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BUTTE CREEK
SPRING-RUN CHINOOK SALMON, ONCORYHNCHUS TSHAWYTSCHA
PRE-SPAWN MORTALITY EVALUATION
2015

By

Clint E. Garman

Inland Fisheries

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ABSTRACT

This is the thirteenth report assessing pre-spawning mortalities among Central Valley (CV) spring-run Chinook salmon (SRCS) (*Oncorhynchus tshawytscha*) in Butte Creek affected by the Pacific Gas and Electric (PG&E) DeSabla-Centerville Project (Project). The Project is located on Butte Creek near Chico, in Butte County, California. In monitoring for pre-spawn mortalities during the 2015 survey, an estimated 152 SRCS died prior to spawning. During the 2015 summer holding period, approximately 95% of the fish held upstream of the Centerville Powerhouse (CVPH) and 5% held downstream. The 152 mortalities observed were distributed 64% upstream and 36% downstream of the CVPH. A mark re-capture carcass survey estimated 413 SRCS survived to spawn with approximately 87% spawning upstream the CVPH and 13% downstream. This was the first year in which snorkel survey estimates (1,081) were higher than the mark re-capture carcass survey (413). Early season Vaki RiverWatcher estimates (1,939) suggest a higher number of adult SRCS escaped ocean fisheries and migrated into Butte Creek. Historic drought conditions played a role in diminishing water quality, physiological health and survival of holding adults.

The Lower Centerville Canal was not in operation during 2015 and all flow was left in the creek channel. Flows were maintained at ≥ 70 cfs throughout the entire holding period in the reach upstream of the CVPH. At the onset of SRCS spawning, additional flows were not available to provide additional potential spawning habitat due to drought conditions. Air temperatures during June of 2015 were substantially warmer (0% exceedance) in the upper watershed compared to the same period in 2003. Water temperatures exceeded 19.4°C at Quartz Bowl Pool a total of 31days for the June 1 - August 31 period. During 2002 and 2003, when significant numbers of pre-spawn mortalities were observed, water temperatures during July exceeded the 19.4°C threshold 16 days and 11 days, respectively. The PG&E temperature contingency plan was implemented on five occasions during July 2015 in response to predicted higher air temperatures. For the second consecutive year, release strategies for Philbrook Reservoir were modified to utilize water storage during the hottest period of adult salmon holding instead of releases later in the season to achieve winter minimum storage.

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INTRODUCTION

This is the thirteenth report prepared under a grant from Pacific Gas and Electric Company (PG&E) and Sport Fish Restoration Act to assess pre-spawning mortalities among adult CV spring-run Chinook salmon (SRCS), *Oncorhynchus tshawytscha*, in Butte Creek within and downstream of PG&E's DeSabla-Centerville Project. 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.
- Monitor and document holding distribution of Butte Creek SRCS.

Salmon in Butte Creek

SRCS are currently state and federally listed as threatened. Butte Creek is one of several streams within California's CV that continues to harbor a self-sustaining population. The first effort to generate a Butte Creek SRCS population estimate was performed in 1954 (Table 1) (CDFG, 1998). However, inconsistent survey methods 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 2015.

Year	Run Size	Year	Run Size	Year	Run Size	Year	Run Size		
							Snorkel	Prespawn Mortality	Spawn
1954	830	1970	285	1986	1371				
1955	400	1971	470	1987	14	2001	9605	193	18312
1956	3000	1972	150	1988	1300	2002	8785	3431	12597
1957	2195	1973	300	1989	1300	2003	4398	11231	6063
1958	1100	1974	150	1990	100	2004	7390	418	10221
1959	500	1975	650	1991	100	2005	10625	617	16998
1960	8700	1976	46	1992	730	2006	4579	244	6303
1961	3100	1977	100	1993	650	2007	4943	638	6220
1962	1750	1978	128	1994	474	2008	3935	1054	10082
1963	6100	1979	10	1995	7500	2009	2061	126	2561
1964	600	1980	226	1996	1413	2010	1160	12	1979
1965	1000	1981	250	1997	635	2011	2130	12	4859
1966	80	1982	534	1998	20212	2012	8616	177	16140[xx]
1967	180	1983	50	1999	3679	2013	11471	903	15886[xx]
1968	280	1984	23	2000	4118	2014	3616	232	4851[xx]
1969	830	1985	254	-	-	2015	1081	152	413[xx]

:highlighted years indicate escapement surveys prior to 1989 used various survey methods with varying precision. Surveys from 1989 to present were conducted using standard snorkel survey methodologies. Long term data suggests snorkel survey methodology underestimates the number of adults in Butte Creek when there are large populations. Snorkel surveys are used to provide long term trends in populations. Spawning survey results for 2001- 2011 were generated by a modified Schaefer Model carcass survey.

[xx] Spawning results for 2012-2015 were generated using a Cormack Jolly-Seber (CJS) Model.

Based on documented usage patterns, 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 Powerhouse (DSPH). Within the 11 mile reach, the uppermost 3 miles between the Quartz Bowl Pool and Pool 4 is the most isolated and contains the deepest holding pools ,while the majority of available spawning habitat is located in the 5 miles downstream of the CVPH (Figures 1 and 2; Appendix A, Figures 1-5). Beginning in 1998, there were reports and observations of occasional significant mortalities during the summer holding period prior to spawning. Pre-spawn mortality was partially documented during 2002 and systematically documented during 2003 through 2015 (Table 1). 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) (Veek, 2003). Mortalities during 2004 through 2014 were primarily due to a variety of natural causes associated with over-summer holding salmon. It was also noted that during 2003, air temperatures during the last two weeks of July, as measured at the nearby California Department of Forestry Cohasset Fire Station, exceeded 37.6° Celsius (C) (100° Fahrenheit (F)) a total of 10 days. It was further concluded that mortalities during 2002 and 2003 appeared to coincide with sustained daily average water temperatures above 19.4°C, as measured at the Quartz Bowl Pool (Figure 1).

Temperature Contingency Plan

As in prior years (2004 through 2014), PG&E developed a 2015 Annual Operations and Management Plan (PG&E, 2015). A component of that plan is a contingency for extreme heat events to decrease water temperatures in Butte Creek by selectively managing flows from the West Branch of the Feather River (WBFR). In consultation with the Resource Group which consists of California Department of Fish and Wildlife (CDFW), National Oceanographic and Atmospheric Administration Fisheries (NOAA Fisheries), and United States Fish and Wildlife Service (USFWS), PG&E agreed to the following contingency language in the plan (PG&E, 2014):

1) "Starting on June 1 or at such time as the Resource Group determines, PG&E 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 United States Forest Service weather stations at Cohasset and Chester. PG&E will provide an e-mail copy of the forecast to NOAA Fisheries, CDFW, and UFWS. 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, PG&E will send an e-mail and phone at least one of the individuals from the Resource Group 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, PG&E will send a second e-mail, phone, or fax, one of the individuals at each Resource Group to discuss actions to be taken. If personal contact cannot 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 – 5 below. If action is taken, PG&E will send a third email or phone the Resource Group and explain the action\s taken."
2) "Due to challenges expected during the 2015 dry water year, PG&E will coordinate weekly conference calls with the Resource Group every Thursday starting after the first set of pre-

spawning mortality surveys through the beginning of the spawning period. The Resource Group will discuss the results of weekly surveys, meteorological forecast, flows and storage in Philbrook Reservoir."

3) "CDFW and PG&E plan to conduct the annual spring-run Chinook salmon spawning escapement snorkel survey in early July. This survey will provide an estimated number of salmon holding in the reach of Butte Creek below Lower Centerville Diversion Dam (LCDD). If the potential for stress on this population is low due to a small run of salmon, consideration will be given to making more constant releases from storage rather than high releases during possible extreme heat events. This decision will be made by the Resource Group."
4) "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 at Philbrook Reservoir will be increased to provide a total release of up to 35 cfs if determined to be appropriate. If determined necessary upon consultation with CDFW and NOAA Fisheries, reductions in the Round Valley release of more than 50% may be implemented."
5) "The actual amount of water released from Philbrook Reservoir during a confirmed extreme heat event will depend on PG&E's assessment of then-existing conditions and recommendations and comments received from the Resource Group in response to the e-mails. Flow amount released from Philbrook Reservoir will also be discussed in the 2015 weekly calls."
6) "At the next forecast date, if temperature forecasts have returned to normal levels, PG&E may reduce the releases from Philbrook Reservoir to the pre-event level (or other level as determined appropriate in consultation with the Resource Group) and assess the quantity of water available for the remainder of the season. If temperature forecasts have not returned to normal, PG&E will consult with the Resource Group regarding whether to continue or adjust the releases based on the then-existing conditions."

Flow Increase for Spawning

Previous evaluations of spawning habitat suggested this may be a limiting factor for SRCS in Butte Creek (Gard et al., 2003; Ward et al., 2004b; Ward, 2004). Based upon this information, in 2015 PG&E agreed to consider increasing flows above the minimum 40 cubic feet per second(cfs) required by the FERC license, in the reach upstream of the CVPH during SRCS spawning period. PG&E agreed to the following language in the 2015 plan:

"Increased flow in Butte Creek below LCDD during the spawning period (i.e., after approximately mid-September) can provide additional spawning habitat. PG&E will consult with the Resource Group to determine what magnitude of flows can be reliably available during the 2015 spawning period. 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, 2015, or other appropriate date determined in consultation with the Resource Group."

During the 2015 Operations Meeting, the Resource Group and PG&E agreed to not operate the Lower Centerville Canal (LCC) due to the dry water-year conditions in the basin and limited water available in storage (PG&E 2015). In previous years, flows from Butte Creek were diverted into the LCC to provide cool water for fish holding downstream of the Lower Centerville Powerhouse. The ability to provide cool water through the LCC is dependent on the amount of flow diverted. Heating of water in the LCC is minimized by decreasing transit time which varies with the amount of flow. As a result, LCC flows need to remain relatively high in order to obtain a significant cooling benefit. Given the 2015 water year type, at the Operations Meeting the Resource Group determined that during the 2015 holding period it was likely that there would not be sufficient flow to effectively divert into the LCC to provide cool water for fish holding downstream of the Centerville Powerhouse. In addition, since 2015 was expected to be dryer than 2014, the Resource Group predicted that fish distribution would, in all likelihood, be similar to 2014 in that most of the adults would be holding above the Centerville Powerhouse. Therefore, by not operating the diversion at the LCC, would provide the coolest and most water possible in the upper reaches where the Resource Group expected the majority of the population to hold.

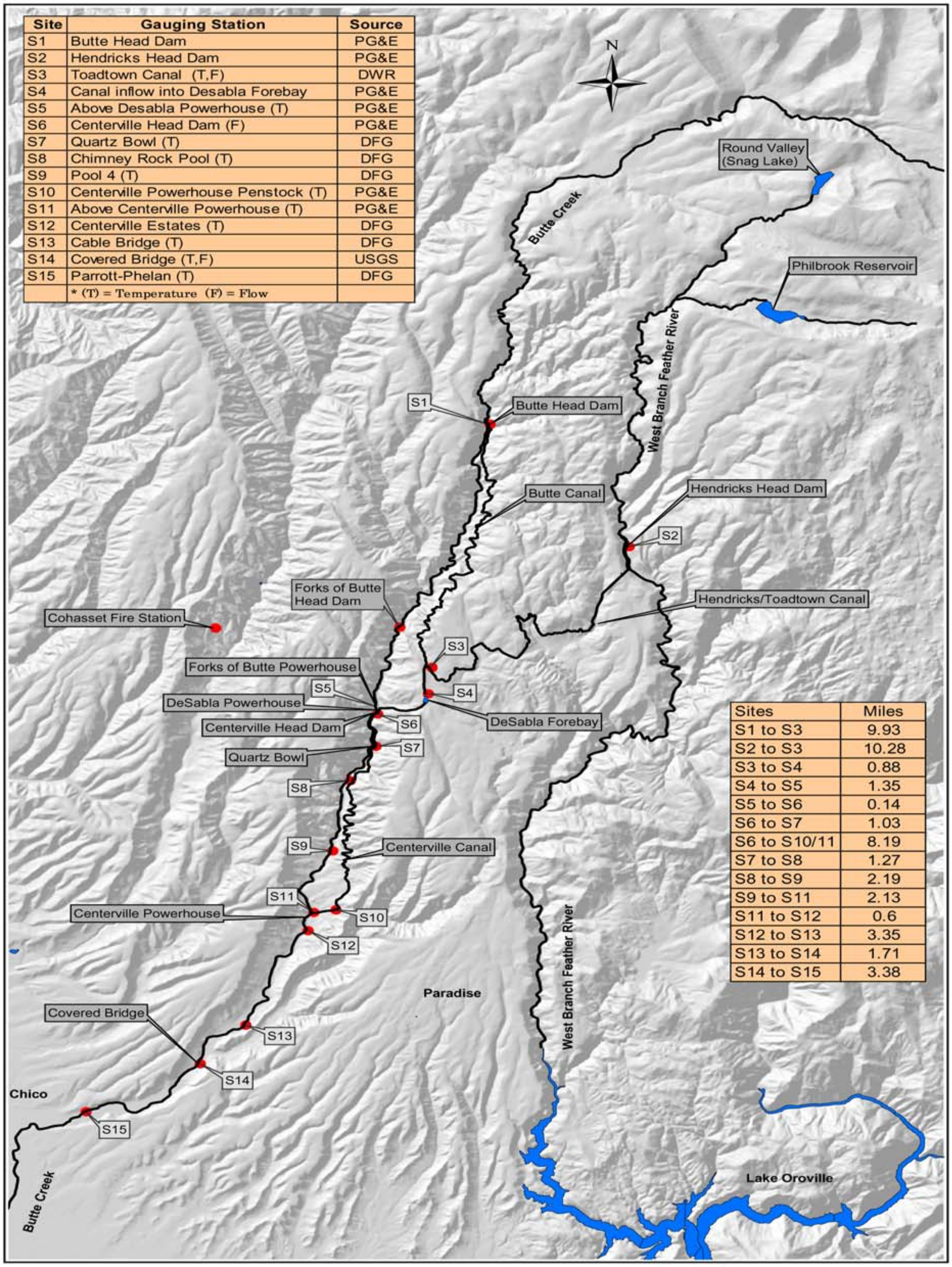


Figure 1. Map showing reaches of Butte Creek and West Branch of the Feather River controlled by Pacific Gas and Electric Company affecting Butte Creek spring-run Chinook salmon, including temperature and flow gage locations and distances.

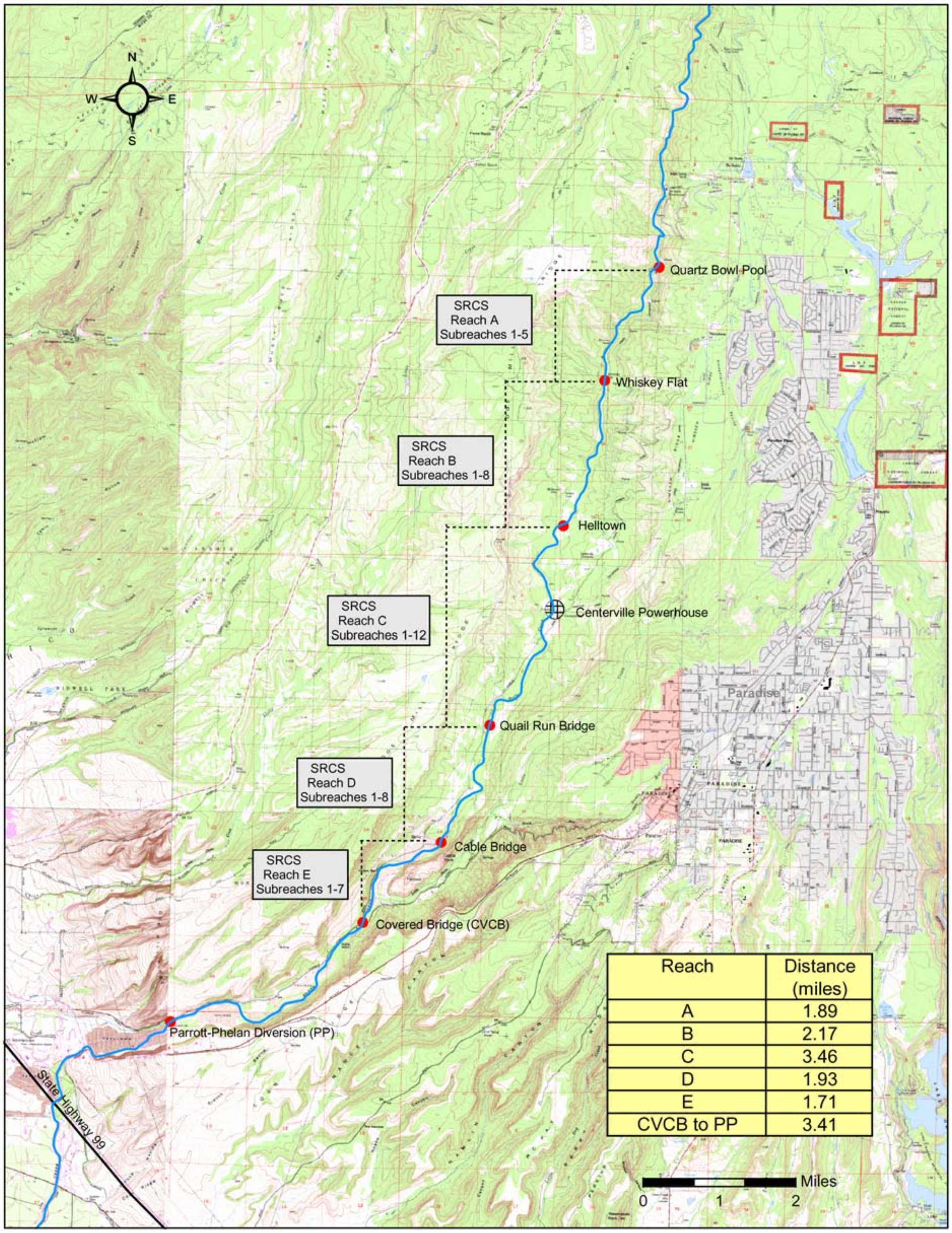


Figure 2. Map of Butte Creek from Quartz Bowl Pool to Covered Bridge showing spring-run Chinook salmon holding and spawning reaches and distances.

MATERIALS AND METHODS

Adult Escapement

Estimating total SRCS escapement to Butte Creek requires incorporating both pre-spawn mortalities and the carcass survey. Since 1989, CDFW has calculated an escapement estimate for adult SRCS in Butte Creek by conducting a swimming-snorkel survey. Final snorkel survey estimates provide relative abundance indices to track yearly population trends in Butte Creek adult SRCS. Adult SRCS are counted by 4-6 surveyors during the over-summer holding period prior to spawning. On Butte Creek, the swimming-snorkel survey extends from the Quartz Bowl Pool downstream to the Centerville Covered Bridge and occasionally downstream to Parrott-Phelan Diversion Dam (Figure 1 & 2). Working from upstream to downstream, surveyors float through each pool once, estimating the number of SRCS encountered. Estimates from each surveyor are recorded to generate an average for each pool. If subsequent analysis of estimated numbers observed by surveyors in each pool reveals significant outliers, these are excluded from the calculation of the population estimate. In such instances, the average estimate of SRCS holding in a 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.

In response to the need to coordinate and improve escapement monitoring programs in the CV, the Interagency Ecological Program (IEP) Salmonid Escapement Project Work Team (SEPWT) initiated reviews of the currently used mark-recapture models. One primary goal was to recommend a CV wide monitoring plan that would improve estimates of the number of Chinook salmon that spawn in California's CV streams. The SEPWT salmon monitoring plan recommended replacement of the models historically used with the super-population modification of the CJS model. The 2015 SRCS spawning escapement was the fourth year that the CJS was performed on Butte Creek to produce the escapement estimate. It is also the fourth year that the CJS model estimates are used for CDFW reporting requirement to the Pacific Fishery Management Council and to the CDFW's Grandtab Table. Detailed CJS model descriptions and equations can be found in the Central Valley in-river Chinook Salmon Escapement Monitoring Plan (Bergman et al. 2012). All analysis and conclusions within this report are based on estimates derived from the CJS model.

Adult Pre-spawning Mortality Survey

Since all Chinook salmon die after spawning, a standard technique employed in California for estimating the number of returning adults is 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 carcasses 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 occurred from June 1 until the onset of spawning on September 15, 2015. During the pre-spawn mortality survey there were periods when limited numbers of fresh carcasses were available to tag on a weekly basis. This is problematic for developing estimates based on mark-recapture statistics. This was accounted for by applying an expansion factor developed in the carcass survey to the pre-spawn mortality survey data. The expansion factor was calculated by dividing the number of fish handled in the carcass survey by the final Cormack-Jolly Seber (CJS) population estimate. The subsequent expansion factor was applied to the pre-spawning survey to determine an estimate of salmon that died prior to spawning because of the inability to use traditional mark-recapture statistics. The final pre-spawn estimate was determined by multiplying the expansion factor by the total number of carcasses handled during the pre-spawning survey.

The survey extended from the Quartz Bowl Pool to the Parrott-Phelan Diversion Dam (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 chopped in half to avoid being counted during subsequent trips. All fresh carcasses were sexed and measured to the nearest millimeter (mm) fork length (FL). Age classification is derived by analyzing all measured fresh carcasses. Individuals that are less than 600 mm are considered to be age 2 based on past CWT analysis of known age Butte Creek SRCS. Remaining fish are considered to be either age 3 or age 4.

Water Temperature

Onset, HOBO Water Temp Pro v2, temperature data loggers calibrated to ± 0.2 ° C set for 30 minute interval recordings were deployed in pools at five sites within the SRCS holding and 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

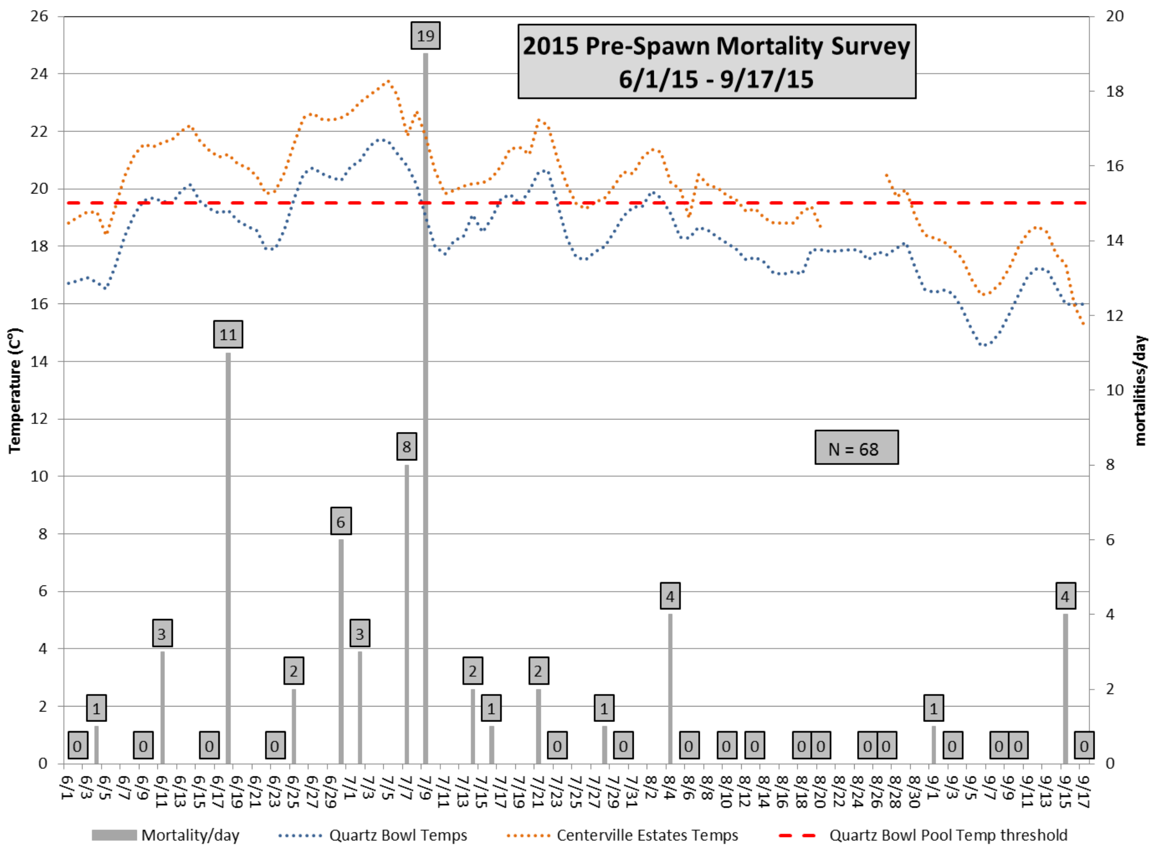
Pre-spawn Mortalities

During the entire pre-spawn survey period from June 1, 2015 through September 17, 2015 there was a total of 68 carcasses encountered with an expanded pre-spawn mortality total of 152 (Table 2). Weekly mortality rates during the entire holding period ranged from zero to 27 fish per week with peak mortality occurring on Week 6 (July 7-9, 2015) (Table 2; Figure 3). Early season surveys conducted outside the traditional survey reaches identified and additional 280 pre-spawn mortalities prior to the start of the pre-spawn survey on June 2, 2015. These carcasses were not part of the traditional survey and outside of the project area and were not included in the table below.

Table 2. Summary of Butte Creek SRCS pre-spawn mortalities encountered during survey period June 1, 2015 through September 17, 2015.

		Total Carcasses Encountered						
		Reach						Weekly Total
Week	Date	A	B	C	D	E	Cov Br toOro-Chico Hwy Bridge	
1	6/2	0	0	-	-	-	-	1
	6/4	-	-	1	0	0	-	
2	6/9	0	0	-	-	-	-	3
	6/11	-	-	1	1	1	-	
3	6/16	0	0	-	-	-	-	11
	6/18	-	-	2	3	6	-	
4	6/23	0	0	-	-	-	-	2
	6/25	-	-	1	0	1	-	
5	6/30	1	5	-	-	-	-	9
	7/2	-	-	3	0	0	-	
6	7/7	-	-	4	1	3	-	27
	7/9	7	12	-	-	-	-	
7	7/14	1	1	-	-	-	-	3
	7/16	-	-	1	0	0	-	
8	7/21	2	0	-	-	-	-	2
	7/23	-	-	0	0	0	-	
9	7/28	0	1	-	-	-	-	1
	7/30	-	-	0	0	0	-	
10	8/4	4	0	-	-	-	-	4
	8/6	-	-	0	0	0	-	
11	8/11	0	0	-	-	-	-	0
	8/13	-	-	0	0	0	-	
12	8/18	0	0				-	0
	8/20	-	-	0	0	0	-	
13	8/25	0	0	-	-	-	-	0
	8/27	-	-	0	0	0	-	
14	9/1	1	0	-	-	-	-	1
	9/3	-	-	0	0	0	-	
15	9/8	0	0	-	-	-	-	0
	9/10	-	-	0	0	0	-	
16	9/15	1	3	-	-	-	-	4
	9/17	-	-	0	0	0	-	
	TOTAL	17	22	13	5	11		68
Cormack Jolly-Seber Expanded Model (Due to low mark/recovery rate a subsequent spawning expansion factor of 2.23 was applied)							152	

Figure 3. Daily pre-spawn mortality and daily average temperatures at Quartz Bowl Pool and Centerville Estates for period June 1, 2014 through September 17, 2015.



The swimming-snorkel survey conducted July 7 &8, 2015 resulted in an estimate of 1,082 salmon (Garman, 2015). Due to the low number of mortalities spread over the entire survey period and the low mark/recovery rate, it was not possible to generate a Cormack Jolly-Seber estimate of total pre-spawn mortality. An expansion factor (F = 2.23) generated from the subsequent Cormack Jolly-Seber estimate of spawning was applied (Appendix B, Figure 1). Spawning onset was first documented on September 17, 2015 and did not appear to overlap with the pre-spawn mortality period which ended the previous week. The subsequent spawning survey from September 22, 2015 through October 27, 2015 encountered a total of 185 carcasses with an estimated spawning population of 413 in the surveyed reaches A-E and from Centerville Covered Bridge to Parrott-Phelan Diversion Dam (Appendix B, Table 1As with the snorkel surveys performed from 2004 through 2014, an attempt was made to conduct the 2015 snorkel survey in early July to develop an estimate prior to any significant pre-spawn mortality. There were 34 pre-spawn mortalities prior to the snorkel survey (Table 2) or an expanded estimate of 76 (34 x 2.23).

Sex and Age Composition

There were a total of 68 carcasses examined during the pre-spawn survey. Of those 68 carcasses, 41 were measured and identified by sex (based on visual characteristics), of which 24 (59%) was female and 17 (41%) was male (Table 3). There were no CWT fish recovered during the pre-spawn mortality survey and none recovered during the subsequent spawning survey. Based upon prior Butte Creek CWT recoveries, analysis of length frequencies from the 41 pre-spawn carcasses, it is estimated that 2 (4.8%) of the 41 carcasses are from age-2 brood year (BY) 2013. The remaining 39 pre-spawn carcasses are assumed to be either an age-3 or age-4 (BY12 or BY11 respectively) based upon past Butte Creek CWT data of substantial overlap of size between three and four year old fish (Appendix C, Figure 1).

