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BUTTE CREEK
SPRING-RUN CHINOOK SALMON, ONCORYHNCHUS TSHAWYTSCHA
PRE-SPAWN MORTALITY EVALUATION
2005

By

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Sacramento Valley – Central Sierra Region

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ABSTRACT

This is the third report assessing pre-spawning mortalities among spring-run Chinook salmon (SRCS) (*Oncorhynchus tshawytscha*) in Butte Creek affected by the Pacific Gas and Electric (PG&E) DeSabla Centerville Project (Project). Project is located on Butte Creek near Chico, in Butte County, California. There were an estimated 617 SRCS that died prior to spawning in 2005 out of a total estimated population of 17,615. Although no fish were examined by a Department of Fish and Game pathologist, based upon the protracted time (June 28 – September 15, 2005) and low numbers, we conclude as during 2004 that mortalities were likely normal attrition for salmon holding in fresh water since early spring. In contrast, during 2003 there were an estimated 11,231 SRCS that died prior to spawning out of a total estimated population of 17,294 while during 2004 there were 418 out of a total estimated population of 10,639. Pre-spawn mortalities during 2003 were the result of large numbers of fish concentrated in limited holding pools, high water temperature, and an outbreak of two pathogens, *Flavobacterium columnare* (columnaris) and the protozoan *Ichthyophthirius multiphilis* (Ich). During the 2005 summer holding period approximately 47% of the fish held above the Centerville Powerhouse (CVPH) and 53% below, while mortalities were distributed 25% above and 75% below. An estimated 16,998 fish survived to spawn with approximately 35% spawning above the CVPH and 65% below. PG&E voluntarily increased Project flows from the required 40 cfs to 75 cfs in the reach above the CVPH at spawning onset during late September to increase usable spawning gravel. In spite of the increase, estimated spawning habitat continues to be over-utilized above the CVPH, but for the first time since inception of surveys in 2001 estimated spawning habitat below the CVPH was also over-utilized.

Air temperatures during late July 2005 were higher than during the same period in 2004 and similar to 2003, although Butte Creek flows were generally somewhat higher. The PG&E temperature contingency plan was implemented on two occasions during late July and early August 2005 in response to predicted higher air temperatures. Flows from the West Branch of the Feather River were increased on both occasions and appeared to have moderated water temperatures in Butte Creek.

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INTRODUCTION

This is the third report prepared under a grant from Pacific Gas and Electric Company (PG&E) to assess pre-spawning mortalities among spring-run Chinook salmon (SRCS), *Oncorhynchus tshawytscha*, in Butte Creek within and below PG&E's DeSabla-Centerville Project (FERC, 1984). Specifically, the grant requires the following:

- Develop an accurate estimate of pre-spawning mortalities among Butte Creek SRCS.
- Assess causal relationship of SRCS pre-spawning mortalities with operation of the PG&E DeSabla Centerville Hydro-power Project.
- Recover coded-wire tags (CWT) from previously marked Butte Creek SRCS.
- Monitor and document holding distribution of Butte Creek SRCS.

Salmon in Butte Creek

Butte Creek is one of several Central Valley streams that continue to harbor a sustaining population of the threatened SRCS. The first somewhat systematic effort to generate a Butte Creek SRCS population estimate was done in 1954 (Table 1) (CDFG, 1998). However, inconsistent methods of evaluation used during the intervening years have made it difficult to assess population trends.

Table 1. Butte Creek SRCS spawning escapement estimates for the period 1954 through 2005.

Year	Run Size	Year	Run Size	Year	Run Size	Year	Run Size		
1954	830	1969	830	1984	23	1999	3679*		
1955	400	1970	285	1985	254	2000	4118*		
1956	3000	1971	470	1986	1371		Snorkel	Prespawn Mortality	Spawn
1957	2195	1972	150	1987	14	2001	9605*	193	18312**
1958	1100	1973	300	1988	1300	2002	8785*	3431	12597
1959	500	1974	150	1989	1300*	2003	4398*	11231	6063
1960	8700	1975	650	1990	100*	2004	7390*	418	10221
1961	3100	1976	46	1991	100*	2005	10625*	617	16998
1962	1750	1977	100	1992	730*				
1963	6100	1978	128	1993	650*				
1964	600	1979	10	1994	474*				
1965	1000	1980	226	1995	7500*				
1966	80	1981	250	1996	1413*				
1967	180	1982	534	1997	635*				
1968	280	1983	50	1998	20212*				

* Surveys prior to 1989 used various methods with varying precision. Snorkel surveys implemented since 1989 are thought to significantly underestimate the actual population size and should only be used as an index. Spawning survey results for 2001- 2005 were generated by a modified Schaefer Model carcass survey.

** Number as reported for 2001 (22,744) in error (Ward et al., 2004b).

The SRCS over-summer holding reach of Butte Creek is approximately 11 miles in length, extending from the Quartz Bowl Pool downstream to the Centerville Covered Bridge (Figures 1 and 2). Flows in this reach are controlled by PG&E for power generation at the DeSabla (DSPH) and Centerville (CVPH) powerhouses. Within the 11 mile SRCS holding/spawning reach, the area with the most deep holding pools and which is most isolated is located in the uppermost 3 miles between the Quartz Bowl Pool and Pool 4, while the majority of spawning gravel is located in the 5 miles below the CVPH (Figures 1 and 2; Appendix A, Figures 1-5). With the recent increased populations of Butte Creek SRCS, there were reports and observations of significant mortalities during the summer holding period prior to spawning. This was partially documented during 2002 when there were an estimated 3,431 pre-spawning mortalities out of a total estimated population of 16,328 (Ward et al., 2004a) and systematically documented during 2003 and 2004. During 2003 there were an estimated 11,231 pre-spawn mortalities out of a total estimated population of 17,294 (Ward et al., 2004b) while during 2004 there were an estimated 418 pre-spawn mortalities out of an estimated population of 10,639 (Ward et al., 2006). While it was concluded that the high mortalities during 2003 were "primarily due to large numbers of fish concentrated in limited holding pools, high water temperatures, and an outbreak of two pathogens, *Flavobacterium columnare* (columnaris) and the protozoan *Ichthyophthirius multiphilis* (Ich)", mortalities during 2004 were concluded to have been due to normal attrition for salmon holding in fresh water since early spring. It was also noted during 2003 that maximum daily air temperatures during the last two weeks of July exceeded 37.6° Celsius (C) (100° Farenheit (F)) a total of 10 days as measured at the nearby California Department of Forestry Cohasset Fire Station. This protracted period of high temperatures was within the top 10 percent of air temperatures for the period of record (1984-2002). Additionally, during the same 2-week period water temperatures at key sites in the holding reaches above the CVPH were also higher than seen during the previous 2 years. It was further concluded that mortalities during 2002 and 2003 appeared to coincide with sustained daily average water temperatures above 19°C, as measured at the Quartz Bowl Pool (Figure 1).

Temperature Contingency Plan

As during 2004, PG&E developed a Project Operations and Management Plan (PG&E, 2005a). A component of that plan was a contingency for extreme heat events to affect water temperatures in Butte Creek by selectively managing flows from the West Branch of the Feather River (WBFR). In consultation with the California Department of Fish and Game (CDFG), National Oceanographic and Atmospheric Administration Fisheries (NOAA Fisheries), and United States Fish and Wildlife Service (USFWS), PG&E agreed to the following contingency plan (PG&E, 2005a):

1. "Starting on June 13, Licensee will prepare a weather forecast for the DeSabla-Centerville Project Area by noon each Monday and Thursday. The weather forecast will be based on information from USFS weather stations at Cohasset and Chester. Licensee will provide an e-mail copy of the forecast to NOAA Fisheries, CDF&G and FWS. If air temperatures in excess of 105ºF for two or more days during the next seven day period are forecasted at Cohasset, with the potential for compression heating at higher elevations as confirmed by data from the Chester location, Licensee will send an e-mail to all, and phone at least one of the individuals at the Resource Agencies identified in paragraph 5 below advising them that an extreme heat event is forecasted. If the next forecast confirms that an extreme heat event has started or is imminent within the next two days, and is expected to continue for over two days, Licensee will send a second e-mail, phone, or fax each of the Resource Agencies to discuss actions to be taken. If personal contact can not be made and PG&E still believes action needs to be taken, it will initiate efforts to modify Project operation as

discussed in paragraphs 2 – 4 below. If action is taken, a fax will be sent to CDF&G and NOAA Fisheries".

2. "If releases are being made from Round Valley Reservoir at the time of the second forecast confirming an extreme heat event, then the releases from Round Valley Reservoir will be reduced by approximately 50% and the release valve at Philbrook Reservoir will be opened to provide a total release of up to 35 cfs if determined to be appropriate."
3. "The actual amount of water released from Philbrook Reservoir during a confirmed extreme heat event will depend on Licensee's assessment of then-existing conditions and recommendations and comments received from the Resource Agencies in response to the e-mails."
4. "At the next forecast date, if temperature forecasts have returned to normal levels, Licensee will reduce the releases at Philbrook Reservoir to the pre-event level and assess the quantity of water available for the remainder of the season. If temperatures forecasts have not returned to normal, Licensee will consult with the Resource Agencies regarding whether to continue or adjust the releases based on the then-existing conditions."

Additionally, during 2004 in conjunction with the Federal Energy Regulatory Commission (FERC) relicense process and in continued coordination with CDFG, NOAA Fisheries, and USFWS, PG&E implemented a study plan to develop a water temperature model (PG&E, 2005b). The goal of that study is to develop a "model that can be used to evaluate the range of operational alternatives for managing stream temperatures in Butte Creek during the summer months (June through September) between DeSabla Powerhouse and immediately upstream of Centerville Powerhouse".

Flow Increase for Spawning

Based upon the previous evaluation of spawning gravel (Gard et al., 2003; Ward et al., 2004b; Ward, 2004) PG&E agreed to consider increased flows above the minimum 40 cfs, in the reach above the CVPH during the spawning period (PG&E, 2005c) as follows:

"Increasing the releases to Butte Creek at the LCDD will continue to be considered. Current data does not support increasing flows below LCDD during the summer months, due to the potential adverse impacts such releases may have on the water temperature below Centerville Powerhouse. However, increased releases below LCDD during the spawning period (i.e., after approximately mid-September) may provide additional spawning habitat in the reach below LCDD. During the 2004 spawning season the release at LCDD was increased to the estimated natural flow in Butte Creek (60 cfs). Accordingly, Licensee will consult with the Resource Agencies over the course of the summer to determine if and when releases below LCDD during the 2005 spawning period can be implemented without adversely impacting water temperatures below Centerville Powerhouse. For 2005, the flows below LCDD will be increased after mid-September up to the total of the mid-September natural flow of Butte Creek plus the flow that is being diverted in mid-September from the West Branch Feather River; this is the same as the total of the flow being released before mid-September to the bypass reach (40 cfs), plus the flow going down the Centerville Canal in mid-September less any releases from storage on the West Branch. The specific quantity of flow available will be determined at that time based on the actual combined flow at that date ("Mid-September Flow"); however it is currently estimated to be a total flow of approximately 80 to 100 cfs. Flow contributions originating from the West Branch Feather River will be subject to the continued availability of the West Branch Feather River diversion and the Hendricks and Toadtown

canals. If implemented, increases in flow for spawning will be continued through February 28, 2006, or other appropriate date determined in consultation with the Resource Agencies. If implementing the "Mid-September Flow" below LCDD requires that operation of Centerville Powerhouse be temporarily discontinued, the powerhouse may be re-started using any flows above the "Mid-September Flow" that may subsequently become available." Note - LCDD as discussed above is referenced throughout this report as the Centerville Head Dam (CVHD).

Based upon subsequent discussions with CDFG, NOAA Fisheries and USFWS, PG&E provided spawning flows of approximately 75 cfs beginning during the third week of September 2005 (Zemke, 2005).

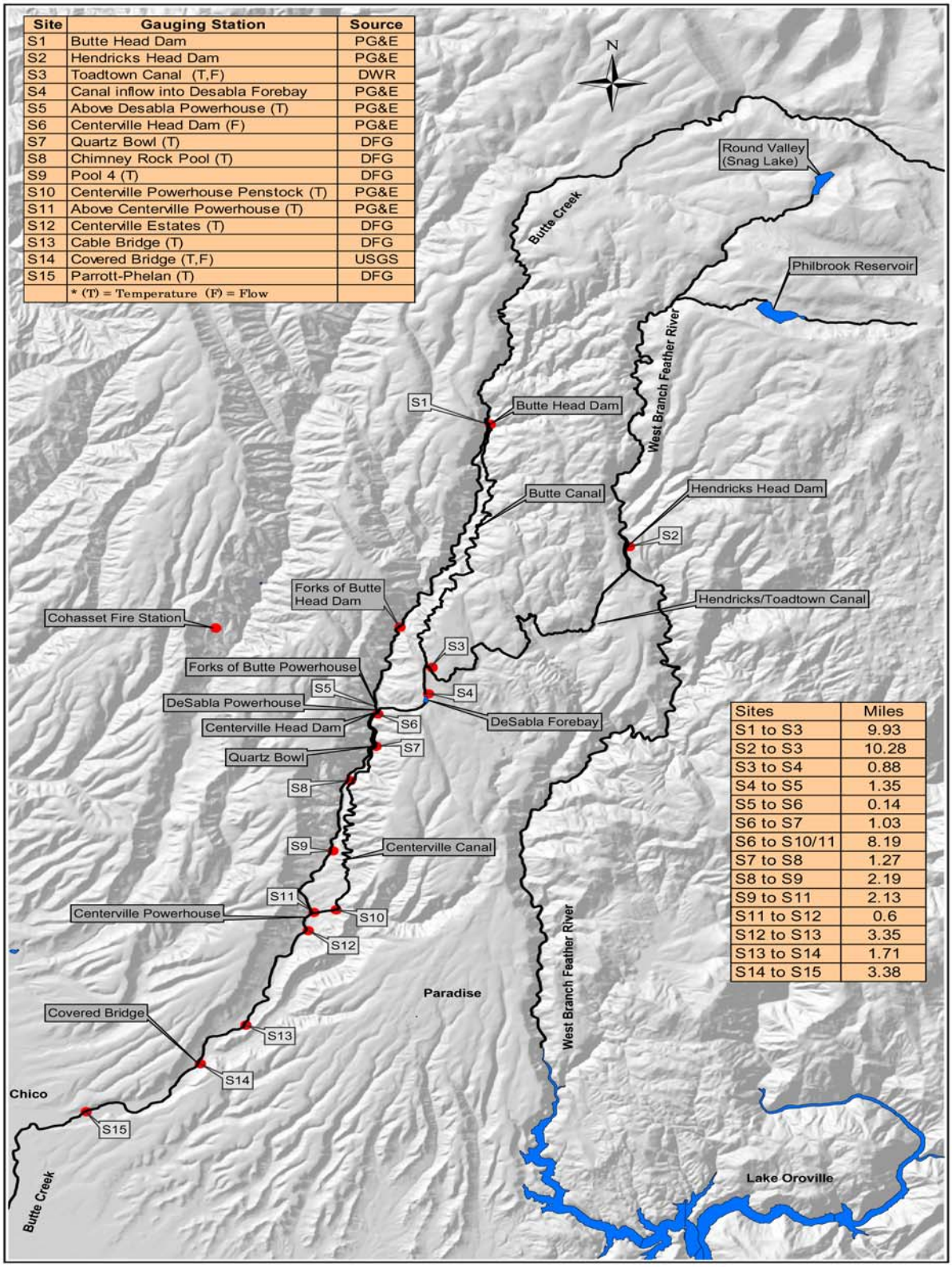


Figure 1. Map showing reaches of Butte Creek and West Branch of the Feather River controlled by Pacific Gas and Electric Company affecting Butte Creek spring-run Chinook salmon, including temperature and flow gage locations and distances.

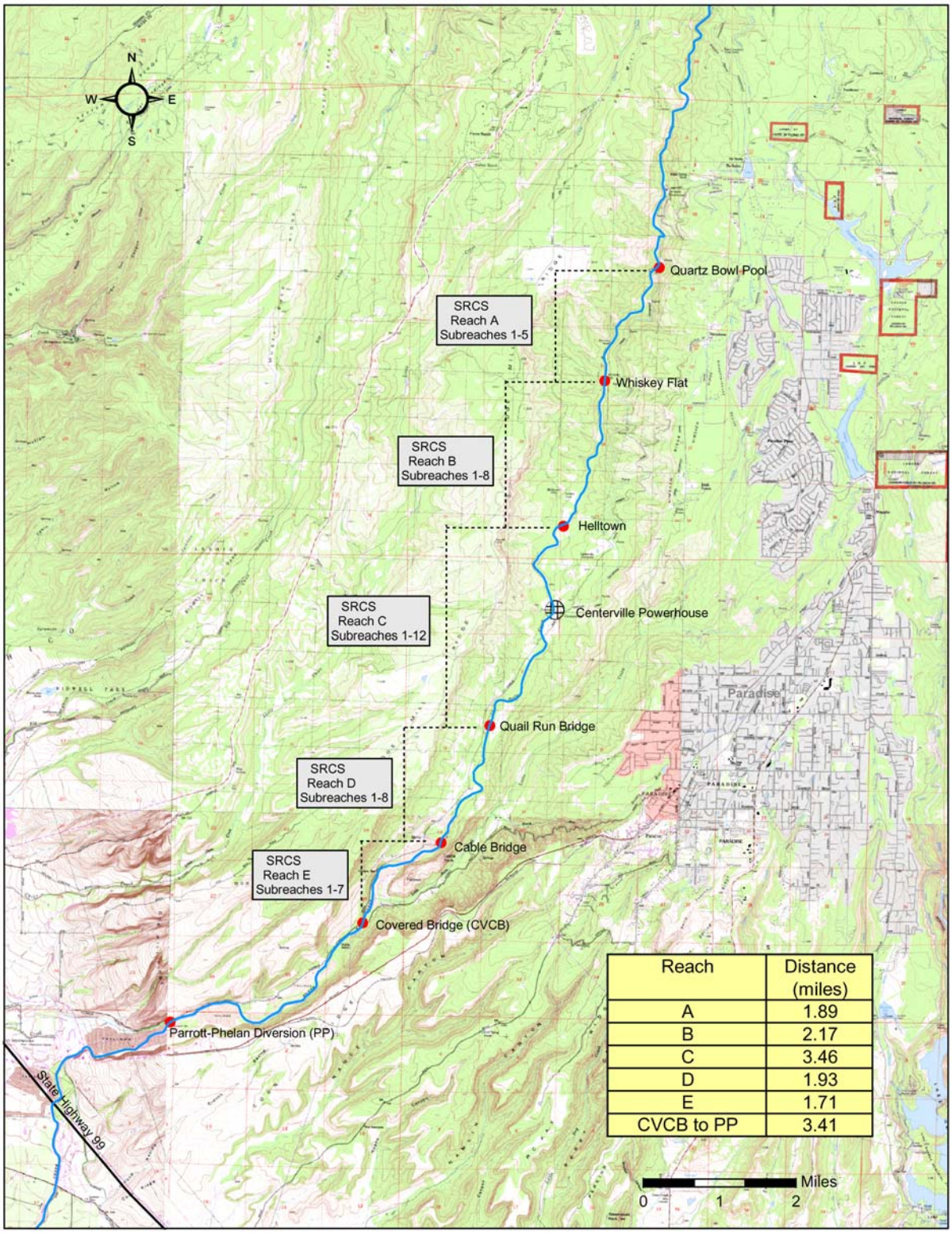


Figure 2. Map of Butte Creek from Quartz Bowl Pool to Covered Bridge showing spring-run Chinook salmon holding and spawning reaches and distances.

MATERIALS AND METHODS

Adult Escapement

CDFG calculates an adult SRCS escapement estimate each summer by conducting a swimming-snorkel survey. Adult SRCS are counted while holding prior to spawning. On Butte Creek, the swimming-snorkel survey extends from the Quartz Bowl Pool to the Covered Bridge (Figure 1 and 2). Each pool is observed only once by each surveyor, with each of the individual independent estimates recorded. If subsequent analysis of the entire data set reveals significant outliers, these are excluded from the calculation of the population estimate. In such instances, the average for the pool reflects only the remaining recorded observations. Individual estimates are then averaged for each pool with the annual total escapement estimate calculated by summing the averages for all survey reaches.

Adult Pre-spawning Mortality Survey

Since all Chinook salmon die after spawning, a standard technique employed in California for estimating population size is the carcass (mark-recapture) survey. This technique employs a physical count of all carcasses during the entire period and develops an expansion factor for carcasses not encountered during the physical count. A sub-sample of the freshest carcasses encountered that have at least one clear eye and firm flesh is externally marked and returned to the water near the spot encountered. All other carcasses are tallied and chopped in half to avoid being counted more than once. During subsequent surveys, the proportion of previously marked carcasses encountered is used to develop an expansion factor to account for carcasses that went unseen. This methodology requires a short duration between surveys, in general no longer than weekly.

A survey to identify pre-spawning mortalities was conducted during the period June 21, until the onset of spawning on September 20, 2005. The survey extended from the Quartz Bowl Pool to the Covered Bridge (Figure 1 & 2; Appendix A, Figures 1-5). The approximately 17.7 km (11 mi) long stream section was divided into five reaches with each reach surveyed weekly. Two to four crew members walked downstream covering both sides of the creek. All carcasses were examined for an adipose fin-clip, and then chopped in half to avoid counting during subsequent trips. Carcasses classified as fresh (clear eye, firm flesh, red gills) were sexed and measured to the nearest mm fork length (FL). Heads were removed from adipose fin-clipped carcasses and returned to the office for recovery of the coded-wire tag (CWT).

The estimation method employed utilized the modified Schaefer Model (Schaefer 1951; Taylor 1974) as follows:

$$E = N_{ij} = R_{ij}(T_i C_j / R_i R_j) - T_i$$

Where:

E = Total run size
N_{ij} = Population size in tagging period i recovery period j,
R_{ij} = number of carcasses tagged in the ith tagging period and recaptured in the jth recovery period,
T_i = number of carcasses tagged in the ith tagging period,
C_j = number of carcasses recovered and examined in the jth recovery period,
R_i = total recaptures of carcasses tagged in the ith tagging period, and
R_j = total recaptures of tagged carcasses in the jth recovery period.

Water Temperature

Onset, HOBO Water Temp Pro, H20-001, SN: 888429 temperature data loggers calibrated to ± 0.2 ° C set for 1-hour interval recordings were deployed in pools at five sites within the SRCS spawning habitat (Figure 1). Each data logger was placed in a galvanized steel pipe and suspended by 6 mm diameter (¼ in) steel cable.

RESULTS AND DISCUSSION

RESULTS

Pre-spawn Mortalities

During the entire pre-spawn sampling period from June 21 through September 15, 2005 there was a total of 443 carcasses encountered with an estimated total pre-spawn mortality of 617 (Table 2; Appendix B, Table 1).

Table 2. Summary of Butte Creek SRCS pre-spawn mortalities during period June 21, through September 15, 2005.

Week	Date	Total Carcasses Encountered					
		Reach					Weekly Total
		A	B	C	D	E	
1	6/21	0	0	-	-	-	0
	6/23	-	-	0	0	0	
2	6/28	2	0	-	-	-	5
	6/30	-	-	0	1	2	
3	7/5	0	2	-	-	-	3
	7/7	-	-	0	1	0	
4	7/12	0	2	-	-	-	4
	7/14	-	-	0	1	1	
5	7/19	0	0	-	-	-	14
	7/20	-	-	3	6	5	
6	7/26	-	-	15	18	12	52
	7/28	4	3	-	-	-	
7	8/2	0	0	-	-	-	17
	8/4	-	-	8	5	4	
8	8/9	2	6	-	-	-	27
	8/11	-	-	14	5	0	
9	8/16	5	7	-	-	-	47
	8/18	-	-	24	6	5	
10	8/23	6	4	-	-	-	53
	8/25	-	-	26	14	3	
11	8/30	8	5	-	-	-	62
	9/1	-	-	17	22	10	
12	9/6	7	1	-	-	-	75
	9/8	-	-	44	16	7	
13	9/13	6	6	-	-	-	84
	9/15	-	-	43	22	7	
1-13	TOTAL	40	36	194	117	56	443
						Schafer Model Expanded Total*	617

* No expansion factor was generated from the pre-carcass survey due to low number of carcasses and low mark/recovery. Expansion factor of 1.39 was applied based upon subsequent spawning survey.

Due to the low number of mortalities spread over the entire period and the low mark/recovery rate, it was not possible to generate a Schaefer Model estimate of total pre-spawn mortality. Instead, an expansion factor (F = 1.39) generated from the subsequent Schaefer Model estimate of spawning was applied (Appendix B, Table 1). Spawning onset was first documented on September 20, 2005 and for this year did not appear to overlap the pre-spawn mortality period which ended the previous week. Determination of spawning onset was based upon evidence of redd building and examination of carcasses for egg retention. The subsequent spawning survey from September 20, through November 3, 2005 encountered a total of 11,024 carcasses with an estimated spawning population of 15,356 in the surveyed reaches A-E (Appendix C, Table 1). Additionally, there were 1,179 spawned carcasses observed below survey reach E which were not assessed with a Schaefer mark/recapture method. Those fish were expanded by the 1.39 factor as previously discussed, for a total estimated spawning population below the traditional spawning reaches of 1,642 and a total estimated spawn for all reaches of 16,998. The previous swimming-snorkel survey conducted July 26-28, 2005 resulted in an estimate of 10,625 fish (Garman, 2005). As with the 2004 snorkel survey, an attempt was made to complete the 2005 survey earlier in the season to develop an estimate prior to any significant pre-spawn mortalities. However due to higher than normal flows, the survey could not be completed until late July. There were 26 pre-spawn mortalities prior to the snorkel survey (Table 2) or an expanded estimate of 36 (1.39 x 26).

Sex and Age Composition

There was a total of 190 carcasses measured and identified by sex during this survey, of which 71% were female and 29% male (Table 3). The average lengths of both females and males during this survey were similar to that observed during 2002 and 2004 but significantly smaller than observed during 2003 (Table 3; Appendix C, Figures 1-3). There were no CWT fish recovered during the pre-spawn mortality survey. Based upon subsequent recoveries of the 38 CWT's during the spawning survey adjusted for release group size, it is estimated that approximately 0.5% of the population was age-2, 97.5% age-3, and 2% age-4 (Appendix B, Table 2).

Table 3. Fork lengths of subsample of Butte Creek SRCS pre-spawn mortalities during 2002- 2005.

	Female					Male				
	Carcasses		FL (MM)			Carcasses		FL (MM)		
Year	Total	Percent	Max	Min	Mean	Total	Percent	Max	Min	Mean
2005	135	71%	898	550	747	55	29%	1006	409	786
2004	83	75%	928	601	737	28	25%	1064	486	778
2003	596	62%	961	473	823	368	38%	1110	452	879
2002	393	65%	931	514	725	213	35%	1048	400	757

Holding and Spawning Distribution

For the purposes of providing a comparative basis for holding, pre-spawn mortality, and spawning, the swimming–snorkel estimate for holding was adjusted to reflect the total carcass estimate for the combined pre-spawn mortality and spawning (Table 4).

