2013 Clear Creek Technical Team Report for the Coordinated Long-Term Operation Biological Opinions Integrated Annual Review September 17, 2013

Contents

Brief Background on Clear Creek and the Technical Team:

Since 1995, Central Valley Project Improvement Act (CVPIA) and later CALFED Bay Delta Program have undertaken extensive anadromous salmonid habitat and flow restoration in Clear Creek (Figure 1). The restoration has increased stocks of fall-run Chinook salmon (*Oncorhynchus tshawytscha*) four fold, and re-established populations of spring-run Chinook salmon and California Central Valley steelhead (*Oncorhynchus mykiss*). The Clear Creek Technical Team (CCTT) has been working since 1996 to facilitate implementation of these CVPIA and CALFED restoration actions. Team attendance and /or participation has varied over the years, depending on what topics are being covered at the meetings. The majority of the topics had involved physical habitat restoration. Since 2009, topics have included actions such as flow and temperature management as part of the National Marine Fisheries Service (NMFS) Coordinated Long-Term Operations Biological Opinion (BO) for the Central Valley Project (CVP) and State Water Project (SWP) Reasonable and Prudent Alternative (RPA).

The Clear Creek Restoration Program of CVPIA has implemented a variety of actions to improve salmon and steelhead populations and the ecosystem on which they depend. Actions included increasing minimum flows, temperature control through flow management, dam removal, large-scale stream and floodplain restoration, gravel augmentation, erosion control. The effect of these actions has been 1) a four- to five-fold increase in the fall-run Chinook salmon escapement (Figure 2); primarily due to increased minimum flows, 2) to re-establish populations of threatened spring-run Chinook salmon and steelhead; primarily through dam removal, increased flows, and temperature management, 3) rehabilitation of stream and floodplain habitats, 4) the re-initiation of sediment transport and stream channel movement processes, which help create and maintain fish habitat, and 5) to increase the amount of salmonid spawning habitat. The actions have probably increased the resilience of the Clear Creek fall-run Chinook salmon population, allowing it to perform better than the rest of the Central Valley watersheds during the 2007 to 2010 Chinook salmon ocean fishery collapse (Figure 3). During that period, while Central Valley Chinook salmon escapement decreased to 24% of baseline, Clear Creek consistently maintained an average 74% of baseline escapement (Figure 3).

Current Active Members:

- Naseem Alston/Bruce Oppenheim/Brycen Swart, National Marine Fisheries Service
- Russ Weatherbee, National Park Service
- Alicia Young, Natural Resources Conservation Service
- Gary Diridoni, U.S. Bureau of Land Management
- Tom Kisanuki, U.S. Bureau of Reclamation
- Matt Brown/Mark Gard/Sarah Giovannetti/Jim Earley, U.S. Fish and Wildlife Service
- Patricia Bratcher/Eda Eggeman/Matt Johnson, CA. Department of Fish and Wildlife
- Aric Lester, CA. Department of Water Resources
- Guy Chetelat, Regional Water Quality Control Board
- Ryan Teubert, Western Shasta Resource Conservation District

List of Clear Creek Technical Team BO Related Discussions:

The following list of topics were covered in CCTT meetings in WY 2013. The list does not include non-BO topics. Items with asterisks* involve NMFS BO RPA-required monitoring.

<u>*December 13, 2012*- n= 18 participants</u>

Discussion of RPA I.1.6 reporting requirements
Discussion of 2012 CLTO Science Panel comments and recommendations
Update on Environmental Water Program (EWP) large pulse flow (relates to RPA I.1.2)
Update on gravel projects (relates to RPA I.1.3)
Cloverview Mercury Abatement/Gravel Project discussion (relates to RPA I.1.3)

<u>*January 29, 2013*- n=17 participants</u>

Spring-Run Chinook salmon monitoring (required by Monitoring and Reporting section 11.2.1.3.7)*
Pulse flow planning for 2013 (RPA I.1.1)*
OCAP Science Panel Review Discussion 2012*
Cloverview Mercury Abatement/Gravel Project discussion (relates to RPA I.1.3)

<u>*March 21, 2013*- n= 13 participants</u>

Pulse flow planning 2013 discussion (RPA I.1.1)
Bedload Monitoring Project (relates to RPA I.1.3)*
Cloverview Mercury Abatement/Gravel Project discussion (relates to RPA I.1.3)

<u>*June 20, 2013*- n=18 participants</u>

Fish Monitoring Updates*
2013 Annual Science Review report preparation schedule*
Gravel project site selection for 2014 (relates to RPA I.1.3)
Cloverview Mercury Abatement/Gravel Project update (relates to RPA I.1.3)

<u>*September 19, 2013-*</u>

Not available at time of report preparation.

Summary of Whiskeytown Reservoir Operations:

- Whiskeytown operations resulted in stream flows and temperature at the Igo gage (IGO) depicted in Figures 4 and 5.

- Beginning in September 2012, releases of 225 cfs were provided try to meet spawning temperature criteria, which were not met in 32% of the days in 2012 ending October 31, 2012.

- Releases were decreased to 200 cfs in early December 2012.

- Pulse flows occurred in April and June (see Action I.1.1 section, below).

- Upper and lower dam gates were used to conserve the cold water pool and improve water temperatures by diverting relatively more water through the upper gate during the spring and diverting relatively less during the summer.

- Releases were decreased in early July and again in late July to conserve cold water.

- Full power peaking operations were avoided during most of the summer at Trinity, Carr and Spring Creek powerhouses due to the large amount of water being diverted from the Trinity River to the Sacramento. More water was diverted from the Trinity through Whiskeytown Reservoir than in any other year since the implementation of the Trinity River Record of Decision in 2005.

- Releases were increased on September 11, 2013, to 160 cfs and on September 13, 2013, to 200 cfs to provide more spawning habitat for the record number of spring-run Chinook salmon returning to Clear Creek in 2013. The spring-run spawning temperature criterion of 56°F at IGO began on September 15, and criteria were not met for the first two days. It appeared on September 27th that criteria would be met for the remainder of the season ending October 31, 2013

Summary of Clear Creek RPA Actions: **WY 2013**

Action	Progress in 2013
• Spring Attraction Flows	Yes
• Channel Maintenance Flows	Yes
• Spawning Gravel Addition	Yes
• Replace Temperature Curtain	Yes
• Thermal Stress Reduction	Yes - Stress Reduction No - Water Temperature Modeling
• Adaptively Manage to Habitat Suitability/ IFIM Study Results	Yes
• Other required monitoring and operations	Yes

Action I.1.1. Spring Attraction Flows

Objective: Encourage spring-run Chinook salmon movement to upstream Clear Creek habitat for holding and spawning.

Action: "Reclamation shall annually conduct at least two pulse flows in Clear Creek in May and June of at least 600 cfs for at least three days for each pulse, to attract adult spring-run holding in the Sacramento River main stem. This may be done in conjunction with channel-maintenance flows (Action I.1.2)". The rationale and requirements for the Action is as follows:

> "In order to prevent spring-run from hybridizing with fall-run in the Sacramento River, it is important to attract early spring-run adults as far upstream in Clear Creek as possible,

where cooler water temperatures can be maintained over the summer holding period through releases from Whiskeytown Dam. This action will also prevent spring-run adults from spawning in the lower reaches of Clear Creek, where water temperatures are inadequate to support eggs and pre-emergent fry during September and October."

Proposal for 2013: When developing the proposal for the timing and magnitude of the pulse flows for 2013, the CCTT considered existing data related to adult spring-run Chinook salmon passage, and other geomorphic and wildlife-related goals, which included transport of fine and course sediment, and reduced impacts to ground-nesting birds. The two proposed pulse flows were (1) an 800 cfs peak event to begin on April 8, 2013, and (2) a 400 cfs peak event to begin on June 24, 2013. The April date was earlier, and the June date later than previous years (Figure 5). A proposal to change the timing and magnitude of the pulse flows from those prescribed in the RPA was developed by the technical team and approved by NMFS. By altering the timing and magnitude of the pulse flows, the same amount of water that two 600 cfs pulse flows would be used, but with potentially greater geomorphological and ecological benefits. The CCTT selected flow timing and magnitudes to be more typical of a natural flow regime for Clear Creek for the time of year.

The timing of the first pulse flow was chosen to more closely mimic the natural migration of spring-run Chinook salmon into tributaries. Chinook salmon passage data collected between 2006 and 2012 on Mill Creek by the California Department of Fish and Wildlife (DFW), suggested that significant numbers of adult spring-run Chinook salmon were migrating in April (DFW, unpublished data). Clear Creek adult spring-run Chinook salmon passage data from snorkel surveys also suggests peak passage occurred in April in some years (Giovannetti and Brown 2008).

The higher magnitude of the first pulse flow would be more useful than a 600 cfs flow for moving sediment and stockpiled spawning gravel downstream to improve spawning habitat for salmonids. Although the second pulse flow in late June would then be lower, it would occur at the time of year when water temperatures are increasing, and flows are decreasing on Clear Creek. The lower magnitude in these conditions may be enough to encourage spring-run Chinook salmon into Clear Creek and further upstream migration for those already present. The timing and magnitude of both pulses was also designed to avoid the period of peak avian nesting productivity. Particularly, having the lower magnitude flow in June could help to decrease impacts to birds nesting in the channel margins.