Table 3. Fork lengths of sub-sample of Butte Creek SRCS pre-spawn mortalities during 2002- 2015.

	Female					Male				
	Carcasses		FL (MM)			Carcasses		FL (MM)		
Year	Total	Percent	Max	Min	Mean	Total	Percent	Max	Min	Mean
2015	24	59%	908	665	792	17	41%	996	430	812
2014	63	79%	916	661	778	17	21%	1011	714	866
2013	223	63%	932	583	722	132	37%	973	476	775
2012	44	44%	819	590	711	56	56%	885	403	703
2011	1	50%	820	820	820	1	50%	470	470	470
2010	1	25%	782	782	782	3	75%	870	655	782
2009	23	68%	936	698	846	11	32%	1010	752	928
2008	126	80%	855	575	745	32	20%	1171	645	809
2007	151	72%	957	639	798	58	28%	1060	451	861
2006	66	72%	938	473	737	25	28%	1077	419	714
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 carcass surveys (Table 4). Comparative tables for holding, pre-spawn mortality and spawning for years 2001 – 2014 are within Appendix I.

Table 4. Summary of Butte Creek SRCS distribution by reach, above and below PG&E CVPH for snorkel, pre-spawn and carcass/spawn survey during 2015.

	Year 2015						
	Snorkel Survey(Holding)			Pre-Spawn Survey		Spawn Survey	
Reach	Actual	Estimated	Percent	Actual	Percent	Actual	Percent
A	767	400	70.8%	40	26.3%	174	42.1%
B	206	108	19.2%	47	31.0%	161	39.0%
C1-5	57	30	5.3%	11	7.2%	25	6.1%
C6-12	46	24	4.2%	18	11.8%	33	8.0%
D	3	2	0.4%	11	7.2%	9	2.2%
E	2	1	0.1%	25	16.5%	0	0.0%
CVCB to PP (Figure 1)	0	0	0%	0	0.0%	11	2.6%
Total	1081	565	100%	152	100%	413	100%
Total Above Powerhouse	1030	538	95%	98	65%	359	87%
Total Below Powerhouse	51	27	5%	54	35%	54	13%

Pre-spawn holding distribution was similar to 2014 with 95% and 5% holding upstream and downstream of the CVPH, respectively (Table 4). The adjusted or estimated holding (snorkel) estimate is usually based upon the combined carcass estimate (pre-spawn and spawn) allocated by the percentage of fish observed in each reach/sub-reach during the swimming-snorkel survey. However, this year was the first year that snorkel survey numbers were greater than the total of both the pre-spawn and spawn survey combined. This is likely due to drought and low water flows making carcasses more susceptible and accessible to predation by wild animals removing them from survey interval days and not being accountable in the CJS model. During the 15-year period 2001-2015, approximately 64% of the fish held above the CVPH and 36% below, while approximately 44% of the fish that survived to spawn, spawned above the CVPH and 56% downstream (Appendix D, Figure 3&5, Appendix I).

For the 2001-2015 period, based upon the various survey methods, 79% of the pre-spawning mortalities occurred upstream of the CVPH and 21% downstream (Appendix D, Figure 4). The percentage of mortalities upstream of the CVPH is heavily skewed due to the large pre-spawning mortalities in 2002 and 2003, when distributions were similar to 2013 and 2014. Since 2003, this is the third consecutive year that percentages of mortalities were higher in the reach upstream of the CVPH compared to the reach downstream. This is most likely due to the large proportion of the total population holding upstream of the CVPH. During 2015, approximately 81 (15.1% of the total) fish holding above the CVPH moved to spawn downstream (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 upstream of the CVPH and 82% below. It was also estimated that the reach of Butte Creek downstream of the CVPH would support approximately 152-1,316 spawners at 40 cfs, and 270-2,352 spawners at 130 cfs, while the reach downstream of the CVPH would support an estimated 1,262-10,976 spawners at 130 cfs. At the onset of spawning on September 22, 2015, flows in the reach upstream of the CVPH averaged around 70 cfs. For the second consecutive year, lack of available storage water from Philbrook Reservoir resulted in the inability to provide additional spawning flows to fish spawning in the reach upstream of the CVPH. The LCDD did not divert any water during the spawning period, giving spawning adults full flow of Butte Creek and imported West Branch Feather River water for the entire spawning period. Very low natural unimpaired flows (70 cfs) during spawning in Butte Creek associated with drought conditions resulted in limited spawning habitat though this was likely not a limiting factor due to the small population size.

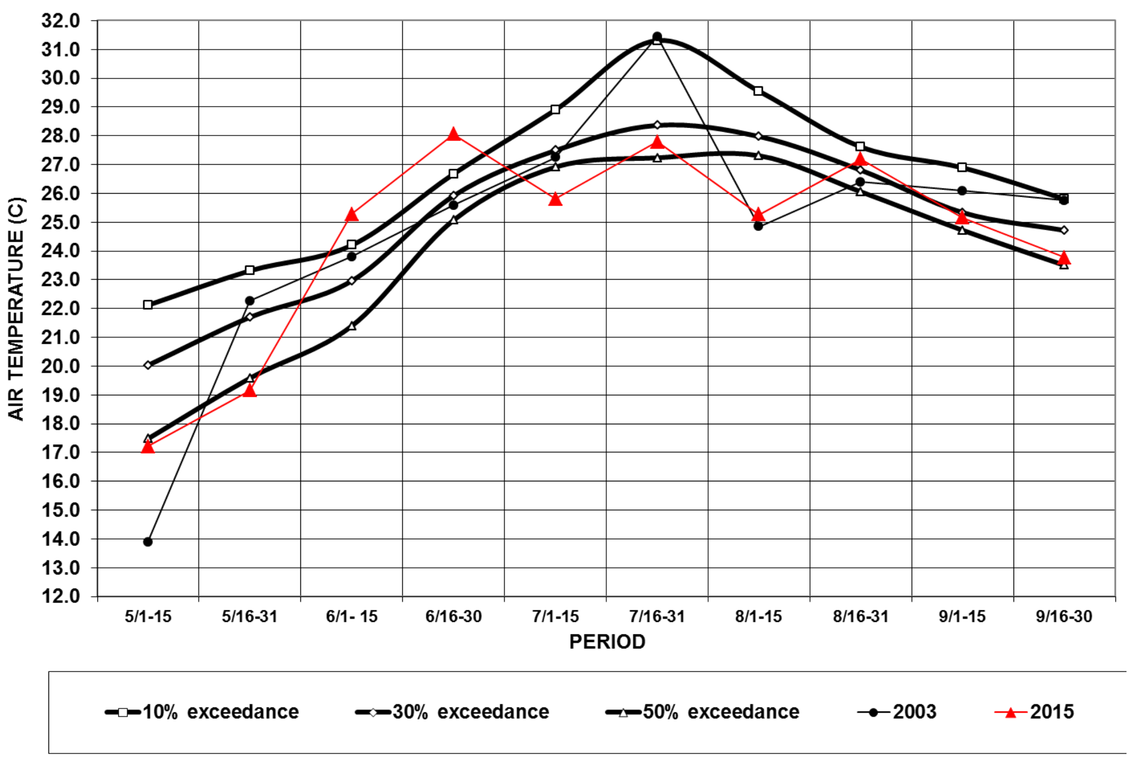
Air Temperatures

Air temperatures measured at the California Department of Forestry Cohasset Fire Station (Figure 1; Appendix E) was monitored to assess resultant stream temperatures and pre-spawn mortalities. Mean daily air temperature exceedance for period 1984-2015 was calculated (Table 5)**.** Air temperatures were moderate during the month of May then increased in June to beyond the 10% exceedence level for the entire month. Temperatures then decreased to below the 50% exceedance levels for early July, rising slightly in mid-July before falling again in the first two weeks of August. Late August through September air temperatures were above or at the 30% level before tapering off to below the 50% level for the commencement of spawning (Table 5, Figure 4) (CDWR, 2014). Maximum daily air temperatures equaled or exceeded 37.6° C (100° F) for only two days during July 2015. Since 1985, there are 21 years where there are complete records for July. During that period of record, the average number of days in which maximum air temperatures equaled or 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 2006-2015.

Period	Year										Avg. 1984-15
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	
June 1-15	21.3	22.8	22.7	18.1	21.2	18.0	22.9	25.3	25.9	25.3	21.4
June 16-30	29.1	24.9	26.3	26.5	24.0	23.7	22.5	23.4	24.7	28.1	24.7
July 1-15	27.0	27.4	28.5	26.3	26.9	25.3	27.6	29.5	29.0	25.8	27.0
July 16-31	31.5	26.1	26.2	29.6	27.7	25.4	25.8	27.7	27.6	27.8	27.4
Aug. 1-15	25.6	25.3	28.1	25.4	25.6	26.1	30.4	24.8	26.4	25.3	26.8
Aug. 16-31	26.1	27.7	27.0	27.8	25.4	26.9	26.8	27.0	25.8	27.2	26.1
Sept. 1-15	25.1	24.3	26.9	24.6	24.3	27.6	26.2	25.4	27.7	25.1	24.9
Sept. 16-30	23.1	17.4	23.6	26.7	24.3	25.2	26.6	18.6	21.0	23.8	23.4

Figure 4. Mean daily air temperature exceedance for period 1984-2015 compared to 2003 (high pre-spawn mortality year) and 2015, California Department of Forestry Cohasset Fire Station.



Water Temperatures and Flows

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 19.4°C a total of 11 days and 9 days, respectively. Water temperatures in 2015 equaled or exceeded 19.4°C a total of 31 days during the June 1-August 31 period, with 14 consecutive days occurring from June 25-July 8

(Figure 5; Appendix F, Table 1). Mean daily flows from Quartz Bowl Pool to Centerville Powerhouse for each of the years were always above 40 cfs. In 2015, flows averaged 79.2 cfs for the entire June 1 through September 15 holding period (Appendix G, Table 1). Mean daily water temperatures at the Quartz Bowl Pool exceeded the 19.4°C temperature threshold for the first time on June 9, 2015. Water temperatures dropped to 17.8°C on June 22, 2015, then increased again to 20.5°C on June 25, 2015 and stayed above the threshold until July 8, peaking on July 4, 2015 at 21.7°C. Water temperatures increased again in mid-July to above the 19.4°C threshold on July 17 to19.5°C for five consecutive days and then dropped to 19.3°C on July 23, 2015. Air temperatures then started a gradual decline and stayed below the 19.4°C threshold the remainder of the holding period until the onset of spawning.

Based upon preliminary data provided by PG&E (Sagraves 2015) mean daily increase in water temperature through the DeSabla Forebay equaled or exceeded 1°C a total of 104 days during the period June 1 - September 30, 2015, with maximum heating occurring on September 29, 2015 at 2.80°C (Figure 6). This was more than observed during 2014 and 2013 with 90 and 77 days respectively and substantially more than the 16 days observed in 2011. Maximum heating during the critical holding period of July 1 – August 15, 2015 occurred on July 23, 2015 with maximum heating at 2.10°C. PG&E concluded that a flow of 108 cfs or greater is required to keep temperature increases through the forebay at or less than 1°C (PG&E, 2013). For the June 15 – September 30, 2015 period, flows averaged 55.3 cfs, and did not exceed 108 cfs for any day. This was similar to 2014 with no days over 108 cfs compared to one day in 2013, 9 days in 2012, and 71 days in 2011.

Figure 5. Mean daily water temperature (C) at Quartz Bowl Pool for period July through September of years 2002, 2003 and 2015.

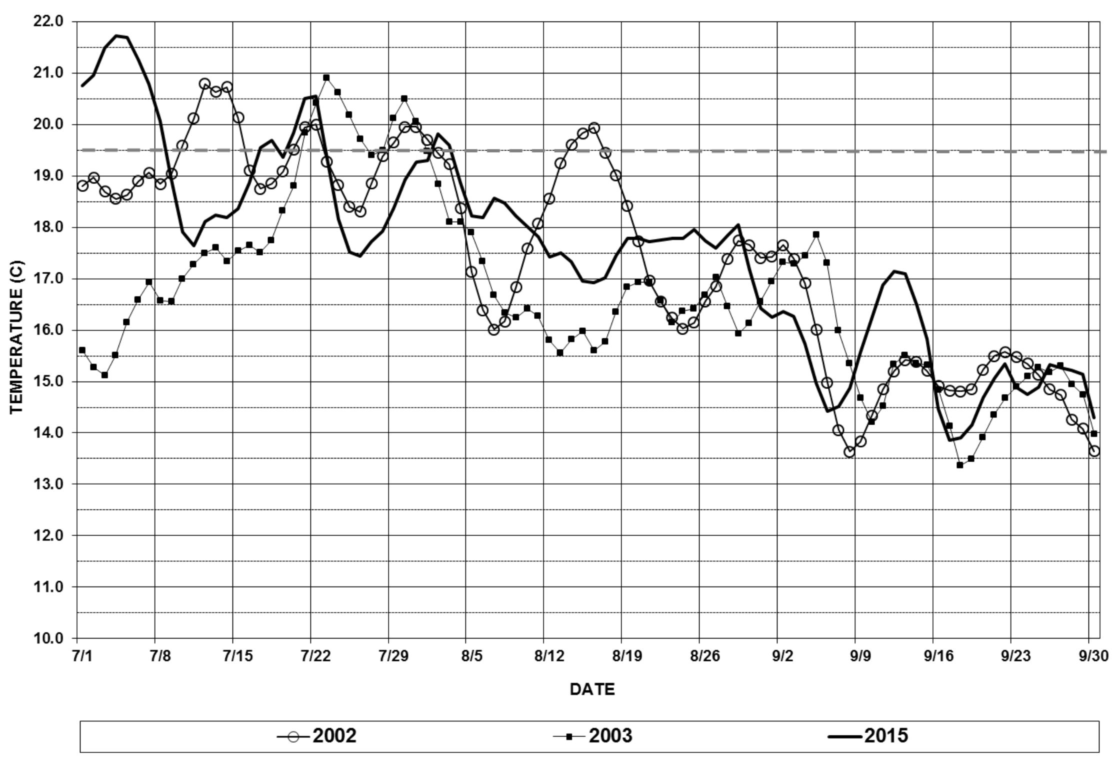
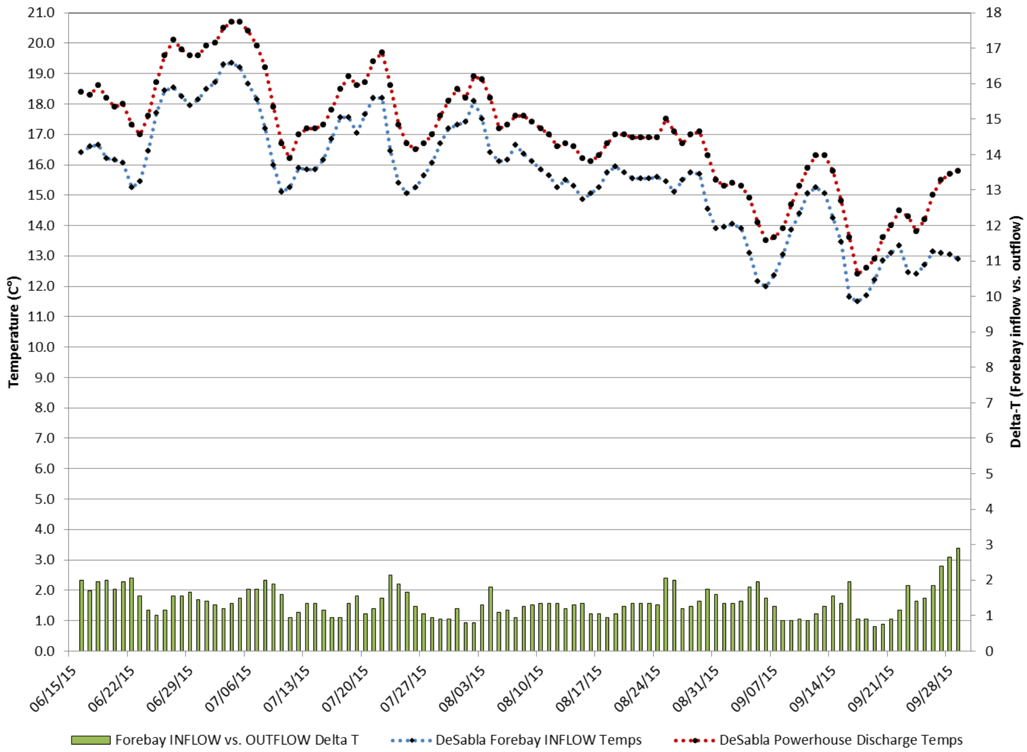


Figure 6. Mean daily water inflow and outflow temperatures (C) at DeSabla Forebay. Delta –T from June 15 – September 30, 2015.



Average heating through the DeSabla Forebay was over 1°C during the key mid-summer period, averaging 1.23°C July 15-31, 2015 and 1.15°C from Aug. 1-15, 2015 which was slightly cooler than 2014 with 1.31°C and 1.21°C, respectively. Flows into the forebay during this same mid-summer period averaged 66.9 cfs in 2015 compared to 64.4 cfs in 2014. The recommended flows through the DeSabla forebay of 108 cfs has not been meet since 2011 due to the prolonged drought conditions in the watershed.

Mean daily heating in the reach from the CVHD to immediately upstream of the CVPH (bypass reach: the reaches between the Lower Centerville Head Dam and CVPH) ranged from 1.30°C to 2.4°C during July and August 2015 with average heating of 1.87°C. The minimum instream flow requirement for the bypass reach is 40 cfs (Kimmerer, 1989; PG&E, 1993). For the 2015 water year, flows were not diverted to the LCC leaving the full natural flow of Butte Creek in the bypass reach. In past years, when flows were conveyed via the LCC to the CVPH, water temperatures released downstream of the CVPH from the LCC were cooler due to the shorter conveyance time and shading.

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	Per Mile	Total	Per Mile	Total	Per Mile	Total	Per Mile	Total	Per Mile	Total	Per Mile
Hendricks Head Dam to Toadtown Canal Gauge-2003 (Site S2 to S3, 10.28 miles)	2015	0.95	0.09	0.80	0.08	0.53	0.05	0.73	0.07	0.79	0.08	1.12	0.11
	2014	1.78	0.17	1.86	0.18	0.42	0.04	0.15	0.01	0.19	0.02	0.23	0.02
	2013	0.83	0.08	0.94	0.09	0.58	0.06	0.50	0.05	0.52	0.05	0.61	0.06
	2012	0.74	0.07	0.79	0.08	0.79	0.08	0.48	0.05	0.56	0.05	0.87	0.08
	2011	0.64	0.06	0.46	0.05	0.50	0.04	0.46	0.04	0.42	0.04	0.40	0.04
	2010	0.57	0.06	0.61	0.06	0.72	0.07	0.63	0.06	0.36	0.04	0.47	0.05
	2009	0.59	0.06	0.93	0.09	0.73	0.07	0.55	0.05	0.44	0.04	0.91	0.09
	2008	0.75	0.07	0.83	0.08	0.74	0.07	0.60	0.06	0.52	0.05	0.82	0.08
	2007	0.76	0.07	0.69	0.07	0.47	0.05	0.56	0.05	0.66	0.06	0.51	0.05
Toadtown Canal Gauge to DeSabla Forebay [2/] - (Site S3 to S4, 0.88 miles)	2015	0.06	0.07	0.04	0.05	0.07	0.08	0.06	0.07	0.02	0.03	-0.04	-0.04
	2014	0.06	0.06	-0.03	-0.03	0.04	0.05	0.05	0.06	0.01	0.02	-0.04	-0.05
	2013	0.05	0.05	0.08	0.09	0.05	0.05	0.07	0.08	0.06	0.07	-0.07	-0.08
	2012	0.05	0.06	0.06	0.07	0.05	0.05	0.13	0.15	0.07	0.08	0.01	0.01
	2011	-0.14	-0.16	-0.03	-0.03	-0.01	-0.01	0.04	0.05	0.12	0.14	0.12	0.14
	2010	1.21	-1.38	0.85	0.97	-0.78	-0.88	-1.83	-2.08	-1.30	-1.47	2.21	2.51
	2009	-0.57	-0.65	1.10	1.25	-0.10	-0.12	-0.04	-0.05	-0.02	-0.02	4.14	4.70
	2008	0.19	0.22	-0.19	-0.22	0.66	0.75	0.88	1.00	0.18	0.20	-1.81	2.06
	2007	0.18	0.21	0.11	0.12	0.03	0.03	0.05	0.06	0.03	0.03	-0.05	-0.06
DeSabla Forebay to DeSabla Powerhouse Outfall (Site S4 to S5, 1.35 miles)	2015	1.38	1.02	1.24	0.92	1.15	0.85	1.31	0.97	1.26	0.93	1.59	1.18
	2014	1.45	1.07	1.29	0.95	1.21	0.89	1.40	1.04	1.47	1.09	2.11	1.56
	2013	1.23	0.91	1.28	0.95	1.15	0.85	1.08	0.80	1.07	0.79	1.20	0.89
	2012	1.07	0.79	1.12	0.83	1.07	0.80	1.22	0.90	1.19	0.88	1.19	0.88
	2011	0.91	0.68	0.81	0.60	0.88	0.65	0.85	0.63	0.82	0.61	0.84	0.62
	2010	0.86	0.63	1.06	0.79	1.03	0.76	1.09	0.81	.089	0.66	0.87	0.64
	2009	1.16	0.86	1.19	0.88	1.33	0.99	1.14	0.85	1.10	0.82	1.53	1.13
	2008	1.30	0.96	1.68	1.25	1.48	1.10	1.58	1.18	1.48	1.09	2.18	1.61
	2007	1.22	0.90	1.27	0.94	1.25	0.93	1.18	0.87	1.46	1.08	1.15	0.85
DeSabla Powerhouse Outflow to Centerville Head Dam [3/] - (Site S5 to S6, 0.14 miles)	2015	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
	2014	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
	2013	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
	2012	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
	2011	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
	2010	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
	2009	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
	2008	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
	2007	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Centerville Head Dam via Centerville Canal to Centerville Powerhouse Outflow –(Site S6 to S10/11, 8.19 miles)	2015	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
	2014	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
	2013	2.27	0.28	2.22	0.27	2.22	0.27	2.12	0.26	2.06	0.25	1.99	0.24
	2012	0.93	0.11	0.98	0.12	1.09	0.13	0.98	0.12	1.24	0.15	1.79	0.22
	2011	1.08	0.13	0.94	0.11	0.90	0.11	0.82	0.10	0.70	0.09	0.91	0.11
	2010	0.78	0.09	0.74	0.09	0.77	0.09	0.82	0.10	0.72	0.09	0.95	0.12
	2009	0.92	0.11	1.12	0.14	1.12	0.14	1.08	0.13	0.98	0.12	1.00	0.12
	2008	0.80	0.10	0.90	0.11	0.99	0.12	0.94	0.12	0.95	0.12	1.85	0.23
	2007	1.13	0.14	1.08	0.13	0.85	0.10	0.95	0.12	1.04	0.13	0.79	0.10
Centerville Head Dam via Creek to immediately above Centerville Powerhouse Outflow – (Site S6 to S11, 6.62 miles)	2015	2.01	0.30	1.88	0.28	1.77	0.27	1.81	0.27	1.76	0.27	1.72	0.26
	2014	1.94	0.29	2.02	0.30	1.91	0.29	1.95	0.29	1.95	0.30	1.79	0.27
	2013	2.64	0.40	2.52	0.38	2.39	0.36	2.18	0.33	2.14	0.32	1.97	0.30
	2012	2.58	.039	2.61	0.39	2.49	0.38	2.40	0.36	2.15	0.32	1.78	0.27
	2011	1.47	0.22	1.67	0.25	2.00	0.30	2.14	0.32	2.20	0.33	1.89	0.29
	2010	1.95	0.29	2.53	0.38	2.63	0.40	2.55	0.38	2.22	0.34	2.02	0.31
	2009	2.47	0.37	2.71	0.41	2.58	0.39	2.37	0.36	2.17	0.33	2.00	0.30
	2008	2.59	0.39	2.85	0.43	2.74	0.41	2.53	0.38	2.43	0.37	1.72	0.26
	2007	3.27	0.49	3.20	0.48	3.03	0.46	2.95	0.45	2.75	0.42	2.35	0.36

Table 6 (continued). 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	Per Mile	Total	Per Mile	Total	Per Mile	Total	Per Mile	Total	Per Mile	Total	Per Mile
Centerville Head Dam to Quartz Bowl Pool – (Map site S6 to S7, 1.03 miles)	2015	0.35	0.34	0.31	0.30	0.31	0.30	0.31	0.30	0.31	0.30	0.33	0.32
	2014	0.44	0.43	0.48	0.47	0.48	0.47	0.46	0.45	0.45	0.44	0.47	0.46
	2013	0.61	0.60	0.75	0.73	0.61	0.60	0.53	0.51	0.52	0.50	0.84	0.81
	2012	0.63	0.61	0.63	0.61	0.62	0.60	0.58	0.56	0.57	0.55	0.50	0.48
	2011	0.46	0.44	0.50	0.49	0.53	0.51	0.56	0.54	0.58	0.56	0.52	0.50
	2010	0.52	0.51	0.58	0.56	0.59	0.57	0.58	0.56	0.53	0.51	0.53	0.52
	2009	0.53	0.52	0.60	0.58	0.56	0.54	0.52	0.51	0.51	0.50	0.47	0.46
	2008	0.60	0.58	0.56	0.54	0.56	0.54	0.51	0.50	0.50	0.48	0.37	0.36
	2007	0.68	0.66	0.60	0.59	0.52	0.51	0.56	0.55	0.54	0.52	0.52	0.50
Quartz Bowl Pool to Chimney Rock (Site S7 to S8, 1.27 miles)	2015	0.50	0.40	0.57	0.45	0.57	0.45	0.54	0.43	0.51	0.40	0.42	0.33
	2014	0.52	0.41	0.58	0.46	0.59	0.47	0.56	0.44	0.52	0.41	0.43	0.34
	2013	0.52	0.41	0.52	0.41	0.53	0.41	0.53	0.42	0.53	0.42	0.54	0.42
	2012	0.63	05.0	0.63	0.50	0.62	0.49	0.62	0.49	0.63	0.49	0.64	0.50
	2011	0.26	0.20	0.26	0.20	0.26	0.21	0.26	0.21	0.26	0.21	0.27	0.21
	2010	0.49	0.39	0.49	0.39	0.49	0.39	0.50	0.39	0.51	0.40	0.51	0.40
	2009	0.53	0.42	0.55	0.43	0.54	0.43	0.50	0.39	0.45	0.36	0.41	0.33
	2008	0.52	0.41	0.60	0.47	0.56	0.44	0.55	0.43	0.53	0.41	0.39	0.30
	2007	0.66	0.52	0.71	0.56	0.71	0.56	0.67	0.53	0.65	0.51	0.52	0.41
Chimney Rock to Pool 4 (Site S8 to S9, 2.19 miles)	2015	0.66	0.30	0.62	0.28	0.58	0.26	0.60	0.27	0.60	0.27	0.58	0.27
	2014	0.72	0.33	0.72	0.33	0.71	0.32	0.67	0.30	0.69	0.31	0.69	0.31
	2013	0.78	0.36	0.74	0.34	0.71	0.33	0.65	0.30	0.63	0.29	0.57	0.26
	2012	0.67	0.31	0.66	0.30	0.69	0.31	0.71	0.32	0.64	0.29	0.52	0.24
	2011	0.35	0.16	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
	2010	0.42	0.19	0.61	0.28	0.68	0.31	0.69	0.31	0.59	0.27	.051	0.23
	2009	0.79	0.36	0.84	0.38	0.81	0.37	0.76	0.35	0.70	0.32	0.69	0.31
	2008	0.78	0.36	0.89	0.41	0.82	0.38	0.77	0.35	0.77	0.35	0.59	0.27
	2007	1.04	0.48	1.01	0.46	0.99	0.45	0.96	0.44	0.89	0.41	0.73	0.33
Pool 4 to immediately above Centerville Powerhouse Outflow –(Site S9 to S11, 2.13 miles)	2015	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
	2014	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
	2013	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
	2012	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
	2011	0.40	0.19	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
	2010	0.53	0.25	0.74	0.35	0.75	0.35	0.68	0.32	0.58	0.27	0.49	0.23
	2009	0.79	0.36	0.84	0.38	0.81	0.37	0.76	0.35	0.70	0.32	0.69	0.31
	2008	0.69	0.33	0.80	0.38	0.80	0.38	0.70	0.33	0.64	0.30	0.40	0.19
	2007	0.86	0.40	0.87	0.41	0.81	0.38	0.76	0.36	0.67	0.31	0.54	0.25

[1/] See Figure 1.
[2/] Values for 2005 & 2006 are calculated Butte Canal plus Toadtown Canal.
[3/] Values for 2005 & 2006 are calculated Butte Creek above DSPH plus DSPH outflow.
nd = No Data