Table 4. Summary of Butte Creek SRCS distribution by reach, above and below PG&E CVPH for snorkel, pre-spawn, and spawn survey during 2001-2005.

Year 2005							
Reach	Snorkel Survey			Pre-Spawn Survey		Spawn Survey	
	Actual	Estimated	Percent	Actual	Percent	Actual	Percent
A	3147	5217	29.6%	56	9.0%	798	4.7%
B	1642	2723	15.5%	50	8.1%	2924	17.2%
C1-5	237	393	2.2%	47	7.7%	2187	12.9%
C6-12	4799	7957	45.2%	233	36.1%	3676	21.6%
D	764	1267	7.2%	163	26.4%	3981	23.4%
E	35	58	0.3%	78	12.6%	1790	10.5%
CVCB to PP (Figure 1)	0	0	0.0%	0	0.0%	1642	9.7%
Total	10625	17615	100.0%	617	100.0%	16998	100.0%
Total Above Powerhouse	5027	8334	47.3%	153	24.8%	5909	34.8%
Total Below Powerhouse	5598	9281	52.7%	464	75.2%	11089	65.2%

Year 2004							
Reach	Snorkel Survey			Pre-Spawn Survey		Spawn Survey	
	Actual	Estimated	Percent	Actual	Percent	Actual	Percent
A	3072	4427	41.6%	87	20.9%	964	9.4%
B	1518	2187	20.6%	75	17.9%	2617	25.6%
C1-5	408	588	5.5%	52	12.4%	1991	19.5%
C6-12	2041	2942	27.6%	133	31.8%	2201	21.5%
D	284	409	3.8%	44	10.4%	1734	17.0%
E	60	86	0.8%	27	6.5%	714	7.0%
Total	7384	10639	100.0%	418	100.0%	10221	100.0%
Total Above Powerhouse	4999	7202	67.7%	214	51.2%	5572	54.5%
Total Below Powerhouse	2385	3437	32.3%	204	48.8%	4649	45.5%

Year 2003							
Reach	Snorkel Survey			Pre-Spawn Survey		Spawn Survey	
	Actual	Estimated	Percent	Actual	Percent	Actual	Percent
A	1421	5584	32.3%	5056	45.0%	160	2.6%
B	671	2637	15.2%	3481	31.0%	635	10.5%
C1-5	82	322	1.9%	1578	14.0%	732	12.1%
C6-12	2097	8240	47.6%	718	6.4%	2536	41.8%
D	120	472	2.7%	305	2.7%	1664	27.5%
E	10	39	0.2%	93	0.8%	336	5.5%
Total	4401	17294	100%	11231	100%	6063	100%
Total Above Powerhouse	2174	8543	49.4%	10115	90%	1527	25.2%
Total Below Powerhouse	2227	8751	50.6%	1116	10%	4536	74.8%

Year 2002							
Reach	Snorkel Survey			Pre-Spawn Survey		Spawn Survey	
	Actual	Estimated	Percent	Actual	Percent	Actual	Percent
A	5284	9821	60.1%	2077	60.5%	1530	11.9%
B	1101	2046	12.5%	841	24.5%	3773	29.3%
C1-5	280	519	3.2%	164	4.8%	1857	14.4%
C6-12	2053	3816	23.4%	232	6.8%	3592	27.9%
D	65	121	0.7%	86	2.5%	1917	14.9%
E	2	4	0.02%	31	0.9%	228	1.8%
Total	8785	16328	100%	3431	100%	12897	100%
Total Above Powerhouse	6665	12386	75.9%	3082	90%	7161	55.5%
Total Below Powerhouse	2120	3941	24.1%	349	10%	5737	44.5%

Year- 2001							
Reach	Snorkel Survey			Pre-Spawn Survey		Spawn Survey	
	Actual	Estimated	Percent	Actual	Percent	Actual	Percent
A	4598	8762	47.8%	ns	ns	2834	15.5%
B	1643	3130	17.1%	ns	ns	5433	29.7%
C1-5	376	716	3.9%	ns	ns	2620	14.3%
C6-12	2141	4079	22.3%	ns	ns	2809	15.3%
D	685	1305	7.1%	ns	ns	3504	19.1%
E	168	320	1.8%	ns	ns	1112	6.1%
Total	9611	18312	100%	193*	ns	18312	100%
Total Above Powerhouse	6617	12608	68.8%	ns	ns	10887	59.5%
Total Below Powerhouse	2994	5704	31.2%	ns	ns	7425	40.5%

* Sporadic surveys conducted beginning week of June 14 through September 6.

The adjusted holding estimate was based upon the combined carcass estimate (pre-spawn and spawn) allocated by the percentages observed in each reach/subreach during the swimming-snorkel survey. During the 5-year period 2001-2005, approximately 61% of the fish held above the CVPH and 39% below, while approximately 48% of the fish spawned above the CVPH and 52% below (Appendix D, Figure 3-5). For the 2002-2005 period based upon the various survey methods, 86% of the mortalities occurred above the CVPH and 14% below. During 2005, it appears that approximately 2,272 (28 % of the total) fish holding above the CVPH moved to spawn below (Table 4; Appendix D, Figure 1&2). Estimates for available spawning habitat and maximum spawners accommodated at various flows were developed and discussed in the 2003 review (Ward et al., 2004b; Gard, 2003). It was concluded that based upon the historic flow record (1930-2003) at the maximum sustainable flow (approximately 130 cfs), approximately 18% of useable spawning gravel is located above the CVPH and 82% below. It was estimated that the reach of Butte Creek above the CVPH would support 152-1,316 spawners at 40 cfs, and 270-2,352 spawners at 130 cfs, while the reach below the CVPH would support an estimated 1,262-10,976 spawners at 130 cfs. During the three-year period 2001-2003, it was estimated that 10,887, 7,161, 1,527, fish respectively spawned above the CVPH (Table 4) at the required minimum release flow of 40 cfs. During 2004, in coordination with CDFG and NOAA Fisheries, PG&E voluntarily increased the flow above the CVPH from the required 40 cfs to 60 cfs, to provide additional habitat for the 5,572 fish that survived to spawn in that reach. Estimated usable spawning gravel increased approximately 26% when flows increased from 40 to 60 cfs, with estimated spawners supported increasing to 191 – 1,661 (Ward et al., 2004b; Gard, 2003). During 2005, PG&E again provided higher flows beginning on September 21, with an increase from 40 to 75 cfs. The higher flows increased the estimated maximum number of spawners supported to 1,868. During the five-year period 2001-2005, there were 7,425, 5,737, 4,536, 4,649, and 11,089 fish spawning respectively in the reach below the powerhouse at the average flow of approximately 130 cfs. Thus, in each of the years it appears that fish surviving to spawn in the reach above the CVPH significantly exceeded the estimated capacity. For the four years 2001-2004, fish surviving to spawn underutilized habitat below the CVPH, only exceeding the estimated capacity during 2005.

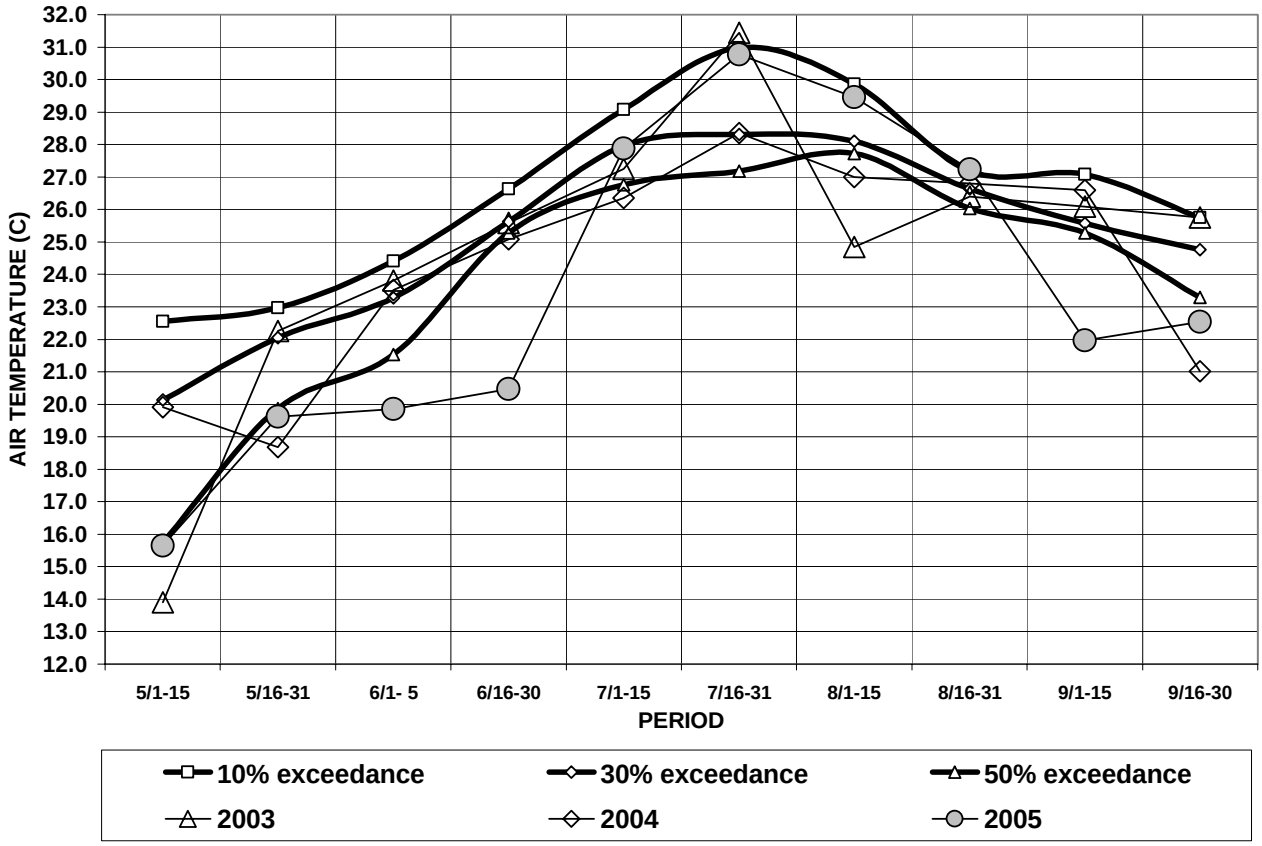
Air Temperatures

Air temperatures measured at the California Department of Forestry Cohasset Fire Station (Figure 1; Appendix E) were once again monitored to assess resultant stream temperatures and pre-spawn mortalities. Air temperatures during 2005 were initially significantly lower than during 2004, but increased during mid-July and were significantly higher than during 2004, and near the upper 10% for the period of record 1984-2004 (Table 5, Figure 3) (CDWR, 2005). Maximum daily air temperatures equaled or exceeded 37.6° C (100° F) on 13 days during July 2005, as compared to 3 days during 2004 and 11 days during 2003. Since 1985 there are 12 years where there are complete records for July. During that period of record the average number of days in which maximum air temperatures exceeded 37.6° C was five days, with a maximum of 13 days during both 1988 and 2005.

Table 5. Mean daily air temperatures (C) as measured at the California Department of Forestry Cohasset Fire Station for the semi-monthly periods June through September 1998-2005.

Period	Year								Avg. 1984-05
	1998	1999	2000	2001	2002	2003	2004	2005	
June 1-15	18.1	18.3	23.0	23.3	24.3	23.8	23.5	19.9	20.9
June 16-30	21.3	26.6	28.0	25.5	25.5	25.6	25.1	20.5	24.4
July 1-15	26.2	27.5	22.7	28.0	29.3	27.2	26.4	27.9	26.8
July 16-31	27.9	23.1	27.2	25.1	27.1	31.4	28.3	30.8	27.3
Aug. 1-15	30.9	21.9	28.1	27.7	27.8	24.8	27.0	29.5	27.1
Aug. 16-31	26.0	27.2	25.0	26.8	26.0	26.4	26.8	27.2	25.7
Sept. 1-15	28.1	25.3	22.2	25.3	25.7	26.1	26.6	22.0	24.4
Sept. 16-30	19.1	25.7	24.7	23.5	24.8	25.1	21.0	22.5	23.6

Figure 3. Mean daily air temperature exceedance for period 1984-2004 compared to 2003, 2004, and 2005, California Department of Forestry Cohasset Fire Station.



Water Temperatures and Flows

Mean daily water temperatures began to rise in mid July, peaking at the Quartz Bowl Pool on July 19, 2005 at 20.1°C, then remaining under 20°C for the rest of year (Figure 4; Appendix F, Table 1). Mean daily water temperatures at Quartz Bowl Pool exceeded 19.5°C a total of 2 days during July 2005. Pre-spawning mortalities during 2002 and 2003 coincided with peak water temperatures at Quartz Bowl Pool during mid-July in which mean daily water temperatures exceeded 19.5°C a total of 11 days and 9 days respectively. The estimated number of holding adult SRCS was similar during 2001, 2002, 2003, and 2005, being 18,312, 16,328, and 17,294, 17,615 respectively. Mean daily flows in the Quartz Bowl Pool to Centerville Powerhouse reach for each of the years were always above the required 40 cfs (Appendix G, Table 1).

Mean daily increase in water temperature through the DeSabla Forebay exceeded 1°C a total of 75 days during the period June 15 - September 30, 2005 (Figure 5). This was less than observed during 2004 when mean daily heating exceeded 1°C for the entire 107 day period. PG&E has previously concluded that to keep temperature increases through the forebay less than 1°C would require a flow of 108 cfs or greater. For the period, flows exceeded 108 cfs until mid-August.

Figure 4. Mean daily water temperature (C) at Quartz Bowl Pool for period July through September 2002-2005.

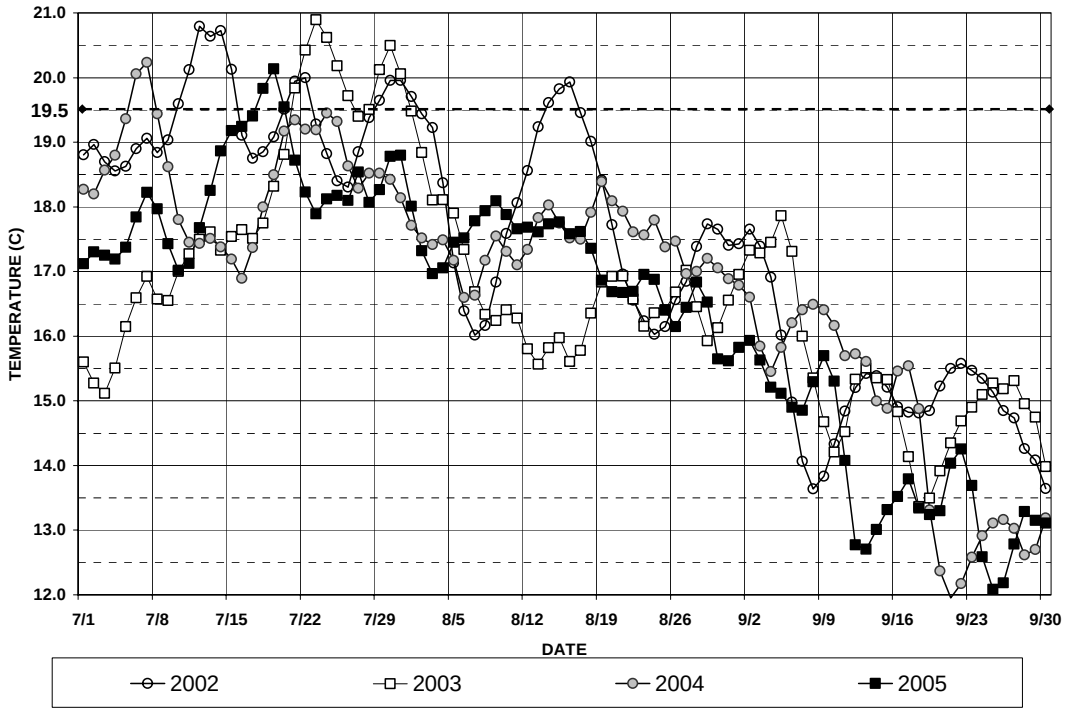
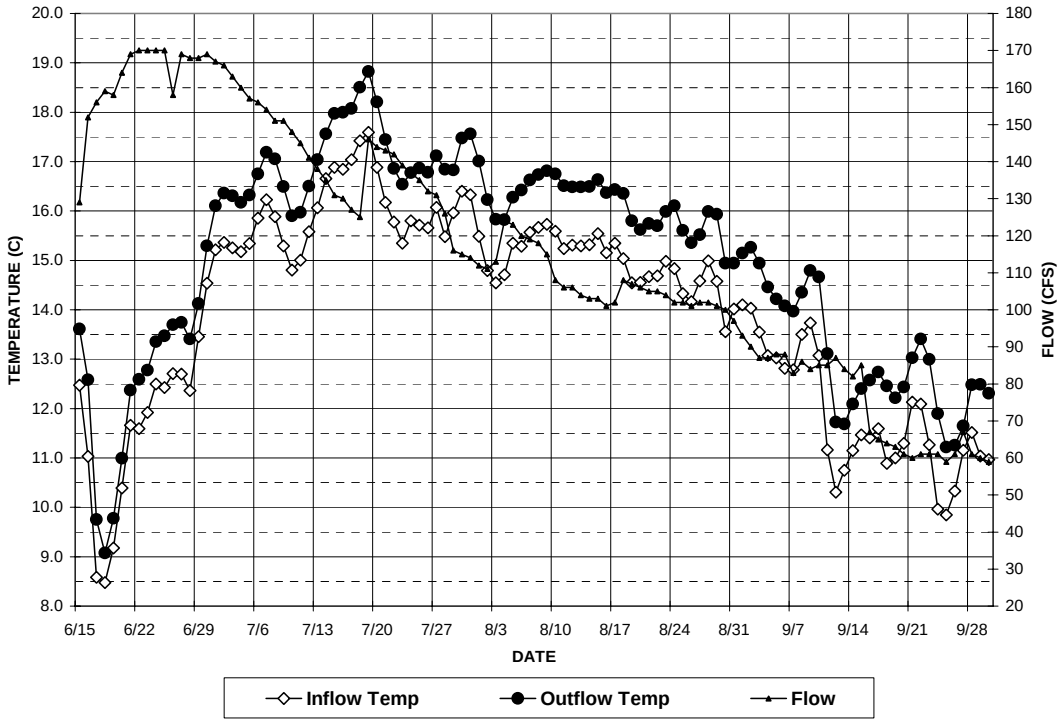


Figure 5. Mean daily water temperature (C) at DeSabla Forebay inflow and DeSabla Powerhouse outflow compared to average daily flows (cfs) June 15 - September 30, 2005.



As was previously identified during 2003, additional sources of heating appeared to be evident within the channel of Butte Creek between the DSPH discharge and the CVHD, and between the CVHD and the CVPH (Tables 6 & 7) (Sagraves, 2005). However, based upon analysis of the newly installed temperature and flow monitoring station in Butte Creek above the DSPH outflow, heating in the reach from the DSPH to the CVHD appears to be primarily from mixing of warmer flows within Butte Creek from above the outflow of the DSPH (Table 6). Mean daily heating in the reach from the CVHD to immediately above the CVPH ranged from 2.1°C to 4.0°C during July and August 2005 (Appendix H, Table 2), compared to 2.9°C to 3.9°C for the same period during 2004, and 1.7°C to 4.3°C during 2003. This reach is affected by the minimum flow release of 40 cfs and the limited ability of flows above 40 cfs to reduce heating (Kimmerer, 1989; PG&E, 1993). Flows conveyed via the Centerville Canal to the CVPH continued to be significantly cooler due to the shorter conveyance time and shading, with mean daily heating ranging from 0.47°C to 0.70°C during July-August 2005, compared to 0.56°C to 0.89°C during 2004, and 0.40°C to 0.86°C during the same period in 2003.

Table 6. Semi-monthly mean water temperature increase (C) at key locations within the PG&E DeSabla Centerville Project conveying water into and within Butte Creek, July through September.

Site and Distance[1/]		July 1-15		July 16-31		Aug. 1-15		Aug. 16-31		Sept. 1-15		Sept. 16-30	
		Total	PM Eirle	Total	PM Eirle	Total	PM Eirle	Total	PM Eirle	Total	PM Eirle	Total	PM Eirle
Hendricks Head Dam to Toadtown Canal Gage - 2003 (Site S2 to S3, 10.28 miles)	2005	0.44	0.04	0.65	0.06	0.58	0.06	0.36	0.04	0.27	0.03	0.73	0.07
	2004	0.62	0.06	0.77	0.07	0.74	0.07	0.43	0.04	0.36	0.04	0.53	0.05
	2003	0.73	0.07	0.95	0.09	0.93	0.09	0.79	0.08	0.69	0.07	1.14	0.11
Toadtown Canal Gage to DeSabla Forebay [2/] - (Site S3 to S4, 0.88 miles)	2005	0.06	0.07	0.08	0.09	0.08	0.09	0.05	0.06	0.02	0.02	0.03	0.03
	2004	-0.01	-0.01	0 .25	0 .29	0 .33	0 .38	-0.14	-0.16	-0.37	-0.42	-0.43	-0.49
	2003	-0.22	-0.25	-0.30	-0.34	nd	nd	-0.14	-0.16	-0.55	-0.63	-0.51	-0.57
DeSabla Forebay to DeSabla Powerhouse Outfall (Site S4 to S5, 1.35 miles)	2005	1.00	0.74	1.14	0.84	1.18	0.87	1.15	0.85	1.23	0.91	1.24	0.92
	2004	1.17	0.87	1.21	0.89	1.21	0.9	1.04	0.77	1.04	0.77	1.17	0.86
	2003	1.37	1.01	1.59	1.18	nd	nd	0.87	0.65	0.79	0.59	1.05	0.78
DeSabla Powerhouse Outflow to Centerville Head Dam [3/] - (Site S5 to S6, 0.14 miles)	2005	0.01	0.0	-0.08	0.0	-0.08	0.0	-0.08	0.0	-0.07	0.0	-0.04	0.0
	2004	0.6	4.31	0.59	4.19	0.63	4.52	0.5	3.59	0.39	2.78	0.65	4.66
	2003	0.21	1.51	0.54	3.87	0.71	5.08	0.51	3.64	0.41	2.90	0.50	3.58
Centerville Head Dam via Centerville Canal to Centerville Powerhouse Outflow –(Site S6 to S10/11, 8.19 miles)	2005	0.56	0.07	0.62	0.08	0.63	0.08	0.60	0.07	0.58	0.07	1.01	0.12
	2004	0.67	0.08	0.77	0.09	0.75	0.09	0.65	0.08	0.61	0.08	0.82	0.10
	2003	0.71	0.09	0.65	0.08	0.55	0.07	0.52	0.06	0.48	0.06	0.63	0.08
Centerville Head Dam via Creek to immediately above Centerville Powerhouse Outflow – (Site S6 to S11, 6.62 miles)	2005	2.81	0.42	3.75	0.57	3.62	0.55	3.25	0.49	2.98	0.45	2.24	0.34
	2004	3.45	0.52	3.40	0.51	3.37	0.51	3.16	0.48	2.94	0.44	2.50	0.38
	2003	2.13	0.32	3.33	0.50	3.77	0.57	3.45	0.52	3.11	0.47	2.86	0.43
Centerville Head Dam to Quartz Bowl Pool – (Map site S6 to S7, 1.03 miles)	2005	0.57	0.55	0.72	0.70	0.64	0.62	0.55	0.53	0.53	0.51	0.42	0.41
	2004	0.72	0.70	0.70	0.68	0.71	0.69	0.70	0.68	0.66	0.64	0.57	0.56
	2003	0.45	0.44	0.65	0.63	0.81	0.78	0.67	0.65	0.63	0.62	0.59	0.57
Quartz Bowl Pool to Chimney Rock (Site S7 to S8, 1.27 miles)	2005	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
	2004	0.63	0.49	0.60	0.48	0.61	0.48	0.57	0.45	0.52	0.41	0.44	0.35
	2003	0.46	0.36	0.70	0.55	0.82	0.65	0.73	0.58	0.61	0.48	0.59	0.47
	2002	0.60	0.47	0.63	0.50	0.55	0.43	0.50	0.39	0.45	0.35	0.40	0.31
	2001	0.56	0.44	0.65	0.51	0.55	0.43	0.52	0.41	0.51	0.40	0.49	0.39
	Avg.	0.56	0.44	0.65	0.51	0.63	0.50	0.58	0.46	0.52	0.41	0.48	0.38
Chimney Rock to Pool 4 (Site S8 to S9, 2.19 miles)	2005	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
	2004	0.95	0.44	0.94	0.43	0.92	0.42	0.85	0.39	0.79	0.36	0.69	0.31
	2003	0.71	0.33	1.03	0.47	1.06	0.48	1.04	0.48	0.93	0.45	0.89	0.41
	2002	0.71	0.32	0.73	0.34	0.72	0.33	0.68	0.31	0.69	0.32	0.64	0.29
	2001	1.08	0.50	1.14	0.52	1.05	0.48	1.03	0.47	0.95	0.43	0.95	0.43
	Avg.	0.87	0.40	0.96	0.44	0.94	0.43	0.90	0.41	0.84	0.38	0.79	0.36
Pool 4 to immediately above Centerville Powerhouse Outflow –(Site S9 to S11, 2.13 miles)	2005	1.09	0.51	1.16	0.54	1.09	0.51	0.94	0.44	0.80	0.38	0.69	0.32
	2004	1.15	0.54	1.15	0.54	1.13	0.53	1.03	0.48	0.96	0.45	0.80	0.38
	2003	0.51	0.24	0.94	0.44	0.97	0.45	1.02	0.48	0.93	0.44	0.79	0.37

[1/] See Figure 1.
[2/] Values for 2005 are calculated Butte Canal plus Toadtown Canal.
[3/] Values for 2005 are calculated Butte Creek above DSPH plus DSPH outflow.