For each pulse, the up-ramping rates were set to be slower than in previous years to provide longer periods of increased turbidity, which may be more effective in attracting adult spring-run Chinook salmon into Clear Creek. In turn, the length of time at the peak release would be reduced, resulting in the same amount of water use as two 600 cfs pulse flows. The down ramping flows for each pulse were selected and timed so that the juvenile Chinook salmon experienced the change during darkness, and chances for stranding were reduced.

Monitoring methods: The main objective of the pulse flows was to attract spring-run Chinook salmon into Clear Creek, and to increase their distribution upstream into more suitable habitat. The secondary objective of the pulse flows was to create a geomorphic response that moved sediment downstream. Several measures were identified to determine the effects of pulse flows, which included:

1. Percent change in counts, and upstream distribution of live adult Chinook salmon before and after pulse flows.
2. Change in the rate of Chinook salmon passage into Clear Creek during pulse flows, compared to passage during the entire migration period.
3. Proportion of steelhead or late-fall-run Chinook salmon redds scoured.
4. Proportion of spawning gravel moved from injection piles per pulse flow.
5. Amount of fine sediment transport at different releases.

To address the first measure and determine if pulse flows were successful at (1) attracting spring-run Chinook salmon into Clear Creek, and (2) moving them further upstream, we used adult live salmon counts from snorkel surveys conducted before and after the pulse flows. For the second measure (change in the rate of Chinook salmon passage into Clear Creek during pulse flows, compared to passage during the entire migration period), a video station was operated near the confluence with the Sacramento during the spring-run Chinook salmon migration period, to obtain live salmon counts throughout the migration period.

One of the purposes of moving the spring-run Chinook salmon further upstream into Clear Creek is that annually, a proportion of the August population index has been downstream of the temperature compliance point at IGO, and the separation weir, which is used to separate spring-run and fall-run Chinook salmon prior to their relative spawning. Based on previous years' survey data since 2003, an average of 50% of the spring-run Chinook salmon were downstream of IGO, and an average 17% of spring-run Chinook salmon were downstream of the lowest temporary separation weir site. The metric for success would be to reduce the proportion of the spring-run Chinook salmon index to ≤ 33% downstream of IGO (based on available habitat from Whiskeytown Dam to the weir), and 0% downstream of the weir.

For 2010-12, the target for the rate of change for salmon passage during the pulse flows was developed based the rate of change observed during snorkel survey counts between May and June from 1999-2005. This year, because the pulse flow was carried out in April and June, new targets need to be developed.

The downstream extent of the spawning gravel from talus cones was documented before and after the pulse flows during snorkel surveys. The methods for spawning gravel evaluation are described in Action I.1.3 Spawning Gravel Augmentation.

The fifth measure (amount of fine sediment transport at different releases) was monitored by Graham Matthew & Associates. Sediment transport measurements were made during up-ramping to estimate these transport rates, and estimate optimal flows for fine sediment removal. For the 2013 pulse flow, GMA collected continuous stage and discharge at the NEED Camp gage (river mile (rm)16.1). A peak discharge of 850 cfs was measured on 4/10/13. Cataraft sampling platforms were deployed both at NEED Camp and IGO from April 11-14. Bedload and suspended sediment samples were collected at NEED and suspended sediment samples were collected at IGO. Results are currently being analyzed.

Flow data were obtained on CDEC for the USGS IGO gaging station at rm 10.5, and for the Whiskeytown Dam (WHI) release (www.cdec.water.ca.gov) at rm 18.1.

Monitoring Results:

Flows: The first pulse flow, of 800 cfs, occurred over a ten-day period, and was at peak flows for two days (Figure 5). A small rain event occurred two days prior to the initial pulse flow increases, which raised the creek to a peak flow of 558 cfs on April 4. Flows gradually decreased after the storm event, and were at 245 cfs by the time the pulse flow increases began on April 8. Peak flows were reached at IGO by April 11. Based on flow readings at IGO, the flows ranged from 85 cfs to 175 cfs higher than the releases at WHI. Based on IGO readings prior to the ramp up, approximately 45 cfs of the difference may have been due to tributary input. Immediately after the first pulse flow, IGO discharge was approximately 20 cfs higher than WHI. During the ramp up, IGO was approximately 130 cfs higher at the 500 cfs release, 200 cfs higher at the 600 cfs and 700 cfs release, and 220 cfs higher at the 800 cfs release.

The second pulse flow began when flows were at a 175 cfs release at WHI, and IGO was reading slightly less, approximately 5 cfs, indicating there was no tributary input. The differences between WHI and IGO during the ramp up were variable, but at the 400 cfs peak reached on June 26, IGO was approximately 30 cfs higher than WHI (Figure 5).

Snorkel Surveys: Snorkel surveys results from the April pulse flow were inconclusive due the low number of spring-run Chinook salmon counted during snorkel surveys (zero before, and 14 after). Snorkel survey results from the June pulse flow suggest that the flow may have attracted more spring-run Chinook salmon into Clear Creek. Snorkel crews counted 400 salmon before the pulse flow, and 561 after, a 40% increase. Salmon continued to migrate into Clear Creek after the second pulse flow. The August Index count was 662, an 18% increase from the June survey. The distribution of Chinook salmon upstream and downstream of IGO and of the weir location did not change following the June pulse flow. After the second pulse flow, 43% of the index was downstream of IGO and 25% was downstream of the weir site. During the August Index, distribution was 38% of the index was downstream of IGO and 22% was downstream of the weir site.

Fish monitoring weir: Video monitoring data are preliminary and draft, and need quality checks and statistical methods applied. However, based on the raw data, there appears to be an increase in fish passage during the pulse flows. Video passage data showed that salmon began entering Clear Creek after the first pulse flow. Video counts were consistent with the increase in counts between April and June (14 to 400). Video counts were also consistent with the increase in between the June and August counts.

This was the first year we had a large number of spring-run Chinook salmon return to Clear Creek since the pulse flows began. The video station was successful in observing when spring-run Chinook salmon were migrating into Clear Creek, so we will have a better understanding of the timing of their migration and if it varies during the pulse flows. Due to turbid conditions, some potential passage during the pulse flows and other storm events was not visible, so some data on passage are absent during those periods. We were able to operate the Aris during the high turbidity flows, and have some sonar images during those periods. Some footage are missing during the high flow periods. This was a pilot year for the Aris, which is a new model for the manufacturer, similar to the older Didson model. We are currently working through analyzing the data collected from the Aris and working through protocols for species identification.

Redd scour: We did not directly measure if steelhead redds or late-fall-run Chinook salmon redds were scoured. The final kayak survey used to count steelhead and late-fall-run Chinook salmon redds was completed on March 28, 2013. Forty-four steelhead redds from previous surveys were visible (31 old, and 13 new), and two late-fall-run Chinook salmon redds were visible (one old, one new). During the snorkel survey prior to the pulse flow, 22 new steelhead redds were observed. No redds were visible after the pulse flow.

Gravel movement: Movement of gravel based on snorkel observations in canyon. The major slug of Guardian Rock spawning injection gravel moved approximately 800 feet following the April pulse flow. We documented gravel movement due to high flows from storms events (peaking at 5,000 cfs at Igo) in December 2012, which only moved the gravel about 200 feet downstream. Gravel at the Placer site moved 350 feet downstream after the early December winter storm, but moved about 60 feet from that point after the first April pulse. Gravel placed below Clear Creek Road Bridge seems to move around but the main slug did not move further downstream.

Juvenile outmigration and turbidity during pulse flows: U.S. Fish and Wildlife Service (USFWS) collected data on juvenile salmonid catch and water turbidity at the lower rotary screw trap (rm 1.7), during the ramping up period. The rates at which flows were ramped up were slower than previous years' pulse flows to provide repeated or longer period of increased turbidity. It may be that repeated or longer turbidity increases would increase Chinook salmon attraction. Crews measured turbidity during the first pulse flow only, during the juvenile outmigration monitoring at the rotary screw trap. Water levels were observed and recorded at a staff plate at the lower rotary screw trap in .01' increments every 15 minutes. Water samples were collected every 15 minutes, and samples were run through a turbidity machine, which recorded turbidity levels in NTU.

Turbidity data suggest that the slower ramping rate resulted in repeated pulses of increased turbidity. The average turbidity on Clear Creek prior to the pulse flows was approximately 2.3 NTU, while during the entire pulse flow the average was 4.5 NTU (Figure 6). There was a peak in turbidity during each ramping up period. During each ramp up from April 8-11, the peaks were 11.2, 11.0, 9.0, and 12.0.

Juvenile fish catch appeared to be independent of flow and turbidity increases. Juvenile catch, instead, followed the diurnal outmigration timing observed throughout the season in which the majority of the catch occurs from 8 PM to midnight.