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)	2015	36	16.2	41	15.7	43	15.9	35	14.9	27	13.2	20	11.7
	2014	30	15.6	40	15.3	39	15.8	30	14.9	26	13.6	19	12.4
	2013	54	15.0	47	15.6	54	13.9	56	14.9	54	14.3	29	10.6
	2012	60	13.9	54	13.4	57	14.1	58	14.4	49	13.2	35	12.1
	2011	122	10.8	124	12.8	109	12.7	95	12.6	76	13.5	66	12.3
	2010	75	13.3	85	15.4	75	13.4	71	12.4	73	12.5	56	11.6
	2009	42	14.2	48	14.8	39	13.8	41	14.6	38	13.7	27	12.6
	2008	48	14.7	46	14.0	41	14.3	39	15.7	36	13.6	22	12.2
	2007	64	14.4	52	14.4	57	14.6	52	14.8	39	13.5	31	10.4

Table 7 (continued). 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
Toadtown Canal Above Butte Canal (Site S3)	2015	31	17.1	37	16.5	40	16.4	32	15.6	23	14.0	13	12.9
	2014	32	17.4	44	17.1	44	16.2	31	15.1	22	13.7	15	12.6
	2013	49	15.9	43	16.5	51	14.5	49	15.4	46	14.8	24	11.2
	2012	52	14.7	46	14.2	49	14.9	50	14.9	33	13.8	26	13.0
	2011	112	11.5	112	13.2	98	13.2	84	13.1	66	13.9	58	12.7
	2010	100	13.9	70	16.0	61	14.1	60	13.1	61	12.9	45	12.1
	2009	44	14.8	47	15.7	41	14.5	43	15.1	40	14.1	23	13.5
	2008	52	15.4	50	14.8	45	15.1	43	16.3	40	14.1	14	13.0
	2007	60	15.2	54	15.1	54	15.0	50	15.4	40	14.2	32	10.9
DeSabla Forebay Inflow (Site S4) (for 2005-2009 is Butte Canal + Toadtown Canal)	2015	62	17.4	66	17.0	68	16.0	60	15.1	49	13.4	35	12.3
	2014	62.3	16.7	73.9	16.1	73.7	16.3	59.3	15.6	49.2	14.4	44.3	13.2
	2013	92	16.4	82	16.8	88	14.3	85	14.7	82	13.9	60	10.4
	2012	96	15.1	84	14.8	85	15.5	84	14.1	67	12.9	57	12.0
	2011	174	12.2	178	13.6	161	13.5	139	13.3	114	13.6	103	12.2
	2010	167	14.3	121	16.1	104	14.2	98	13.3	101	12.6	80	11.7
	2009	86	14.9	83	16.3	74	14.8	74	15.1	70	13.9	52	13.1
	2008	84	15.7	77	15.2	73	15.4	71	16.2	68	13.8	41	12.5
	2007	106	15.7	98	15.3	95	15.0	91	15.1	80	13.9	75	10.5
Butte Creek Above DeSabla PH Discharge (Site S5), PG&E temporary gauge 2004-06	2015	nr	nr	nr	nr	nr	nr	nr	nr	nr	nr	nr	nr
	2014	nr	nr	nr	nr	nr	nr	nr	nr	nr	nr	nr	nr
	2013	nr	nr	nr	nr	nr	nr	nr	nr	nr	nr	nr	nr
	2012	nr	nr	nr	nr	nr	nr	nr	nr	nr	nr	nr	nr
	2011	nr	nr	nr	nr	nr	nr	nr	nr	nr	nr	nr	nr
	2010	nr	nr	nr	nr	nr	nr	nr	nr	nr	nr	nr	nr
	2009	nr	nr	nr	nr	nr	nr	nr	nr	nr	nr	nr	nr
	2008	nr	nr	nr	nr	nr	nr	nr	nr	nr	nr	nr	nr
	2007	nr	19.4	nr	18.9	nr	18.1	nr	18.3	nr	17.4	nr	13.5
DeSabla PH Discharge (Below site S5)	2015	59	18.7	62	18.0	64	17.4	51	16.7	45	14.2	25	14.1
	2014	55	18.5	65	17.9	64	17.5	51	16.8	45	15.0	39	15.0
	2013	82	17.4	72	18.0	76	15.6	73	16.2	69	12.2	52	12.0
	2012	93	16.0	80	15.7	75	16.3	75	15.8	57	14.6	40	13.7
	2011	161	13.1	164	14.4	152	14.4	123	14.1	108	14.4	97	13.1
	2010	152	15.2	117	17.1	99	15.2	92	14.4	91	13.5	75	12.5
	2009	82	16.1	78	17.5	69	16.2	68	16.2	64	15.0	45	14.6
	2008	76	17.0	63	16.9	65	16.9	62	17.8	58	15.4	32	14.5
	2007	101	16.9	91	16.6	90	16.2	85	16.3	68	15.4	69	11.4
Below Centerville Head Dam (Site S6), (for 2005 flow is as measured immediately above CVPH)	2015	87	19.4	89	18.6	91	18.0	82	17.2	75	14.5	70	14.5
	2014	92	19.0	96	18.5	95	18.1	75	17.3	65	15.4	64	15.4
	2013	70	18.0	62	18.6	73	16.2	74	16.7	67	12.9	80	12.7
	2012	65	16.7	61	16.4	61	17.0	61	16.3	61	15.1	77	14.5
	2011	341	14.0	222	15.1	137	15.1	103	14.8	72	15.0	100	13.6
	2010	173	15.9	77	17.8	69	15.9	69	15.0	69	14.0	73	13.1
	2009	55	16.6	54	18.3	56	16.8	54	16.7	54	15.5	61	15.0
	2008	50	17.4	50	17.4	50	17.2	50	18.0	53	15.5	65	14.7
	2007	50	17.3	49	17.0	47	16.5	48	16.7	52	15.8	59	11.9
Quartz Bowl (Site S7)	2015	87	19.7	89	18.9	91	18.3	82	17.5	75	15.9	70	14.8
	2014	92	19.4	96	19.0	95	18.6	75	17.7	65	16.4	64	15.9
	2013	70	18.6	62	19.3	73	16.8	74	17.3	67	16.6	80	13.5
	2012	65	17.3	61	17.0	61	17.6	61	16.9	61	15.6	77	15.0
	2011	341	14.5	222	15.6	137	15.7	103	15.3	72	15.6	100	14.1
	2010	173	16.4	77	18.4	69	16.5	69	15.6	69	14.5	73	13.7
	2009	55	17.2	54	18.9	56	17.4	54	17.2	54	16.0	61	15.5
	2008	50	18.0	50	17.9	50	17.8	50	18.5	53	16.0	65	14.6
	2007	50	18.0	49	17.6	47	17.0	48	17.2	52	16.3	59	12.1
Chimney Rock (Site S8	2015	87	20.1	89	19.3	91	18.6	82	17.9	75	16.2	70	15.1
	2014	92	19.8	96	19.4	95	18.9	75	18.1	65	16.8	64	16.2
	2013	70	19.1	62	19.7	73	17.2	74	17.7	67	17.0	80	13.6
	2012	65	17.8	61	17.5	61	18.1	61	17.3	61	16.0	77	15.4
	2011	341	14.7	222	15.9	137	16.1	103	15.8	72	16.1	100	14.5
	2010	173	17.7	77	19.0	69	17.1	69	16.2	69	15.1	73	14.2
	2009	55	17.7	54	19.4	56	17.9	54	17.7	54	16.4	61	15.9
	2008	50	18.6	50	18.5	50	18.4	50	19.1	53	16.6	65	15.0

Table 7 (continued). 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.

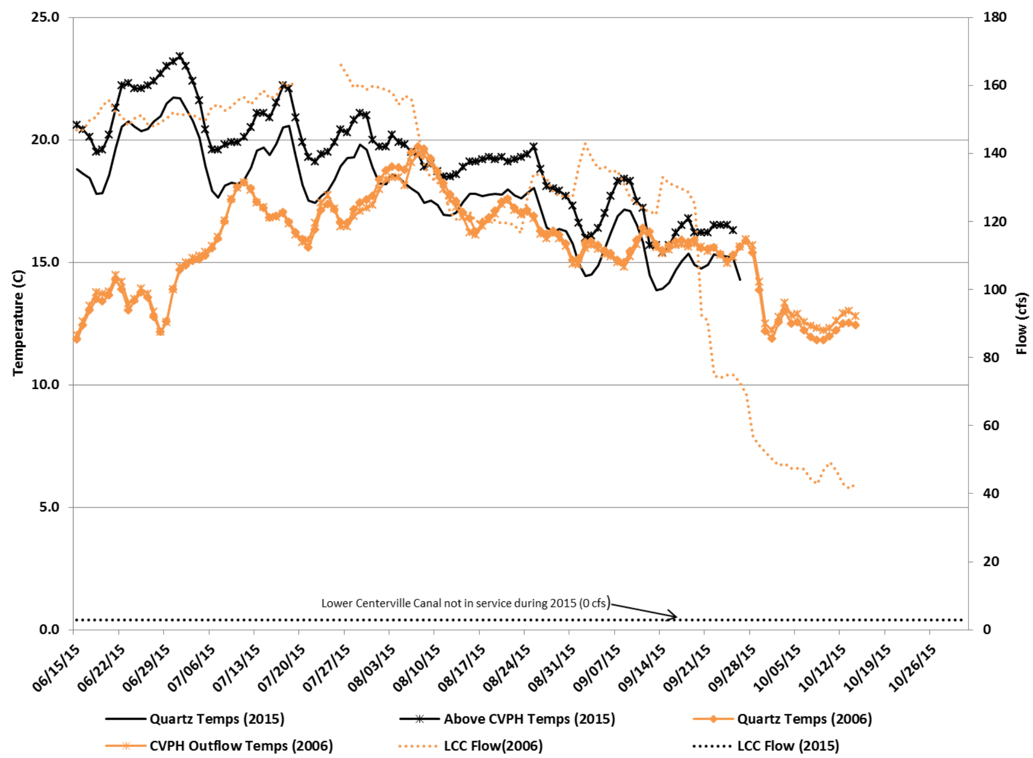
Locations[1/]		July 1-15		July 16-31		Aug. 1-15		Aug. 16-31		Sept. 1-15		Sept. 16-30	
		Flow	Temp	Flow	Temp	Flow	Temp	Flow	Temp	Flow	Temp	Flow	Temp
Pool 4 (Site S9)	2015	87	20.8	89	19.9	91	19.2	82	18.5	75	16.8	70	15.7
	2014	92	20.5	96	20.1	95	19.6	75	18.8	65	17.5	64	16.8
	2013	70	19.9	62	20.4	73	17.9	74	18.4	67	17.7	80	14.2
	2012	65	18.4	61	18.2	61	18.8	61	18.0	61	16.7	77	15.9
	2011	341	15.1	222	14.8	137	nr	103	nr	72	nr	100	nr
	2010	173	17.3	77	19.6	69	17.7	69	16.9	69	15.7	73	14.7
	2009	55	18.5	54	20.3	56	18.7	54	18.5	54	17.1	61	16.6
	2008	50	19.3	50	19.4	50	19.2	50	19.9	53	17.3	65	15.5
	2007	50	19.7	49	19.3	47	18.7	48	18.8	52	17.9	59	13.3
Butte Creek above Centerville PH (Site S11)	2015	87	21.4	89	20.5	91	19.7	82	19.1	75	17.4	70	16.2
	2014	92	20.9	96	20.5	95	20.0	75	19.2	65	17.9	64	17.2
	2013	70	20.6	62	21.1	73	18.5	74	18.9	67	18.2	80	14.7
	2012	65	19.2	61	19.0	61	19.5	61	18.7	61	17.2	77	16.3
	2011	341	15.5	222	16.8	137	17.1	103	16.9	72	17.2	100	15.5
	2010	173	17.8	77	20.3	69	18.5	69	17.6	69	16.2	73	15.1
	2009	55	19.1	54	21.0	56	19.4	54	19.1	54	17.6	61	17.0
	2008	50	20.0	50	20.2	50	20.0	50	20.6	53	18.0	65	16.4
	2007	50	20.6	49	20.2	47	19.5	48	19.6	52	18.6	59	14.3
Centerville PH Discharge (Site S10)	2015	nr	nr	nr	nr	nr	nr	nr	nr	nr	nr	nr	nr
	2014	nr	nr	nr	nr	nr	nr	nr	nr	nr	nr	nr	nr
	2013	49	19.3	40	19.9	33	17.6	26	18.3	27	17.4	7	16.0
	2012	67	17.6	55	17.4	51	18.1	48	17.3	31	16.3	13	16.6
	2011	79	15.1	79	16.0	80	16.0	81	15.6	80	15.7	46	14.5
	2010	50	16.7	51	18.5	49	16.6	49	15.9	49	14.7	45	14.2
	2009	49	17.6	51	19.4	47	18.0	47	17.8	46	16.4	33	16.1
	2008	60	18.2	48	18.3	49	18.2	49	19.0	46	16.5	25	16.5
	2007	68	18.8	62	18.1	59	17.3	55	17.6	46	16.9	34	12.7
Centerville Estates (Site S12)	2015	87	21.7	89	20.7	91	20.0	82	18.6	75	17.1	70	16.6
	2014	92	21.2	96	20.8	95	20.3	75	19.5	65	18.2	64	16.7
	2013	119	20.4	102	21.0	106	18.6	100	19.0	94	18.2	87	14.8
	2012	131	18.8	116	18.6	112	19.3	109	18.4	92	17.2	90	16.6
	2011	421	15.7	302	16.9	217	17.1	184	16.8	152	16.9	146	15.6
	2010	223	17.7	128	19.8	118	18.0	118	17.2	118	15.9	118	15.2
	2009	104	18.7	105	20.6	103	19.1	101	18.8	100	17.4	94	17.1
	2008	110	nr	98	nr	99	nr	99	nr	99	nr	90	nr
	2007	118	nr	111	nr	106	nr	103	nr	98	nr	93	nr
Cable Bridge (Site S13)	2015	87	22.5	89	21.7	91	20.6	82	20.1	75	18.2	70	17.1
	2014	92	nr	96	nr	95	nr	75	nr	65	nr	64	nr
	2013	119	nr	102	nr	106	nr	100	nr	94	nr	87	nr
	2012	131	19.7	116	19.5	112	20.2	109	19.2	92	17.9	90	17.2
	2011	421	16.2	302	17.6	217	17.8	184	17.5	152	17.6	146	16.2
	2010	223	18.4	128	20.6	118	18.8	118	18.0	118	16.6	118	15.8
	2009	104	19.7	105	21.5	103	20.1	101	19.7	100	18.2	94	17.9
	2008	110	nr	98	nr	99	nr	99	nr	99	nr	90	nr
	2007	118	nr	111	nr	106	nr	103	nr	98	nr	93	nr
Covered Bridge (Site S14)	2015	108	23.0	74	22.2	76	21.1	81	20.5	71	18.5	66	17.5
	2014	85	22.7	92	22.3	97	21.5	96	20.8	82	19.4	76	18.4
	2013	112	22.1	108	22.6	115	20.2	113	20.5	108	19.6	102	16.0
	2012	153	20.4	134	20.2	131	20.9	126	19.9	93	18.5	83	17.8
	2011	397	16.8	286	18.1	241	18.5	199	18.1	166	18.2	154	16.7
	2010	290	19.0	186	21.3	149	19.5	137	18.6	133	17.2	117	16.3
	2009	190	20.6	164	22.5	125	21.0	106	20.6	96	19.1	76	20.4
	2008	117	20.6	102	21.0	95	20.9	90	21.5	84	18.9	70	17.4
	2007	151	21.3	152	21.1	129	20.3	118	20.5	113	19.7	110	15.0

[1/] See Figure 1.

nr = No Record

Water temperatures during the 2015 holding period measured below the CVPH where substantially warmer than water temperatures in the Quartz Bowl Pool reach due to low natural flows within the watershed. During the 2015 holding period all available flow was being delivered to the bypass reach of Butte Creek. In previous years flow was split between Butte Creek and the LCC, this provided a temperature benefit in the reaches below the Centerville Powerhouse. This was observed in the 2006 holding period when LCC flows were near capacity and discharged from the Centerville Powerhouse (Figure 7). Historically, blending water from the LCC with existing water in the Butte Creek has had a beneficial effect on SRCS holding and spawning distribution downstream of the CVPH, with fish distribution closer to 60% above the CVPH to 40% below the CVPH. The effects of full flow running through Butte Creek on holding and spawning distributions needs to be better evaluated across water year types. Similar to 2014, a smaller percentage of salmon were holding downstream of CVPH in 2015, so the 2015 operations benefited the majority of salmon by keeping flows in the reaches above the CVPH.

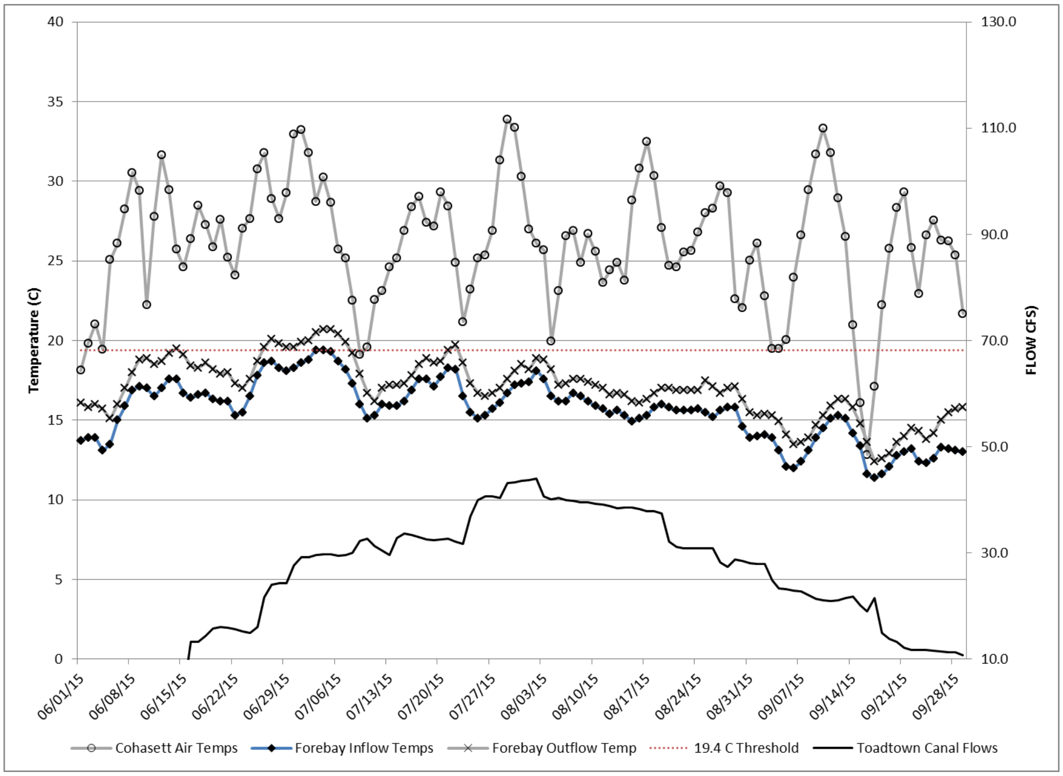
Figure 7. Mean daily water temperatures (C) and flows (cfs) at Quartz Bowl and upstream of CVPH for 2015 and 2006.



The PG&E temperature contingency plan was implemented on five different occasions during the June-July 2015 period based upon air temperature forecasts provided by PG&E meteorologists. Severe drought conditions prohibited Round Valley Reservoir from filling up and no flows were drafted from the reservoir the entire spring/summer period. Releases from Philbrook Reservoir to augment flows into Butte Creek were initiated on June 24, 2015 and were increased on June 29, July 1, July 15, and July 29 to mitigate rising water temperatures during predicted heat events throughout the summer. Temperature mitigation releases from Philbrook Reservoir ended on September 14, 2015.

Ambient air temperatures from the Chester station for the month of June were classified as “Hot” above the 0% exceedance with July, August and September classified as “above normal”. The Paradise/Cohasett station for June was also classified as “Hot” and was in the 2% exceedance range. These higher than normal air temperatures in the upper watershed combined with low natural flows in the West Branch Feather River and Toadtown Canal contributed to increased DeSabla forebay outflow temperatures. Water temperatures reached the 19.4°C threshold in mid-June for a short period of time and intensified for a prolonged period in late-June through early July (Figure 8).

Figure 8. DeSabla Forebay and Toadtown Canal temperatures (C) and flows (cfs) during June - September 2015 period.



Flows and temperatures within the SRCS holding and spawning reach of Butte Creek are directly affected by the PG&E DeSabla-Centerville Project (FERC-803). Of interest is whether the project as currently operated provides a benefit to SRCS on Butte Creek. It was concluded during previous reviews conducted from 2003 through 2014, that the current method of operation provided a net benefit to both holding and spawning for Butte Creek SRCS (Ward et al., 2004b; Ward et al., 2006a,b; Ward et al., 2007-1). For the 2015 season, and the third consecutive year, California experienced one of the driest periods in recorded history and the natural flow of Butte Creek was at very low levels entering the summer holding period. As a result, in 2015, the Resource Group decided to deliver all the flow to the bypass reach upstream of the CVPH with no flows delivered via the LCC. As the summer progressed, salmon holding distribution continued to ascend upstream where cooler water was available due to the full flow in the traditional bypass section.

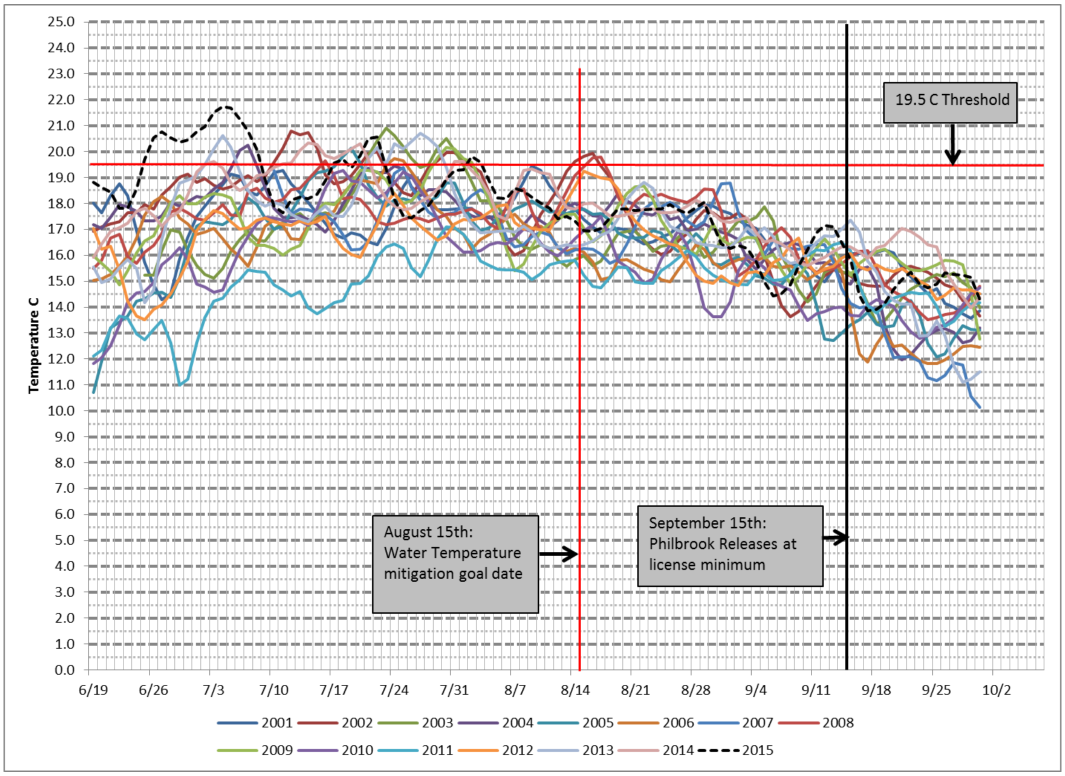
Prior to conducting the summer snorkel survey, data from a Vaki Riverwatcher(Vaki) located at Durham Mutual fish ladder indicated that 1939 adult SRCS ascended the ladder and migrated upstream of the Vaki by early June. The unprecedented “hot” June period and low flows lead to the discovery of pre-spawn mortalities outside of the project area. Several surveys were conducted from the Centerville Covered Bridge downstream to the Oro-Chico Highway using CDFW Drought Funds. Approximately 300 carcasses were encountered during the survey efforts and chopped in half and recorded. Of the total number of fish that had previously moved through the Vaki, this early season event decreased the number of spring-run in Butte Creek to approximately 1600 fish available to be observed during the snorkel survey. After the summer snorkel survey estimate of 1,082, distribution was determined to be 95% and 5% holding upstream and downstream of the CVPH, respectively. As the summer holding period progressed from June through late August, the number of fish holding downstream of the CVPH diminished. Approximately 51 fish were seen holding in early July on the aforementioned snorkel survey and by early August, no fish were observed holding downstream of the CVPH during pre-spawning surveys. It is assumed that these fish moved upstream to seek cooler water temperatures before spawning occurred. Without the Vaki documenting the actual number of live fish passing into holding reaches of the creek, the total number of fish that escaped ocean fisheries and returned to Butte Creek would not have been known.

At the onset of spawning on September 22, 2015, flows in the reach upstream of the CVPH were approximately 70 cfs and had averaged 80.2 cfs for the entire summer holding period (FERC requirement of 40 cfs). Typically, when the LCC is in operation, with concurrence from CDFW and NOAA Fisheries, PG&E voluntarily increases flows in the reach above CVPH to increase available spawning habitat. Due to the drought conditions and the LCC outage during the 2015 spawning period, PG&E was unable to increase flows and flows were kept at 70 cfs during the spawning period.

Every year since 2001, the snorkel survey estimate has underestimated the actual number of returning adults compared to the mark re-capture models used. Due to historic drought conditions, predators/scavengers may have played a role in altering the outcome of the CJS model results. A higher density of predators/scavengers congregating around the creek may have artificially changed the number of carcasses encountered in the survey. Warmer than average air temperatures may have also contributed to an increase in the rate of decomposition of marked carcasses, therefore decreasing the likelihood of recapture. Additionally, if marked carcasses are removed from the potential recovery pool of fish, it changes the statistics of how the CJS model generates weekly estimates of marked carcasses. On several different occasions freshly marked carcasses placed in the creek for future recovery were scavenged by bears right after being returned to the water. Several crew members with multiple years of experience on the survey noted that it was the largest number of bears they had encountered on the creek during the holding and spawning periods. Our two day per week survey schedule may have been too infrequent to encounter pre-spawn mortalities during the historical drought and hot ambient air temperatures. Low creek flows may have made carcasses more visible to predators/scavengers making it easier for them to remove, taking them out of the potential carcass pool before our crews could encounter them. Decreasing the interval timing between survey days in future drought situations may aid in recovering more carcasses and may bolster the CJS model estimate. There are numerous environmental factors affecting SRCS, facing a historic drought perhaps the most daunting.

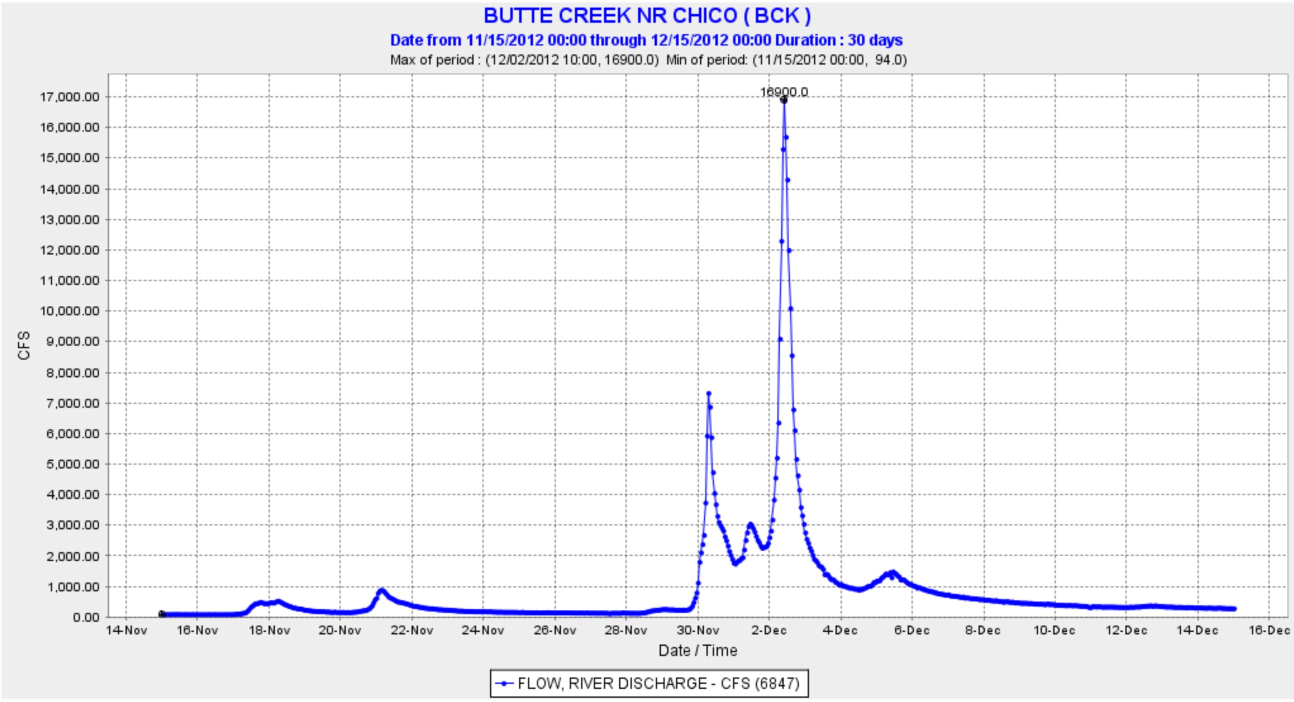
In 2004, operational changes in WBFR delivery were made in response to the large die-offs in 2002 and 2003. As a result of these changes, pre-spawn mortality were relatively low from 2004-2014. From 2001-2014 the earliest the threshold exceeded 19.4°C was on July 4 in 2013 and lasted for three days. In comparison, 2015 exceeded the threshold much earlier than previous years on June 25 and lasted much longer. There were also two additional threshold exceedance events in July and August that subjected fish to stressful water temperatures prior to spawning in mid-September (Figure 9).