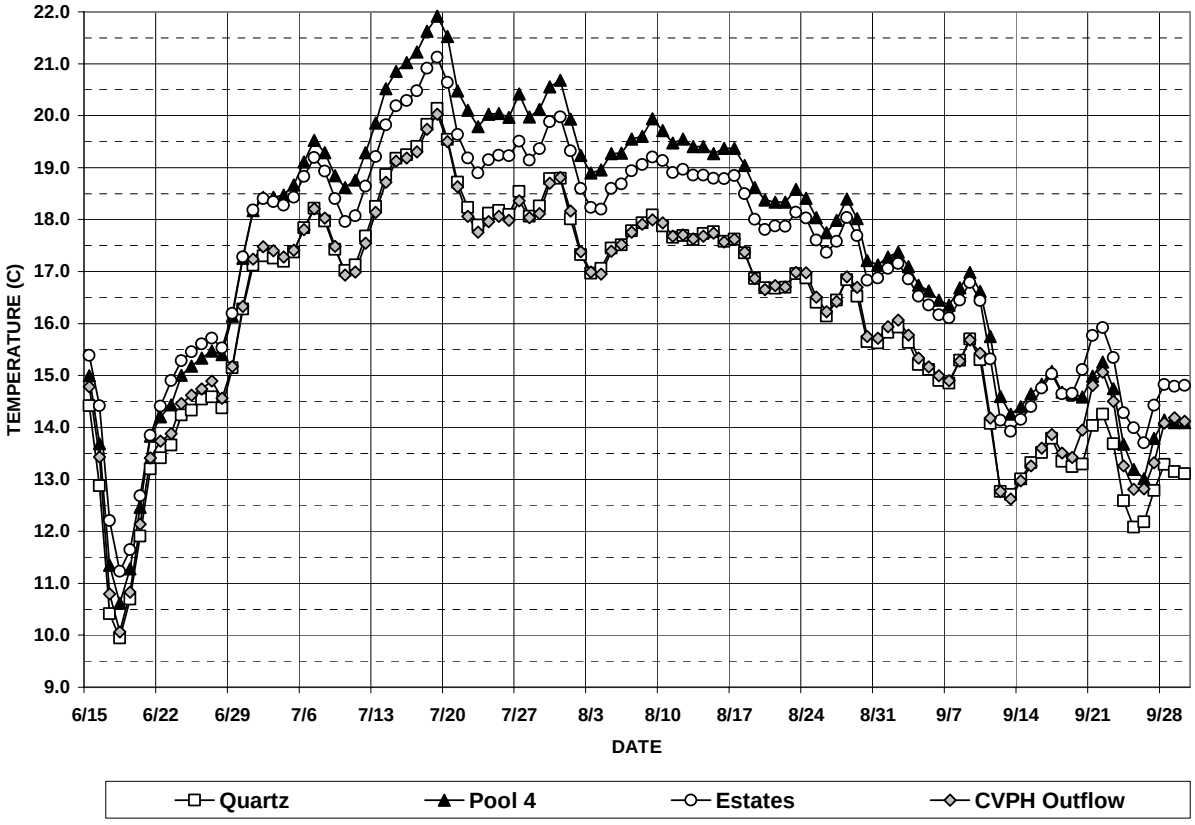
Table 7. Semi-monthly mean daily flows (cfs) and water temperature (C) for key sites within PG&E DeSabla Centerville Project affecting Butte Creek SRCS holding and spawning.

Locations[1/]		July 1-15		July 16-31		Aug. 1-15		Aug. 16-31		Sept. 1-15		Sept. 16-30	
		Flow	Temp	Flow	Temp	Flow	Temp	Flow	Temp	Flow	Temp	Flow	Temp
Hendricks Canal at Head Dam (Site S2)	2005	98	15.0	87	15.2	76	14.4	72	14.4	65	12.8	28	10.7
	2004	55	15.3	51	15.0	50	13.7	63	15.0	60	13.9	34	10.8
	2003	nr	14.0	nr	16.5	nr	13.6	nr	13.7	nr	14.1	nr	11.8
Toadtown Canal Above Butte Canal (Site S3)	2005	90	15.4	82	15.9	71	15.0	66	14.8	51	13.0	29	11.4
	2004	55	15.9	50	15.8	50	14.5	62	15.4	58	14.2	26	11.3
	2003	84	14.8	59	17.4	59	14.6	66	14.5	64	14.8	33	12.9
	1998-2002	69	15.8	67	15.1	64	15.1	57	14.7	58	13.8	43	12.9
DeSabla Forebay Inflow (Site S4) (for 2005 is Butte Canal + Toadtwn Canal)	2005	160	15.6	136	16.3	116	15.3	106	14.6	90	12.6	67	11.1
	2004	99	15.9	87	16.1	83	14.8	94	15.3	88	13.9	53	10.9
	2003	86	14.5	96	14.9	102	nr	101	14.3	98	14.2	64	12.4
	1998-2002	121	nr	113	nr	109	nr	103	nr	96	nr	80	nr
Butte Creek Above DeSabla Ph Discharge (Site S5), PG&E temporary gage 2004-05	2005	57	18.7	43	20.2	38	18.8	36	17.5	35	15.2	34	13.8
	2004	36	19.2	33	19.3	31	18.2	30	18.2	29	16.3	30	13.6
	2003	121	nr	57	nr	44	nr	41	nr	40	nr	37	nr
	1998-2002	42	nr	39	nr	39	nr	36	nr	35	nr	35	nr
DeSabla PH Discharge (Below site S5)	2005	151	16.6	131	17.4	112	16.5	103	15.8	86	13.8	62	12.3
	2004	99	17.1	87	17.3	83	16.0	94	16.3	88	14.9	53	12.0
	2003	86	15.9	96	18.3	102	15.6	101	15.2	98	15.0	64	13.5
	1998-2002	121	nr	113	nr	109	nr	103	nr	96	nr	80	nr
Below Centerville Head Dam (Site S6), (for 2005 flow is as measured immediately above CVPH)	2005	87	17.2	55	18.0	52	17.0	50	16.1	49	14.1	72	12.8
	2004	45	17.7	45	17.9	44	16.7	45	16.8	45	15.3	52	12.7
	2003	nr	16.1	52	18.8	45	16.3	44	15.7	44	15.4	44	14.0
	1998-2002	48	nr	47	nr	48	nr	46	nr	46	nr	46	nr
Quartz Bowl (Site S7) (for 2005 flow is as measured immediately above CVPH)	2005	87	17.7	55	18.7	52	17.6	50	16.7	49	14.6	72	13.2
	2004	45	18.4	45	18.6	44	17.4	45	17.5	45	15.9	52	13.3
	2003	nr	16.6	52	19.5	45	17.0	44	16.4	44	16.0	44	14.5
	2002	47	19.4	47	19.2	47	18.1	47	17.5	47	15.5	46	14.9
	2001	48	18.5	47	17.5	47	18.1	47	17.1	47	16.1	47	15.0
Chimney Rock (Site S8) (for 2005 flow is as measured immediately above CVPH. Primary & secondary thermographs failed during June 22 – October 10, 2005	2005	87	nr	55	nr	52	nr	50	nr	49	nr	72	nr
	2004	45	19.0	45	19.2	44	18.0	45	18.1	45	16.5	52	13.7
	2003	nr	17.0	52	20.2	45	17.8	44	17.1	44	16.6	44	15.1
	2002	47	20.0	47	19.9	47	18.7	47	18.0	47	15.9	46	15.3
	2001	48	19.1	47	18.2	47	18.7	47	17.6	47	16.6	47	15.5
Pool 4 (Site S9) (for 2005 flow is as measured immediately above CVPH)	2005	87	18.9	55	20.6	52	19.5	50	18.4	49	16.3	72	14.4
	2004	45	20.0	45	20.1	44	18.9	45	18.9	45	17.3	52	14.4
	2003	nr	17.7	52	21.2	45	18.9	44	18.2	44	17.6	44	16.0
	2002	47	20.7	47	20.6	47	19.4	47	18.7	47	16.6	46	15.9
	2001	49	20.1	47	19.3	47	19.7	47	18.7	47	17.6	47	16.4
Butte Creek above Centerville PH (Site S11)	2005	87	20.0	55	21.8	52	20.6	50	19.4	49	17.0	72	15.1
	2004	45	21.2	45	21.3	44	20.0	45	20.0	45	18.2	52	15.2
	2003	nr	18.3	52	22.1	45	20.0	44	19.2	44	18.5	44	16.8
Centerville PH Discharge (Site S10)	2005	172	17.7	159	18.6	139	17.6	125	16.7	101	14.7	62	13.8
	2004	119	18.4	108	18.6	100	17.4	103	17.5	105	15.9	52	13.5
	2003	116	16.8	130	19.5	116	16.8	117	16.3	112	15.9	76	14.6
	1998-2002	118	nr	105	nr	101	nr	95	nr	93	nr	77	nr
Centerville Estates (Site S12) (Flows are calculated PGE above CVPH + CVPH outfall)	2005	259	18.7	214	19.8	191	18.8	175	17.9	150	15.9	134	14.8
	2004	192	19.6	171	19.9	179	18.7	160	18.7	146	17.0	110	14.7
	2003	194	18.1	133	20.9	132	18.3	147	17.7	147	17.6	109	nr
	2002	120	20.9	113	20.9	118	19.7	118	19.0	117	16.9	81	16.5
	2001	143	19.9	136	19.0	127	19.7	118	18.7	115	17.6	106	16.5
Cable Bridge (Site S13) (Flows are calculated PGE above CVPH + CVPH outfall)	2005	259	19.4	214	20.6	191	19.6	175	18.6	150	16.5	134	15.4
	2004	192	20.4	171	20.8	179	19.8	160	19.4	146	17.8	110	15.3
	2003	194	18.7	133	21.7	132	19.1	147	18.3	147	17.9	109	nr
	2002	120	22.0	113	21.9	118	20.7	118	19.9	117	17.7	81	17.4
	2001	143	nr	136	20.9	127	20.6	118	19.7	115	18.5	106	17.4
Covered Bridge (Site S14)	2005	240	19.8	202	21.2	169	20.6	150	19.6	147	17.6	108	16.3
	2004	176	21.1	171	21.6	179	20.5	160	20.3	146	18.6	110	16.3
	2003	194	19.6	133	22.6	132	20.1	147	19.3	147	18.6	109	17.4
	2002	120	22.9	113	22.7	118	21.5	118	20.6	117	18.4	81	18.0
	2001	143	21.6	136	20.9	127	21.4	118	20.5	115	19.2	106	18.0

[1/] See Figure 1.
nr = No Record

As observed during 2003 & 2004, water temperatures at Pool 4 and Estates Pool (Figures 1 & 6) continue to demonstrate the beneficial effects of the diversion through the CVPH and the related effect upon SRCS holding and spawning distribution. Flows diverted through the CVPH as measured approximately 1 kilometer (0.6 miles) downstream of the CVPH at the Estates Pool continue to be close to temperatures at Pool 4 for those flows remaining in Butte Creek (Figure 6) and reflect the impacts of the cooler CVPH discharge.

Figure 6. Mean daily water temperatures (C) at select SRCS holding pools in Butte Creek from June 15, through September 30, 2005.



The PG&E temperature contingency plan was implemented on two occasions during late July and early August based upon air temperature forecasts provided by PG&E meteorologists. PG&E provided short-term increased releases from Philbrook Reservoir on July 22, and August 3 (Figures 7 & 8). The increased releases of cooler water seem to have reduced the temperature of flows into the DeSabla Forebay, although near simultaneous reductions in air temperature somewhat confuse the magnitude of the temperature effect of the flow increases.

Figure 7. Hourly temperatures (C) at key sites during PG&E flow increase from WBFR for period July 17 through July 22, 2005.

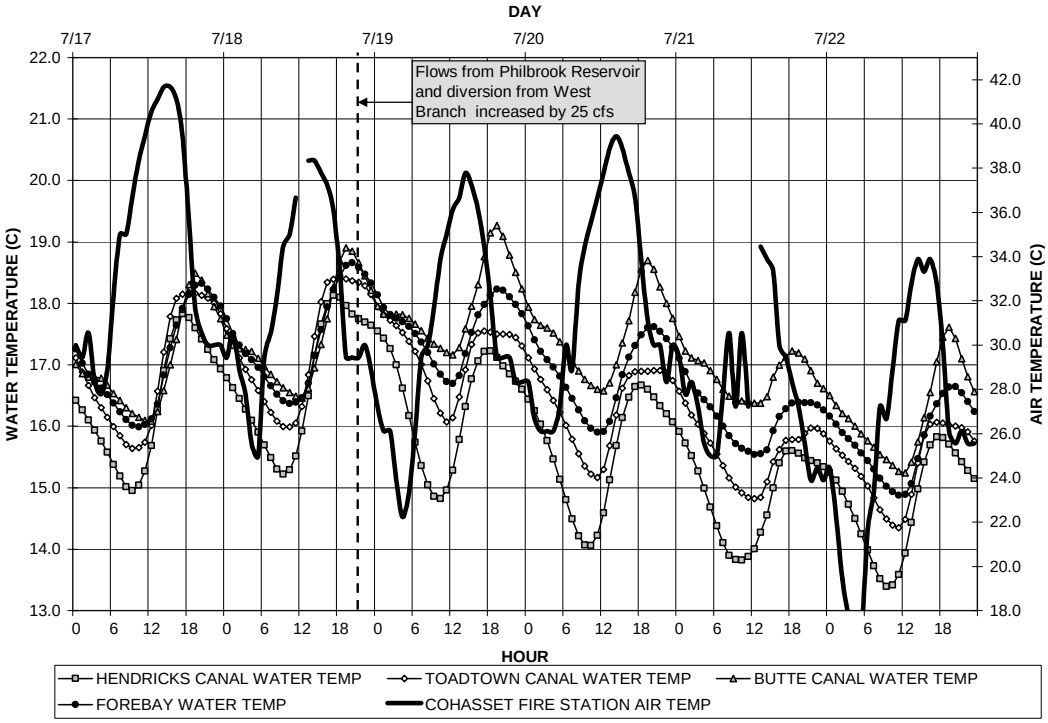
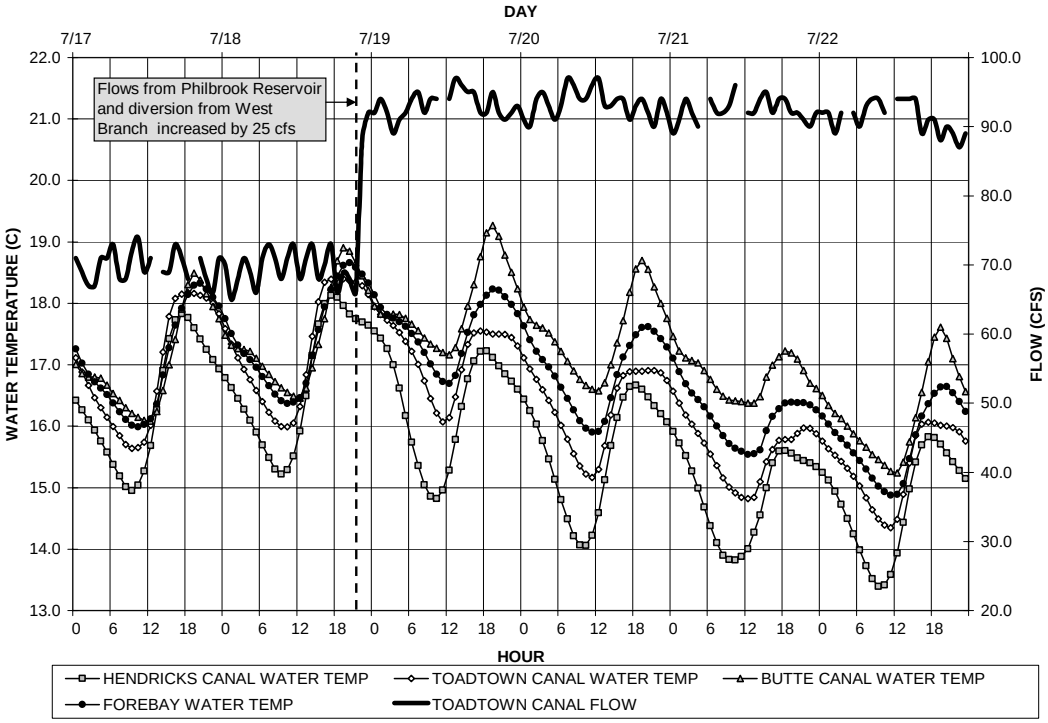


Figure 8. Hourly temperatures (C) at key sites compared to PG&E flow increase from WBFR for period July 17 through July 22, 2005.



DISCUSSION

The basis for this analysis is the recognition that flow and temperatures within the SRCS holding and spawning reach of Butte Creek are directly affected by the PG&E DeSabla-Centerville Project (FERC-803). At issue has been and is whether the project as currently operated negatively impacts SRCS survival and spawning success. As concluded during 2003 & 2004, current operations appear to benefit both holding and spawning for Butte Creek SRCS (Ward et al., 2004b; Ward et al., 2006). Flows discharged at the CVPH continue to be significantly cooler during the key summer holding period than the flows in Butte Creek above the CVPH. Again during 2005, as was previously observed, the cooler water below the CVPH provided more SRCS holding habitat and significantly enhanced the spawning distribution allowing better utilization of the majority of the spawning gravel below the powerhouse. The flow-temperature evaluation conducted by (Kimmerer, 1989; PG&E, 1993) showed that increased flows would not materially reduce the temperatures above the CVPH and would significantly increase water temperatures below. Evaluation of holding and spawning since 2001 continues to show a net downstream movement of SRCS from holding pools to spawning areas. However, in general the downstream movement is limited, with limited net movement from above the CVPH to below. During 2005, approximately 2,272 fish holding above the CVPH (28% of the total) moved to spawn below (Table 4; Appendix D, Figures 1-5). Due to the shift in proportion holding and surviving below the CVPH during 2005, use of estimated spawning gravel below the CVPH was exceeded. Additionally, spawning gravel above the CVPH continued to be significantly overutilized..

Previous evaluations suggested that an extended period of mean daily temperatures above 19.4°C during July as measured at the Quartz Bowl Pool preceded the onset of significant pre-spawn mortalities (Ward et al., 2004b; Ward et al.,2006). During 2002, temperatures exceeded 19.4°C a total of 16 days with a maximum of 20.8°C on July 12, while during 2003, temperatures exceed 19.4°C a total of 11 days with a maximum of 20.9°C on July 23. However during 2004, maximum daily water temperatures exceeded 19.4°C on only 2 days in early July, with a maximum of 20.2°C on July 7, followed by a significant cooling period. Mean daily water temperature during 2005, as measured at the Quartz Bowl Pool, exceeded 19.4°C on three days during July, with a peak on July 19, at 20.1°C (Appendix F, Table 1). The subsequent decline after the peak on July 19, appears to have been the result of increased and cooler flows from the WBFR, in response to implementation of the temperature contingency plan. Even with the large holding population of SRCS (17,615) pre-spawn mortalities were relatively small during 2005 (617).

Based upon the biweekly reports provided by PG&E meteorologists the temperature contingency plan was implemented on two occasions, July 19, and August 3, 2005 (PG&E, 2005c). Evidence of the impact of the increased cooler flows was demonstrated on July 20, when water temperatures within the Hendricks, Toadtown and DeSabla Forebay showed a decrease in spite of increased temperatures in the Butte Canal component of the DeSabla Forebay inflow. At the onset of spawning with the concurrence of CDFG and NOAA Fisheries, PG&E voluntarily increased flows in the reach above the CVPH from the FERC requirement of 40 cfs to 75 cfs (Zemke, 2005). It is estimated that the increased flows provided access to approximately 40% more spawning gravel, increasing the estimated maximum number of spawners accommodated from 1,316 to 1,868.

CONCLUSIONS AND RECOMMENDATIONS

There were approximately 617 SRCS that died prior to spawning during 2005, of which 153 were in the reach above the Centerville Powerhouse and 464 below. Mortalities were fairly low from initiation of

the survey on June 21 until mid-July and then evenly spread over the remainder of the pre-spawn period through September 15, 2005. Due to the low number of mortalities, none was examined by a CDFG pathologist. As reported during 2004, we conclude that all were likely normal attrition among a population of salmon holding in fresh water since early spring. Pre-spawn mortalities consisted of approximately 71% female and 29% male. Although there were no CWT's recovered from pre-spawn mortalities, based upon recovery of 38 CWT's during the subsequent spawning survey, we estimate that there were approximately 0.5% age-2, 97.5% age-3 and 2% age-4 (Appendix B, Table 2).

Air temperatures and resultant water temperatures were lower during June and early July 2005, but were significantly warmer from mid-July through mid-August than was observed during 2004. While air temperatures during that period were comparable or higher than during the previous two years in which there were significant pre-spawn mortalities 2002 and 2003, water temperatures were generally cooler. The cooler water temperatures appear to have been at least partially the result of implementation of the temperature contingency plan to increase flows from WBFR. Also of significance was the larger population of holding SRCS (17,615) during 2005 than during 2004 (10,639) and comparable to the 2002 and 2003 seasons which were 17,294 and16,328, respectively. The 2005 results, as with 2004, continue to support the conclusion that the 1991 FERC requirement that PG&E maintain a minimum release of 40 cfs from June 1 through September 14, below the CVHD, appears to have maximized survival and spawning success. Increased flows in the reach below the CVHD at onset of spawning increased the available spawning habitat, although spawning habitat was again significantly over-utilized in that reach. However due to increased survival and significantly more fish holding below the CVPH during 2005, estimated spawning gravel appears to have been over-utilized below the CVPH.

As previously demonstrated, diversions through the CVPH significantly decreased temperatures in Butte Creek below the CVPH, providing important holding habitat during the summer, and ultimately contributing to more efficient usage of spawning habitat.

We continue to conclude that current PG&E project operations appear to provide a net benefit to Butte Creek SRCS, and continue to recommend that PG&E consider the following:

- Investigate and implement alternatives to reduce or eliminate heating through the DeSabla Forebay.
- Continue to investigate other means to reduce sources of heating.
- Continue to schedule maintenance operations for periods after SRCS have spawned.
- Continue development of a predictive model to potentially better manage flows from the WBFR.
- Continue to increase flows up to 80 cfs, in the reach above the CVPH at onset of SRCS spawning to maximize available spawning gravel.

ACKNOWLEDGMENTS

This project was funded by the Pacific Gas and Electric Company with co-funding provided by the CALFED Bay-Delta Program through State Proposition 204, by the Federal Aid in Sport Fish Restoration Act, and in partnership with the California Department of Fish and Game. Additionally, we wish to acknowledge the various field crew members that participated during the 2005 season to include Mitch Azevedo, Chris Bennett, Jeff Humble, Jeremy Notch, Sam Plemons, and Kyle Thompson.

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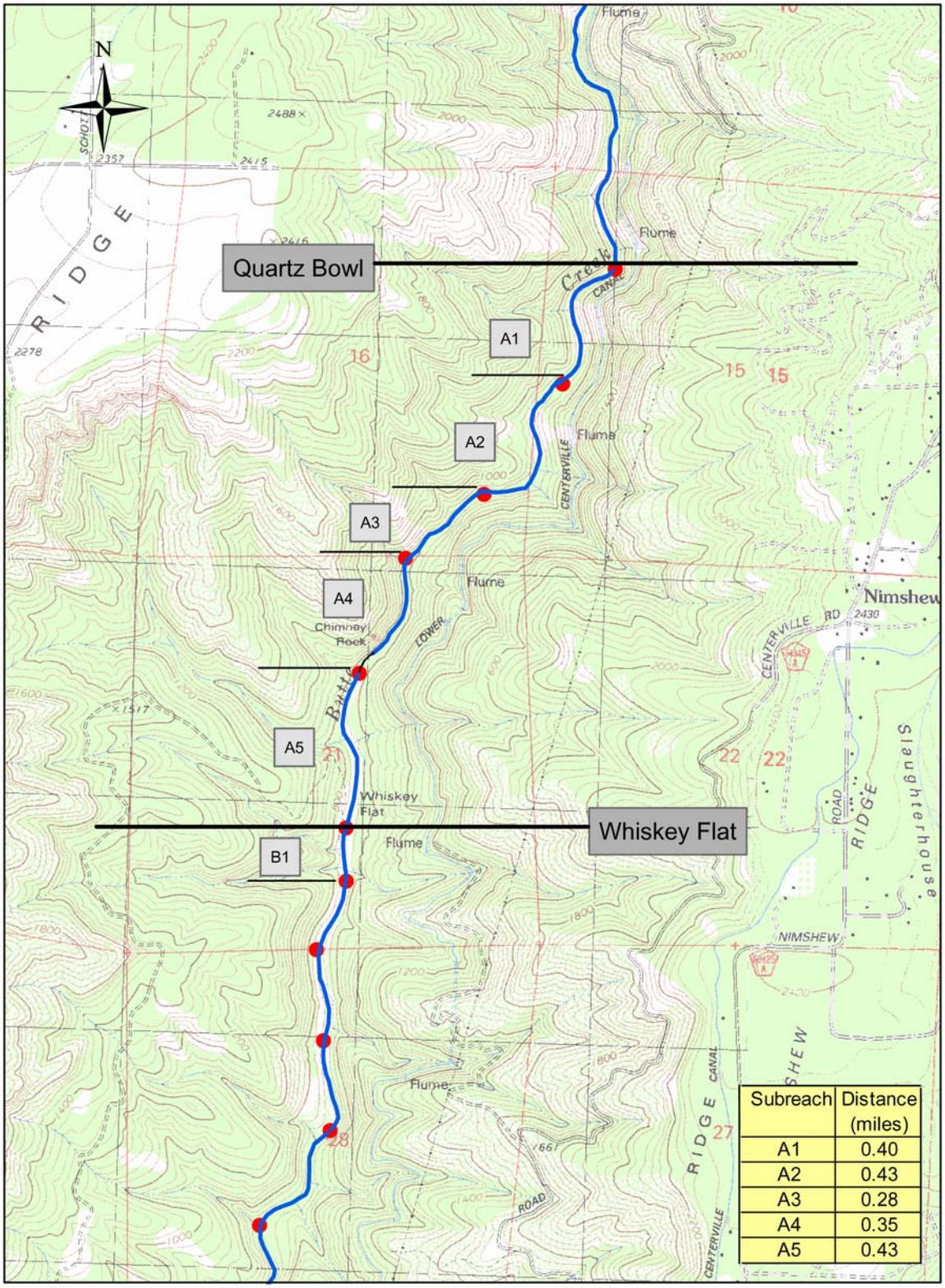
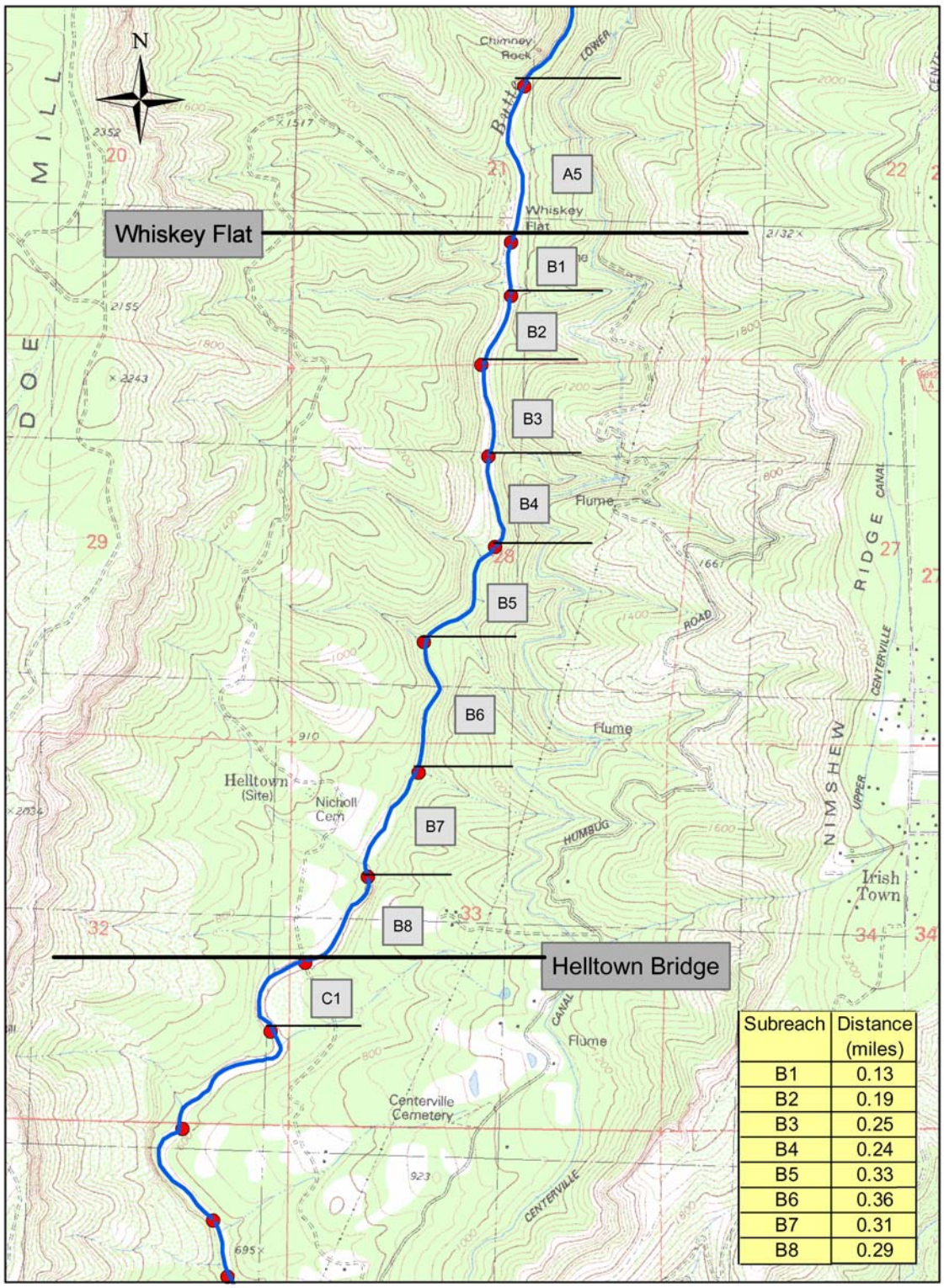
APPENDIX A