Recommendation: The CCTT recommends that the U.S. Bureau of Reclamation (Reclamation) perform tests to verify and/or adjust the water tables for the City of Redding and Reclamation regulating gates at Whiskeytown Dam. Tests are suggested due to apparent differences in discharge between the Whiskeytown releases and IGO and also due to flow differences when changing releases between the City of Redding and Reclamation regulating gates.

Action I.1.2. Channel Maintenance Flows

Objective: Minimize project effects by enhancing and maintain previously degraded spawning habitat for spring-run and CV steelhead.

Action: "Reclamation shall re-operate Whiskeytown Glory Hole spills during the winter and spring to produce channel maintenance flows of a minimum of 3,250 cfs mean daily spill from Whiskeytown for one day, to occur seven times in a ten-year period, unless flood control operations provide similar releases. Re-operation of Whiskeytown Dam should be implemented with other project facilities described in the Environmental Water Program (EWP) Pilot Program".

Results: This RPA Action has not been implemented. DFW has funded the USFWS Environmental Water Program (EWP) to implement the pilot re-operation. In 2013, six technical memos from the 2011 EWP Orientation and Review Workshop were drafted and distributed for review. A Core Monitoring and Adaptive Management Plan based on the 2012 Monitoring and Adaptive Management Workshop was drafted and distributed for review. A core team of consisting of CDFW, FWS, USFWS, Reclamation, ESSA Inc, Stillwater Sciences and Graham Matthews and Associates began regular monthly meetings in the Summer of 2013. It is anticipated that reoperation will not occur in 2014 because a planned outage of a Spring Creek Powerplant generator will limit Reclamation's ability to provide the flows.

Action I.1.3. Spawning Gravel Augmentation

Objective: Enhance and maintain previously degraded spawning habitat for spring-run and CV steelhead.

Action: "Reclamation, in coordination with the Clear Creek Technical Team, shall continue spawning gravel augmentation efforts. By December 31 each year, Reclamation shall provide a report to NMFS on implementation and effectiveness of the gravel augmentation program".

Results: Ongoing spawning gravel actions that continued in Clear Creek were: design and permitting of the long-term gravel supply project, obtaining long-term permits for gravel additions and performing geomorphic monitoring and fish monitoring. Although no gravel was placed in 2013, gravel injections proposed for 2014 include:

Proposed 2014 Gravel Injections	
Location	**Amount (tons)**
Whiskeytown	1,500
Guardian Rock	1,500
Placer Road Bridge	2,000
Clear Creek Road Crossing	1,000
Above 3A	1,700

Clear Creek Mercury Abatement and Fisheries Restoration Project (also known as Lower Clear Creek Long-term Gravel Supply Project): CVPIA Clear Creek Restoration Program continued work on projects to provide a long-term supply of spawning gravel and provide long-term permits for placing it instream. CVPIA funded the planning, design and permitting for this project to provide an inexpensive, long-term gravel supply for Clear Creek restoration. The project, which is located on Bureau of Land Management and DFW lands, could provide gravel for 20 to 40 years with a fixed acquisition cost. The Ecosystem Restoration Program will fund implementation of the $4.5 million project using a combination of Proposition 13 Mine Remediation and Proposition 84 funds. Revisions to the project design have been implemented with active assistance from the Clear Creek Technical Team. Implementation of this project is expected to begin in 2014.

Monitoring: Evaluation of the effectiveness of the gravel additions has been ongoing since 1996 and consists of many complementary physical and biological elements on a range of scales. The following monitoring and evaluation activities occur on the following scales:

Watershed Scale:

- Longitudinal topographic surveys
- LiDAR topography
- Bedload transport and Sediment budget
- Annual adult salmonid population estimates
- Annual juvenile production estimates
- Annual juvenile productivity estimates (juvenile production/adult escapement, see Figures 9 through 11)
- Temperature monitoring through a system of 11 loggers in Clear Creek

Spawning Reach Scale:

- Topographical change estimating volumes of gravel moving in and out of project sites
- Salmonid spawning habitat suitability mapping
- Salmonid spawning habitat use
- Redd distribution surveys
- Salmonid use of supplemental gravel

Smaller Scales:

- Spawning gravel evaluation of sediment size
- Juvenile habitat use studies compare salmonid densities between:

  - Restored and control reaches
  - Physical habitat treatments
  - Habitat types
  - Types or presence of riparian vegetation
- Macro-invertebrate studies comparing gravel restoration types in treated and control areas

Approximately 172,335 tons of supplemental spawning gravel (injection gravel) has been added to Clear Creek from 1996–2012. Sites are located from Whiskeytown Dam (rm 18.1) downstream to rm 2.5. Gravel supplementation projects consist of placing 3/8–6 inch sized spawning gravel into the creek using several different methods including talus cones, channel reconstruction, riffle construction, and lateral berms. Spawning gravel from talus cones and lateral berms are dependent on high creek flows for transport downstream to become usable spawning habitat. Riffle and channel reconstruction make gravel available for immediate use by spawning salmonids. Many sites are replenished on a regular basis, as gravel moves downstream following high flows.

To evaluate the use of spawning habitat created by the spawning gravel supplementation projects, crews recorded the boundaries of injection gravel at each site, and noted when redds contained injection gravel. For talus cone sites, crews took a GPS location point at the downstream extent of the gravel to track the distance gravel moved downstream following the winter storm season. For created instream riffles, crews used a Trimble to trace the boundary of the injection gravel yearly, until it was no longer discernible from native gravel.

Following high flows, injection gravel from each site mixes with native spawning gravel. Redds described as containing injection gravel were usually mixed with native material. Crews identified injection gravel in redds based on (1) their proximity to the gravel injection site, (2) how far injection gravel moved downstream, (3) the presence of tracer rock (chert, not native to the watershed, which is present in some but not all of the sites), and (4) uniform size (2–4") and shape (rounded edges).

There are several gravel injection sites in spring-run Chinook salmon spawning habitat, which have been supplied with 86,864 tons of injection gravel through the summer of 2012. From 2003 to 2012, an average of 35% of spring-run Chinook salmon redds were observed in injection gravel (redds upstream of the separation weir). From 2003 to 2012, an average of 42% of steelhead redds were located in injection gravel upstream of the Gorge Cascade. In 2013 67% of steelheads redds were in injection gravel in the reach. A large portion of the steelhead spawn downstream of the Gorge Cascade, where supplemental gravel has dispersed throughout the reach making it difficult to distinguish from native material.

Action I.1.4. Spring Creek Temperature Control Curtain

Objective: Reduce adverse impacts of project operations on water temperature for listed salmonids in the Sacramento River.

Action: "Reclamation shall replace the Spring Creek Temperature Control Curtain in Whiskeytown Lake by 2011". [This action was not implemented by the CCTT]

Results: Replacement of the broken Spring Creek Temperature Control Curtain (SCTCC) in 2011 was intended to reduce the temperature of water diverted to the Sacramento River via the Spring Creek tunnel. This down-reservoir curtain was designed to pull cold water from lower levels of Whiskeytown Reservoir. Since 2011, it has become known that the Oak Bottom Temperature Control Curtain (OBTCC) is damaged and cannot be fully deployed (Figure 12). The OBTCC was intended to prevent mixing of cold and warm water at the upper end of the reservoir and is more effective than the SCTCC at reducing water temperatures (Tracy Vermeyen, Reclamation, Personal Communication, March 2012). If the water is allowed to mix upstream, then the downstream curtain will be withdrawing warmer water than intended. Therefore, the action to replace just the SCTTT may not be meeting the intent of this RPA action. Since the SCTTT is not functioning as the RPA anticipated because the upstream curtain is damaged, the agencies should consider if the OBTCC should become a requirement of the SCTCC RPA action.

Recommendation: The CCTT recommends that Reclamation replace the OBTCC.

Action I.1.5. Thermal Stress Reduction

Objective: To reduce thermal stress to over-summering steelhead and spring-run during holding, spawning, and embryo incubation.

Action: "Reclamation shall manage Whiskeytown releases to meet a daily water temperature of:

1) 60°F at the Igo gage from June 1 through September 15; and

2) 56°F at the Igo gage from September 15 to October 31.

Reclamation, in coordination with NMFS, will assess improvements to modeling water temperatures in Clear Creek and identify a schedule for making improvements."

Results: Reclamation has not identified a schedule for making improvements to modeling water temperatures in Clear Creek. Reclamation has not fully assessed improvements to modeling water temperatures in Clear Creek.

Table 2. Proportion of days that Clear Creek water temperatures at IGO met targets.

	From	To	Target	Avg 2001-08	2009	2010	2011	2012	2013
Holding	01-Jun	14-Sep	60° F	99%	100%	100%	100%	100%	100%
Spawning	15-Sep	31-Oct	56° F	93%	28%	26%	62%	68%	**96%**

More water was diverted from the Trinity River to the Sacramento River this year than in any other year since the implementation of the Trinity River Record of Decision in 2005. This likely kept Whiskeytown reservoir and, therefore, Clear Creek relatively cool. Actions taken to reduce thermal stress included using the upper and lower dam gates to conserve cold water and access colder water during periods of thermal stress, and reducing releases in early July and again in late July to conserve cold water. In addition, thermal stress may have been less because full power peaking operations were avoided during most of the summer at Trinity, Carr and Spring Creek powerhouses due to the large amount of water being diverted from the Trinity.

