State of California
The Resources Agency
DEPARTMENT OF FISH AND GAME

# BUTTE CREEK
# SPRING-RUN CHINOOK SALMON, ONCORYHNCHUS TSHAWYTSCHA
# PRE-SPAWN MORTALITY EVALUATION
# 2013

By

Clint E. Garman

Inland Fisheries

Report No. 2014-1

2014

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## ABSTRACT

This is the eleventh report assessing pre-spawning mortalities among spring-run Chinook salmon (SRCS) (*Oncorhynchus tshawytscha*) in Butte Creek affected by the Pacific Gas and Electric (PG&E) DeSabla-Centerville Project (Project). Project is located on Butte Creek near Chico, in Butte County, California. During the 2013 pre-spawning mortality survey funded by PG&E, an estimated 896 SRCS died prior to spawning out of a total estimated population of 16,782. Two fish were examined by a CDFW pathologist and results found that *Flavobacterium columnare* (columnaris) and the protozoan *Ichthyophthirius multiphilis* (Ich) were present but not at levels high enough to cause mortality. The remaining pre-spawn mortalities were lost to normal attrition for salmon holding in fresh water since early spring. During the 2013 summer holding period, approximately 90% of the fish held upstream the Centerville Powerhouse (CVPH) and 10% downstream and mortalities were distributed 82% upstream and 18% downstream. A mark re-capture carcass survey estimated 15,886 fish survived to spawn with approximately 47% spawning upstream the CVPH and 53% downstream. Flows were maintained above 60 cfs throughout the entire holding period in the reach upstream of the CVPH and at the onset of SRCS spawning, flows were increased 15-20 cfs to provide additional potential spawning habitat and were maintained throughout the entire spawning period.

Air temperatures during July 2013 were as warm as the same period in 2002 and 2003, when pre-spawn mortalities were high. In 2013, water temperatures exceeded 19.4°C a total of 15 days for the June 1 – August 31 period. During 2002 and 2003, with significant pre-spawn mortalities, water temperatures exceeded the 19.4°C threshold 16 days and 11 days, respectively. The PG&E temperature contingency plan was implemented on four occasions during July 2013 in response to predicted higher air temperatures.

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[1] Inland Fisheries Administrative Report No. 2014-1. Edited by Tracy McReynolds, North Central Region, 1701 Nimbus Road, Rancho Cordova, California 95670.

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# INTRODUCTION

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

- Develop an accurate estimate of pre-spawning mortalities among Butte Creek SRCS.
- Assess causal relationship of SRCS pre-spawning mortalities with operation of the PG&E DeSabla-Centerville Hydro-power Project.
- Monitor and document holding distribution of Butte Creek SRCS.

## Salmon in Butte Creek

Butte Creek is one of several Central Valley streams that continue to harbor a sustaining population of the state and federally listed threatened SRCS. 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 2013.

| Year | Run Size | Year | Run Size | Year | Run Size | Year | Run Size | | |
|---|---|---|---|---|---|---|---|---|---|
| 1954 | 830 | 1969 | 830 | 1984 | 23 | 1999 | 3679* | | |
| 1955 | 400 | 1970 | 285 | 1985 | 254 | 2000 | 4118* | | |
| 1956 | 3000 | 1971 | 470 | 1986 | 1371 | | Snorkel | Prespawn Mortality | Spawn |
| 1957 | 2195 | 1972 | 150 | 1987 | 14 | 2001 | 9605* | 193 | 18312** |
| 1958 | 1100 | 1973 | 300 | 1988 | 1300 | 2002 | 8785* | 3431 | 12597 |
| 1959 | 500 | 1974 | 150 | 1989 | 1300* | 2003 | 4398* | 11231 | 6063 |
| 1960 | 8700 | 1975 | 650 | 1990 | 100* | 2004 | 7390* | 418 | 10221 |
| 1961 | 3100 | 1976 | 46 | 1991 | 100* | 2005 | 10625* | 617 | 16998 |
| 1962 | 1750 | 1977 | 100 | 1992 | 730* | 2006 | 4579* | 244 | 6303 |
| 1963 | 6100 | 1978 | 128 | 1993 | 650* | 2007 | 4943* | 638 | 6220 |
| 1964 | 600 | 1979 | 10 | 1994 | 474* | 2008 | 3935* | 1054 | 10082 |
| 1965 | 1000 | 1980 | 226 | 1995 | 7500* | 2009 | 2061* | 126 | 2561 |
| 1966 | 80 | 1981 | 250 | 1996 | 1413* | 2010 | 1160* | 12 | 1979 |
| 1967 | 180 | 1982 | 534 | 1997 | 635* | 2011 | 2130* | 12 | 4859 |
| 1968 | 280 | 1983 | 50 | 1998 | 20212* | 2012 | 8616* | 177 | 16140×× |
| | | | | | | 2013 | 1147[illegible]* | 903 | 15886×× |

* Surveys prior to 1989 used various methods with varying precision. Snorkel surveys implemented since 1989 are thought to significantly underestimate the actual population size and should only be used as an index. Spawning survey results for 2001- 2011 were generated by a modified Schaefer Model carcass survey. ××Spawning results for 2012& 2103 were generated using a Cormack Jolly-Seber (CJS) Model.

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

The SRCS over-summer holding reach of Butte Creek is approximately 11 miles in length, extending from the Quartz Bowl Pool downstream to the Centerville Covered Bridge (Figures 1 and 2). Flows in this reach are controlled by PG&E for power generation at the DeSabla (DSPH) and Centerville (CVPH) powerhouses. Within the 11 mile SRCS reach, the most isolated area containing the deepest holding pools is located in the uppermost 3 miles between the Quartz Bowl Pool and Pool 4, while the majority of spawning gravel is located in the 5 miles below the CVPH (Figures 1 and 2; Appendix A, Figures 1-5). Beginning in 1998, with the increased returns of Butte Creek SRCS, there were reports and observations of occasional significant mortalities during the summer holding period prior to spawning. This was partially documented during 2002 and systematically documented during 2003 through 2012 (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), and that mortalities during 2004 through 2012 were due to normal attrition for salmon holding in fresh water since early spring. 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 2012), PG&E developed a 2013 Annual Operations and Management Plan (PG&E, 2013). 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 Project Operations Team which consist 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, 2013):

1. "Starting on June 24th, Licensee will prepare a weather forecast for the DeSabla-Centerville Project Area by noon each Monday and Thursday. The weather forecast will be based on information from USFS weather stations at Cohasset and Chester. Licensee will provide an e-mail copy of the forecast to NOAA Fisheries, CDF&W and FWS. If air temperatures in excess of 105ºF for two or more days during the next seven day period are forecasted at Cohasset, with the potential for compression heating at higher elevations as confirmed by data from the Chester location, Licensee will send an e-mail to all, and phone at least one of the individuals at the Resource Agencies identified in paragraph 6 below advising them that an extreme heat event is forecasted. If the next forecast confirms that an extreme heat event has started or is imminent within the next two days, and is expected to continue for over two days, Licensee will send a second e-mail, phone, or fax each of the Resource Agencies to discuss actions to be taken. If personal contact 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, Licensee will send a third email or phone the CDF&W and NOAA Fisheries and explain action taken."
2. "CDF&W plans to conduct the annual spring-run spawning escapement snorkel survey in early July. This survey will provide information on the number of salmon holding in the reach of Butte Creek below 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."

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

**Flow Increase for Spawning**

Based upon a previous evaluation of spawning gravel (Gard et al., 2003; Ward et al., 2004b; Ward, 2004) PG&E agreed to consider increasing flows above the minimum 40 cubic feet per second(cfs) required by the FERC license, in the reach above the CVPH during the 2013 SRCS spawning period (PG&E, 2013) as follows:

"Increasing the releases to Butte Creek at the LCDD for temperature control in the Centerville reach will continue to be considered. Current data does not support increasing flows below LCDD during the summer months, due to the potential adverse impacts such releases may have on the water temperature below Centerville Powerhouse. However, increased releases below LCDD during the spawning period (i.e., after approximately mid-September) can provide additional spawning habitat in the reach below LCDD. As in 2012, Licensee will consult with the Resource Agencies over the course of the summer to determine if and when releases below LCDD during the 2013 spawning period can be implemented without adversely impacting water temperatures below Centerville Powerhouse. The maximum available flow will be the flow being released before mid-September to the bypass reach (40 cfs minimum flow), plus the flow going down the Centerville Canal in mid-September less any releases from storage on the West Branch. The specific quantity of flow available will be determined at that time based on the actual combined flow at that date ("Mid-September Flow"). Consideration may also be given to temporarily discontinuing use of the Centerville Canal and Powerhouse if effective control of the flow between Butte Creek and the canal becomes operationally difficult due to low flows. 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, 2014, or other appropriate date determined in consultation with the Resource Agencies. If implementing the "Mid-September Flow" below LCDD requires that operation of Centerville Powerhouse be temporarily discontinued, or the operation is temporarily discontinued due to operational issues, the powerhouse may be re-started using any flows above the "Mid-September Flow" that may subsequently become available." Note - LCDD as discussed above is referenced throughout this report as the Centerville Head Dam (CVHD).

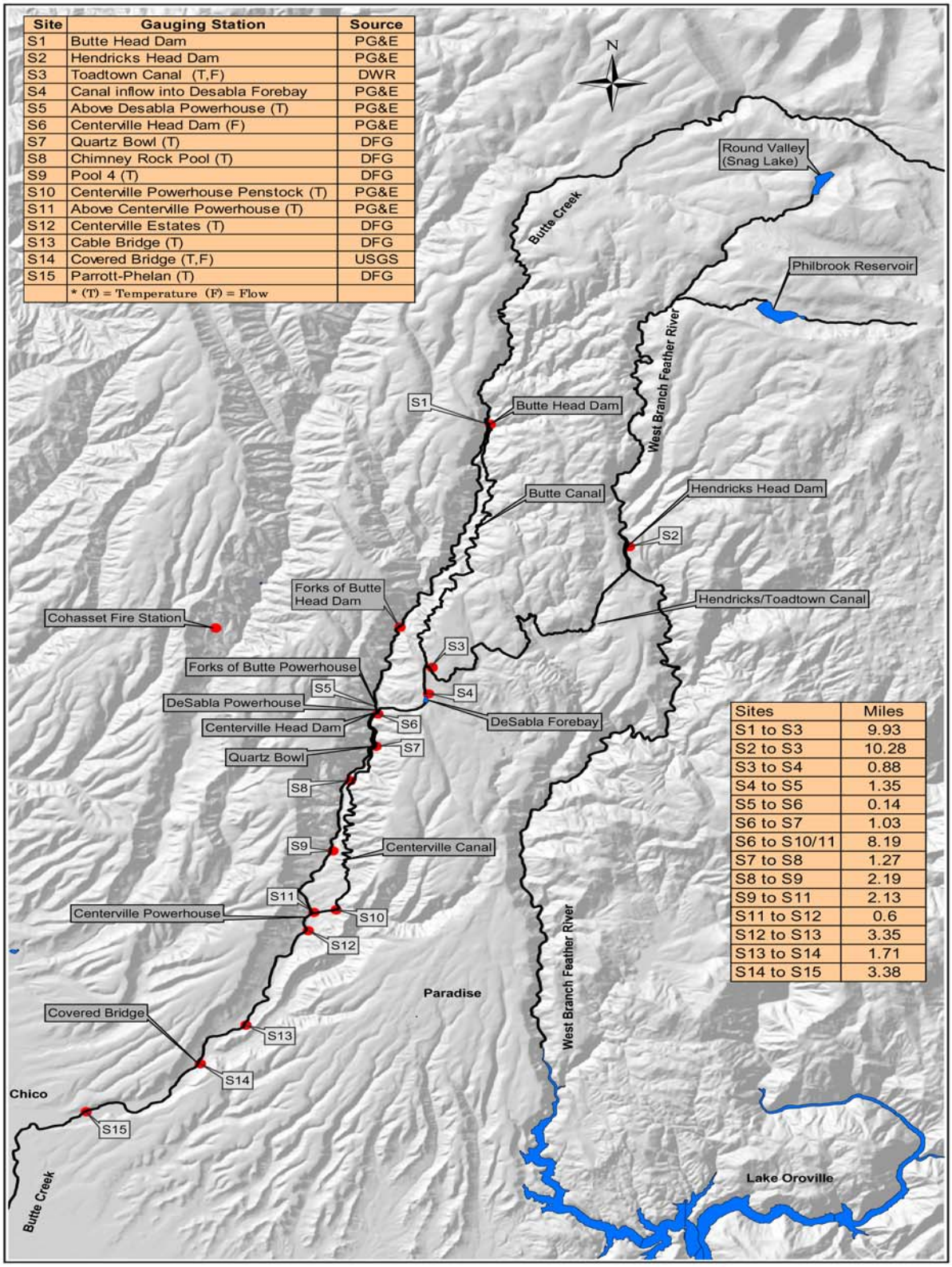



Figure 1. Map showing reaches of Butte Creek and West Branch of the Feather River controlled by Pacific Gas and Electric Company affecting Butte Creek spring-run Chinook salmon, including temperature and flow gage locations and distances.

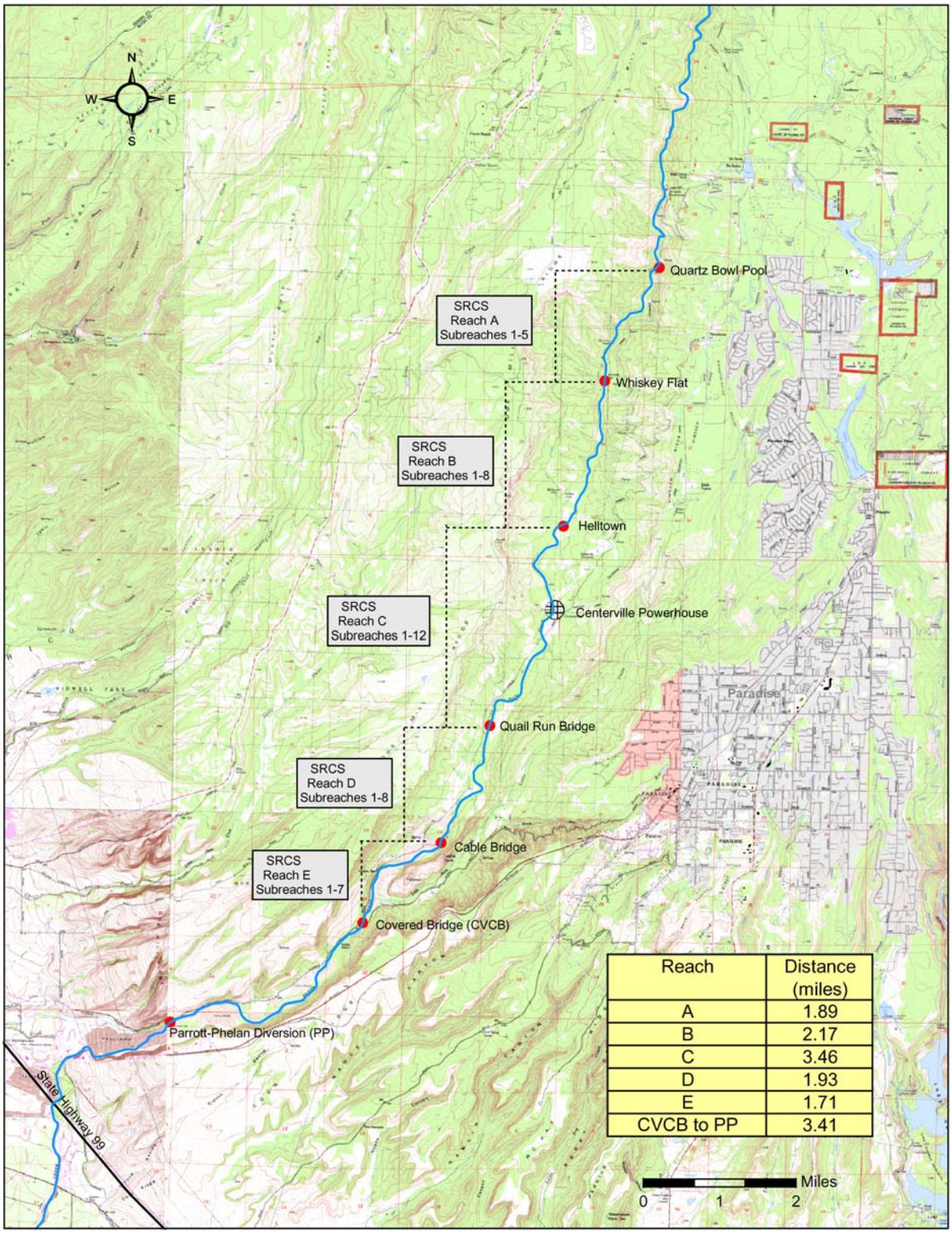



Figure 2. Map of Butte Creek from Quartz Bowl Pool to Covered Bridge showing spring-run Chinook salmon holding and spawning reaches and distances.

# MATERIALS AND METHODS

## Adult Escapement

Since 1989, CDFW calculates an adult SRCS escapement estimate each summer by conducting a swimming-snorkel survey composed of 4-6 surveyors. Adult SRCS are counted while holding 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). During snorkel surveys, surveyors float through each pool once estimating the number of SRCS. 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 Central Valley (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 currently used with the super-population modification of the Cormack-Jolly-Seber (CJS) model. The 2013 SRCS spawning escapement was the third year that the CJS was performed on Butte Creek for an alternative escapement estimate. It is the second year that the CJS model estimates are used for CDFW reporting requirement to the Pacific States Fishery Commission and to the Department's Grandtab Table. Future escapement estimates will attempt to include both modified-Schaefer (Schaefer, 1951) and CJS methodologies for comparison. Detailed CJS model descriptions and equations can be found in, 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 population size is the carcass (mark-recapture) survey. This technique employs a physical count of all carcasses during the entire period and develops an expansion factor for carcasses not encountered during the physical count. A sub-sample of 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.

In an event where a limited number of fresh carcasses are available to tag to obtain a population estimate via a mark-recapture survey, an expansion factor will be applied to the pre-spawning survey to estimate the number of carcasses that died prior to spawning. This will be accomplished by dividing the actual number of fish handled in the carcass survey by the CJS population estimate.

A survey to identify pre-spawning mortalities occurred from June 4 until the onset of spawning on September 17, 2013. 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. A sub-sample of carcasses were sexed and measured to the nearest millimeter (mm) fork length (FL). Age determination is calculated by analyzing all measured fresh carcasses. Individuals that are less than 600 mm are considered to be age 2. Remaining fish are considered to be either age 3 or age 4 based on previous findings of Butte Creek coded-wire tag readings where overlapping of sizes occur.

## Water Temperature

Onset, HOBO Water Temp Pro, H20-001, SN: 888429 temperature data loggers calibrated to ± 0.2 ° C set for 1-hour interval recordings were deployed in pools at five sites within the SRCS 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

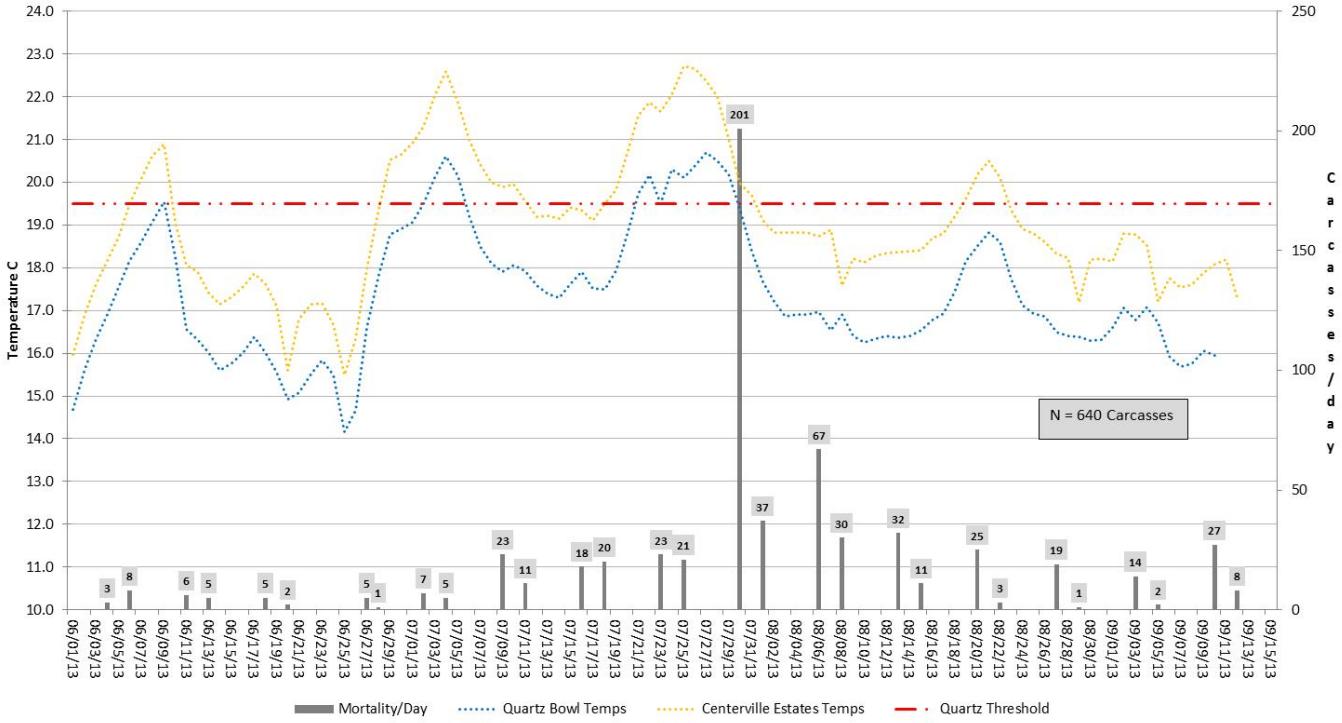
### Pre-spawn Mortalities

During the entire pre-spawn survey period from June 4 through September 12, 2013 there was a total of 640 carcasses encountered with an expanded pre-spawn mortality total of 896 (Table 2). Weekly mortality rates remained consistent throughout the entire holding period with peak mortality occurring on July 30, 2013 (Figure 3).

Table 2. Summary of Butte Creek SRCS pre-spawn mortalities encountered during survey period June 4 through September 12, 2013.

| Week | Date | Total Carcasses Encountered | | | | | | Weekly Total |
|---|---|---|---|---|---|---|---|---|
| | | Reach | | | | | | |
| | | A | B | C | D | E | Cov-Oro-Chico | |
| 1 | 6/4 | 3 | 0 | - | - | - | - | 11 |
| | 6/6 | - | - | 5 | 2 | 1 | - | |
| 2 | 6/11 | 1 | 5 | - | - | - | - | 11 |
| | 6/13 | - | - | 4 | 0 | 1 | - | |
| 3 | 6/18 | 2 | 3 | - | - | - | - | 7 |
| | 6/20 | - | - | 1 | 0 | 1 | - | |
| 4 | 6/27 | 1 | 4 | - | - | - | - | 6 |
| | 6/28 | - | - | 0 | 1 | 0 | - | |
| 5 | 7/2 | 3 | 4 | - | - | - | - | 12 |
| | 7/4 | - | - | 4 | 0 | 1 | - | |
| 6 | 7/9 | - | - | 14 | 3 | 6 | - | 34 |
| | 7/11 | 1 | 10 | - | - | - | - | |
| 7 | 7/16 | 1 | 17 | - | - | - | - | 38 |
| | 718 | - | - | 18 | 2 | 0 | - | |
| 8 | 7/23 | 9 | 14 | - | - | - | - | 44 |
| | 7/25 | - | - | 20 | 1 | 0 | - | |
| 9 | 7/30 | 59 | 142 | - | - | - | - | 238 |
| | 8/1 | - | - | 32 | 4 | 1 | - | |
| 10 | 8/6 | 28 | 39 | - | - | - | - | 97 |
| | 8/8 | - | - | 27 | 2 | 1 | - | |
| 11 | 8/13 | 17 | 15 | - | - | - | - | 43 |
| | 8/15 | - | - | 10 | 0 | 1 | - | |
| 12 | 8/20 | 9 | 16 | | | | - | 28 |
| | 8/22 | - | - | 2 | 1 | 0 | - | |
| 13 | 8/27 | 16 | 3 | - | - | - | - | 20 |
| | 8/29 | - | - | 1 | 0 | 0 | - | |
| 14 | 9/3 | 12 | 2 | - | - | - | - | 16 |
| | 9/5 | - | - | 2 | - | - | - | |
| 15 | 9/10 | 17 | 10 | - | - | - | - | 35 |
| | 9/12 | - | - | 7 | 1 | 0 | - | |
| | TOTAL | 179 | 284 | 147 | 17 | 13 | | 640 |
| Cormack Jolly-Seber Expanded Model (Due to low mark/recovery rate a subsequent spawning expansion factor of 1.4 was applied) | | | | | | | 896 | |

Figure 3. Daily pre-spawn mortality and daily average temperatures at Quartz Bowl Pool and Centerville Estates for period June 1 through September 15, 2013.




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. Alternatively, an expansion factor (F = 1.4) generated from the subsequent Cormack Jolly-Seber estimate of spawning was applied (Appendix B, Figure 1*). Spawning onset was first documented on September 17, 2013 and did not appear to overlap the pre-spawn mortality period which ended the previous week. Determination of spawning onset was based upon evidence of redd building and examination of carcasses for egg retention. The subsequent spawning survey from September 17 through October 26, 2013 encountered a total of 10,991 carcasses with an estimated spawning population of 15,886 in the surveyed reaches A-E and from Centerville Covered Bridge to Parrott-Phelan Diversion Dam (Appendix B, Table 1). The swimming-snorkel survey conducted July 9-11, 2013 resulted in an estimate of 11,470 salmon (Garman, 2013). As with the snorkel surveys performed from 2004 through 2012, an attempt was made to complete the 2013 snorkel survey earlier in the season to develop an estimate prior to any significant pre-spawn mortality. There were 70 pre-spawn mortalities prior to the snorkel survey (Table 2) or an expanded estimate of 98 (70 x 1.4).

## Sex and Age Composition

There were a total of 640 carcasses examined. Of those 640 carcasses, 355 were measured and identified by sex (based on visual characteristics), of which 222 (63%) was female and 132 (37%) was male (Table 3). The small sample size of measured adults makes any assumptions about size inconclusive. There were no CWT fish recovered during the pre-spawn mortality survey and none recovered during the subsequent spawning survey. Based upon analysis of length frequencies of

1055 carcasses from the subsequent spawning survey it is estimated that 3 of 355 pre-spawn carcasses fall into a frequency mode of age-2 brood year (BY) 2011. The remaining 352 pre-spawn carcasses are assumed to be either an age-3 or age-4 (BY10 or BY09 respectively) based upon past 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- 2013.

| Year | Female | | | | | Male | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Carcasses | | FL (MM) | | | Carcasses | | FL (MM) | | |
| | Total | Percent | Max | Min | Mean | Total | Percent | Max | Min | Mean |
| 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 spawning for the 2013 spawning period (Table 4). Comparative tables for holding, pre-spawn mortality, and spawning for years 2001 – 2012 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 spawn survey during 2013.

| Year 2013 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Reach | Snorkel Survey(Holding) | | | Pre-Spawn Survey | | 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% |

Pre-spawn holding distribution was much different this year than in previous years with 90% and 10% holding upstream and downstream of the CVPH, respectively. The adjusted holding (snorkel) estimate was based upon the combined carcass estimate (pre-spawn and spawn) allocated by the

percentages observed in each reach/subreach during the swimming-snorkel survey. During the 12-year period 2001-2013, approximately 63% of the fish held above the CVPH and 37% below, while approximately 43% of the fish that survived, spawned above the CVPH and 57% below (Appendix D, Figure 3&5, Appendix I). For the 2001-2013 period, based upon the various survey methods, 79% of the mortalities occurred above the CVPH and 21% below (Appendix D, Figure 4). The percentage of mortalities upstream of the CVPH is heavily weighted due to the large die-offs in 2002 and 2003, when distributions were similar to 2013. This is the first year since the 2003 pre-spawn mortality event that percentages of mortalities were higher in the reach above the CVPH compared to the reach below. During 2013, it appears that approximately 7021 (46.0% of the total) fish holding above the CVPH moved to spawn below (Table 4; Appendix D, Figure 1&2). Estimates for available spawning habitat and maximum spawners accommodated at various flows were developed and discussed in the 2003 review (Ward et al., 2004b; Gard, 2003). It was concluded that based upon the historic flow record (1930-2003) at the maximum sustainable flow (approximately 130 cfs), approximately 18% of useable spawning gravel is located above the CVPH and 82% below. It was also estimated that the reach of Butte Creek above the CVPH would support approximately 152-1,316 spawners at 40 cfs, and 270-2,352 spawners at 130cfs, while the reach below the CVPH would support an estimated 1,262-10,976 spawners at 130 cfs. At the onset of spawning on September 17, 2013, flows in the reach upstream of the CVPH were adjusted and increased from 60 cfs to an average of 79 cfs throughout the entire spawning period (FERC requirement of 40cfs).