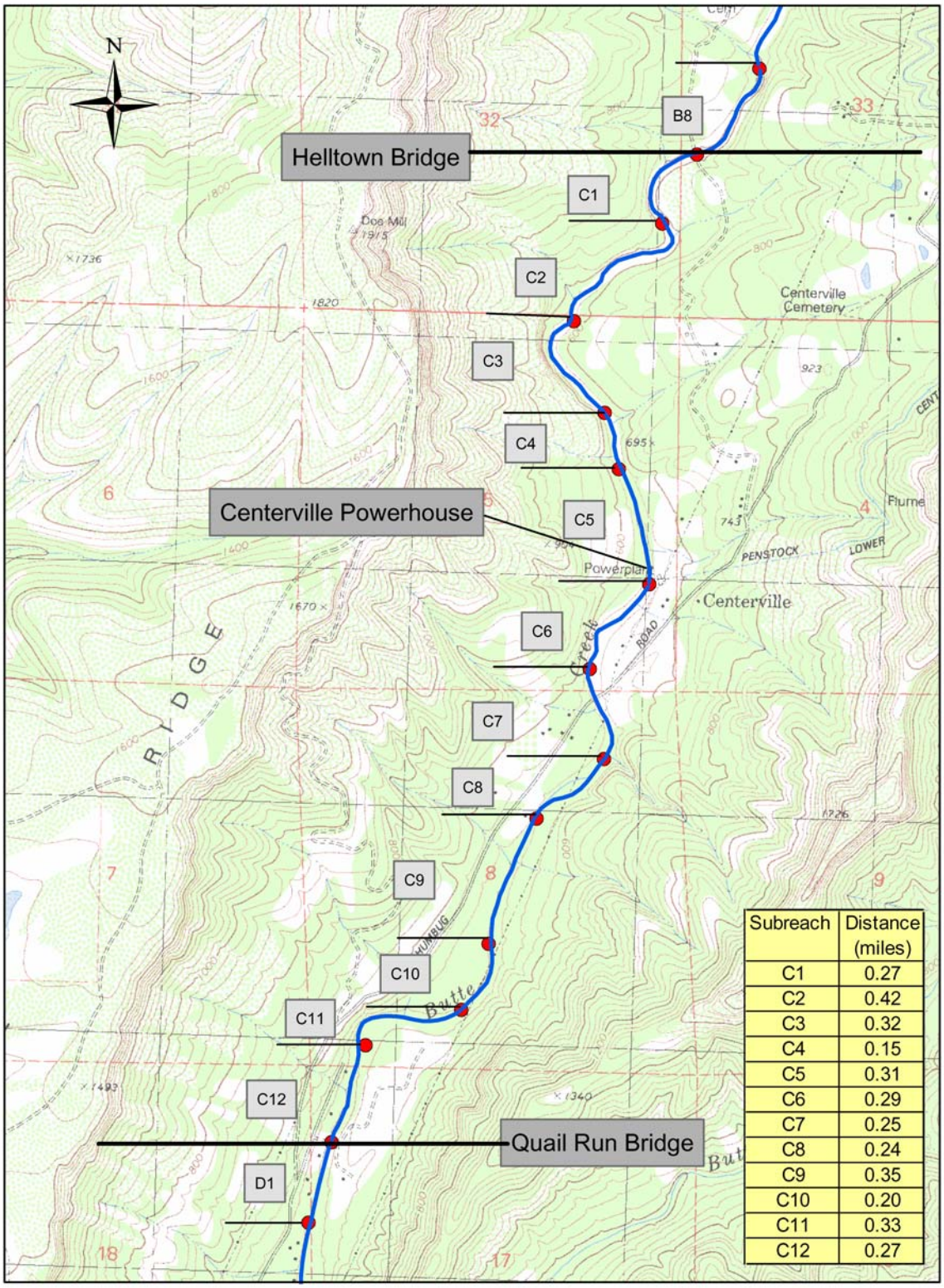
FIGURES 1-5
MAPS OF BUTTE CREEK HOLDING AND SPAWNING REACHES



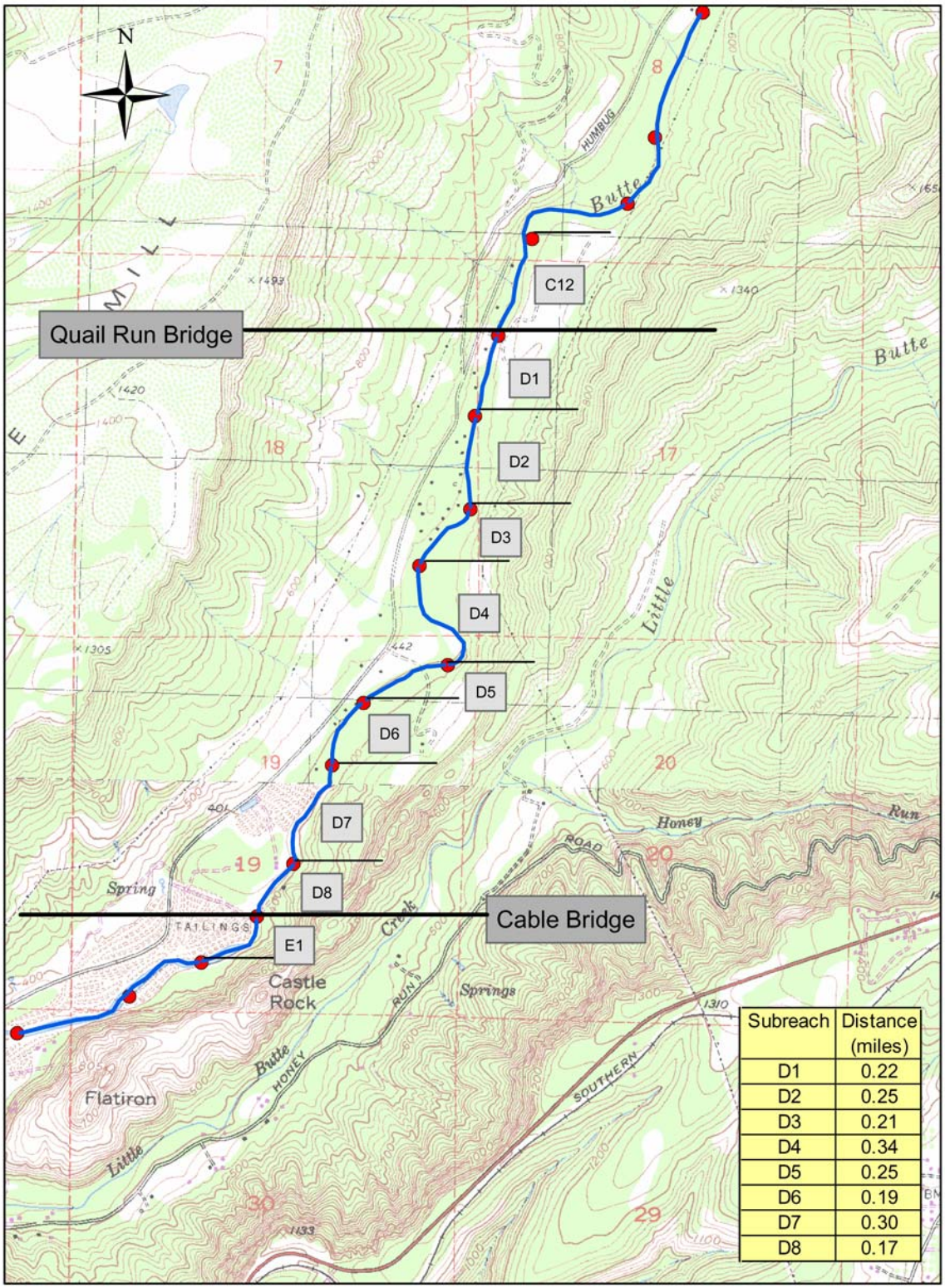
APPENDIX A, Figure 1. Map of Butte Creek SRCS holding and spawning Reach A, showing sub-reaches and distances.



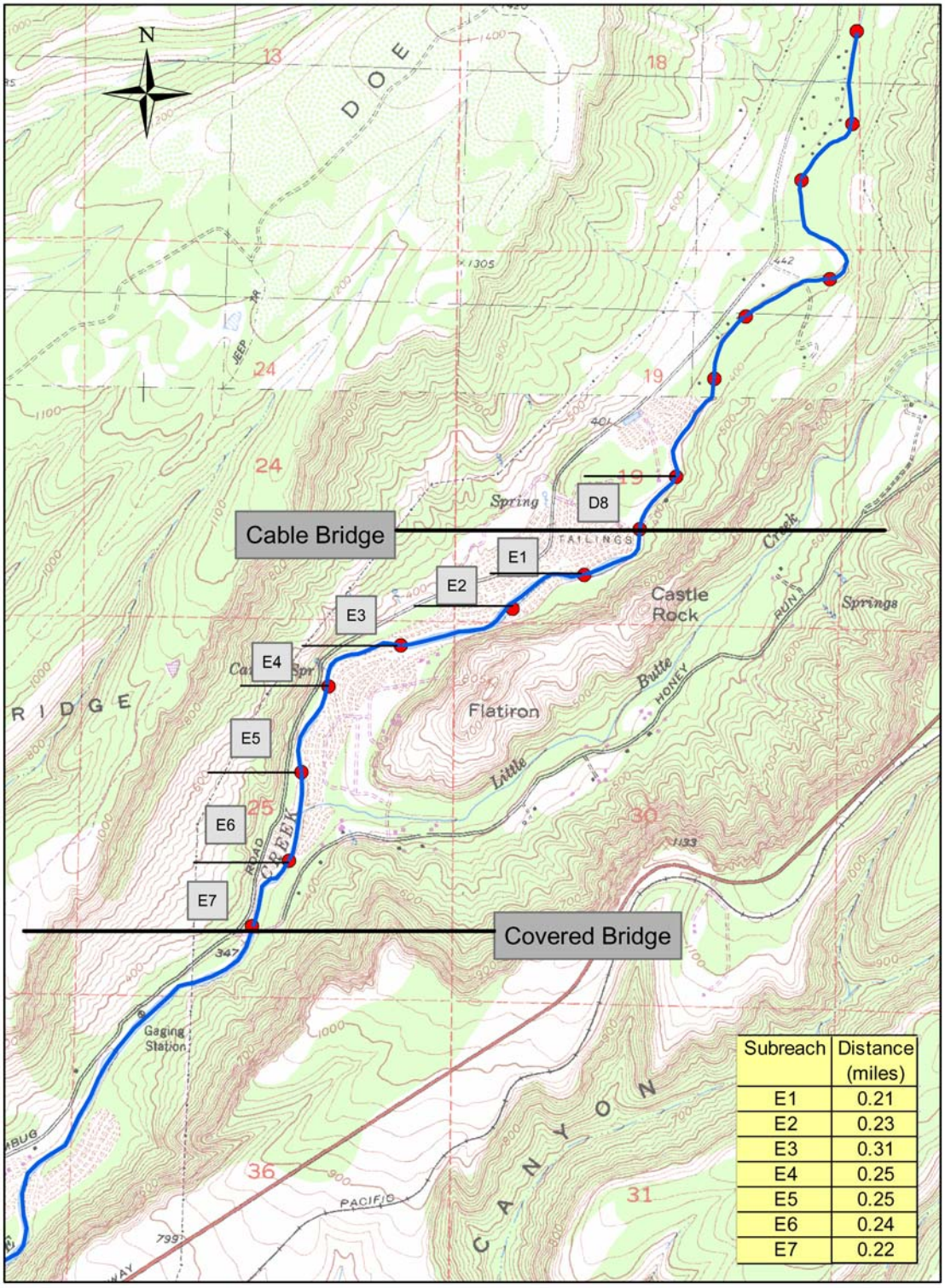
APPENDIX A, Figure 2. Map of Butte Creek SRCS holding and spawning Reach B, showing sub-reaches and distances.



APPENDIX A, Figure 3. Map of Butte Creek SRCS holding and spawning Reach C, showing sub-reaches and distances.



APPENDIX A, Figure 4. Map of Butte Creek SRCS holding and spawning Reach D, showing sub-reaches and distances.



APPENDIX A, Figure 5. Map of Butte Creek SRCS holding and spawning Reach E, showing sub-reaches and distances.

APPENDIX B

TABLES 1 & 2
2005 SPRING-RUN CHINOOK ESCAPEMENT ESTIMATE EXPANSION FACTOR AND AGE COMPOSITION CALCULATION

APPENDIX B, Table 1. Butte Creek spring-run Chinook spawning escapement estimate for 2005 using modified Schaefer Model and expansion factor calculation.

Week of Recovery $R_{(j)}$	$R_{(ij)}$ Week of Tagging $T_{(i)}$					Tags Recovered $R_{(j)}$	Carcasses Counted $C_{(j)}$	Population Estimate $E_{(j)}$
	1	**2**	**3**	**4**	**5**			
	Sept. 20-22	Sept. 27-29	Oct. 4-6	Oct. 11-13	Oct. 18-20			
1 Sept. 27-29	55	-	-	-	-	55	2187	4382
2 Oct. 4-6	2	223	-	-	-	225	4864	6621
3 Oct. 11-13	0	26	257	-	-	283	2597	3291
4 Oct. 18-20	0	4	50	83	-	137	671	759
5 Oct. 25-27	0	1	5	7	6	19	142	122
6 Nov. 1-3	0	0	0	1	2	3	22	22
Tag Recovery $\mathbf{R_{(i)}}$	57	254	312	91	8	Total		15197
Tagged $\mathbf{M_{(i)}}$	112	348	441	184	19	Carcasses chopped first period (Sept. 20-22, Reaches A-E)		159
Total Population Estimate Surveyed Reaches A-E = E								15356
*Plus Chops from Covered Bridge to Parrott Diversion (1179) adjusted by F = 1.39								1642
Total Population Estimate								16998

* Expansion factor for reaches with incomplete survey and for CWT recoveries F = 1.39

* For the purpose of determing an expansion factor for the pre-spawn mortality survey, reaches with an incomplete survey, and for expansion of CWT recoveries we used the following calculation:

$$F = E / (C + T)$$

Where:

F = Expansion Factor
E = Total population estimate for surveyed reaches
C = Total untagged carcasses chopped for surveyed reaches
T = Total tagged carcasses for surveyed reaches

Where:

$$C = (\sum C_{(j)} - \sum R_{(i)}) + C_{(i)}$$
$$T = \sum M_{(i)}$$

And Where:

$C_{(j)}$ = Carcasses Counted
$R_{(i)}$) = Tag Recovery
$C_{(i)}$ = Carcasses chopped first period
$M_{(i)}$ = Tagged

APPENDIX B, Table 2. Butte Creek spring-run Chinook 2005 spawning escapement age estimate composition and calculation from coded wire tag recoveries.

Brood Year (BY)	Coded wire tag releases (REL)	Coded wire tag recoveries in 2005 (REC)	Proportion of current 2005 population ($P_{(BYi)}$)	Age
2001	155413	3	2.0%	4
2002	36415	34	97.5%	3
2003	202570	1	0.5%	2

For the purposes of making an estimate of the relative age composition of the 2005 SRCS spawning population we used the following calculation:

$$P_{(BYi)} = (BY_{(RECi)} / BY_{(REL1i)}) / \sum_{i-n} (BY_{(REC)} / BY_{(REL)})$$

Where:

$P_{(BYi)}$ = Proportion of current population from each brood year i to n.
$BY_{(RECi)}$ = Recoveries of coded wire tags from each brood year releases i to n.
$BY_{(RELi)}$ = Total number of coded wire tagged releases in each brood year i to n.

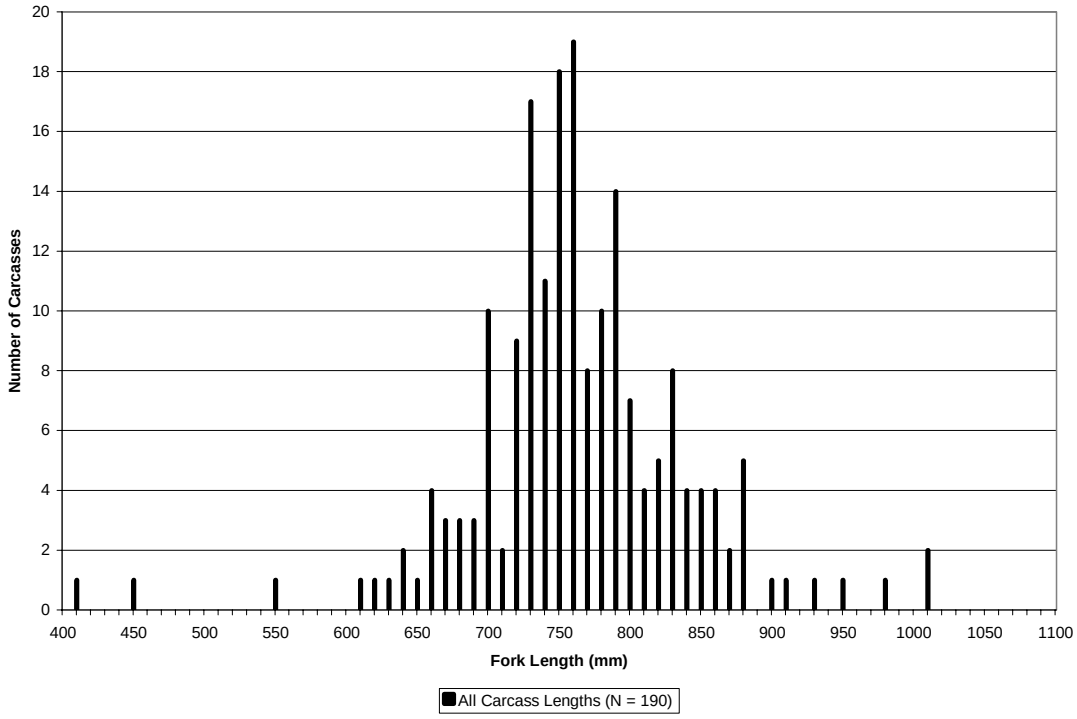
Calculation:

$P_{(BY01)} = (3/155413)/\{(3/155413)+(34/36415)+(1/202570)\}$
$P_{(BY02)} = (34/36415)/\{(34/36415)+(3/155413)+(1/202570)\}$
$P_{(BY03)} = (1/202570)/\{(1/202570)+(3/155413)+(34/36415)\}$
$P_{(BY01)} = .02$
$P_{(BY02)} = .975$
$P_{(BY03)} = .005$

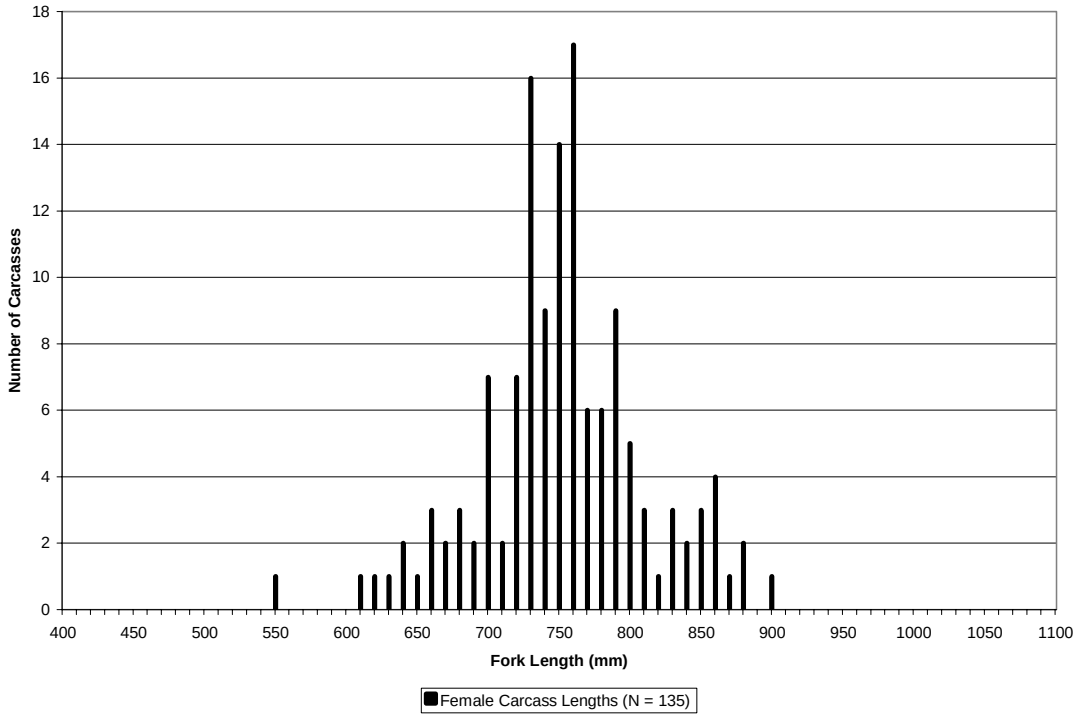
APPENDIX C

FIGURES 1-3
LENGTH FREQUENCY DISTRIBUTION OF ADULT BUTTE CREEK SPRING-RUN CHINOOK SALMON

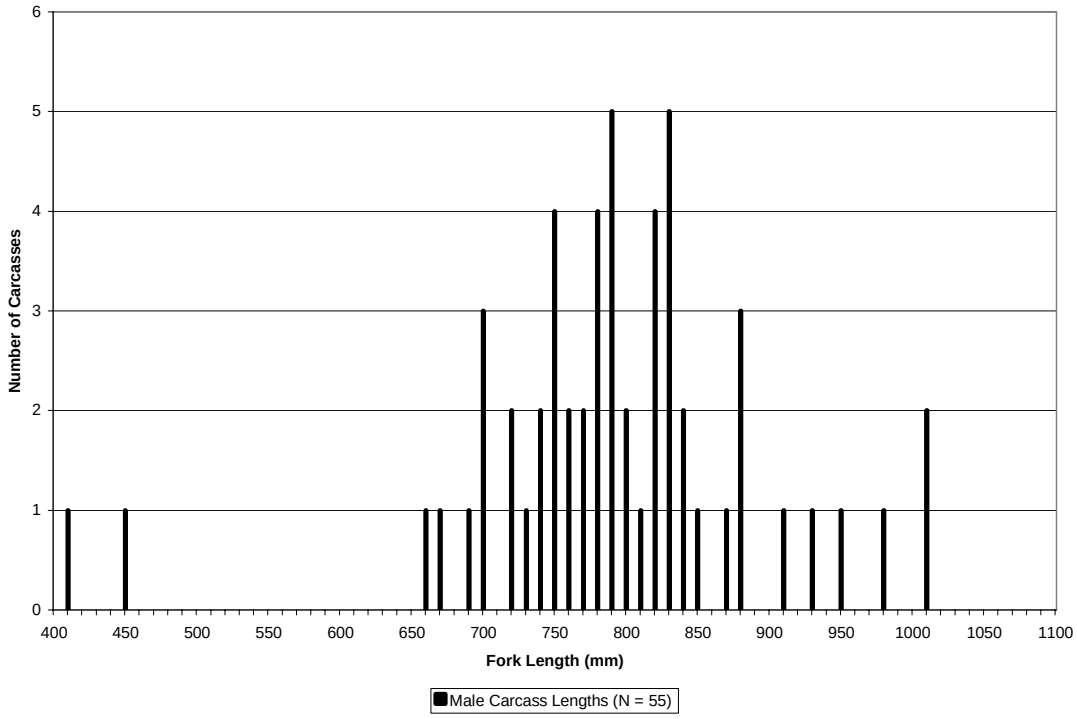
APPENDIX C, Figure 1. Length frequency distribution of 190 adult SRCS carcasses measured and marked for abundance estimate between June 21 and September 15, 2005.



APPENDIX C, Figure 2. Length frequency distribution of 135 adult female SRCS carcasses measured and marked for abundance estimate between June 21 and September 15, 2005.