Action I.1.6. Adaptively Manage to Habitat Suitability/IFIM Study Results

Objective: Decrease risk to Clear Creek spring-run and CV steelhead population through improved flow management designed to implement state-of-the-art scientific analysis on habitat suitability.

Action: "Reclamation shall operate Whiskeytown Reservoir as described in the Project Description with the modifications in Action I.1 until September 30, 2012, or until 6 months after current Clear Creek salmonids habitat suitability (e.g. IFIM) studies are completed, whichever occurs later."

Results: FWS began a new IFIM study on Clear Creek in 2004. Field work for the project is complete. The results of the study will be contained in 5 reports, 4 of which are complete. The fifth FWS report will be a synthesis of the previous findings. This report will not reflect the full scope of state-of-the-art scientific analysis. According to the NMFS RPA with 2011 amendments (page 16), "When the salmonid habitat suitability studies are completed, Reclamation will, in conjunction with the CCTT, assess whether Clear Creek flows shall be further adapted to reduce adverse impacts on spring-run and CV steelhead, and report their findings and proposed operational flows to NMFS within 6 months of completion of the studies." Although Reclamation has not assessed whether Clear Creek flows shall be further adapted or proposed operational flows to NMFS, the CCTT and its Reclamation representative have stated a willingness to produce a report and prescription meeting the intent the RPA Action I.1.6. The prescription would cover 5 types of flow needs to:

1. Meet habitat needs based on IFIM and habitat suitability study results;
2. Provide temperature control;
3. Move and maintain spawning gravels and create and maintain riparian vegetation;
4. Avoid fish and redd stranding / dewatering; and
5. Encourage anadromy of *Oncorhynchus mykiss* (steelhead / rainbow trout) through an adaptive management approach.

Recommendations: The CCTT recommends that Reclamation continue working with NMFS and the CCTT, to assess if Clear Creek flows shall be further adapted to reduce adverse impacts on spring-run Chinook salmon and steelhead and encourage the restoration of these runs/species.

Other CLTO BO Required Monitoring:

The following annual reports for the BO which required monitoring were finalized in 2013:

- Clear Creek Juvenile Salmonid Monitoring 2011
- Clear Creek Juvenile Salmonid Monitoring 2012
- Clear Creek Adult Steelhead and Late-Fall Chinook Monitoring 2010
- Clear Creek Adult Steelhead and Late-Fall Chinook Monitoring 2011
- Clear Creek Adult Steelhead and Late-Fall Chinook Monitoring 2012
- Clear Creek Adult Spring Chinook Monitoring 2009
- Clear Creek Adult Spring Chinook Monitoring 2010
- Clear Creek Adult Spring Chinook Monitoring 2011
- Clear Creek Adult Spring Chinook Monitoring 2012

In addition the following related but not required fisheries reports were also completed in 2013:

- Clear Creek Spawning Area Mapping 2008 to 2012
- Juvenile Chinook Habitat Use in Lower Clear Creek, 2008
- Juvenile Chinook Habitat Use in Lower Clear Creek, 2010

Acronyms and Abbreviations

BO	Biological Opinion
CDFG	California Department of Fish & Game
CCTT	Clear Creek Technical Team
CLTO	Coordinated Long-term Operation
cfs	Cubic feet per second
CVP	Central Valley Project
CVPIA	Central Valley Project Improvement Act
FWS	U.S. Fish & Wildlife Service
IFIM	Instream Flow Incremental Methodology
NMFS	National Marine Fisheries Service
OBTC	Oak Bottom Temperature curtain
Reclamation	U.S. Bureau of Reclamation
rm	river mile
RPA	Reasonable and prudent alternative
SCTCC	Spring Creek TCC
TCC	Temperature control curtain

References

Giovannetti, S. L., and M. R. Brown. 2008. Adult spring Chinook salmon monitoring in Clear Creek, California: 2007 annual report. USFWS Report. U.S. Fish and Wildlife Service, Red Bluff Fish and Wildlife Office, Red Bluff, California.

Figures

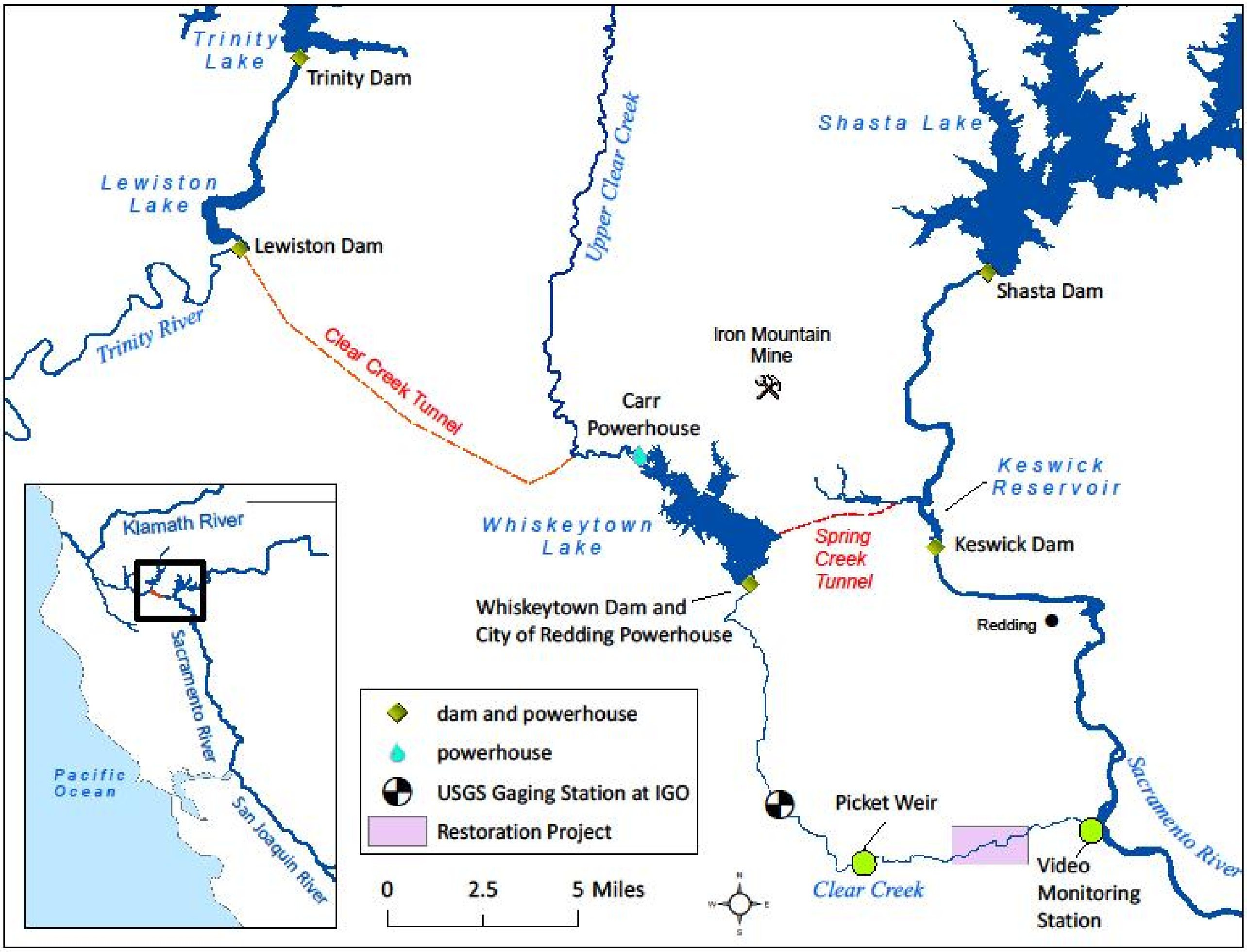

Figure 1. Map of Clear Creek in Northern California, and related Central Valley Project facilities, including Trinity, Whiskeytown, and Shasta Reservoirs, and associated powerhouses.