Figure 9. Average daily water temperatures from 2001-2015 at Quartz Bowl pool from June 19 through September 30.



A very low returning adult population (1,082 snorkel, 413 CJS), and low holding densities per pool, most likely helped reduce disease-related mortalities during the summer holding period of 2015, despite the repeated and prolonged exposure to water temperatures considered deleterious to salmon. One possible explanation for the small returning population of adult SRCS may have been poor brood year survival of BY 2012 fry. On December 2, 2012 during the time frame of egg incubation, hatching, emergence and downstream fry emigration, flows in Butte Creek peaked at 16,900 cfs (Figure 10). The intense high flow during this period presumably scoured redds, dislodged eggs, and swept many potential fry downstream. Typically, the outmigration of Butte Creek fry occurs at a more protracted time rate and fry move volitionally downstream under less violent conditions. Any surviving fry that were not swept downstream, injured or destroyed from the high flows were subject to a very dry period in the spring of 2013.

Figure 10. Peak flow event on December 2, 2012 at CDEC Gauge Butte Creek near Chico (BCK).



2015 was the second consecutive year that minimal snowpack and run-off resulted in warmer conditions overall, with a limited volume of cold-water pooling within the reservoir. Consequently, Philbrook Reservoir started out the 2015 season approximately 3°C warmer compared to previous years. In past Philbrook Reservoir release strategies, flows would be increased based on forecasted heat events and then lowered if ambient air forecasts were not predicting imminent heat storms. In 2015, as agreed upon by the Resource Group, releases were made on a stair-step approach by incrementally increasing flows by 5-10 cfs throughout the critical holding period from early-July through early-August, keeping the volume of water at higher levels. Once the critical holding period passed, flows were incrementally decreased by the same 5-10 cfs increments until the start of spawn in mid -September. Despite poor storage and temperature conditions, this approach utilized Philbrook Reservoir storage water in a prudent and protective manner during the most critical holding period. As opposed to holding water for potential heat events late in the year, water was released proactively in a protective manner during times when it was most needed.

CONCLUSIONS AND RECOMMENDATIONS

As during 2003-2015, we continue to conclude that current PG&E project operations appear to provide a net benefit to Butte Creek SRCS, and recommend that PG&E consider the following:

- Adaptively manage project water deliveries based on real-time information regarding density and distribution of returning SRCS, water availability and temperatures.
- Implement alternatives to reduce or eliminate heating through the DeSabla Forebay.
- Schedule maintenance operations for periods after SRCS have spawned and young-of-year have emerged and prior to natural flows dropping during adult immigration and holding periods.

- Increase flows in the reach above the CVPH, when LCC is in operation and water is available at onset of SRCS spawning to maximize available spawning habitat.

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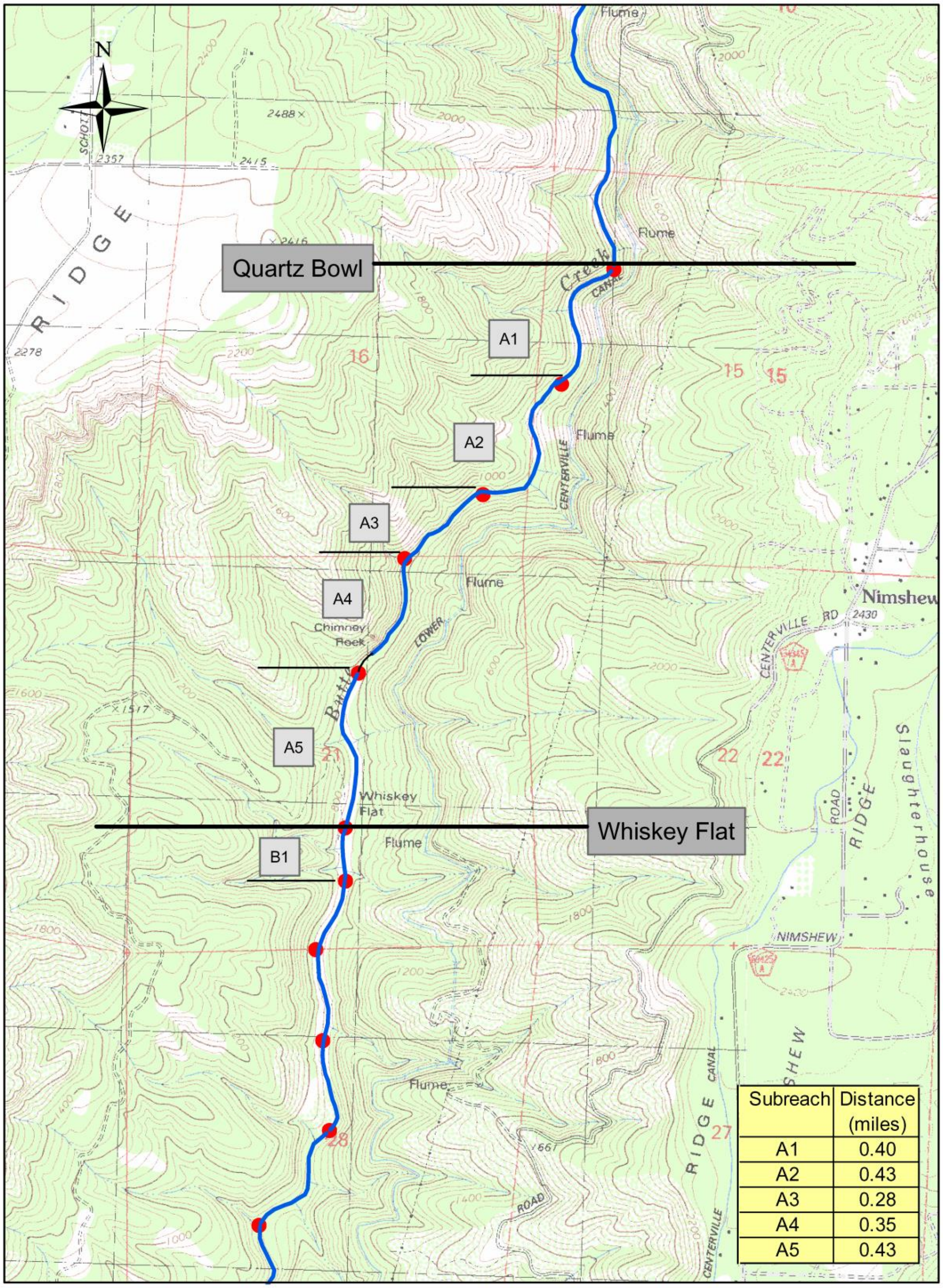
Ward, P.D., T. R. McReynolds and C. E. Garman. 2006b. Butte Creek Spring-Run Chinook Salmon, *Oncorhynchus tshawytscha*, Pre-spawn Mortality Evaluation, 2005. Calif. Dept. of Fish and Game, Inland Fisheries Admin. Report No.2006-5, 2006. 56 pp.

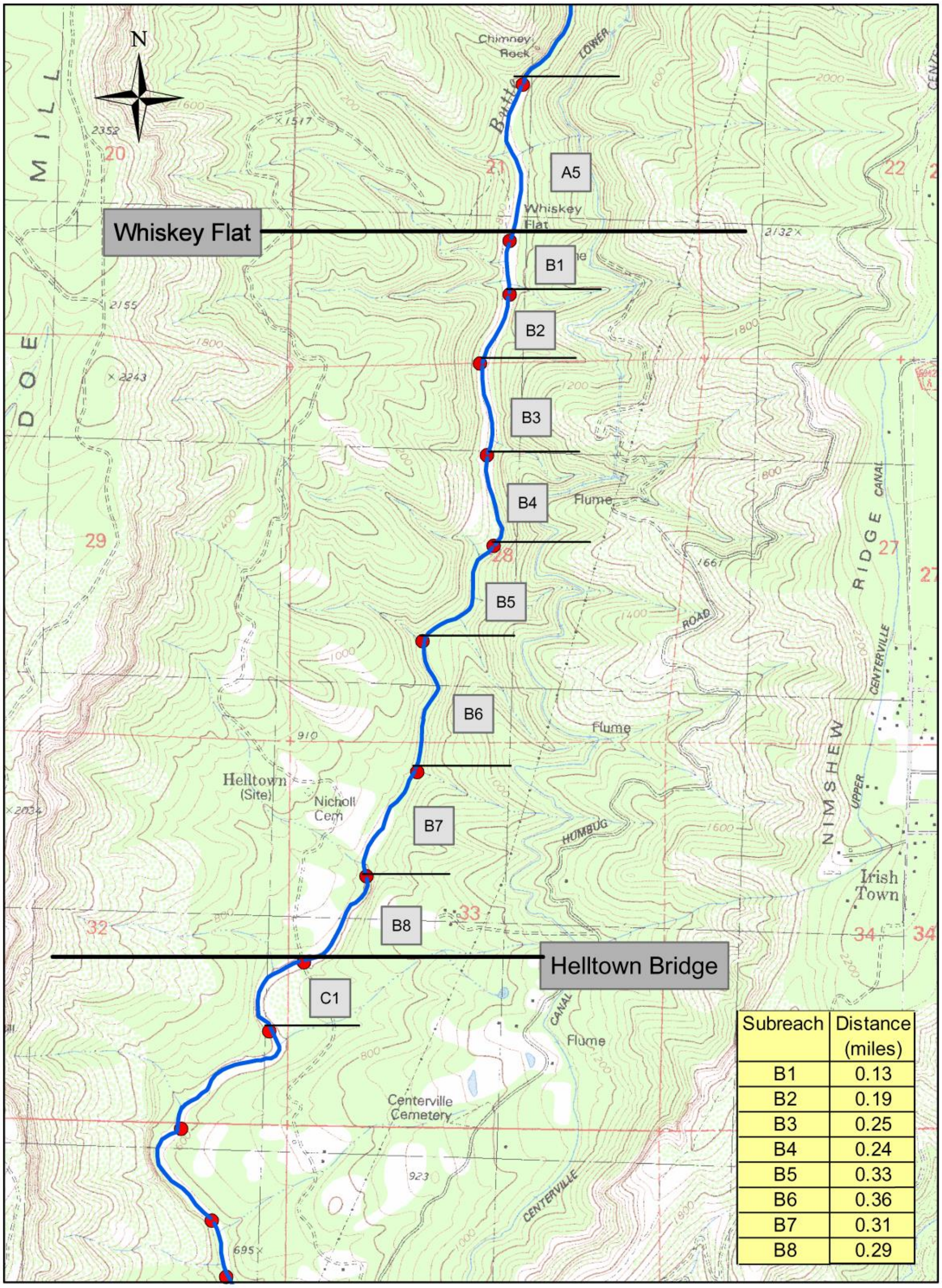
Ward, P.D., T. R. McReynolds and C. E. Garman. 2007-1. Butte Creek Spring-Run Chinook Salmon, *Oncorhynchus tshawytscha*, Pre-spawn Mortality Evaluation, 2006. Calif. Dept. of Fish and Game, Inland Fisheries Admin. Report No.2007-1, 2007. 61 pp.

APPENDIX A

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

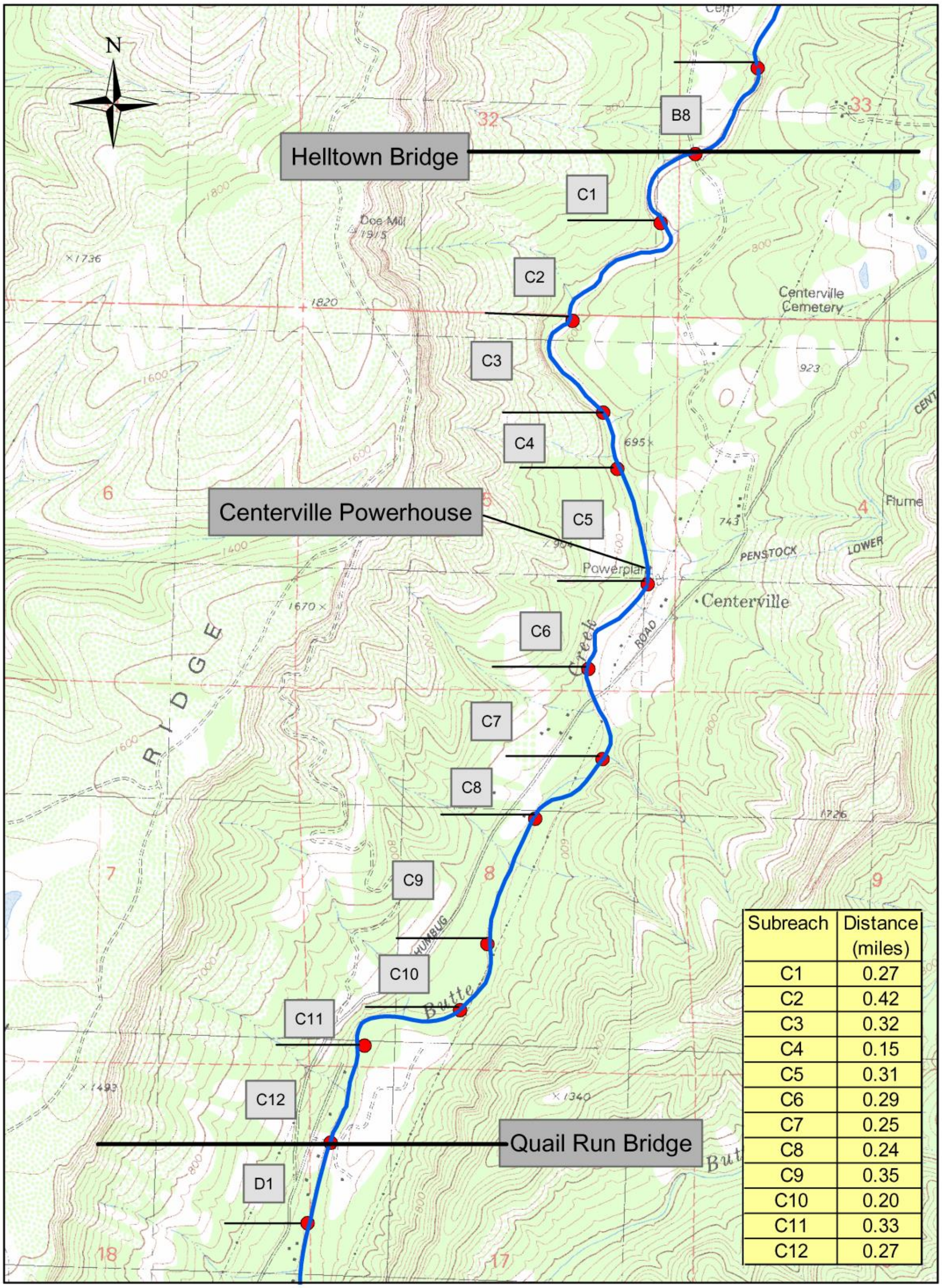


APPENDIX A, Figure 1. Map of Butte Creek SRCS holding and spawning Reach A, showing sub-reaches and distances.



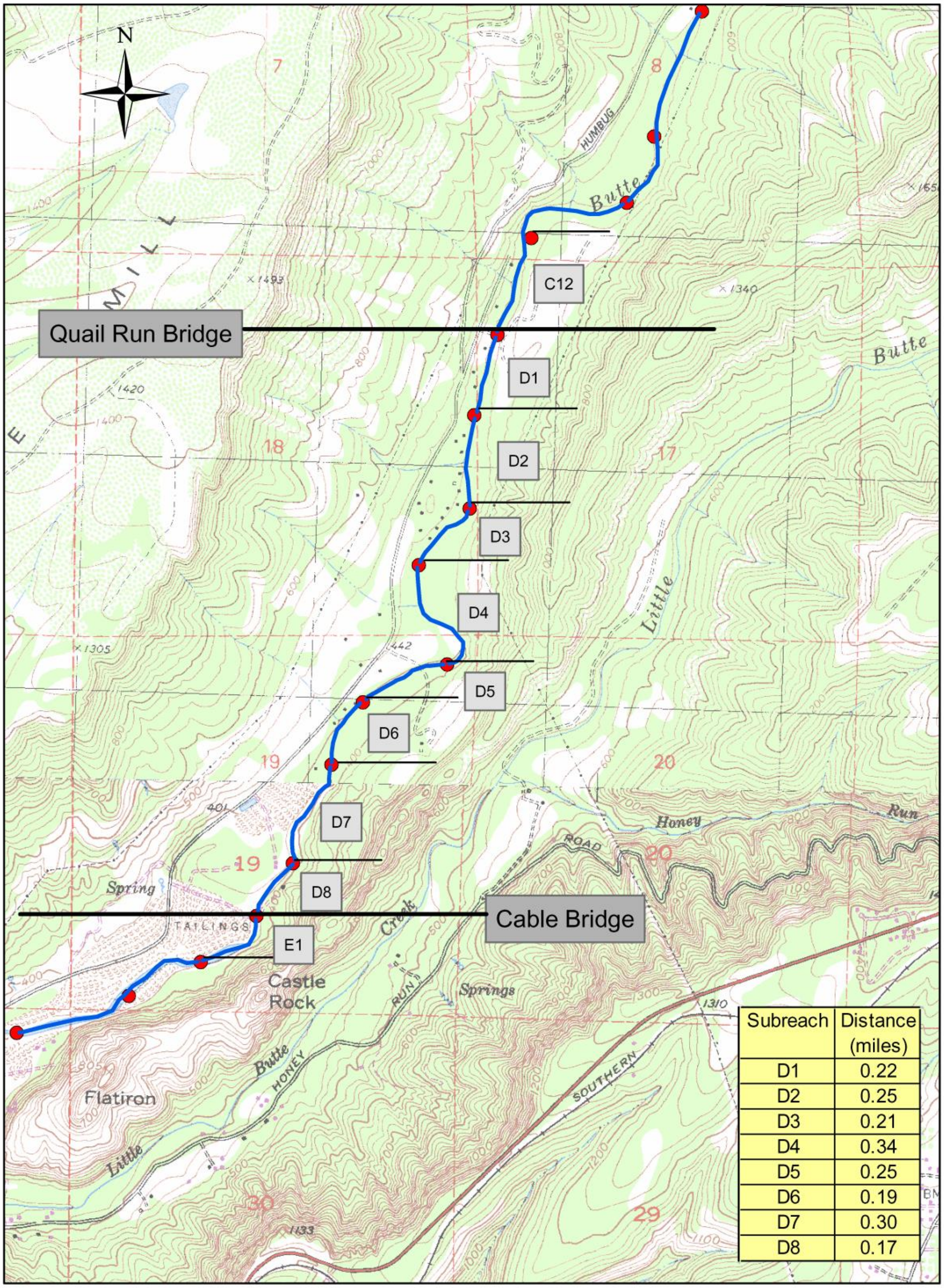
Subreach	Distance (miles)
B1	0.13
B2	0.19
B3	0.25
B4	0.24
B5	0.33
B6	0.36
B7	0.31
B8	0.29

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



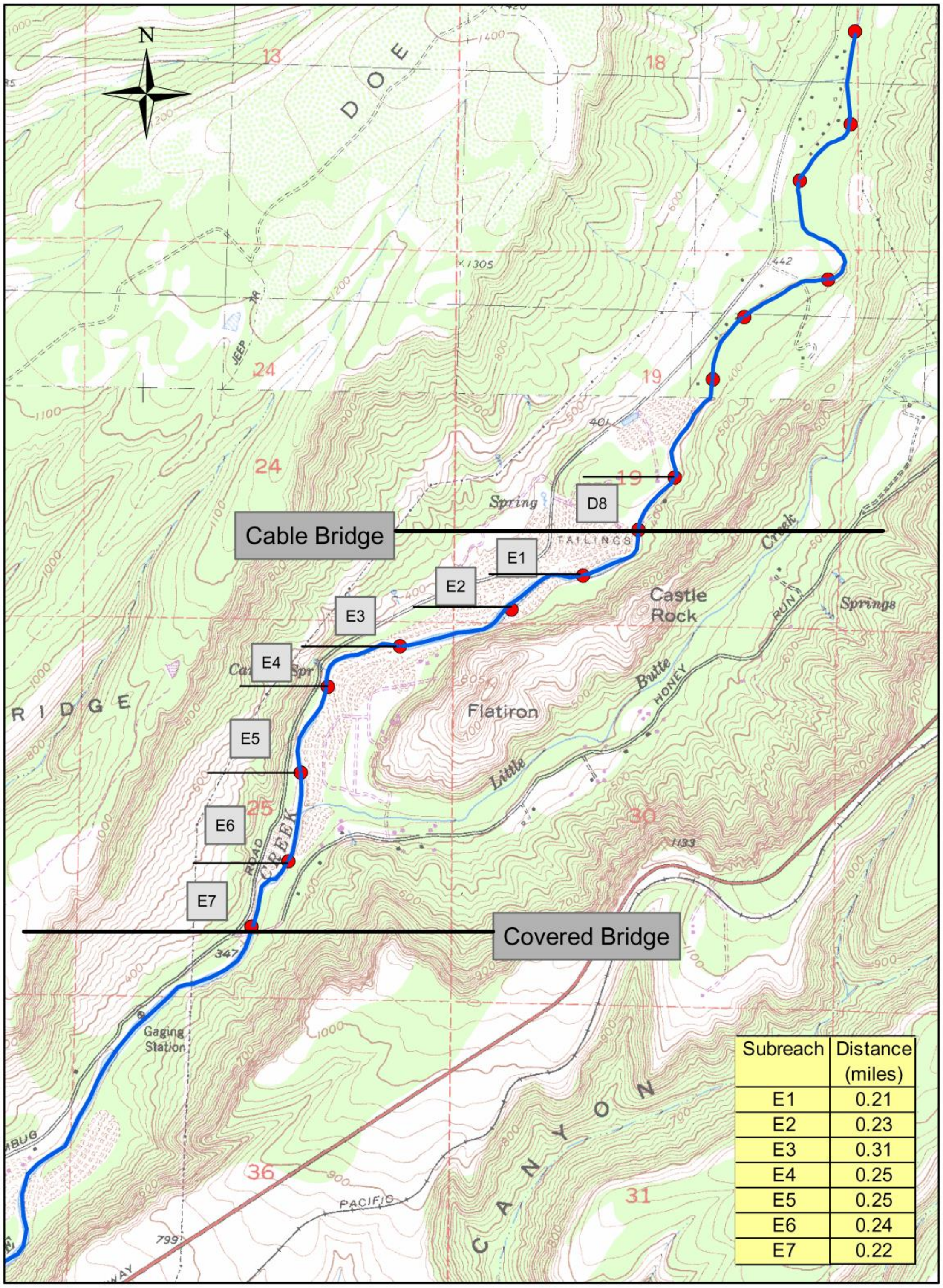
Subreach	Distance (miles)
C1	0.27
C2	0.42
C3	0.32
C4	0.15
C5	0.31
C6	0.29
C7	0.25
C8	0.24
C9	0.35
C10	0.20
C11	0.33
C12	0.27

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



Subreach	Distance (miles)
D1	0.22
D2	0.25
D3	0.21
D4	0.34
D5	0.25
D6	0.19
D7	0.30
D8	0.17

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

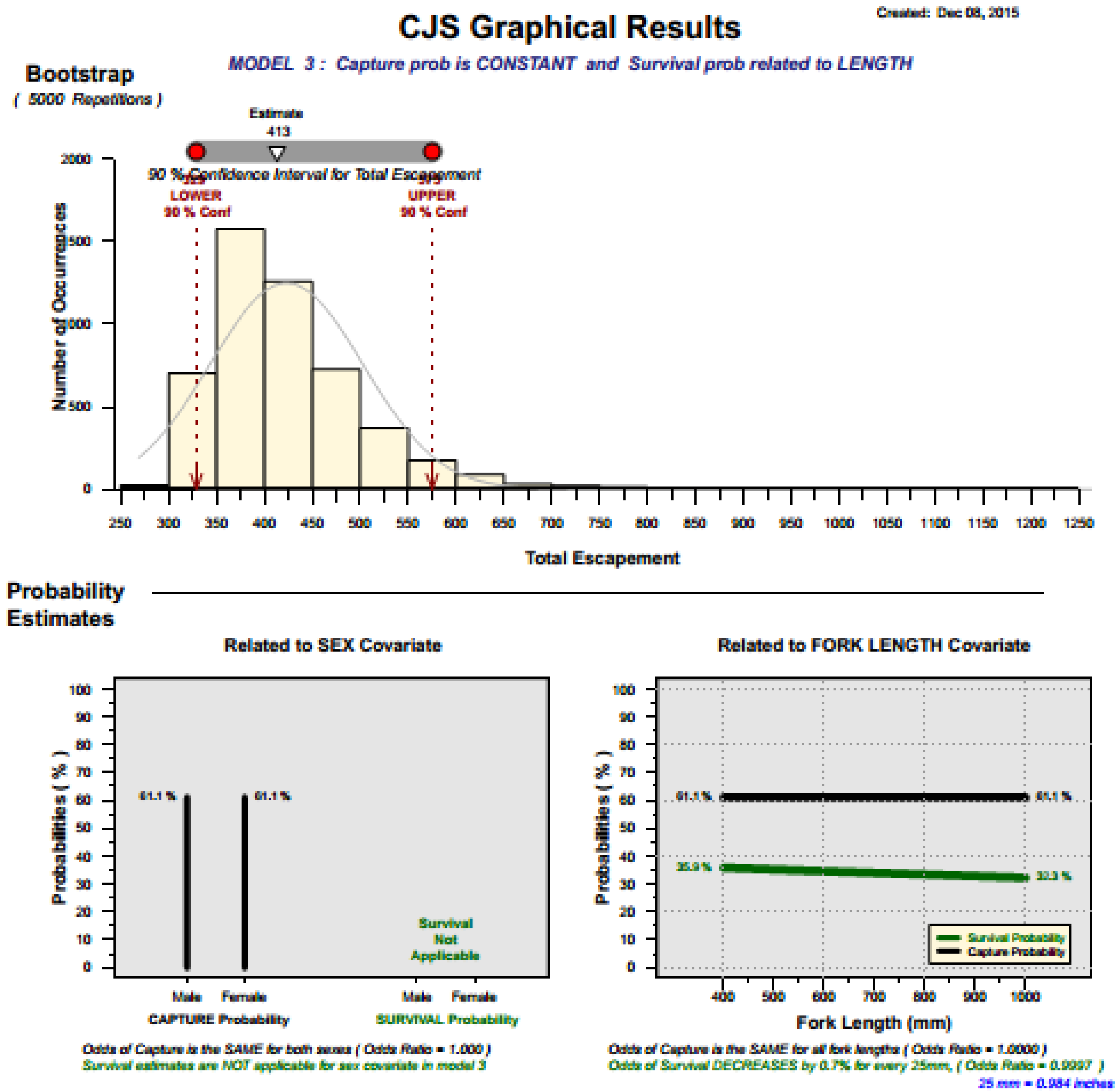


APPENDIX A, Figure 5. Map of Butte Creek SRCS holding and spawning Reach E, showing sub-reaches and distances.

APPENDIX B

FIGURE 1
2015 SPRING-RUN CHINOOK ESCAPEMENT
ESTIMATE & EXPANSION FACTOR

APPENDIX B, Figure 1. Butte Creek Spring-Run Chinook Spawning Escapement Estimate for 2015 using Cormack Jolly-Seber Model and Expansion Factor Calculation.