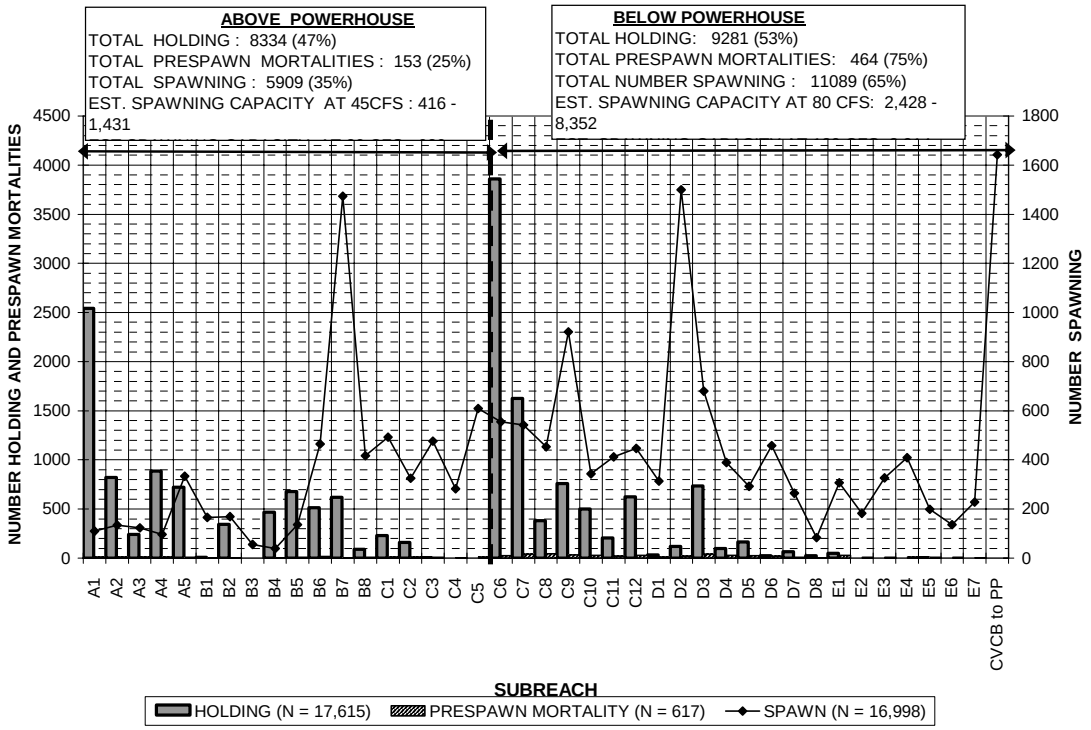
APPENDIX C, Figure 3. Length frequency distribution of 55 adult male SRCS carcasses measured and marked for abundance estimate between June 21 and September 15, 2005.



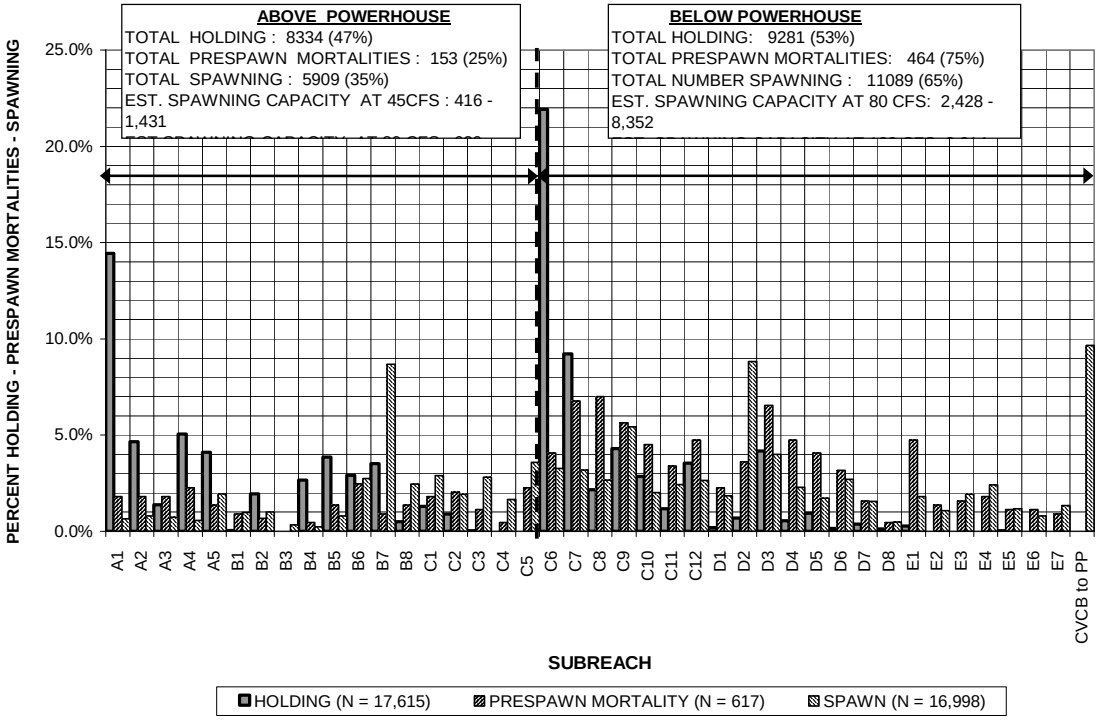
APPENDIX D

FIGURES 1-5
HOLDING, PRE-SPAWN MORTALITY AND SPAWNING
DISTRIBUTION OF BUTTE CREEK SPRING-RUN CHINOOK SALMON

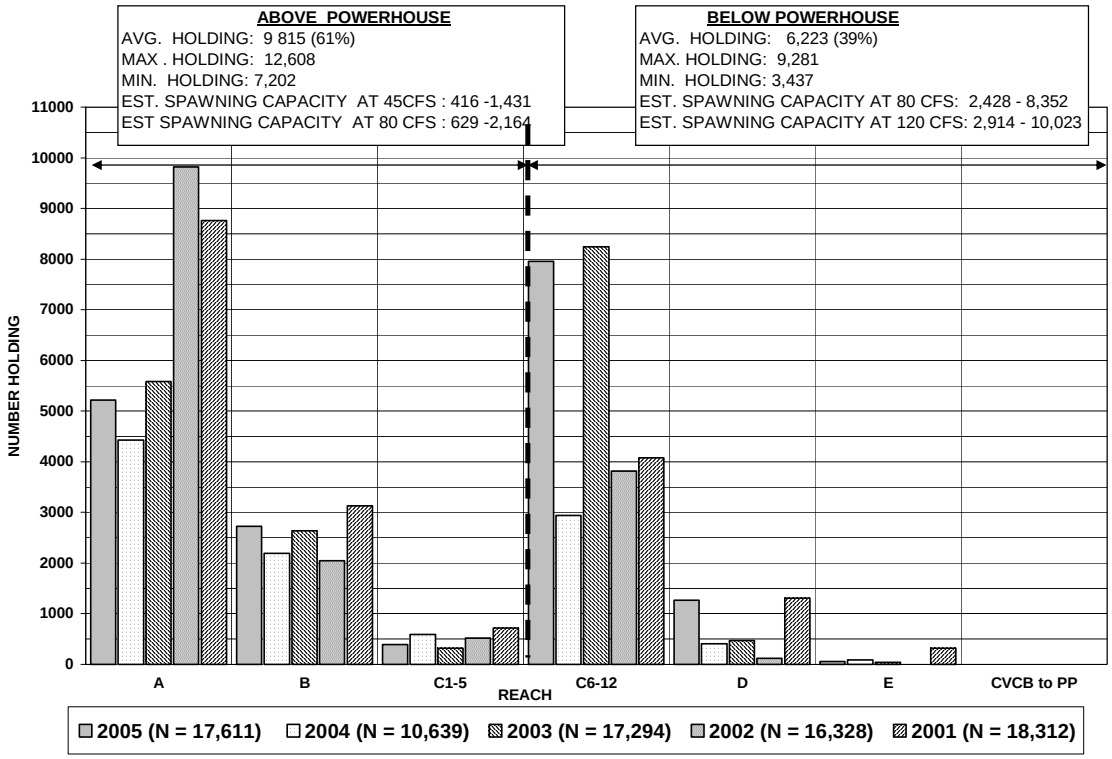
APPENDIX D, Figure 1. Distribution by sub-reach of the number of Butte Creek SRCS holding, pre-spawn mortalities, and spawning during 2005.



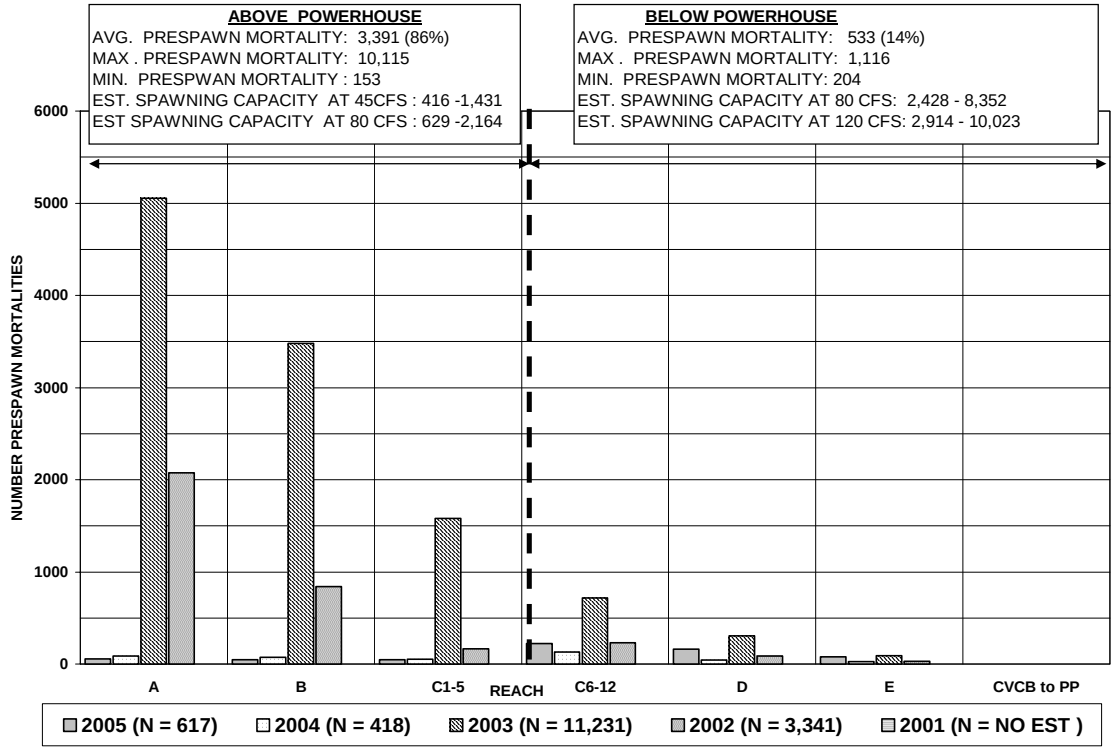
APPENDIX D, Figure 2. Distribution by sub-reach of the percent of Butte Creek SRCS holding, pre-spawn mortalities, and spawning during 2005.



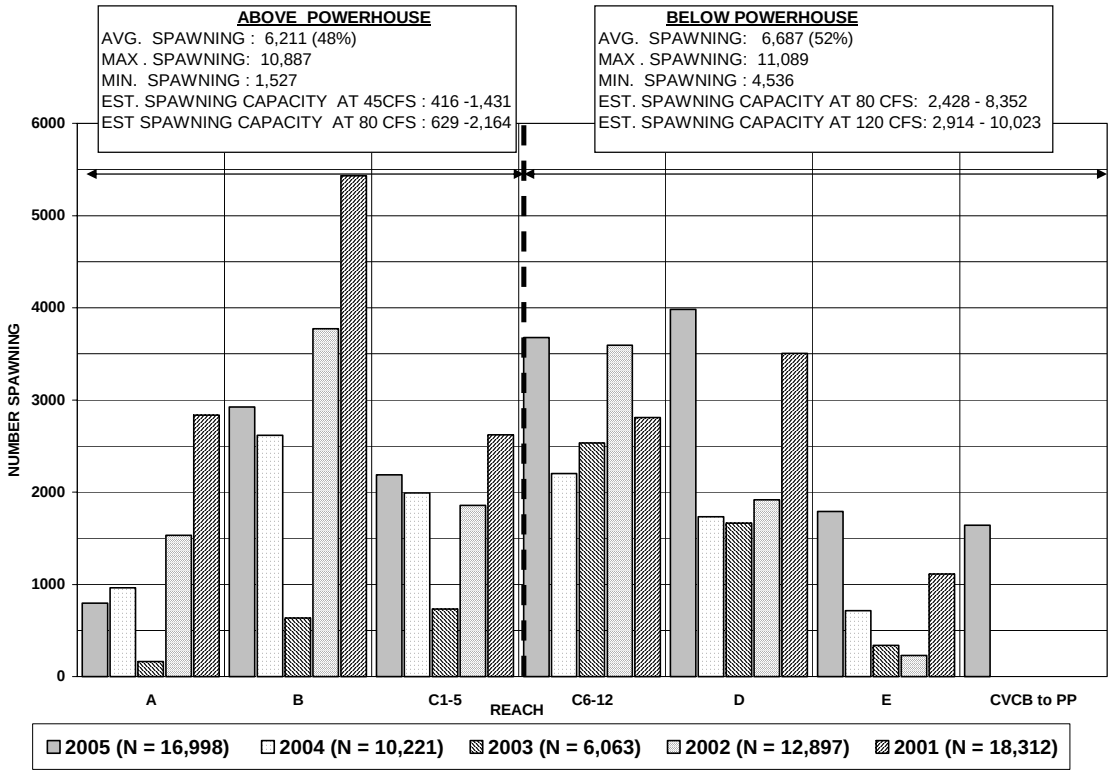
APPENDIX D, Figure 3. Distribution by reach of the number of Butte Creek SRCS holding, during 2001-2005.



APPENDIX D, Figure 4. Distribution by reach of the number of Butte Creek SRCS prespawn mortalities during 2001-2005.



APPENDIX D, Figure 5. Distribution by reach of the number of Butte Creek SRCS spawning during 2001-2005.



APPENDIX E

AIR TEMPERATURES AT COHASSET FIRE STATION
JUNE 1- SEPTEMBER 30, 2005

APPENDIX E, Table 1. Air temperature (C) as measured at California Department of Forestry Cohasset Fire Station (CST), Elevation 1600 Feet, Latitude 39.9000° N, Longitude 121.7000° W, for period June 1 through September 30, 2005.

YEAR - 2005							
DATE	**MAX**	**MIN**	**MEAN**	**DATE**	**MAX**	**MIN**	**MEAN**
6/1	26.7	15.0	20.9	**8/1**	36.7	23.9	29.8
6/2	27.2	14.4	21.2	**8/2**	35.0	22.8	28.9
6/3	30.0	16.1	23.1	**8/3**	36.1	21.1	29.2
6/4	27.8	15.6	22.1	**8/4**	37.2	21.7	30.0
6/5	23.3	9.4	16.4	**8/5**	39.4	26.1	31.9
6/6	20.0	7.8	12.5	**8/6**	38.9	24.4	32.2
6/7	19.4	7.2	14.4	**8/7**	38.9	25.6	32.1
6/8	13.9	9.4	12.2	**8/8**	37.8	26.7	31.0
6/9	21.7	12.8	16.6	**8/9**	38.3	23.9	30.2
6/10	27.8	14.4	20.6	**8/10**	37.2	23.9	30.0
6/11	27.8	15.6	21.6	**8/11**	38.3	23.3	30.1
6/12	29.4	14.4	22.8	**8/12**	37.2	24.4	30.1
6/13	33.3	18.9	25.7	**8/13**	33.3	21.1	26.7
6/14	30.0	19.4	25.3	**8/14**	33.9	17.8	25.6
6/15	27.8	16.1	22.4	**8/15**	31.7	18.3	24.1
6/16	18.9	8.3	12.5	**8/16**	33.9	19.4	26.7
6/17	16.1	9.4	12.2	**8/17**	33.9	21.1	27.6
6/18	19.4	9.4	14.1	**8/18**	30.6	17.2	23.9
6/19	22.8	11.1	17.2	**8/19**	31.1	14.4	23.6
6/20	27.2	13.9	20.6	**8/20**	33.9	18.3	26.1
6/21	26.1	15.0	20.3	**8/21**	35.0	21.7	27.9
6/22	29.4	13.3	22.0	**8/22**	38.3	21.7	29.0
6/23	29.4	18.3	23.7	**8/23**	36.1	22.2	28.9
6/24	29.4	16.1	22.3	**8/24**	33.3	20.0	26.8
6/25	27.2	16.7	21.9	**8/25**	32.8	20.0	26.1
6/26	27.2	14.4	21.1	**8/26**	35.6	21.7	28.3
6/27	26.1	12.2	20.3	**8/27**	36.1	23.3	29.2
6/28	29.4	12.2	22.1	**8/28**	36.7	25.0	29.8
6/29	35.6	19.4	27.7	**8/29**	32.8	18.3	25.7
6/30	36.7	24.4	29.2	**8/30**	34.4	17.2	26.7
7/1	36.7	23.9	29.9	**8/31**	37.2	22.8	29.2
7/2	35.0	21.7	28.6	**9/1**	34.4	21.7	28.1
7/3	33.9	20.0	27.1	**9/2**	33.9	20.0	26.4
7/4	35.0	22.2	28.6	**9/3**	31.7	19.4	25.1
7/5	33.9	21.7	27.8	**9/4**	29.4	17.2	22.9
7/6	34.4	20.6	27.5	**9/5**	31.7	16.1	24.0
7/7	32.2	19.4	26.0	**9/6**	31.1	18.9	24.5
7/8	29.4	15.6	23.3	**9/7**	31.7	18.3	24.3
7/9	28.3	13.9	21.6	**9/8**	28.3	15.0	21.9
7/10	30.0	14.4	23.2	**9/9**	26.1	12.2	19.0
7/11	36.1	20.0	27.5	**9/10**	25.0	9.4	16.7
7/12	37.2	23.9	30.2	**9/11**	24.4	12.2	17.8
7/13	38.3	26.1	31.8	**9/12**	26.7	12.8	18.8
7/14	38.9	25.0	32.3	**9/13**	27.8	14.4	20.0
7/15	39.4	26.7	32.9	**9/14**	27.2	11.7	19.3
7/16	39.4	28.3	33.1	**9/15**	28.3	13.3	20.7
7/17	41.7	27.8	34.4	**9/16**	25.6	13.3	19.2
7/18	38.3	25.0	31.9	**9/17**	26.1	11.7	18.2
7/19	37.8	22.2	30.4	**9/18**	28.9	13.3	20.8
7/20	39.4	26.1	32.2	**9/19**	33.9	17.8	25.3
7/21	34.4	23.9	28.1	**9/20**	33.3	21.7	26.8
7/22	33.9	16.7	26.4	**9/21**	30.6	17.2	23.2
7/23	38.9	24.4	31.4	**9/22**	30.0	19.4	23.8
7/24	37.8	26.1	31.7	**9/23**	25.6	11.1	18.9
7/25	38.3	22.8	30.1	**9/24**	25.6	11.7	19.0
7/26	39.4	24.4	31.5	**9/25**	28.9	16.1	22.4
7/27	37.2	23.3	30.6	**9/26**	26.1	17.2	21.6
7/28	37.8	21.7	30.3	**9/27**	29.4	13.3	21.6
7/29	36.7	23.9	30.1	**9/28**	35.0	20.6	27.5
7/30	37.2	22.8	30.1	**9/29**	33.9	19.4	25.9
7/31	37.2	22.8	30.1	**9/30**	32.2	21.1	26.0

APPENDIX F

TABLES 1-6
BUTTE CREEK WATER TEMPERATURES
MAY 1 - OCTOBER 31, 2005

APPENDIX F, Table 1. Butte Creek water temperatures (C) at Quartz Bowl Pool for period May 1 through October 31, 2005.

DATE	MAX	MIN	MEAN	DATE	MAX	MIN	MEAN	DATE	MAX	MIN	MEAN
5/1	10.1	9.3	9.7	**7/1**	18.1	16.3	17.1	**9/1**	17.2	14.9	15.8
5/2	10.7	8.6	9.6	**7/2**	18.2	16.6	17.3	**9/2**	17.3	15.1	15.9
5/3	11.3	10.4	9.7	**7/3**	18.2	16.5	17.3	**9/3**	17.0	14.8	15.6
5/4	10.9	10.1	10.5	**7/4**	18.4	16.3	17.2	**9/4**	16.4	14.4	15.2
5/5	10.0	9.5	9.7	**7/5**	18.7	16.5	17.4	**9/5**	16.4	14.3	15.1
5/6	9.6	8.9	9.2	**7/6**	19.2	16.9	17.8	**9/6**	16.2	14.0	14.9
5/7	10.2	8.5	9.3	**7/7**	19.6	17.3	18.2	**9/7**	16.1	13.9	14.9
5/8	10.0	9.0	9.4	**7/8**	19.3	17.0	18.0	**9/8**	16.5	14.5	15.3
5/9	9.3	7.5	8.2	**7/9**	18.4	16.7	17.4	**9/9**	16.8	15.0	15.7
5/10	9.0	6.8	8.0	**7/10**	18.5	16.0	17.0	**9/10**	16.2	14.6	15.3
5/11	10.1	7.2	8.7	**7/11**	18.7	15.9	17.1	**9/11**	15.3	13.2	14.1
5/12	10.9	8.7	9.9	**7/12**	19.4	16.5	17.7	**9/12**	13.9	12.0	12.8
5/13	11.8	9.5	10.9	**7/13**	19.9	17.1	18.3	**9/13**	13.9	11.8	12.7
5/14	12.4	10.3	11.5	**7/14**	20.5	17.7	18.9	**9/14**	14.2	12.2	13.0
5/15	12.1	10.4	11.0	**7/15**	20.9	18.0	19.2	**9/15**	14.5	12.5	13.3
5/16	10.4	9.7	10.0	**7/16**	20.9	18.1	19.2	**9/16**	14.6	12.7	13.5
5/17	9.6	8.3	8.6	**7/17**	21.1	18.2	19.4	**9/17**	15.0	13.1	13.8
5/18	10.0	8.0	8.8	**7/18**	21.5	18.6	19.8	**9/18**	14.5	12.6	13.3
5/19	9.8	8.7	9.3	**7/19**	21.7	19.2	20.1	**9/19**	14.5	12.4	13.2
5/20	10.9	8.9	9.9	**7/20**	21.0	18.5	19.5	**9/20**	14.3	12.6	13.3
5/21	11.2	8.3	9.9	**7/21**	19.7	18.2	18.7	**9/21**	15.1	13.3	14.0
5/22	12.0	9.6	11.0	**7/22**	19.7	17.2	18.2	**9/22**	15.1	13.6	14.3
5/23	12.1	10.1	11.3	**7/23**	19.6	16.7	17.9	**9/23**	14.5	13.2	13.7
5/24	12.4	9.9	11.3	**7/24**	19.9	17.0	18.1	**9/24**	13.4	12.0	12.6
5/25	13.2	11.0	12.3	**7/25**	19.8	17.1	18.2	**9/25**	12.9	11.4	12.1
5/26	13.9	11.9	13.1	**7/26**	19.8	16.8	18.1	**9/26**	12.4	11.9	12.2
5/27	14.5	12.5	13.7	**7/27**	20.2	17.5	18.5	**9/27**	13.8	12.1	12.8
5/28	14.1	12.1	13.0	**7/28**	19.6	17.0	18.1	**9/28**	14.2	12.6	13.3
5/29	12.0	10.3	11.0	**7/29**	19.9	17.2	18.3	**9/29**	14.1	12.4	13.2
5/30	12.9	10.1	11.5	**7/30**	20.4	17.7	18.8	**9/30**	14.0	12.4	13.1
5/31	14.2	12.1	13.2	**7/31**	20.5	17.9	18.8	**10/1**	13.5	12.6	13.0
6/1	13.8	12.2	13.1	**8/1**	19.6	17.1	18.0	**10/2**	13.1	12.3	12.7
6/2	13.4	11.5	12.5	**8/2**	18.8	16.4	17.3	**10/3**	12.4	11.6	12.0
6/3	13.0	11.2	12.2	**8/3**	18.6	15.9	17.0	**10/4**	11.7	10.4	11.0
6/4	13.5	11.6	12.6	**8/4**	18.6	16.0	17.1	**10/5**	11.3	9.8	10.4
6/5	13.2	12.0	12.6	**8/5**	19.1	16.5	17.5	**10/6**	11.4	9.8	10.5
6/6	11.8	10.0	10.8	**8/6**	19.1	16.5	17.5	**10/7**	11.8	10.3	11.0
6/7	10.7	8.9	9.9	**8/7**	19.4	16.8	17.8	**10/8**	12.1	10.8	11.4
6/8	10.4	10.1	10.2	**8/8**	19.3	17.0	17.9	**10/9**	11.9	10.5	11.1
6/9	12.3	10.4	11.1	**8/9**	19.6	17.2	18.1	**10/10**	11.6	10.1	10.8
6/10	12.9	10.9	12.0	**8/10**	19.4	16.9	17.9	**10/11**	11.8	10.4	11.0
6/11	13.7	12.1	12.8	**8/11**	19.1	16.6	17.7	**10/12**	12.0	10.6	11.2
6/12	13.7	11.8	12.8	**8/12**	19.2	16.6	17.7	**10/13**	12.1	10.7	11.3
6/13	14.4	12.3	13.4	**8/13**	19.1	16.6	17.6	**10/14**	12.1	10.7	11.3
6/14	15.0	13.0	14.1	**8/14**	19.1	16.8	17.7	**10/15**	11.6	10.7	11.2
6/15	15.2	13.5	14.4	**8/15**	19.0	17.0	17.8	**10/16**	11.5	10.1	10.7
6/16	14.5	11.2	12.9	**8/16**	18.9	16.6	17.6	**10/17**	11.8	10.4	11.1
6/17	11.1	9.9	10.4	**8/17**	19.1	16.7	17.6	**10/18**	12.0	10.9	11.4
6/18	10.3	9.6	9.9	**8/18**	18.7	16.4	17.4	**10/19**	11.6	11.2	11.3
6/19	11.6	9.8	10.7	**8/19**	18.2	15.9	16.9	**10/20**	11.6	10.6	11.0
6/20	13.1	10.8	11.9	**8/20**	18.1	15.7	16.7	**10/21**	11.3	10.1	10.7
6/21	14.1	12.3	13.2	**8/21**	18.1	15.7	16.7	**10/22**	11.3	10.1	10.7
6/22	14.0	12.5	13.4	**8/22**	18.2	15.6	16.7	**10/23**	11.3	10.1	10.6
6/23	14.5	12.7	13.7	**8/23**	18.4	16.0	17.0	**10/24**	11.0	9.8	10.4
6/24	15.0	13.3	14.2	**8/24**	18.2	15.9	16.9	**10/25**	10.9	9.9	10.4
6/25	14.8	13.5	14.3	**8/25**	17.7	15.5	16.4	**10/26**	10.4	10.1	10.3
6/26	15.3	13.7	14.5	**8/26**	17.5	15.2	16.1	**10/27**	10.1	9.6	9.9
6/27	15.2	13.8	14.6	**8/27**	17.9	15.5	16.4	**10/28**	9.8	9.3	9.5
6/28	14.9	13.4	14.4	**8/28**	18.3	16.0	16.8	**10/29**	10.3	9.2	9.6
6/29	16.0	14.1	15.1	**8/29**	17.8	15.8	16.5	**10/30**	9.9	9.0	9.4
6/30	17.2	15.3	16.3	**8/30**	16.9	14.7	15.7	**10/31**	9.3	8.4	9.0
				8/31	17.0	14.6	15.6				

APPENDIX F, Table 2. Butte Creek water temperatures (C) at Chimney Rock Pool for period May 1 through October 31, 2005.