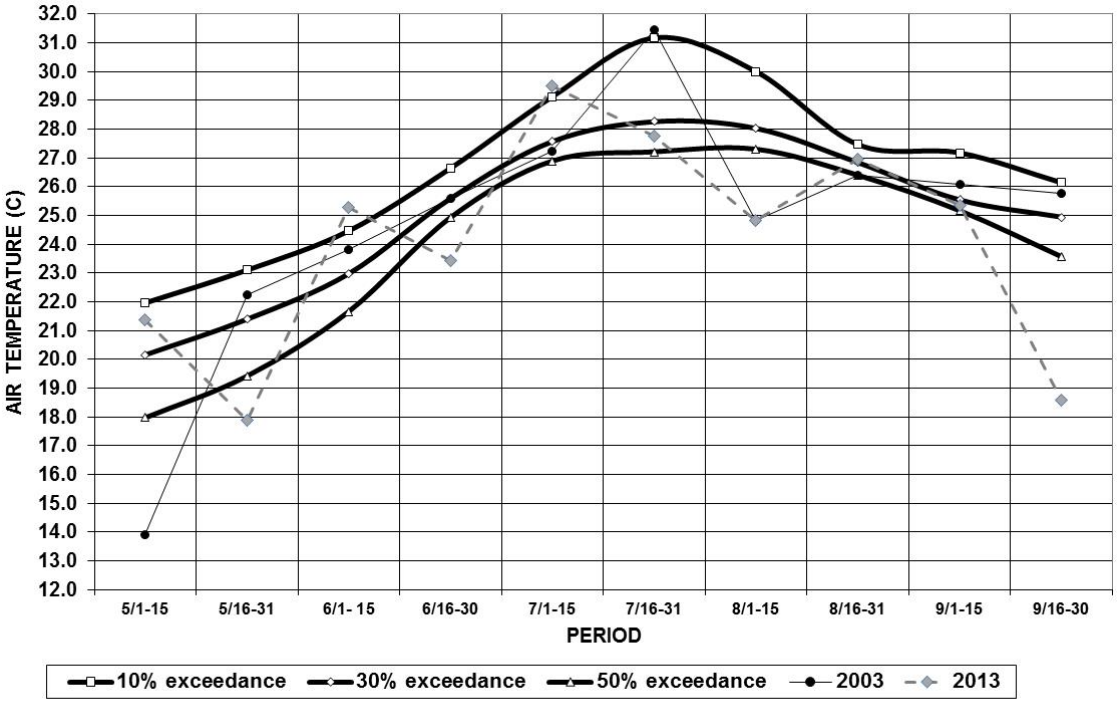
## Air Temperatures

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 exceedence for period 1984-2013 was calculated**.** Air temperatures increased in early June and early July to beyond the 10% exceedence level then decreased well below the 50% exceedence level in early August. Temperatures then increased to a more normal trend for the late August/early September period before cooling off for the start of the mid- September spawning period (Table 5, Figure 4) (CDWR, 2012). Maximum daily air temperatures equaled or exceeded 37.6° C (100° F) for 5 days during July 2013. Since 1985, there are 20 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 2004-2013.

| Period | Year | | | | | | | | | | Avg. 1984-13 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | |
| June 1-15 | 23.5 | 19.9 | 21.3 | 22.8 | 22.7 | 18.1 | 21.2 | 18.0 | 22.9 | 25.3 | 21.1 |
| June 16-30 | 25.1 | 20.5 | 29.1 | 24.9 | 26.3 | 26.5 | 24.0 | 23.7 | 22.5 | 23.4 | 24.6 |
| July 1-15 | 26.4 | 27.9 | 27.0 | 27.4 | 28.5 | 26.3 | 26.9 | 25.3 | 27.6 | 29.5 | 27.0 |
| July 16-31 | 28.3 | 30.8 | 31.5 | 26.1 | 26.2 | 29.6 | 27.7 | 25.4 | 25.8 | 27.7 | 27.3 |
| Aug. 1-15 | 27.0 | 29.5 | 25.6 | 25.3 | 28.1 | 25.4 | 25.6 | 26.1 | 30.4 | 24.8 | 26.9 |
| Aug. 16-31 | 26.8 | 27.2 | 26.1 | 27.7 | 27.0 | 27.8 | 25.4 | 26.9 | 26.8 | 27.0 | 26.1 |
| Sept. 1-15 | 26.6 | 22.0 | 25.1 | 24.3 | 26.9 | 24.6 | 24.3 | 27.6 | 26.2 | 25.4 | 24.8 |
| Sept. 16-30 | 21.0 | 22.5 | 23.1 | 17.4 | 23.6 | 26.7 | 24.3 | 25.2 | 26.6 | 18.6 | 23.5 |

Figure 4. Mean daily air temperature exceedence for period 1984-2013 compared to 2003(high pre-spawn mortality year) and 2013, California Department of Forestry Cohasset Fire Station.




## Water Temperatures and Flows

At the Quartz Bowl Pool, mean daily water temperatures increased to 19.5 on June 9, then declined to 15.6°C on June 14, 2013, then increased again from 19.1°C on July 1, 2013 to 21.8°C on July 4 followed by a period of decreased temperatures to 17.9°C on July 9, 2013. Water temperatures increased for a second episode in July to above the 19.4°C threshold on July 21to 19.7°C and sustained high temperatures until July 30 at 19.4°C, with a peak of 20.7°C on July 27. 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 equaled or exceeded 19.4°C a total of 15 days during the June 1 to August 31period, with 10 consecutive days occurring from July 21-July 31 (Figure 5; Appendix F, Table 1). The estimated number of holding adult SRCS during 2013 (16,782) was comparable to the numbers holding during 2002 and 2003, at 16,328 and 17,294, respectively. Mean daily flows from Quartz Bowl Pool to Centerville Powerhouse for each of the years were always above 40 cfs. Flows averaged above 68 cfs for the entire holding period in 2013 (Appendix G, Table 1).

Based upon preliminary data provided by PG&E (PG&E, 2014), mean daily increase in water temperature through the DeSabla forebay equaled or exceeded 1°C a total of 77 days during the period June 15 - September 30, 2013, with maximum heating occurring on September 26, 2013 at 1.85°C (Figure 6). This was more than observed during 2012 with 71 days but substantially more than the 16 days observed in 2011. It is similar to 2009 and 2008 when mean daily heating exceeded 1°C for 71 and 97 days, respectively during the same period. Maximum heating during the critical holding period of July 1 – August 15, 2013 occurred on July 29, 2013 with maximum heating at 1.73°C. PG&E (1993) concluded that a flow of 108 cfs or greater is required to keep temperature increases through the forebay at or less than 1°C. For the June 15 – September 30, 2013 period

flows averaged 73 cfs, and exceeded 108 cfs for 1 day as compared to 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 2013.

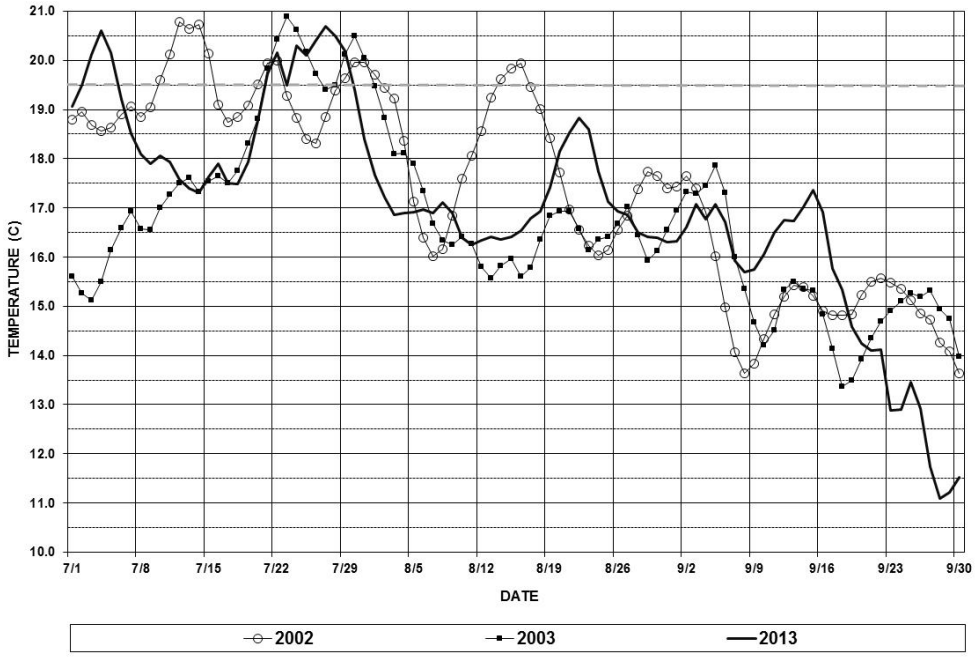
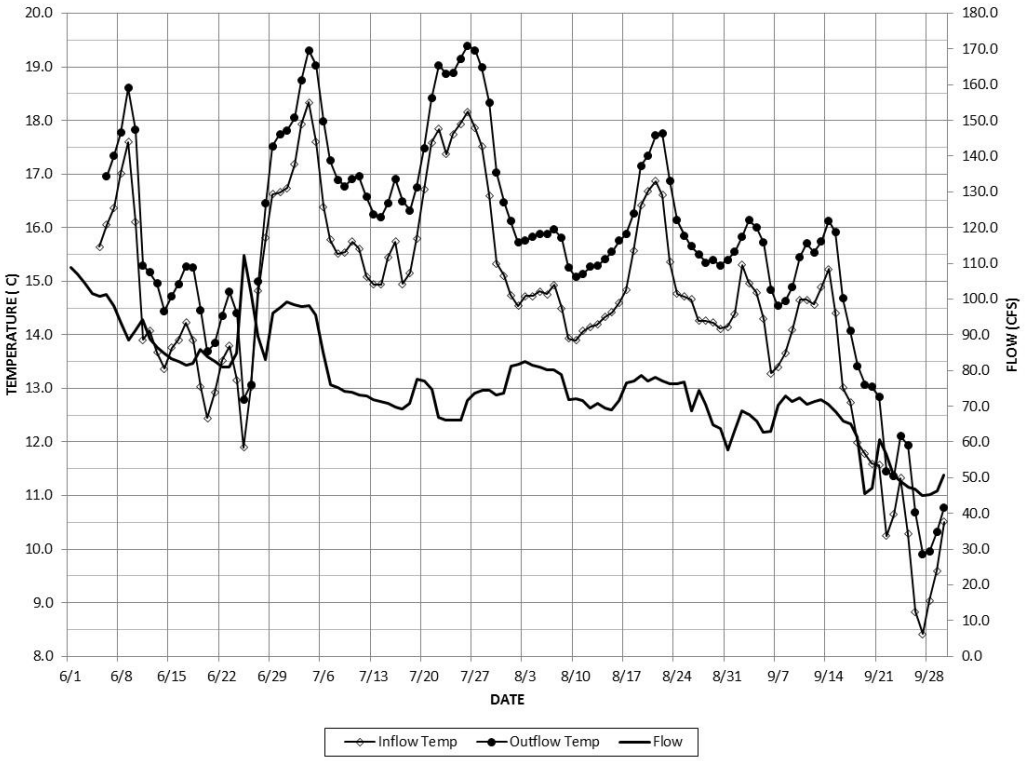



Figure 6. Mean daily water temperature (C) at DeSabla Forebay inflow and DeSabla Powerhouse outflow compared to mean daily flows (cfs) June 6 - September 30, 2013.



Heating in the reach from the DSPH to CVHD appears to be from mixing of warmer flows from within Butte Creek from above the DSPH outflow with those of the DSPH outflow (Table 7). Mean daily heating in the reach from the CVHD to immediately above the CVPH ranged from 1.74°C to 2.95°C during July and August 2013 with average heating of 2.43°C. The minimum flow release for this reach is 40cfs. (Kimmerer, 1989; PG&E, 1993). Flows conveyed via the Centerville Canal to the CVPH continued to be significantly cooler due to the shorter conveyance time and shading, with mean daily heating ranging from 1.03°C to 1.99°C during the same period and average heating of 1.40°C (Appendix H-Table 2).

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

| Site and Distance[1/] | | July 1-15 | | July 16-31 | | Aug. 1-15 | | Aug. 16-31 | | Sept. 1-15 | | Sept. 16-30 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Total | PM Peirle | Total | PM Peirle | Total | PM Peirle | Total | PM Peirle | Total | PM Peirle | Total | PM Peirle |
| Hendricks Head Dam to Toadtown Canal Gage-2003 (Site S2 to S3, 10.28 miles) | 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 |
| | 2006 | 0.46 | 0.05 | 0.78 | 0.08 | 0.55 | 0.05 | 0.33 | 0.03 | 0.57 | 0.06 | 0.53 | 0.05 |
| | 2005 | 0.44 | 0.04 | 0.65 | 0.06 | 0.58 | 0.06 | 0.36 | 0.04 | 0.27 | 0.03 | 0.73 | 0.07 |
| Toadtown Canal Gage to DeSabla Forebay [2/] - (Site S3 to S4, 0.88 miles) | 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 |
| | 2006 | 0.02 | 0.07 | 0.04 | 0.05 | 0.02 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 2005 | 0.06 | 0.07 | 0.08 | 0.09 | 0.08 | 0.09 | 0.05 | 0.06 | 0.02 | 0.02 | 0.03 | 0.03 |
| DeSabla Forebay to DeSabla Powerhouse Outfall (Site S4 to S5, 1.35 miles) | 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 |
| | 2006 | 1.13 | 0.84 | 1.16 | 0.86 | 1.12 | 0.83 | 1.04 | 0.77 | 1.17 | 0.87 | 1.08 | 0.80 |
| | 2005 | 1.00 | 0.74 | 1.14 | 0.84 | 1.18 | 0.87 | 1.15 | 0.85 | 1.23 | 0.91 | 1.24 | 0.92 |
| DeSabla Powerhouse Outflow to Centerville Head Dam [3/] - (Site S5 to S6, 0.14 miles) | 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 |
| | 2006 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.05 | 0.00 | 0.00 |
| | 2005 | 0.01 | 0.00 | - | 0.00 | - | 0.00 | - | 0.00 | - | 0.00 | - | 0.00 |
| Centerville Head Dam via Centerville Canal to Centerville Powerhouse Outflow –(Site S6 to S10/11, 8.19 miles) | 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 |
| | 2006 | 0.60 | 0.07 | 0.63 | 0.08 | 0.56 | 0.07 | 0.49 | 0.06 | 0.58 | 0.07 | 0.81 | 0.10 |
| | 2005 | 0.56 | 0.07 | 0.62 | 0.08 | 0.63 | 0.08 | 0.60 | 0.07 | 0.58 | 0.07 | 1.01 | 0.12 |

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 | PM ile | Total | PM ile | Total | PM ile | Total | PM ile | Total | PM ile | Total | PM ile |
| Centerville Head Dam via Creek to immediately above Centerville Powerhouse Outflow – (Site S6 to S11, 6.62 miles) | 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 |
| | 2006 | 2.66 | 0.40 | 4.13 | 0.62 | 3.64 | 0.55 | 3.40 | 0.51 | 3.09 | 0.47 | 2.23 | 0.34 |
| | 2005 | 2.81 | 0.42 | 3.75 | 0.57 | 3.62 | 0.55 | 3.25 | 0.49 | 2.98 | 0.45 | 2.24 | 0.34 |
| Centerville Head Dam to Quartz Bowl Pool – (Map site S6 to S7, 1.03 miles) | 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 |
| | 2006 | 0.61 | 0.59 | 0.95 | 0.92 | 0.70 | 0.68 | 0.64 | 0.62 | 0.60 | 0.58 | 0.44 | 0.43 |
| | 2005 | 0.57 | 0.55 | 0.72 | 0.70 | 0.64 | 0.62 | 0.55 | 0.53 | 0.53 | 0.51 | 0.42 | 0.41 |
| Quartz Bowl Pool to Chimney Rock (Site S7 to S8, 1.27 miles) | 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 |
| | 2006 | 0.55 | 0.43 | 0.86 | 0.67 | 0.90 | 0.71 | 0.76 | 0.60 | 0.63 | 0.50 | 0.46 | 0.36 |
| | 2005 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| Chimney Rock to Pool 4 (Site S8 to S9, 2.19 miles) | 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 |
| | 2006 | 0.64 | 0.29 | 1.11 | 0.51 | 1.02 | 0.46 | 1.05 | 0.48 | 1.03 | 0.47 | 0.75 | 0.34 |
| | 2005 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| Pool 4 to immediately above Centerville Powerhouse Outflow –(Site S9 to S11, 2.13 miles) | 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 |
| | 2006 | 0.86 | 0.40 | 1.21 | 0.57 | 1.03 | 0.48 | 0.95 | 0.44 | 0.82 | 0.39 | 0.58 | 0.27 |
| | 2005 | 1.09 | 0.51 | 1.16 | 0.54 | 1.09 | 0.51 | 0.94 | 0.44 | 0.80 | 0.38 | 0.69 | 0.32 |

[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)** | 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 |
| | 2006 | 90 | 14.2 | 81 | 14.5 | 77 | 13.8 | 95 | 13.6 | 71 | 13.1 | 40 | 10.0 |
| | 2005 | 98 | 15.0 | 87 | 15.2 | 76 | 14.4 | 72 | 14.4 | 65 | 12.8 | 28 | 10.7 |
| **Toadtown Canal Above Butte Canal (Site S3)** | 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 |
| | 2006 | 85 | 14.6 | 74 | 15.3 | 71 | 14.4 | 83 | 13.9 | 57 | 13.7 | 37 | 10.6 |
| | 2005 | 90 | 15.4 | 82 | 15.9 | 71 | 15.0 | 66 | 14.8 | 51 | 13.0 | 29 | 11.4 |
| **DeSabla Forebay Inflow (Site S4)** (for 2005-2009 is Butte Canal + Toadtown Canal) | 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 |
| | 2006 | 157 | 14.6 | 139 | 15.7 | 129 | 14.4 | 136 | 13.6 | 106 | 13.2 | 85 | 10.3 |
| | 2005 | 160 | 15.6 | 136 | 16.3 | 116 | 15.3 | 106 | 14.6 | 90 | 12.6 | 67 | 11.1 |
| **Butte Creek Above DeSabla Ph Discharge (Site S5),** PG&E temporary gage 2004-06 | 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 |
| | 2006 | 52 | 17.3 | 43 | 19.8 | 38 | 18.0 | 35 | 16.5 | 34 | 16.3 | 33 | 13.1 |
| | 2005 | 57 | 18.7 | 43 | 20.2 | 38 | 18.8 | 36 | 17.5 | 35 | 15.2 | 34 | 13.8 |
| **DeSabla PH Discharge (Below site S5)** | 2013 | | 17.4 | 72 | 18.0 | 76 | 15.6 | 73 | 16.2 | | 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 |
| | 2006 | 146 | 15.7 | 134 | 16.9 | 123 | 15.5 | 128 | 14.6 | 100 | 14.4 | 81 | 11.3 |
| | 2005 | 151 | 16.6 | 131 | 17.4 | 112 | 16.5 | 103 | 15.8 | 86 | 13.8 | 62 | 12.3 |
| **Below Centerville Head Dam (Site S6),** (for 2005 flow is as measured immediately above CVPH) | 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 |
| | 2006 | 123[2/] | 16.1 | 64[2/] | 17.6 | 53[2/] | 16.1 | 50[2/] | 14.9 | 48[2/] | 14.9 | 78[2/] | 11.8 |
| | 2005 | 87 | 17.2 | 55 | 18.0 | 52 | 17.0 | 50 | 16.1 | 49 | 14.1 | 72 | 12.8 |
| **Quartz Bowl (Site S7)** (for 2005 flow is as measured immediately above CVPH) | 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 |
| | 2006 | 123[2/] | 16.7 | 64[2/] | 18.5 | 53[2/] | 16.8 | 50[2/] | 15.6 | 48[2/] | 15.5 | 78[2/] | 12.3 |
| | 2005 | 87 | 17.7 | 55 | 18.7 | 52 | 17.6 | 50 | 16.7 | 49 | 14.6 | 72 | 13.2 |

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 |
| **Chimney Rock (Site S8)** (for 2005 flow is measured immediately above CVPH. | 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 |
| | 2007 | 50 | 18.7 | 49 | 18.3 | 47 | 17.1 | 48 | 17.9 | 52 | 17.0 | 59 | 12.6 |
| | 2006 | 123[2/] | 17.3 | 64[2/] | 19.4 | 53[2/] | 17.7 | 50[2/] | 16.3 | 48[2/] | 16.1 | 78[2/] | 12.7 |
| | 2005 | 87 | nr | 55 | nr | 52 | nr | 50 | nr | 49 | nr | 72 | nr |
| **Pool 4 (Site S9)** (for 2005 flow is as measured immediately above CVPH) | 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 |
| | 2006 | 123[2/] | 17.9 | 64[2/] | 20.5 | 53[2/] | 18.7 | 50[2/] | 17.4 | 48[2/] | 17.1 | 78[2/] | 13.5 |
| | 2005 | 87 | 18.9 | 55 | 20.6 | 52 | 19.5 | 50 | 18.4 | 49 | 16.3 | 72 | 14.4 |
| **Butte Creek above Centerville PH (Site S11)** (for 2005 flow is measured immediately above CVPH) | 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 |
| | 2006 | 123[2/] | 18.8 | 64[2/] | 21.7 | 53[2/] | 19.7 | 50[2/] | 18.3 | 48[2/] | 18.0 | 78[2/] | 14.1 |
| | 2005 | 87 | 20.0 | 55 | 21.8 | 52 | 20.6 | 50 | 19.4 | 49 | 17.0 | 72 | 15.1 |
| **Centerville PH Discharge (Site S10)** | 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 |
| | 2006 | 122 | 16.7 | 138 | 18.2 | 112 | 16.6 | 110 | 15.4 | 85 | 15.5 | 47 | 12.6 |
| | 2005 | 172 | 17.7 | 159 | 18.6 | 139 | 17.6 | 125 | 16.7 | 101 | 14.7 | 62 | 13.8 |
| **Centerville Estates (Site S12)** (Flows are calculated PGE above CVPH + CVPH outfall) | 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 |
| | 2006 | 243[2/] | 17.8 | 202[2/] | 19.4 | 165[2/] | 17.9 | 160[2] | 16.5 | 133[2/] | 16.7 | 125[2/] | 13.9 |
| | 2005 | 259 | 18.7 | 214 | 19.8 | 191 | 18.8 | 175 | 17.9 | 150 | 15.9 | 134 | 14.8 |
| **Cable Bridge (Site S13)** (Flows are calculated PGE above CVPH + CVPH outfall) | 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 |
| | 2006 | 243[2/] | 18.5 | 202[2/] | 20.3 | 165[2/] | 18.7 | 160[2] | 17.3 | 133[2/] | 17.3 | 125[2/] | 14.5 |
| | 2005 | 259 | 19.4 | 214 | 20.6 | 191 | 19.6 | 175 | 18.6 | 150 | 16.5 | 134 | 15.4 |

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 |
| **Covered Bridge (Site S14)** | 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 |
| | 2006 | 238 | 19.3 | 241 | 21.1 | 228 | 19.6 | 237 | 18.1 | 178 | 18.1 | 137 | 15.3 |
| | 2005 | 240 | 19.8 | 202 | 21.2 | 169 | 20.6 | 150 | 19.6 | 147 | 17.6 | 108 | 16.3 |

[1/] See Figure 1.

[2/] For period July 1 -31, 2006 and Sept. 16-30 2006, flows are as measured at USGS gage #11389780 below Lower Centerville Diversion Dam. For period Aug. 1 – Sept. 13, flows are as measured at temporary gage installed by PG&E in Butte Creek immediately above Centerville Powerhouse. Temporary gage was inoperable during July 1 – 25, 2006, and Sept. 14-30, 2006 due to backwater effect of overflow spill from PG&E Centerville Canal.

nr = No Record

Water temperatures during the 2013 holding period measured below the CVPH where substantially warmer than water temperatures at the Quartz Bowl Pool because of the increased flows down the bypass section of the creek and the reduced flows delivered via the LCC. When higher flows are delivered via the LCC the water temperatures at the CVPH are similar and less heating occurs between the two sites as seen in the 2006 holding period. In 2013, a greater percentage of the available water was given to the holding fish in the section upstream of the CVPH and less water delivered via LCC downstream which resulted in higher water temperatures below the CVPH (Figures 7). Typically, blending water from the Centerville Canal with existing water in the creek has a beneficial effect on SRCS holding and spawning distribution downstream of the CVPH. However, in 2013 only a small percentage of salmon were holding downstream of CVPH and water temperatures were substantially warmer downstream of the CVPH than in previous years (Figure 8).

Figure 7. Mean daily water temperatures (C) at select SRCS holding pools in Butte Creek from June 15 - September 30, 2013.

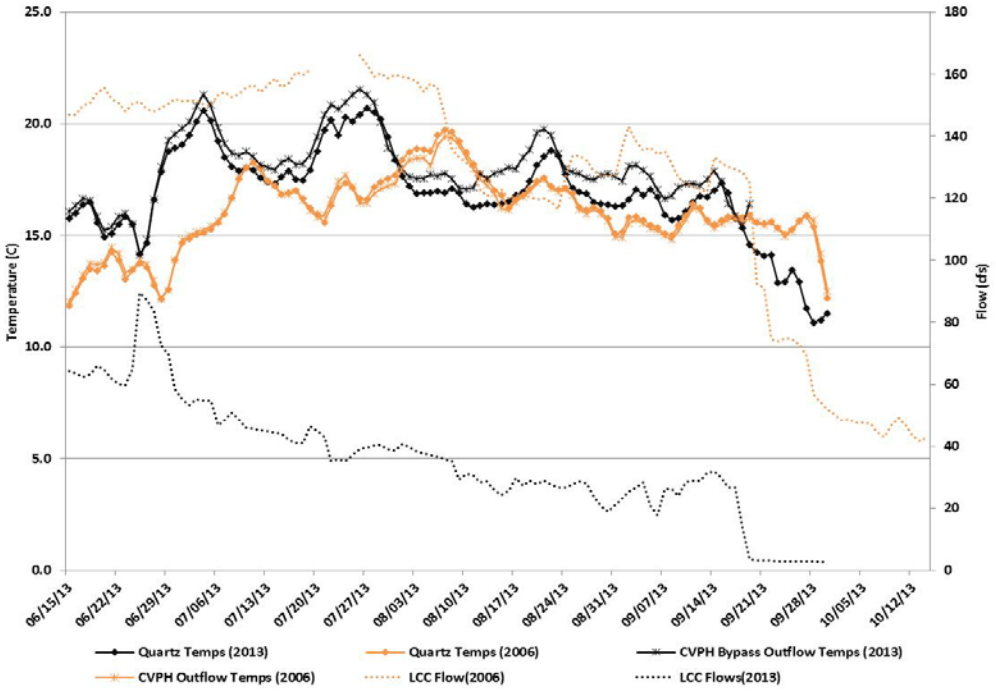
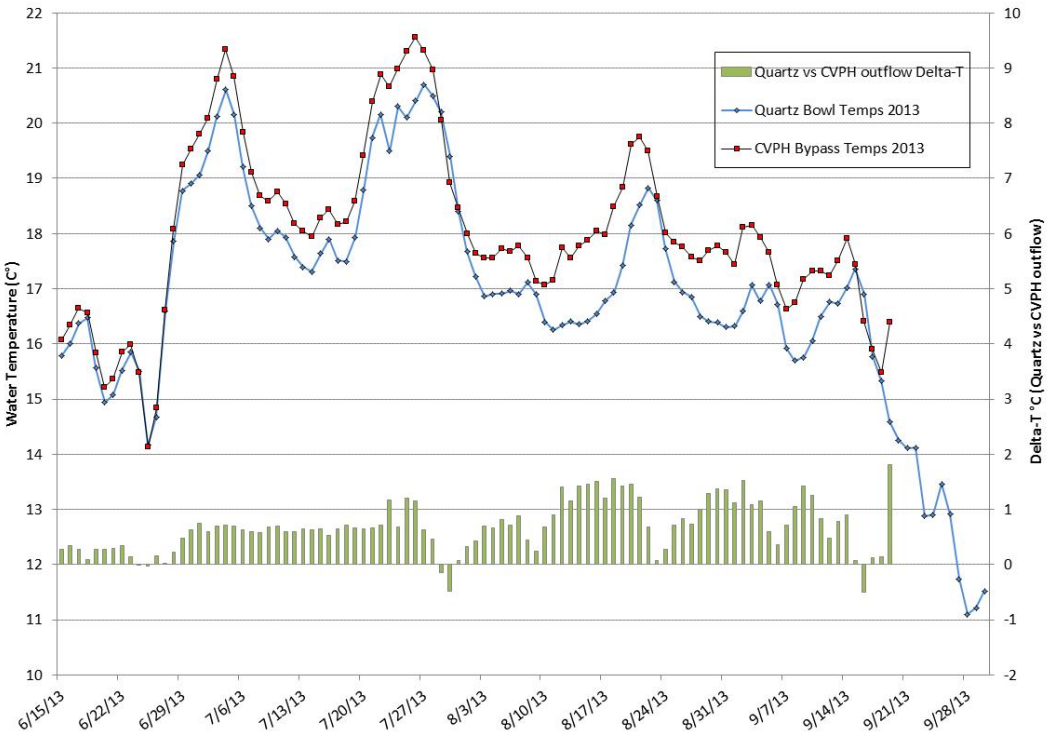
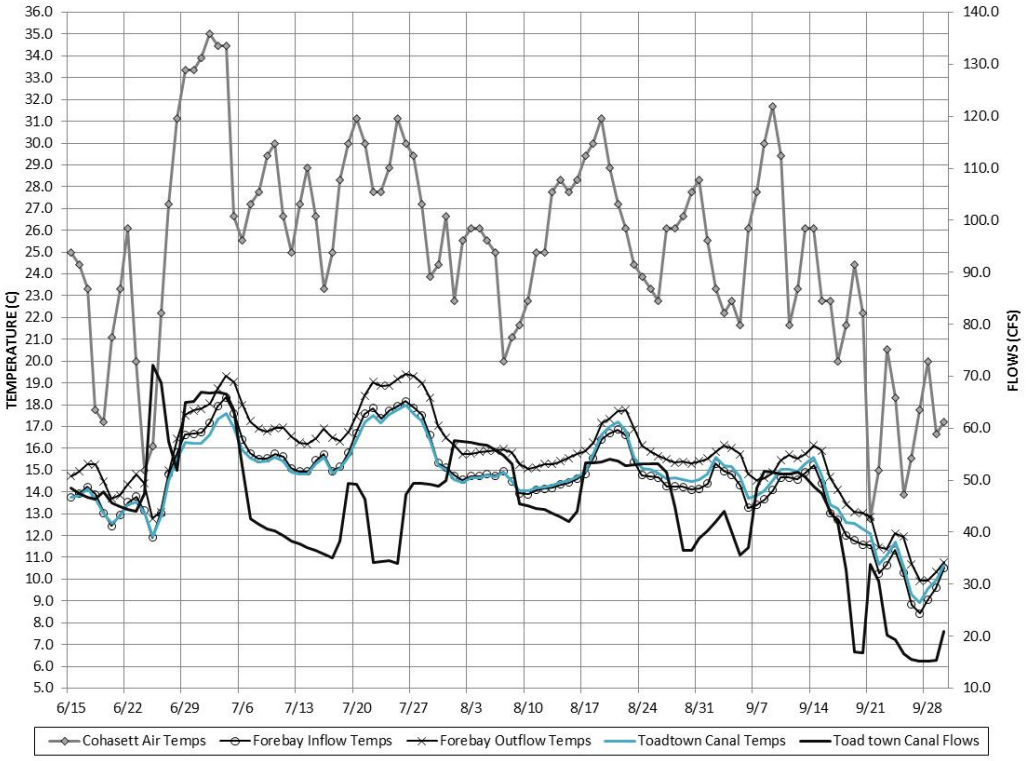


Figure 8. Mean daily water temperatures (C) at Quartz Bowl Pool and CVPH Bypass Spill. Delta-T in Butte Creek from June 15 - September 30, 2013.