* For the purpose of determining an expansion factor for the pre-spawn mortality survey and for expansion of CWT recoveries we used the following calculation:

$F = E/(C + T)$
$F = 413/(77 + 108)$
$F = 413/185$
$F = 2.23$

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:

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

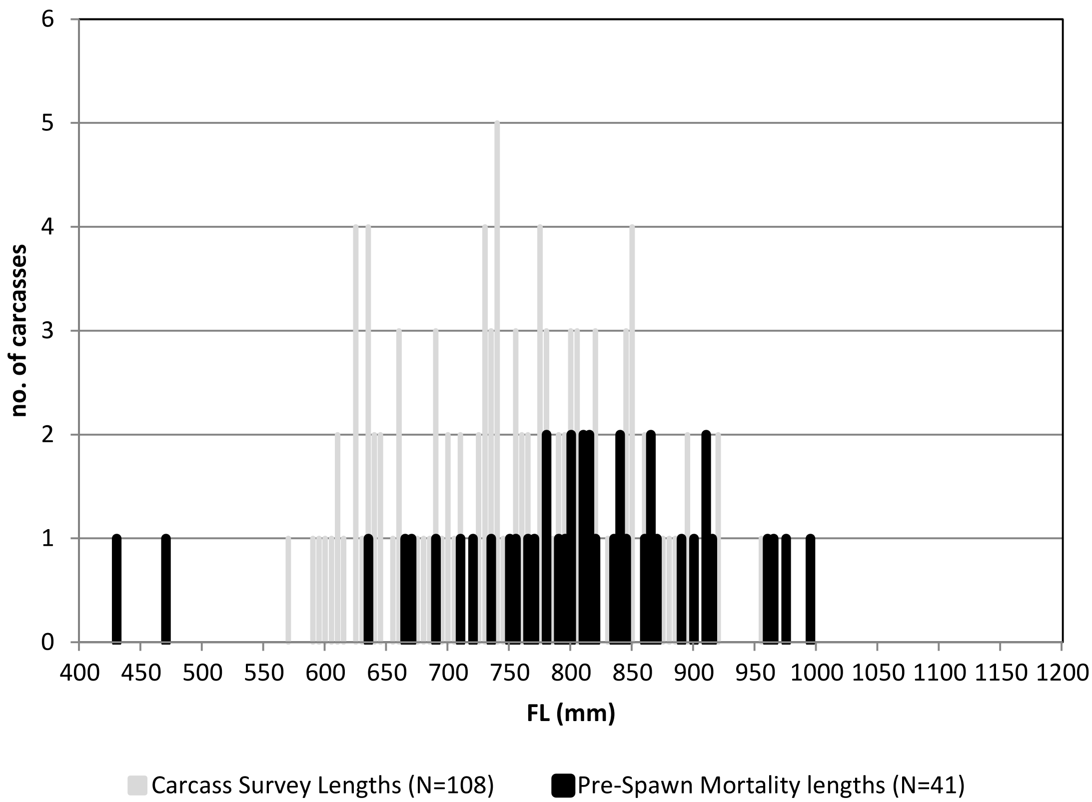
And Where:

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

APPENDIX C

FIGURE 1
LENGTH FREQUENCY DISTRIBUTON OF 149 ADULT BUTTE CREEK CARCASSES MEASURED FOR ABUNDANCE FROM JUNE 1 TO OCTOBER 29, 2015.

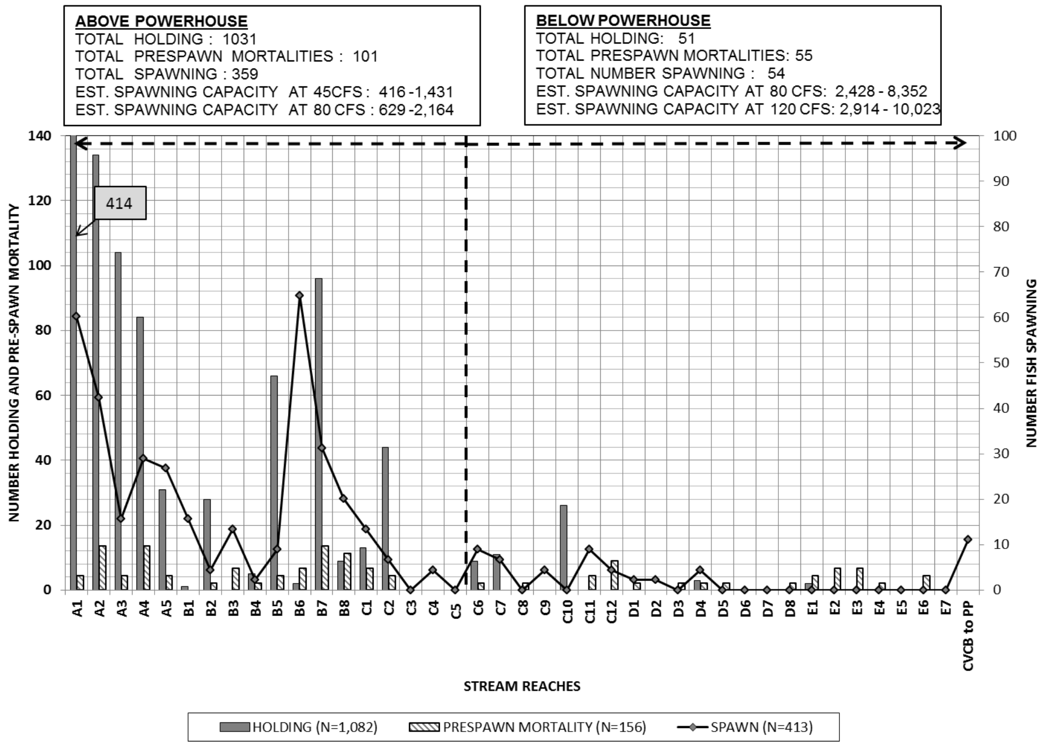
APPENDIX C, Figure 1. Length frequency distribution of 149 Butte Creek salmon carcasses measured for abundance estimates from June 1 to October 29, 2015.



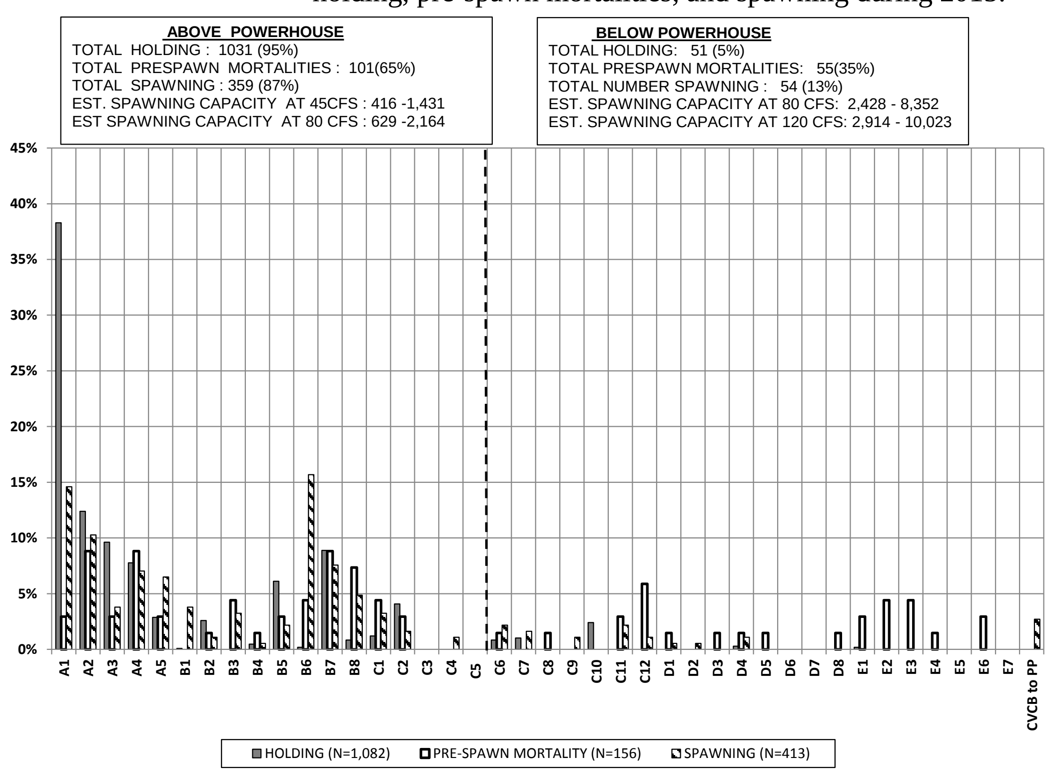
APPENDIX D

FIGURES 1-5
2015 HOLDING, PRE-SPAWN MORTALITY AND SPAWNING DISTRIBUTION OF BUTTE CREEK SPRING-RUN CHINOOK SALMON

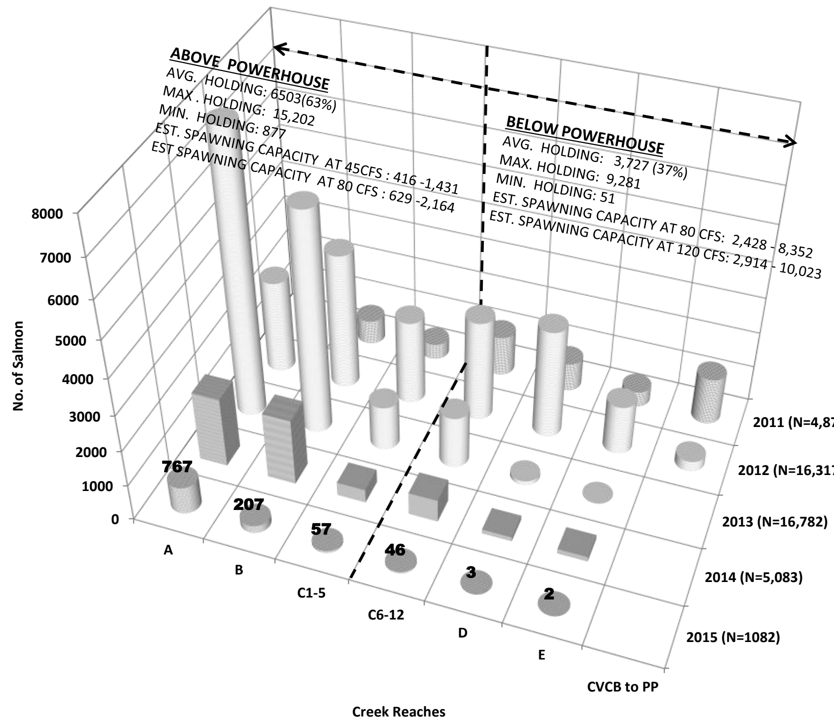
APPENDIX D, Figure 1. Distribution by sub-reach of the number of Butte Creek SRCS holding, pre-spawn mortalities, and spawning during 2015.



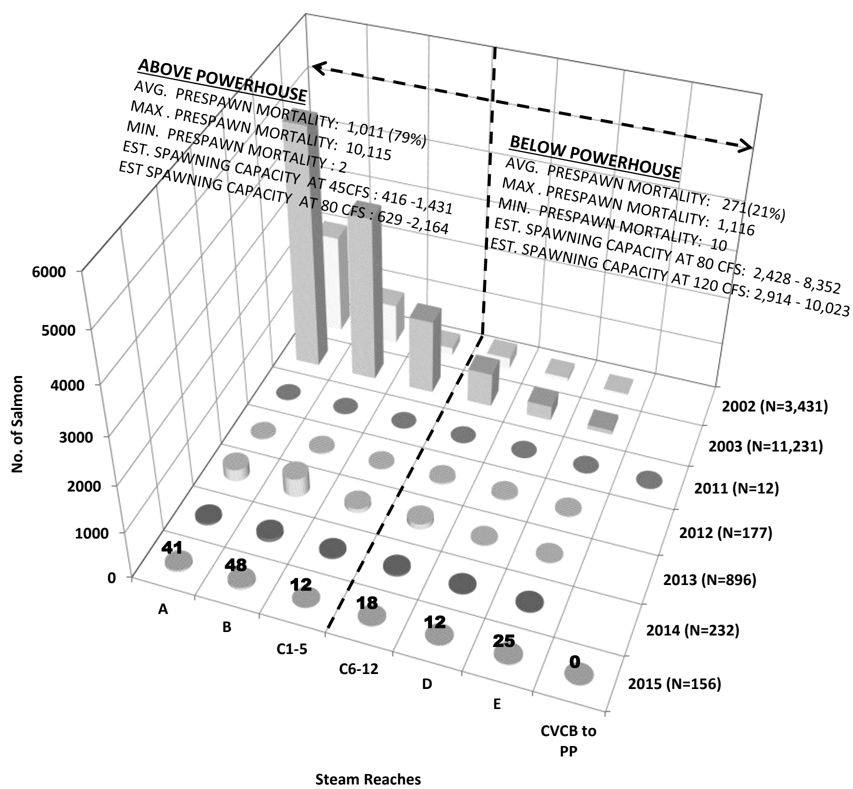
APPENDIX D, Figure 2. Distribution by sub-reach of the percent of Butte Creek SRCS holding, pre-spawn mortalities, and spawning during 2015.



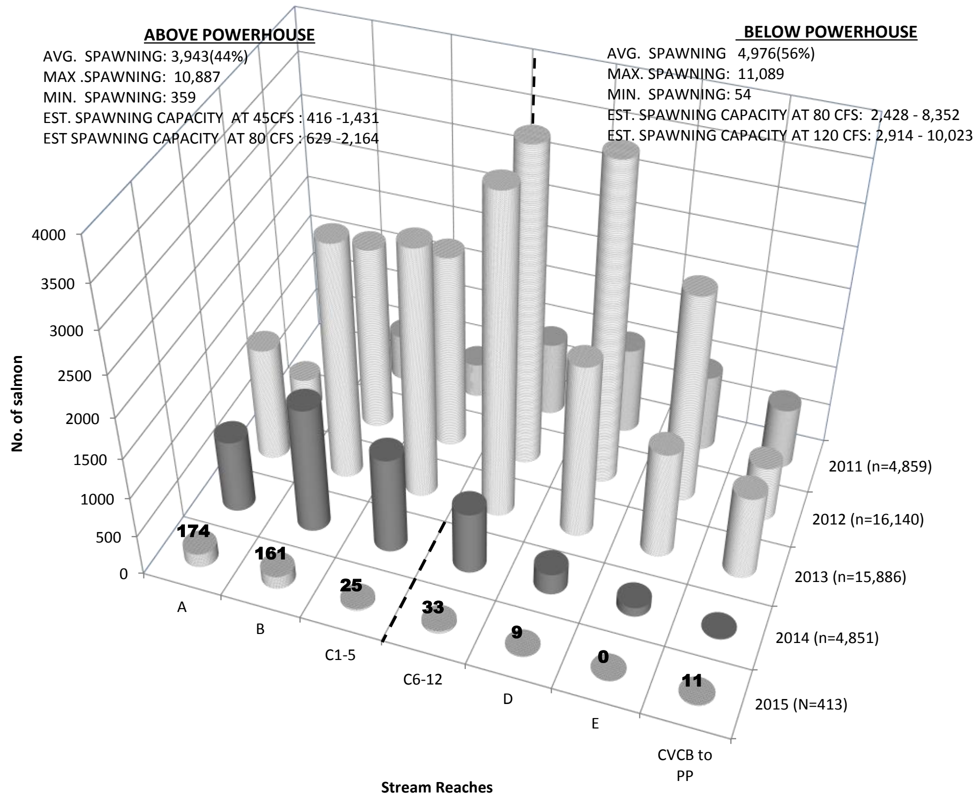
APPENDIX D, Figure 3**.** Distribution by reach of the number of Butte Creek SRCS holding, during 2011-2015.



APPENDIX D, Figure 4**.** Distribution by reach of the number of Butte Creek SRCS pre-spawn mortalities during 2002, 2003, and 2011-2015.



APPENDIX D, Figure 5**.** Distribution by reach of the number of Butte Creek SRCS spawning during 2011-2015.



APPENDIX E

AIR TEMPERATURES AT COHASSET FIRE STATION
JUNE 1- SEPTEMBER 30, 2015

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, 2015.

YEAR - 2015							
DATE	**MAX**	**MIN**	**MEAN**	**DATE**	**MAX**	**MIN**	**MEAN**
6/1	23.3	11.1	18.1	**8/1**	32.8	20.6	27.0
6/2	26.1	12.8	19.8	**8/2**	32.8	20.6	26.1
6/3	25.6	15.6	21.0	**8/3**	32.2	20.6	25.7
6/4	27.8	13.3	19.4	**8/4**	24.4	16.1	19.9
6/5	31.1	19.4	25.1	**8/5**	30.0	15.6	23.1
6/6	32.2	21.1	26.1	**8/6**	33.3	21.7	26.6
6/7	35.6	21.1	28.2	**8/7**	32.2	22.2	26.9
6/8	36.7	25.0	30.5	**8/8**	30.6	18.3	24.9
6/9	35.6	20.6	29.4	**8/9**	33.9	18.3	26.7
6/10	26.1	18.9	22.2	**8/10**	31.1	20.0	25.6
6/11	36.1	18.9	27.8	**8/11**	30.0	15.0	23.6
6/12	38.9	22.8	31.6	**8/12**	30.6	18.9	24.4
6/13	35.0	23.3	29.5	**8/13**	30.6	19.4	24.9
6/14	32.2	18.9	25.7	**8/14**	30.6	16.7	23.8
6/15	31.1	17.2	24.6	**8/15**	35.0	22.8	28.8
6/16	33.9	16.7	26.4	**8/16**	36.7	25.0	30.8
6/17	34.4	21.7	28.5	**8/17**	38.3	28.3	32.5
6/18	32.2	22.8	27.3	**8/18**	36.7	24.4	30.3
6/19	32.2	18.9	25.9	**8/19**	33.9	21.1	27.1
6/20	33.3	22.2	27.6	**8/20**	31.1	18.3	24.7
6/21	30.0	20.6	25.2	**8/21**	31.7	19.4	24.6
6/22	31.1	16.7	24.1	**8/22**	32.2	20.0	25.6
6/23	33.9	20.0	27.0	**8/23**	31.7	20.6	25.6
6/24	33.3	21.7	27.6	**8/24**	32.8	20.6	26.8
6/25	36.7	25.0	30.8	**8/25**	34.4	23.3	28.0
6/26	37.8	25.6	31.8	**8/26**	33.9	22.8	28.3
6/27	34.4	23.3	28.9	**8/27**	35.6	23.9	29.7
6/28	34.4	22.2	27.7	**8/28**	34.4	25.0	29.3
6/29	35.6	21.7	29.3	**8/29**	27.8	18.3	22.6
6/30	40.0	26.1	33.0	**8/30**	28.3	15.0	22.0
7/1	37.2	29.4	33.2	**8/31**	31.1	19.4	25.0
7/2	37.2	25.0	31.8	**9/1**	31.7	21.1	26.1
7/3	34.4	21.1	28.7	**9/2**	28.3	17.2	22.8
7/4	36.1	25.6	30.3	**9/3**	25.6	13.3	19.5
7/5	35.0	22.2	28.7	**9/4**	25.0	13.9	19.5
7/6	31.7	18.9	25.7	**9/5**	25.0	13.9	20.1
7/7	30.0	20.0	25.2	**9/6**	29.4	18.9	24.0
7/8	27.2	17.2	22.5	**9/7**	32.8	21.1	26.6
7/9	23.3	15.0	19.1	**9/8**	36.1	23.3	29.5
7/10	25.0	13.9	19.6	**9/9**	37.8	27.2	31.7
7/11	28.9	16.7	22.6	**9/10**	38.9	28.3	33.3
7/12	28.3	18.3	23.1	**9/11**	37.8	28.3	31.8
7/13	30.6	17.2	24.6	**9/12**	32.8	23.9	28.9
7/14	31.7	17.8	25.2	**9/13**	31.7	21.1	26.5
7/15	33.9	19.4	26.9	**9/14**	26.1	16.7	21.0
7/16	33.9	23.3	28.4	**9/15**	18.9	12.8	16.1
7/17	35.0	22.8	29.0	**9/16**	17.2	11.7	12.8
7/18	32.2	22.2	27.4	**9/17**	23.3	12.2	17.1
7/19	33.9	22.2	27.2	**9/18**	28.3	16.1	22.2
7/20	35.6	23.9	29.3	**9/19**	32.2	20.0	25.8
7/21	33.9	22.2	28.4	**9/20**	34.4	22.8	28.3
7/22	31.1	19.4	24.9	**9/21**	35.0	24.4	29.3
7/23	28.3	12.8	21.2	**9/22**	31.1	21.7	25.8
7/24	30.0	13.9	23.2	**9/23**	30.6	14.4	22.9
7/25	31.1	20.6	25.2	**9/24**	33.3	21.1	26.6
7/26	31.7	18.9	25.4	**9/25**	33.3	23.3	27.6
7/27	32.8	18.9	26.9	**9/26**	31.7	21.7	26.3
7/28	36.7	25.0	31.3	**9/27**	31.7	22.2	26.2
7/29	39.4	28.9	33.9	**9/28**	31.1	21.1	25.4
7/30	38.9	30.0	33.4	**9/29**	27.8	16.7	21.7
7/31	37.2	23.3	30.3	**9/30**	18.9	18.9	18.9

APPENDIX F

TABLES 1-6
BUTTE CREEK WATER TEMPERATURES
MAY 1 - OCTOBER 31, 2015

APPENDIX F, Table 1. Butte Creek water temperatures (C) at Quartz Bowl Pool for period May 1 through October 31, 2015.

DATE	MAX	MIN	MEAN	DATE	MAX	MIN	MEAN	DATE	MAX	MIN	MEAN
5/1	16.4	14.0	15.0	**7/1**	21.6	20.1	20.8	**9/1**	17.3	15.5	16.3
5/2	16.7	14.4	15.3	**7/2**	22.1	20.2	21.0	**9/2**	17.5	15.7	16.4
5/3	16.7	14.4	15.4	**7/3**	22.4	20.9	21.5	**9/3**	17.4	15.6	16.3
5/4	16.4	14.2	15.1	**7/4**	22.6	21.1	21.7	**9/4**	16.7	15.2	15.7
5/5	16.0	14.0	14.9	**7/5**	22.7	21.0	21.7	**9/5**	15.9	14.3	15.0
5/6	15.9	14.0	14.7	**7/6**	22.2	20.5	21.3	**9/6**	15.5	13.7	14.4
5/7	14.6	13.4	13.9	**7/7**	21.7	20.1	20.8	**9/7**	15.7	13.7	14.5
5/8	14.4	12.2	13.2	**7/8**	20.7	19.6	20.1	**9/8**	16.1	14.1	14.9
5/9	15.3	12.8	13.9	**7/9**	19.7	18.3	18.9	**9/9**	16.9	14.8	15.6
5/10	15.9	13.6	14.6	**7/10**	18.6	17.5	17.9	**9/10**	17.5	15.5	16.2
5/11	16.1	14.0	14.8	**7/11**	18.7	16.8	17.6	**9/11**	17.8	16.3	16.9
5/12	14.7	13.4	14.1	**7/12**	19.2	17.5	18.1	**9/12**	18.0	16.6	17.1
5/13	13.7	12.2	12.8	**7/13**	19.2	17.6	18.2	**9/13**	17.6	16.8	17.1
5/14	13.5	11.5	12.3	**7/14**	19.3	17.4	18.2	**9/14**	16.8	16.2	16.5
5/15	12.8	11.9	12.4	**7/15**	19.6	17.5	18.4	**9/15**	16.2	15.3	15.8
5/16	14.0	11.9	12.7	**7/16**	20.2	18.0	18.9	**9/16**	15.2	14.0	14.5
5/17	14.0	12.4	13.0	**7/17**	20.8	18.8	19.5	**9/17**	14.5	13.2	13.9
5/18	14.9	12.5	13.5	**7/18**	20.7	19.0	19.7	**9/18**	15.1	13.1	13.9
5/19	14.3	12.6	13.3	**7/19**	20.4	18.5	19.4	**9/19**	15.4	13.4	14.2
5/20	15.1	12.8	13.7	**7/20**	21.1	19.0	19.8	**9/20**	16.0	14.0	14.7
5/21	15.3	13.0	14.0	**7/21**	21.6	19.9	20.5	**9/21**	16.3	14.3	15.1
5/22	15.4	13.5	14.3	**7/22**	21.5	20.0	20.6	**9/22**	16.5	14.7	15.3
5/23	15.9	14.1	14.7	**7/23**	20.2	18.7	19.3	**9/23**	15.8	14.1	14.9
5/24	16.6	14.0	15.1	**7/24**	19.1	17.4	18.2	**9/24**	15.9	14.1	14.8
5/25	17.2	14.7	15.7	**7/25**	18.4	16.7	17.5	**9/25**	16.3	14.0	14.9
5/26	17.8	15.3	16.3	**7/26**	18.4	16.6	17.4	**9/26**	16.5	14.6	15.3
5/27	17.6	15.6	16.5	**7/27**	18.8	16.9	17.7	**9/27**	16.4	14.4	15.3
5/28	17.7	15.7	16.6	**7/28**	19.1	17.1	17.9	**9/28**	16.3	14.4	15.2
5/29	18.3	16.0	16.9	**7/29**	19.6	17.6	18.4	**9/29**	16.1	14.5	15.1
5/30	18.7	16.2	17.2	**7/30**	20.1	18.1	18.9	**9/30**	14.9	13.9	14.3
5/31	18.1	16.4	17.1	**7/31**	19.6	19.0	19.3	**10/1**	15.1	13.9	14.4
6/1	18.1	15.6	16.7	**8/1**	20.3	18.6	19.3	**10/2**	15.3	13.7	14.4
6/2	18.2	15.7	16.8	**8/2**	20.7	19.3	19.8	**10/3**	15.1	13.4	14.2
6/3	18.2	15.9	16.9	**8/3**	20.6	18.9	19.6	**10/4**	15.2	13.7	14.3
6/4	17.6	16.2	16.8	**8/4**	19.6	18.3	18.9	**10/5**	15.2	13.6	14.3
6/5	17.4	15.6	16.5	**8/5**	19.0	17.7	18.2	**10/6**	15.3	13.8	14.4
6/6	19.0	16.1	17.3	**8/6**	19.2	17.4	18.2	**10/7**	15.2	13.8	14.5
6/7	20.2	17.2	18.3	**8/7**	19.4	18.0	18.6	**10/8**	15.6	14.3	14.8
6/8	20.9	18.0	19.1	**8/8**	19.3	17.8	18.5	**10/9**	15.8	14.2	14.9
6/9	20.9	18.6	19.6	**8/9**	19.2	17.5	18.2	**10/10**	15.6	14.1	14.7
6/10	20.7	19.3	19.7	**8/10**	18.9	17.4	18.0	**10/11**	15.6	14.1	14.7
6/11	21.1	18.6	19.6	**8/11**	18.8	17.1	17.8	**10/12**	15.5	13.9	14.6
6/12	21.2	18.4	19.5	**8/12**	18.4	16.7	17.4	**10/13**	15.4	13.8	14.5
6/13	21.7	18.9	19.9	**8/13**	18.6	16.7	17.5	**10/14**	15.3	13.8	14.4
6/14	21.7	19.1	20.2	**8/14**	18.3	16.6	17.3	**10/15**	15.4	14.0	14.6
6/15	20.9	18.4	19.6	**8/15**	17.8	16.1	17.0	**10/16**	15.7	14.3	14.8
6/16	20.4	18.1	19.1	**8/16**	17.9	16.1	16.9	**10/17**	15.0	14.7	14.8
6/17	20.6	18.0	19.1	**8/17**	18.1	16.2	17.0	**10/18**	15.1	13.9	14.4
6/18	20.5	18.2	19.2	**8/18**	18.6	16.7	17.4	**10/19**	14.1	13.1	13.7
6/19	19.9	17.8	18.8	**8/19**	18.8	17.0	17.8	**10/20**	13.6	12.4	13.0
6/20	19.8	17.6	18.6	**8/20**	18.6	17.2	17.8	**10/21**	13.1	11.7	12.4
6/21	19.6	17.6	18.4	**8/21**	18.7	17.0	17.7	**10/22**	13.1	11.8	12.4
6/22	19.0	16.8	17.8	**8/22**	18.8	17.0	17.8	**10/23**	12.9	11.7	12.3
6/23	19.3	16.7	17.8	**8/23**	18.7	17.1	17.8	**10/24**	12.8	11.8	12.2
6/24	20.0	17.5	18.6	**8/24**	18.9	17.0	17.8	**10/25**	12.8	11.6	12.1
6/25	21.2	18.7	19.7	**8/25**	19.1	17.1	18.0	**10/26**	12.2	10.9	11.6
6/26	21.9	19.7	20.5	**8/26**	18.7	17.2	17.7	**10/27**	11.3	11.0	11.1
6/27	21.8	20.1	20.8	**8/27**	18.7	16.9	17.6	**10/28**	nd	nd	nd
6/28	21.5	19.9	20.5	**8/28**	18.8	17.2	17.8	**10/29**	nd	nd	nd
6/29	21.6	19.5	20.4	**8/29**	18.8	17.7	18.0	**10/30**	nd	nd	nd
6/30	21.5	19.6	20.4	**8/30**	18.0	16.5	17.2	**10/31**	nd	nd	nd
				8/31	17.4	15.6	16.4				

nd = no data

APPENDIX F, Table 2. Butte Creek water temperatures (C) at Chimney Rock Pool for period May 1 through October 31, 2015.