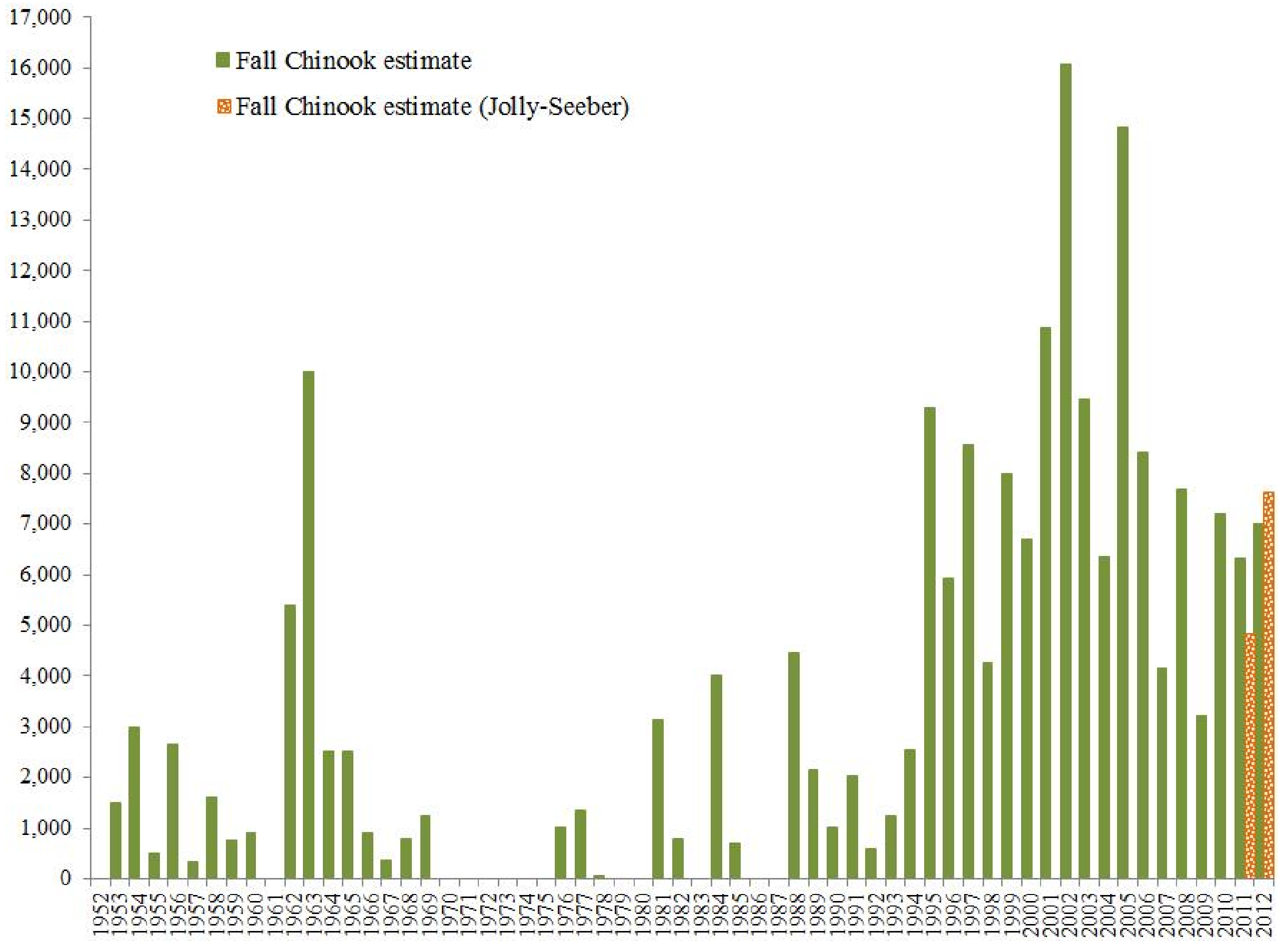

Figure 2. Fall Chinook salmon escapement into Clear Creek, 1952—2012. Restoration work began in 1995 with increased minimum flows and escapement estimates have increased since then. Years without data indicate no survey was completed. In 2011, escapement estimates were calculated using the Jolly-Seber statistical methods. In 2012, estimates calculated using Jolly-Seber, and video station counts. For 2011 and 2012, estimates using modified Schafer method estimates are shown in green for comparison with previous years.

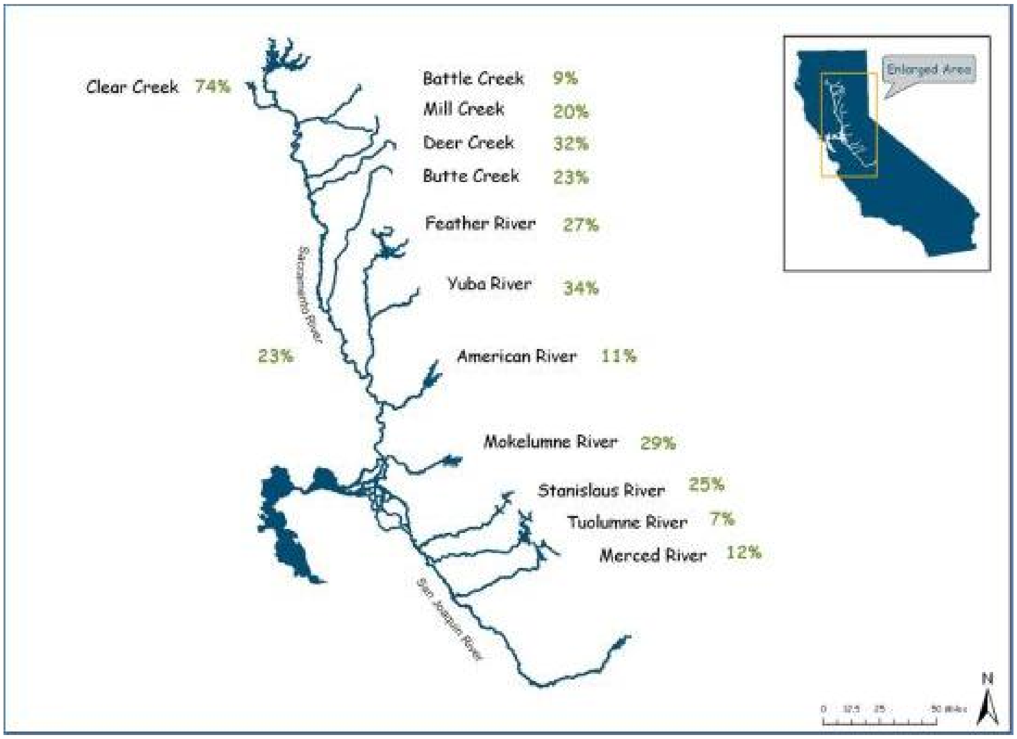

Figure 3. From 2007-2010, the Central Valley fall Chinook salmon escapement estimate was 21% of the fifteen year average from 1992 to 2006 but the Clear Creek estimate was 74%.

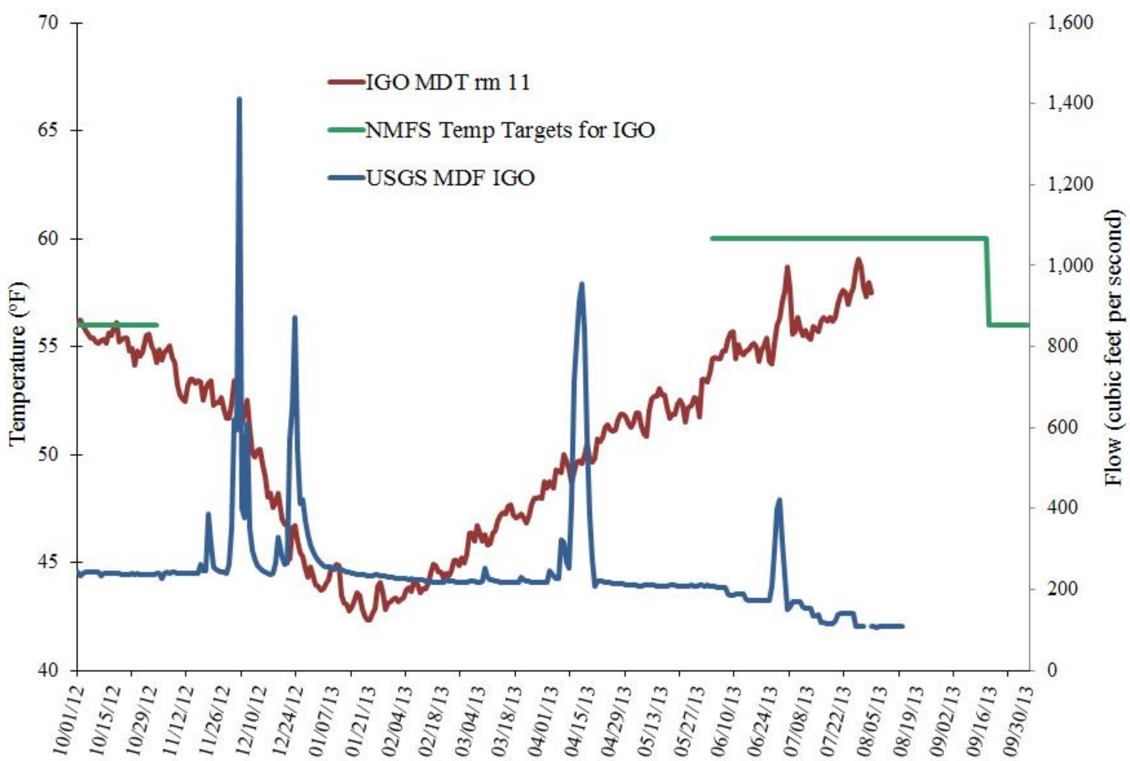

Figure 4. Clear Creek mean daily flows (MDT) and mean daily water temperatures (MDF; by FWS) recorded at Igo gage during WY 2013. NMFS temperature targets are from the 2009 BO.