DATE	MAX	MIN	MEAN	DATE	MAX	MIN	MEAN	DATE	MAX	MIN	MEAN
5/1	10.5	9.6	10.1	**7/1**	nd	nd	nd	**9/1**	nd	nd	nd
5/2	11.2	9.0	10.0	**7/2**	nd	nd	nd	**9/2**	nd	nd	nd
5/3	11.6	9.9	10.7	**7/3**	nd	nd	nd	**9/3**	nd	nd	nd
5/4	11.2	10.4	10.9	**7/4**	nd	nd	nd	**9/4**	nd	nd	nd
5/5	10.4	9.8	10.0	**7/5**	nd	nd	nd	**9/5**	nd	nd	nd
5/6	9.9	9.3	9.5	**7/6**	nd	nd	nd	**9/6**	nd	nd	nd
5/7	10.5	8.8	9.7	**7/7**	nd	nd	nd	**9/7**	nd	nd	nd
5/8	10.2	9.4	9.7	**7/8**	nd	nd	nd	**9/8**	nd	nd	nd
5/9	9.6	7.9	8.5	**7/9**	nd	nd	nd	**9/9**	nd	nd	nd
5/10	9.3	7.1	8.2	**7/10**	nd	nd	nd	**9/10**	nd	nd	nd
5/11	10.2	7.4	8.9	**7/11**	nd	nd	nd	**9/11**	nd	nd	nd
5/12	11.3	9.1	10.2	**7/12**	nd	nd	nd	**9/12**	nd	nd	nd
5/13	12.1	9.9	11.2	**7/13**	nd	nd	nd	**9/13**	nd	nd	nd
5/14	12.7	10.8	11.9	**7/14**	nd	nd	nd	**9/14**	nd	nd	nd
5/15	12.4	10.7	11.3	**7/15**	nd	nd	nd	**9/15**	nd	nd	nd
5/16	10.7	9.9	10.3	**7/16**	nd	nd	nd	**9/16**	nd	nd	nd
5/17	9.9	8.5	8.9	**7/17**	nd	nd	nd	**9/17**	nd	nd	nd
5/18	10.2	8.4	9.0	**7/18**	nd	nd	nd	**9/18**	nd	nd	nd
5/19	10.1	9.0	9.5	**7/19**	nd	nd	nd	**9/19**	nd	nd	nd
5/20	11.2	9.1	10.2	**7/20**	nd	nd	nd	**9/20**	nd	nd	nd
5/21	11.3	8.7	10.2	**7/21**	nd	nd	nd	**9/21**	nd	nd	nd
5/22	12.2	9.9	11.3	**7/22**	nd	nd	nd	**9/22**	nd	nd	nd
5/23	12.4	10.4	11.6	**7/23**	nd	nd	nd	**9/23**	nd	nd	nd
5/24	12.5	10.2	11.6	**7/24**	nd	nd	nd	**9/24**	nd	nd	nd
5/25	13.5	11.5	12.6	**7/25**	nd	nd	nd	**9/25**	nd	nd	nd
5/26	14.2	12.4	13.4	**7/26**	nd	nd	nd	**9/26**	nd	nd	nd
5/27	14.9	13.0	14.0	**7/27**	nd	nd	nd	**9/27**	nd	nd	nd
5/28	14.2	12.4	13.4	**7/28**	nd	nd	nd	**9/28**	nd	nd	nd
5/29	12.2	10.8	11.4	**7/29**	nd	nd	nd	**9/29**	nd	nd	nd
5/30	13.2	10.5	11.8	**7/30**	nd	nd	nd	**9/30**	nd	nd	nd
5/31	14.6	12.5	13.5	**7/31**	nd	nd	nd	**10/1**	nd	nd	nd
6/1	14.2	12.7	13.5	**8/1**	nd	nd	nd	**10/2**	nd	nd	nd
6/2	13.8	11.9	12.9	**8/2**	nd	nd	nd	**10/3**	nd	nd	nd
6/3	13.3	11.6	12.6	**8/3**	nd	nd	nd	**10/4**	nd	nd	nd
6/4	13.8	12.1	13.0	**8/4**	nd	nd	nd	**10/5**	nd	nd	nd
6/5	13.6	12.4	12.9	**8/5**	nd	nd	nd	**10/6**	nd	nd	nd
6/6	12.2	10.4	11.3	**8/6**	nd	nd	nd	**10/7**	nd	nd	nd
6/7	10.8	9.3	10.2	**8/7**	nd	nd	nd	**10/8**	nd	nd	nd
6/8	10.7	10.4	10.5	**8/8**	nd	nd	nd	**10/9**	nd	nd	nd
6/9	12.5	10.7	11.4	**8/9**	nd	nd	nd	**10/10**	nd	nd	nd
6/10	13.3	11.3	12.3	**8/10**	nd	nd	nd	**10/11**	12.6	11.5	12.0
6/11	14.1	12.4	13.2	**8/11**	nd	nd	nd	**10/12**	12.7	11.0	11.7
6/12	13.9	12.2	13.2	**8/12**	nd	nd	nd	**10/13**	12.9	11.2	11.8
6/13	14.7	12.5	13.7	**8/13**	nd	nd	nd	**10/14**	12.7	11.2	11.8
6/14	15.5	13.3	14.5	**8/14**	nd	nd	nd	**10/15**	12.6	11.2	11.7
6/15	15.7	13.9	14.8	**8/15**	nd	nd	nd	**10/16**	12.1	10.5	11.2
6/16	14.9	11.8	13.3	**8/16**	nd	nd	nd	**10/17**	12.6	10.9	11.5
6/17	11.6	10.2	10.8	**8/17**	nd	nd	nd	**10/18**	12.7	11.3	11.8
6/18	10.5	9.9	10.3	**8/18**	nd	nd	nd	**10/19**	12.3	11.5	11.8
6/19	11.8	10.1	11.0	**8/19**	nd	nd	nd	**10/20**	12.4	11.0	11.5
6/20	13.3	11.2	12.3	**8/20**	nd	nd	nd	**10/21**	12.1	10.5	11.2
6/21	13.6	12.5	12.9	**8/21**	nd	nd	nd	**10/22**	11.9	10.5	11.2
6/22	*nd	nd	nd	**8/22**	nd	nd	nd	**10/23**	11.9	10.5	11.1
6/23	nd	nd	nd	**8/23**	nd	nd	nd	**10/24**	11.6	10.4	10.9
6/24	nd	nd	nd	**8/24**	nd	nd	nd	**10/25**	11.5	10.4	10.9
6/25	nd	nd	nd	**8/25**	nd	nd	nd	**10/26**	10.9	10.5	10.8
6/26	nd	nd	nd	**8/26**	nd	nd	nd	**10/27**	10.9	9.9	10.3
6/27	nd	nd	nd	**8/27**	nd	nd	nd	**10/28**	10.1	9.6	9.9
6/28	nd	nd	nd	**8/28**	nd	nd	nd	**10/29**	10.7	9.6	10.0
6/29	nd	nd	nd	**8/29**	nd	nd	nd	**10/30**	10.5	9.3	9.8
6/30	nd	nd	nd	**8/30**	nd	nd	nd	**10/31**	9.9	8.8	9.4
				8/31	nd	nd	nd				

* Both the primary and backup thermographs failed and were not replaced until 10/11/05

APPENDIX F, Table 3. Butte Creek water temperatures (C) at Pool 4 for period May 1 through October 12, 2005.

DATE	MAX	MIN	MEAN	DATE	MAX	MIN	MEAN	DATE	MAX	MIN	MEAN
5/1	11.4	9.9	10.5	**7/1**	19.7	15.7	17.3	**9/1**	18.9	15.4	17.1
5/2	11.9	9.3	10.4	**7/2**	20.5	16.8	18.2	**9/2**	19.0	15.6	17.3
5/3	12.4	9.9	11.1	**7/3**	20.7	17.1	18.4	**9/3**	19.1	15.8	17.4
5/4	11.6	10.7	11.2	**7/4**	20.6	17.0	18.4	**9/4**	18.8	15.5	17.1
5/5	10.5	9.9	10.3	**7/5**	20.7	16.8	18.5	**9/5**	18.3	15.2	16.7
5/6	9.9	9.7	9.8	**7/6**	20.9	16.9	18.7	**9/6**	18.3	15.1	16.6
5/7	10.2	9.4	9.8	**7/7**	21.4	17.3	19.1	**9/7**	18.1	14.9	16.4
5/8	10.9	9.0	9.9	**7/8**	21.6	17.9	19.5	**9/8**	17.9	14.7	16.4
5/9	10.3	9.6	9.9	**7/9**	21.2	17.7	19.3	**9/9**	18.1	15.3	16.7
5/10	9.7	8.0	8.7	**7/10**	20.6	17.5	18.8	**9/10**	18.4	15.7	17.0
5/11	9.4	7.2	8.3	**7/11**	20.6	17.0	18.6	**9/11**	17.9	15.6	16.6
5/12	10.3	7.7	9.1	**7/12**	21.1	16.7	18.8	**9/12**	17.2	14.5	15.7
5/13	11.4	9.4	10.4	**7/13**	21.6	17.2	19.3	**9/13**	15.9	13.3	14.6
5/14	12.2	10.2	11.3	**7/14**	22.1	17.9	19.9	**9/14**	15.8	12.8	14.3
5/15	12.9	11.1	12.1	**7/15**	22.7	18.6	20.5	**9/15**	15.9	12.9	14.4
5/16	12.4	10.8	11.5	**7/16**	23.0	18.9	20.9	**9/16**	16.3	13.2	14.6
5/17	10.9	10.0	10.5	**7/17**	23.2	19.1	21.0	**9/17**	16.2	13.4	14.8
5/18	10.0	8.7	9.1	**7/18**	23.4	19.2	21.2	**9/18**	16.5	13.8	15.1
5/19	10.2	8.4	9.1	**7/19**	23.7	19.7	21.6	**9/19**	16.1	13.3	14.7
5/20	10.1	9.0	9.6	**7/20**	23.9	20.2	21.9	**9/20**	16.2	13.2	14.6
5/21	11.2	9.3	10.2	**7/21**	23.5	19.7	21.5	**9/21**	16.0	13.2	14.6
5/22	11.3	8.9	10.3	**7/22**	21.6	19.4	20.5	**9/22**	16.5	13.8	15.0
5/23	12.1	10.3	11.3	**7/23**	22.1	18.4	20.1	**9/23**	16.7	14.2	15.3
5/24	12.3	10.9	11.8	**7/24**	21.9	17.8	19.8	**9/24**	16.1	13.8	14.7
5/25	12.3	10.8	11.7	**7/25**	22.2	18.1	20.0	**9/25**	14.9	12.7	13.7
5/26	13.2	11.8	12.6	**7/26**	22.1	18.1	20.0	**9/26**	14.6	12.1	13.2
5/27	14.0	12.7	13.4	**7/27**	22.0	18.0	20.0	**9/27**	13.6	12.5	13.0
5/28	14.7	13.3	14.0	**7/28**	22.5	18.6	20.4	**9/28**	15.2	12.7	13.8
5/29	14.1	12.7	13.6	**7/29**	21.8	18.2	20.0	**9/29**	15.6	13.0	14.1
5/30	12.5	11.2	11.8	**7/30**	22.1	18.2	20.1	**9/30**	15.4	13.0	14.1
5/31	13.0	10.8	11.9	**7/31**	22.6	18.7	20.6	**10/1**	15.4	13.0	14.1
6/1	14.6	12.7	13.6	**8/1**	22.7	18.9	20.7	**10/2**	14.5	13.2	13.9
6/2	14.4	13.0	13.6	**8/2**	21.8	18.1	19.9	**10/3**	14.3	12.8	13.5
6/3	13.9	12.4	13.1	**8/3**	21.2	17.4	19.2	**10/4**	14.1	12.3	13.0
6/4	13.5	12.1	12.9	**8/4**	20.9	17.0	18.9	**10/5**	13.2	11.1	11.9
6/5	14.0	12.3	13.1	**8/5**	21.0	17.1	19.0	**10/6**	12.7	10.5	11.6
6/6	13.9	12.6	13.1	**8/6**	21.3	17.5	19.3	**10/7**	12.9	10.5	11.5
6/7	12.5	10.8	11.7	**8/7**	21.3	17.3	19.3	**10/8**	13.2	11.0	12.0
6/8	11.5	9.8	10.6	**8/8**	21.6	17.7	19.6	**10/9**	13.3	11.3	12.2
6/9	10.9	10.7	10.8	**8/9**	21.4	17.9	19.6	**10/10**	13.2	11.2	12.0
6/10	12.2	10.8	11.5	**8/10**	21.7	18.2	19.9	**10/11**	13.0	10.8	11.8
6/11	13.3	11.5	12.3	**8/11**	21.6	18.0	19.7	**10/12**	11.8	11.2	11.3
6/12	14.2	12.5	13.3	**8/12**	21.3	17.6	19.5	**10/13**	nd	nd	nd
6/13	14.2	12.5	13.3	**8/13**	21.4	17.7	19.5	**10/14**	nd	nd	nd
6/14	14.9	12.8	13.8	**8/14**	21.1	17.7	19.4	**10/15**	nd	nd	nd
6/15	16.1	13.5	14.6	**8/15**	21.2	17.7	19.4	**10/16**	nd	nd	nd
6/16	16.2	14.1	15.0	**8/16**	20.7	17.9	19.3	**10/17**	nd	nd	nd
6/17	14.9	12.3	13.7	**8/17**	21.2	17.7	19.4	**10/18**	nd	nd	nd
6/18	12.2	10.7	11.3	**8/18**	21.2	17.7	19.4	**10/19**	nd	nd	nd
6/19	10.9	10.3	10.6	**8/19**	20.7	17.4	19.0	**10/20**	nd	nd	nd
6/20	12.5	10.3	11.3	**8/20**	20.3	17.0	18.6	**10/21**	nd	nd	nd
6/21	13.9	11.3	12.5	**8/21**	20.2	16.7	18.4	**10/22**	nd	nd	nd
6/22	15.5	12.7	13.8	**8/22**	20.1	16.6	18.3	**10/23**	nd	nd	nd
6/23	15.9	13.1	14.2	**8/23**	20.2	16.5	18.3	**10/24**	nd	nd	nd
6/24	16.2	13.3	14.4	**8/24**	20.4	16.9	18.6	**10/25**	nd	nd	nd
6/25	16.8	13.9	15.0	**8/25**	20.1	16.7	18.4	**10/26**	nd	nd	nd
6/26	16.8	14.2	15.2	**8/26**	19.7	16.4	18.0	**10/27**	nd	nd	nd
6/27	17.1	14.3	15.3	**8/27**	19.5	16.1	17.8	**10/28**	nd	nd	nd
6/28	17.2	14.5	15.5	**8/28**	19.9	16.2	18.0	**10/29**	nd	nd	nd
6/29	17.5	14.2	15.4	**8/29**	20.3	16.7	18.4	**10/30**	nd	nd	nd
6/30	18.5	14.7	16.1	**8/30**	19.6	16.5	18.0	**10/31**	nd	nd	nd
				8/31	18.9	15.5	17.2				

APPENDIX F, Table 4. Butte Creek water temperatures (C) at Estates Pool for period May 1 through October 10, 2005.

DATE	MAX	MIN	MEAN	DATE	MAX	MIN	MEAN	DATE	MAX	MIN	MEAN
5/1	12.3	10.1	11.0	**7/1**	20.0	16.8	18.2	**9/1**	18.8	15.8	17.1
5/2	12.6	9.5	10.8	**7/2**	20.1	17.2	18.4	**9/2**	18.9	15.9	17.2
5/3	12.9	10.1	11.4	**7/3**	20.0	17.1	18.3	**9/3**	18.6	15.6	16.9
5/4	12.0	11.1	11.5	**7/4**	19.9	16.9	18.3	**9/4**	18.2	15.3	16.5
5/5	11.1	10.3	10.7	**7/5**	20.1	17.1	18.4	**9/5**	18.1	15.1	16.4
5/6	10.9	9.8	10.3	**7/6**	20.6	17.4	18.8	**9/6**	17.9	15.0	16.2
5/7	11.5	9.4	10.3	**7/7**	20.8	17.9	19.2	**9/7**	17.6	14.8	16.1
5/8	10.6	10.0	10.2	**7/8**	20.4	17.7	18.9	**9/8**	18.0	15.3	16.5
5/9	10.1	8.4	9.2	**7/9**	19.7	17.4	18.4	**9/9**	18.4	15.7	16.8
5/10	9.8	7.5	8.7	**7/10**	19.5	16.7	18.0	**9/10**	17.8	15.6	16.4
5/11	10.6	8.3	9.5	**7/11**	19.7	16.7	18.1	**9/11**	16.9	14.4	15.3
5/12	12.2	9.8	10.8	**7/12**	20.3	17.2	18.6	**9/12**	15.6	13.0	14.1
5/13	12.9	10.9	11.8	**7/13**	20.9	17.8	19.2	**9/13**	15.5	12.7	13.9
5/14	13.7	11.8	12.6	**7/14**	21.5	18.5	19.8	**9/14**	15.7	13.0	14.2
5/15	12.8	11.2	12.1	**7/15**	21.8	18.9	20.2	**9/15**	16.0	13.1	14.4
5/16	11.2	10.5	11.0	**7/16**	21.9	18.9	20.3	**9/16**	16.3	13.5	14.8
5/17	10.3	9.1	9.7	**7/17**	22.2	19.1	20.5	**9/17**	16.7	13.9	15.0
5/18	10.6	8.9	9.4	**7/18**	22.6	19.5	20.9	**9/18**	16.2	13.3	14.6
5/19	10.5	9.4	9.9	**7/19**	22.7	19.9	21.1	**9/19**	16.4	13.3	14.7
5/20	11.5	9.8	10.6	**7/20**	22.2	19.4	20.6	**9/20**	17.1	13.4	15.1
5/21	11.5	9.7	10.8	**7/21**	20.5	19.1	19.6	**9/21**	17.5	14.3	15.8
5/22	12.6	10.9	11.8	**7/22**	20.8	18.0	19.2	**9/22**	17.7	14.4	15.9
5/23	12.9	11.5	12.3	**7/23**	20.5	17.6	18.9	**9/23**	16.8	14.1	15.3
5/24	12.9	11.5	12.2	**7/24**	20.9	17.8	19.2	**9/24**	15.8	12.9	14.3
5/25	13.9	12.3	13.1	**7/25**	20.9	18.0	19.2	**9/25**	15.6	12.6	14.0
5/26	14.6	13.4	13.9	**7/26**	21.5	17.8	19.2	**9/26**	14.3	13.1	13.7
5/27	15.4	14.0	14.5	**7/27**	21.2	18.3	19.5	**9/27**	16.1	13.1	14.4
5/28	14.6	13.5	14.3	**7/28**	20.6	18.0	19.1	**9/28**	16.7	13.2	14.8
5/29	13.4	12.0	12.6	**7/29**	21.1	18.0	19.4	**9/29**	16.5	13.2	14.8
5/30	13.4	11.4	12.4	**7/30**	21.6	18.6	19.9	**9/30**	16.4	13.3	14.8
5/31	14.9	13.1	13.9	**7/31**	21.9	18.7	20.0	**10/1**	15.3	13.6	14.5
6/1	14.9	13.5	14.2	**8/1**	21.1	18.1	19.3	**10/2**	14.9	13.1	14.0
6/2	14.5	13.1	13.7	**8/2**	20.4	17.3	18.6	**10/3**	14.9	12.5	13.6
6/3	14.2	12.8	13.5	**8/3**	20.1	16.8	18.2	**10/4**	14.0	11.2	12.5
6/4	14.5	12.9	13.6	**8/4**	19.8	16.9	18.2	**10/5**	13.7	10.9	12.2
6/5	14.5	13.2	13.7	**8/5**	20.4	17.3	18.6	**10/6**	12.0	10.7	11.2
6/6	13.4	11.7	12.5	**8/6**	20.4	17.3	18.7	**10/7**	nd	nd	nd
6/7	11.8	10.6	11.3	**8/7**	20.7	17.7	18.9	**10/8**	nd	nd	nd
6/8	11.4	11.1	11.2	**8/8**	20.6	17.9	19.1	**10/9**	nd	nd	nd
6/9	12.6	11.1	11.8	**8/9**	20.7	18.0	19.2	**10/10**	nd	nd	nd
6/10	13.7	11.8	12.7	**8/10**	20.9	17.9	19.1	**10/11**	nd	nd	nd
6/11	14.6	12.9	13.6	**8/11**	20.7	17.6	18.9	**10/12**	nd	nd	nd
6/12	14.8	13.1	13.8	**8/12**	20.7	17.6	19.0	**10/13**	nd	nd	nd
6/13	15.1	13.4	14.2	**8/13**	20.5	17.6	18.9	**10/14**	nd	nd	nd
6/14	16.1	14.0	14.9	**8/14**	20.5	17.6	18.9	**10/15**	nd	nd	nd
6/15	16.4	14.6	15.4	**8/15**	20.2	17.8	18.8	**10/16**	nd	nd	nd
6/16	15.4	13.2	14.4	**8/16**	20.4	17.6	18.8	**10/17**	nd	nd	nd
6/17	13.1	11.5	12.2	**8/17**	20.5	17.6	18.8	**10/18**	nd	nd	nd
6/18	11.5	10.9	11.2	**8/18**	20.0	17.3	18.5	**10/19**	nd	nd	nd
6/19	12.8	10.8	11.6	**8/19**	19.6	16.8	18.0	**10/20**	nd	nd	nd
6/20	14.0	11.7	12.7	**8/20**	19.5	16.5	17.8	**10/21**	nd	nd	nd
6/21	14.9	13.1	13.8	**8/21**	19.6	16.6	17.9	**10/22**	nd	nd	nd
6/22	15.4	13.7	14.4	**8/22**	19.6	16.5	17.9	**10/23**	nd	nd	nd
6/23	16.5	13.9	14.9	**8/23**	19.9	16.9	18.1	**10/24**	nd	nd	nd
6/24	17.0	14.0	15.3	**8/24**	19.6	16.8	18.0	**10/25**	nd	nd	nd
6/25	17.0	14.4	15.5	**8/25**	19.2	16.4	17.6	**10/26**	nd	nd	nd
6/26	17.2	14.4	15.6	**8/26**	19.0	16.2	17.4	**10/27**	nd	nd	nd
6/27	17.4	14.6	15.7	**8/27**	19.3	16.2	17.6	**10/28**	nd	nd	nd
6/28	17.2	14.3	15.5	**8/28**	19.8	16.8	18.0	**10/29**	nd	nd	nd
6/29	18.0	14.7	16.2	**8/29**	19.2	16.7	17.7	**10/30**	nd	nd	nd
6/30	19.1	15.8	17.3	**8/30**	18.4	15.6	16.8	**10/31**	nd	nd	nd
				8/31	18.6	15.6	16.9				

APPENDIX F, Table 5. Butte Creek water temperatures (C) at Cable Bridge for period May 1 through October 31, 2005.