DATE	MAX	MIN	MEAN	DATE	MAX	MIN	MEAN	DATE	MAX	MIN	MEAN
5/1	17.3	14.2	15.4	**7/1**	22.5	20.2	21.1	**9/1**	18.2	15.7	16.7
5/2	17.5	14.6	15.7	**7/2**	23.0	20.4	21.3	**9/2**	18.2	15.8	16.7
5/3	17.5	14.7	15.8	**7/3**	23.3	21.1	21.8	**9/3**	18.1	15.7	16.6
5/4	17.2	14.4	15.6	**7/4**	23.4	21.2	22.0	**9/4**	17.6	15.3	16.1
5/5	16.8	14.2	15.3	**7/5**	23.7	21.2	22.1	**9/5**	16.7	14.6	15.4
5/6	16.8	14.2	15.2	**7/6**	23.1	20.8	21.6	**9/6**	16.3	13.9	14.8
5/7	15.3	13.8	14.4	**7/7**	22.4	20.4	21.1	**9/7**	16.5	13.9	14.9
5/8	15.3	12.5	13.7	**7/8**	21.1	19.8	20.4	**9/8**	16.9	14.2	15.2
5/9	16.2	13.1	14.3	**7/9**	19.9	18.7	19.3	**9/9**	17.7	14.9	15.9
5/10	16.7	13.8	15.0	**7/10**	19.2	17.8	18.3	**9/10**	18.1	15.6	16.5
5/11	16.9	14.1	15.2	**7/11**	19.8	17.2	18.1	**9/11**	18.4	16.4	17.2
5/12	15.4	13.7	14.5	**7/12**	20.1	17.7	18.5	**9/12**	18.4	16.7	17.4
5/13	14.7	12.6	13.4	**7/13**	20.0	17.7	18.6	**9/13**	18.0	16.9	17.3
5/14	14.4	11.9	12.9	**7/14**	20.3	17.6	18.6	**9/14**	17.0	16.5	16.7
5/15	13.5	12.2	12.8	**7/15**	20.6	17.7	18.7	**9/15**	16.4	15.6	16.2
5/16	15.1	12.4	13.3	**7/16**	21.1	18.2	19.2	**9/16**	15.5	14.3	14.8
5/17	14.5	12.6	13.4	**7/17**	21.7	18.9	19.9	**9/17**	15.5	13.6	14.3
5/18	15.7	12.8	13.9	**7/18**	21.6	19.2	20.0	**9/18**	15.8	13.4	14.3
5/19	15.2	13.0	13.8	**7/19**	21.4	18.7	19.7	**9/19**	16.1	13.5	14.5
5/20	16.0	13.1	14.2	**7/20**	22.1	19.2	20.2	**9/20**	16.6	14.1	15.0
5/21	16.2	13.3	14.5	**7/21**	22.5	20.0	20.9	**9/21**	16.9	14.5	15.4
5/22	16.4	13.9	14.8	**7/22**	22.3	20.1	20.8	**9/22**	17.0	14.8	15.7
5/23	16.6	14.5	15.2	**7/23**	21.0	18.8	19.7	**9/23**	16.4	14.3	15.2
5/24	17.5	14.3	15.6	**7/24**	20.2	17.6	18.6	**9/24**	16.4	14.3	15.1
5/25	18.0	15.0	16.2	**7/25**	19.5	16.9	17.9	**9/25**	16.6	14.1	15.2
5/26	18.6	15.5	16.7	**7/26**	19.4	16.9	17.8	**9/26**	16.9	14.7	15.6
5/27	18.6	15.8	16.9	**7/27**	19.8	17.2	18.1	**9/27**	16.7	14.7	15.6
5/28	18.7	15.9	17.0	**7/28**	20.1	17.3	18.3	**9/28**	16.7	14.6	15.5
5/29	19.0	16.2	17.4	**7/29**	20.6	17.7	18.7	**9/29**	16.4	14.7	15.4
5/30	19.4	16.4	17.6	**7/30**	21.0	18.2	19.2	**9/30**	15.1	14.2	14.6
5/31	18.8	16.6	17.5	**7/31**	20.0	19.2	19.5	**10/1**	15.5	14.1	14.7
6/1	18.8	15.9	17.2	**8/1**	21.3	18.8	19.7	**10/2**	15.8	13.9	14.7
6/2	19.0	16.0	17.2	**8/2**	21.4	19.5	20.1	**10/3**	15.6	13.7	14.5
6/3	18.9	16.1	17.3	**8/3**	21.5	19.0	19.9	**10/4**	15.7	13.9	14.6
6/4	18.1	16.5	17.1	**8/4**	19.5	18.6	19.1	**10/5**	15.6	13.9	14.6
6/5	18.2	15.9	17.0	**8/5**	19.9	17.9	18.6	**10/6**	15.7	14.0	14.7
6/6	19.7	16.3	17.7	**8/6**	20.0	17.6	18.5	**10/7**	15.6	14.1	14.8
6/7	20.8	17.3	18.7	**8/7**	20.3	18.2	18.9	**10/8**	15.9	14.5	15.1
6/8	21.6	18.0	19.5	**8/8**	20.2	18.0	18.8	**10/9**	16.2	14.4	15.2
6/9	21.5	18.7	19.9	**8/9**	20.2	17.6	18.6	**10/10**	16.0	14.3	15.0
6/10	21.2	19.4	20.0	**8/10**	19.7	17.6	18.3	**10/11**	16.0	14.3	15.0
6/11	21.9	18.9	20.0	**8/11**	19.7	17.3	18.2	**10/12**	15.9	14.1	14.9
6/12	22.0	18.6	20.0	**8/12**	19.3	16.8	17.8	**10/13**	15.7	14.0	14.8
6/13	22.4	18.9	20.3	**8/13**	19.5	16.9	17.8	**10/14**	15.6	14.1	14.7
6/14	22.3	19.2	20.5	**8/14**	19.2	16.7	17.6	**10/15**	15.7	14.3	14.9
6/15	21.7	18.6	20.0	**8/15**	18.8	16.3	17.3	**10/16**	16.1	14.5	15.1
6/16	21.3	18.4	19.6	**8/16**	18.8	16.3	17.3	**10/17**	15.3	14.9	15.0
6/17	21.4	18.2	19.5	**8/17**	19.0	16.3	17.3	**10/18**	15.4	14.1	14.7
6/18	21.3	18.4	19.5	**8/18**	19.5	16.8	17.8	**10/19**	14.6	13.4	14.0
6/19	20.9	18.1	19.2	**8/19**	19.6	17.2	18.1	**10/20**	14.0	12.7	13.3
6/20	20.7	17.7	19.0	**8/20**	19.3	17.3	18.1	**10/21**	13.4	12.1	12.7
6/21	20.3	17.8	18.8	**8/21**	19.6	17.2	18.1	**10/22**	13.4	12.1	12.7
6/22	19.9	17.0	18.2	**8/22**	19.7	17.2	18.1	**10/23**	13.2	12.0	12.6
6/23	20.2	16.9	18.2	**8/23**	19.6	17.2	18.1	**10/24**	13.1	12.0	12.5
6/24	20.8	17.6	18.9	**8/24**	19.7	17.2	18.1	**10/25**	13.1	11.9	12.4
6/25	22.1	18.7	20.0	**8/25**	19.9	17.1	18.2	**10/26**	12.4	11.2	11.9
6/26	22.8	19.7	20.9	**8/26**	19.7	17.3	18.1	**10/27**	11.8	11.2	11.4
6/27	22.4	20.2	21.0	**8/27**	19.6	17.1	18.0	**10/28**	nd	nd	nd
6/28	22.4	20.1	20.9	**8/28**	19.4	17.4	18.2	**10/29**	nd	nd	nd
6/29	22.5	19.7	20.7	**8/29**	19.6	17.9	18.4	**10/30**	nd	nd	nd
6/30	22.5	19.8	20.8	**8/30**	18.9	16.8	17.6	**10/31**	nd	nd	nd
				8/31	18.3	15.9	16.8				

nd = no data

APPENDIX F, Table 3. Butte Creek water temperatures (C) at Pool 4 for period May 1 through October 31, 2015.

DATE	MAX	MIN	MEAN	DATE	MAX	MIN	MEAN	DATE	MAX	MIN	MEAN
5/1	15.3	14.6	14.9	**7/1**	23.4	20.3	21.8	**9/1**	18.8	16.0	17.3
5/2	15.6	14.9	15.2	**7/2**	24.0	20.5	22.1	**9/2**	18.7	16.1	17.3
5/3	15.7	15.1	15.4	**7/3**	24.0	21.1	22.4	**9/3**	18.6	15.9	17.2
5/4	15.8	15.2	15.5	**7/4**	24.3	21.3	22.7	**9/4**	18.1	15.5	16.7
5/5	15.7	15.1	15.4	**7/5**	24.6	21.4	22.8	**9/5**	17.2	15.0	16.0
5/6	15.7	15.0	15.4	**7/6**	24.0	20.9	22.3	**9/6**	16.8	14.2	15.5
5/7	15.6	14.8	15.2	**7/7**	23.3	20.5	21.8	**9/7**	16.9	14.3	15.6
5/8	15.2	14.2	14.7	**7/8**	21.7	20.1	20.9	**9/8**	17.2	14.6	15.9
5/9	15.2	14.2	14.7	**7/9**	20.5	19.3	19.8	**9/9**	17.9	15.1	16.5
5/10	15.5	14.6	15.0	**7/10**	20.2	18.2	19.0	**9/10**	18.4	15.8	17.1
5/11	15.7	14.9	15.3	**7/11**	20.7	17.5	18.9	**9/11**	18.8	16.6	17.7
5/12	15.7	14.9	15.2	**7/12**	20.9	17.7	19.1	**9/12**	18.9	17.0	17.9
5/13	15.1	14.2	14.6	**7/13**	20.9	17.8	19.2	**9/13**	18.4	17.2	17.8
5/14	14.6	13.6	14.0	**7/14**	21.3	17.7	19.3	**9/14**	17.8	16.9	17.2
5/15	14.2	13.5	13.8	**7/15**	21.4	17.8	19.4	**9/15**	17.2	16.3	16.8
5/16	14.4	13.6	13.9	**7/16**	22.0	18.2	19.8	**9/16**	16.2	15.0	15.3
5/17	14.4	13.7	14.1	**7/17**	22.6	18.9	20.5	**9/17**	16.0	14.3	15.1
5/18	14.7	13.8	14.2	**7/18**	22.4	19.1	20.5	**9/18**	16.2	13.8	14.9
5/19	14.7	14.0	14.4	**7/19**	22.2	18.8	20.3	**9/19**	16.4	14.0	15.2
5/20	15.0	14.1	14.5	**7/20**	23.0	19.3	20.9	**9/20**	16.9	14.5	15.7
5/21	15.1	14.4	14.7	**7/21**	23.4	20.0	21.5	**9/21**	17.2	14.8	16.0
5/22	15.4	14.6	15.0	**7/22**	23.1	20.2	21.4	**9/22**	17.4	15.1	16.2
5/23	15.6	15.0	15.3	**7/23**	21.9	18.9	20.3	**9/23**	16.7	14.6	15.8
5/24	16.0	15.0	15.4	**7/24**	21.1	17.8	19.3	**9/24**	16.9	14.7	15.8
5/25	16.3	15.5	15.9	**7/25**	20.4	17.1	18.6	**9/25**	16.8	14.6	15.7
5/26	16.8	15.9	16.3	**7/26**	20.3	17.1	18.5	**9/26**	17.2	15.0	16.1
5/27	17.0	16.2	16.6	**7/27**	20.7	17.3	18.7	**9/27**	17.1	15.1	16.1
5/28	17.2	16.3	16.7	**7/28**	20.9	17.3	18.9	**9/28**	17.1	15.2	16.1
5/29	17.4	16.5	16.9	**7/29**	21.4	17.6	19.3	**9/29**	16.8	15.1	16.0
5/30	17.6	16.9	17.2	**7/30**	21.8	18.3	19.8	**9/30**	15.9	14.5	15.0
5/31	17.6	17.1	17.4	**7/31**	20.6	19.2	19.8	**10/1**	15.9	14.3	15.0
6/1	17.6	16.9	17.2	**8/1**	22.1	19.0	20.3	**10/2**	16.2	14.2	15.2
6/2	19.8	16.9	18.1	**8/2**	22.1	19.5	20.6	**10/3**	16.0	14.0	15.0
6/3	19.8	16.6	18.2	**8/3**	22.2	19.1	20.5	**10/4**	16.2	14.2	15.1
6/4	18.8	17.0	18.0	**8/4**	20.3	18.9	19.5	**10/5**	16.0	14.1	15.0
6/5	19.2	16.5	17.7	**8/5**	20.7	18.1	19.2	**10/6**	16.2	14.3	15.2
6/6	20.5	16.8	18.6	**8/6**	20.8	17.8	19.2	**10/7**	16.0	14.5	15.3
6/7	21.5	17.8	19.6	**8/7**	21.2	18.4	19.6	**10/8**	16.5	14.9	15.6
6/8	22.3	18.6	20.4	**8/8**	20.9	18.1	19.3	**10/9**	16.7	14.7	15.7
6/9	22.3	19.2	20.8	**8/9**	21.0	17.8	19.2	**10/10**	16.5	14.6	15.5
6/10	22.1	19.9	20.9	**8/10**	20.5	17.7	18.9	**10/11**	16.5	14.6	15.5
6/11	22.9	19.2	20.9	**8/11**	20.4	17.5	18.8	**10/12**	16.4	14.4	15.4
6/12	22.8	19.0	20.9	**8/12**	20.1	16.9	18.4	**10/13**	16.2	14.5	15.3
6/13	23.2	19.4	21.2	**8/13**	20.2	17.1	18.4	**10/14**	16.2	14.4	15.3
6/14	23.1	19.7	21.5	**8/14**	19.9	16.8	18.2	**10/15**	16.4	14.6	15.4
6/15	22.5	19.1	20.9	**8/15**	19.6	16.5	17.9	**10/16**	16.4	14.9	15.6
6/16	22.2	18.8	20.7	**8/16**	19.6	16.5	17.9	**10/17**	15.8	15.3	15.5
6/17	22.2	18.3	20.2	**8/17**	19.7	16.5	18.0	**10/18**	15.9	14.6	15.2
6/18	22.1	18.5	20.2	**8/18**	20.2	16.8	18.3	**10/19**	15.3	13.8	14.5
6/19	21.7	18.2	19.9	**8/19**	20.2	17.2	18.6	**10/20**	14.6	13.1	13.8
6/20	21.6	18.0	19.7	**8/20**	19.9	17.4	18.6	**10/21**	14.1	12.5	13.3
6/21	21.0	17.9	19.4	**8/21**	20.3	17.3	18.7	**10/22**	14.1	12.5	13.2
6/22	20.7	17.2	18.9	**8/22**	20.4	17.3	18.7	**10/23**	13.7	12.4	13.1
6/23	21.0	17.0	18.9	**8/23**	20.2	17.3	18.7	**10/24**	13.6	12.3	12.9
6/24	21.6	17.7	19.5	**8/24**	20.4	17.4	18.7	**10/25**	13.7	12.2	12.8
6/25	22.9	18.9	20.7	**8/25**	20.2	17.2	18.7	**10/26**	13.0	11.6	12.3
6/26	23.5	19.8	21.5	**8/26**	20.2	17.3	18.7	**10/27**	12.2	11.6	11.8
6/27	23.2	20.3	21.7	**8/27**	20.2	17.2	18.6	**10/28**	nd	nd	nd
6/28	23.2	20.3	21.6	**8/28**	20.2	17.6	18.8	**10/29**	nd	nd	nd
6/29	23.4	19.8	21.4	**8/29**	20.5	18.1	19.1	**10/30**	nd	nd	nd
6/30	23.4	19.9	21.5	**8/30**	19.5	17.1	18.2	**10/31**	nd	nd	nd
				8/31	18.9	16.2	17.5				

nd = no data

APPENDIX F, Table 4. Butte Creek water temperatures (C) at Estates Pool for period May 1 through October 31, 2015.

DATE	MAX	MIN	MEAN	DATE	MAX	MIN	MEAN	DATE	MAX	MIN	MEAN
5/1	17.8	15.4	16.6	**7/1**	24.3	20.9	22.7	**9/1**	20.0	16.6	18.3
5/2	18.1	15.8	16.9	**7/2**	25.0	21.1	23.0	**9/2**	19.8	16.5	18.2
5/3	18.2	16.0	17.1	**7/3**	24.8	21.7	23.3	**9/3**	19.7	16.3	17.9
5/4	18.1	15.8	17.0	**7/4**	25.2	21.8	23.5	**9/4**	19.2	16.1	17.6
5/5	17.7	15.7	16.8	**7/5**	25.7	22.0	23.8	**9/5**	18.4	15.2	16.8
5/6	17.8	15.6	16.7	**7/6**	25.1	21.4	23.3	**9/6**	18.0	14.6	16.3
5/7	17.0	15.3	16.2	**7/7**	24.5	21.0	22.7	**9/7**	18.1	14.7	16.4
5/8	16.5	14.4	15.6	**7/8**	22.8	20.6	21.8	**9/8**	18.4	15.0	16.7
5/9	17.1	14.7	15.8	**7/9**	21.5	20.1	20.6	**9/9**	19.2	15.6	17.3
5/10	17.4	15.2	16.3	**7/10**	21.2	18.7	19.8	**9/10**	19.6	16.4	18.0
5/11	17.7	15.5	16.6	**7/11**	22.0	18.1	20.0	**9/11**	19.8	17.3	18.5
5/12	17.1	15.6	16.3	**7/12**	22.0	18.3	20.1	**9/12**	19.9	17.5	18.7
5/13	16.3	14.4	15.3	**7/13**	22.2	18.3	20.2	**9/13**	19.0	17.9	18.5
5/14	15.7	13.7	14.8	**7/14**	22.3	18.2	20.2	**9/14**	18.3	17.3	17.7
5/15	15.4	13.7	14.6	**7/15**	22.5	18.2	20.4	**9/15**	18.0	17.0	17.4
5/16	16.5	14.0	15.0	**7/16**	22.9	18.7	20.8	**9/16**	16.9	15.4	15.9
5/17	15.8	14.3	15.1	**7/17**	23.5	19.4	21.4	**9/17**	17.2	14.9	15.9
5/18	16.8	14.2	15.3	**7/18**	23.3	19.5	21.4	**9/18**	17.3	14.1	15.7
5/19	16.6	14.6	15.6	**7/19**	23.2	19.2	21.2	**9/19**	17.5	14.5	16.0
5/20	17.3	14.7	15.9	**7/20**	23.9	19.8	21.8	**9/20**	18.1	15.0	16.4
5/21	17.3	14.9	16.2	**7/21**	24.3	20.6	22.4	**9/21**	18.3	15.3	16.8
5/22	17.6	15.4	16.4	**7/22**	24.0	20.5	22.2	**9/22**	18.5	15.7	17.1
5/23	17.7	16.0	16.8	**7/23**	22.8	19.2	21.0	**9/23**	17.8	15.0	16.4
5/24	18.5	15.7	17.0	**7/24**	22.1	18.2	20.1	**9/24**	18.0	15.3	16.5
5/25	19.1	16.5	17.8	**7/25**	21.4	17.5	19.5	**9/25**	18.0	15.2	16.5
5/26	19.5	17.0	18.2	**7/26**	21.3	17.3	19.3	**9/26**	18.2	15.4	16.7
5/27	19.5	17.1	18.3	**7/27**	21.6	17.5	19.5	**9/27**	18.2	15.6	16.8
5/28	19.7	17.2	18.4	**7/28**	21.8	17.6	19.7	**9/28**	18.3	15.5	16.8
5/29	19.7	17.4	18.6	**7/29**	22.3	17.9	20.1	**9/29**	17.9	15.4	16.6
5/30	20.2	17.9	19.0	**7/30**	22.7	18.6	20.6	**9/30**	16.3	14.9	15.6
5/31	19.9	18.1	19.1	**7/31**	21.3	19.6	20.5	**10/1**	16.6	14.8	15.6
6/1	20.1	17.6	18.8	**8/1**	23.0	19.4	21.1	**10/2**	17.1	14.7	15.9
6/2	20.4	17.8	19.0	**8/2**	22.9	19.9	21.4	**10/3**	16.8	14.4	15.7
6/3	20.3	18.1	19.2	**8/3**	23.2	19.4	21.3	**10/4**	17.0	14.7	15.9
6/4	21.5	18.2	19.2	**8/4**	21.3	19.2	20.2	**10/5**	16.8	14.5	15.7
6/5	20.2	16.6	18.4	**8/5**	21.7	18.5	20.0	**10/6**	17.1	14.7	15.8
6/6	21.6	17.4	19.4	**8/6**	21.8	18.2	20.1	**10/7**	16.8	14.9	15.9
6/7	22.7	18.5	20.4	**8/7**	22.3	18.8	20.5	**10/8**	17.3	15.3	16.3
6/8	23.5	19.3	21.2	**8/8**	21.8	18.3	20.1	**10/9**	17.5	15.1	16.3
6/9	23.2	20.0	21.5	**8/9**	21.9	18.1	20.0	**10/10**	17.3	15.1	16.2
6/10	22.8	20.5	21.5	**8/10**	21.2	18.1	19.8	**10/11**	17.3	15.0	16.2
6/11	24.0	19.7	21.6	**8/11**	21.4	17.8	19.6	**10/12**	17.2	14.8	16.0
6/12	24.0	19.7	21.7	**8/12**	21.1	17.2	19.2	**10/13**	17.2	14.8	16.0
6/13	24.3	20.1	22.0	**8/13**	21.2	17.4	19.3	**10/14**	17.1	14.9	16.0
6/14	24.4	20.4	22.2	**8/14**	20.8	17.1	19	**10/15**	17.2	15.1	16.1
6/15	23.8	19.7	21.7	**8/15**	20.6	16.8	18.8	**10/16**	17.4	15.3	16.3
6/16	23.5	19.3	21.3	**8/16**	20.5	16.9	18.8	**10/17**	16.7	16.0	16.2
6/17	23.4	19.2	21.1	**8/17**	20.7	17	18.8	**10/18**	16.7	15.0	15.9
6/18	23.4	19.2	21.2	**8/18**	21.1	17.2	19.2	**10/19**	15.9	14.5	15.3
6/19	23.1	18.8	20.9	**8/19**	21.1	17.5	19.4	**10/20**	15.4	13.5	14.5
6/20	22.8	18.7	20.7	**8/20**	19.8	17.7	18.6	**10/21**	15.1	13.1	14.1
6/21	22.4	18.6	20.5	**8/21**	21.3	18.7	20.5	**10/22**	14.9	13.0	13.9
6/22	22.1	17.7	19.8	**8/22**	21.1	18.2	19.7	**10/23**	14.6	12.7	13.7
6/23	22.3	17.7	19.9	**8/23**	21.3	18.8	20.0	**10/24**	14.4	12.8	13.6
6/24	22.8	18.5	20.6	**8/24**	20.6	17.5	19.1	**10/25**	14.4	12.8	13.5
6/25	23.9	19.6	21.6	**8/25**	20.1	16.7	18.4	**10/26**	13.9	12.1	13.0
6/26	24.7	20.5	22.5	**8/26**	24.3	20.9	22.7	**10/27**	13.0	12.2	12.6
6/27	24.4	20.9	22.6	**8/27**	25.0	21.1	23.0	**10/28**	13.4	12.4	12.8
6/28	24.4	20.7	22.4	**8/28**	24.8	21.7	23.3	**10/29**	12.5	11.3	11.8
6/29	24.6	20.3	22.4	**8/29**	25.2	21.8	23.5	**10/30**	nd	nd	nd
6/30	24.7	20.5	22.5	**8/30**	25.7	22.0	23.8	**10/31**	nd	nd	nd
				8/31	25.1	21.4	23.3				

nd = no data

APPENDIX F, Table 5. Butte Creek water temperatures (C) at Cable Bridge for period May 1 through October 31, 2015.

DATE	MAX	MIN	MEAN	DATE	MAX	MIN	MEAN	DATE	MAX	MIN	MEAN
5/1	26.4	12.8	17.6	7/1	25.3	21.9	23.6	9/1	21.2	17.3	19.2
5/2	26.6	13.4	18.1	7/2	26.2	22.0	23.9	9/2	20.9	17.3	19.0
5/3	26.3	13.4	17.8	7/3	25.8	22.7	24.1	9/3	20.6	17.1	18.7
5/4	25.1	12.2	16.8	7/4	26.3	22.6	24.3	9/4	20.2	16.6	18.3
5/5	24.5	12.5	16.6	7/5	26.8	22.8	24.6	9/5	19.3	15.8	17.5
5/6	25.0	12.7	16.4	7/6	26.2	22.2	24.1	9/6	19.1	15.2	17.1
5/7	20.9	13.8	16.2	7/7	25.2	21.8	23.5	9/7	19.3	15.2	17.2
5/8	21.5	10.2	14.9	7/8	23.4	21.4	22.6	9/8	19.6	15.6	17.5
5/9	24.9	12.2	16.6	7/9	22.1	20.7	21.4	9/9	20.4	16.2	18.1
5/10	24.8	13.0	17.2	7/10	22.3	19.4	20.7	9/10	20.9	17.0	18.8
5/11	19.7	12.9	16.1	7/11	23.3	19.0	20.9	9/11	20.8	18.0	19.4
5/12	22.6	13.7	15.5	7/12	23.1	19.5	21.1	9/12	20.8	18.0	19.4
5/13	22.5	11.5	15.1	7/13	23.3	19.2	21.1	9/13	19.8	18.5	19.2
5/14	21.2	11.0	14.7	7/14	23.6	19.1	21.2	9/14	18.8	17.8	18.2
5/15	21.0	11.6	15.0	7/15	23.9	19.2	21.4	9/15	18.7	17.4	17.9
5/16	23.5	13.6	16.5	7/16	24.2	19.7	21.8	9/16	17.4	15.8	16.4
5/17	18.9	12.6	15.7	7/17	24.7	20.4	22.4	9/17	18.6	15.5	16.7
5/18	25.1	12.4	16.4	7/18	24.4	20.5	22.3	9/18	18.4	14.7	16.5
5/19	25.8	12.1	16.4	7/19	24.4	20.0	22.1	9/19	18.8	15.0	16.8
5/20	26.5	14.4	17.6	7/20	25.2	20.8	22.8	9/20	19.3	15.5	17.3
5/21	25.8	12.8	17.2	7/21	25.6	21.7	23.5	9/21	19.5	15.8	17.5
5/22	26.7	14.7	17.9	7/22	25.1	21.5	23.2	9/22	19.6	16.2	17.8
5/23	26.6	15.7	18.7	7/23	23.9	20.0	21.8	9/23	18.8	15.3	17.1
5/24	28.8	14.5	19.1	7/24	23.4	19.0	21.1	9/24	19.1	15.7	17.3
5/25	28.0	15.2	19.3	7/25	22.9	18.5	20.6	9/25	19.2	15.5	17.3
5/26	29.3	15.6	19.3	7/26	22.7	18.3	20.4	9/26	19.2	15.7	17.4
5/27	27.4	15.4	18.9	7/27	23.0	18.6	20.6	9/27	19.1	15.8	17.4
5/28	28.5	15.2	19.4	7/28	23.3	18.4	20.7	9/28	19.2	15.7	17.4
5/29	28.9	16.0	19.9	7/29	23.8	18.9	21.1	9/29	18.7	15.7	17.1
5/30	25.8	15.8	19.7	7/30	23.8	19.6	21.5	9/30	16.8	15.2	16.0
5/31	25.9	15.2	19.3	7/31	22.0	20.4	21.2	10/1	17.4	15.2	16.1
6/1	26.2	14.7	18.8	8/1	24.1	19.8	21.8	10/2	18.1	15.1	16.5
6/2	28.3	15.1	19.2	8/2	23.9	20.6	22.1	10/3	17.7	14.7	16.2
6/3	23.3	15.9	19.4	8/3	24.2	20.1	22.0	10/4	18.0	15.2	16.5
6/4	21.8	17.3	19.9	8/4	22.0	19.8	20.7	10/5	17.7	14.9	16.3
6/5	21.7	17.4	19.5	8/5	22.8	19.0	20.7	10/6	17.9	15.1	16.4
6/6	23.2	18.4	20.6	8/6	22.9	18.8	20.8	10/7	17.6	15.2	16.5
6/7	24.3	19.3	21.7	8/7	23.3	19.8	21.4	10/8	18.1	15.7	16.8
6/8	25.2	20.1	22.5	8/8	22.8	19.2	20.9	10/9	18.4	15.4	16.8
6/9	24.5	20.8	22.7	8/9	23.2	18.8	20.8	10/10	18.2	15.3	16.7
6/10	23.8	21.2	22.4	8/10	22.2	18.9	20.6	10/11	18.2	15.3	16.7
6/11	25.4	20.4	22.7	8/11	22.6	18.7	20.5	10/12	18.1	15.1	16.5
6/12	25.6	20.4	22.9	8/12	22.3	18.1	20.0	10/13	18.1	15.1	16.5
6/13	25.8	20.8	23.2	8/13	22.4	18.2	20.1	10/14	18.0	15.2	16.6
6/14	25.7	21.1	23.3	8/14	22.0	17.9	19.8	10/15	18.0	15.4	16.7
6/15	25.0	20.4	22.7	8/15	21.9	17.6	19.6	10/16	18.3	15.7	17.0
6/16	25.0	20.2	22.5	8/16	21.8	17.7	19.6	10/17	17.6	16.4	16.9
6/17	24.9	20.1	22.3	8/17	22.1	17.9	19.8	10/18	17.2	15.4	16.3
6/18	24.7	20.1	22.3	8/18	22.4	17.9	20.0	10/19	16.7	14.9	15.8
6/19	24.2	19.6	21.8	8/19	22.2	18.3	20.2	10/20	16.2	13.7	15.0
6/20	24.1	19.5	21.7	8/20	21.6	18.4	20.0	10/21	16.0	13.4	14.7
6/21	23.4	19.4	21.4	8/21	22.3	18.3	20.2	10/22	15.8	13.5	14.6
6/22	23.3	18.4	20.7	8/22	22.5	18.5	20.4	10/23	15.1	12.9	14.1
6/23	23.6	18.5	20.9	8/23	22.3	18.5	20.3	10/24	15.1	13.2	14.1
6/24	23.9	19.4	21.6	8/24	22.5	18.5	20.3	10/25	15.2	13.1	14.1
6/25	25.3	20.4	22.7	8/25	22.2	18.3	20.2	10/26	14.6	12.3	13.5
6/26	26.0	21.4	23.5	8/26	22.0	18.1	20.1	10/27	13.5	12.5	13.1
6/27	25.2	21.8	23.4	8/27	22.4	18.7	20.4	10/28	14.3	12.8	13.4
6/28	25.5	21.5	23.3	8/28	22.1	19.0	20.6	10/29	12.9	9.7	12.1
6/29	25.8	21.2	23.4	8/29	22.3	19.7	20.8	10/30	nd	nd	nd
6/30	25.9	21.4	23.5	8/30	21.6	18.2	19.8	10/31	nd	nd	nd
				8/31	21.3	17.3	19.2				

nd= no data
red font = thermograph out of water

APPENDIX F, Table 6. Butte Creek water temperatures (C) at Covered Bridge (USGS Gauge #113900000, Butte Creek near Chico) for period May 1 through September 30, 2015.

