Date	Time	Date	Time	Date	Time	Date	Time	Date	Time
05/27/08	10:40	06/24/08	16:00	07/25/08	12:47	08/29/08	13:30	10/05/08	13:51		
Elevation		Elevation		Elevation		Elevation		Elevation			
(USGS)	(PG&E)	(USGS)	(PG&E)	(USGS)	(PG&E)	(USGS)	(PG&E)	(USGS)	(PG&E)		
4130.94	4120.74	4129.92	4119.72	4133.38	4123.18	4136.48	4126.28	4137.20	4127.00		

Elevation (ft.)	Temp. (°C)	Elevation (ft.)	Temp. (°C)	Elevation (ft.)	Temp. (°C)	Elevation (ft.)	Temp. (°C)	Elevation (ft.)	Temp. (°C)
4130.44	15.8	4129.79	20.9	4133.01	22.0	4136.15	21.6	4136.80	17.0
4127.19	15.7	4128.55	20.9	4132.31	22.0	4134.97	21.6	4136.20	17.0
4124.12	15.5	4127.81	20.9	4130.90	21.9	4134.34	21.6	4134.82	17.0
4120.74	15.4	4126.21	20.8	4129.83	21.7	4133.40	21.5	4133.95	17.0
4117.39	15.2	4125.50	20.7	4129.10	21.6	4131.90	21.5	4133.22	17.0
		4124.67	20.6	4128.16	21.5	4131.16	21.5	4132.08	17.0
		4123.63	20.6	4126.79	21.3	4130.02	21.4	4130.27	17.0
		4122.63	20.4	4126.02	21.2	4129.05	21.4	4129.41	17.0
		4121.46	20.2	4125.28	21.0	4128.25	21.3	4128.60	16.9
		4120.92	20.1	4123.91	20.6	4127.11	21.3	4127.80	16.9
		4119.55	20.0	4123.14	20.6	4126.38	21.3	4126.83	16.9
		4118.85	19.9	4122.11	20.5	4124.84	21.3	4125.89	16.9
				4120.73	20.4	4124.30	21.2	4124.89	16.9
				4120.23	20.2	4123.47	21.2	4123.89	16.9
				4119.06	18.9	4122.46	21.1	4122.81	16.9
				4118.26	18.8	4121.36	21.0	4121.88	16.9
				4117.26	18.7	4120.22	20.9	4121.14	16.9
						4119.25	20.9	4119.57	16.6
						4118.48	20.9	4118.73	16.5
						4117.41	20.5	4117.80	16.5
								4116.99	16.5
								4116.02	16.4

8 APPENDIX D

SUMMARY OF STAGE-FLOW RATINGS AND APPLIED SHIFTS

Appendix D – Stage-flow ratings and applied shifts

								Shift Information				
Station	Date	Time	Discharge (cfs)	GHT (ft)	Rating in use	Rating Estimate	Percent	Shifted Gage	Shifted Discharge	Percent	Stage shift	Shift Equation
NF1	5/31/2008	11:30	328	2.29	R2007_NF1	355	-8%	2.15	326	0%	-0.14	-0.13
	6/20/2008	11:00	174	1.83	" "	257	-32%	1.49	174	0%	-0.34	-0.13
	7/20/2008	12:30	122	1.45	" "	163	-25%	1.30	121	0%	-0.15	-0.13
	9/25/2008	14:00	88.4	1.29	" "	118	-25%	1.19	88.5	0%	-0.10	-0.13
HB1	5/16/2008	12:30	85.8	2.42	R2003_HB1	89.4	-4%	No Shift	--	--	--	--
	6/20/2008	14:00	69.7	2.22	" "	71.8	-3%	No Shift	--	--	--	--
	7/20/2008	10:00	70.5	2.21	" "	71.1	-1%	No Shift	--	--	--	--
	9/25/2008	16:00	64.6	2.19	" "	69.6	-7%	No Shift	--	--	--	--
BC3	5/14/2008	13:30	11.7	1.19	R2007_BC3	13.3	-12%	1.16	11.6	1%	-0.03	-0.03
	6/19/2008	11:30	11.7	1.18	" "	12.8	-9%	1.16	11.6	0%	-0.02	-0.02
	7/19/2008	12:15	11.6	1.15	" "	11.1	5%	1.16	11.6	0%	0.01	0.01
	10/1/2008	15:00	11.1	1.15	" "	11.1	0%	1.15	11.1	0%	0.00	0.01
NF3	5/14/2008	11:00	48.3	1.30	--	No rating for this station.						
	6/19/2008	09:15	48.5	1.31	--	No rating for this station.						
	7/19/2008	09:45	47.5	1.30	--	No rating for this station.						
	9/25/2008	10:30	42.7	1.25	--	No rating for this station.						
NF4	5/15/2008	10:30	68.0	2.59	R2005_NF4	67.4	1%	No Shift	--	--	--	--
	6/18/2008	10:45	60.3	2.54	" "	60.4	0%	No Shift	--	--	--	--
	7/18/2008	13:30	60.1	2.53	" "	59.1	2%	No Shift	--	--	--	--
	9/24/2008	13:30	55.0	2.49	" "	53.8	2%	No Shift	--	--	--	--
MC1	5/13/2008	12:00	10.9	2.57	--	No rating for this station, curvilinear decay used to estimate daily flow						
	6/18/2008	09:30	5.98	2.42	--	No rating for this station, curvilinear decay used to estimate daily flow						
	7/18/2008	12:00	3.78	2.35	--	No rating for this station, curvilinear decay used to estimate daily flow						
	9/24/2008	11:30	3.32	2.25	--	No rating for this station, curvilinear decay used to estimate daily flow						