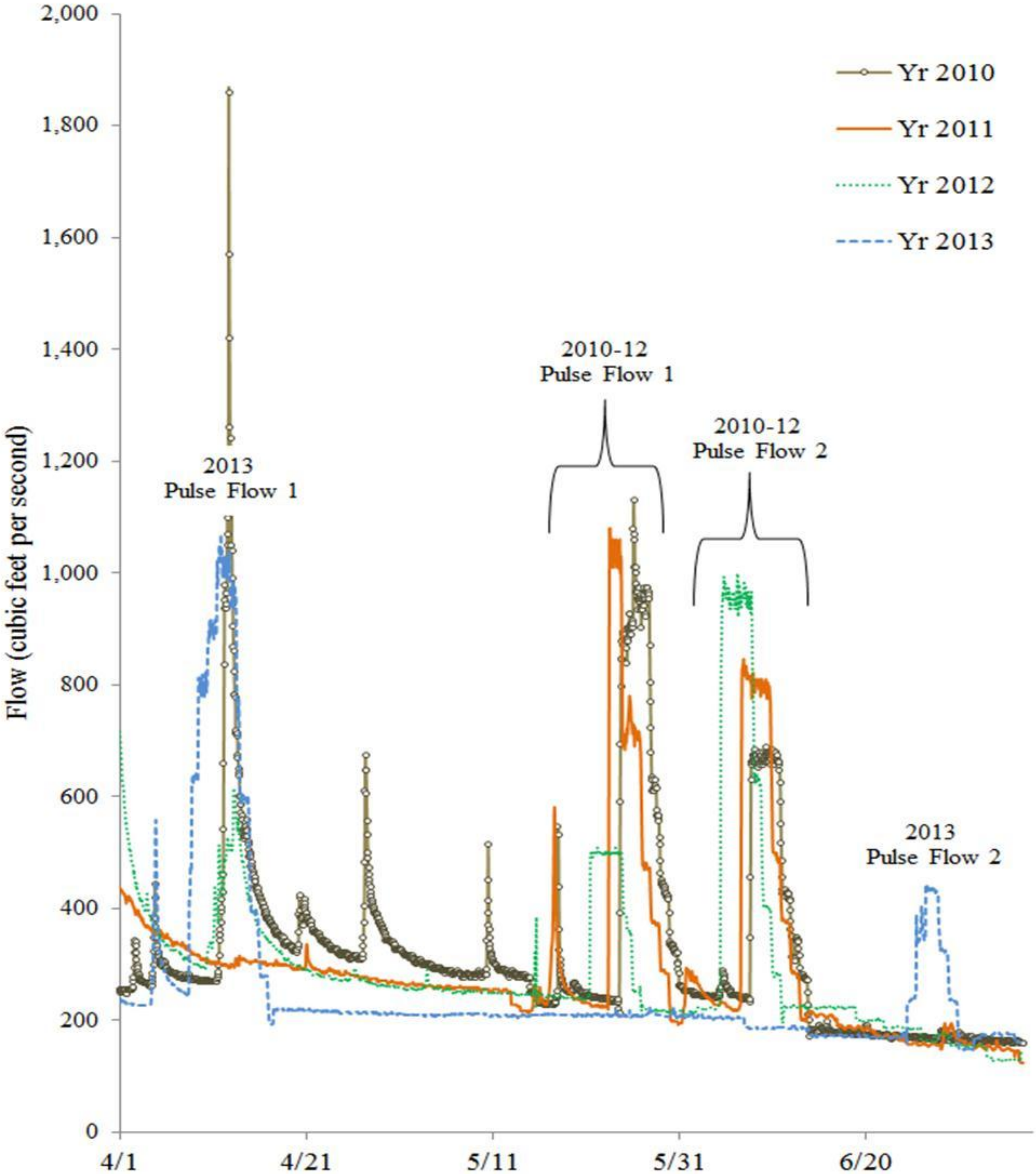

Figure 5. Hourly flows at the USGS Igo gaging station (IGO) on Clear Creek during the pulse flow period, 2010―13. The timing and magnitude of the pulse flows have varied annually.

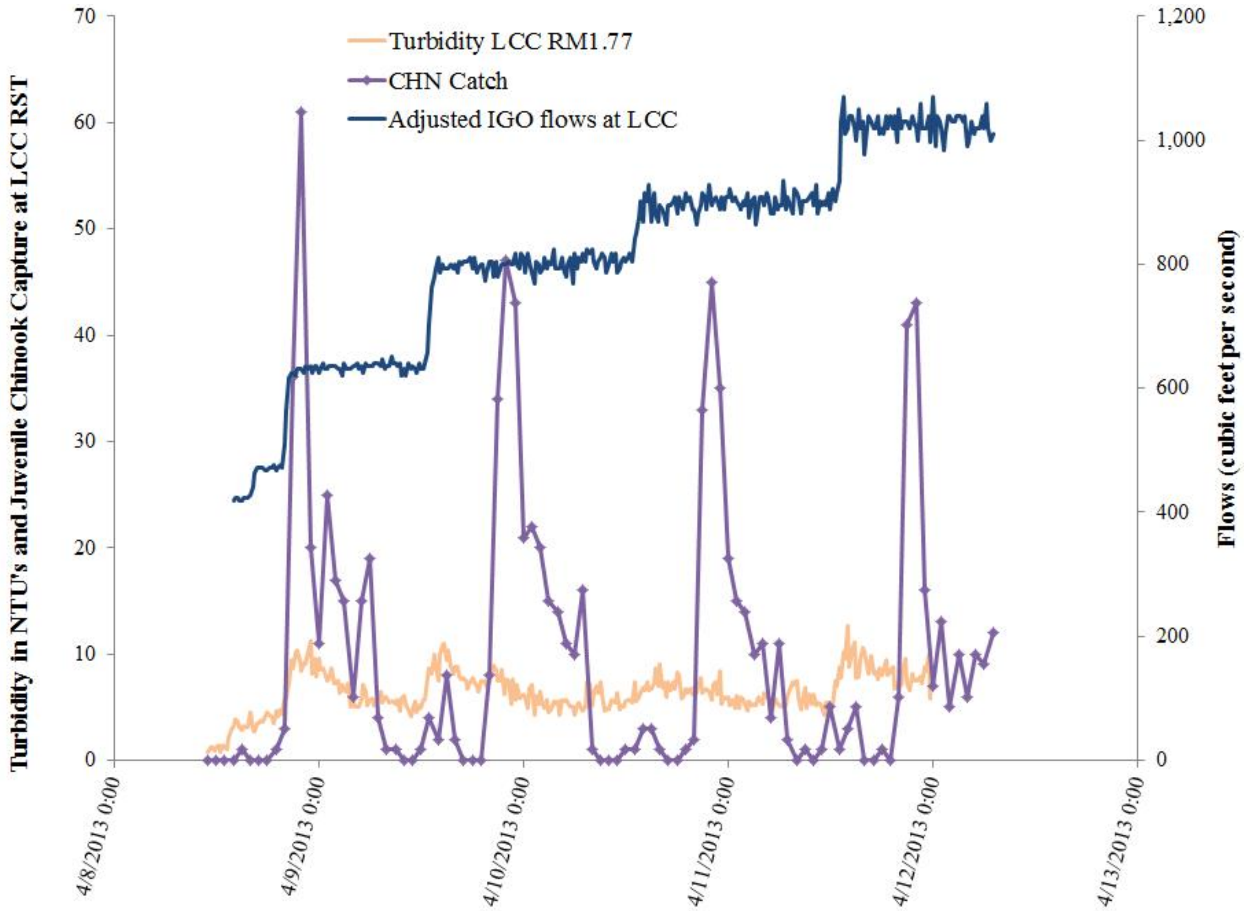

Figure 6. Clear Creek flows in cubic feet per second in 15 minute intervals estimated at the lower rotary screw trap (LCC). Turbidity and fish capture was measured in 15 minute and 1 hour intervals respectively at LCC by the U.S. Fish and Wildlife Service. Flows were adjusted for the 9.3 rm from the IGO gauge to LCC by delaying approximately 3 hours.