DATE	MAX	MIN	MEAN	DATE	MAX	MIN	MEAN	DATE	MAX	MIN	MEAN
5/1	20.2	15.3	17.7	**7/1**	25.8	22.3	24.1	**9/1**	21.7	17.7	19.7
5/2	20.3	15.8	18.1	**7/2**	26.6	22.3	24.4	**9/2**	21.5	17.7	19.5
5/3	20.3	16.0	18.2	**7/3**	26.3	23.1	24.7	**9/3**	21.1	17.4	19.2
5/4	20.1	15.7	17.9	**7/4**	27.2	22.9	24.9	**9/4**	20.6	16.8	18.7
5/5	19.6	15.6	17.6	**7/5**	27.1	23.2	25.1	**9/5**	19.7	16.0	17.9
5/6	19.6	15.6	17.5	**7/6**	26.4	22.7	24.6	**9/6**	19.6	15.3	17.5
5/7	18.3	15.2	16.7	**7/7**	25.5	22.3	23.9	**9/7**	19.8	15.4	17.6
5/8	18.5	14.2	16.4	**7/8**	24.2	21.8	23.0	**9/8**	20.0	15.7	17.9
5/9	19.4	14.9	17.2	**7/9**	22.8	20.9	21.8	**9/9**	20.8	16.2	18.5
5/10	19.7	15.4	17.6	**7/10**	22.8	19.8	21.1	**9/10**	21.4	17.1	19.3
5/11	19.8	15.6	17.6	**7/11**	23.6	19.4	21.5	**9/11**	21.3	18.3	19.8
5/12	18.6	15.6	16.8	**7/12**	23.6	19.9	21.7	**9/12**	21.3	18.2	19.7
5/13	18.2	14.3	16.1	**7/13**	23.6	19.7	21.7	**9/13**	20.3	18.8	19.4
5/14	17.2	13.7	15.5	**7/14**	24.1	19.6	21.8	**9/14**	18.9	17.9	18.3
5/15	18.0	13.9	15.9	**7/15**	24.2	19.7	22.0	**9/15**	18.9	17.4	18.0
5/16	18.8	14.6	16.6	**7/16**	24.6	20.2	22.4	**9/16**	17.3	16.1	16.6
5/17	17.6	14.8	16.2	**7/17**	25.2	20.8	23.0	**9/17**	18.8	15.7	17.1
5/18	18.8	14.4	16.6	**7/18**	24.7	20.8	22.8	**9/18**	18.8	14.9	16.9
5/19	18.7	14.8	16.6	**7/19**	24.7	20.3	22.6	**9/19**	19.3	15.2	17.2
5/20	19.6	15.2	17.4	**7/20**	25.7	21.2	23.5	**9/20**	19.7	15.7	17.7
5/21	19.6	15.4	17.5	**7/21**	26.1	22.1	24.1	**9/21**	19.9	16.0	18.0
5/22	20.0	15.7	17.8	**7/22**	25.5	21.9	23.6	**9/22**	20.1	16.3	18.1
5/23	20.3	16.7	18.2	**7/23**	24.2	20.4	22.3	**9/23**	19.2	15.4	17.4
5/24	20.9	16.1	18.6	**7/24**	23.7	19.4	21.6	**9/24**	19.4	15.8	17.6
5/25	21.3	17.0	19.2	**7/25**	23.2	19.0	21.1	**9/25**	19.6	15.6	17.6
5/26	21.7	17.3	19.5	**7/26**	22.9	18.8	21.0	**9/26**	19.6	15.9	17.7
5/27	21.5	17.3	19.4	**7/27**	23.3	19.1	21.2	**9/27**	19.4	15.9	17.6
5/28	21.7	17.3	19.6	**7/28**	23.4	18.9	21.3	**9/28**	19.4	15.8	17.6
5/29	21.8	17.6	19.8	**7/29**	24.0	19.3	21.7	**9/29**	18.9	15.7	17.3
5/30	22.1	17.9	19.9	**7/30**	24.0	20.1	22.0	**9/30**	16.8	16.8	16.8
5/31	21.5	17.8	19.7	**7/31**	22.3	20.8	21.5				
6/1	21.9	17.6	19.7	**8/1**	24.2	20.1	22.1				
6/2	22.5	17.8	20.1	**8/2**	24.1	21.0	22.5				
6/3	22.6	18.2	20.4	**8/3**	24.3	20.5	22.4				
6/4	22.6	18.8	20.3	**8/4**	22.1	20.1	21.0				
6/5	22.2	17.7	20.1	**8/5**	22.9	19.2	21.0				
6/6	23.8	18.6	21.1	**8/6**	23.2	19.2	21.3				
6/7	24.7	19.6	22.2	**8/7**	23.5	20.2	21.8				
6/8	25.7	20.6	23.1	**8/8**	23.1	19.6	21.3				
6/9	25.2	21.1	23.1	**8/9**	23.4	19.1	21.3				
6/10	24.3	21.4	22.7	**8/10**	22.4	19.3	21.0				
6/11	25.6	20.6	23.0	**8/11**	22.8	19.0	21.0				
6/12	26.1	20.7	23.4	**8/12**	22.5	18.3	20.5				
6/13	26.2	21.3	23.8	**8/13**	22.6	18.4	20.5				
6/14	26.2	21.6	23.8	**8/14**	22.3	18.2	20.3				
6/15	25.4	20.9	23.2	**8/15**	22.1	17.8	20.0				
6/16	25.4	20.7	23.0	**8/16**	22.0	17.9	20.1				
6/17	25.4	20.4	23.0	**8/17**	22.4	18.2	20.3				
6/18	25.1	20.6	22.9	**8/18**	22.6	18.2	20.5				
6/19	24.6	20.0	22.4	**8/19**	22.4	18.6	20.6				
6/20	24.6	19.9	22.3	**8/20**	21.8	18.6	20.3				
6/21	24.1	19.8	21.9	**8/21**	22.6	18.5	20.6				
6/22	23.6	18.8	21.2	**8/22**	22.9	18.8	20.9				
6/23	24.0	18.8	21.6	**8/23**	22.6	18.7	20.7				
6/24	24.4	19.8	22.2	**8/24**	22.8	18.7	20.8				
6/25	25.7	20.7	23.3	**8/25**	22.6	18.5	20.6				
6/26	26.4	21.7	24.1	**8/26**	22.4	18.2	20.4				
6/27	25.7	22.2	23.9	**8/27**	22.8	18.8	20.9				
6/28	25.8	21.8	23.7	**8/28**	22.6	19.2	21.0				
6/29	26.2	21.7	23.9	**8/29**	23.3	20.0	21.3				
6/30	26.4	21.7	24.1	**8/30**	21.9	18.6	20.2				
				8/31	21.7	17.6	19.7				

APPENDIX G

TABLE 1
FLOWS AT KEY SITES WITHIN
PG&E DESABLA-CENTERVILLE PROJECT (FERC 803)
JUNE 1 - SEPTEMBER 30, 2015

APPENDIX G, Table 1. Mean daily flows (cfs) at key sites affecting Butte Creek SRCS for period June 1 through September 30, 2015.

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	25.4	0.0	36.3	30.9	nd	67.3	0.0	nd	80.3
6/2	25.6	0.0	36.6	30.7	nd	68.3	0.0	nd	80.0
6/3	25.4	0.0	36.5	30.5	nd	68.2	0.0	nd	79.3
6/4	27.0	0.0	33.4	28.3	nd	68.0	0.0	nd	81.4
6/5	25.7	0.0	33.1	27.0	nd	69.7	0.0	nd	83.8
6/6	24.8	0.0	32.6	27.0	nd	69.3	0.0	nd	77.8
6/7	24.6	0.0	32.5	26.9	nd	62.9	0.0	nd	74.4
6/8	23.9	0.0	31.1	29.1	nd	61.4	0.0	nd	71.6
6/9	23.7	0.0	33.1	31.2	nd	62.6	0.0	nd	73.1
6/10	23.7	0.0	36.2	34.8	nd	64.8	0.0	nd	71.1
6/11	23.8	0.0	36.9	35.9	nd	65.0	0.0	nd	71.8
6/12	23.0	0.0	35.3	35.0	nd	66.3	0.0	nd	70.3
6/13	22.4	0.0	34.9	32.0	nd	64.4	0.0	nd	64.3
6/14	22.0	0.0	34.6	32.1	nd	59.7	0.0	nd	61.8
6/15	21.8	3.3	34.4	36.0	nd	59.9	0.0	nd	64.0
6/16	21.8	13.2	32.3	42.1	nd	63.3	0.0	nd	72.3
6/17	21.7	13.3	29.5	36.8	nd	70.3	0.0	nd	69.5
6/18	23.3	14.4	29.4	39.9	nd	69.1	0.0	nd	69.8
6/19	24.0	15.8	29.1	42.6	nd	71.7	0.0	nd	76.7
6/20	24.2	16.1	29.1	42.8	nd	74.1	0.0	nd	74.4
6/21	24.2	15.9	28.8	42.9	nd	74.2	0.0	nd	74.0
6/22	23.9	15.7	28.7	42.9	nd	74.0	0.0	nd	74.3
6/23	24.0	15.2	28.7	41.3	nd	74.0	0.0	nd	72.4
6/24	23.8	14.9	28.9	40.9	nd	73.2	0.0	nd	82.1
6/25	25.0	16.0	29.9	42.9	nd	73.7	0.0	nd	93.5
6/26	29.6	21.7	30.9	50.1	nd	75.2	0.0	nd	99.9
6/27	30.6	24.0	30.5	52.5	nd	79.3	0.0	nd	102.1
6/28	30.9	24.3	30.4	52.5	nd	81.3	0.0	nd	102.2
6/29	30.7	24.3	30.3	52.8	nd	81.5	0.0	nd	101.2
6/30	34.5	27.6	29.9	55.0	nd	81.9	0.0	nd	110.5
7/1	35.2	29.2	29.5	56.1	nd	83.5	0.0	nd	119.4
7/2	35.2	29.2	29.5	56.1	nd	84.5	0.0	nd	122.5
7/3	35.2	29.6	29.4	56.8	nd	84.4	0.0	nd	128.3
7/4	35.3	29.8	29.5	57.3	nd	84.6	0.0	nd	127.8
7/5	35.1	29.8	29.5	58.0	nd	85.6	0.0	nd	127.3
7/6	34.9	29.5	29.0	57.8	nd	86.4	0.0	nd	129.0
7/7	35.0	29.6	29.2	55.7	nd	85.8	0.0	nd	120.8
7/8	35.9	30.0	30.6	57.6	nd	84.1	0.0	nd	111.0
7/9	36.7	32.3	35.8	64.7	nd	85.9	0.0	nd	97.4
7/10	36.8	32.7	37.0	65.3	nd	96.0	0.0	nd	97.2
7/11	35.9	31.3	33.5	61.5	nd	96.8	0.0	nd	93.6
7/12	35.6	30.4	31.7	58.8	nd	90.2	0.0	nd	86.5
7/13	35.1	29.6	31.1	57.3	nd	87.4	0.0	nd	83.5
7/14	37.9	32.9	30.6	60.5	nd	85.9	0.0	nd	84.5
7/15	37.9	33.6	30.1	61.7	nd	88.5	0.0	nd	85.1
7/16	37.8	33.4	29.8	60.3	nd	88.8	0.0	nd	79.8
7/17	37.7	33.0	29.5	59.3	nd	87.6	0.0	nd	71.3
7/18	37.6	32.6	29.2	59.4	nd	86.5	0.0	nd	71.1
7/19	37.6	32.4	29.0	59.4	nd	86.4	0.0	nd	71.1
7/20	37.7	32.6	29.1	58.3	nd	86.5	0.0	nd	70.0
7/21	37.8	32.7	29.8	58.9	nd	85.8	0.0	nd	68.9
7/22	37.4	32.2	29.1	59.3	nd	86.3	0.0	nd	70.3
7/23	37.2	31.7	28.6	57.6	nd	86.5	0.0	nd	68.3
7/24	41.2	36.9	28.5	60.1	nd	84.8	0.0	nd	68.2
7/25	43.4	40.0	28.7	66.2	nd	86.8	0.0	nd	77.6
7/26	43.8	40.7	28.9	66.9	nd	92.0	0.0	nd	79.7
7/27	43.6	40.7	28.9	65.6	nd	92.3	0.0	nd	78.2
7/28	43.1	40.4	28.5	64.5	nd	91.6	0.0	nd	75.5
7/29	45.9	43.2	28.3	66.7	nd	90.3	0.0	nd	75.0
7/30	45.9	43.3	27.9	68.6	nd	91.7	0.0	nd	78.2
7/31	46.1	43.6	28.1	67.8	nd	93.1	0.0	nd	78.3

APPENDIX G, Table 1 (Continued). Mean daily flows (cfs) at key sites affecting Butte Creek SRCS for period June 1 through September 30, 2015.

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	45.9	43.7	28.4	68.2	nd	92.8	0.0	nd	78.9
8/2	45.9	44.0	28.4	68.4	nd	93.5	0.0	nd	78.3
8/3	42.8	40.7	28.6	67.1	nd	93.9	0.0	nd	77.6
8/4	42.9	40.1	28.4	63.8	nd	92.6	0.0	nd	74.6
8/5	43.4	40.4	29.3	64.5	nd	90.1	0.0	nd	74.0
8/6	42.8	39.9	28.7	65.9	nd	91.1	0.0	nd	77.2
8/7	42.5	39.8	28.4	65.0	nd	92.3	0.0	nd	74.9
8/8	42.3	39.6	28.2	63.7	nd	91.2	0.0	nd	73.9
8/9	42.3	39.5	28.1	62.6	nd	89.9	0.0	nd	70.8
8/10	42.1	39.2	28.0	62.8	nd	89.1	0.0	nd	70.3
8/11	41.9	39.1	28.1	62.6	nd	89.3	0.0	nd	70.8
8/12	41.9	38.9	28.2	62.2	nd	88.7	0.0	nd	68.8
8/13	41.7	38.4	28.0	62.4	nd	88.6	0.0	nd	71.9
8/14	41.5	38.6	27.8	62.7	nd	88.3	0.0	nd	89.4
8/15	41.4	38.5	27.7	63.8	nd	89.0	0.0	nd	90.8
8/16	41.1	38.3	27.6	60.6	nd	89.8	0.0	nd	87.3
8/17	41.0	37.9	27.5	61.1	nd	86.9	0.0	nd	85.8
8/18	40.9	37.9	27.5	62.0	nd	87.0	0.0	nd	87.3
8/19	40.2	37.5	27.5	59.5	nd	87.6	0.0	nd	86.1
8/20	35.6	32.1	27.5	53.5	nd	85.6	0.0	nd	81.2
8/21	35.4	31.2	27.7	54.6	nd	80.2	0.0	nd	78.4
8/22	35.2	30.9	27.6	56.1	nd	81.1	0.0	nd	82.3
8/23	35.1	30.9	27.5	53.9	nd	83.3	0.0	nd	81.4
8/24	35.0	30.9	27.6	52.3	nd	81.0	0.0	nd	77.8
8/25	34.8	30.9	27.5	14.0	nd	79.6	0.0	nd	78.9
8/26	34.6	30.9	27.4	27.5	nd	80.9	0.0	nd	78.3
8/27	31.5	28.2	27.5	52.1	nd	81.2	0.0	nd	79.5
8/28	31.0	27.5	27.5	49.6	nd	79.1	0.0	nd	74.5
8/29	32.1	28.8	28.0	51.3	nd	76.3	0.0	nd	75.8
8/30	31.7	28.6	28.6	53.6	nd	78.5	0.0	nd	81.7
8/31	31.2	28.1	28.3	51.1	nd	81.4	0.0	nd	78.3
9/1	31.0	27.9	27.4	49.7	nd	78.5	0.0	nd	75.5
9/2	31.0	27.9	25.9	48.2	nd	76.5	0.0	nd	76.0
9/3	27.8	24.8	26.0	45.1	nd	78.2	0.0	nd	74.7
9/4	27.1	23.3	26.3	45.2	nd	75.0	0.0	nd	70.3
9/5	27.1	23.3	26.4	47.0	nd	75.3	0.0	nd	73.3
9/6	27.0	22.9	26.1	45.2	nd	77.3	0.0	nd	72.3
9/7	26.9	22.7	26.0	44.2	nd	74.7	0.0	nd	69.4
9/8	26.8	22.1	25.8	44.2	nd	73.9	0.0	nd	69.1
9/9	26.7	21.4	25.6	42.4	nd	74.1	0.0	nd	68.3
9/10	26.7	21.2	25.6	42.8	nd	72.1	0.0	nd	67.0
9/11	26.7	21.0	25.5	43.2	nd	72.3	0.0	nd	68.3
9/12	26.7	21.2	25.4	41.9	nd	72.7	0.0	nd	67.0
9/13	26.8	21.6	25.6	44.3	nd	71.4	0.0	nd	68.4
9/14	26.9	21.8	25.9	44.1	nd	73.8	0.0	nd	69.6
9/15	24.5	20.2	27.0	44.1	nd	73.7	0.0	nd	70.3
9/16	24.7	19.0	28.2	43.0	nd	74.6	0.0	nd	72.4
9/17	24.5	21.6	32.9	54.3	nd	75.2	0.0	nd	85.9
9/18	20.6	15.0	29.0	41.1	nd	88.0	0.0	nd	73.7
9/19	19.6	13.8	28.1	39.5	nd	72.7	0.0	nd	67.0
9/20	19.2	13.2	27.7	39.3	nd	70.4	0.0	nd	65.7
9/21	19.0	12.2	27.3	37.2	nd	69.6	0.0	nd	64.0
9/22	18.7	11.7	27.2	36.4	nd	67.2	0.0	nd	60.5
9/23	18.7	11.7	26.9	37.5	nd	66.4	0.0	nd	62.0
9/24	18.7	11.7	26.9	34.6	nd	67.0	0.0	nd	62.3
9/25	18.7	11.6	20.3	13.1	nd	63.8	0.0	nd	57.0
9/26	18.7	11.5	12.6	0.0	nd	61.4	0.0	nd	62.7
9/27	18.7	11.3	11.6	0.0	nd	68.0	0.0	nd	65.0
9/28	18.7	11.3	10.7	0.0	nd	67.8	0.0	nd	62.1
9/29	18.7	10.8	10.1	0.0	nd	66.3	0.0	nd	63.2
9/30	18.7	10.8	9.7	0.0	nd	67.1	0.0	nd	63.4

1/ PG&E Hendricks Canal Downstream of Head Dam, flow for period June 1 through September 30, 2015. PG&E BW8, Latitude 39°56.1839'N, Longitude 121°31.8097'W NAS83 (Preliminary data received from PG&E 2/16).

2/ PG&E Toadtown/Hendricks Canal flow for period June 1 through September 30, 2015. USGS gage #11389800, PG&E BW12 , Latitude 39°53'09", Longitude 121°36'35" NAD27 (Preliminary data received from PG&E 2/16).

3/ PG&E Butte Canal flow above confluence with Toadtown/Hendricks Canal for period June 1 through September 30, 2015. PG&E BW15, Latitude 39°53.2093'N, Longitude 121°36.7342'W NAD83 (Preliminary data received from PG&E 2/16).

4/ PG&E DeSabla Powerhouse discharge for period June 1 through September 30, 2015. USGS gage #11389750, PG&E BW82, Latitude 39°52'10", Longitude 121°37'51" NAD27. (Preliminary data received from PG&E 2/16).

5/ Butte Creek immediately above DeSabla Powerhouse discharge not installed for period June 1 through September 30, 2015.

6/ Butte Creek below Centerville Head Dam discharge for period June 1 through September 30, 2015. USGS gage #11389780, PG&E BW98, Latitude 39°52'01", Longitude 121°37'58" NAD27, (Preliminary data received from PG&E 2/16, gage reviewed for accuracy only for flows less than 90 cfs)

7/ PG&E Centerville Powerhouse discharge for period June 1 through September 30, 2015. USGS gage #11389775, PG&E BW80, Latitude 39°47'20", Longitude 121°39'23" NAD27. (Preliminary data received from PG&E 2/15). * Powerhouse not producing power and offline for extended period of time.

8/ Butte Creek immediately above Centerville Powerhouse discharge not installed for period June 1 through September 30, 2015.

9/ USGS gage #11390000 for period June 1 through September 30, 2015, 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, 2015

APPENDIX H, Table 1. Water temperature (C) at key sites within PG&E DeSabla-Centerville Project for period June 1 through September 30, 2015 (PG&E preliminary data 2015 [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	14.2	13.0	0	0	15.0	13.6	14.9	13.7	16.8	16.1
6/2	14.6	13.0	0	0	15.7	13.8	15.6	13.9	16.3	15.8
6/3	14.2	13.0	0	0	15.4	13.7	15.4	13.9	16.4	16.0
6/4	13.1	12.5	0	0	13.6	13.0	13.8	13.1	16.4	15.7
6/5	14.6	12.9	0	0	15.4	13.5	15.4	13.5	15.6	15.1
6/6	15.4	13.8	0	0	16.7	14.8	16.8	15.0	16.6	16.0
6/7	16.5	14.6	0	0	17.9	15.8	18.0	15.9	17.6	17.0
6/8	17.0	15.3	0	0	18.7	16.8	18.8	16.9	18.6	18.0
6/9	17.1	15.6	0	0	18.3	17.0	18.4	17.1	19.3	18.8
6/10	16.1	15.5	0	0	17.9	16.9	17.9	17.0	19.4	18.9
6/11	17.2	15.4	0	0	18.3	16.3	18.4	16.5	19.1	18.5
6/12	17.5	15.7	0	0	19.1	16.9	19.2	17.0	19.2	18.7
6/13	17.9	16.1	0	0	19.5	17.4	19.5	17.6	19.7	19.2
6/14	17.8	16.2	0	0	19.2	17.4	19.2	17.6	19.9	19.5
6/15	17.1	15.5	0	0	18.2	16.5	18.5	16.7	19.9	19.1
6/16	17.1	15.4	18.6	16.6	18.4	16.2	18.4	16.4	19.5	18.4
6/17	17.4	15.5	18.8	16.7	18.7	16.5	18.7	16.6	19.0	18.3
6/18	17.1	15.5	18.3	16.7	18.4	16.6	18.3	16.7	19.2	18.6
6/19	16.9	15.2	18.1	16.3	18.1	16.1	18.1	16.3	19.1	18.2
6/20	16.9	15.2	18.1	16.2	18.2	16.1	18.1	16.2	18.7	17.9
6/21	16.5	15.1	17.6	16.1	17.7	16.0	17.5	16.2	18.6	18.0
6/22	16.2	14.5	17.2	15.3	17.2	15.2	17.2	15.3	18.3	17.3
6/23	16.5	14.7	17.8	15.6	17.8	15.3	17.7	15.5	17.7	17.0
6/24	17.3	15.4	18.8	16.6	18.8	16.3	18.8	16.5	18.4	17.6
6/25	18.2	16.4	19.7	17.7	20.1	17.7	19.9	17.8	19.5	18.7
6/26	18.8	17.1	20.1	18.3	20.9	18.6	20.5	18.6	20.4	19.6
6/27	18.6	17.3	19.8	18.4	20.2	18.7	20.1	18.7	20.6	20.1
6/28	18.4	17.1	19.5	18.1	20.1	18.4	19.8	18.3	20.6	19.8
6/29	18.5	16.9	19.7	17.9	20.1	18.0	19.9	18.1	20.3	19.6
6/30	18.3	16.9	19.6	18.0	20.5	18.3	20.1	18.3	20.2	19.6
7/1	18.3	17.1	19.5	18.2	20.5	18.8	20.1	18.6	20.4	19.9
7/2	18.8	17.3	20.0	18.4	21.0	19.0	20.5	18.8	20.7	20.0
7/3	19.1	17.8	20.4	18.9	21.6	19.7	21.0	19.4	21.2	20.5
7/4	19.2	17.9	20.4	19.0	21.2	19.7	20.8	19.4	21.3	20.7
7/5	19.1	17.8	20.5	19.0	21.2	19.4	20.8	19.3	21.3	20.7
7/6	18.8	17.4	19.9	18.4	20.7	18.9	20.2	18.7	21.3	20.4
7/7	18.4	17.0	19.4	18.0	19.7	18.3	19.5	18.2	20.9	19.9
7/8	17.0	16.2	18.3	17.1	18.3	17.3	18.4	17.3	20.2	19.2
7/9	15.8	15.3	17.1	16.1	16.7	15.9	17.0	16.0	19.0	17.9
7/10	15.0	14.5	15.9	15.2	15.9	15.0	15.8	15.1	17.4	16.7
7/11	15.9	14.5	17.0	15.3	17.4	15.2	17.1	15.3	16.9	16.2
7/12	15.8	14.8	17.2	15.8	17.7	16.0	17.4	16.0	17.6	17.0
7/13	16.3	14.9	17.3	15.7	17.6	16.0	17.4	15.9	17.7	17.2
7/14	16.2	14.8	17.3	15.7	18.1	16.0	17.6	15.9	17.8	17.2
7/15	16.5	15.1	17.6	15.9	18.6	16.4	18.1	16.2	18.0	17.3
7/16	17.2	15.7	18.4	16.6	19.4	17.1	18.8	16.9	18.5	17.8
7/17	17.7	16.3	18.8	17.2	20.0	17.9	19.4	17.6	19.2	18.5
7/18	17.5	16.3	18.6	17.2	19.7	17.9	19.0	17.6	19.4	18.9
7/19	17.2	15.9	18.2	16.7	19.4	17.4	18.7	17.1	19.4	18.6
7/20	17.8	16.4	19.1	17.4	20.0	17.9	19.6	17.7	19.4	18.7
7/21	18.1	16.8	19.4	17.9	20.5	18.5	19.9	18.3	20.0	19.4
7/22	18.0	16.9	19.1	17.9	20.0	18.5	19.3	18.2	20.2	19.7
7/23	16.5	15.4	17.4	16.2	18.1	16.7	17.9	16.5	20.0	18.6
7/24	15.7	14.6	16.6	15.2	17.4	15.6	16.8	15.5	18.5	17.3
7/25	15.5	14.3	16.3	14.9	17.2	15.2	16.6	15.1	17.5	16.7
7/26	15.7	14.5	16.5	15.1	17.4	15.4	16.8	15.3	17.1	16.5
7/27	16.1	14.9	16.9	15.5	17.9	15.8	17.2	15.7	17.4	16.7
7/28	16.5	15.2	17.4	15.9	18.5	16.2	17.8	16.1	17.7	17.0
7/29	16.9	15.7	17.9	16.5	19.2	16.9	18.4	16.7	18.3	17.6
7/30	17.4	16.2	18.4	17.0	19.7	17.4	18.9	17.2	18.8	18.1
7/31	16.9	16.4	17.8	17.1	18.3	17.5	18.1	17.3	19.0	18.5