The PG&E temperature contingency plan was implemented on four different occasions during the June - August 2013 period based upon air temperature forecasts provided by PG&E meteorologists. PG&E started drafting flows from Round Valley Reservoir in mid-May and was drained on or about June 28th. Releases from Philbrook Reservoir to augment flows into Butte Creek initiated on June 28 and were adjusted again on July 18, July 31 and August 15 to combat predicted heat events throughout the summer. Round Valley Reservoir releases were shut down when Philbrook Reservoir releases were initiated to eliminate any additional potential heating from warmer water released from Round Valley Reservoir. A prolonged heat storm in late July lasting longer than forecasted in the upper watershed lead to water temperatures within the forebay increasing, while releases from Philbrook Reservoir were reduced in an effort to conserve the cold water pool (Figure 9).

Figure 9. Temperatures (C) at key sites during June – September 2013 period.




## DISCUSSION

The basis for this analysis continues to be the recognition that flow and temperatures within the SRCS holding and spawning reach of Butte Creek are directly affected by the PG&E DeSabla-Centerville Project (FERC-803). The primary issue is whether the project as currently operated negatively impacts SRCS survival and spawning success. It was concluded during previous reviews, conducted from 2003 through 2012, 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). Under licensed project operations, higher volumes of water (i.e. >70 cfs) traveling down the LCC are kept much cooler by faster travel time and canyon shading when delivered to the CVPH compared to travel times via the creek. As a result, cooler water is delivered to holding fish downstream of the CVPH providing thermal protection for salmon holding downstream of the CVPH over summer. Pre-spawn holding distribution was much different this year than in previous years with 90% and 10% holding upstream and downstream of the CVPH, respectively. Therefore, the Project Operations Team decided to deliver the majority of the flow to the bypass reach upstream of the CVPH. Flows delivered via the LCC, discharged at the CVPH bypass channel, were substantially reduced compared to previous years resulting in higher water temperatures (Figure 7 & 8).

At the onset of spawning on September 17, 2013, flows in the reach above the CVPH were approximately 60cfs (FERC requirement of 40cfs). With concurrence of CDFW and NOAA Fisheries, PG&E voluntarily increased flows in the reach above CVPH from 60 cfs to 79 cfs. Based upon the previous estimate of spawning habitat availability with flow (Ward et al., 2004b), 60 cfs would accommodate approximately 1,646 spawners. The increase from 60 cfs to 80 cfs is thought to provide habitat for an additional 518 spawners and be able to accommodate approximately 2,164

spawners. There was an estimated 8,181 fish that spawned within that reach. As with previous evaluations, 2003 through 2012, there was a net downstream movement from holding pools to spawning areas. During 2013, approximately 7,021 fish holding above the CVPH (46.0% of the total) moved to spawn below. Due to the large number of fish holding in the section upstream of the CVPH the remaining 8,181 (54% of the total) that stayed to spawn saturated and over utilized the available habit upstream of CVPH(Table 4; Appendix D, Figures 1-5).

The California DWR State Index designated 2013 as a dry water year and water flows were low to start the over-summer holding period. Ambient air temperatures from the Cohasset station for early June and early July were in the" above normal range", and August was in the "normal" range. During the two years, 2002 and 2003, with significant pre-spawn mortalities, the 19.4°C threshold was exceeded 16 days and 11 days, respectively. In 2013, mean daily water temperatures at the Quartz Bowl Pool exceeded the previously defined temperature threshold goal of 19.4°C (Ward et al., 2004b; Ward et al.,2006a,b; Ward et al., 2007-1) a total of 15 days from June through August with a maximum mean daily temperature of 20.7 °C on July 27, 2013 (Appendix F, Table 1). In 2004, operational changes in WBFR delivery were made in response to the large die-off. As a result, pre-spawn mortality in 2013 was low in comparison to the 2002 and 2003 events. Most notably, the bi-weekly weather forecasts and the cessation of Round Valley Reservoir releases during a forecasted heat event and Philbrook Reservoir releases commencing, ostensibly played a role in minimizing pre-spawn mortalities during the holding period.

Average heating through the DeSabla forebay complex was over 1°C during the key mid-summer period, averaging 1.26°C and 1.15°C from July 15-31, and Aug. 1-15, 2013 which is slightly warmer than last year with 1.12°C and 1.07°C, respectively. Flows into the forebay averaged 73.7 cfs compared to 79.1 for 2012 and would explain the slightly warmer increase of temperature through the forebay for the 2013 mid-summer period. The recommended flows through the DeSabla forebay of 108 cfs has not been meet since 2011.

The 2013 PG&E temperature contingency plan was implemented four times during the 2013 SRCS holding and spawning period due to high ambient air temperatures occurring in early June and mid-July. Past evidence of the impact of the increased cooler flows from the Hendricks, Toadtown and Butte canal complex showing an effect on outflow temperatures at DSPH was not as substantial this year. Releases from Philbrook Reservoir started out approximately 3°C warmer this year compared to previous years. Also, unexpected variance from a forecasted weather event impacted operational decisions during a late-July heat event. Flows were increased on July 19 in anticipation of a heat event and were decreased on July 22nd in accordance with the weather forecast. However, ambient air temperatures in the upper watershed did not decline when flows were dropped on July 22$^{nd}$ and water temperatures at Quartz Bowl Pool increased (Figure 9; Appendix F, Table 1). Pre-spawn mortalities increased and peaked during this unpredicted heat event in the upper watershed (Figure 3).

# CONCLUSIONS AND RECOMMENDATIONS

There were an estimated 896 SRCS that died prior to spawning during 2013, of which 738 were in the reach above the Centerville Powerhouse and 158 below. During 2013, mortalities were low from initiation of the survey on June 4 and increased in late July when ambient air temperatures did not cool down in the upper watershed. Air temperatures then declined in early August and numbers of mortalities leveled off and stayed more constant until the start of spawn on September 17, 2013 (Figure 1). During 2013, salmon were examined by a CDFG pathologist on June 11 after observations of approximately 10% of holding adults showing signs of stress and physical lesions on early season mortalities. Two carcasses that were collected tested positive for both Ich and Columnaris but not in amounts consistent with causing mortality (Adkison, 2013). Pre-spawn mortalities consisted of an estimated 63% female and 37% male (Table 3). There were no CWT's recovered from pre-spawn mortalities or the subsequent carcass spawning survey.

During "normal" water years, and normal distribution of holding SRCS, the utilization of the LCC to deliver cooler water to fish holding downstream of the CVPH appears to keep large numbers of returning adults more evenly distributed above and below the CVPH. Diversions through the CVPH continue to decrease temperatures in Butte Creek below the CVPH, providing important holding habitat during the summer, and ultimately contributing to more efficient usage of spawning habitat. Even distribution of fish holding upstream and downstream of the CVPH maximizes survival and contributes to more efficient usage of spawning habitat downstream of CVPH.

The 2013 results show that collaborative efforts by the Project Operations Team are essential in maximizing survival and spawning success of Butte Creek SRCS. Early season field surveys of holding distribution estimated 15,202 salmon and 1,580 salmon holding upstream and downstream of the CVPH, respectively. This unusual holding percentage discrepancy lead to the deviation from the traditional flow split between the bypass reach and the LCC. A greater percentage of water was delivered to the reach upstream of the CVPH to benefit the majority of fish that were holding in that reach. By decreasing the volume of water in the LCC a marked increase in water temperatures downstream of the CVPH occurred, compromising available holding habitat for SRCS but ostensibly benefited fish holding upstream of CVPH. Holding densities and mortalities in the bypass reach were the highest since 2003. Higher average flows in the bypass section and a cooling event in early August appears to have minimized the mortalities and a pre-spawn mortality event similar to 2003 was averted.

As during 2003-2012, we continue to conclude that current PG&E project operations appear to provide a net benefit to Butte Creek SRCS, and continue to recommend that PG&E consider the following:

- Continue to adaptively manage project water deliveries based on annual 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.
- Continue to schedule maintenance operations for periods after SRCS have spawned and young-of-year have emerged.
- Continue discussions within the FERC re-licensing process regarding management of flows from the WBFR.
- Continue to increase flows in the reach above the CVPH 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.

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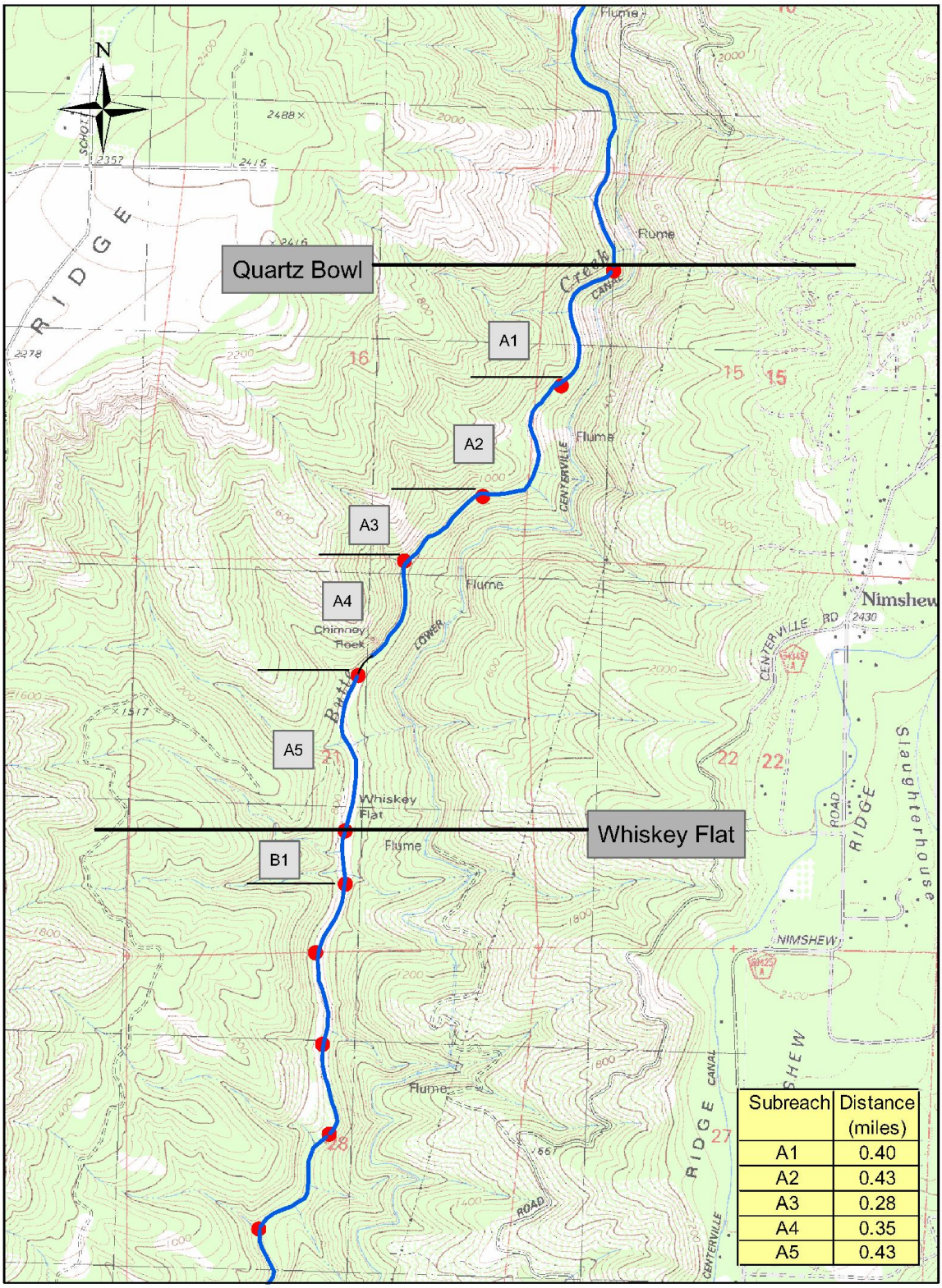
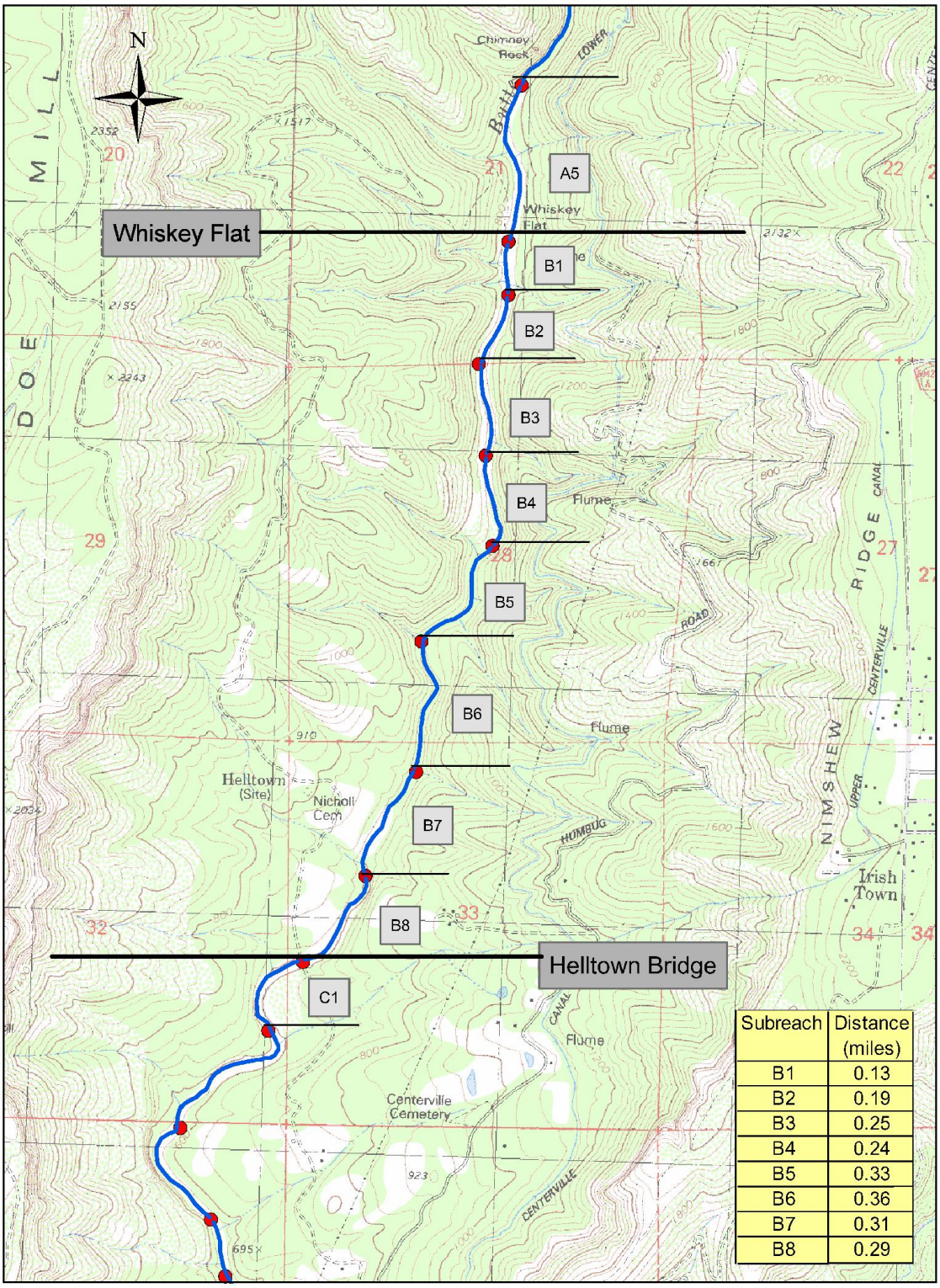
# APPENDIX A

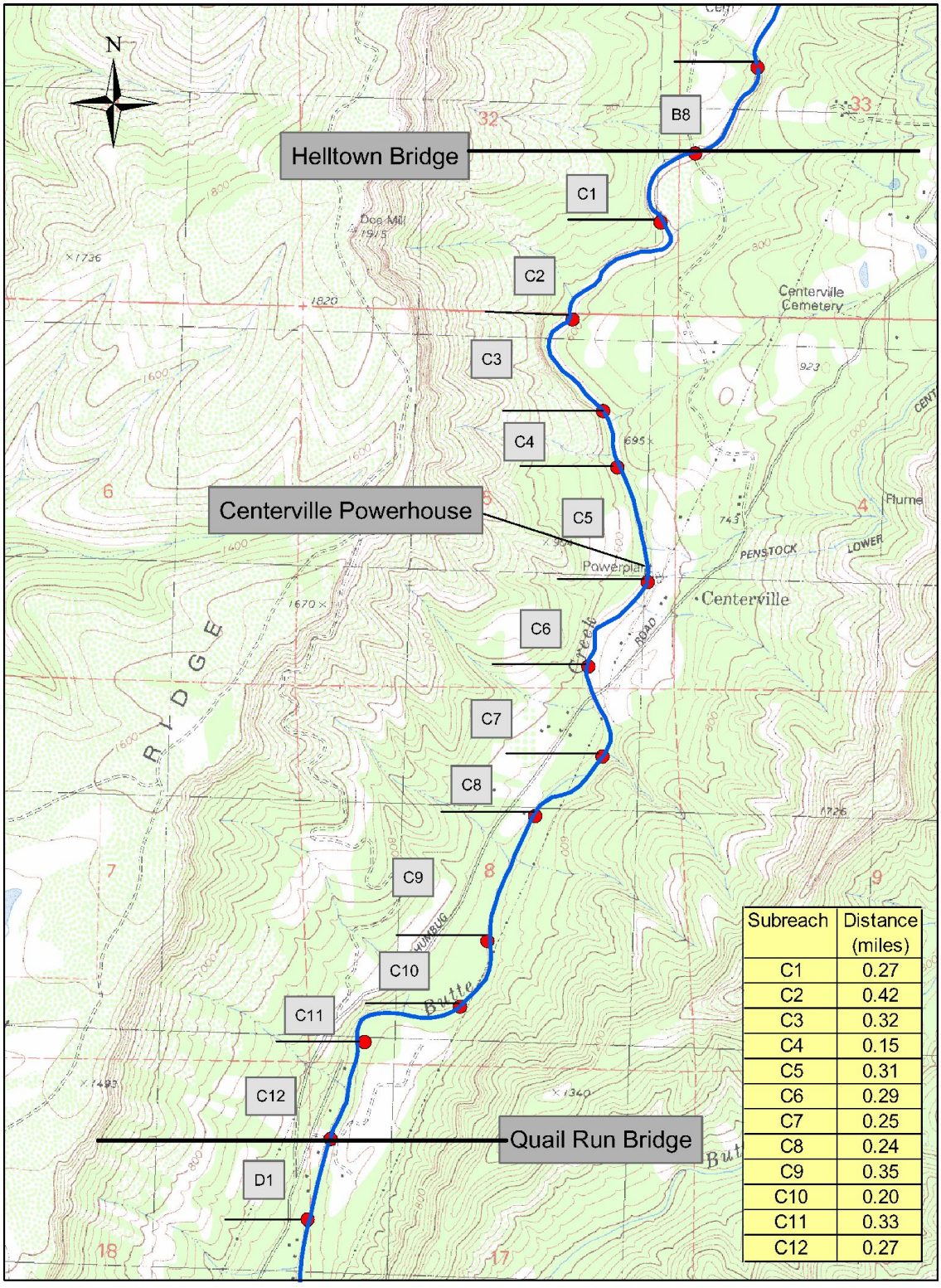
## FIGURES 1-5
## MAPS OF BUTTE CREEK HOLDING AND SPAWNING REACHES



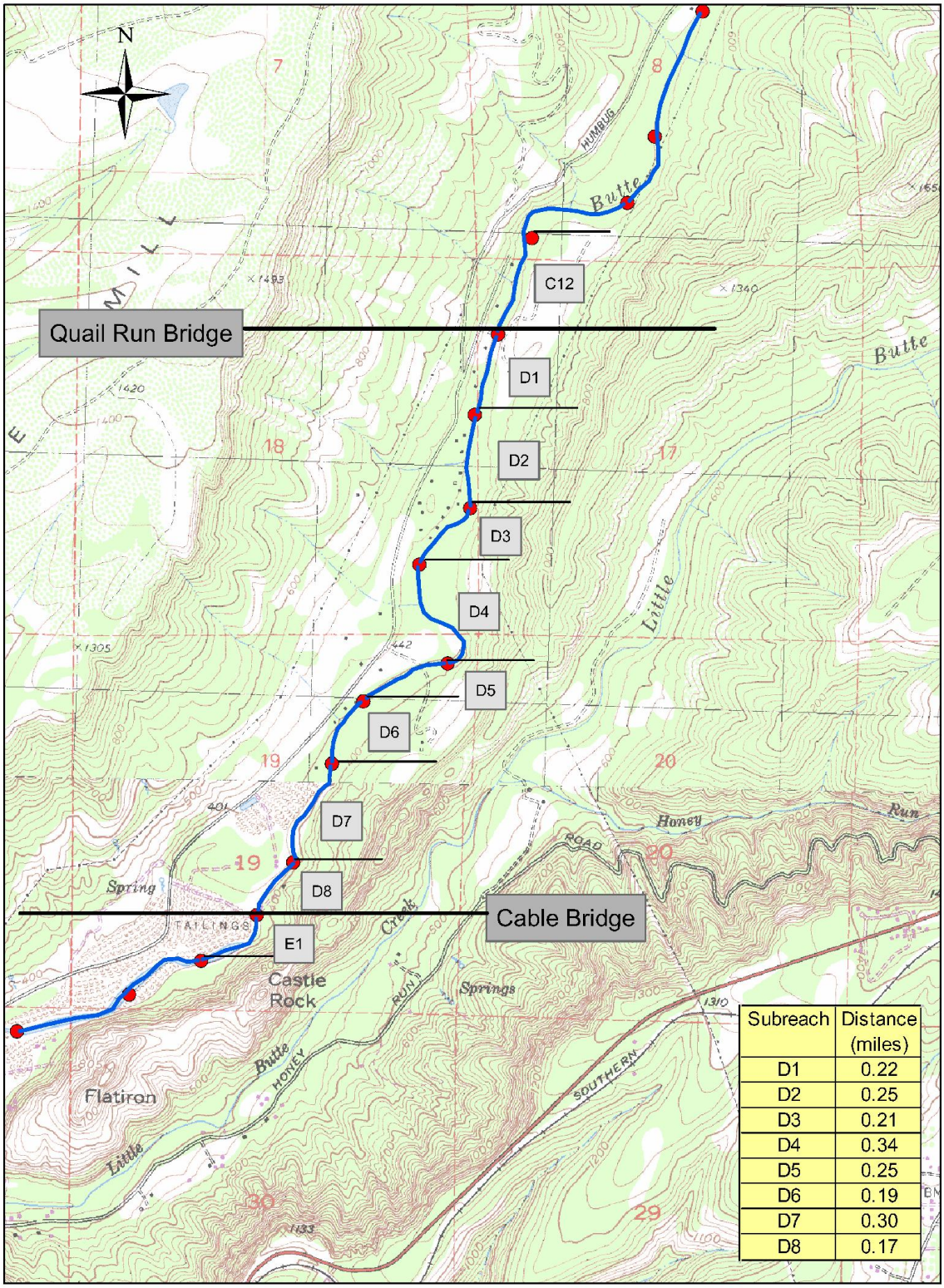

APPENDIX A, Figure 1. Map of Butte Creek SRCS holding and spawning Reach A, showing sub-reaches and distances.



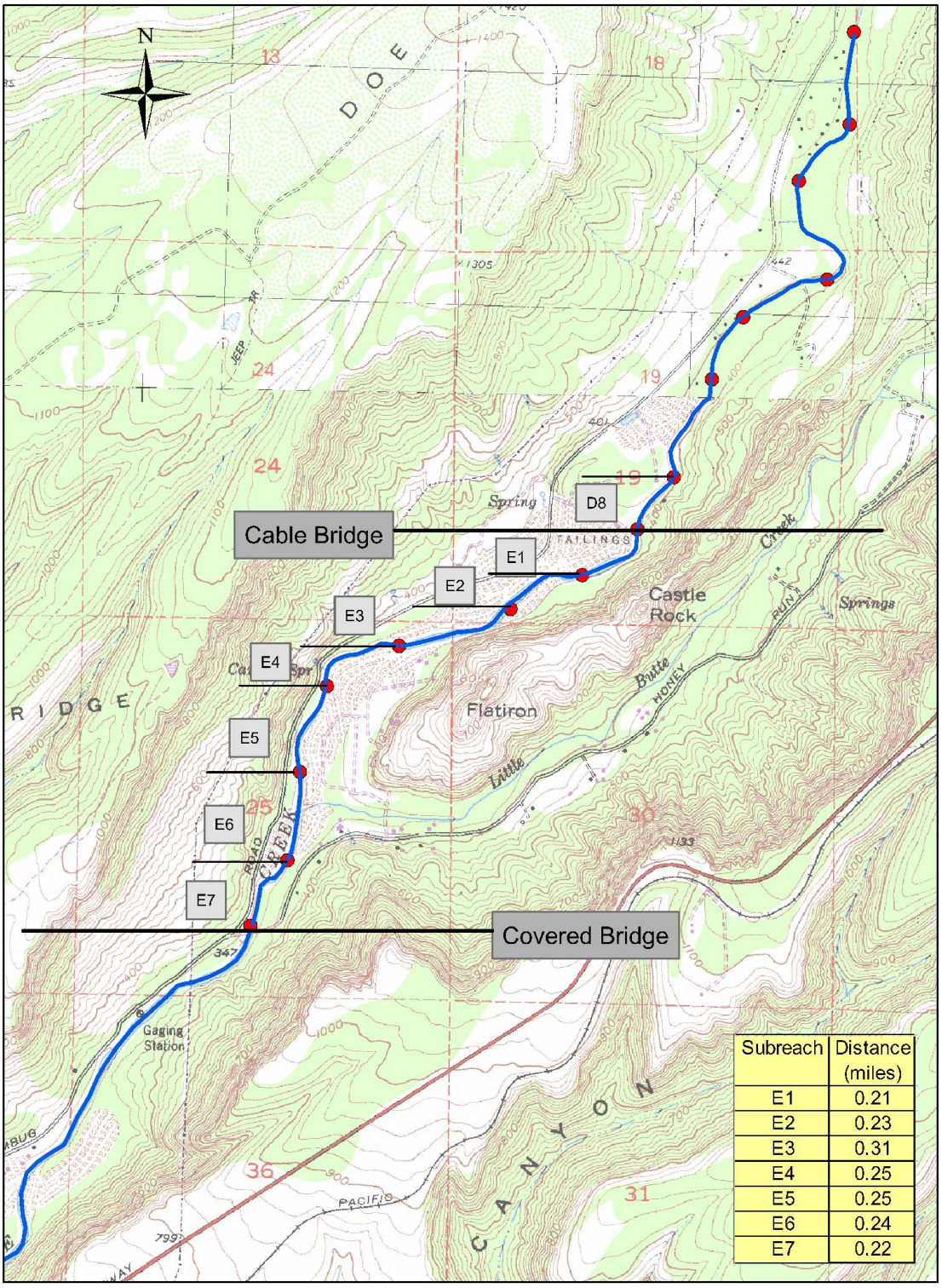

APPENDIX A, Figure 2. Map of Butte Creek SRCS holding and spawning Reach B, showing sub-reaches and distances.