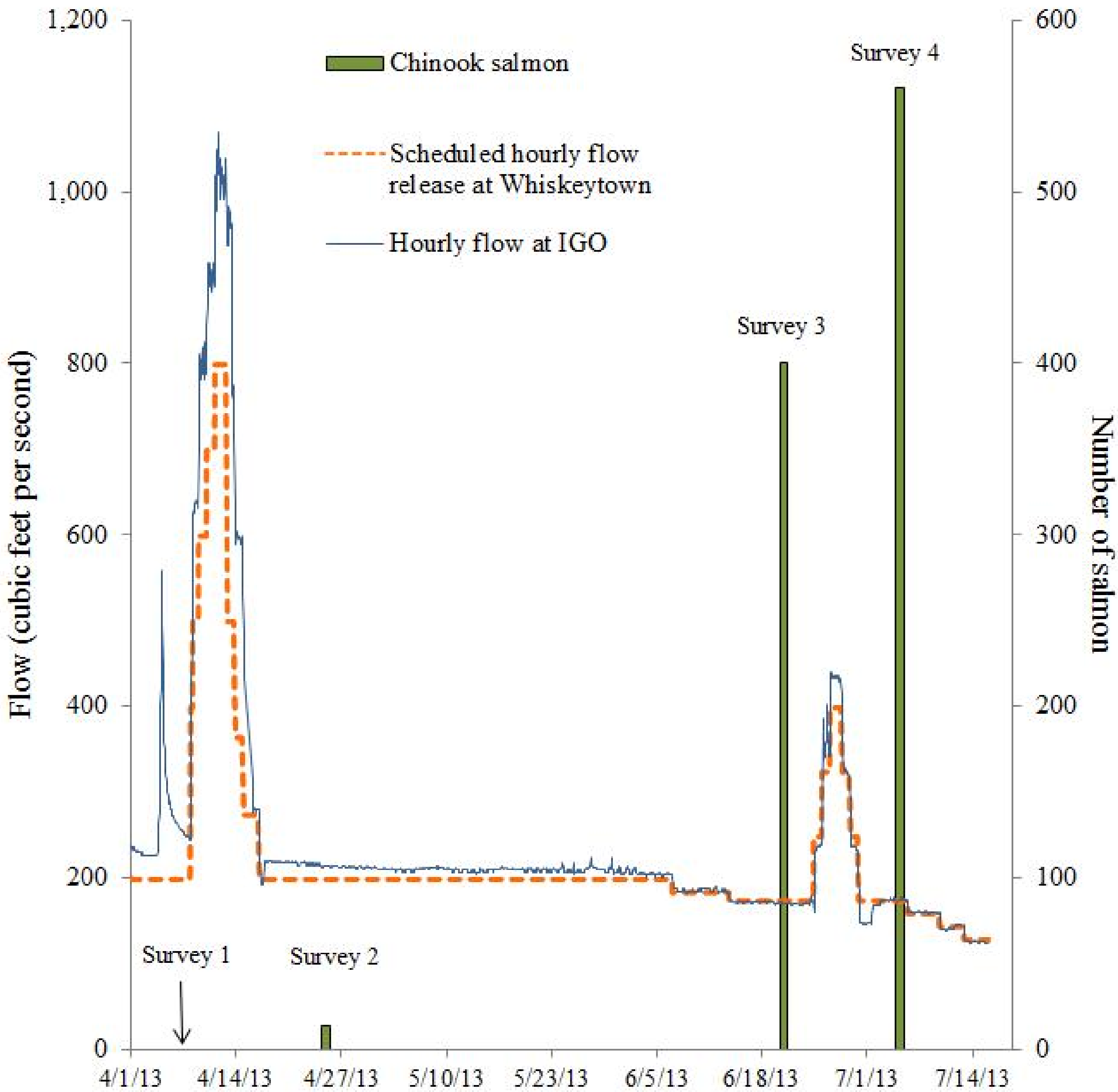

Figure 7. Flow at the USGS Igo gaging station (IGO), and nominal flow release from Whiskeytown Reservoir during the 2013 pulse flow period on Clear Creek. Spring-run Chinook salmon counts from snorkel surveys before and after the pulse flows are shown.

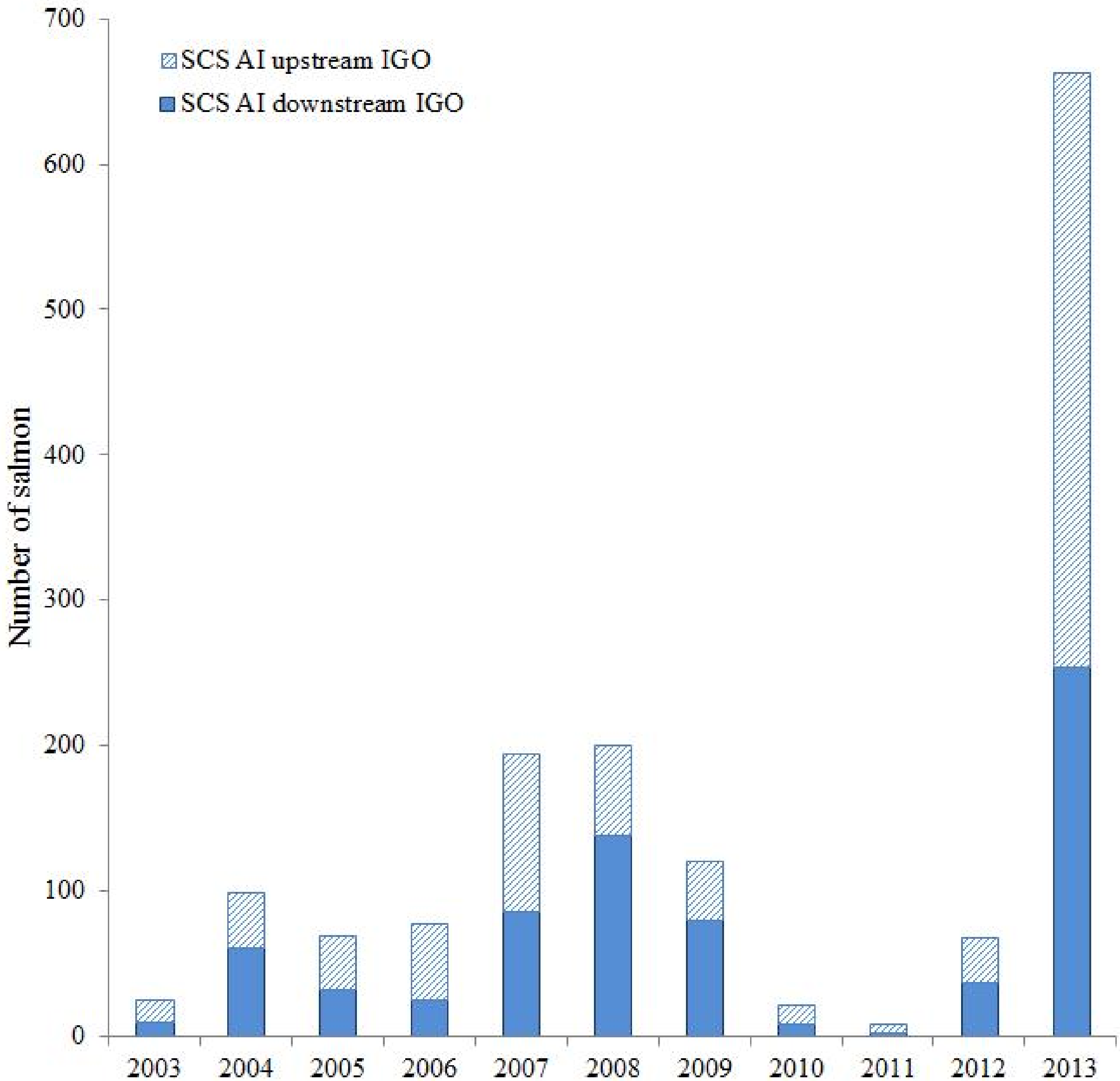

Figure 8. Distribution of Clear Creek spring-run Chinook salmon August Index (SCS AI) upstream and downstream of USGS Igo gaging station (IGO) temperature compliance point, 2003 through 2013.