APPENDIX H, Table 1 (continued). Water temperature (C) at key sites within PG&E DeSabla-Centerville Project for period June 1 through September 30, 2015 (PG&E preliminary data 2015[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	18.1	16.7	18.8	17.4	19.4	17.4	19.0	17.4	19.0	18.2
8/2	18.4	17.5	18.9	18.1	19.6	18.1	19.2	18.1	19.4	18.9
8/3	18.0	17.0	18.8	17.6	19.1	17.4	18.8	17.6	19.5	18.8
8/4	16.8	16.1	17.7	16.6	17.3	16.2	17.7	16.5	19.3	18.2
8/5	17.0	16.0	17.6	16.4	17.4	15.8	17.5	16.2	17.7	17.2
8/6	16.9	15.9	17.7	16.4	17.5	15.9	17.6	16.2	17.8	17.3
8/7	17.3	16.3	17.9	16.9	18.1	16.4	17.9	16.7	18.2	17.6
8/8	17.0	16.0	17.6	16.5	17.8	16.2	17.7	16.5	18.3	17.6
8/9	16.9	15.8	17.5	16.3	17.7	15.9	17.5	16.2	18.0	17.4
8/10	16.6	15.6	17.2	16.1	17.2	15.6	17.2	15.9	17.8	17.2
8/11	16.3	15.4	16.9	15.9	17.0	15.4	16.8	15.7	17.6	17.0
8/12	16.3	15.1	16.9	15.5	16.9	15.0	16.8	15.4	17.3	16.6
8/13	16.4	15.3	17.1	15.8	17.1	15.2	17.0	15.6	17.2	16.7
8/14	16.1	15.1	16.7	15.6	16.7	15.0	16.6	15.3	17.3	16.6
8/15	15.7	14.6	16.5	15.2	16.3	14.5	16.4	14.9	17.0	16.2
8/16	16.0	14.8	16.9	15.4	16.6	14.7	16.7	15.1	16.7	16.1
8/17	16.1	14.9	17.0	15.6	16.9	14.9	16.9	15.3	16.9	16.3
8/18	16.6	15.4	17.5	16.0	17.6	15.5	17.4	15.8	17.3	16.7
8/19	16.5	15.5	17.4	16.2	17.4	15.7	17.4	16.0	17.5	17.0
8/20	16.3	15.4	17.1	16.0	16.8	15.5	16.9	15.8	17.6	17.0
8/21	16.3	15.2	17.1	15.9	16.9	15.2	17.0	15.6	17.2	16.9
8/22	16.3	15.1	17.1	15.8	17.1	15.3	17.1	15.6	17.3	16.9
8/23	16.2	15.1	17.0	15.8	16.8	15.3	16.9	15.6	17.4	16.9
8/24	16.4	15.1	17.1	15.9	17.1	15.3	17.1	15.7	17.3	16.9
8/25	16.0	14.9	16.7	15.7	16.6	15.2	16.6	15.5	18.1	17.5
8/26	15.8	14.6	16.7	15.4	16.4	14.8	16.5	15.2	18.1	17.1
8/27	16.2	15.0	17.1	15.8	16.9	15.2	17.0	15.6	17.1	16.7
8/28	16.2	15.1	17.1	16.0	16.8	15.5	16.9	15.8	17.3	17.0
8/29	15.5	15.0	16.6	15.9	16.5	15.5	16.4	15.8	17.4	17.1
8/30	15.0	14.1	15.5	14.7	15.6	14.4	15.5	14.6	17.1	16.3
8/31	14.7	13.5	15.4	14.2	15.1	13.6	15.2	13.9	16.2	15.5
9/1	14.7	13.6	15.4	14.3	15.3	13.6	15.3	14.0	15.7	15.3
9/2	14.8	13.6	15.3	14.3	15.3	13.8	15.3	14.1	15.8	15.4
9/3	14.6	13.5	15.0	14.1	15.0	13.7	14.9	13.9	15.8	15.3
9/4	13.6	12.8	14.2	13.3	13.9	12.9	14.0	13.1	15.5	14.9
9/5	13.1	12.1	13.4	12.5	13.0	11.8	13.1	12.1	15.0	14.1
9/6	13.1	11.8	13.7	12.4	13.3	11.6	13.4	12.0	14.0	13.5
9/7	13.3	12.0	14.1	12.7	13.7	12.0	13.9	12.4	13.9	13.6
9/8	13.9	12.5	14.8	13.4	14.6	12.7	14.7	13.1	14.4	13.9
9/9	14.4	13.1	15.5	14.1	15.4	13.6	15.4	13.9	15.1	14.7
9/10	14.8	13.5	16.0	14.6	15.9	14.2	15.9	14.5	15.7	15.3
9/11	15.2	14.1	16.4	15.3	16.3	14.8	16.3	15.1	16.3	15.9
9/12	15.4	14.4	16.3	15.4	15.9	15.1	16.1	15.3	16.5	16.3
9/13	15.0	14.4	16.0	15.4	15.4	14.7	15.6	15.1	16.6	16.3
9/14	14.3	13.7	15.5	14.6	14.6	13.9	15.1	14.2	16.2	15.8
9/15	13.6	13.2	14.2	13.8	13.4	13.1	13.8	13.4	15.3	14.8
9/16	12.6	11.7	13.4	12.0	12.5	11.3	12.9	11.6	14.6	13.6
9/17	12.2	11.4	13.3	12.0	12.2	11.0	12.5	11.4	12.8	12.4
9/18	12.6	11.4	13.5	12.1	12.8	11.3	13.0	11.6	12.9	12.6
9/19	12.9	11.6	14.0	12.6	13.5	11.8	13.6	12.1	13.3	12.9
9/20	13.2	12.0	14.5	13.3	13.9	12.4	14.1	12.8	14.0	13.6
9/21	13.4	12.2	14.8	13.5	14.2	12.7	14.3	13.0	14.3	14.0
9/22	13.3	12.3	14.6	13.8	14.0	12.9	14.1	13.2	14.8	14.5
9/23	12.7	11.7	14.0	12.8	13.2	12.1	13.3	12.4	14.7	14.3
9/24	12.8	11.7	14.0	12.9	13.3	11.9	13.5	12.3	14.2	13.8
9/25	12.7	11.6	14.0	13.0	14.2	12.4	14.0	12.6	14.7	14.2
9/26	12.8	11.7	14.1	13.1	14.4	13.2	14.2	13.3	15.5	15.0
9/27	12.7	11.7	14.0	13.0	14.3	13.2	14.1	13.2	15.8	15.5
9/28	12.7	11.7	14.0	13.0	14.3	13.1	14.1	13.1	15.9	15.7
9/29	12.6	11.6	13.7	12.9	13.9	12.9	13.9	13.0	16.0	15.8
9/30	11.4	10.9	nd	nd	nd	nd	nd	nd	nd	nd

APPENDIX H, Table 2. Water temperature (C) at key sites within PG&E DeSabla-Centerville Project for period June 1 through September 30, 2015(PG&E preliminary data 2015[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	17.6	16.6	17.1	16.5	20.7	18.4	nd	nd	nd	nd
6/2	17.8	16.8	17.1	16.4	21.2	18.6	nd	nd	nd	nd
6/3	17.9	16.9	17.1	16.6	21.0	18.9	nd	nd	nd	nd
6/4	17.4	17.0	17.0	16.5	20.4	18.6	nd	nd	nd	nd
6/5	17.5	16.5	16.6	16.0	20.5	18.4	nd	nd	nd	nd
6/6	18.8	17.4	17.8	16.9	21.6	19.3	nd	nd	nd	nd
6/7	19.7	18.5	18.8	17.9	22.7	20.4	nd	nd	nd	nd
6/8	20.4	19.2	19.6	18.7	23.6	21.2	nd	nd	nd	nd
6/9	20.6	19.5	20.0	19.3	23.3	21.5	nd	nd	nd	nd
6/10	20.3	19.7	19.8	19.4	22.9	21.4	nd	nd	nd	nd
6/11	20.8	19.7	19.8	19.2	23.4	21.4	nd	nd	nd	nd
6/12	20.6	19.6	19.9	19.2	23.5	21.5	nd	nd	nd	nd
6/13	21.0	19.9	20.4	19.6	23.7	21.8	nd	nd	nd	nd
6/14	21.0	20.1	20.5	19.9	23.8	22.0	nd	nd	nd	nd
6/15	20.4	19.3	20.1	19.4	23.2	21.5	nd	nd	nd	nd
6/16	20.1	19.1	19.6	18.8	23.0	21.1	nd	nd	nd	nd
6/17	20.2	19.1	19.3	18.8	22.9	20.9	nd	nd	nd	nd
6/18	20.1	19.1	19.4	18.9	22.8	21.0	nd	nd	nd	nd
6/19	19.7	18.8	19.2	18.5	22.4	20.6	nd	nd	nd	nd
6/20	19.7	18.6	18.8	18.3	22.2	20.4	nd	nd	nd	nd
6/21	19.2	18.5	18.8	18.3	21.7	20.1	nd	nd	nd	nd
6/22	18.8	17.7	18.3	17.6	21.4	19.5	nd	nd	nd	nd
6/23	19.2	17.9	18.2	17.5	21.6	19.6	nd	nd	nd	nd
6/24	20.1	18.7	19.0	18.2	22.1	20.2	nd	nd	nd	nd
6/25	21.3	20.0	20.1	19.3	23.3	21.3	nd	nd	nd	nd
6/26	21.9	20.9	20.8	20.2	24.1	22.2	nd	nd	nd	nd
6/27	21.7	21.0	20.9	20.5	23.9	22.3	nd	nd	nd	nd
6/28	21.5	20.8	20.8	20.2	23.8	22.1	nd	nd	nd	nd
6/29	21.6	20.7	20.6	20.1	23.9	22.1	nd	nd	nd	nd
6/30	21.9	20.8	20.7	20.1	24.1	22.2	nd	nd	nd	nd
7/1	22.1	21.2	20.9	20.4	23.9	22.4	nd	nd	nd	nd
7/2	22.5	21.5	21.2	20.6	24.5	22.7	nd	nd	nd	nd
7/3	23.0	22.2	21.6	21.1	24.4	23.0	nd	nd	nd	nd
7/4	23.2	22.3	21.7	21.3	24.7	23.2	nd	nd	nd	nd
7/5	23.1	22.3	21.8	21.3	25.1	23.4	nd	nd	nd	nd
7/6	22.6	21.8	21.7	21.0	24.6	23.0	nd	nd	nd	nd
7/7	22.0	21.3	21.2	20.5	24.0	22.4	nd	nd	nd	nd
7/8	21.5	20.7	20.6	19.8	22.5	21.6	nd	nd	nd	nd
7/9	20.5	19.8	19.5	18.6	21.3	20.4	nd	nd	nd	nd
7/10	19.5	19.0	18.1	17.5	20.8	19.6	nd	nd	nd	nd
7/11	19.9	18.9	17.8	17.2	21.4	19.6	nd	nd	nd	nd
7/12	20.1	19.3	18.2	17.8	21.5	19.8	nd	nd	nd	nd
7/13	20.0	19.2	18.3	17.9	21.6	19.9	nd	nd	nd	nd
7/14	20.1	19.1	18.3	17.8	21.8	19.9	nd	nd	nd	nd
7/15	20.3	19.3	18.5	18.0	21.9	20.1	nd	nd	nd	nd
7/16	21.0	19.8	19.1	18.5	22.4	20.5	nd	nd	nd	nd
7/17	21.4	20.5	19.7	19.2	23.0	21.1	nd	nd	nd	nd
7/18	21.1	20.4	19.8	19.5	22.8	21.1	nd	nd	nd	nd
7/19	20.9	19.9	19.7	19.1	22.7	20.9	nd	nd	nd	nd
7/20	21.9	20.7	20.0	19.4	23.4	21.5	nd	nd	nd	nd
7/21	22.4	21.5	20.6	20.1	23.9	22.2	nd	nd	nd	nd
7/22	22.2	21.5	20.7	20.3	23.6	22.1	nd	nd	nd	nd
7/23	21.2	20.0	20.3	19.1	22.4	20.9	nd	nd	nd	nd
7/24	19.7	18.9	18.8	17.9	21.6	19.9	nd	nd	nd	nd
7/25	19.3	18.4	17.9	17.2	21.0	19.3	nd	nd	nd	nd
7/26	19.3	18.4	17.6	17.1	20.9	19.1	nd	nd	nd	nd
7/27	19.7	18.8	17.9	17.4	21.2	19.4	nd	nd	nd	nd
7/28	19.9	18.9	18.2	17.6	21.4	19.5	nd	nd	nd	nd
7/29	20.3	19.2	18.7	18.1	21.9	19.9	nd	nd	nd	nd
7/30	20.8	19.7	19.3	18.6	22.2	20.4	nd	nd	nd	nd
7/31	20.7	20.1	19.4	19.0	21.2	20.3	nd	nd	nd	nd

APPENDIX H, Table 2 (continued). Water temperature (C) at key sites within PG&E DeSabla-Centerville Project for period June 1 through September 30, 2015 (PG&E preliminary data 2015[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	21.3	20.3	19.5	18.9	22.5	20.8	nd	nd	nd	nd
8/2	21.6	20.9	19.9	19.5	22.6	21.1	nd	nd	nd	nd
8/3	21.1	20.3	19.9	19.3	22.6	21.0	nd	nd	nd	nd
8/4	20.7	19.5	19.6	18.6	21.3	20.0	nd	nd	nd	nd
8/5	19.9	19.2	18.2	17.8	21.2	19.7	nd	nd	nd	nd
8/6	19.9	19.0	18.3	17.9	21.3	19.7	nd	nd	nd	nd
8/7	20.3	19.6	18.7	18.2	21.8	20.2	nd	nd	nd	nd
8/8	20.0	19.3	18.6	18.2	21.4	19.9	nd	nd	nd	nd
8/9	19.8	19.0	18.5	18.0	21.4	19.8	nd	nd	nd	nd
8/10	19.5	18.7	18.2	17.7	20.9	19.5	nd	nd	nd	nd
8/11	19.2	18.5	18.0	17.5	20.9	19.4	nd	nd	nd	nd
8/12	19.0	18.1	17.7	17.1	20.6	18.9	nd	nd	nd	nd
8/13	19.0	18.2	17.6	17.2	20.7	19.0	nd	nd	nd	nd
8/14	18.7	17.9	17.6	17.1	20.3	18.7	nd	nd	nd	nd
8/15	18.3	17.5	17.3	16.7	20.1	18.5	nd	nd	nd	nd
8/16	18.5	17.5	17.1	16.6	20.1	18.5	nd	nd	nd	nd
8/17	18.5	17.6	17.3	16.8	20.2	18.6	nd	nd	nd	nd
8/18	19.0	18.1	17.7	17.1	20.6	18.9	nd	nd	nd	nd
8/19	19.3	18.4	18.0	17.5	20.7	19.1	nd	nd	nd	nd
8/20	19.0	18.3	18.0	17.5	20.4	19.1	nd	nd	nd	nd
8/21	19.1	18.3	17.7	17.4	20.7	19.2	nd	nd	nd	nd
8/22	19.2	18.4	17.8	17.4	20.8	19.3	nd	nd	nd	nd
8/23	19.1	18.4	17.8	17.5	20.7	19.2	nd	nd	nd	nd
8/24	19.2	18.4	17.8	17.4	20.8	19.3	nd	nd	nd	nd
8/25	18.8	18.1	18.2	17.8	20.6	19.1	nd	nd	nd	nd
8/26	18.6	17.8	18.1	17.4	20.7	19.2	nd	nd	nd	nd
8/27	19.0	18.1	17.7	17.2	20.7	19.3	nd	nd	nd	nd
8/28	19.0	18.4	17.8	17.5	20.7	19.4	nd	nd	nd	nd
8/29	19.4	18.7	18.0	17.7	20.9	19.7	nd	nd	nd	nd
8/30	18.7	17.9	17.6	16.9	20.1	18.8	nd	nd	nd	nd
8/31	17.8	17.1	16.7	16.1	19.5	18.1	nd	nd	nd	nd
9/1	17.7	17.0	16.2	15.9	19.4	18.0	nd	nd	nd	nd
9/2	17.7	17.0	16.5	16.1	19.2	17.9	nd	nd	nd	nd
9/3	17.4	16.7	16.3	16.0	19.1	17.7	nd	nd	nd	nd
9/4	16.9	16.1	16.0	15.5	18.5	17.3	nd	nd	nd	nd
9/5	16.0	15.4	15.4	14.7	17.8	16.6	nd	nd	nd	nd
9/6	15.7	14.9	14.5	14.1	17.5	16.0	nd	nd	nd	nd
9/7	15.9	14.9	14.6	14.2	17.6	16.1	nd	nd	nd	nd
9/8	16.2	15.3	15.0	14.5	17.9	16.4	nd	nd	nd	nd
9/9	16.9	15.9	15.8	15.2	18.6	17.0	nd	nd	nd	nd
9/10	17.4	16.5	16.3	15.9	19.1	17.7	nd	nd	nd	nd
9/11	18.0	17.2	16.9	16.5	19.4	18.3	nd	nd	nd	nd
9/12	18.0	17.4	17.1	16.8	19.6	18.4	nd	nd	nd	nd
9/13	17.8	17.4	17.0	16.8	18.8	18.3	nd	nd	nd	nd
9/14	17.5	16.8	16.7	16.3	18.2	17.5	nd	nd	nd	nd
9/15	16.6	16.3	15.9	15.5	17.7	17.2	nd	nd	nd	nd
9/16	15.9	14.9	15.1	14.2	16.7	15.7	nd	nd	nd	nd
9/17	15.7	14.9	13.8	13.4	17.0	15.7	nd	nd	nd	nd
9/18	15.5	14.7	14.0	13.5	16.8	15.4	nd	nd	nd	nd
9/19	15.6	14.8	14.3	13.8	17.1	15.7	nd	nd	nd	nd
9/20	16.0	15.2	14.9	14.3	17.6	16.2	nd	nd	nd	nd
9/21	16.2	15.4	15.2	14.7	17.9	16.5	nd	nd	nd	nd
9/22	16.3	15.6	15.6	15.0	18.0	16.8	nd	nd	nd	nd
9/23	15.7	14.9	15.2	14.6	17.3	16.2	nd	nd	nd	nd
9/24	15.6	14.9	14.8	14.4	17.5	16.2	nd	nd	nd	nd
9/25	15.6	14.9	15.3	14.6	17.5	16.2	nd	nd	nd	nd
9/26	15.6	14.8	15.7	15.0	17.8	16.5	nd	nd	nd	nd
9/27	15.3	14.5	15.6	15.0	17.8	16.5	nd	nd	nd	nd
9/28	15.2	14.4	15.6	14.9	17.8	16.5	nd	nd	nd	nd
9/29	14.8	14.2	15.4	14.9	17.4	16.3	nd	nd	nd	nd
9/30	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd

[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, Vemco minilog recorder #354605, QA/QC = ± 0.1°C , Lat (NAD83) 039° 56.1839'N, Long (NAD83) 121° 31.8097'W.

[3/] Toadtown Canal at BW-12 gage site, Vemco minilog recorder #350623, QA/QC = ± 0.1°C, Lat (NAD83) 039° 53.1700'N, Long (NAD83) 121° 36.7168'W.

[4/] Butte Canal at BW-15 gage site, Vemco minilog recorder #350626, QA/QC = ± 0.1°C, Lat (NAD83) 039° 53.2093'N, Long (NAD83) 121° 36.7342'W.

[5/] Butte Canal at inflow to DeSabla Forebay (total canal flow), Vemco minilog recorder #354599, QA/QC = ± 0.1°C, Lat (NAD83) 039° 52.5452'N, Long (NAD83) 121° 36.7236'W.

[6/] DeSabla Powerhouse - Internal recorder off of tailrace, Vemco minilog recorder #350622, QA/QC =± 0.1°C, Lat (NAD83) 039° 52.1618'N, Long (NAD83) 121° 37.9314'W.

[7/] Butte Creek above DeSabla Powerhouse, Vemco minilog recorder #354711, QA/QC = ± 0.1°C, Lat (NAD83) 039° 52.2114'N, Long (NAD83) 121° 37.9609'W.

[8/] Butte Creek at Lower Centerville Diversion Dam, Vemco minilog recorder #354709, QA/QC =± 0.1°C, Lat (NAD83) 039° 52.0615'N, Long (NAD83) 121° 37.9448'W.

[9/] Butte Creek above Centerville Powerhouse, Vemco minilog recorder #356126, QA/QC = ± 0.1°C, Lat (NAD83) 039° 47.4298'N, Long (NAD83) 121° 39.4915'W.

[10/] Lower Centerville Canal at Centerville Powerhouse penstock headworks, Lat (NAD83) 039° 47.4156'N, Long (NAD83) 121° 39.9039'W.
Note: Not in use in 2015, no flow in canal

[11/] Butte Creek below Centerville Powerhouse, Lat (NAD83) 039° 47.2308'N, Long (NAD83) 121° 39.5875'W.
Note: Not in use in 2015, no flow in canal

APPENDIX I

Table 1
BUTTE CREEK SRCS DISTRIBUTION BY REACH, ABOVE AND BELOW PG&E CVPH FOR SNORKEL, PRE-SPAWN, AND SPAWN SURVEY FROM 2001-2014.

Appendix I, Table 1. Summary of Butte Creek SRCS distribution by reach, above and below PG&E CVPH for snorkel, pre-spawn, and spawn survey during 2001-2014.

Year 2014							
	Snorkel Survey(Holding)			Pre-Spawn Survey		Spawn Survey	
Reach	Actual	Estimated	Percent	Actual	Percent	Actual	Percent
A	1391	1956	38.5%	46	19.8%	911	18.8%
B	1330	1870	36.8%	71	30.6%	1572	32.4%
C1-5	265	372	7.3%	32	13.8%	1202	24.8%
C6-12	449	631	12.4%	40	17.2%	774	16.0%
D	87	122	2.4%	20	8.6%	263	5.4%
E	94	132	2.6%	22	9.5%	117	2.4%
CVCB to PP (Figure 1)	0	0	0%	0	0%	12	0.2%
Total	3616	5083	100%	232	100%	4851	100%
Total Above Powerhouse	2986	4198	83%	149	64.2%	3685	76%
Total Below Powerhouse	630	885	17%	83	35.8%	1166	24%

Year 2013							
Reach	Snorkel Survey			Pre-Spawn		Spawn Survey	
	Actual	Estimated	Percent	Actual	Percent	Actual	Percent
A	5329	7796	46.5%	251	28.0%	1427	9.0%
B	4213	6164	36.7%	397	44.3%	2933	18.5%
C1-5	849	1242	7.4%	90	10.0%	3083	19.4%
C6-12	991	1450	8.6%	116	13.0%	3895	24.5%
D	80	117	0.6%	24	2.7%	2162	13.6%
E	9	13	>1%	18	2.0%	1340	8.4%
CVCB to PP (Figure 1)	0	0	0%	0	0%	1046	6.6%
Total	11471	16782	100%	896	100%	15886	100%
Total Above Powerhouse	10391	15202	90.6%	738	82.4%	7443	46.9%
Total Below Powerhouse	1080	1580	9.4%	158	17.6%	8443	53.1%

Year 2012							
	Snorkel Survey			Pre-Spawn Survey		Spawn Survey	
Reach	Actual	Estimated	Percent	Actual	Percent	Actual	Percent
A	1373	2601	15.9%	18	10%	390	2.4%
B	2011	3809	23.4%	33	19%	2294	14.2%
C1-5	1247	2361	14.5%	20	11%	2405	14.9%
C6-12	1492	2826	17.3%	48	27%	3867	24.0%
D	1606	3041	18.6%	37	21%	3888	24.1%
E	732	1387	8.5%	21	12%	2594	16.1%
CVCB to PP (Figure 1)	154	292	1.8%	0	0%	702	4.3%
Total	8615	16317	100%	177	100%	16140	100%
Total Above Powerhouse	4631	8771	53.8%	71	40.1%	5089	31.5%
Total Below Powerhouse	3984	7546	46.2%	106	59.9%	11051	68.5%

Year 2011							
	Snorkel Survey			Pre-Spawn Survey		Spawn Survey	
Reach	Actual	Estimated	Percent	Actual	Percent	Actual	Percent
A	45	102	2.1%	0	0%	118	2.4%
B	296	677	13.9%	2	16.7%	579	11.9%
C1-5	187	427	8.8%	0	0%	428	8.8%
C6-12	492	1125	23.1%	0	0%	927	19.1%
D	352	805	16.5%	2	16.7%	1080	22.2%
E	189	432	8.9%	0	0%	958	19.7%
CVCB to PP (Figure 1)	570	1303	26.7%	8	66.6%	769	15.8%
Total	2131	4871	100%	12	100%	4859	100%
Total Above Powerhouse	528	1207	24.8%	2	16.7%	1125	23.1%
Total Below Powerhouse	1603	3664	75.2%	10	83.3%	3734	76.9%

Appendix I, Table 1 (continued). Summary of Butte Creek SRCS distribution by reach, above and below PG&E CVPH for snorkel, pre-spawn, and spawn survey during 2001-2014.

Year 2010							
	Snorkel Survey			Pre-Spawn Survey		Spawn Survey	
Reach	Actual	Estimated	Percent	Actual	Percent	Actual	Percent
A	168	288	14.5%	0	0%	32	1.6%
B	264	453	22.8%	0	0%	233	11.8%
C1-5	79	136	6.8%	2	14.3%	224	11.3%
C6-12	244	419	21.0%	5	42.9%	404	20.4%
D	283	486	24.4%	3	28.5%	469	23.7%
E	122	209	10.5%	2	14.3%	379	19.2%
CVCB to PP (Figure 1)	0	0	0%	0	0%	238	12.0%
Total	1160	1991	100%	12	100%	1979	100%
Total Above Powerhouse	511	877	44.0%	2	16.7%	489	24.7%
Total Below Powerhouse	649	1114	56.0%	10	83.3%	1490	75.3%

Year 2009							
	Snorkel Survey			Pre-Spawn Survey		Spawn Survey	
Reach	Actual	Estimated	Percent	Actual	Percent	Actual	Percent
A	227	296	11.0%	6	4.8%	70	2.7%
B	763	995	37.0%	15	11.9%	466	18.2%
C1-5	131	171	6.4%	11	8.7%	406	15.9%
C6-12	499	650	24.2%	29	23.0%	720	28.1%
D	312	407	15.1%	33	26.2%	514	20.1%
E	129	168	6.3%	32	25.4%	297	11.6%
CVCB to PP (Figure 1)	0	0	0%	0	0%	88	3.4%
Total	2061	2687	100%	126	100%	2561	100%
Total Above Powerhouse	1121	1461	54.4%	32	25.4%	943	37.0%
Total Below Powerhouse	940	1226	45.6%	94	74.6%	1618	63.0%

Year 2008							
	Snorkel Survey			Pre-Spawn Survey		Spawn Survey	
Reach	Actual	Estimated	Percent	Actual	Percent	Actual	Percent
A	1968	5569	50.0%	88	8.4%	714	7.1%
B	725	2052	18.4%	88	8.4%	2110	20.9%
C1-5	282	798	7.2%	62	5.8%	1810	18.0%
C6-12	854	2417	21.7%	478	45.4%	2217	22.0%
D	105	297	2.7%	182	17.3%	1952	19.4%
E	1	3	0%	79	7.9%	914	9.1%
CVCB to PP (Figure 1)	0	0	0%	77	7.3%	365	3.6%
Total	3935	11136	100%	1054	100%	10082	100%
Total Above Powerhouse	2975	8419	75.6%	238	22.6%	4634	46.0%
Total Below Powerhouse	960	2717	24.4%	816	77.4%	5448	54.0%

Year 2007							
	Snorkel Survey			Pre-Spawn Survey		Spawn Survey	
Reach	Actual	Estimated	Percent	Actual	Percent	Actual	Percent
A	1719	2387	34.7%	32	5.0%	461	7.4%
B	1348	1869	27.3%	96	15.1%	1473	23.7%
C1-5	424	588	8.6%	75	11.8%	841	13.5%
C6-12	1048	1453	21.2%	253	39.6%	1135	18.2%
D	312	433	6.3%	132	20.7%	1216	19.6%
E	92	128	1.9%	50	7.8%	655	10.5%
CVCB to PP (Figure 1)	0	0	0%	0	0	439	7.1%
Total	4943	6858	100%	638	100%	6220	100%
Total Above Powerhouse	3491	4844	70.6%	203	31.9%	2772	44.6%
Total Below Powerhouse	1452	2014	29.4%	435	68.1%	3442	55.4%

Appendix I, Table 1 (continued). Summary of Butte Creek SRCS distribution by reach, above and below PG&E CVPH for snorkel, pre-spawn, and spawn survey during 2001-2014.

Year 2006							
	Snorkel Survey			Pre-Spawn Survey		Spawn Survey	
Reach	Actual	Estimated	Percent	Actual	Percent	Actual	Percent
A	841	1203	18.4%	22	9.0%	138	2.2%
B	726	1037	15.8%	34	14.0%	652	10.4%
C1-5	204	291	4.4%	16	6.7%	760	12.0%
C6-12	2183	3122	47.7%	89	36.5%	1351	21.4%
D	523	748	11.4%	53	21.4%	1804	28.6%
E	102	146	2.2%	30	12.4%	947	15.0%
CVCB to PP (Figure 1)	0	0	0	0	0	651	10.3%
Total	4579	6547	100.0%	244	100.0%	6303	100.0%
Total Above Powerhouse	1771	2532	38.7%	72	29.5%	1550	24.6%
Total Below Powerhouse	2808	4016	61.3%	172	70.5%	4753	75.4%

Year 2005							
	Snorkel Survey			Pre-Spawn Survey		Spawn Survey	
Reach	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							
	Snorkel Survey			Pre-Spawn Survey		Spawn Survey	
Reach	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							
	Snorkel Survey			Pre-Spawn Survey		Spawn Survey	
Reach	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%

Appendix I, Table 1 (continued). Summary of Butte Creek SRCS distribution by reach, above and below PG&E CVPH for snorkel, pre-spawn, and spawn survey during 2001-2014.

Year 2002							
	Snorkel Survey			Pre-Spawn Survey		Spawn Survey	
Reach	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							
	Snorkel Survey			Pre-Spawn Survey		Spawn Survey	
Reach	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.