DATE	MAX	MIN	MEAN	DATE	MAX	MIN	MEAN	DATE	MAX	MIN	MEAN
5/1	13.6	10.4	11.6	**7/1**	21.2	17.0	18.8	**9/1**	20.3	15.8	17.7
5/2	13.3	9.6	11.3	**7/2**	21.3	17.3	19.0	**9/2**	20.3	16.0	17.8
5/3	13.8	10.2	11.8	**7/3**	21.2	17.3	19.0	**9/3**	20.2	15.5	17.5
5/4	12.6	11.3	11.8	**7/4**	21.3	17.1	19.0	**9/4**	19.7	15.5	17.2
5/5	11.6	10.4	11.1	**7/5**	21.3	17.3	19.1	**9/5**	19.7	15.2	17.0
5/6	11.5	10.1	10.7	**7/6**	21.8	17.7	19.5	**9/6**	19.4	15.0	16.9
5/7	12.3	9.6	10.7	**7/7**	22.2	18.2	19.9	**9/7**	19.2	14.9	16.8
5/8	10.7	10.1	10.4	**7/8**	21.7	18.1	19.6	**9/8**	19.4	15.5	17.1
5/9	10.1	8.5	9.4	**7/9**	21.0	17.7	19.1	**9/9**	19.5	16.0	17.4
5/10	10.1	7.8	8.9	**7/10**	20.8	17.1	18.7	**9/10**	19.2	15.8	17.1
5/11	11.0	8.5	9.8	**7/11**	21.2	17.1	18.8	**9/11**	18.4	14.6	16.1
5/12	12.6	9.9	11.0	**7/12**	21.8	17.6	19.4	**9/12**	17.1	13.3	14.9
5/13	13.5	11.0	12.0	**7/13**	22.3	18.2	20.0	**9/13**	17.1	12.9	14.7
5/14	14.3	11.9	12.9	**7/14**	23.0	18.9	20.6	**9/14**	17.3	13.2	14.8
5/15	12.9	11.5	12.3	**7/15**	23.3	19.4	21.0	**9/15**	17.6	13.3	15.0
5/16	11.9	10.5	11.3	**7/16**	23.5	19.4	21.1	**9/16**	17.7	13.6	15.3
5/17	10.4	9.3	9.9	**7/17**	23.8	19.5	21.3	**9/17**	18.1	14.1	15.6
5/18	10.5	9.0	9.4	**7/18**	24.2	20.0	21.7	**9/18**	17.7	13.5	15.3
5/19	10.5	9.5	10.1	**7/19**	24.0	20.3	21.9	**9/19**	17.9	13.3	15.3
5/20	12.1	9.8	10.8	**7/20**	23.7	19.9	21.5	**9/20**	17.9	13.5	15.6
5/21	11.8	9.8	10.9	**7/21**	21.8	19.5	20.3	**9/21**	18.7	14.7	16.5
5/22	13.3	11.0	12.1	**7/22**	22.3	18.4	20.0	**9/22**	18.7	14.7	16.5
5/23	13.8	11.8	12.6	**7/23**	22.2	17.9	19.7	**9/23**	17.7	14.4	15.9
5/24	13.8	11.5	12.5	**7/24**	22.5	18.2	20.0	**9/24**	17.0	13.0	14.8
5/25	15.0	12.4	13.6	**7/25**	22.5	18.2	20.0	**9/25**	16.8	12.9	14.5
5/26	16.0	13.5	14.5	**7/26**	22.7	18.2	20.1	**9/26**	14.9	13.6	14.3
5/27	16.8	14.1	15.2	**7/27**	22.8	18.6	20.3	**9/27**	17.3	13.6	15.1
5/28	15.8	13.3	14.7	**7/28**	22.3	18.4	20.0	**9/28**	17.7	13.5	15.4
5/29	14.0	11.6	12.7	**7/29**	22.7	18.4	20.2	**9/29**	17.6	13.5	15.4
5/30	14.9	11.2	12.8	**7/30**	23.3	18.9	20.7	**9/30**	17.3	13.6	15.4
5/31	16.6	13.0	14.6	**7/31**	23.5	19.2	20.8	**10/1**	16.0	14.0	15.1
6/1	16.6	13.5	14.8	**8/1**	22.8	18.4	20.2	**10/2**	15.5	13.3	14.4
6/2	16.0	12.7	14.1	**8/2**	22.0	17.7	19.5	**10/3**	15.8	12.9	14.1
6/3	15.8	12.4	13.9	**8/3**	21.8	17.1	19.1	**10/4**	14.9	11.5	13.0
6/4	16.2	12.7	14.2	**8/4**	21.5	17.3	19.0	**10/5**	14.9	11.2	12.8
6/5	15.8	13.0	14.1	**8/5**	22.0	17.6	19.4	**10/6**	14.7	11.0	12.7
6/6	14.3	11.3	12.6	**8/6**	22.0	17.7	19.5	**10/7**	15.0	11.3	13.1
6/7	13.0	10.1	11.4	**8/7**	22.3	17.9	19.7	**10/8**	14.9	11.8	13.2
6/8	11.8	11.0	11.3	**8/8**	22.2	18.2	19.8	**10/9**	14.9	11.3	13.0
6/9	14.3	11.2	12.4	**8/9**	22.3	18.4	20.0	**10/10**	14.9	11.3	12.9
6/10	15.8	11.8	13.5	**8/10**	22.7	18.1	19.9	**10/11**	14.9	11.5	13.0
6/11	16.6	12.9	14.4	**8/11**	22.3	17.9	19.7	**10/12**	15.4	11.6	13.2
6/12	16.6	12.9	14.5	**8/12**	22.5	17.9	19.8	**10/13**	15.4	11.8	13.4
6/13	17.1	13.2	14.9	**8/13**	22.0	17.9	19.7	**10/14**	15.0	11.8	13.3
6/14	18.1	14.0	15.7	**8/14**	22.2	17.7	19.6	**10/15**	14.9	12.4	13.3
6/15	18.2	14.6	16.1	**8/15**	21.3	18.1	19.4	**10/16**	14.4	10.9	12.5
6/16	15.4	13.0	14.3	**8/16**	22.0	17.9	19.6	**10/17**	15.0	11.5	13.0
6/17	12.9	11.3	12.1	**8/17**	22.2	17.9	19.7	**10/18**	14.6	11.8	13.1
6/18	12.9	10.7	11.5	**8/18**	21.7	17.6	19.2	**10/19**	13.8	12.6	13.0
6/19	14.6	10.5	12.2	**8/19**	21.2	17.1	18.8	**10/20**	14.6	11.5	12.8
6/20	16.0	11.6	13.5	**8/20**	21.0	16.8	18.5	**10/21**	14.3	11.2	12.6
6/21	17.0	13.0	14.7	**8/21**	21.2	16.8	18.6	**10/22**	14.3	11.2	12.5
6/22	17.4	13.5	15.1	**8/22**	21.3	16.6	18.6	**10/23**	14.3	11.2	12.4
6/23	17.6	13.6	15.3	**8/23**	21.5	17.1	18.9	**10/24**	14.0	11.0	12.3
6/24	18.1	14.3	15.9	**8/24**	21.2	17.0	18.7	**10/25**	13.6	11.0	12.2
6/25	18.1	14.6	16.1	**8/25**	20.8	16.5	18.3	**10/26**	12.4	11.2	11.9
6/26	18.4	14.6	16.2	**8/26**	20.8	16.3	18.1	**10/27**	12.9	10.7	11.6
6/27	18.6	14.9	16.4	**8/27**	21.0	16.3	18.3	**10/28**	11.5	10.9	11.2
6/28	18.4	14.6	16.2	**8/28**	21.5	17.0	18.8	**10/29**	12.4	10.6	11.3
6/29	19.4	14.9	16.8	**8/29**	20.7	16.8	18.3	**10/30**	12.4	9.6	10.9
6/30	20.3	16.0	17.9	**8/30**	20.0	15.5	17.5	**10/31**	12.3	9.5	10.6
				8/31	20.2	15.5	17.5				

APPENDIX F, Table 6. Butte Creek water temperatures (C) at Covered Bridge (USGS Gauge #113900000, Butte Creek near Chico) for period May 1 through October 31, 2005.

DATE	MAX	MIN	MEAN	DATE	MAX	MIN	MEAN	DATE	MAX	MIN	MEAN
5/1	12.4	14.0	11.3	**7/1**	18.8	20.2	17.7	**9/1**	18.7	20.3	17.0
5/2	12.2	13.8	10.8	**7/2**	19.2	20.4	18.2	**9/2**	18.8	20.4	17.2
5/3	12.5	14.0	11.2	**7/3**	19.3	20.4	18.3	**9/3**	18.5	20.1	16.8
5/4	12.6	13.1	12.2	**7/4**	19.3	20.4	18.3	**9/4**	18.3	19.7	16.8
5/5	12.1	12.6	11.6	**7/5**	19.4	20.6	18.4	**9/5**	18.1	19.7	16.6
5/6	11.5	12.2	11.0	**7/6**	19.7	20.9	18.7	**9/6**	17.9	19.4	16.3
5/7	11.6	12.8	10.5	**7/7**	20.1	21.2	19.2	**9/7**	17.7	19.3	16.2
5/8	11.5	11.8	11.1	**7/8**	20.0	20.9	19.1	**9/8**	18.0	19.3	16.7
5/9	10.4	11.1	9.7	**7/9**	19.7	20.6	18.9	**9/9**	18.2	19.5	17.0
5/10	9.9	10.9	8.9	**7/10**	19.4	20.3	18.5	**9/10**	18.1	19.2	17.0
5/11	10.7	11.8	9.7	**7/11**	19.4	20.6	18.4	**9/11**	17.2	18.5	16.0
5/12	11.8	13.1	10.7	**7/12**	19.8	21.0	18.7	**9/12**	16.3	17.6	15.0
5/13	12.7	14.0	11.7	**7/13**	20.2	21.5	19.2	**9/13**	15.8	17.3	14.4
5/14	13.5	14.7	12.6	**7/14**	20.8	22.0	19.7	**9/14**	15.9	17.3	14.5
5/15	13.2	13.7	12.4	**7/15**	21.2	22.4	20.2	**9/15**	16.0	17.6	14.6
5/16	12.2	12.8	11.4	**7/16**	21.7	22.6	20.4	**9/16**	16.2	17.6	14.8
5/17	10.9	11.3	10.3	**7/17**	21.6	22.8	20.6	**9/17**	16.5	17.8	15.2
5/18	10.2	11.0	10.0	**7/18**	22.0	23.2	21.0	**9/18**	16.3	17.6	14.8
5/19	10.8	11.3	10.2	**7/19**	22.2	23.3	21.3	**9/19**	16.3	17.7	14.7
5/20	11.5	12.5	10.8	**7/20**	22.1	23.1	21.1	**9/20**	16.4	17.8	14.8
5/21	11.7	12.3	11.1	**7/21**	21.3	22.2	20.8	**9/21**	17.3	18.4	16.1
5/22	12.6	13.4	11.9	**7/22**	20.7	21.8	19.7	**9/22**	17.3	18.4	16.1
5/23	13.2	13.9	12.6	**7/23**	20.5	21.8	19.3	**9/23**	16.9	17.8	15.8
5/24	13.2	14.0	12.5	**7/24**	20.6	21.9	19.4	**9/24**	15.9	16.8	14.7
5/25	13.9	14.9	13.1	**7/25**	20.7	21.9	19.6	**9/25**	15.5	16.7	14.1
5/26	14.7	15.8	13.9	**7/26**	20.7	21.9	19.6	**9/26**	15.4	15.8	14.8
5/27	15.4	16.5	14.6	**7/27**	20.9	22.1	19.9	**9/27**	15.9	17.4	14.6
5/28	15.4	16.0	14.8	**7/28**	20.7	21.8	19.7	**9/28**	16.2	17.6	14.6
5/29	13.8	14.6	13.3	**7/29**	20.7	21.9	19.7	**9/29**	16.2	17.5	14.6
5/30	13.5	14.7	12.6	**7/30**	21.1	22.3	20.1	**9/30**	16.2	17.4	14.7
5/31	14.8	16.1	13.8	**7/31**	21.4	22.5	20.3	**10/1**	16.0	16.5	15.2
6/1	15.3	16.3	14.4	**8/1**	21.0	22.1	19.8	**10/2**	15.4	15.9	14.7
6/2	14.8	15.8	13.9	**8/2**	20.4	21.5	19.3	**10/3**	15.1	15.8	14.3
6/3	14.6	15.6	13.7	**8/3**	20.1	22.4	18.8	**10/4**	14.2	15.0	13.2
6/4	14.7	15.8	13.8	**8/4**	20.1	22.3	18.2	**10/5**	13.8	14.8	12.7
6/5	14.8	15.7	14.1	**8/5**	20.4	22.7	18.5	**10/6**	13.8	14.7	12.7
6/6	13.8	14.5	13.0	**8/6**	20.5	22.7	18.5	**10/7**	14.0	14.9	12.9
6/7	12.6	13.4	11.7	**8/7**	20.6	22.8	18.8	**10/8**	14.2	14.9	13.4
6/8	12.4	12.6	12.2	**8/8**	20.7	22.7	19.1	**10/9**	13.9	14.7	12.9
6/9	12.8	13.9	12.2	**8/9**	21.0	23.0	19.2	**10/10**	13.8	14.7	12.8
6/10	13.8	15.1	12.8	**8/10**	20.9	23.1	19.1	**10/11**	13.9	14.8	12.9
6/11	14.7	15.8	13.8	**8/11**	20.7	22.8	18.8	**10/12**	14.0	15.0	13.0
6/12	14.9	15.9	14.0	**8/12**	20.8	22.8	18.9	**10/13**	14.2	15.0	13.2
6/13	15.2	16.3	14.2	**8/13**	20.7	22.4	19.1	**10/14**	14.2	14.9	13.3
6/14	15.9	17.1	14.9	**8/14**	20.5	22.4	18.8	**10/15**	14.4	14.9	13.7
6/15	16.3	17.3	15.4	**8/15**	20.4	21.9	19.1	**10/16**	13.5	14.3	12.5
6/16	15.4	16.6	14.4	**8/16**	20.5	22.4	18.8	**10/17**	13.8	14.7	12.8
6/17	13.6	14.3	12.9	**8/17**	20.6	22.5	18.9	**10/18**	14.0	14.6	13.2
6/18	12.8	13.5	12.3	**8/18**	20.2	21.9	18.7	**10/19**	14.1	14.6	13.7
6/19	13.0	14.4	12.0	**8/19**	19.8	21.6	18.2	**10/20**	13.7	14.4	12.8
6/20	13.9	15.3	12.8	**8/20**	19.5	21.4	17.8	**10/21**	13.5	14.2	12.7
6/21	14.8	16.1	13.8	**8/21**	19.6	21.5	17.9	**10/22**	13.4	14.1	12.6
6/22	15.4	16.6	14.4	**8/22**	19.6	21.5	17.8	**10/23**	13.4	14.1	12.6
6/23	15.6	16.8	14.6	**8/23**	19.8	21.7	18.2	**10/24**	13.3	13.8	12.4
6/24	16.1	17.2	15.1	**8/24**	19.7	21.4	18.1	**10/25**	13.2	13.7	12.4
6/25	16.4	17.4	15.5	**8/25**	19.3	21.0	17.7	**10/26**	13.1	13.5	12.7
6/26	16.5	17.6	15.6	**8/26**	19.1	20.9	17.4	**10/27**	12.6	13.2	12.1
6/27	16.7	17.7	15.8	**8/27**	19.2	21.0	17.4	**10/28**	12.5	12.8	12.2
6/28	16.6	17.8	15.6	**8/28**	19.7	21.4	18.1	**10/29**	12.3	12.9	11.9
6/29	17.1	18.5	15.9	**8/29**	19.4	20.8	17.9	**10/30**	11.9	12.6	11.2
6/30	18.0	19.4	16.8	**8/30**	18.5	20.1	16.8	**10/31**	11.7	12.3	11.0
				8/31	18.5	20.2	16.8				

APPENDIX G

TABLE 1
FLOWS AT KEY SITES WITHIN
PG&E DESABLA CENTERVILLE PROJECT (FERC 803)
JUNE 1-SEPTEMBER 30, 2005

APPENDIX G, Table 1. Mean daily flows (cfs) at key sites affecting Butte Creek SRCS for period June 1 through September 30, 2005.

DATE	GAGE								
	Hendricks Canal at Head Dam [1]	Toadtown /Hendricks Canal [2]	Butte Canal [3]	DeSabla Powerhouse Outflow [4]	Butte Creek Above DeSabla Powerhouse [5]	Butte Creek Below Centerville Head Dam [6]	Centerville Powerhouse Outflow [7]	Butte Creek Above Centerville Powerhouse [8]	Butte Creek Near Chico [9]
6/1	nd	14	73	83	nd	>55	121	nd	483
6/2	76	33	nd	99	nd	>55	118	nd	464
6/3	87	79	74	144	nd	>55	119	nd	480
6/4	nd	85	74	150	nd	>55	120	nd	470
6/5	87	85	72	149	nd	>55	119	nd	457
6/6	114	96	72	157	nd	>55	124	nd	447
6/7	nd	94	71	154	nd	>55	139	nd	438
6/8	nd	100	72	160	nd	>55	136	nd	450
6/9	115	101	72	162	nd	>55	121	nd	602
6/10	nd	100	71	160	nd	>55	123	nd	483
6/11	nd	99	71	159	nd	>55	125	nd	453
6/12	nd	102	72	161	nd	>55	125	nd	426
6/13	nd	82	57	130	nd	>55	125	nd	392
6/14	115	70	45	100	nd	>55	126	nd	358
6/15	nd	82	53	129	nd	>55	123	nd	353
6/16	115	95	64	152	nd	>55	119	nd	368
6/17	nd	100	nd	156	>77	>55	120	> 257	424
6/18	nd	103	65	159	>77	>55	121	> 257	407
6/19	115	102	65	158	>77	>55	122	> 257	381
6/20	nd	107	67	164	>77	>55	121	> 257	374
6/21	nd	111	71	169	>77	>55	131	> 257	356
6/22	nd	112	71	170	>77	>55	143	> 257	346
6/23	114	113	71	170	>77	>55	145	255	340
6/24	118	113	71	170	>77	>55	146	246	331
6/25	nd	113	71	170	>77	>55	146	236	320
6/26	118	111	71	158	>77	>55	145	222	307
6/27	nd	110	71	169	>77	>55	145	219	295
6/28	114	111	70	168	>77	>55	150	196	285
6/29	118	111	71	168	>77	>55	166	167	303
6/30	116	110	71	169	>77	>55	173	153	270
7/1	114	109	71	167	>77	>55	177	145	263
7/2	111	108	71	166	>77	>55	176	135	259
7/3	108	104	72	163	77	>55	175	120	255
7/4	105	100	72	160	71	>55	177	109	247
7/5	101	97	71	157	67	>55	174	100	243
7/6	100	94	72	156	63	>55	175	93	243
7/7	97	91	nd	154	58	>55	172	85	241
7/8	95	89	72	151	55	>55	167	80	236
7/9	nd	89	71	151	54	>55	167	75	232
7/10	93	86	71	148	53	55	169	68	230
7/11	nd	83	70	145	52	52	172	64	221
7/12	87	80	69	141	50	52	172	62	219
7/13	84	77	67	138	49	50	173	59	211
7/14	nd	75	65	135	48	48	172	57	211
7/15	79	72	64	131	47	47	156	54	292
7/16	78	72	62	130	46	47	155	52	199
7/17	75	70	61	127	45	47	155	51	196
7/18	nd	71	59	125	45	47	166	51	196
7/19	102	94	59	146	45	52	175	57	219
7/20	102	93	57	144	44	51	175	59	222
7/21	101	93	57	143	44	50	164	59	220
7/22	nd	92	nd	142	44	50	164	61	230
7/23	97	90	55	139	43	48	164	58	209
7/24	nd	88	54	137	43	48	167	56	202
7/25	nd	87	53	135	42	50	161	58	203
7/26	94	85	52	132	42	48	149	63	204
7/27	94	84	51	131	41	45	159	54	198
7/28	93	80	51	126	41	45	153	53	197
7/29	75	69	50	116	41	45	144	52	181
7/30	74	68	50	115	40	45	146	51	177
7/31	72	68	49	114	40	45	146	50	179

APPENDIX G, Table 1 (Continued). Mean daily flows (cfs) at key sites affecting Butte Creek SRCS for period June 1 through September 30, 2005.

DATE	GAGE								
	Hendricks Canal at Head Dam 1/	Toadtown /Hendricks Canal 2/	Butte Canal 3/	DeSabla Powerhouse Outflow 4/	Butte Creek Above DeSabla Powerhouse 5/	Butte Creek Below Centerville Head Dam 6/	Centerville Powerhouse Outflow 7/	Butte Creek Above Centerville Powerhouse 8/	Butte Creek Near Chico 9/
8/1	71	67	49	112	40	46	139	51	172
8/2	71	66	48	111	40	47	135	53	204
8/3	69	70	48	113	40	47	137	52	167
8/4	nd	81	47	124	39	48	147	54	171
8/5	88	80	47	123	39	48	148	54	178
8/6	87	79	46	120	38	48	148	54	173
8/7	87	78	46	119	38	49	146	53	171
8/8	88	77	45	118	38	50	143	57	174
8/9	86	74	45	115	38	46	144	52	172
8/10	nd	67	44	108	38	46	136	51	160
8/11	69	66	44	106	38	46	135	51	160
8/12	68	65	44	106	37	46	134	51	161
8/13	68	64	43	104	37	46	132	50	159
8/14	68	63	43	103	37	46	130	50	161
8/15	65	63	43	103	37	46	125	50	157
8/16	65	62	43	101	37	46	127	50	157
8/17	65	63	43	102	37	46	127	50	150
8/18	77	69	42	108	37	46	129	50	160
8/19	75	68	42	107	36	46	128	51	158
8/20	76	68	42	106	36	46	129	50	158
8/21	73	67	41	105	36	47	130	51	154
8/22	nd	67	41	105	36	47	127	51	146
8/23	71	66	41	104	35	47	127	51	142
8/24	72	66	40	102	36	47	122	50	140
8/25	73	65	40	102	36	47	120	50	140
8/26	nd	65	40	101	35	47	121	51	142
8/27	73	66	39	102	35	48	125	50	147
8/28	72	66	39	102	35	47	126	50	140
8/29	70	65	39	101	35	47	120	50	138
8/30	70	64	39	100	35	47	119	50	136
8/31	70	62	38	97	35	47	120	48	189
9/1	70	58	38	93	35	47	114	49	265
9/2	nd	55	38	90	35	47	111	49	156
9/3	nd	53	38	87	34	47	102	49	153
9/4	nd	53	38	87	34	48	106	51	149
9/5	68	54	38	88	35	48	107	50	150
9/6	66	53	38	88	35	47	106	49	150
9/7	nd	52	38	83	35	47	91	51	136
9/8	65	51	38	86	35	47	93	48	132
9/9	65	50	38	84	35	48	97	49	134
9/10	65	48	40	85	35	48	97	50	132
9/11	nd	49	40	85	36	47	100	49	130
9/12	64	49	41	87	37	48	99	50	135
9/13	63	48	40	84	36	47	96	49	130
9/14	nd	47	39	82	35	47	95	48	127
9/15	60	50	39	85	35	47	101	48	127
9/16	nd	33	39	67	35	46	96	47	114
9/17	29	31	39	65	35	46	92	47	116
9/18	29	30	39	64	35	45	92	47	106
9/19	nd	30	38	63	34	45	91	47	105
9/20	nd	28	37	61	34	>55	71	60	101
9/21	28	28	37	60	33	>55	50	81	102
9/22	27	28	37	61	34	>55	50	81	108
9/23	nd	28	37	61	34	>55	49	81	107
9/24	27	28	37	61	34	>55	49	82	107
9/25	nd	28	37	59	33	>55	50	83	105
9/26	28	28	38	61	34	>55	48	83	106
9/27	30	30	41	67	35	>55	49	86	115
9/28	28	28	38	61	34	>55	49	85	110
9/29	27	27	nd	60	33	>55	50	83	108
9/30	nd	27	37	59	33	>55	50	83	109

APPENDIX G, Table 1 (Continued). Mean daily flows (cfs) at key sites affecting Butte Creek SRCS for period June 1 through September 30, 2005.

[1/] PG&E Hendricks Canal Downstream of Head Dam, flow for period June 1 through September 30, 2005. PG&E BW8, Latitude 39°56.1839'N, Longitude 121°31.8097'W NAS83 (Preliminary data received from PG&E 11/05)

[2/] PG&E Toadtown/Hendricks Canal flow for period June 1 through September 30, 2005. USGS gage #11389800, PG&E BW12 , Latitude 39°53'09", Longitude 121°36'35" NAD27 (Preliminary data received from PG&E 11/05)

[3/] PG&E Butte Canal flow above confluence with Toadtown/Hendricks Canal for period June 1 through September 30, 2005. PG&E BW15, Latitude 39°53.2093'N, Longitude 121°36.7342'W NAS83 (Preliminary data received from PG&E 11/05).

[4/] PG&E DeSabla Powerhouse discharge for period June 1 through September 30, 2005. USGS gage #11389750, PG&E BW82, Latitude 39°52'10", Longitude 121°37'51" NAD27. (Preliminary data received from PG&E 12/04)

[5/] Butte Creek immediately above DeSabla Powerhouse discharge for period June 17 through September 30, 2005. Temporary gage installed for PG&E flow model development. (Data preliminary per Tim Sagraves, TES. Gage only rated for flows less than 78 cfs)

[6/] Butte Creek below Centerville Head Dam discharge for period June 1 through September 30, 2005. USGS gage #11389780, PG&E BW98, Latitude 39°52'01", Longitude 121°37'58" NAD27, (Preliminary data received from PG&E 11/05, gage rated for flows less than 56 cfs)

[7/] PG&E Centerville Powerhouse discharge for period June 1 through September 30, 2005. USGS gage #11389775, PG&E BW80, Latitude 39°47'20", Longitude 121°39'23" NAD27. (Preliminary data received from PG&E 11/05)

[8/] Butte Creek immediately above Centerville Powerhouse discharge for period June 25 through September 30, 2005. Temporary gage installed for PG&E flow model development. (Data preliminary per Tim Sagraves, TES. Gage data estimated +-10%, and rated for flows less than 258 cfs)

[9/] USGS gage #11390000 for period June 1 through September 30, 2005, Butte Creek Near Chico. (Preliminary data DWR CDEC)

APPENDIX H

TABLES 1 & 2
PG&E WATER TEMPERATURES AT KEY SITES
WITHIN DESABLA CENTERVILLE PROJECT (FERC 803)
JUNE 1 THROUGH SEPTEMBER 30, 2005

APPENDIX H, Table 1. Water temperature (C) at key sites within PG&E DeSabla Centerville Project for period June 1 through September 30, 2005 (PG&E preliminary data 2005 [1/]).

	Hendricks Head Dam[2/]		Hendricks/Toadtown Canal at BW12[3/]		Butte Canal at BW15[4/]		DeSabla Forebay Inflow[5/]		DeSabla Powerhouse Discharge[6/]	
DATE	**MAX**	**MEAN**	**MAX**	**MEAN**	**MAX**	**MEAN**	**MAX**	**MEAN**	**MAX**	**MEAN**
6/1	nd	nd	16.8	12.9	nd	nd	12.9	11.7	13.9	13.4
6/2	nd	nd	13.7	11.6	12.4	11.0	12.8	11.1	13.6	12.9
6/3	11.4	9.4	11.5	10.2	12.5	10.9	11.9	10.6	13.0	12.0
6/4	11.8	9.8	11.8	10.6	12.9	11.3	12.3	11.0	12.7	12.0
6/5	10.9	9.6	11.4	10.4	12.3	11.3	11.9	10.9	12.8	12.1
6/6	9.1	8.0	10.1	8.8	11.0	9.2	10.6	9.0	12.2	10.6
6/7	9.1	7.6	9.2	8.0	9.6	8.3	9.4	8.2	9.9	9.2
6/8	8.5	8.0	9.0	8.6	9.5	9.0	9.3	8.8	9.8	9.5
6/9	9.2	8.4	10.1	9.2	11.3	9.9	10.6	9.5	11.0	10.1
6/10	10.6	8.9	10.9	9.6	12.5	10.7	11.5	10.1	12.1	10.9
6/11	11.0	9.5	11.2	10.3	12.8	11.7	11.9	10.9	12.5	11.9
6/12	11.6	9.7	11.7	10.3	13.2	11.6	12.3	10.9	12.7	11.9
6/13	12.0	10.3	12.3	11.0	13.9	12.3	12.9	11.6	13.2	12.4
6/14	12.6	10.9	12.8	11.6	14.2	12.8	13.3	12.1	13.9	13.2
6/15	13.0	11.4	13.0	12.0	14.0	13.0	13.4	12.5	14.1	13.6
6/16	12.0	9.8	12.6	10.6	13.7	11.4	13.2	11.0	14.1	12.6
6/17	8.2	7.7	9.0	8.3	9.4	8.8	9.2	8.6	10.6	9.8
6/18	8.7	7.9	9.0	8.3	9.6	8.7	9.2	8.5	9.5	9.1
6/19	10.2	8.6	10.3	9.0	10.8	9.4	10.4	9.2	10.8	9.8
6/20	11.8	9.8	11.8	10.1	12.6	10.8	12.1	10.4	12.3	11.0
6/21	12.4	10.9	12.4	11.3	13.5	12.1	12.9	11.7	13.3	12.4
6/22	12.3	10.7	12.4	11.2	13.1	12.0	12.7	11.6	13.2	12.6
6/23	12.8	11.1	12.8	11.5	13.8	12.4	13.2	11.9	13.6	12.8
6/24	13.3	11.6	13.3	12.1	14.3	13.0	13.7	12.5	14.2	13.4
6/25	12.9	11.6	13.0	12.1	13.9	12.8	13.3	12.4	14.2	13.5
6/26	13.2	11.9	13.3	12.3	14.1	13.2	13.6	12.7	15.1	13.7
6/27	13.0	11.8	13.2	12.3	14.1	13.2	13.5	12.7	14.2	13.7
6/28	13.1	11.6	13.3	12.1	13.8	12.7	13.5	12.4	14.1	13.4
6/29	14.6	12.7	14.7	13.1	15.5	14.0	15.0	13.5	15.3	14.1
6/30	15.4	13.8	15.6	14.2	16.4	15.0	15.9	14.5	16.3	15.3
7/1	15.9	14.4	16.0	14.9	16.8	15.6	16.3	15.2	16.9	16.1
7/2	16.0	14.6	16.1	15.0	16.7	15.7	16.3	15.4	16.9	16.4
7/3	15.9	14.5	15.9	15.0	16.5	15.5	16.2	15.3	16.9	16.3
7/4	16.0	14.5	16.1	14.9	16.6	15.4	16.3	15.2	16.8	16.2
7/5	16.3	14.7	16.3	15.1	16.7	15.5	16.4	15.3	17.0	16.3
7/6	16.7	15.3	16.8	15.7	17.1	16.0	16.9	15.9	17.5	16.8
7/7	17.0	15.6	17.0	16.0	17.5	16.3	17.2	16.2	17.9	17.2
7/8	16.4	15.2	16.5	15.7	16.8	15.9	16.7	15.9	17.8	17.1
7/9	15.6	14.7	15.8	15.1	16.0	15.3	15.9	15.3	17.2	16.5
7/10	15.7	14.4	15.7	14.7	16.1	14.8	15.8	14.8	16.5	15.9
7/11	16.1	14.5	16.1	14.9	16.4	15.0	16.2	15.0	16.8	16.0
7/12	16.6	15.0	16.7	15.5	17.0	15.6	16.8	15.6	17.4	16.5
7/13	16.8	15.4	17.0	15.9	17.4	16.1	17.1	16.1	17.8	17.0
7/14	17.5	16.0	17.7	16.5	18.0	16.7	17.8	16.7	18.5	17.6
7/15	17.6	16.2	17.9	16.8	18.1	16.9	17.9	16.9	18.6	18.0
7/16	17.4	16.1	17.7	16.7	18.0	16.8	17.9	16.8	18.6	18.0
7/17	17.8	16.4	18.2	16.9	18.5	17.0	18.3	17.0	18.9	18.1
7/18	18.1	16.7	18.4	17.3	18.9	17.5	18.7	17.4	19.3	18.5
7/19	17.5	16.4	17.9	17.2	19.3	18.0	18.2	17.6	19.3	18.8
7/20	16.7	15.6	17.1	16.3	18.7	17.5	17.6	16.9	19.0	18.2
7/21	15.9	14.9	16.6	15.6	17.5	16.8	17.1	16.2	18.4	17.4
7/22	15.8	14.7	16.1	15.4	17.6	16.2	16.6	15.8	17.4	16.9
7/23	15.6	14.3	15.8	14.9	17.4	15.9	16.3	15.3	17.3	16.5
7/24	15.9	14.7	16.1	15.3	17.9	16.4	16.8	15.8	17.5	16.8
7/25	15.7	14.5	15.9	15.2	17.8	16.4	16.6	15.7	17.4	16.9
7/26	15.8	14.5	16.0	15.2	17.8	16.3	16.7	15.7	17.3	16.8
7/27	15.9	14.8	16.2	15.5	18.2	16.8	17.0	16.1	17.8	17.1
7/28	15.2	14.2	15.8	14.9	17.2	16.1	16.4	15.5	17.6	16.8
7/29	16.3	15.1	16.7	15.6	18.0	16.4	17.3	16.0	17.8	16.8
7/30	16.5	15.4	17.0	16.0	18.3	16.8	17.5	16.4	18.2	17.5
7/31	16.3	15.2	16.9	15.9	18.0	16.6	17.3	16.3	18.2	17.6

APPENDIX H, Table 1 (continued). Water temperature (C) at key sites within PG&E DeSabla Centerville Project for period June 1 through September 30, 2005 (PG&E preliminary data 2005[1/]).