								Shift Information				
Station	Date	Time	Discharge (cfs)	GHT (ft)	Rating in use	Rating Estimate	Percent	Shifted Gage	Shifted Discharge	Percent	Stage shift	Shift Equation
YC1	6/4/2008	15:00	118.15	0.97	R2006_YC1	132	-10%	0.90	118	0%	-0.07	-0.08
	6/18/2008	13:00	80.52	0.70	" "	84.5	-5%	0.67	80.2	0%	-0.03	-0.03
	7/18/2008	10:00	56.56	0.45	" "	54.9	3%	0.47	56.7	0%	0.02	0.04
	9/24/2008	10:30	48.88	0.25	" "	40.7	20%	0.38	49.0	0%	0.13	0.12

Appendix D – Stage-flow ratings and applied shifts

Station	Date	Time	Discharge (cfs)	GHT (ft)		Rating Estimate	Percent	Shift Information: Shifted Gage	Shifted Discharge	Percent	Stage shift	Shift Equation
CHIP	6/4/2008	16:30	106	17.4	--	No rating for this station, curvilinear decay used to estimate daily flow						
	6/17/2008	13:30	56.7	16.9	--	No rating for this station, curvilinear decay used to estimate daily flow						
	7/17/2008	09:15	22.6	16.4	--	No rating for this station, curvilinear decay used to estimate daily flow						
	9/23/2008	13:30	11.4	16.2	--	No rating for this station, curvilinear decay used to estimate daily flow						
MR1	5/13/2008	13:15	24.6	2.54	R2008_MRC	24.5	0%	No Shift used				--
	6/17/2008	11:00	8.54	2.30	" "	8.73	5%	No Shift used				--
	7/17/2008	13:30	3.70	2.10	" "	3.99	-15%	No Shift used				--
	9/23/2008	10:30	2.09	1.97	" "	2.67	11%	No Shift used				--
CHAM	5/16/2008	11:00	41.4	2.75	--	No rating for this station, curvilinear decay used to estimate daily flow						
	6/17/2008	09:30	10.5	2.16	--	No rating for this station, curvilinear decay used to estimate daily flow						
	7/17/2008	14:45	3.41	1.85	--	No rating for this station, curvilinear decay used to estimate daily flow						
	9/23/2008	09:30	2.06	1.67	--	No rating for this station, curvilinear decay used to estimate daily flow						
Buck2	5/12/2008	13:00	43.50	1.35	R2008_Buck1	45.3	0%	No Shift used				--
	6/16/2008	13:30	22.76	1.03	" "	23.1	-1%	No Shift used				--
	7/16/2008	13:30	19.11	0.93	" "	18.7	2%	No Shift used				--
	9/22/2008	14:10	12.50	0.73	" "	12.6	-1%	No Shift used				--
ROCK2	6/10/2008	12:00	82.68	1.51	--	No rating for this station, curvilinear decay used to estimate daily flow						
	6/16/2008	13:00	49.37	1.33	--	No rating for this station, curvilinear decay used to estimate daily flow						
	7/16/2008	11:45	4.04	1.00	--	No rating for this station, curvilinear decay used to estimate daily flow						
	9/22/2008	12:30	1.98	0.90	--	No rating for this station, curvilinear decay used to estimate daily flow						
GR1	5/12/2008	11:00	92.88	1.47	R2008_GR1	93.5	-1%	No Shift used				--
	6/16/2008	11:00	31.84	0.72	" "	33.4	-5%	No Shift used				--
	7/16/2008	10:00	19.73	0.46	" "	19.5	1%	No Shift used				--
	9/22/2008	10:15	13.11	0.29	" "	12.7	3%	No Shift used				--