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




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

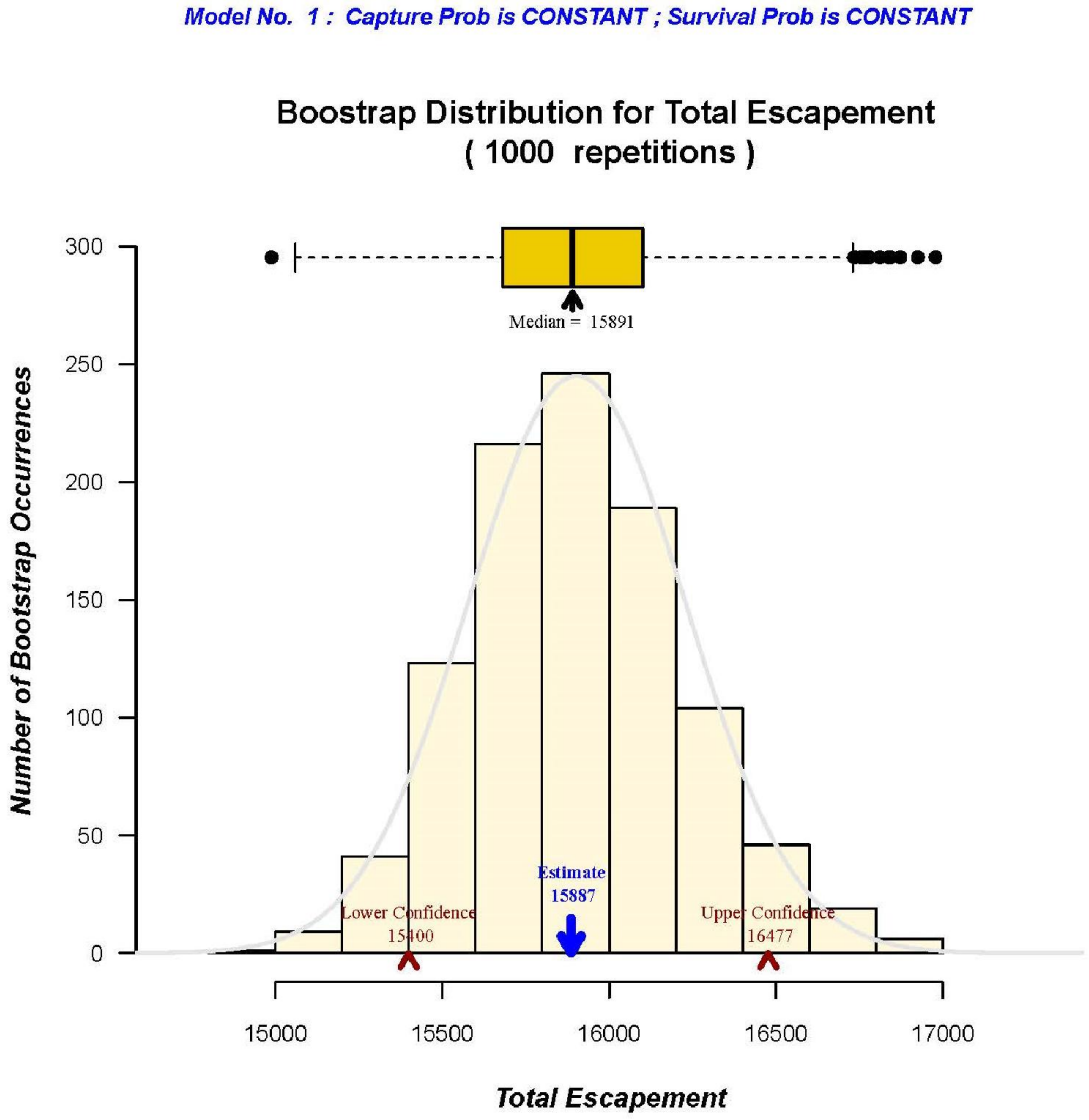



APPENDIX A, Figure 5. Map of Butte Creek SRCS holding and spawning Reach E, showing sub-reaches and distances.

# APPENDIX B

## FIGURE 1
## 2013 SPRING-RUN CHINOOK ESCAPEMENT
## ESTIMATE & EXPANSION FACTOR

APPENDIX B, Figure 1. Butte Creek Spring-Run Chinook Spawning Escapement Estimate for 2013 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:

$F = E/(C+ T_)$
$F = 15{,}886/ (9936 + 1055)$
$F = 15{,}886/10{,}991$
$F = 1.4$

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:

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

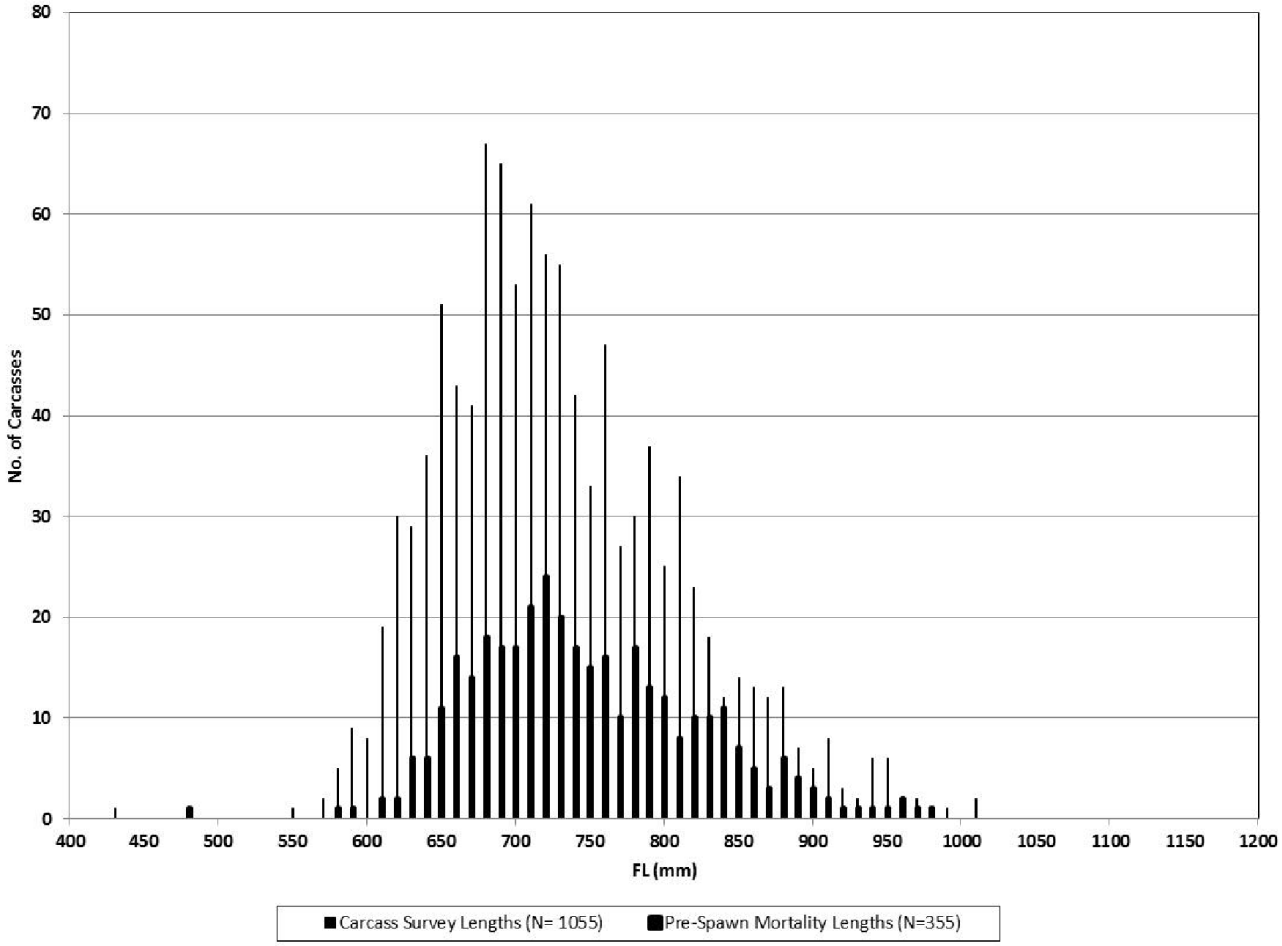
And Where:

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

# APPENDIX C

**FIGURE 1**
**LENGTH FREQUENCY DISTRIBUTON OF 1410 ADULT BUTTE CREEK CARCASSES MEASURED FOR ABUNDANCE FROM JUNE 4 TO OCTOBER 26, 2013.**

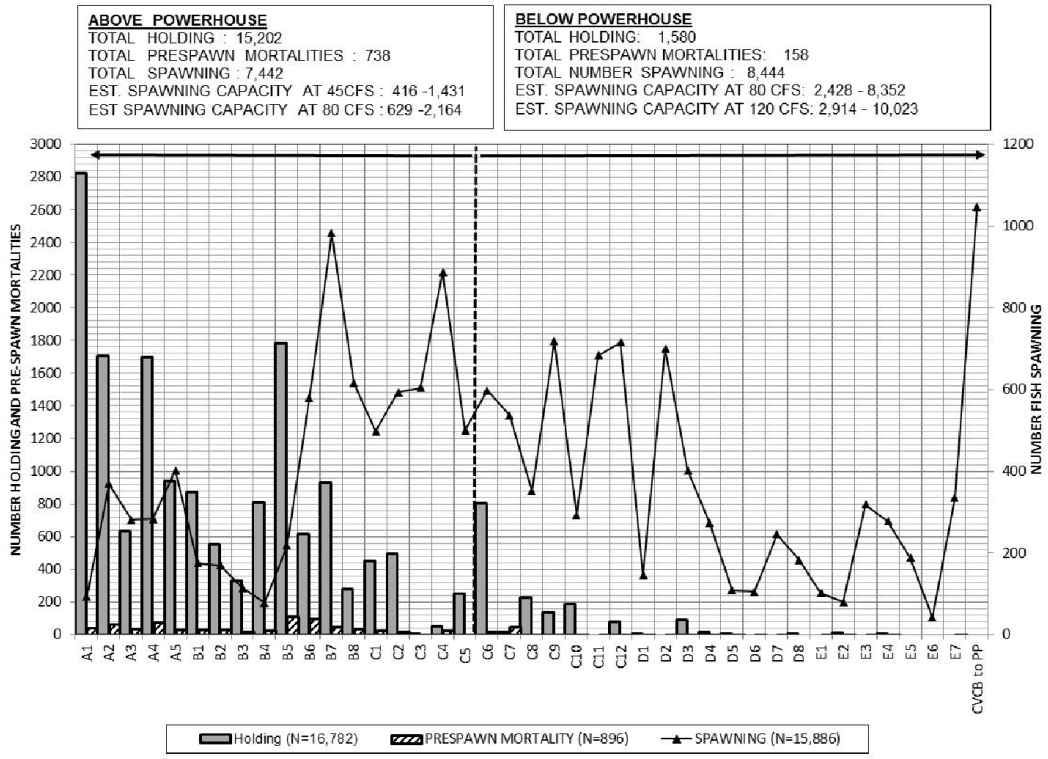
APPENDIX C, Figure 1. Length frequency distribution of 1410 Butte Creek salmon carcasses measured for abundance estimates from June 4 to October 26, 2013.



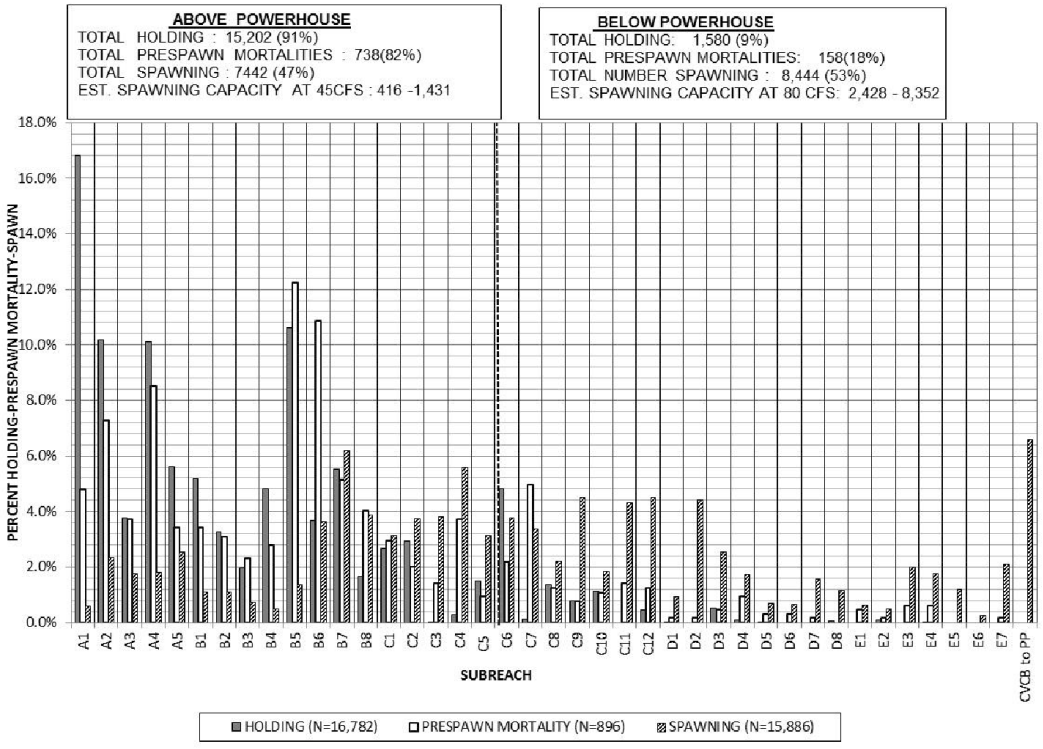
# APPENDIX D

## FIGURES 1-5
## 2013 HOLDING, PRE-SPAWN MORTALITY AND SPAWNING DISTRIBUTION OF BUTTE CREEK SPRING-RUN CHINOOK SALMON

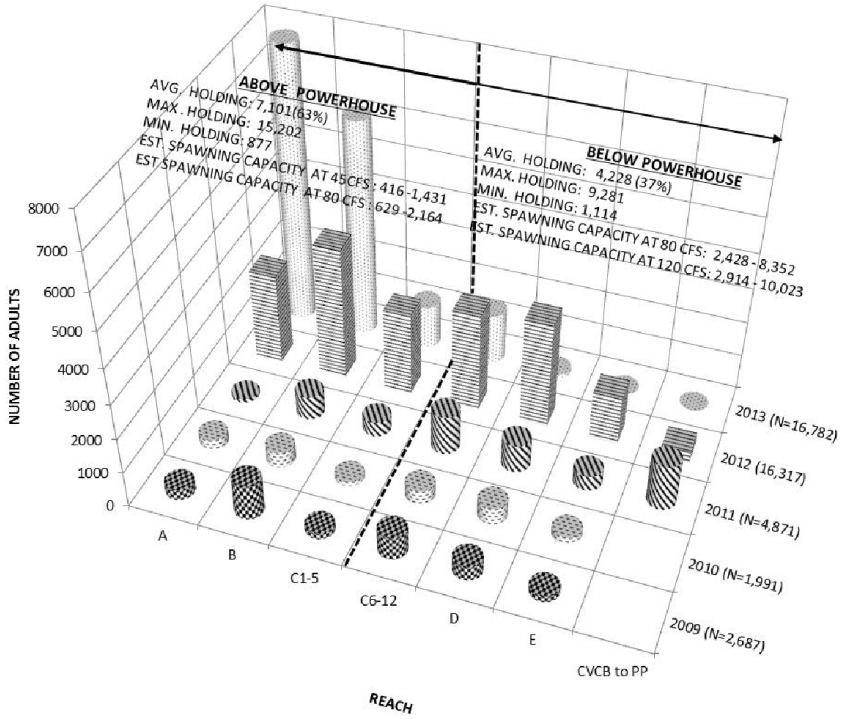
APPENDIX D, Figure 1. Distribution by sub-reach of the number of Butte Creek SRCS holding, pre-spawn mortalities, and spawning during 2013.



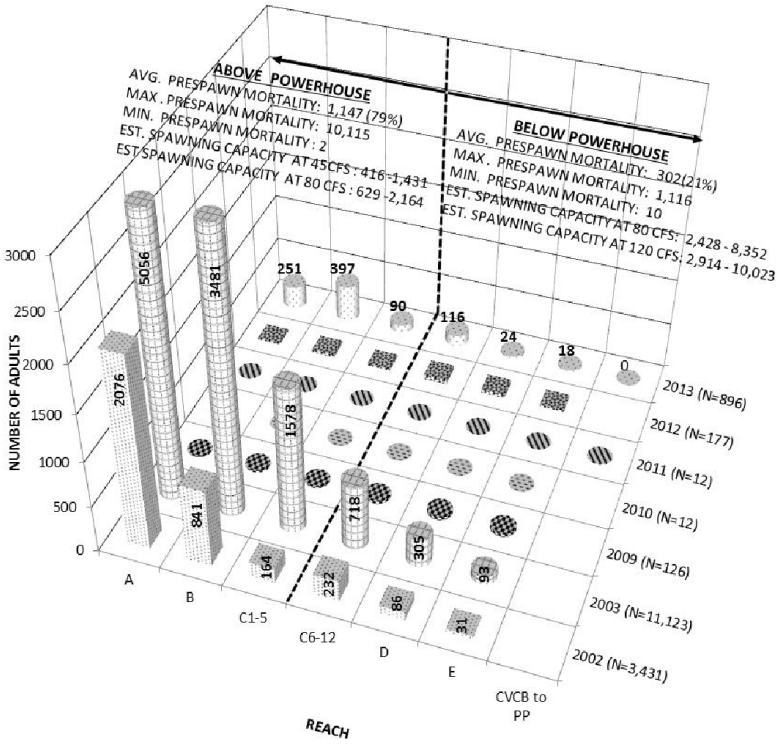

APPENDIX D, Figure 2. Distribution by sub-reach of the percent of Butte Creek SRCS holding, pre-spawn mortalities, and spawning during 2013.



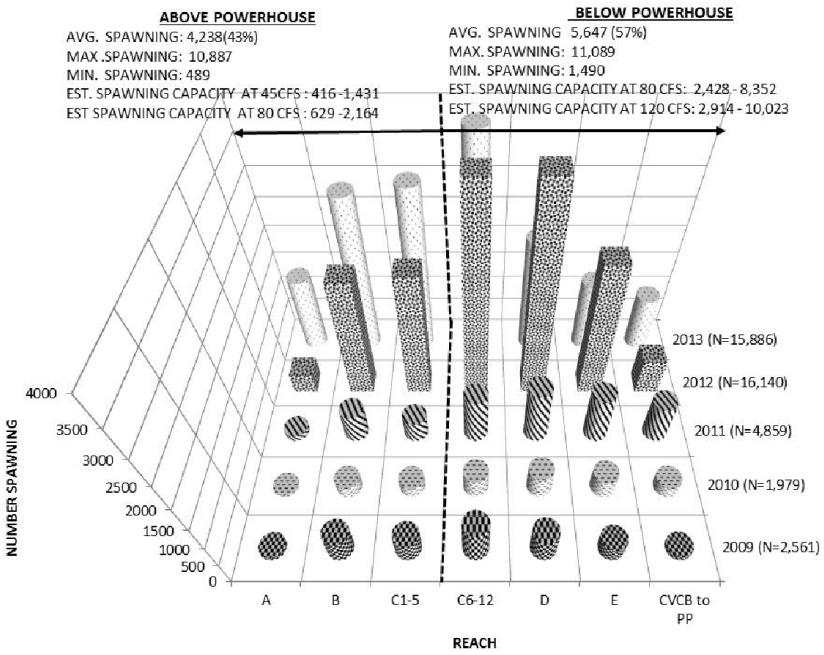
APPENDIX D, Figure 3. Distribution by reach of the number of Butte Creek SRCS holding, during 2009-2013.




APPENDIX D, Figure 4. Distribution by reach of the number of Butte Creek SRCS pre-spawn mortalities during 2002, 2003, 2009-2013.



APPENDIX D, Figure 5. Distribution by reach of the number of Butte Creek SRCS spawning during 2009-2013.



# APPENDIX E

## AIR TEMPERATURES AT COHASSET FIRE STATION
## JUNE 1- SEPTEMBER 30, 2013

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, 2013.

| YEAR - 2011 | | | | | | | |
|---|---|---|---|---|---|---|---|
| **DATE** | **MAX** | **MIN** | **MEAN** | **DATE** | **MAX** | **MIN** | **MEAN** |
| **6/1** | 35.0 | 23.9 | 28.3 | **8/1** | 28.9 | 16.7 | 22.8 |
| **6/2** | 33.3 | 22.2 | 27.8 | **8/2** | 31.7 | 20.6 | 25.6 |
| **6/3** | 35.0 | 22.8 | 28.9 | **8/3** | 32.2 | 20.0 | 26.1 |
| **6/4** | 30.0 | 17.2 | 24.4 | **8/4** | 32.2 | 20.6 | 26.1 |
| **6/5** | 30.6 | 16.1 | 23.9 | **8/5** | 32.2 | 20.6 | 25.6 |
| **6/6** | 33.3 | 19.4 | 26.1 | **8/6** | 31.1 | 21.1 | 25.0 |
| **6/7** | 39.4 | 21.1 | 31.1 | **8/7** | 27.2 | 11.1 | 20.0 |
| **6/8** | 40.0 | 28.9 | 35.0 | **8/8** | 27.2 | 13.3 | 21.1 |
| **6/9** | 30.0 | 17.2 | 26.1 | **8/9** | 28.9 | 15.6 | 21.7 |
| **6/10** | 20.0 | 12.8 | 15.0 | **8/10** | 28.9 | 14.4 | 22.8 |
| **6/11** | 26.7 | 13.9 | 20.6 | **8/11** | 31.7 | 20.0 | 25.0 |
| **6/12** | 27.2 | 17.2 | 22.2 | **8/12** | 31.1 | 20.0 | 25.0 |
| **6/13** | 27.2 | 13.3 | 21.7 | **8/13** | 33.9 | 21.1 | 27.8 |
| **6/14** | 30.0 | 16.7 | 23.3 | **8/14** | 34.4 | 22.2 | 28.3 |
| **6/15** | 30.0 | 21.1 | 25.0 | **8/15** | 34.4 | 21.7 | 27.8 |
| **6/16** | 30.6 | 18.3 | 24.4 | **8/16** | 35.0 | 22.8 | 28.3 |
| **6/17** | 28.3 | 18.3 | 23.3 | **8/17** | 35.0 | 24.4 | 29.4 |
| **6/18** | 22.8 | 12.8 | 17.8 | **8/18** | 36.7 | 22.2 | 30.0 |
| **6/19** | 23.3 | 9.4 | 17.2 | **8/19** | 34.4 | 27.2 | 31.1 |
| **6/20** | 26.7 | 15.0 | 21.1 | **8/20** | 35.0 | 23.9 | 28.9 |
| **6/21** | 28.9 | 16.7 | 23.3 | **8/21** | 33.3 | 22.8 | 27.2 |
| **6/22** | 32.2 | 20.0 | 26.1 | **8/22** | 31.7 | 22.2 | 26.1 |
| **6/23** | 23.9 | 16.1 | 20.0 | **8/23** | 30.6 | 16.7 | 24.4 |
| **6/24** | 18.3 | 12.8 | 15.0 | **8/24** | 29.4 | 17.2 | 23.9 |
| **6/25** | 18.9 | 13.3 | 16.1 | **8/25** | 28.3 | 19.4 | 23.3 |
| **6/26** | 27.2 | 17.2 | 22.2 | **8/26** | 28.9 | 13.9 | 22.8 |
| **6/27** | 33.3 | 20.6 | 27.2 | **8/27** | 31.7 | 20.6 | 26.1 |
| **6/28** | 39.4 | 25.6 | 31.1 | **8/28** | 31.7 | 20.0 | 26.1 |
| **6/29** | 39.4 | 26.1 | 33.3 | **8/29** | 32.2 | 21.7 | 26.7 |
| **6/30** | 39.4 | 28.9 | 33.3 | **8/30** | 33.9 | 22.2 | 27.8 |
| **7/1** | 40.0 | 27.8 | 33.9 | **8/31** | 33.9 | 22.8 | 28.3 |
| **7/2** | 40.0 | 30.0 | 35.0 | **9/1** | 30.0 | 21.7 | 25.6 |
| **7/3** | 42.2 | 28.3 | 34.4 | **9/2** | 28.3 | 18.9 | 23.3 |
| **7/4** | 40.0 | 29.4 | 34.4 | **9/3** | 28.9 | 16.7 | 22.2 |
| **7/5** | 32.2 | 22.2 | 26.7 | **9/4** | 28.9 | 14.4 | 22.8 |
| **7/6** | 32.2 | 17.8 | 25.6 | **9/5** | 27.2 | 14.4 | 21.7 |
| **7/7** | 33.3 | 21.7 | 27.2 | **9/6** | 32.2 | 18.3 | 26.1 |
| **7/8** | 33.3 | 23.3 | 27.8 | **9/7** | 33.3 | 22.2 | 27.8 |
| **7/9** | 35.0 | 23.9 | 29.4 | **9/8** | 35.6 | 25.0 | 30.0 |
| **7/10** | 35.0 | 25.0 | 30.0 | **9/9** | 37.2 | 26.1 | 31.7 |
| **7/11** | 32.8 | 20.6 | 26.7 | **9/10** | 34.4 | 22.8 | 29.4 |
| **7/12** | 31.7 | 18.3 | 25.0 | **9/11** | 28.9 | 15.6 | 21.7 |
| **7/13** | 32.8 | 22.8 | 27.2 | **9/12** | 29.4 | 16.7 | 23.3 |
| **7/14** | 34.4 | 23.9 | 28.9 | **9/13** | 31.7 | 20.0 | 26.1 |
| **7/15** | 31.7 | 21.7 | 26.7 | **9/14** | 32.2 | 21.1 | 26.1 |
| **7/16** | 30.0 | 15.6 | 23.3 | **9/15** | 29.4 | 15.0 | 22.8 |
| **7/17** | 32.8 | 16.1 | 25.0 | **9/16** | 28.9 | 16.7 | 22.8 |
| **7/18** | 34.4 | 21.1 | 28.3 | **9/17** | 25.0 | 13.9 | 20.0 |
| **7/19** | 36.1 | 23.9 | 30.0 | **9/18** | 28.3 | 15.6 | 21.7 |
| **7/20** | 37.8 | 25.0 | 31.1 | **9/19** | 30.0 | 19.4 | 24.4 |
| **7/21** | 36.7 | 22.8 | 30.0 | **9/20** | 26.7 | 16.1 | 22.2 |
| **7/22** | 33.9 | 20.6 | 27.8 | **9/21** | 15.0 | 10.6 | 12.8 |
| **7/23** | 32.2 | 20.6 | 27.8 | **9/22** | 20.0 | 10.6 | 15.0 |
| **7/24** | 35.0 | 23.3 | 28.9 | **9/23** | 26.1 | 15.0 | 20.6 |
| **7/25** | 36.7 | 25.6 | 31.1 | **9/24** | 21.7 | 12.2 | 18.3 |
| **7/26** | 36.1 | 23.3 | 30.0 | **9/25** | 19.4 | 9.4 | 13.9 |
| **7/27** | 35.6 | 22.8 | 29.4 | **9/26** | 21.1 | 10.0 | 15.6 |
| **7/28** | 33.9 | 20.6 | 27.2 | **9/27** | 23.9 | 12.2 | 17.8 |
| **7/29** | 30.6 | 17.2 | 23.9 | **9/28** | 24.4 | 15.0 | 20.0 |
| **7/30** | 31.1 | 16.7 | 24.4 | **9/29** | 19.4 | 15.0 | 16.7 |
| **7/31** | 32.8 | 20.0 | 26.7 | **9/30** | 21.7 | 15.0 | 17.2 |

# APPENDIX F

## TABLES 1-6
## BUTTE CREEK WATER TEMPERATURES
## MAY 1 - OCTOBER 31, 2013

APPENDIX F, Table 1. Butte Creek water temperatures (C) at Quartz Bowl Pool for period May 1 through October 31, 2013.