	Hendricks Head Dam[2/]		Hendricks/Toadtown Canal at BW12[3/]		Butte Canal at BW15[4/]		DeSabla Forebay Inflow[5/]		DeSabla Powerhouse Discharge[6/]	
DATE	**MAX**	**MEAN**	**MAX**	**MEAN**	**MAX**	**MEAN**	**MAX**	**MEAN**	**MAX**	**MEAN**
8/1	15.5	14.5	16.0	15.1	17.0	15.7	16.4	15.5	18.0	17.0
8/2	15.0	13.9	15.5	14.5	16.4	15.0	15.9	14.8	17.1	16.2
8/3	14.9	13.7	15.4	14.3	16.2	14.7	15.7	14.5	16.5	15.8
8/4	15.1	13.9	15.3	14.4	16.8	15.1	15.8	14.7	16.4	15.8
8/5	15.5	14.4	15.8	15.0	17.4	15.8	16.4	15.3	17.0	16.3
8/6	15.5	14.3	15.7	14.9	17.3	15.7	16.3	15.3	17.0	16.4
8/7	15.7	14.6	16.0	15.2	17.6	16.0	16.6	15.6	17.3	16.6
8/8	15.7	14.7	16.0	15.3	17.4	16.1	16.6	15.7	17.3	16.7
8/9	15.9	14.8	16.2	15.4	17.4	16.0	16.7	15.7	17.3	16.8
8/10	15.7	14.7	16.1	15.3	17.2	15.8	16.6	15.6	17.3	16.7
8/11	15.5	14.5	15.9	15.0	16.9	15.4	16.3	15.2	17.2	16.5
8/12	15.6	14.5	16.0	15.1	16.9	15.4	16.4	15.3	17.0	16.5
8/13	15.6	14.6	16.0	15.1	16.9	15.4	16.4	15.3	17.0	16.5
8/14	15.7	14.6	16.0	15.2	16.9	15.4	16.4	15.3	17.0	16.5
8/15	15.7	14.9	16.0	15.4	16.8	15.6	16.3	15.5	17.1	16.6
8/16	15.6	14.6	16.0	15.1	16.6	15.1	16.2	15.2	17.0	16.4
8/17	15.7	14.7	16.2	15.2	16.9	15.4	16.4	15.4	17.1	16.4
8/18	15.2	14.4	15.5	14.9	16.3	15.0	15.8	15.0	17.0	16.4
8/19	15.1	14.1	15.3	14.5	15.9	14.4	15.5	14.5	16.5	15.8
8/20	15.4	14.3	15.5	14.6	15.9	14.3	15.6	14.5	16.1	15.6
8/21	15.4	14.4	15.5	14.8	15.8	14.4	15.6	14.7	16.2	15.7
8/22	15.7	14.5	15.8	14.8	15.9	14.3	15.8	14.7	16.3	15.7
8/23	16.0	14.9	16.1	15.2	16.2	14.5	16.1	15.0	16.6	16.0
8/24	15.5	14.7	15.7	15.0	15.7	14.4	15.7	14.8	16.6	16.1
8/25	15.4	14.3	15.5	14.6	15.3	13.8	15.4	14.3	16.3	15.6
8/26	15.3	14.2	15.3	14.5	15.0	13.5	15.2	14.2	15.9	15.4
8/27	15.9	14.7	15.9	15.0	15.6	13.9	15.8	14.6	16.2	15.5
8/28	16.0	15.0	16.2	15.3	15.9	14.3	16.1	15.0	16.6	16.0
8/29	15.3	14.5	15.6	14.9	15.1	14.0	15.2	14.6	16.6	15.9
8/30	14.8	13.7	14.9	13.9	14.5	12.9	14.7	13.6	15.9	14.9
8/31	15.3	14.2	15.4	14.5	14.8	13.2	15.1	14.0	15.5	14.9
9/1	15.2	14.2	15.3	14.5	14.9	13.4	15.1	14.1	15.6	15.1
9/2	14.8	14.0	15.1	14.4	14.8	13.4	14.9	14.0	15.6	15.3
9/3	14.3	13.5	14.6	13.9	14.3	13.0	14.4	13.5	15.5	14.9
9/4	14.0	13.2	14.2	13.5	13.8	12.4	14.0	13.1	15.1	14.5
9/5	14.0	13.2	14.2	13.5	13.8	12.3	14.0	13.0	14.7	14.2
9/6	13.8	13.0	14.0	13.2	13.5	12.1	13.8	12.8	14.6	14.1
9/7	13.9	13.0	14.0	13.2	13.6	12.1	13.8	12.8	14.4	14.0
9/8	14.5	13.8	14.7	14.0	14.3	12.8	14.5	13.5	15.0	14.3
9/9	14.5	13.8	14.7	14.1	14.3	13.1	14.5	13.7	15.2	14.8
9/10	14.0	13.0	14.3	13.5	13.2	12.4	13.8	13.1	15.1	14.7
9/11	12.2	11.4	12.4	11.7	11.3	10.5	11.9	11.2	14.3	13.1
9/12	11.9	10.9	11.8	11.0	10.7	9.5	11.3	10.3	12.5	11.7
9/13	12.2	11.3	12.2	11.4	11.5	10.0	11.8	10.7	12.3	11.7
9/14	12.5	11.6	12.5	11.7	11.9	10.5	12.2	11.1	12.6	12.1
9/15	12.5	11.7	12.7	11.9	12.3	10.9	12.5	11.5	13.0	12.4
9/16	12.3	11.5	12.8	12.0	12.0	10.9	12.3	11.4	12.9	12.6
9/17	12.2	11.4	12.9	12.0	12.4	11.2	12.5	11.6	13.1	12.7
9/18	11.6	10.7	12.2	11.3	11.6	10.6	11.8	10.9	13.1	12.5
9/19	11.8	10.7	12.6	11.4	12.2	10.7	12.3	11.0	12.7	12.2
9/20	11.8	10.8	12.8	11.6	12.4	11.0	12.5	11.3	12.9	12.4
9/21	12.6	11.5	13.3	12.3	13.4	11.9	13.3	12.1	13.6	13.0
9/22	12.2	11.3	13.0	12.2	12.8	11.9	12.9	12.1	13.7	13.4
9/23	11.4	10.7	12.3	11.4	11.8	11.1	11.9	11.3	13.6	13.0
9/24	10.5	9.7	11.0	10.3	10.7	9.7	10.7	10.0	12.8	11.9
9/25	10.5	9.6	11.3	10.3	10.8	9.5	11.0	9.8	11.7	11.2
9/26	10.4	9.8	11.2	10.6	10.7	10.1	10.9	10.3	11.5	11.3
9/27	11.6	10.6	12.3	11.3	12.3	11.0	12.3	11.2	12.4	11.6
9/28	11.6	10.7	12.6	11.6	12.4	11.4	12.4	11.5	13.0	12.5
9/29	11.2	10.3	12.1	11.2	11.9	10.8	11.9	11.0	13.0	12.5
9/30	11.3	10.4	12.2	11.2	11.9	10.7	12.0	11.0	12.7	12.3

APPENDIX H, Table 2. Water temperature (C) at key sites within PG&E DeSabla Centerville Project for period June 1 through September 30, 2005 (PG&E preliminary data 2005[1/]).

	Butte Creek Above Desabla Powerhouse[7/]		Butte Creek at Centerville Head Dam[8/]		Butte Creek Above Centerville Powerhouse[9/]		Centerville Powerhouse Discharge[10/]		Butte Creek Below Centerville Powerhouse[11/]	
DATE	**MAX**	**MEAN**	**MAX**	**MEAN**	**MAX**	**MEAN**	**MAX**	**MEAN**	**MAX**	**MEAN**
6/1	13.5	12.6	13.5	12.8	15.5	14.2	15.0	13.8	nd	nd
6/2	13.2	12.1	13.2	12.3	15.1	13.6	14.5	13.1	nd	nd
6/3	13.3	12.0	12.9	12.0	14.6	13.3	14.2	12.8	nd	nd
6/4	13.9	12.5	13.3	12.3	15.1	13.6	14.6	13.1	nd	nd
6/5	13.6	12.6	13.1	12.4	14.9	13.6	14.3	13.2	nd	nd
6/6	12.0	10.9	12.0	10.7	13.1	12.2	12.6	11.4	nd	nd
6/7	11.2	9.8	10.5	9.5	12.5	11.0	10.7	10.0	nd	nd
6/8	10.6	10.3	10.2	10.0	11.4	11.1	10.6	10.3	nd	nd
6/9	12.6	11.1	12.0	10.8	13.3	11.8	13.2	11.4	nd	nd
6/10	13.4	11.9	12.7	11.5	14.7	12.9	14.0	12.3	nd	nd
6/11	14.4	13.0	13.5	12.5	15.5	13.8	14.8	13.3	nd	nd
6/12	14.6	13.0	13.6	12.5	15.5	13.9	14.6	13.3	nd	nd
6/13	14.9	13.4	14.2	13.0	16.0	14.3	15.2	13.7	nd	nd
6/14	15.6	14.0	14.8	13.7	17.2	15.1	16.0	14.4	nd	nd
6/15	15.9	14.5	15.0	14.1	17.4	15.6	16.0	14.8	nd	nd
6/16	15.1	13.2	14.6	12.8	15.3	14.2	15.0	13.4	15.3	14.1
6/17	11.4	10.6	11.0	10.2	12.7	11.8	11.7	10.8	12.6	11.7
6/18	10.8	10.2	10.1	9.6	11.5	10.9	10.4	10.1	11.5	10.9
6/19	12.4	10.9	11.5	10.3	13.6	11.7	12.2	10.8	13.6	11.6
6/20	14.1	12.1	13.0	11.5	15.0	12.9	13.8	12.1	15.0	12.9
6/21	15.3	13.5	14.0	12.8	16.3	14.2	14.6	13.4	16.2	14.2
6/22	15.3	13.9	13.9	13.1	16.8	14.7	14.6	13.7	16.6	14.7
6/23	15.8	14.1	14.4	13.3	17.1	14.9	14.9	13.9	16.8	14.8
6/24	16.4	14.7	14.9	13.9	17.6	15.5	15.5	14.5	17.3	15.4
6/25	16.2	14.9	14.8	14.0	17.5	15.7	15.5	14.6	17.4	15.6
6/26	16.5	15.2	15.4	14.2	17.8	15.9	15.7	14.7	17.5	15.7
6/27	16.3	15.3	14.9	14.2	18.1	16.1	15.8	14.9	17.7	15.9
6/28	16.4	15.1	14.8	13.9	18.1	16.0	15.4	14.6	17.6	15.7
6/29	17.3	15.7	15.9	14.6	19.2	16.7	16.3	15.2	18.5	16.3
6/30	18.2	16.8	16.9	15.8	20.3	17.8	17.5	16.3	19.5	17.4
7/1	18.6	17.9	17.4	16.6	21.2	18.8	18.4	17.2	20.4	18.3
7/2	18.7	18.2	17.4	16.9	21.4	19.1	18.4	17.5	20.4	18.6
7/3	18.5	18.1	17.3	16.8	21.3	19.2	18.4	17.4	20.3	18.6
7/4	18.7	18.1	17.1	16.7	21.5	19.3	18.4	17.3	20.2	18.5
7/5	19.0	18.3	17.3	16.8	21.6	19.5	18.6	17.4	20.3	18.6
7/6	19.7	18.8	17.9	17.3	21.7	19.8	19.1	17.8	20.8	19.0
7/7	20.3	19.2	18.3	17.7	22.0	20.3	19.4	18.2	21.0	19.4
7/8	19.8	19.0	18.1	17.5	21.7	20.2	19.0	18.0	20.5	19.1
7/9	19.1	18.5	17.6	16.9	21.2	19.8	18.3	17.5	19.9	18.6
7/10	19.2	18.1	17.0	16.4	21.4	19.6	17.9	16.9	19.6	18.1
7/11	19.5	18.2	17.3	16.5	21.8	19.8	18.2	17.0	19.8	18.2
7/12	20.0	18.7	17.9	17.0	22.2	20.2	18.8	17.5	20.4	18.7
7/13	20.5	19.3	18.3	17.6	22.7	20.8	19.4	18.1	20.9	19.3
7/14	21.2	20.0	19.0	18.1	23.4	21.4	20.0	18.7	21.5	19.9
7/15	21.4	20.2	19.2	18.5	23.7	21.8	20.3	19.1	21.9	20.3
7/16	21.5	20.3	19.2	18.5	23.9	22.0	20.4	19.2	21.9	20.4
7/17	21.8	20.5	19.5	18.7	24.2	22.2	20.6	19.3	22.2	20.5
7/18	22.2	20.9	19.9	19.1	24.5	22.7	21.1	19.7	22.5	21.0
7/19	22.6	21.5	19.9	19.4	24.6	22.9	21.1	20.0	22.8	21.2
7/20	22.2	21.2	19.5	18.8	24.4	22.7	20.5	19.5	22.2	20.8
7/21	21.3	20.4	18.9	18.0	22.9	21.8	19.3	18.6	20.6	19.9
7/22	21.0	20.0	18.1	17.5	23.0	21.3	19.1	18.1	20.8	19.3
7/23	20.6	19.4	17.8	17.1	22.8	21.0	18.8	17.8	20.6	19.0
7/24	20.9	19.7	18.1	17.4	23.0	21.2	19.2	18.0	20.9	19.2
7/25	20.8	19.7	18.1	17.5	23.0	21.3	19.2	18.1	20.9	19.4
7/26	20.8	19.6	18.0	17.4	23.3	21.4	19.2	18.0	21.0	19.3
7/27	21.3	20.1	18.4	17.8	23.8	21.6	19.6	18.4	21.2	19.6
7/28	20.5	19.6	18.1	17.4	23.2	21.3	19.0	18.0	20.6	19.3
7/29	20.9	19.7	18.4	17.5	23.4	21.3	19.6	18.1	21.1	19.4
7/30	21.2	20.0	18.8	18.1	23.8	21.7	20.0	18.7	21.5	19.9
7/31	21.3	20.1	18.7	18.1	24.1	21.9	20.1	18.8	21.7	20.0

APPENDIX H, Table 2 (continued). Water temperature (C) at key sites within PG&E DeSabla Centerville Project for period June 1 through September 30, 2005 (PG&E preliminary data 2005[1/]).

	Butte Creek Above Desabla Powerhouse[7/]		Butte Creek at Centerville Head Dam[8/]		Butte Creek Above Centerville Powerhouse[9/]		Centerville Powerhouse Discharge[10/]		Butte Creek Below Centerville Powerhouse[11/]	
DATE	**MAX**	**MEAN**	**MAX**	**MEAN**	**MAX**	**MEAN**	**MAX**	**MEAN**	**MAX**	**MEAN**
8/1	20.3	19.1	18.3	17.5	23.3	21.3	19.3	18.2	21.0	19.4
8/2	19.6	18.4	17.4	16.7	22.6	20.5	18.6	17.4	20.3	18.7
8/3	19.3	18.1	17.0	16.3	22.3	20.2	18.3	17.0	20.0	18.3
8/4	19.5	18.3	17.0	16.3	22.2	20.2	18.2	17.0	19.8	18.3
8/5	20.0	18.8	17.5	16.8	22.6	20.5	18.8	17.4	20.4	18.7
8/6	19.9	18.7	17.5	16.9	22.5	20.5	18.8	17.5	20.4	18.7
8/7	20.3	19.1	17.8	17.1	22.8	20.7	19.1	17.8	20.7	19.0
8/8	20.3	19.2	17.9	17.3	22.5	20.7	19.1	17.9	20.5	19.1
8/9	20.5	19.4	18.0	17.4	23.1	21.1	19.1	18.0	20.8	19.3
8/10	20.2	19.1	17.8	17.3	22.9	20.9	19.2	17.9	20.8	19.2
8/11	19.8	18.8	17.6	17.0	22.6	20.7	19.0	17.7	20.5	18.9
8/12	19.9	18.8	17.6	17.0	22.7	20.7	19.0	17.7	20.6	19.0
8/13	19.7	18.7	17.6	17.0	22.4	20.6	18.8	17.6	20.3	18.9
8/14	19.9	18.9	17.6	17.1	22.3	20.5	19.0	17.7	20.4	18.8
8/15	19.6	18.9	17.6	17.2	21.5	20.3	19.0	17.7	20.1	18.8
8/16	19.7	18.6	17.4	16.9	22.3	20.5	18.8	17.6	20.3	18.8
8/17	19.7	18.7	17.6	17.0	22.3	20.5	18.9	17.6	20.4	18.9
8/18	19.2	18.3	17.4	16.8	21.9	20.2	18.5	17.4	19.9	18.5
8/19	18.8	17.9	16.9	16.3	21.5	19.7	18.0	16.9	19.5	18.1
8/20	18.7	17.7	16.6	16.1	21.3	19.5	17.9	16.6	19.4	17.8
8/21	18.5	17.6	16.6	16.1	21.3	19.5	18.1	16.7	19.5	17.9
8/22	18.6	17.5	16.7	16.1	21.3	19.4	18.1	16.7	19.5	17.8
8/23	18.8	17.8	17.0	16.4	21.5	19.6	18.4	17.0	19.8	18.1
8/24	18.5	17.6	16.9	16.4	21.2	19.5	18.2	17.0	19.5	18.0
8/25	18.1	17.1	16.5	15.9	20.9	19.1	17.6	16.5	19.1	17.6
8/26	17.7	16.8	16.1	15.6	20.6	18.8	17.5	16.2	18.9	17.4
8/27	18.2	17.0	16.6	15.8	20.9	19.0	17.9	16.4	19.2	17.5
8/28	18.5	17.4	16.9	16.3	21.3	19.4	18.4	16.9	19.7	18.0
8/29	17.8	17.0	16.7	16.1	20.6	19.1	17.8	16.7	19.1	17.7
8/30	17.1	16.1	16.0	15.2	19.9	18.2	16.8	15.7	18.2	16.8
8/31	17.0	16.0	15.7	15.1	19.9	18.2	17.1	15.7	18.4	16.8
9/1	17.2	16.1	15.9	15.3	20.0	18.3	17.3	15.9	18.7	17.0
9/2	17.2	16.3	15.9	15.5	20.1	18.4	17.5	16.1	18.7	17.1
9/3	16.9	16.0	15.6	15.2	19.7	18.0	17.1	15.8	18.4	16.8
9/4	16.6	15.7	15.2	14.7	19.3	17.7	16.6	15.3	18.0	16.5
9/5	16.6	15.7	15.0	14.6	19.3	17.6	16.6	15.2	17.9	16.3
9/6	16.4	15.4	14.8	14.4	19.1	17.4	16.4	15.0	17.7	16.1
9/7	16.3	15.4	14.8	14.3	19.0	17.3	16.2	14.9	17.4	16.0
9/8	16.7	15.9	15.3	14.7	19.1	17.6	16.6	15.3	17.8	16.3
9/9	17.0	16.3	15.7	15.2	19.2	17.8	17.0	15.7	18.1	16.7
9/10	16.4	15.9	15.5	15.0	18.8	17.6	16.5	15.4	17.6	16.5
9/11	15.2	14.5	14.5	13.5	18.1	16.7	15.3	14.2	16.6	15.3
9/12	14.2	13.4	12.9	12.2	17.1	15.8	13.9	12.8	15.4	14.1
9/13	14.2	13.3	12.7	12.1	16.8	15.3	14.0	12.6	15.3	13.8
9/14	14.4	13.5	13.0	12.5	16.9	15.3	14.3	13.0	15.5	14.1
9/15	14.7	13.8	13.3	12.7	17.2	15.5	14.6	13.3	15.8	14.3
9/16	14.7	13.9	13.5	13.0	17.2	15.7	14.9	13.6	16.1	14.7
9/17	15.2	14.4	13.7	13.3	17.4	15.9	15.4	13.9	16.5	15.0
9/18	14.5	13.8	13.4	12.9	17.0	15.5	14.8	13.5	16.0	14.6
9/19	14.6	13.7	13.2	12.7	17.1	15.5	15.0	13.4	16.1	14.6
9/20	14.7	13.7	13.4	12.8	16.8	15.5	16.1	13.9	16.8	15.0
9/21	15.6	14.7	14.2	13.6	17.2	15.7	16.9	14.8	17.2	15.6
9/22	15.5	14.8	14.2	13.9	17.5	15.9	17.1	15.1	17.5	15.8
9/23	14.8	14.2	14.0	13.4	16.7	15.4	16.2	14.5	16.7	15.3
9/24	13.9	13.2	13.1	12.3	15.6	14.4	14.8	13.3	15.5	14.2
9/25	13.4	12.7	12.1	11.7	15.4	14.0	14.7	12.8	15.3	13.8
9/26	13.3	12.8	12.0	11.8	14.2	13.7	13.5	12.8	14.2	13.6
9/27	14.5	13.6	13.0	12.3	15.9	14.4	14.9	13.3	15.8	14.2
9/28	14.6	13.9	13.4	12.9	16.3	14.7	16.1	14.1	16.4	14.7
9/29	14.3	13.5	13.2	12.8	16.2	14.7	16.0	14.2	16.2	14.7
9/30	14.3	13.5	13.1	12.7	16.2	14.7	16.0	14.1	16.2	14.7

[1/] Preliminary information provided by PG&E and qualified as follows: "All data was collected by personnel from PG&E's Land and water quality unit or staff under contract with the same group. All data should be considered preliminary and subject to revision. Periods when recorders were not deployed insitu, or suspected of being out of the water, or during periods of powerhouse/canal outage have been corrected (removed). Therefore, all data represents water temperatures insitu at the location indicated. All recorders were deployed in well mixed and/or high velocity locations. Locations were selected to be representative of conditions as well as to prevent vandalism. All recorders were QA/QC'd prior to deployment and meet or exceed manufacture recommendations."

[2/] Hendricks Canal at Head Dam, Seamon mini recorder #T-1745, QA/QC = ± 0.1°C , Lat (NAS83) 039° 56.1839'N, Long (NAS83) 121° 31.8097'W.

[3/] Toadtown Canal at BW-12 gage site, Seamon mini recorder #T-1739, QA/QC = ± 0.1°C, Lat (NAS83) 039° 53.1700'N, Long (NAS83) 121° 36.7168'W.

[4/] Butte Canal at BW-15 gage site, Seamon mini recorder #D-832, QA/QC = ± 0.1°C, Lat (NAS83) 039° 53.2093'N, Long (NAS83) 121° 36.7342'W.

[5/] Butte Canal at inflow to DeSabla Forebay (total canal flow), Seamon mini recorder #T-1741, QA/QC = ± 0.1°C, Lat (NAS83) 039° 52.5452'N, Long (NAS83) 121° 36.7236'W.

[6/] DeSabla Powerhouse - Internal recorder off of tailrace, Campbell Sci CR200 #1467, QA/QC =± 0.1°C, Lat (NAS83) 039° 52.1618'N, Long (NAS83) 121° 37.9314'W.

[7/] Butte Creek above DeSabla Powerhouse, Seamon mini recorder #T-1734, QA/QC = ± 0.1°C, Lat (NAS83) 039° 52.2114'N, Long (NAS83) 121° 37.9609'W.

[8/] Butte Creek at Lower Centerville Diversion Dam, Seamon mini recorder #T-1732, QA/QC =± 0.1°C, Lat (NAS83) 039° 52.0615'N, Long (NAS83) 121° 37.9448'W.

[9/] Butte Creek above Centerville Powerhouse, Seamon mini recorder #T-1791, QA/QC = ± 0.1°C, Lat (NAS83) 039° 47.4298'N, Long (NAS83) 121° 39.4915'W.

[10/] Lower Centerville Canal at Centerville Powerhouse penstock headworks, Seamon mini recorder #T-1731, QA/QC = ± 0.1°C, Lat (NAS83) 039° 47.4156'N, Long (NAS83) 121° 39.9039'W.

[11/] Butte Creek below Centerville Powerhouse, Seamon mini recorder #T-1384, QA/QC = ± 0.1°C, Lat (NAS83) 039° 47.2308'N, Long (NAS83) 121° 39.5875'W.