| DATE | MAX | MIN | MEAN | DATE | MAX | MIN | MEAN | DATE | MAX | MIN | MEAN |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **5/1** | 12.9 | 11.2 | 12.2 | **7/1** | 20.0 | 18.1 | 19.1 | **9/1** | 17.1 | 16.0 | 16.6 |
| **5/2** | 13.1 | 10.7 | 12.0 | **7/2** | 20.5 | 18.5 | 19.5 | **9/2** | 18.2 | 16.6 | 17.1 |
| **5/3** | 13.8 | 11.6 | 12.8 | **7/3** | 21.3 | 19.2 | 20.1 | **9/3** | 18.3 | 17.2 | 16.8 |
| **5/4** | 14.1 | 12.1 | 13.3 | **7/4** | 21.8 | 19.8 | 20.6 | **9/4** | 18.1 | 16.4 | 17.1 |
| **5/5** | 13.8 | 12.7 | 13.3 | **7/5** | 21.0 | 19.4 | 20.2 | **9/5** | 17.7 | 16.0 | 16.7 |
| **5/6** | 13.5 | 11.9 | 12.5 | **7/6** | 20.2 | 18.2 | 19.2 | **9/6** | 16.9 | 15.1 | 15.9 |
| **5/7** | 11.7 | 10.8 | 11.1 | **7/7** | 19.9 | 17.3 | 18.5 | **9/7** | 16.8 | 15.0 | 15.7 |
| **5/8** | 12.5 | 10.9 | 11.5 | **7/8** | 19.5 | 17.0 | 18.1 | **9/8** | 16.8 | 15.0 | 15.8 |
| **5/9** | 14.2 | 11.8 | 13.0 | **7/9** | 19.5 | 17.0 | 17.9 | **9/9** | 17.2 | 15.3 | 16.1 |
| **5/10** | 15.6 | 13.2 | 14.5 | **7/10** | 19.6 | 17.0 | 18.1 | **9/10** | 17.7 | 15.7 | 16.5 |
| **5/11** | 16.1 | 14.2 | 15.4 | **7/11** | 19.3 | 17.0 | 17.9 | **9/11** | 17.5 | 16.2 | 16.8 |
| **5/12** | 16.9 | 15.0 | 16.0 | **7/12** | 19.0 | 16.6 | 17.6 | **9/12** | 17.7 | 16.1 | 16.7 |
| **5/13** | 16.5 | 14.6 | 15.7 | **7/13** | 18.9 | 16.3 | 17.4 | **9/13** | 18.1 | 16.3 | 17.0 |
| **5/14** | 17.3 | 14.9 | 15.9 | **7/14** | 18.8 | 16.2 | 17.3 | **9/14** | 18.4 | 16.7 | 17.4 |
| **5/15** | 16.5 | 15.0 | 15.9 | **7/15** | 19.0 | 16.7 | 17.6 | **9/15** | 17.8 | 16.3 | 16.9 |
| **5/16** | 16.1 | 14.5 | 15.2 | **7/16** | 19.2 | 17.0 | 17.9 | **9/16** | 16.6 | 15.0 | 15.8 |
| **5/17** | 14.6 | 13.3 | 13.9 | **7/17** | 18.8 | 16.4 | 17.5 | **9/17** | 16.2 | 14.7 | 15.3 |
| **5/18** | 14.2 | 12.5 | 13.3 | **7/18** | 18.9 | 16.4 | 17.5 | **9/18** | 15.3 | 13.9 | 14.6 |
| **5/19** | 14.6 | 12.4 | 13.4 | **7/19** | 19.3 | 16.9 | 17.9 | **9/19** | 15.3 | 13.5 | 14.3 |
| **5/20** | 14.9 | 12.7 | 13.7 | **7/20** | 20.2 | 17.8 | 18.8 | **9/20** | 14.9 | 13.4 | 14.1 |
| **5/21** | 15.2 | 13.4 | 14.2 | **7/21** | 21.1 | 18.8 | 19.7 | **9/21** | 14.5 | 13.5 | 14.1 |
| **5/22** | 13.8 | 12.0 | 12.8 | **7/22** | 21.4 | 19.4 | 20.2 | **9/22** | 13.4 | 12.3 | 12.9 |
| **5/23** | 12.7 | 10.8 | 11.7 | **7/23** | 21.0 | 19.1 | 19.9 | **9/23** | 14.0 | 12.2 | 12.9 |
| **5/24** | 12.6 | 10.3 | 11.4 | **7/24** | 21.0 | 19.4 | 20.3 | **9/24** | 14.2 | 13.0 | 13.5 |
| **5/25** | 13.4 | 11.1 | 12.2 | **7/25** | 21.3 | 19.4 | 20.1 | **9/25** | 13.5 | 12.4 | 12.9 |
| **5/26** | 14.1 | 11.8 | 12.8 | **7/26** | 21.7 | 19.6 | 20.4 | **9/26** | 12.5 | 11.2 | 11.7 |
| **5/27** | 12.9 | 12.1 | 12.4 | **7/27** | 21.8 | 19.9 | 20.7 | **9/27** | 12.0 | 10.4 | 11.1 |
| **5/28** | 13.0 | 11.6 | 12.3 | **7/28** | 21.6 | 19.6 | 20.5 | **9/28** | 12.1 | 10.6 | 11.2 |
| **5/29** | 14.2 | 12.4 | 13.2 | **7/29** | 21.2 | 19.3 | 20.2 | **9/29** | 11.9 | 11.3 | 11.5 |
| **5/30** | 14.8 | 12.6 | 13.5 | **7/30** | 20.1 | 18.7 | 19.4 | **9/30** | 12.6 | 12.0 | 12.2 |
| **5/31** | 15.2 | 12.5 | 13.7 | **7/31** | 19.1 | 17.4 | 18.4 | **10/1** | 13.8 | 12.2 | 12.8 |
| **6/1** | 16.2 | 13.6 | 14.7 | **8/1** | 18.9 | 16.8 | 17.7 | **10/2** | 13.3 | 11.9 | 12.4 |
| **6/2** | 17.1 | 14.6 | 15.6 | **8/2** | 18.3 | 16.3 | 17.2 | **10/3** | 12.1 | 10.8 | 11.4 |
| **6/3** | 17.8 | 15.2 | 16.3 | **8/3** | 18.0 | 16.0 | 16.9 | **10/4** | 11.3 | 9.9 | 10.6 |
| **6/4** | 18.3 | 15.7 | 16.9 | **8/4** | 18.0 | 16.0 | 16.9 | **10/5** | 11.1 | 9.5 | 10.2 |
| **6/5** | 18.9 | 16.4 | 17.5 | **8/5** | 18.1 | 16.0 | 16.9 | **10/6** | 11.3 | 9.8 | 10.4 |
| **6/6** | 19.6 | 17.0 | 18.2 | **8/6** | 18.1 | 16.0 | 17.0 | **10/7** | 11.0 | 9.8 | 10.3 |
| **6/7** | 20.1 | 17.5 | 18.6 | **8/7** | 18.1 | 16.1 | 16.9 | **10/8** | 10.9 | 9.6 | 10.1 |
| **6/8** | 20.6 | 17.9 | 19.1 | **8/8** | 18.2 | 16.3 | 17.1 | **10/9** | 10.9 | 9.7 | 10.1 |
| **6/9** | 20.8 | 18.6 | 19.5 | **8/9** | 17.9 | 16.1 | 16.9 | **10/10** | 10.9 | 9.6 | 10.1 |
| **6/10** | 19.4 | 17.1 | 18.3 | **8/10** | 17.4 | 15.6 | 16.4 | **10/11** | 10.9 | 9.6 | 10.1 |
| **6/11** | 17.8 | 15.6 | 16.6 | **8/11** | 17.3 | 15.4 | 16.3 | **10/12** | 10.7 | 9.5 | 10.0 |
| **6/12** | 17.7 | 15.4 | 16.3 | **8/12** | 17.5 | 15.5 | 16.3 | **10/13** | 10.7 | 9.4 | 10.0 |
| **6/13** | 17.3 | 15.1 | 16.0 | **8/13** | 17.5 | 15.7 | 16.4 | **10/14** | 10.4 | 9.1 | 9.7 |
| **6/14** | 17.0 | 14.5 | 15.6 | **8/14** | 17.5 | 15.5 | 16.4 | **10/15** | 10.4 | 9.2 | 9.6 |
| **6/15** | 17.2 | 14.7 | 15.8 | **8/15** | 17.6 | 15.6 | 16.4 | **10/16** | 10.1 | 8.7 | 9.4 |
| **6/16** | 17.5 | 14.9 | 16.0 | **8/16** | 17.8 | 15.6 | 16.5 | **10/17** | 10.1 | 8.8 | 9.4 |
| **6/17** | 17.7 | 15.4 | 16.4 | **8/17** | 18.0 | 15.9 | 16.8 | **10/18** | 10.3 | 9.0 | 9.5 |
| **6/18** | 20.2 | 15.6 | 16.5 | **8/18** | 17.9 | 16.1 | 16.9 | **10/19** | 10.6 | 9.2 | 9.8 |
| **6/19** | 16.5 | 14.8 | 15.6 | **8/19** | 18.6 | 16.5 | 17.4 | **10/20** | 10.7 | 9.4 | 9.9 |
| **6/20** | 16.3 | 13.9 | 14.9 | **8/20** | 18.6 | 17.7 | 18.2 | **10/21** | 10.8 | 9.5 | 10.0 |
| **6/21** | 16.6 | 14.0 | 15.1 | **8/21** | 19.5 | 18.0 | 18.5 | **10/22** | 11.0 | 9.6 | 10.0 |
| **6/22** | 17.1 | 14.4 | 15.5 | **8/22** | 19.7 | 18.2 | 18.8 | **10/23** | nd | nd | nd |
| **6/23** | 16.9 | 15.3 | 15.8 | **8/23** | 19.4 | 18.1 | 18.6 | **10/24** | nd | nd | nd |
| **6/24** | 16.0 | 14.9 | 15.5 | **8/24** | 18.5 | 17.0 | 17.7 | **10/25** | nd | nd | nd |
| **6/25** | 14.8 | 13.7 | 14.2 | **8/25** | 18.0 | 16.4 | 17.1 | **10/26** | nd | nd | nd |
| **6/26** | 15.9 | 13.8 | 14.7 | **8/26** | 17.9 | 16.3 | 16.9 | **10/27** | nd | nd | nd |
| **6/27** | 18.2 | 15.4 | 16.6 | **8/27** | 17.9 | 16.0 | 16.9 | **10/28** | nd | nd | nd |
| **6/28** | 19.5 | 16.6 | 17.9 | **8/28** | 17.5 | 15.6 | 16.5 | **10/29** | nd | nd | nd |
| **6/29** | 20.0 | 17.7 | 18.8 | **8/29** | 17.6 | 15.6 | 16.4 | **10/30** | nd | nd | nd |
| **6/30** | 20.1 | 17.8 | 18.9 | **8/30** | 17.5 | 15.6 | 16.4 | **10/31** | nd | nd | nd |
| | | | | **8/31** | 17.4 | 15.5 | 16.3 | | | | |

nd = no data

APPENDIX F, Table 2. Butte Creek water temperatures (C) at Chimney Rock Pool for period May 1 through October 31, 2013.

| DATE | MAX | MIN | MEAN | DATE | MAX | MIN | MEAN | DATE | MAX | MIN | MEAN |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **5/1** | 14.0 | 11.6 | 12.7 | **7/1** | 21.1 | 18.4 | 19.5 | **9/1** | 17.5 | 16.4 | 16.9 |
| **5/2** | 14.0 | 11.1 | 12.5 | **7/2** | 21.5 | 18.8 | 19.9 | **9/2** | 18.8 | 16.8 | 17.5 |
| **5/3** | 14.6 | 11.9 | 13.2 | **7/3** | 22.4 | 19.5 | 20.6 | **9/3** | 19.2 | 16.8 | 17.6 |
| **5/4** | 15.1 | 12.5 | 13.7 | **7/4** | 22.8 | 20.1 | 21.1 | **9/4** | 18.9 | 16.6 | 17.5 |
| **5/5** | 14.5 | 13.0 | 13.7 | **7/5** | 22.1 | 19.8 | 20.6 | **9/5** | 18.5 | 16.2 | 17.1 |
| **5/6** | 13.7 | 12.2 | 12.9 | **7/6** | 21.4 | 18.6 | 19.8 | **9/6** | 17.9 | 15.4 | 16.4 |
| **5/7** | 12.1 | 11.3 | 11.6 | **7/7** | 21.0 | 17.7 | 19.1 | **9/7** | 17.7 | 15.3 | 16.2 |
| **5/8** | 12.4 | 11.3 | 11.8 | **7/8** | 20.7 | 17.4 | 18.7 | **9/8** | 17.8 | 15.3 | 16.2 |
| **5/9** | 15.0 | 12.1 | 13.3 | **7/9** | 20.5 | 17.3 | 18.5 | **9/9** | 18.1 | 15.6 | 16.5 |
| **5/10** | 16.6 | 13.5 | 14.8 | **7/10** | 20.6 | 17.3 | 18.6 | **9/10** | 18.5 | 15.9 | 16.9 |
| **5/11** | 16.9 | 14.7 | 15.7 | **7/11** | 20.3 | 17.3 | 18.4 | **9/11** | 18.3 | 16.4 | 17.1 |
| **5/12** | 18.0 | 15.4 | 16.4 | **7/12** | 20.0 | 16.8 | 18.1 | **9/12** | 18.5 | 16.3 | 17.1 |
| **5/13** | 17.7 | 15.1 | 16.1 | **7/13** | 19.9 | 16.7 | 18.0 | **9/13** | 18.9 | 16.6 | 17.5 |
| **5/14** | 18.1 | 15.2 | 16.3 | **7/14** | 19.9 | 16.5 | 17.8 | **9/14** | 19.2 | 17.0 | 17.8 |
| **5/15** | 17.5 | 15.5 | 16.2 | **7/15** | 20.0 | 17.0 | 18.1 | **9/15** | 18.5 | 16.6 | 17.3 |
| **5/16** | 16.2 | 14.8 | 15.5 | **7/16** | 20.2 | 17.2 | 18.3 | **9/16** | 17.5 | 15.4 | 16.3 |
| **5/17** | 15.6 | 13.6 | 14.4 | **7/17** | 19.9 | 16.8 | 18.0 | **9/17** | 16.9 | 15.1 | 15.8 |
| **5/18** | 15.3 | 12.8 | 13.7 | **7/18** | 20.1 | 16.8 | 18.1 | **9/18** | 16.1 | 14.3 | 15.0 |
| **5/19** | 15.6 | 12.7 | 13.9 | **7/19** | 20.4 | 17.2 | 18.5 | **9/19** | 16.0 | 13.8 | 14.7 |
| **5/20** | 15.9 | 12.9 | 14.1 | **7/20** | 21.2 | 18.1 | 19.3 | **9/20** | 15.6 | 13.7 | 14.5 |
| **5/21** | 16.2 | 13.7 | 14.5 | **7/21** | 22.1 | 19.1 | 20.2 | **9/21** | 14.7 | 13.7 | 14.4 |
| **5/22** | 14.7 | 12.4 | 13.3 | **7/22** | 22.2 | 19.6 | 20.6 | **9/22** | 14.3 | 12.7 | 13.3 |
| **5/23** | 13.8 | 11.2 | 12.2 | **7/23** | 22.0 | 19.3 | 20.4 | **9/23** | 14.8 | 12.5 | 13.3 |
| **5/24** | 13.7 | 10.7 | 12.0 | **7/24** | 22.3 | 19.7 | 20.6 | **9/24** | 14.6 | 13.3 | 13.8 |
| **5/25** | 14.4 | 11.3 | 12.6 | **7/25** | 22.8 | 19.9 | 20.9 | **9/25** | 14.2 | 12.5 | 13.2 |
| **5/26** | 15.1 | 12.1 | 13.2 | **7/26** | 22.9 | 20.2 | 21.2 | **9/26** | 13.0 | 11.5 | 12.1 |
| **5/27** | 13.4 | 12.5 | 12.8 | **7/27** | 22.6 | 20.0 | 21.0 | **9/27** | 12.7 | 10.7 | 11.5 |
| **5/28** | 14.0 | 12.0 | 12.8 | **7/28** | 22.3 | 19.6 | 20.7 | **9/28** | 12.7 | 10.9 | 11.6 |
| **5/29** | 15.2 | 12.7 | 13.6 | **7/29** | 21.1 | 19.1 | 19.9 | **9/29** | 12.2 | 11.5 | 11.8 |
| **5/30** | 15.9 | 12.8 | 14.0 | **7/30** | 20.2 | 17.8 | 18.8 | **9/30** | 12.9 | 12.2 | 12.5 |
| **5/31** | 16.2 | 12.8 | 14.2 | **7/31** | 20.0 | 17.2 | 18.3 | **10/1** | 14.4 | 12.5 | 13.1 |
| **6/1** | 17.2 | 13.8 | 15.1 | **8/1** | 19.4 | 16.8 | 17.8 | **10/2** | 13.8 | 12.2 | 12.8 |
| **6/2** | 18.1 | 14.8 | 16.0 | **8/2** | 19.1 | 16.3 | 17.4 | **10/3** | 12.6 | 11.1 | 11.7 |
| **6/3** | 18.8 | 15.4 | 16.7 | **8/3** | 19.1 | 16.4 | 17.4 | **10/4** | 12.0 | 10.4 | 11.0 |
| **6/4** | 19.2 | 16.0 | 17.3 | **8/4** | 19.2 | 16.3 | 17.4 | **10/5** | 11.7 | 9.8 | 10.6 |
| **6/5** | 19.9 | 16.6 | 17.9 | **8/5** | 19.2 | 16.4 | 17.5 | **10/6** | 11.7 | 10.0 | 10.7 |
| **6/6** | 20.6 | 17.3 | 18.6 | **8/6** | 19.1 | 16.4 | 17.4 | **10/7** | 11.5 | 10.0 | 10.6 |
| **6/7** | 21.1 | 17.8 | 19.0 | **8/7** | 19.2 | 16.6 | 17.6 | **10/8** | 11.4 | 9.9 | 10.5 |
| **6/8** | 21.7 | 18.2 | 19.5 | **8/8** | 18.8 | 16.4 | 17.3 | **10/9** | 11.5 | 9.9 | 10.4 |
| **6/9** | 21.7 | 18.8 | 19.9 | **8/9** | 18.4 | 15.9 | 16.9 | **10/10** | 11.4 | 9.9 | 10.4 |
| **6/10** | 19.4 | 17.5 | 18.5 | **8/10** | 18.4 | 15.7 | 16.7 | **10/11** | 11.4 | 9.8 | 10.5 |
| **6/11** | 19.0 | 16.2 | 17.3 | **8/11** | 18.6 | 15.8 | 16.8 | **10/12** | 11.3 | 9.8 | 10.4 |
| **6/12** | 18.8 | 15.7 | 16.9 | **8/12** | 18.5 | 15.9 | 16.9 | **10/13** | 11.2 | 9.7 | 10.3 |
| **6/13** | 18.4 | 15.5 | 16.6 | **8/13** | 18.6 | 15.8 | 16.9 | **10/14** | 11.0 | 9.4 | 10.0 |
| **6/14** | 18.1 | 14.9 | 16.2 | **8/14** | 18.8 | 15.9 | 16.9 | **10/15** | 10.9 | 9.4 | 10.0 |
| **6/15** | 18.4 | 15.0 | 16.3 | **8/15** | 18.9 | 15.9 | 17.0 | **10/16** | 10.5 | 9.0 | 9.6 |
| **6/16** | 18.6 | 15.2 | 16.5 | **8/16** | 19.1 | 16.2 | 17.3 | **10/17** | 10.6 | 9.1 | 9.7 |
| **6/17** | 18.8 | 15.7 | 16.9 | **8/17** | 19.1 | 16.4 | 17.4 | **10/18** | 10.8 | 9.3 | 9.9 |
| **6/18** | 18.3 | 15.9 | 16.7 | **8/18** | 19.6 | 16.8 | 17.9 | **10/19** | 11.1 | 9.5 | 10.1 |
| **6/19** | 17.7 | 15.2 | 16.2 | **8/19** | 19.2 | 17.9 | 18.5 | **10/20** | 11.2 | 9.6 | 10.2 |
| **6/20** | 17.5 | 14.4 | 15.6 | **8/20** | 20.3 | 18.3 | 19.0 | **10/21** | 11.1 | 9.8 | 10.3 |
| **6/21** | 17.7 | 14.4 | 15.7 | **8/21** | 20.6 | 18.5 | 19.2 | **10/22** | 10.3 | 9.9 | 10.1 |
| **6/22** | 18.2 | 14.7 | 16.1 | **8/22** | 20.3 | 18.3 | 19.0 | **10/23** | nd | nd | nd |
| **6/23** | 17.5 | 15.5 | 16.3 | **8/23** | 19.6 | 17.3 | 18.2 | **10/24** | nd | nd | nd |
| **6/24** | 16.2 | 15.3 | 15.9 | **8/24** | 19.0 | 16.7 | 17.6 | **10/25** | nd | nd | nd |
| **6/25** | 15.3 | 14.1 | 14.6 | **8/25** | 18.9 | 16.7 | 17.5 | **10/26** | nd | nd | nd |
| **6/26** | 17.0 | 14.1 | 15.2 | **8/26** | 18.9 | 16.3 | 17.3 | **10/27** | nd | nd | nd |
| **6/27** | 19.3 | 15.5 | 17.0 | **8/27** | 18.5 | 16.1 | 17.0 | **10/28** | nd | nd | nd |
| **6/28** | 20.5 | 16.8 | 18.3 | **8/28** | 18.5 | 15.9 | 16.9 | **10/29** | nd | nd | nd |
| **6/29** | 21.1 | 18.1 | 19.2 | **8/29** | 18.5 | 15.8 | 16.8 | **10/30** | nd | nd | nd |
| **6/30** | 21.2 | 18.1 | 19.3 | **8/30** | 18.4 | 15.8 | 16.8 | **10/31** | nd | nd | nd |
| | | | | **8/31** | 18.5 | 15.7 | 16.8 | | | | |

nd = no data

APPENDIX F, Table 3. Butte Creek water temperatures (C) at Pool 4 for period May 1 through October 31, 2013.

| DATE | MAX | MIN | MEAN | DATE | MAX | MIN | MEAN | DATE | MAX | MIN | MEAN |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **5/1** | 14.4 | 12.4 | 13.4 | **7/1** | 22.2 | 18.7 | 20.2 | **9/1** | 18.1 | 16.6 | 17.4 |
| **5/2** | 14.4 | 12.1 | 13.1 | **7/2** | 22.4 | 19.2 | 20.6 | **9/2** | 19.6 | 17.2 | 18.1 |
| **5/3** | 14.9 | 12.6 | 13.5 | **7/3** | 23.4 | 19.7 | 21.3 | **9/3** | 19.8 | 16.9 | 18.2 |
| **5/4** | 15.3 | 13.0 | 14.1 | **7/4** | 23.9 | 20.4 | 21.8 | **9/4** | 19.5 | 16.8 | 18.0 |
| **5/5** | 14.7 | 13.5 | 14.0 | **7/5** | 23.1 | 20.1 | 21.4 | **9/5** | 19.1 | 16.5 | 17.7 |
| **5/6** | 14.0 | 13.1 | 13.4 | **7/6** | 22.3 | 18.9 | 20.5 | **9/6** | 18.6 | 15.8 | 17.1 |
| **5/7** | 13.0 | 12.1 | 12.4 | **7/7** | 21.8 | 18.2 | 20.0 | **9/7** | 18.5 | 15.6 | 16.9 |
| **5/8** | 12.9 | 11.9 | 12.3 | **7/8** | 21.5 | 17.8 | 19.6 | **9/8** | 18.5 | 15.6 | 16.9 |
| **5/9** | 15.1 | 12.4 | 13.4 | **7/9** | 21.4 | 17.6 | 19.4 | **9/9** | 18.8 | 15.9 | 17.2 |
| **5/10** | 16.4 | 13.8 | 14.8 | **7/10** | 21.4 | 17.6 | 19.4 | **9/10** | 19.2 | 16.0 | 17.5 |
| **5/11** | 17.0 | 15.0 | 15.8 | **7/11** | 21.1 | 17.3 | 19.1 | **9/11** | 18.8 | 16.6 | 17.7 |
| **5/12** | 17.8 | 15.6 | 16.5 | **7/12** | 20.8 | 17.0 | 18.8 | **9/12** | 19.2 | 16.5 | 17.7 |
| **5/13** | 17.6 | 15.4 | 16.4 | **7/13** | 20.7 | 17.0 | 18.8 | **9/13** | 19.6 | 16.8 | 18.1 |
| **5/14** | 17.9 | 15.4 | 16.5 | **7/14** | 20.7 | 16.8 | 18.7 | **9/14** | 19.8 | 17.2 | 18.4 |
| **5/15** | 17.4 | 15.7 | 16.5 | **7/15** | 20.8 | 17.2 | 18.9 | **9/15** | 19.2 | 16.9 | 18.0 |
| **5/16** | 16.4 | 15.3 | 15.9 | **7/16** | 20.8 | 17.3 | 19.0 | **9/16** | 18.2 | 15.8 | 17.0 |
| **5/17** | 16.0 | 14.5 | 15.1 | **7/17** | 20.7 | 16.9 | 18.7 | **9/17** | 17.7 | 15.5 | 16.6 |
| **5/18** | 15.5 | 13.4 | 14.3 | **7/18** | 20.9 | 17.0 | 18.8 | **9/18** | 16.8 | 14.7 | 15.8 |
| **5/19** | 15.7 | 13.3 | 14.4 | **7/19** | 21.2 | 17.4 | 19.2 | **9/19** | 16.6 | 14.1 | 15.2 |
| **5/20** | 16.0 | 13.4 | 14.6 | **7/20** | 22.1 | 18.2 | 20.0 | **9/20** | 16.2 | 13.9 | 15.1 |
| **5/21** | 16.1 | 14.1 | 14.9 | **7/21** | 23.0 | 19.2 | 20.9 | **9/21** | 15.5 | 14.2 | 14.9 |
| **5/22** | 15.0 | 13.1 | 14.1 | **7/22** | 23.0 | 19.7 | 21.3 | **9/22** | 14.8 | 13.0 | 13.9 |
| **5/23** | 14.1 | 12.1 | 13.1 | **7/23** | 22.7 | 19.5 | 21.1 | **9/23** | 15.3 | 12.8 | 13.9 |
| **5/24** | 14.1 | 11.7 | 12.8 | **7/24** | 22.9 | 19.8 | 21.3 | **9/24** | 15.3 | 13.5 | 14.3 |
| **5/25** | 14.5 | 12.0 | 13.1 | **7/25** | 23.5 | 20.1 | 21.7 | **9/25** | 14.8 | 12.9 | 13.8 |
| **5/26** | 15.1 | 12.5 | 13.7 | **7/26** | 23.8 | 20.5 | 22.0 | **9/26** | 13.6 | 11.6 | 12.7 |
| **5/27** | 14.2 | 13.0 | 13.5 | **7/27** | 23.4 | 20.2 | 21.8 | **9/27** | 13.2 | 11.0 | 12.1 |
| **5/28** | 14.3 | 12.7 | 13.4 | **7/28** | 23.1 | 19.9 | 21.5 | **9/28** | 13.4 | 11.2 | 12.2 |
| **5/29** | 15.2 | 13.1 | 14.0 | **7/29** | 21.8 | 19.5 | 20.6 | **9/29** | 12.7 | 11.7 | 12.2 |
| **5/30** | 15.8 | 13.2 | 14.4 | **7/30** | 21.1 | 18.1 | 19.6 | **9/30** | 13.5 | 12.7 | 13.0 |
| **5/31** | 16.2 | 13.2 | 14.6 | **7/31** | 20.8 | 17.7 | 19.2 | **10/1** | 14.8 | 12.7 | 13.6 |
| **6/1** | 17.0 | 14.1 | 15.4 | **8/1** | 20.2 | 17.0 | 18.6 | **10/2** | 14.3 | 12.4 | 13.3 |
| **6/2** | 17.9 | 14.9 | 16.2 | **8/2** | 20.0 | 16.7 | 18.2 | **10/3** | 13.1 | 11.4 | 12.3 |
| **6/3** | 18.4 | 15.6 | 16.9 | **8/3** | 20.0 | 16.7 | 18.2 | **10/4** | 12.6 | 10.6 | 11.5 |
| **6/4** | 19.9 | 16.2 | 17.8 | **8/4** | 20.0 | 16.5 | 18.1 | **10/5** | 12.2 | 10.1 | 11.1 |
| **6/5** | 20.5 | 16.7 | 18.4 | **8/5** | 20.0 | 16.7 | 18.2 | **10/6** | 12.3 | 10.2 | 11.2 |
| **6/6** | 21.4 | 17.4 | 19.2 | **8/6** | 19.9 | 16.6 | 18.1 | **10/7** | 11.9 | 10.2 | 11.1 |
| **6/7** | 21.9 | 18.0 | 19.7 | **8/7** | 19.9 | 16.9 | 18.2 | **10/8** | 12.0 | 10.1 | 11.0 |
| **6/8** | 22.4 | 18.3 | 20.2 | **8/8** | 19.7 | 16.7 | 18.0 | **10/9** | 11.9 | 10.0 | 10.9 |
| **6/9** | 22.4 | 18.9 | 20.5 | **8/9** | 19.2 | 16.2 | 17.6 | **10/10** | 11.9 | 10.1 | 10.9 |
| **6/10** | 20.8 | 18.2 | 19.0 | **8/10** | 19.2 | 16.0 | 17.5 | **10/11** | 11.9 | 10.1 | 10.9 |
| **6/11** | 20.0 | 16.7 | 18.1 | **8/11** | 19.4 | 16.1 | 17.5 | **10/12** | 11.8 | 10.1 | 10.9 |
| **6/12** | 19.7 | 16.0 | 17.7 | **8/12** | 19.3 | 16.1 | 17.6 | **10/13** | 11.7 | 10.0 | 10.8 |
| **6/13** | 19.2 | 15.7 | 17.3 | **8/13** | 19.4 | 16.2 | 17.6 | **10/14** | 11.4 | 9.7 | 10.5 |
| **6/14** | 19.0 | 15.2 | 17.0 | **8/14** | 19.5 | 16.1 | 17.6 | **10/15** | 11.5 | 9.7 | 10.4 |
| **6/15** | 19.1 | 15.2 | 17.1 | **8/15** | 19.6 | 16.1 | 17.7 | **10/16** | 10.8 | 9.2 | 10.1 |
| **6/16** | 19.4 | 15.4 | 17.3 | **8/16** | 19.8 | 16.4 | 18.0 | **10/17** | 11.1 | 9.3 | 10.2 |
| **6/17** | 19.6 | 15.8 | 17.6 | **8/17** | 19.8 | 16.7 | 18.1 | **10/18** | 11.3 | 9.5 | 10.3 |
| **6/18** | 19.1 | 16.0 | 17.4 | **8/18** | 20.4 | 17.1 | 18.5 | **10/19** | 11.5 | 9.7 | 10.5 |
| **6/19** | 18.7 | 15.6 | 17.1 | **8/19** | 19.9 | 18.1 | 19.0 | **10/20** | 11.6 | 9.9 | 10.6 |
| **6/20** | 18.3 | 14.7 | 16.4 | **8/20** | 21.1 | 18.6 | 19.6 | **10/21** | 11.6 | 9.9 | 10.7 |
| **6/21** | 18.6 | 14.7 | 16.5 | **8/21** | 21.4 | 18.8 | 19.9 | **10/22** | 11.8 | 10.1 | 10.8 |
| **6/22** | 19.0 | 14.8 | 16.8 | **8/22** | 21.0 | 18.5 | 19.6 | **10/23** | 11.4 | 9.8 | 10.5 |
| **6/23** | 18.2 | 15.7 | 16.9 | **8/23** | 20.3 | 17.6 | 18.8 | **10/24** | 11.2 | 9.5 | 10.3 |
| **6/24** | 17.4 | 16.1 | 16.6 | **8/24** | 19.7 | 17.1 | 18.3 | **10/25** | 11.0 | 9.3 | 10.1 |
| **6/25** | 16.0 | 14.5 | 15.2 | **8/25** | 19.8 | 17.0 | 18.2 | **10/26** | 10.8 | 9.2 | 10.0 |
| **6/26** | 17.9 | 14.5 | 15.8 | **8/26** | 19.5 | 16.7 | 18.0 | **10/27** | 10.7 | 9.2 | 9.9 |
| **6/27** | 20.1 | 15.6 | 17.5 | **8/27** | 19.2 | 16.5 | 17.8 | **10/28** | 9.9 | 9.0 | 9.3 |
| **6/28** | 21.3 | 17.0 | 18.9 | **8/28** | 19.2 | 16.2 | 17.5 | **10/29** | 9.3 | 8.7 | 9.0 |
| **6/29** | 22.1 | 18.2 | 20.0 | **8/29** | 19.1 | 16.1 | 17.5 | **10/30** | nd | nd | nd |
| **6/30** | 22.2 | 18.5 | 20.1 | **8/30** | 19.1 | 16.1 | 17.5 | **10/31** | nd | nd | nd |
| | | | | **8/31** | 19.1 | 16.0 | 17.5 | | | | |

nd = no data

APPENDIX F, Table 4. Butte Creek water temperatures (C) at Estates Pool for period May 1 through October 31, 2013.

| DATE | MAX | MIN | MEAN | DATE | MAX | MIN | MEAN | DATE | MAX | MIN | MEAN |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **5/1** | 15.3 | 12.2 | 13.7 | **7/1** | 22.9 | 19.0 | 20.9 | **9/1** | 19.1 | 17.2 | 18.2 |
| **5/2** | 15.4 | 11.9 | 13.6 | **7/2** | 23.1 | 19.6 | 21.3 | **9/2** | 20.3 | 17.7 | 18.8 |
| **5/3** | 16.0 | 12.4 | 14.1 | **7/3** | 24.1 | 20.1 | 22.0 | **9/3** | 20.5 | 17.2 | 18.8 |
| **5/4** | 16.6 | 13.0 | 14.7 | **7/4** | 24.3 | 20.8 | 22.6 | **9/4** | 20.2 | 16.8 | 18.5 |
| **5/5** | 15.9 | 13.3 | 14.5 | **7/5** | 23.5 | 20.3 | 21.9 | **9/5** | 19.8 | 17.2 | 17.2 |
| **5/6** | 14.3 | 12.8 | 13.6 | **7/6** | 22.9 | 19.1 | 21.0 | **9/6** | 19.4 | 16.0 | 17.8 |
| **5/7** | 13.0 | 11.8 | 12.4 | **7/7** | 22.4 | 18.4 | 20.4 | **9/7** | 19.2 | 15.8 | 17.5 |
| **5/8** | 13.5 | 11.9 | 12.5 | **7/8** | 22.1 | 18.1 | 20.0 | **9/8** | 19.3 | 15.9 | 17.6 |
| **5/9** | 16.4 | 12.5 | 14.2 | **7/9** | 22.0 | 18.0 | 19.9 | **9/9** | 19.7 | 16.1 | 17.9 |
| **5/10** | 17.8 | 13.9 | 15.7 | **7/10** | 22.2 | 18.0 | 20.0 | **9/10** | 19.8 | 16.3 | 18.1 |
| **5/11** | 18.3 | 15.1 | 16.7 | **7/11** | 21.7 | 17.6 | 19.6 | **9/11** | 19.5 | 16.8 | 18.2 |
| **5/12** | 19.2 | 15.8 | 17.3 | **7/12** | 21.3 | 17.1 | 19.2 | **9/12** | 19.8 | 16.7 | 18.2 |
| **5/13** | 18.9 | 15.3 | 17.0 | **7/13** | 21.4 | 17.2 | 19.2 | **9/13** | 20.2 | 17.1 | 18.6 |
| **5/14** | 19.2 | 15.4 | 17.2 | **7/14** | 21.3 | 17.2 | 19.1 | **9/14** | 20.5 | 17.5 | 19.0 |
| **5/15** | 18.5 | 15.7 | 17.1 | **7/15** | 21.6 | 17.6 | 19.4 | **9/15** | 19.7 | 17.1 | 18.4 |
| **5/16** | 17.3 | 15.4 | 16.3 | **7/16** | 21.5 | 17.5 | 19.3 | **9/16** | 19.0 | 15.8 | 17.5 |
| **5/17** | 17.0 | 14.3 | 15.4 | **7/17** | 21.3 | 17.0 | 19.1 | **9/17** | 18.4 | 15.8 | 17.1 |
| **5/18** | 16.4 | 13.1 | 14.6 | **7/18** | 21.7 | 19.0 | 19.5 | **9/18** | 17.6 | 15.0 | 16.3 |
| **5/19** | 16.7 | 13.0 | 14.7 | **7/19** | 22.0 | 17.8 | 19.8 | **9/19** | 17.6 | 14.3 | 15.9 |
| **5/20** | 17.1 | 13.3 | 15.1 | **7/20** | 22.9 | 18.7 | 20.7 | **9/20** | 17.2 | 14.4 | 15.8 |
| **5/21** | 17.2 | 14.1 | 15.4 | **7/21** | 23.7 | 19.7 | 21.6 | **9/21** | 16.3 | 14.6 | 15.5 |
| **5/22** | 15.4 | 12.4 | 13.9 | **7/22** | 23.7 | 20.2 | 21.9 | **9/22** | 15.7 | 13.5 | 14.5 |
| **5/23** | 14.7 | 11.5 | 13.0 | **7/23** | 23.4 | 19.9 | 21.7 | **9/23** | 16.2 | 13.2 | 14.6 |
| **5/24** | 14.6 | 11.1 | 12.8 | **7/24** | 23.9 | 20.3 | 22.1 | **9/24** | 16.2 | 14.0 | 15.1 |
| **5/25** | 15.3 | 11.6 | 13.3 | **7/25** | 30.7 | 18.8 | 22.7 | **9/25** | 15.7 | 13.3 | 14.5 |
| **5/26** | 15.9 | 12.3 | 14.0 | **7/26** | 24.6 | 20.9 | 22.6 | **9/26** | 14.6 | 12.0 | 13.3 |
| **5/27** | 14.0 | 12.9 | 13.4 | **7/27** | 24.2 | 20.6 | 22.4 | **9/27** | 14.1 | 11.4 | 12.8 |
| **5/28** | 15.2 | 12.7 | 13.7 | **7/28** | 23.9 | 20.1 | 22.0 | **9/28** | 14.4 | 11.7 | 13.0 |
| **5/29** | 16.2 | 13.1 | 14.4 | **7/29** | 22.4 | 19.5 | 21.0 | **9/29** | 13.3 | 12.3 | 12.8 |
| **5/30** | 16.6 | 13.1 | 14.7 | **7/30** | 21.8 | 18.1 | 20.0 | **9/30** | 14.4 | 13.2 | 13.6 |
| **5/31** | 17.2 | 13.1 | 15.0 | **7/31** | 21.7 | 18.0 | 19.7 | **10/1** | 15.5 | 13.0 | 14.1 |
| **6/1** | 18.1 | 14.1 | 16.0 | **8/1** | 21.2 | 17.2 | 19.1 | **10/2** | 15.1 | 12.8 | 13.9 |
| **6/2** | 19.0 | 15.1 | 16.9 | **8/2** | 20.8 | 16.9 | 18.8 | **10/3** | 13.9 | 11.6 | 12.9 |
| **6/3** | 19.7 | 15.7 | 17.6 | **8/3** | 20.8 | 17.0 | 18.8 | **10/4** | 13.4 | 10.9 | 12.1 |
| **6/4** | 20.2 | 16.3 | 18.2 | **8/4** | 20.9 | 16.8 | 18.8 | **10/5** | 13.1 | 10.7 | 12.0 |
| **6/5** | 20.7 | 16.9 | 18.7 | **8/5** | 20.9 | 16.9 | 18.8 | **10/6** | 13.0 | 10.6 | 11.9 |
| **6/6** | 21.5 | 17.7 | 19.5 | **8/6** | 20.7 | 16.8 | 18.7 | **10/7** | 12.7 | 10.5 | 11.7 |
| **6/7** | 22.0 | 18.3 | 20.1 | **8/7** | 20.7 | 17.1 | 18.9 | **10/8** | 12.6 | 10.4 | 11.5 |
| **6/8** | 22.7 | 18.7 | 20.6 | **8/8** | 20.4 | 16.8 | 18.6 | **10/9** | 12.5 | 10.3 | 11.5 |
| **6/9** | 22.8 | 19.2 | 20.9 | **8/9** | 20.1 | 16.4 | 18.2 | **10/10** | 12.6 | 10.4 | 11.5 |
| **6/10** | 20.5 | 18.0 | 19.1 | **8/10** | 20.0 | 16.3 | 18.1 | **10/11** | 12.6 | 10.4 | 11.5 |
| **6/11** | 20.0 | 16.5 | 18.1 | **8/11** | 20.3 | 16.3 | 18.3 | **10/12** | 12.5 | 10.4 | 11.5 |
| **6/12** | 19.9 | 16.2 | 17.9 | **8/12** | 20.2 | 16.5 | 18.3 | **10/13** | 12.4 | 10.3 | 11.5 |
| **6/13** | 19.2 | 15.8 | 17.4 | **8/13** | 20.3 | 16.5 | 18.4 | **10/14** | 12.2 | 10.1 | 11.1 |
| **6/14** | 19.1 | 15.4 | 17.1 | **8/14** | 20.5 | 16.4 | 18.4 | **10/15** | 12.2 | 10.1 | 11.1 |
| **6/15** | 19.4 | 15.5 | 17.3 | **8/15** | 20.4 | 16.4 | 18.4 | **10/16** | 11.6 | 9.7 | 10.7 |
| **6/16** | 19.7 | 15.7 | 17.6 | **8/16** | 20.7 | 16.7 | 18.7 | **10/17** | 11.8 | 9.6 | 10.7 |
| **6/17** | 19.8 | 16.1 | 17.9 | **8/17** | 20.6 | 17 | 18.8 | **10/18** | 11.9 | 9.6 | 10.7 |
| **6/18** | 19.2 | 16.2 | 17.6 | **8/18** | 21.2 | 17.3 | 19.2 | **10/19** | 12.1 | 9.8 | 11.0 |
| **6/19** | 18.8 | 15.6 | 17.1 | **8/19** | 20.5 | 18.5 | 19.6 | **10/20** | 12.2 | 10.0 | 11.1 |
| **6/20** | 18.6 | 14.8 | 16.6 | **8/20** | 21.8 | 19 | 20.2 | **10/21** | 12.1 | 10.1 | 11.1 |
| **6/21** | 18.9 | 15.0 | 16.8 | **8/21** | 22.2 | 19 | 20.5 | **10/22** | 12.3 | 10.1 | 11.2 |
| **6/22** | 19.3 | 15.2 | 17.2 | **8/22** | 21.7 | 18.6 | 20.1 | **10/23** | 12.0 | 9.9 | 11.0 |
| **6/23** | 18.6 | 16.1 | 17.2 | **8/23** | 21.1 | 17.5 | 19.3 | **10/24** | 10.8 | 9.7 | 10.2 |
| **6/24** | 17.4 | 16.0 | 16.7 | **8/24** | 20.5 | 17.2 | 18.9 | **10/25** | nd | nd | nd |
| **6/25** | 15.9 | 15.0 | 15.5 | **8/25** | 20.6 | 17.2 | 18.8 | **10/26** | nd | nd | nd |
| **6/26** | 18.4 | 14.8 | 16.3 | **8/26** | 20.3 | 16.9 | 18.6 | **10/27** | nd | nd | nd |
| **6/27** | 20.2 | 16.1 | 18.0 | **8/27** | 20.1 | 16.6 | 18.3 | **10/28** | nd | nd | nd |
| **6/28** | 21.7 | 17.4 | 19.4 | **8/28** | 20.0 | 16.4 | 18.2 | **10/29** | nd | nd | nd |
| **6/29** | 22.6 | 18.7 | 20.5 | **8/29** | 20.0 | 16.4 | 18.2 | **10/30** | nd | nd | nd |
| **6/30** | 22.8 | 18.7 | 20.7 | **8/30** | 20.0 | 16.4 | 18.2 | **10/31** | nd | nd | nd |
| | | | | **8/31** | 20.0 | 16.3 | 18.2 | | | | |

nd = no data

APPENDIX F, Table 5. Butte Creek water temperatures (C) at Cable Bridge for period May 1 through October 31, 2012.

| DATE | MAX | MIN | MEAN | DATE | MAX | MIN | MEAN | DATE | MAX | MIN | MEAN |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **5/1** | 16.8 | 12.7 | 14.4 | **7/1** | nd | nd | nd | **9/1** | nd | nd | nd |
| **5/2** | 17.0 | 12.5 | 14.5 | **7/2** | nd | nd | nd | **9/2** | nd | nd | nd |
| **5/3** | 17.4 | 13.0 | 14.9 | **7/3** | nd | nd | nd | **9/3** | nd | nd | nd |
| **5/4** | 18.1 | 13.5 | 15.4 | **7/4** | nd | nd | nd | **9/4** | nd | nd | nd |
| **5/5** | 16.9 | 13.9 | 15.2 | **7/5** | nd | nd | nd | **9/5** | nd | nd | nd |
| **5/6** | 15.1 | 13.8 | 14.3 | **7/6** | nd | nd | nd | **9/6** | nd | nd | nd |
| **5/7** | 13.8 | 12.4 | 13.1 | **7/7** | nd | nd | nd | **9/7** | nd | nd | nd |
| **5/8** | 14.4 | 12.4 | 13.2 | **7/8** | nd | nd | nd | **9/8** | nd | nd | nd |
| **5/9** | 17.5 | 12.7 | 14.7 | **7/9** | nd | nd | nd | **9/9** | nd | nd | nd |
| **5/10** | 19.1 | 14.2 | 16.3 | **7/10** | nd | nd | nd | **9/10** | nd | nd | nd |
| **5/11** | 19.6 | 15.6 | 17.4 | **7/11** | nd | nd | nd | **9/11** | nd | nd | nd |
| **5/12** | 20.6 | 16.3 | 18.1 | **7/12** | nd | nd | nd | **9/12** | nd | nd | nd |
| **5/13** | 20.4 | 15.8 | 17.8 | **7/13** | nd | nd | nd | **9/13** | nd | nd | nd |
| **5/14** | 20.7 | 16.0 | 18.0 | **7/14** | nd | nd | nd | **9/14** | nd | nd | nd |
| **5/15** | 19.7 | 16.3 | 17.8 | **7/15** | nd | nd | nd | **9/15** | nd | nd | nd |
| **5/16** | 17.8 | 16.2 | 16.9 | **7/16** | nd | nd | nd | **9/16** | nd | nd | nd |
| **5/17** | 18.2 | 14.7 | 16.1 | **7/17** | nd | nd | nd | **9/17** | nd | nd | nd |
| **5/18** | 17.7 | 13.4 | 15.4 | **7/18** | nd | nd | nd | **9/18** | nd | nd | nd |
| **5/19** | 17.9 | 13.4 | 15.4 | **7/19** | nd | nd | nd | **9/19** | nd | nd | nd |
| **5/20** | 18.3 | 13.7 | 15.8 | **7/20** | nd | nd | nd | **9/20** | nd | nd | nd |
| **5/21** | 18.3 | 14.5 | 16.1 | **7/21** | nd | nd | nd | **9/21** | nd | nd | nd |
| **5/22** | 16.5 | 12.8 | 14.6 | **7/22** | nd | nd | nd | **9/22** | nd | nd | nd |
| **5/23** | 16.0 | 12.0 | 13.7 | **7/23** | nd | nd | nd | **9/23** | nd | nd | nd |
| **5/24** | 16.0 | 11.6 | 13.6 | **7/24** | nd | nd | nd | **9/24** | nd | nd | nd |
| **5/25** | 16.4 | 12.1 | 14.0 | **7/25** | nd | nd | nd | **9/25** | nd | nd | nd |
| **5/26** | 17.1 | 12.8 | 14.6 | **7/26** | nd | nd | nd | **9/26** | nd | nd | nd |
| **5/27** | 14.9 | 13.4 | 14.0 | **7/27** | nd | nd | nd | **9/27** | nd | nd | nd |
| **5/28** | 15.8 | 13.1 | 14.3 | **7/28** | nd | nd | nd | **9/28** | nd | nd | nd |
| **5/29** | 17.6 | 13.5 | 15.1 | **7/29** | nd | nd | nd | **9/29** | nd | nd | nd |
| **5/30** | 17.9 | 13.5 | 15.4 | **7/30** | nd | nd | nd | **9/30** | nd | nd | nd |
| **5/31** | 18.4 | 13.6 | 15.8 | **7/31** | nd | nd | nd | **10/1** | nd | nd | nd |
| **6/1** | 19.5 | 14.6 | 16.7 | **8/1** | nd | nd | nd | **10/2** | nd | nd | nd |
| **6/2** | 20.4 | 15.6 | 17.7 | **8/2** | nd | nd | nd | **10/3** | nd | nd | nd |
| **6/3** | 21.2 | 16.3 | 18.4 | **8/3** | nd | nd | nd | **10/4** | nd | nd | nd |
| **6/4** | 21.5 | 17.0 | 19.0 | **8/4** | nd | nd | nd | **10/5** | nd | nd | nd |
| **6/5** | 22.1 | 17.5 | 19.5 | **8/5** | nd | nd | nd | **10/6** | nd | nd | nd |
| **6/6** | 20.0 | 18.3 | 18.9 | **8/6** | nd | nd | nd | **10/7** | nd | nd | nd |
| **6/7** | nd | nd | nd | **8/7** | nd | nd | nd | **10/8** | nd | nd | nd |
| **6/8** | nd | nd | nd | **8/8** | nd | nd | nd | **10/9** | nd | nd | nd |
| **6/9** | nd | nd | nd | **8/9** | nd | nd | nd | **10/10** | nd | nd | nd |
| **6/10** | nd | nd | nd | **8/10** | nd | nd | nd | **10/11** | nd | nd | nd |
| **6/11** | nd | nd | nd | **8/11** | nd | nd | nd | **10/12** | nd | nd | nd |
| **6/12** | nd | nd | nd | **8/12** | nd | nd | nd | **10/13** | nd | nd | nd |
| **6/13** | nd | nd | nd | **8/13** | nd | nd | nd | **10/14** | nd | nd | nd |
| **6/14** | nd | nd | nd | **8/14** | nd | nd | nd | **10/15** | nd | nd | nd |
| **6/15** | nd | nd | nd | **8/15** | nd | nd | nd | **10/16** | nd | nd | nd |
| **6/16** | nd | nd | nd | **8/16** | nd | nd | nd | **10/17** | nd | nd | nd |
| **6/17** | nd | nd | nd | **8/17** | nd | nd | nd | **10/18** | nd | nd | nd |
| **6/18** | nd | nd | nd | **8/18** | nd | nd | nd | **10/19** | nd | nd | nd |
| **6/19** | nd | nd | nd | **8/19** | nd | nd | nd | **10/20** | nd | nd | nd |
| **6/20** | nd | nd | nd | **8/20** | nd | nd | nd | **10/21** | nd | nd | nd |
| **6/21** | nd | nd | nd | **8/21** | nd | nd | nd | **10/22** | nd | nd | nd |
| **6/22** | nd | nd | nd | **8/22** | nd | nd | nd | **10/23** | nd | nd | nd |
| **6/23** | nd | nd | nd | **8/23** | nd | nd | nd | **10/24** | nd | nd | nd |
| **6/24** | nd | nd | nd | **8/24** | nd | nd | nd | **10/25** | nd | nd | nd |
| **6/25** | nd | nd | nd | **8/25** | nd | nd | nd | **10/26** | nd | nd | nd |
| **6/26** | nd | nd | nd | **8/26** | nd | nd | nd | **10/27** | nd | nd | nd |
| **6/27** | nd | nd | nd | **8/27** | nd | nd | nd | **10/28** | nd | nd | nd |
| **6/28** | nd | nd | nd | **8/28** | nd | nd | nd | **10/29** | nd | nd | nd |
| **6/29** | nd | nd | nd | **8/29** | nd | nd | nd | **10/30** | nd | nd | nd |
| **6/30** | nd | nd | nd | **8/30** | nd | nd | nd | **10/31** | nd | nd | nd |
| | | | | **8/31** | nd | nd | nd | | | | |

nd= no data

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, 2013.

| DATE | MAX | MIN | MEAN | DATE | MAX | MIN | MEAN | DATE | MAX | MIN | MEAN |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **5/1** | 17.2 | 12.8 | 14.9 | **7/1** | 24.8 | 20.3 | 22.5 | **9/1** | 20.7 | 18.6 | 19.7 |
| **5/2** | 17.4 | 12.8 | 15.0 | **7/2** | 25.1 | 21.1 | 23.1 | **9/2** | 22.2 | 19.0 | 20.4 |
| **5/3** | 17.7 | 13.2 | 15.3 | **7/3** | 26.1 | 21.4 | 23.7 | **9/3** | 22.0 | 18.4 | 20.2 |
| **5/4** | 18.3 | 13.7 | 15.8 | **7/4** | 26.3 | 22.2 | 24.1 | **9/4** | 21.6 | 17.9 | 19.8 |
| **5/5** | 17.0 | 14.1 | 15.5 | **7/5** | 25.4 | 21.8 | 23.5 | **9/5** | 21.3 | 17.6 | 19.4 |
| **5/6** | 15.2 | 13.8 | 14.4 | **7/6** | 24.7 | 20.7 | 22.7 | **9/6** | 21.1 | 17.2 | 19.2 |
| **5/7** | 14.6 | 12.6 | 13.5 | **7/7** | 24.4 | 20.2 | 22.3 | **9/7** | 21.0 | 17.1 | 19.1 |
| **5/8** | 14.7 | 12.7 | 13.6 | **7/8** | 24.1 | 19.6 | 21.9 | **9/8** | 21.0 | 17.2 | 19.2 |
| **5/9** | 17.9 | 13.0 | 15.3 | **7/9** | 24.0 | 19.3 | 21.6 | **9/9** | 21.3 | 17.5 | 19.4 |
| **5/10** | 19.5 | 14.6 | 16.9 | **7/10** | 24.1 | 19.6 | 21.9 | **9/10** | 21.3 | 17.7 | 19.6 |
| **5/11** | 20.1 | 15.9 | 17.9 | **7/11** | 23.6 | 19.3 | 21.4 | **9/11** | 21.1 | 18.2 | 19.6 |
| **5/12** | 20.9 | 16.6 | 18.5 | **7/12** | 23.1 | 18.5 | 20.9 | **9/12** | 21.1 | 17.7 | 19.5 |
| **5/13** | 20.6 | 16.1 | 18.2 | **7/13** | 23.3 | 18.7 | 21.0 | **9/13** | 21.6 | 18.1 | 19.9 |
| **5/14** | 20.9 | 16.2 | 18.5 | **7/14** | 23.4 | 18.6 | 21.0 | **9/14** | 21.8 | 18.5 | 20.2 |
| **5/15** | 20.0 | 16.7 | 18.3 | **7/15** | 23.3 | 18.9 | 21.1 | **9/15** | 21.2 | 18.2 | 19.7 |
| **5/16** | 18.4 | 16.6 | 17.3 | **7/16** | 23.0 | 18.9 | 20.9 | **9/16** | 20.3 | 16.9 | 18.7 |
| **5/17** | 18.7 | 15.1 | 16.7 | **7/17** | 23.0 | 18.3 | 20.7 | **9/17** | 20.1 | 17.3 | 18.6 |
| **5/18** | 18.3 | 13.9 | 16.0 | **7/18** | 23.4 | 18.5 | 21.1 | **9/18** | 19.2 | 16.0 | 17.7 |
| **5/19** | 18.4 | 13.7 | 16.0 | **7/19** | 23.7 | 19.0 | 21.4 | **9/19** | 19.1 | 15.3 | 17.2 |
| **5/20** | 18.9 | 14.1 | 16.4 | **7/20** | 24.5 | 19.9 | 22.3 | **9/20** | 18.8 | 15.3 | 17.2 |
| **5/21** | 18.9 | 14.9 | 16.6 | **7/21** | 25.3 | 20.9 | 23.1 | **9/21** | 17.6 | 15.6 | 16.7 |
| **5/22** | 17.1 | 13.3 | 15.0 | **7/22** | 25.2 | 21.3 | 23.3 | **9/22** | 17.3 | 14.2 | 15.8 |
| **5/23** | 16.6 | 12.3 | 14.3 | **7/23** | 24.9 | 21.1 | 23.1 | **9/23** | 17.9 | 14.3 | 16.1 |
| **5/24** | 16.6 | 12.1 | 14.2 | **7/24** | 25.7 | 21.7 | 23.6 | **9/24** | 17.9 | 15.4 | 16.6 |
| **5/25** | 16.9 | 12.4 | 14.6 | **7/25** | 26.1 | 21.9 | 24.0 | **9/25** | 17.1 | 14.3 | 15.7 |
| **5/26** | 17.6 | 13.1 | 15.2 | **7/26** | 26.3 | 22.4 | 24.3 | **9/26** | 16.1 | 12.9 | 14.6 |
| **5/27** | 15.2 | 13.6 | 14.4 | **7/27** | 25.9 | 22.2 | 24.1 | **9/27** | 15.7 | 12.4 | 14.2 |
| **5/28** | 16.9 | 13.4 | 14.9 | **7/28** | 25.6 | 21.8 | 23.7 | **9/28** | 15.8 | 12.8 | 14.4 |
| **5/29** | 18.1 | 13.9 | 15.8 | **7/29** | 24.0 | 21.2 | 22.6 | **9/29** | 14.8 | 13.8 | 14.3 |
| **5/30** | 18.4 | 13.8 | 16.0 | **7/30** | 23.3 | 19.7 | 21.6 | **9/30** | nd | nd | nd |
| **5/31** | 19.0 | 13.8 | 16.3 | **7/31** | 23.6 | 19.6 | 21.5 | | | | |
| **6/1** | 19.9 | 14.8 | 17.2 | **8/1** | 22.7 | 18.9 | 20.9 | | | | |
| **6/2** | 20.8 | 15.8 | 18.2 | **8/2** | 22.6 | 18.3 | 20.5 | | | | |
| **6/3** | 21.4 | 16.5 | 18.9 | **8/3** | 22.6 | 18.3 | 20.4 | | | | |
| **6/4** | 21.8 | 17.4 | 19.5 | **8/4** | 22.4 | 18.2 | 20.4 | | | | |
| **6/5** | 22.2 | 17.7 | 19.9 | **8/5** | 22.4 | 18.3 | 20.4 | | | | |
| **6/6** | 23.1 | 18.4 | 20.7 | **8/6** | 22.3 | 18.1 | 20.2 | | | | |
| **6/7** | 24.1 | 19.3 | 21.5 | **8/7** | 22.2 | 18.6 | 20.4 | | | | |
| **6/8** | 24.6 | 19.6 | 22.1 | **8/8** | 21.9 | 18.2 | 20.1 | | | | |
| **6/9** | 24.3 | 20.4 | 22.3 | **8/9** | 21.7 | 17.8 | 19.8 | | | | |
| **6/10** | 21.5 | 18.7 | 19.9 | **8/10** | 21.7 | 17.8 | 19.8 | | | | |
| **6/11** | 22.0 | 17.3 | 19.5 | **8/11** | 22.0 | 17.9 | 20.0 | | | | |
| **6/12** | 21.9 | 17.3 | 19.5 | **8/12** | 21.9 | 18.0 | 20.0 | | | | |
| **6/13** | 21.3 | 16.9 | 19.0 | **8/13** | 22.2 | 18.0 | 20.1 | | | | |
| **6/14** | 21.2 | 16.4 | 18.7 | **8/14** | 22.1 | 17.9 | 20.1 | | | | |
| **6/15** | 21.4 | 16.7 | 19.0 | **8/15** | 22.1 | 18.0 | 20.1 | | | | |
| **6/16** | 21.6 | 16.8 | 19.2 | **8/16** | 22.4 | 18.2 | 20.4 | | | | |
| **6/17** | 21.8 | 17.2 | 19.5 | **8/17** | 22.3 | 18.6 | 20.5 | | | | |
| **6/18** | 20.9 | 17.6 | 19.2 | **8/18** | 22.7 | 18.8 | 20.9 | | | | |
| **6/19** | 20.8 | 16.8 | 18.7 | **8/19** | 22.0 | 19.8 | 21.0 | | | | |
| **6/20** | 20.6 | 16.1 | 18.3 | **8/20** | 23.3 | 20.2 | 21.6 | | | | |
| **6/21** | 20.9 | 16.1 | 18.5 | **8/21** | 23.6 | 20.4 | 21.9 | | | | |
| **6/22** | 21.3 | 16.2 | 18.8 | **8/22** | 23.2 | 19.9 | 21.5 | | | | |
| **6/23** | 19.7 | 17.1 | 18.4 | **8/23** | 22.4 | 18.7 | 20.7 | | | | |
| **6/24** | 18.4 | 17.0 | 17.8 | **8/24** | 22.1 | 18.6 | 20.4 | | | | |
| **6/25** | 17.0 | 16.2 | 16.6 | **8/25** | 22.2 | 18.6 | 20.4 | | | | |
| **6/26** | 20.6 | 15.7 | 17.9 | **8/26** | 21.9 | 18.3 | 20.1 | | | | |
| **6/27** | 22.2 | 17.0 | 19.5 | **8/27** | 21.6 | 17.6 | 19.7 | | | | |
| **6/28** | 23.5 | 18.3 | 20.8 | **8/28** | 21.6 | 17.8 | 19.7 | | | | |
| **6/29** | 24.6 | 19.8 | 22.1 | **8/29** | 21.8 | 17.7 | 19.8 | | | | |
| **6/30** | 24.7 | 20.0 | 22.3 | **8/30** | 21.8 | 17.7 | 19.8 | | | | |
| | | | | **8/31** | 21.9 | 17.9 | 19.9 | | | | |

# APPENDIX G

**TABLE 1**
**FLOWS AT KEY SITES WITHIN**
**PG&E DESABLA-CENTERVILLE PROJECT (FERC 803)**
**JUNE 1 - SEPTEMBER 30, 2013**

APPENDIX G, Table 1. Mean daily flows (cfs) at key sites affecting Butte Creek SRCS for period June 1 through September 30, 2013.

| 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** | 69.7 | 64.7 | 52.4 | 109 | nd | 65.5 | 0.0 | nd | 159.5 |
| **6/2** | 68.3 | 62.9 | 51.4 | 107 | nd | 65.4 | 0.0 | nd | 154.4 |
| **6/3** | 66.4 | 61.4 | 50.3 | 104 | nd | 65.9 | 0.0 | nd | 148.3 |
| **6/4** | 64.7 | 59.7 | 49.2 | 102 | nd | 66.1 | 0.0 | nd | 143.3 |
| **6/5** | 63.0 | 58.7 | 49.8 | 101 | nd | 63.2 | 0.0 | nd | 141.3 |
| **6/6** | 61.4 | 57.3 | 51.9 | 101 | nd | 60.2 | 0.0 | nd | 134.7 |
| **6/7** | 59.2 | 55.6 | 51.2 | 98.3 | nd | 60.3 | 0.0 | nd | 127.7 |
| **6/8** | 53.2 | 50.6 | 50.3 | 93.2 | nd | 59.9 | 0.0 | nd | 119.0 |
| **6/9** | 50.6 | 47.2 | 49.4 | 88.5 | nd | 60.1 | 0.0 | nd | 106.8 |
| **6/10** | 52.2 | 48.3 | 51.3 | 91.2 | nd | 60.0 | 0.0 | nd | 113.0 |
| **6/11** | 51.9 | 52.4 | 53.4 | 94.3 | nd | 60.1 | 0.0 | nd | 127.7 |
| **6/12** | 50.2 | 52.8 | 50.5 | 88.8 | nd | 60.0 | 0.0 | nd | 115.9 |
| **6/13** | 49.3 | 51.7 | 49.3 | 86.6 | nd | 58.5 | 0.0 | nd | 122.8 |
| **6/14** | 48.5 | 50.9 | 48.6 | 84.8 | nd | 57.2 | 0.0 | nd | 116.8 |
| **6/15** | 47.9 | 48.6 | 48.0 | 83.4 | nd | 57.2 | 0.0 | nd | 114.9 |
| **6/16** | 47.4 | 47.4 | 47.4 | 82.6 | nd | 56.7 | 0.0 | nd | 112.5 |
| **6/17** | 47.1 | 46.8 | 46.9 | 81.6 | nd | 56.4 | 0.0 | nd | 109.6 |
| **6/18** | 47.2 | 46.3 | 47.4 | 81.9 | nd | 56.6 | 0.0 | nd | 110.5 |
| **6/19** | 47.5 | 47.8 | 49.6 | 85.9 | nd | 57.3 | 0.0 | nd | 115.6 |
| **6/20** | 46.9 | 45.6 | 47.6 | 83.9 | nd | 56.7 | 0.0 | nd | 113.1 |
| **6/21** | 46.3 | 44.8 | 46.7 | 82.5 | nd | 56.3 | 0.0 | nd | 108.9 |
| **6/22** | 45.5 | 44.4 | 46.1 | 80.9 | nd | 56.0 | 0.0 | nd | 104.1 |
| **6/23** | 45.6 | 44.0 | 46.0 | 80.9 | nd | 56.3 | 0.0 | nd | 103.8 |
| **6/24** | 48.3 | 47.4 | 47.9 | 84.9 | nd | 56.8 | 0.0 | nd | 113.4 |
| **6/25** | 72.7 | 72.2 | 51.1 | 112 | nd | 128.6 | 0.0 | nd | 213.3 |
| **6/26** | 68.0 | 68.7 | 43.5 | 101 | nd | 97.6 | 0.0 | nd | 223.3 |
| **6/27** | 55.5 | 57.4 | 42.8 | 89.6 | nd | 61.9 | 0.0 | nd | 163.8 |
| **6/28** | 51.6 | 52.0 | 43.5 | 83.2 | nd | 58.2 | 0.0 | nd | 138.0 |
| **6/29** | 68.8 | 65.0 | 43.7 | 96.2 | nd | 74.0 | 0.0 | nd | 136.0 |
| **6/30** | 69.3 | 65.2 | 43.7 | 97.6 | nd | 82.9 | 0.0 | nd | 139.2 |
| **7/1** | 71.3 | 67.0 | 43.6 | 99.2 | nd | 90.1 | 0.0 | nd | 139.2 |
| **7/2** | 70.9 | 66.8 | 43.4 | 98.6 | nd | 87.6 | 0.0 | nd | 136.5 |
| **7/3** | 70.6 | 66.9 | 43.3 | 98.0 | nd | 83.2 | 0.0 | nd | 132.2 |
| **7/4** | 70.9 | 66.7 | 43.3 | 98.3 | nd | 83.5 | 0.0 | nd | 131.2 |
| **7/5** | 66.3 | 63.5 | 43.2 | 95.7 | nd | 83.5 | 0.0 | nd | 129.0 |
| **7/6** | 54.1 | 52.8 | 43.1 | 85.0 | nd | 74.6 | 0.0 | nd | 110.7 |
| **7/7** | 46.7 | 42.5 | 43.0 | 76.0 | nd | 63.4 | 0.0 | nd | 94.0 |
| **7/8** | 46.1 | 41.5 | 42.7 | 75.3 | nd | 59.7 | 0.0 | nd | 88.8 |
| **7/9** | 45.5 | 40.6 | 42.4 | 74.1 | nd | 60.2 | 0.0 | nd | 90.0 |
| **7/10** | 45.2 | 40.3 | 42.2 | 74.0 | nd | 60.3 | 0.0 | nd | 108.3 |
| **7/11** | 44.9 | 39.4 | 42.0 | 73.3 | nd | 60.0 | 0.0 | nd | 107.0 |
| **7/12** | 44.7 | 38.3 | 41.8 | 72.8 | nd | 60.4 | 0.0 | nd | 106.8 |
| **7/13** | 44.3 | 37.8 | 41.6 | 72.0 | nd | 60.2 | 0.0 | nd | 105.5 |
| **7/14** | 44.0 | 37.1 | 41.3 | 71.3 | nd | 59.8 | 0.0 | nd | 103.3 |
| **7/15** | 43.8 | 36.4 | 41.0 | 70.8 | nd | 59.6 | 0.0 | nd | 102.7 |
| **7/16** | 43.4 | 35.8 | 40.8 | 69.7 | nd | 60.0 | 0.0 | nd | 102.2 |
| **7/17** | 43.1 | 35.0 | 40.5 | 69.2 | nd | 59.1 | 0.0 | nd | 100.2 |
| **7/18** | 46.2 | 38.4 | 40.4 | 70.7 | nd | 60.3 | 0.0 | nd | 100.0 |
| **7/19** | 52.1 | 49.4 | 40.1 | 77.7 | nd | 62.5 | 0.0 | nd | 112.0 |
| **7/20** | 51.8 | 49.2 | 39.8 | 77.1 | nd | 64.0 | 0.0 | nd | 112.0 |
| **7/21** | 48.8 | 46.3 | 39.4 | 74.8 | nd | 64.2 | 0.0 | nd | 111.5 |
| **7/22** | 41.8 | 34.2 | 39.1 | 66.8 | nd | 61.3 | 0.0 | nd | 98.3 |
| **7/23** | 41.5 | 34.4 | 38.9 | 66.1 | nd | 60.1 | 0.0 | nd | 106.5 |
| **7/24** | 41.8 | 34.6 | 39.4 | 66.2 | nd | 61.1 | 0.0 | nd | 106.2 |
| **7/25** | 41.5 | 34.0 | 39.0 | 66.2 | nd | 59.5 | 0.0 | nd | 106.3 |
| **7/26** | 50.9 | 47.2 | 38.5 | 71.5 | nd | 62.3 | 0.0 | nd | 109.1 |
| **7/27** | 50.9 | 49.4 | 38.2 | 73.7 | nd | 64.3 | 0.0 | nd | 112.4 |
| **7/28** | 50.8 | 49.3 | 38.2 | 74.6 | nd | 64.4 | 0.0 | nd | 113.3 |
| **7/29** | 50.5 | 49.2 | 38.0 | 74.4 | nd | 64.6 | 0.0 | nd | 113.8 |
| **7/30** | 50.2 | 48.8 | 37.8 | 73.1 | nd | 63.7 | 0.0 | nd | 112.4 |
| **7/31** | 52.8 | 50.0 | 37.7 | 73.7 | nd | 64.5 | 0.0 | nd | 111.3 |

APPENDIX G, Table 1 (Continued). Mean daily flows (cfs) at key sites affecting Butte Creek SRCS for period June 1 through September 30, 2013.

| 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 | 60.2 | 57.6 | 37.8 | 81.1 | nd | 71.1 | 0.0 | nd | 116.8 |
| 8/2 | 60.3 | 57.5 | 38.1 | 81.8 | nd | 74.3 | 0.0 | nd | 120.4 |
| 8/3 | 60.0 | 57.3 | 38.0 | 82.4 | nd | 75.1 | 0.0 | nd | 119.9 |
| 8/4 | 59.7 | 56.9 | 37.7 | 81.5 | nd | 74.7 | 0.0 | nd | 118.8 |
| 8/5 | 59.2 | 56.8 | 37.5 | 80.9 | nd | 74.7 | 0.0 | nd | 118.9 |
| 8/6 | 59.0 | 55.9 | 37.4 | 80.3 | nd | 73.8 | 0.0 | nd | 117.4 |
| 8/7 | 58.9 | 54.7 | 37.3 | 80.1 | nd | 74.4 | 0.0 | nd | 119.3 |
| 8/8 | 55.9 | 53.1 | 37.4 | 78.8 | nd | 74.2 | 0.0 | nd | 118.8 |
| 8/9 | 49.6 | 45.4 | 37.6 | 71.8 | nd | 73.2 | 0.0 | nd | 113.8 |
| 8/10 | 49.3 | 45.0 | 37.7 | 72.2 | nd | 71.7 | 0.0 | nd | 113.2 |
| 8/11 | 49.1 | 44.6 | 37.6 | 71.5 | nd | 71.3 | 0.0 | nd | 112.5 |
| 8/12 | 48.8 | 44.3 | 37.3 | 69.5 | nd | 71.5 | 0.0 | nd | 110.2 |
| 8/13 | 48.4 | 43.6 | 37.2 | 70.7 | nd | 71.7 | 0.0 | nd | 110.6 |
| 8/14 | 48.2 | 42.9 | 36.9 | 69.6 | nd | 72.1 | 0.0 | nd | 109.8 |
| 8/15 | 48.0 | 42.1 | 36.7 | 68.9 | nd | 71.4 | 0.0 | nd | 107.6 |
| 8/16 | 51.0 | 44.1 | 36.5 | 71.7 | nd | 71.3 | 0.0 | nd | 109.1 |
| 8/17 | 56.9 | 53.4 | 36.5 | 76.5 | nd | 73.0 | 0.0 | nd | 114.6 |
| 8/18 | 56.9 | 53.4 | 36.6 | 77.0 | nd | 75.5 | 0.0 | nd | 114.5 |
| 8/19 | 56.7 | 53.5 | 36.4 | 78.6 | nd | 75.9 | 0.0 | nd | 117.8 |
| 8/20 | 57.2 | 54.0 | 37.3 | 77.0 | nd | 75.2 | 0.0 | nd | 115.7 |
| 8/21 | 56.8 | 53.8 | 36.9 | 78.1 | nd | 75.5 | 0.0 | nd | 117.3 |
| 8/22 | 56.1 | 52.9 | 36.3 | 77.0 | nd | 75.5 | 0.0 | nd | 115.6 |
| 8/23 | 56.0 | 53.0 | 36.3 | 76.2 | nd | 75.9 | 0.0 | nd | 114.6 |
| 8/24 | 56.0 | 53.1 | 36.5 | 76.2 | nd | 75.7 | 0.0 | nd | 114.4 |
| 8/25 | 56.0 | 53.2 | 36.6 | 76.8 | nd | 74.7 | 0.0 | nd | 115.0 |
| 8/26 | 55.9 | 53.2 | 30.9 | 68.8 | nd | 71.1 | 0.0 | nd | 110.9 |
| 8/27 | 55.5 | 51.5 | 37.2 | 74.5 | nd | 75.4 | 0.0 | nd | 118.4 |
| 8/28 | 55.4 | 45.0 | 37.1 | 70.5 | nd | 72.7 | 0.0 | nd | 110.7 |
| 8/29 | 55.2 | 36.5 | 36.9 | 64.7 | nd | 70.8 | 0.0 | nd | 104.8 |
| 8/30 | 55.0 | 36.6 | 36.8 | 63.9 | nd | 70.7 | 0.0 | nd | 102.6 |
| 8/31 | 54.8 | 38.9 | 36.6 | 57.8 | nd | 70.4 | 0.0 | nd | 104.8 |
| 9/1 | 55.7 | 40.2 | 36.6 | 63.0 | nd | 70.5 | 0.0 | nd | 105.7 |
| 9/2 | 56.1 | 42.0 | 37.4 | 68.7 | nd | 71.2 | 0.0 | nd | 109.0 |
| 9/3 | 55.7 | 44.0 | 37.0 | 67.8 | nd | 70.6 | 0.0 | nd | 108.3 |
| 9/4 | 55.3 | 40.1 | 36.9 | 66.0 | nd | 70.3 | 0.0 | nd | 107.0 |
| 9/5 | 54.9 | 35.7 | 36.6 | 62.8 | nd | 71.0 | 0.0 | nd | 104.2 |
| 9/6 | 54.4 | 37.0 | 36.5 | 62.9 | nd | 67.5 | 0.0 | nd | 102.5 |
| 9/7 | 54.2 | 48.5 | 36.3 | 70.3 | nd | 66.0 | 0.0 | nd | 106.1 |
| 9/8 | 54.1 | 51.8 | 35.7 | 73.0 | nd | 70.8 | 0.0 | nd | 112.1 |
| 9/9 | 53.8 | 51.5 | 35.6 | 71.3 | nd | 69.9 | 0.0 | nd | 109.3 |
| 9/10 | 53.5 | 51.2 | 35.3 | 72.3 | nd | 64.9 | 0.0 | nd | 109.7 |
| 9/11 | 53.4 | 51.1 | 35.2 | 70.6 | nd | 64.9 | 0.0 | nd | 110.8 |
| 9/12 | 53.4 | 51.5 | 35.5 | 71.4 | nd | 64.7 | 0.0 | nd | 110.0 |
| 9/13 | 53.1 | 50.6 | 35.6 | 71.9 | nd | 62.2 | 0.0 | nd | 111.4 |
| 9/14 | 52.8 | 48.9 | 35.4 | 70.5 | nd | 60.3 | 0.0 | nd | 111.1 |
| 9/15 | 52.4 | 47.3 | 35.2 | 68.3 | nd | 60.2 | 0.0 | nd | 108.6 |
| 9/16 | 52.2 | 44.0 | 35.1 | 65.9 | nd | 60.5 | 0.0 | nd | 106.3 |
| 9/17 | 52.3 | 41.9 | 35.2 | 65.0 | nd | 60.3 | 0.0 | nd | 105.5 |
| 9/18 | 43.4 | 32.8 | 35.3 | 61.5 | nd | 79.0 | 0.0 | nd | 108.0 |
| 9/19 | 31.5 | 16.9 | 35.2 | 45.5 | nd | 71.4 | 0.0 | nd | 92.6 |
| 9/20 | 24.2 | 16.7 | 35.2 | 47.1 | nd | 73.3 | 0.0 | nd | 89.9 |
| 9/21 | 37.6 | 33.9 | 36.8 | 60.7 | nd | 115 | 0.0 | nd | 118.7 |
| 9/22 | 30.2 | 30.5 | 36.5 | 56.7 | nd | 112 | 0.0 | nd | 133.0 |
| 9/23 | 23.3 | 20.2 | 36.4 | 50.6 | nd | 84.5 | 0.0 | nd | 103.1 |
| 9/24 | 22.1 | 19.3 | 36.1 | 49.0 | nd | 80.5 | 0.0 | nd | 100.6 |
| 9/25 | 20.3 | 16.7 | 36.0 | 47.3 | nd | 78.5 | 0.0 | nd | 100.4 |
| 9/26 | 19.5 | 15.6 | 36.0 | 46.9 | nd | 77.1 | 0.0 | nd | 97.1 |
| 9/27 | 18.9 | 15.1 | 36.0 | 45.0 | nd | 74.4 | 0.0 | nd | 95.0 |
| 9/28 | 18.7 | 15.1 | 36.0 | 45.2 | nd | 74.2 | 0.0 | nd | 92.8 |
| 9/29 | 18.7 | 15.3 | 35.9 | 46.4 | nd | 75.6 | 0.0 | nd | 95.1 |
| 9/30 | 25.0 | 21.0 | 36.2 | 50.7 | nd | 86.3 | 0.0 | nd | 96.0 |

[1/] PG&E Hendricks Canal Downstream of Head Dam, flow for period June 1 through September 30, 2013. PG&E BW8, Latitude 39°56.1839'N, Longitude 121°31.8097'W NAS83 (Preliminary data received from PG&E 1/13).

[2/] PG&E Toadtown/Hendricks Canal flow for period June 1 through September 30, 2012. USGS gage #11389800, PG&E BW12 , Latitude 39°53'09", Longitude 121°36'35" NAD27 (Preliminary data received from PG&E 1/13).

[3/] PG&E Butte Canal flow above confluence with Toadtown/Hendricks Canal for period June 1 through September 30, 2012. PG&E BW15, Latitude 39°53.2093'N, Longitude 121°36.7342'W NAD83 (Preliminary data received from PG&E 1/13).

[4/] PG&E DeSabla Powerhouse discharge for period June 1 through September 30, 2012. USGS gage #11389750, PG&E BW82, Latitude 39°52'10", Longitude 121°37'51" NAD27. (Preliminary data received from PG&E 1/13).

[5/] Butte Creek immediately above DeSabla Powerhouse discharge not installed for period June 1 through September 30, 2013.

[6/] Butte Creek below Centerville Head Dam discharge for period June 1 through September 30, 2012. USGS gage #11389780, PG&E BW98, Latitude 39°52'01", Longitude 121°37'58" NAD27, (Preliminary data received from PG&E 1/13, gage reviewed for accuracy only for flows less than 90 cfs)

[7/] PG&E Centerville Powerhouse discharge for period June 1 through September 30, 2012. USGS gage #11389775, PG&E BW80, Latitude 39°47'20", Longitude 121°39'23" NAD27. (Preliminary data received from PG&E 1/13). * 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, 2013.

[9/] USGS gage #11390000 for period June 1 through September 30, 2013, 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, 2013**

APPENDIX H, Table 1. Water temperature (C) at key sites within PG&E DeSabla-Centerville Project for period June 1 through September 30, 2013 (PG&E preliminary data 2013 [1/]).

| | Hendricks Head Dam[2/] | | Hendricks/Toadtown Canal at BW12[3/] | | Butte Canal at BW15[4/] | | DeSabla Forebay Inflow[5/] | | DeSabla Powerhouse Discharge[6/] | |
|---|---|---|---|---|---|---|---|---|---|---|
| **DATE** | **MAX** | **MEAN** | **MAX** | **MEAN** | **MAX** | **MEAN** | **MAX** | **MEAN** | **MAX** | **MEAN** |
| **6/1** | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| **6/2** | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| **6/3** | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| **6/4** | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| **6/5** | 16.3 | 14.8 | 16.8 | 15.5 | 17.3 | 15.7 | 17.0 | 15.6 | nd | nd |
| **6/6** | 16.6 | 15.2 | 17.3 | 15.9 | 17.7 | 16.1 | 17.5 | 16.1 | 17.8 | 17.0 |
| **6/7** | 17.0 | 15.5 | 17.6 | 16.2 | 17.9 | 16.4 | 17.8 | 16.4 | 18.1 | 17.4 |
| **6/8** | 17.8 | 16.1 | 18.5 | 16.9 | 18.8 | 17.0 | 18.7 | 17.0 | 18.8 | 17.8 |
| **6/9** | 18.2 | 16.6 | 18.8 | 17.4 | 18.9 | 17.6 | 18.9 | 17.6 | 19.3 | 18.6 |
| **6/10** | 16.8 | 15.4 | 17.8 | 16.0 | 17.6 | 16.1 | 17.8 | 16.1 | 19.2 | 17.8 |
| **6/11** | 15.3 | 13.8 | 15.8 | 14.3 | 15.1 | 13.5 | 15.3 | 13.9 | 16.4 | 15.3 |
| **6/12** | 15.1 | 13.6 | 15.7 | 14.2 | 15.3 | 13.9 | 15.4 | 14.1 | 15.9 | 15.2 |
| **6/13** | 14.6 | 13.2 | 15.2 | 13.7 | 14.8 | 13.5 | 14.9 | 13.7 | 15.8 | 15.0 |
| **6/14** | 14.6 | 12.9 | 15.0 | 13.4 | 15.0 | 13.3 | 15.0 | 13.4 | 15.3 | 14.4 |
| **6/15** | 14.8 | 13.2 | 15.4 | 13.8 | 15.3 | 13.7 | 15.3 | 13.8 | 15.6 | 14.7 |
| **6/16** | 14.8 | 13.2 | 15.5 | 13.9 | 15.5 | 13.8 | 15.5 | 13.9 | 15.7 | 14.9 |
| **6/17** | 15.0 | 13.5 | 15.7 | 14.1 | 15.8 | 14.2 | 15.7 | 14.2 | 16.1 | 15.3 |
| **6/18** | 13.9 | 13.1 | 14.7 | 13.7 | 15.0 | 14.0 | 14.7 | 13.9 | 16.0 | 15.3 |
| **6/19** | 13.6 | 12.6 | 14.3 | 13.0 | 13.8 | 12.9 | 13.9 | 13.0 | 15.3 | 14.5 |
| **6/20** | 13.6 | 12.0 | 14.2 | 12.5 | 13.9 | 12.3 | 14.0 | 12.4 | 14.5 | 13.7 |
| **6/21** | 14.0 | 12.3 | 14.7 | 12.9 | 14.6 | 12.9 | 14.6 | 12.9 | 14.8 | 13.8 |
| **6/22** | 14.5 | 12.8 | 15.2 | 13.4 | 15.3 | 13.5 | 15.3 | 13.5 | 15.3 | 14.4 |
| **6/23** | 14.0 | 13.0 | 14.6 | 13.6 | 14.8 | 13.9 | 14.7 | 13.8 | 15.4 | 14.8 |
| **6/24** | 13.1 | 12.5 | 14.1 | 13.1 | 13.9 | 13.1 | 14.0 | 13.2 | 15.1 | 14.4 |
| **6/25** | 11.7 | 11.4 | 12.3 | 12.0 | 12.0 | 11.8 | 12.2 | 11.9 | 13.6 | 12.8 |
| **6/26** | 14.0 | 12.5 | 14.3 | 12.9 | 15.0 | 13.1 | 14.7 | 13.0 | 14.6 | 13.1 |
| **6/27** | 15.5 | 13.8 | 16.2 | 14.5 | 16.8 | 15.0 | 16.5 | 14.8 | 16.4 | 15.0 |
| **6/28** | 16.4 | 14.7 | 17.2 | 15.5 | 17.8 | 16.0 | 17.6 | 15.8 | 17.6 | 16.4 |
| **6/29** | 16.7 | 15.4 | 17.5 | 16.3 | 18.7 | 16.9 | 18.0 | 16.6 | 18.4 | 17.5 |
| **6/30** | 16.7 | 15.4 | 17.4 | 16.2 | 18.6 | 17.0 | 18.0 | 16.7 | 18.5 | 17.7 |
| **7/1** | 16.4 | 15.4 | 17.2 | 16.2 | 18.8 | 17.2 | 17.9 | 16.7 | 18.4 | 17.8 |
| **7/2** | 17.0 | 15.8 | 17.7 | 16.6 | 19.5 | 17.8 | 18.5 | 17.2 | 18.9 | 18.1 |
| **7/3** | 17.5 | 16.4 | 18.3 | 17.3 | 20.4 | 18.6 | 19.2 | 17.9 | 19.6 | 18.7 |
| **7/4** | 17.7 | 16.7 | 18.6 | 17.6 | 20.7 | 19.1 | 19.5 | 18.3 | 20.0 | 19.3 |
| **7/5** | 16.9 | 16.0 | 17.8 | 17.0 | 19.5 | 18.2 | 18.5 | 17.6 | 19.9 | 19.0 |
| **7/6** | 16.3 | 15.1 | 17.1 | 15.9 | 18.1 | 16.7 | 17.6 | 16.4 | 19.1 | 18.0 |
| **7/7** | 16.1 | 14.8 | 17.1 | 15.5 | 17.4 | 15.8 | 17.2 | 15.8 | 18.1 | 17.3 |
| **7/8** | 16.1 | 14.6 | 17.0 | 15.4 | 17.3 | 15.5 | 17.1 | 15.5 | 17.7 | 16.9 |
| **7/9** | 16.1 | 14.6 | 17.1 | 15.4 | 17.4 | 15.5 | 17.2 | 15.5 | 17.5 | 16.8 |
| **7/10** | 16.3 | 14.8 | 17.3 | 15.6 | 17.6 | 15.7 | 17.4 | 15.7 | 17.7 | 16.9 |
| **7/11** | 16.0 | 14.6 | 16.9 | 15.4 | 17.3 | 15.7 | 17.0 | 15.6 | 17.7 | 17.0 |
| **7/12** | 15.5 | 14.1 | 16.4 | 14.9 | 16.7 | 15.1 | 16.5 | 15.1 | 17.5 | 16.6 |
| **7/13** | 15.5 | 14.0 | 16.4 | 14.8 | 16.7 | 14.9 | 16.6 | 14.9 | 17.0 | 16.3 |
| **7/14** | 15.6 | 14.0 | 16.5 | 14.8 | 16.8 | 14.9 | 16.6 | 14.9 | 16.9 | 16.2 |
| **7/15** | 15.9 | 14.5 | 17.0 | 15.3 | 17.3 | 15.5 | 17.1 | 15.4 | 17.3 | 16.5 |
| **7/16** | 16.0 | 14.7 | 17.0 | 15.6 | 17.3 | 15.7 | 17.0 | 15.7 | 17.6 | 16.9 |
| **7/17** | 15.5 | 14.1 | 16.4 | 14.9 | 16.6 | 14.9 | 16.5 | 15.0 | 17.5 | 16.5 |
| **7/18** | 15.8 | 14.3 | 16.8 | 15.1 | 17.1 | 15.1 | 17.0 | 15.2 | 17.2 | 16.3 |
| **7/19** | 16.1 | 14.8 | 17.1 | 15.6 | 17.9 | 15.9 | 17.5 | 15.8 | 17.6 | 16.8 |
| **7/20** | 16.9 | 15.5 | 17.9 | 16.4 | 19.0 | 16.9 | 18.4 | 16.7 | 18.5 | 17.5 |
| **7/21** | 17.5 | 16.2 | 18.6 | 17.2 | 19.8 | 17.8 | 19.2 | 17.6 | 19.3 | 18.4 |
| **7/22** | 17.8 | 16.5 | 18.9 | 17.5 | 19.5 | 17.9 | 19.2 | 17.8 | 19.6 | 19.0 |
| **7/23** | 17.3 | 16.2 | 18.4 | 17.2 | 18.9 | 17.4 | 18.7 | 17.4 | 19.6 | 18.9 |
| **7/24** | 17.9 | 16.6 | 18.9 | 17.5 | 19.5 | 17.8 | 19.2 | 17.7 | 19.6 | 18.9 |
| **7/25** | 18.0 | 16.7 | 19.2 | 17.8 | 19.6 | 17.9 | 19.4 | 17.9 | 19.8 | 19.2 |
| **7/26** | 18.1 | 16.9 | 19.3 | 18.0 | 20.1 | 18.2 | 19.6 | 18.2 | 20.1 | 19.4 |
| **7/27** | 17.6 | 16.5 | 18.8 | 17.6 | 19.6 | 18.0 | 19.1 | 17.9 | 20.1 | 19.3 |
| **7/28** | 17.3 | 16.3 | 18.4 | 17.2 | 19.2 | 17.6 | 18.7 | 17.5 | 19.7 | 19.0 |
| **7/29** | 16.2 | 15.4 | 17.3 | 16.4 | 17.7 | 16.7 | 17.6 | 16.6 | 19.4 | 18.3 |
| **7/30** | 15.4 | 14.4 | 16.3 | 15.2 | 16.7 | 15.3 | 16.5 | 15.3 | 18.2 | 17.0 |
| **7/31** | 15.4 | 14.2 | 16.2 | 15.0 | 16.8 | 15.1 | 16.5 | 15.1 | 17.2 | 16.5 |

APPENDIX H, Table 1 (continued). Water temperature (C) at key sites within PG&E DeSabla-Centerville Project for period June 1 through September 30, 2013 (PG&E preliminary data 2013[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** | 14.8 | 13.9 | 15.5 | 14.6 | 16.4 | 14.8 | 15.9 | 14.7 | 16.9 | 16.1 |
| **8/2** | 14.9 | 13.8 | 15.6 | 14.4 | 16.3 | 14.6 | 15.9 | 14.5 | 16.4 | 15.7 |
| **8/3** | 15.1 | 14.0 | 15.8 | 14.7 | 16.5 | 14.7 | 16.1 | 14.7 | 16.4 | 15.8 |
| **8/4** | 15.0 | 14.0 | 15.8 | 14.7 | 16.4 | 14.7 | 16.0 | 14.7 | 16.4 | 15.8 |
| **8/5** | 15.2 | 14.1 | 15.9 | 14.8 | 16.5 | 14.7 | 16.1 | 14.8 | 16.5 | 15.9 |
| **8/6** | 15.1 | 14.1 | 15.7 | 14.7 | 16.3 | 14.7 | 15.9 | 14.8 | 16.4 | 15.9 |
| **8/7** | 15.4 | 14.4 | 15.9 | 14.9 | 16.6 | 14.9 | 16.2 | 14.9 | 16.6 | 16.0 |
| **8/8** | 14.8 | 13.9 | 15.3 | 14.5 | 15.7 | 14.4 | 15.5 | 14.5 | 16.5 | 15.8 |
| **8/9** | 14.7 | 13.6 | 15.2 | 14.1 | 15.3 | 13.7 | 15.2 | 13.9 | 16.0 | 15.3 |
| **8/10** | 14.6 | 13.5 | 15.2 | 14.0 | 15.3 | 13.7 | 15.2 | 13.9 | 15.6 | 15.1 |
| **8/11** | 14.9 | 13.7 | 15.5 | 14.2 | 15.6 | 13.9 | 15.5 | 14.1 | 15.8 | 15.1 |
| **8/12** | 14.7 | 13.7 | 15.3 | 14.2 | 15.4 | 14.0 | 15.3 | 14.1 | 15.8 | 15.3 |
| **8/13** | 14.9 | 13.7 | 15.6 | 14.3 | 15.7 | 14.0 | 15.6 | 14.2 | 15.9 | 15.3 |
| **8/14** | 15.1 | 13.8 | 15.8 | 14.5 | 15.8 | 14.1 | 15.8 | 14.3 | 16.0 | 15.4 |
| **8/15** | 15.1 | 13.9 | 15.8 | 14.5 | 15.9 | 14.2 | 15.9 | 14.4 | 16.1 | 15.5 |
| **8/16** | 15.2 | 14.0 | 15.9 | 14.7 | 16.1 | 14.4 | 16.0 | 14.6 | 16.4 | 15.8 |
| **8/17** | 15.5 | 14.4 | 16.1 | 14.9 | 16.3 | 14.6 | 16.2 | 14.8 | 16.5 | 15.9 |
| **8/18** | 16.5 | 15.3 | 17.1 | 15.7 | 17.2 | 15.3 | 17.2 | 15.6 | 17.2 | 16.3 |
| **8/19** | 16.7 | 16.1 | 17.2 | 16.6 | 17.0 | 16.1 | 17.1 | 16.4 | 17.5 | 17.2 |
| **8/20** | 17.3 | 16.4 | 17.8 | 17.0 | 17.4 | 16.2 | 17.6 | 16.7 | 17.9 | 17.3 |
| **8/21** | 17.5 | 16.6 | 18.1 | 17.2 | 17.7 | 16.3 | 17.9 | 16.9 | 18.3 | 17.7 |
| **8/22** | 16.9 | 16.2 | 17.5 | 16.8 | 17.4 | 16.2 | 17.4 | 16.6 | 18.2 | 17.8 |
| **8/23** | 15.8 | 15.1 | 16.4 | 15.6 | 16.2 | 15.0 | 16.3 | 15.4 | 17.9 | 16.9 |
| **8/24** | 15.5 | 14.6 | 15.9 | 15.1 | 15.7 | 14.3 | 15.8 | 14.8 | 16.9 | 16.1 |
| **8/25** | 15.5 | 14.6 | 15.9 | 15.0 | 15.5 | 14.3 | 15.7 | 14.7 | 16.3 | 15.9 |
| **8/26** | 15.4 | 14.4 | 15.8 | 14.9 | 17.1 | 14.3 | 16.4 | 14.7 | 16.3 | 15.6 |
| **8/27** | 15.0 | 14.2 | 15.5 | 14.6 | 15.2 | 13.8 | 15.3 | 14.3 | 16.2 | 15.5 |
| **8/28** | 15.1 | 14.2 | 15.6 | 14.6 | 15.3 | 13.8 | 15.5 | 14.3 | 15.9 | 15.3 |
| **8/29** | 15.0 | 14.1 | 15.5 | 14.6 | 15.3 | 13.8 | 15.4 | 14.2 | 15.9 | 15.4 |
| **8/30** | 14.9 | 14.0 | 15.5 | 14.5 | 15.2 | 13.7 | 15.3 | 14.1 | 15.8 | 15.3 |
| **8/31** | 14.9 | 14.0 | 15.6 | 14.6 | 15.2 | 13.7 | 15.4 | 14.2 | 16.7 | 15.4 |
| **9/1** | 14.8 | 14.3 | 15.3 | 14.8 | 14.6 | 13.9 | 15.0 | 14.4 | 16.7 | 15.5 |
| **9/2** | 15.9 | 15.1 | 16.3 | 15.6 | 16.2 | 14.9 | 16.2 | 15.3 | 16.6 | 15.8 |
| **9/3** | 15.7 | 14.7 | 16.0 | 15.2 | 15.9 | 14.6 | 15.9 | 15.0 | 16.6 | 16.1 |
| **9/4** | 15.5 | 14.6 | 16.0 | 15.1 | 15.6 | 14.4 | 15.8 | 14.8 | 16.5 | 16.0 |
| **9/5** | 14.8 | 14.2 | 15.3 | 14.7 | 14.9 | 13.8 | 15.0 | 14.3 | 16.3 | 15.7 |
| **9/6** | 14.0 | 13.3 | 14.6 | 13.7 | 14.0 | 12.8 | 14.3 | 13.3 | 15.7 | 14.8 |
| **9/7** | 14.3 | 13.4 | 14.9 | 13.8 | 14.3 | 12.8 | 14.7 | 13.4 | 15.1 | 14.5 |
| **9/8** | 14.4 | 13.5 | 15.1 | 14.1 | 14.5 | 13.1 | 14.8 | 13.7 | 15.2 | 14.6 |
| **9/9** | 15.0 | 14.0 | 15.7 | 14.5 | 15.1 | 13.5 | 15.4 | 14.1 | 15.5 | 14.9 |
| **9/10** | 15.3 | 14.4 | 16.0 | 15.0 | 15.5 | 14.1 | 15.8 | 14.7 | 16.1 | 15.5 |
| **9/11** | 15.1 | 14.5 | 15.7 | 15.0 | 15.1 | 14.1 | 15.4 | 14.7 | 16.1 | 15.7 |
| **9/12** | 15.2 | 14.4 | 15.8 | 14.9 | 15.4 | 14.1 | 15.6 | 14.6 | 16.0 | 15.5 |
| **9/13** | 15.6 | 14.8 | 16.2 | 15.3 | 15.7 | 14.3 | 16.0 | 14.9 | 16.3 | 15.7 |
| **9/14** | 15.7 | 15.0 | 16.3 | 15.6 | 15.9 | 14.7 | 16.2 | 15.2 | 16.6 | 16.1 |
| **9/15** | 14.8 | 14.1 | 15.6 | 14.7 | 14.7 | 13.9 | 15.2 | 14.4 | 16.6 | 15.9 |
| **9/16** | 13.6 | 12.9 | 14.2 | 13.4 | 13.4 | 12.5 | 13.7 | 13.0 | 15.7 | 14.7 |
| **9/17** | 13.4 | 12.8 | 13.9 | 13.3 | 13.2 | 12.1 | 13.6 | 12.7 | 14.5 | 14.1 |
| **9/18** | 13.0 | 12.2 | 13.5 | 12.6 | 12.5 | 11.4 | 12.9 | 12.0 | 14.2 | 13.4 |
| **9/19** | 12.9 | 11.9 | 13.6 | 12.6 | 12.5 | 11.3 | 12.9 | 11.8 | 13.5 | 13.1 |
| **9/20** | 12.3 | 11.5 | 13.3 | 12.3 | 12.1 | 11.1 | 12.4 | 11.6 | 13.4 | 13.0 |
| **9/21** | 11.8 | 11.3 | 12.9 | 12.1 | 11.5 | 11.2 | 11.9 | 11.6 | 13.3 | 12.8 |
| **9/22** | 10.8 | 10.2 | 11.5 | 10.7 | 10.6 | 9.9 | 10.9 | 10.3 | 12.2 | 11.5 |
| **9/23** | 11.5 | 10.5 | 12.3 | 11.1 | 11.7 | 10.4 | 11.9 | 10.6 | 11.9 | 11.4 |
| **9/24** | 11.5 | 10.9 | 12.4 | 11.7 | 11.9 | 11.1 | 12.1 | 11.3 | 12.5 | 12.1 |
| **9/25** | 10.9 | 10.1 | 11.7 | 10.5 | 11.1 | 10.1 | 11.4 | 10.3 | 12.5 | 11.9 |
| **9/26** | 9.4 | 8.9 | 10.2 | 9.3 | 9.2 | 8.6 | 9.5 | 8.8 | 11.5 | 10.7 |
| **9/27** | 9.4 | 8.4 | 10.0 | 8.9 | 9.3 | 8.2 | 9.5 | 8.4 | 10.5 | 9.9 |
| **9/28** | 9.8 | 8.9 | 10.7 | 9.6 | 9.9 | 8.8 | 10.1 | 9.0 | 10.4 | 10.0 |
| **9/29** | 9.4 | 9.1 | 10.4 | 9.9 | 10.0 | 9.4 | 10.2 | 9.6 | 10.4 | 10.3 |
| **9/30** | 10.2 | 9.8 | 10.9 | 10.6 | 11.0 | 10.4 | 11.0 | 10.5 | 11.1 | 10.8 |

nd = no data * = Mass Balance Estimate ±0.2°C

APPENDIX H, Table 2. Water temperature (C) at key sites within PG&E DeSabla-Centerville Project for period June 1 through September 30, 2013(PG&E preliminary data 2013[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** | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| **6/2** | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| **6/3** | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| **6/4** | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| **6/5** | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| **6/6** | 19.9 | 18.7 | 18.4 | 17.5 | 21.8 | 19.7 | 20.1 | 18.3 | 21.3 | 19.3 |
| **6/7** | 20.4 | 19.2 | 18.6 | 17.9 | 22.5 | 20.4 | 20.7 | 18.8 | 21.8 | 19.9 |
| **6/8** | 20.8 | 19.6 | 19.3 | 18.4 | 23.0 | 20.8 | 21.5 | 19.4 | 22.5 | 20.4 |
| **6/9** | 20.8 | 19.9 | 19.6 | 19.0 | 23.0 | 21.1 | 21.8 | 19.9 | 22.5 | 20.7 |
| **6/10** | 19.9 | 18.3 | 19.5 | 18.0 | 21.3 | 19.4 | 19.6 | 18.5 | 20.5 | 19.0 |
| **6/11** | 17.8 | 16.7 | 16.6 | 15.8 | 20.9 | 18.7 | 18.4 | 16.7 | 19.8 | 17.9 |
| **6/12** | 17.8 | 16.7 | 16.3 | 15.7 | 20.5 | 18.5 | 18.5 | 16.6 | 19.7 | 17.7 |
| **6/13** | 17.3 | 16.4 | 16.1 | 15.4 | 20.0 | 18.1 | 18.1 | 16.2 | 19.1 | 17.3 |
| **6/14** | 17.1 | 16.0 | 15.6 | 15.0 | 19.8 | 17.8 | 17.9 | 15.9 | 19.0 | 17.0 |
| **6/15** | 17.3 | 16.1 | 15.9 | 15.2 | 19.9 | 17.9 | 18.2 | 16.1 | 19.2 | 17.2 |
| **6/16** | 17.5 | 16.3 | 16.2 | 15.4 | 20.1 | 18.1 | 18.5 | 16.3 | 19.5 | 17.4 |
| **6/17** | 17.7 | 16.7 | 16.5 | 15.8 | 20.4 | 18.3 | 18.7 | 16.6 | 19.7 | 17.7 |
| **6/18** | 17.4 | 16.6 | 16.4 | 15.7 | 19.8 | 18.1 | 18.3 | 16.6 | 19.1 | 17.5 |
| **6/19** | 17.0 | 16.1 | 15.7 | 15.0 | 19.5 | 17.8 | 17.4 | 15.8 | 18.6 | 17.0 |
| **6/20** | 16.5 | 15.5 | 14.9 | 14.3 | 19.3 | 17.3 | 17.2 | 15.2 | 18.4 | 16.4 |
| **6/21** | 16.9 | 15.7 | 15.2 | 14.4 | 19.4 | 17.3 | 17.6 | 15.4 | 18.6 | 16.6 |
| **6/22** | 17.3 | 16.0 | 15.8 | 14.9 | 19.6 | 17.5 | 18.3 | 15.9 | 19.1 | 16.9 |
| **6/23** | 16.9 | 16.2 | 15.7 | 15.3 | 18.7 | 17.5 | 17.5 | 16.0 | 18.4 | 17.0 |
| **6/24** | 16.6 | 16.1 | 15.6 | 15.0 | 17.9 | 17.1 | 15.9 | 15.5 | 17.3 | 16.5 |
| **6/25** | 15.5 | 14.6 | 14.2 | 13.6 | 16.5 | 15.8 | 14.7 | 14.1 | 15.8 | 15.4 |
| **6/26** | 16.9 | 15.0 | 15.3 | 13.9 | 18.6 | 16.3 | 16.8 | 14.8 | 18.1 | 16.1 |
| **6/27** | 18.5 | 17.1 | 17.1 | 15.8 | 20.5 | 18.1 | 18.9 | 16.6 | 20.0 | 17.7 |
| **6/28** | 19.8 | 18.3 | 18.3 | 17.2 | 21.8 | 19.6 | 20.5 | 18.1 | 21.4 | 19.1 |
| **6/29** | 20.7 | 19.4 | 18.9 | 18.1 | 22.7 | 20.7 | 21.7 | 19.2 | 22.4 | 20.3 |
| **6/30** | 20.8 | 19.5 | 19.0 | 18.3 | 22.7 | 20.7 | 22.1 | 19.5 | 22.5 | 20.5 |
| **7/1** | 21.1 | 19.9 | 19.1 | 18.4 | 22.7 | 20.9 | 22.2 | 19.8 | 22.7 | 20.7 |
| **7/2** | 21.9 | 20.6 | 19.6 | 18.8 | 22.9 | 21.2 | 22.1 | 20.1 | 22.9 | 21.1 |
| **7/3** | 22.5 | 21.3 | 20.3 | 19.5 | 23.9 | 22.0 | 23.2 | 20.8 | 23.9 | 21.8 |
| **7/4** | 22.8 | 21.7 | 20.6 | 20.0 | 24.3 | 22.5 | 23.5 | 21.3 | 24.1 | 22.3 |
| **7/5** | 21.9 | 21.1 | 20.4 | 19.6 | 23.7 | 22.0 | 22.8 | 20.9 | 23.4 | 21.7 |
| **7/6** | 21.0 | 20.1 | 19.7 | 18.6 | 23.0 | 21.2 | 21.9 | 19.8 | 22.6 | 20.9 |
| **7/7** | 20.2 | 19.3 | 18.8 | 17.9 | 22.7 | 20.8 | 21.3 | 19.1 | 22.2 | 20.3 |
| **7/8** | 19.8 | 18.8 | 18.2 | 17.5 | 22.4 | 20.4 | 21.1 | 18.7 | 21.9 | 19.8 |
| **7/9** | 19.7 | 18.6 | 18.0 | 17.3 | 22.3 | 20.2 | 21.1 | 18.6 | 21.8 | 19.7 |
| **7/10** | 19.8 | 18.6 | 18.2 | 17.4 | 22.3 | 20.2 | 21.6 | 18.7 | 21.9 | 19.8 |
| **7/11** | 19.4 | 18.4 | 18.0 | 17.4 | 21.8 | 19.9 | 21.1 | 18.5 | 21.4 | 19.4 |
| **7/12** | 19.0 | 17.9 | 17.7 | 17.0 | 21.5 | 19.5 | 20.9 | 18.2 | 21.2 | 19.1 |
| **7/13** | 19.0 | 17.9 | 17.4 | 16.8 | 21.5 | 19.5 | 20.8 | 18.0 | 21.2 | 19.1 |
| **7/14** | 19.0 | 17.8 | 17.4 | 16.7 | 21.4 | 19.4 | 20.6 | 17.9 | 21.1 | 19.0 |
| **7/15** | 19.3 | 18.2 | 17.8 | 17.0 | 21.5 | 19.6 | 20.7 | 18.3 | 21.4 | 19.3 |
| **7/16** | 19.4 | 18.4 | 18.0 | 17.4 | 21.5 | 19.6 | 21.2 | 18.4 | 21.2 | 19.2 |
| **7/17** | 18.9 | 17.9 | 17.8 | 17.0 | 21.4 | 19.4 | 20.7 | 18.2 | 21.2 | 19.0 |
| **7/18** | 19.2 | 18.1 | 17.6 | 16.9 | 21.6 | 19.5 | 21.0 | 18.2 | 21.4 | 19.1 |
| **7/19** | 19.9 | 18.6 | 18.2 | 17.3 | 21.8 | 19.9 | 21.2 | 18.6 | 21.7 | 19.6 |
| **7/20** | 20.9 | 19.6 | 19.1 | 18.1 | 22.6 | 20.6 | 22.0 | 19.4 | 22.6 | 20.4 |
| **7/21** | 21.7 | 20.7 | 19.9 | 19.1 | 23.4 | 21.5 | 22.9 | 20.4 | 23.4 | 21.3 |
| **7/22** | 21.6 | 20.9 | 20.0 | 19.6 | 23.6 | 21.9 | 23.3 | 20.9 | 23.5 | 21.6 |
| **7/23** | 21.3 | 20.4 | 20.0 | 19.4 | 23.2 | 21.7 | 23.0 | 20.7 | 23.2 | 21.4 |
| **7/24** | 21.7 | 20.9 | 20.1 | 19.5 | 23.6 | 22.0 | 23.5 | 21.0 | 23.6 | 21.8 |
| **7/25** | 22.1 | 21.1 | 20.4 | 19.8 | 24.2 | 22.3 | 23.9 | 21.3 | 24.2 | 22.2 |
| **7/26** | 22.4 | 21.5 | 20.6 | 20.0 | 24.5 | 22.7 | 24.0 | 21.6 | 24.4 | 22.5 |
| **7/27** | 22.0 | 21.2 | 20.5 | 19.9 | 24.1 | 22.5 | 23.6 | 21.3 | 24.0 | 22.2 |
| **7/28** | 21.7 | 20.9 | 20.2 | 19.5 | 23.8 | 22.2 | 23.3 | 21.0 | 23.7 | 21.9 |
| **7/29** | 21.2 | 20.2 | 19.8 | 18.9 | 22.5 | 21.3 | 21.8 | 20.1 | 22.2 | 20.9 |
| **7/30** | 19.8 | 18.9 | 18.6 | 17.6 | 21.7 | 20.2 | 21.1 | 18.9 | 21.6 | 19.9 |
| **7/31** | 19.4 | 18.6 | 17.7 | 17.1 | 21.6 | 19.9 | 20.8 | 18.5 | 21.4 | 19.6 |

nd = no data

APPENDIX H, Table 2 (continued). Water temperature (C) at key sites within PG&E DeSabla-Centerville Project for period June 1 through September 30, 2013 (PG&E preliminary data 2013[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** | 19.0 | 18.2 | 17.4 | 16.7 | 20.9 | 19.3 | 20.7 | 18.0 | 20.8 | 18.9 |
| **8/2** | 18.8 | 17.9 | 16.9 | 16.3 | 20.6 | 18.9 | 20.0 | 17.6 | 20.5 | 18.6 |
| **8/3** | 18.9 | 17.9 | 16.9 | 16.3 | 20.6 | 18.8 | 20.1 | 17.6 | 20.5 | 18.6 |
| **8/4** | 18.8 | 17.9 | 17.0 | 16.4 | 20.6 | 18.8 | 19.8 | 17.6 | 20.6 | 18.6 |
| **8/5** | 18.9 | 17.9 | 17.0 | 16.4 | 20.5 | 18.8 | 19.8 | 17.7 | 20.6 | 18.6 |
| **8/6** | 18.7 | 17.9 | 16.9 | 16.4 | 20.5 | 18.7 | 19.7 | 17.7 | 20.5 | 18.5 |
| **8/7** | 19.0 | 18.1 | 17.1 | 16.6 | 20.4 | 18.8 | 19.9 | 17.8 | 20.4 | 18.6 |
| **8/8** | 18.5 | 17.8 | 17.0 | 16.3 | 20.2 | 18.6 | 19.5 | 17.6 | 20.2 | 18.4 |
| **8/9** | 18.0 | 17.2 | 16.5 | 15.8 | 19.8 | 18.2 | 19.2 | 17.1 | 19.8 | 18.0 |
| **8/10** | 18.0 | 17.1 | 16.2 | 15.7 | 19.7 | 18.1 | 19.1 | 17.1 | 19.8 | 17.9 |
| **8/11** | 18.2 | 17.2 | 16.3 | 15.7 | 19.9 | 18.2 | 19.2 | 17.1 | 20.0 | 18.1 |
| **8/12** | 18.0 | 17.2 | 16.3 | 15.8 | 19.8 | 18.2 | 20.8 | 17.7 | 20.1 | 18.2 |
| **8/13** | 18.1 | 17.2 | 16.4 | 15.9 | 20.0 | 18.3 | 20.5 | 17.6 | 20.1 | 18.2 |
| **8/14** | 18.1 | 17.2 | 16.5 | 15.9 | 20.0 | 18.3 | 21.0 | 17.8 | 20.3 | 18.2 |
| **8/15** | 18.3 | 17.2 | 16.6 | 16.0 | 20.0 | 18.3 | 21.0 | 17.9 | 20.3 | 18.3 |
| **8/16** | 18.5 | 17.5 | 16.8 | 16.3 | 20.3 | 18.6 | 21.1 | 18.0 | 20.5 | 18.6 |
| **8/17** | 18.7 | 17.7 | 17.0 | 16.4 | 20.3 | 18.8 | 20.5 | 18.0 | 20.5 | 18.7 |
| **8/18** | 19.6 | 18.4 | 17.7 | 16.8 | 20.7 | 19.1 | 21.4 | 18.5 | 21.0 | 19.1 |
| **8/19** | 19.5 | 19.1 | 18.0 | 17.7 | 20.2 | 19.4 | 20.0 | 18.8 | 20.4 | 19.5 |
| **8/20** | 20.2 | 19.5 | 18.4 | 17.9 | 21.4 | 20.0 | 21.9 | 19.6 | 21.7 | 20.1 |
| **8/21** | 20.5 | 19.8 | 18.7 | 18.3 | 21.9 | 20.4 | 22.0 | 19.7 | 22.0 | 20.4 |
| **8/22** | 20.0 | 19.3 | 18.7 | 18.2 | 21.5 | 20.1 | 21.7 | 19.5 | 21.5 | 20.0 |
| **8/23** | 19.1 | 18.3 | 18.2 | 17.3 | 20.8 | 19.3 | 21.2 | 18.7 | 20.9 | 19.2 |
| **8/24** | 18.6 | 17.9 | 17.3 | 16.6 | 20.2 | 18.9 | 20.3 | 18.0 | 20.3 | 18.7 |
| **8/25** | 18.6 | 17.8 | 16.8 | 16.4 | 20.3 | 18.8 | 20.1 | 17.8 | 20.3 | 18.6 |
| **8/26** | 18.6 | 17.6 | 17.4 | 16.4 | 20.0 | 18.5 | 20.3 | 17.8 | 20.1 | 18.4 |
| **8/27** | 17.8 | 17.1 | 16.7 | 16.0 | 19.8 | 18.3 | 20.3 | 17.6 | 19.9 | 18.2 |
| **8/28** | 17.9 | 17.0 | 16.3 | 15.8 | 19.6 | 18.1 | 20.4 | 17.5 | 19.8 | 18.1 |
| **8/29** | 17.8 | 16.9 | 16.3 | 15.9 | 19.6 | 18.1 | 20.9 | 17.7 | 19.8 | 18.0 |
| **8/30** | 17.7 | 16.8 | 16.2 | 15.8 | 19.6 | 18.0 | 20.8 | 17.8 | 19.8 | 18.0 |
| **8/31** | 17.8 | 16.9 | 16.9 | 15.8 | 19.6 | 18.0 | 20.4 | 17.7 | 19.8 | 18.1 |
| **9/1** | 17.6 | 17.1 | 16.9 | 16.0 | 18.9 | 18.0 | 18.9 | 17.4 | 19.0 | 18.0 |
| **9/2** | 18.9 | 18.0 | 17.0 | 16.5 | 20.0 | 18.6 | 20.6 | 18.1 | 20.1 | 18.6 |
| **9/3** | 18.6 | 17.8 | 17.1 | 16.7 | 20.2 | 18.7 | 20.6 | 18.1 | 20.3 | 18.6 |
| **9/4** | 18.4 | 17.7 | 16.9 | 16.5 | 19.9 | 18.5 | 20.6 | 17.9 | 20.0 | 18.4 |
| **9/5** | 17.8 | 17.2 | 16.8 | 16.2 | 19.5 | 18.1 | 20.5 | 17.7 | 19.6 | 18.1 |
| **9/6** | 17.2 | 16.4 | 16.1 | 15.3 | 19.1 | 17.7 | 19.7 | 17.1 | 19.2 | 17.6 |
| **9/7** | 17.2 | 16.4 | 15.5 | 15.1 | 19.0 | 17.5 | 18.9 | 16.6 | 19.0 | 17.4 |
| **9/8** | 17.3 | 16.5 | 15.7 | 15.2 | 19.0 | 17.5 | 19.3 | 16.8 | 19.1 | 17.4 |
| **9/9** | 17.7 | 16.8 | 16.0 | 15.4 | 19.3 | 17.8 | 19.7 | 17.2 | 19.4 | 17.7 |
| **9/10** | 18.0 | 17.1 | 16.5 | 15.9 | 19.5 | 18.0 | 19.5 | 17.3 | 19.6 | 18.0 |
| **9/11** | 17.9 | 17.4 | 16.5 | 16.2 | 19.3 | 18.2 | 19.1 | 17.3 | 19.3 | 18.1 |
| **9/12** | 18.1 | 17.5 | 16.5 | 16.1 | 19.5 | 18.2 | 19.2 | 17.2 | 19.5 | 18.1 |
| **9/13** | 18.6 | 17.8 | 16.9 | 16.3 | 20.0 | 18.5 | 19.6 | 17.5 | 20.0 | 18.4 |
| **9/14** | 18.8 | 18.2 | 17.1 | 16.7 | 20.3 | 18.9 | 20.0 | 17.9 | 20.3 | 18.8 |
| **9/15** | 18.3 | 17.5 | 17.0 | 16.4 | 19.7 | 18.5 | 19.1 | 17.4 | 19.4 | 18.3 |
| **9/16** | 17.0 | 16.3 | 16.1 | 15.2 | 18.8 | 17.6 | 18.3 | 16.4 | 18.6 | 17.3 |
| **9/17** | 16.6 | 16.1 | 15.1 | 14.7 | 18.3 | 17.2 | 17.6 | 15.9 | 18.1 | 17.0 |
| **9/18** | 16.0 | 15.4 | 14.7 | 14.1 | 17.3 | 16.3 | 20.1 | 15.5 | 17.3 | 16.2 |
| **9/19** | 15.4 | 14.8 | 14.1 | 13.7 | 17.1 | 15.7 | 21.4 | 16.4 | 17.1 | 15.8 |
| **9/20** | 15.1 | 14.4 | 13.9 | 13.6 | 16.7 | 15.6 | nd | nd | 16.8 | 15.7 |
| **9/21** | 15.0 | 14.7 | 14.0 | 13.6 | 16.1 | 15.3 | nd | nd | 16.1 | 15.4 |
| **9/22** | 13.9 | 13.3 | 13.0 | 12.3 | 15.3 | 14.3 | nd | nd | 15.4 | 14.3 |
| **9/23** | 14.6 | 13.6 | 12.8 | 12.3 | 15.8 | 14.3 | nd | nd | 15.8 | 14.4 |
| **9/24** | 14.6 | 14.1 | 13.3 | 12.9 | 15.8 | 14.8 | nd | nd | 15.9 | 14.9 |
| **9/25** | 14.2 | 13.3 | 13.2 | 12.5 | 15.2 | 14.3 | nd | nd | 15.3 | 14.3 |
| **9/26** | 12.6 | 12.0 | 12.0 | 11.3 | 14.2 | 13.1 | nd | nd | 14.2 | 13.2 |
| **9/27** | 12.1 | 11.5 | 11.0 | 10.6 | 13.7 | 12.6 | nd | nd | 13.7 | 12.7 |
| **9/28** | 12.3 | 11.7 | 11.1 | 10.7 | 14.0 | 12.8 | nd | nd | 14.0 | 12.9 |
| **9/29** | 12.5 | 12.0 | 11.3 | 11.0 | 13.0 | 12.6 | nd | nd | 13.2 | 12.7 |
| **9/30** | 13.2 | 12.9 | 12.0 | 11.7 | 14.2 | 13.4 | nd | nd | 14.1 | 13.4 |

nd = no data

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

[2/] Hendricks Canal at Head Dam, Seamon mini recorder #1394, 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, Seamon mini recorder #1743, 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, Seamon mini recorder #D-833, 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), Seamon mini recorder #1748, 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, Campbell Sci CR200 #1465, QA/QC =± 0.1°C, Lat (NAD83) 039° 52.1618'N, Long (NAD83) 121° 37.9314'W.

[7/] Butte Creek above DeSabla Powerhouse, Seamon mini recorder #1750, 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, Seamon mini recorder #1739, QA/QC =± 0.1°C, Lat (NAD83) 039° 52.0615'N, Long (NAD83) 121° 37.9448'W.

[9/] Butte Creek above Centerville Powerhouse, Seamon mini recorder #1396, 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, Seamon mini recorder #1392, QA/QC = ± 0.1°C, Lat (NAD83) 039° 47.4156'N, Long (NAD83) 121° 39.9039'W.

[11/] Butte Creek below Centerville Powerhouse, Seamon mini recorder #T-1389, QA/QC = ± 0.1°C, Lat (NAD83) 039° 47.2308'N, Long (NAD83) 121° 39.5875'W.

# APPENDIX I

**Table 1**
**BUTTE CREEK SRCS DISTRIBUTION BY REACH, ABOVE AND BELOW PG&E CVPH FOR SNORKEL, PRE-SPAWN, AND SPAWN SURVEY FROM 2001-2012.**

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 2001-2012.

| 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% |

| 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% |

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 2001-2012.

| 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% |

| 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% |

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 2001-2012.

| 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% |

| 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.