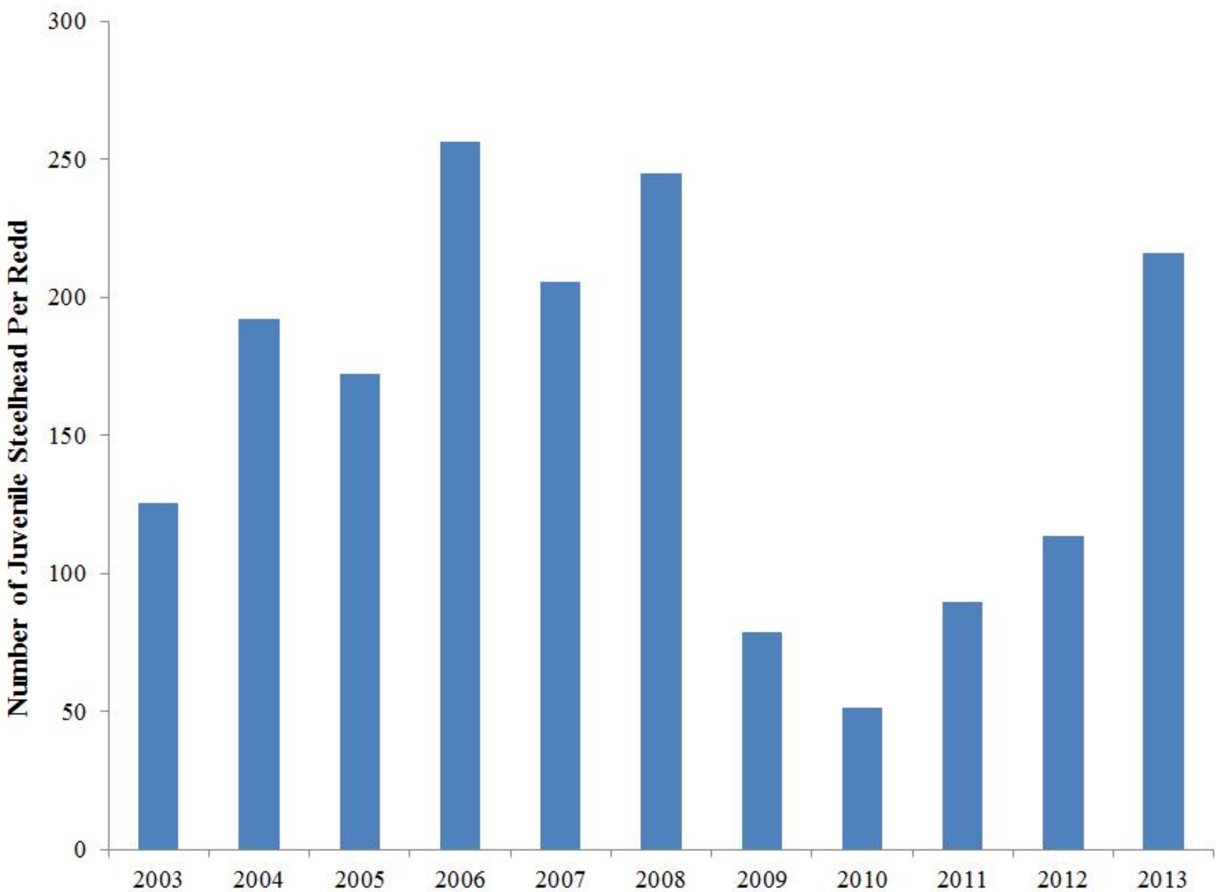

Figure 9. The number of juvenile steelhead / rainbow trout (*O. mykiss*) produced per redd has increased from a low in 2010. Broodyear 2013 is an estimate, as final passage calculations have not been completed to date.

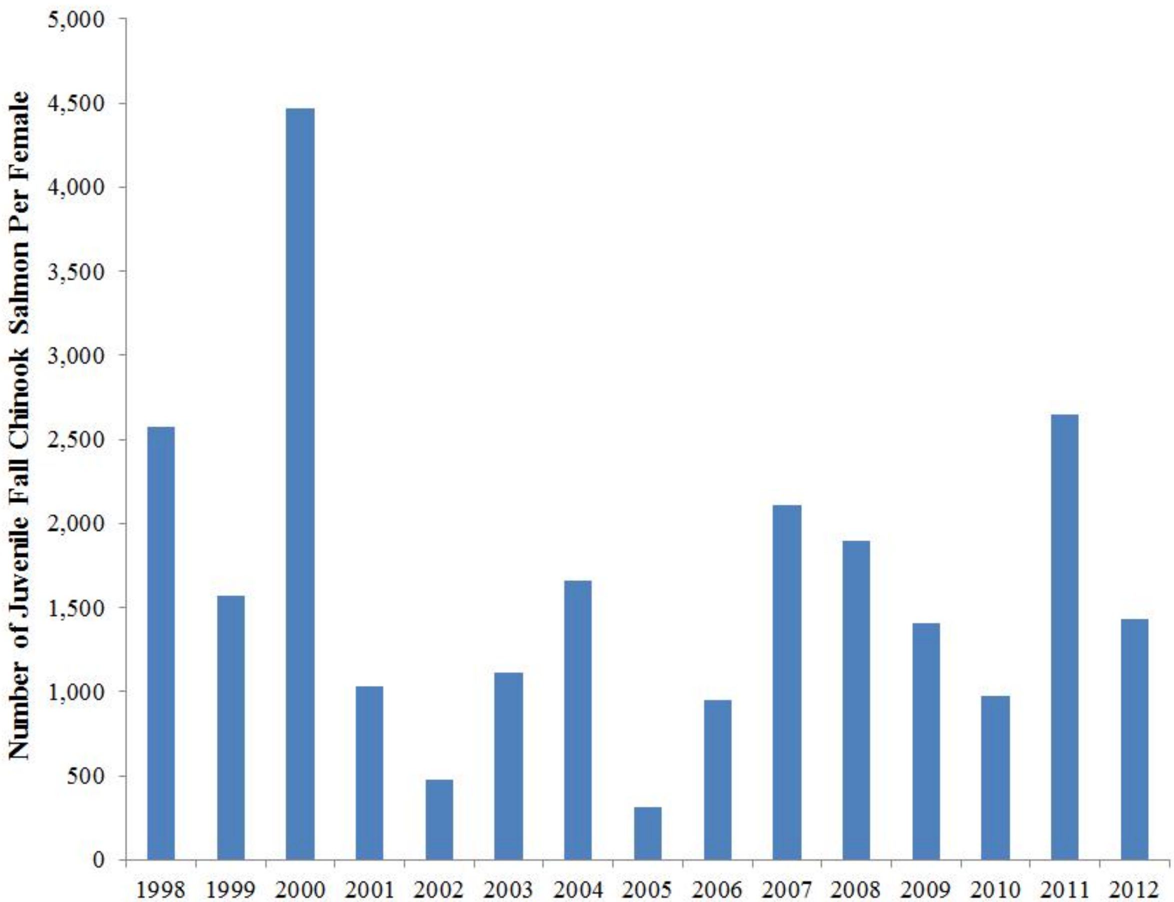

Figure 10. The number of juvenile fall Chinook salmon (*O. tshawytscha*) produced per female. Broodyear 2012 is an estimate, as final passage calculations have not been completed as of August 2013.

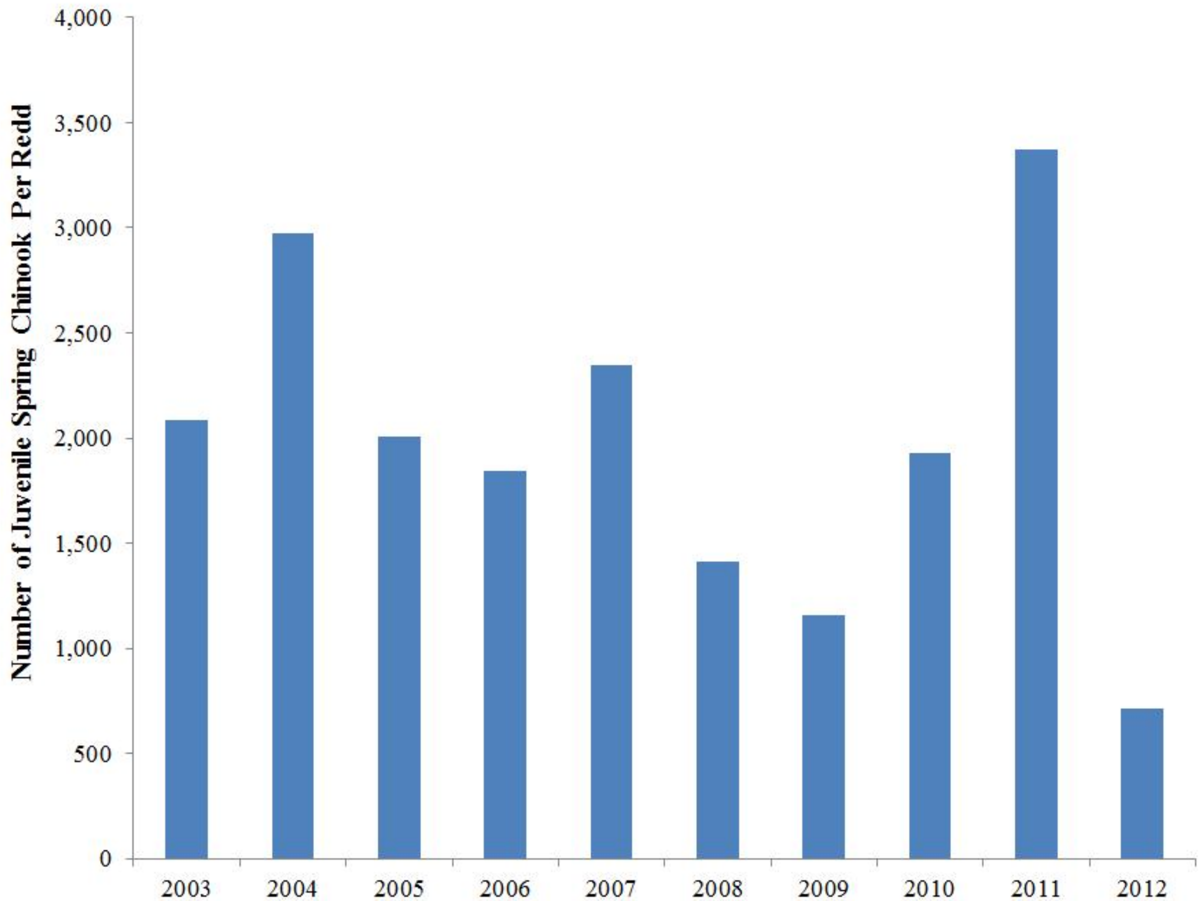

Figure 11. The number of juvenile spring-run Chinook salmon (*O. tshawytscha*) produced per female. Broodyear 2012 is an estimate, as final passage calculations have not been completed as of August 2013. The low estimate for Broodyear 2012 may be related to a high flow event (4,920 cfs) that occurred on December 2, 2012, which reduced our ability to operate our rotary screw traps at the same time that many juveniles may have out-migrated. Therefore we may have missed the peak of juvenile passage.

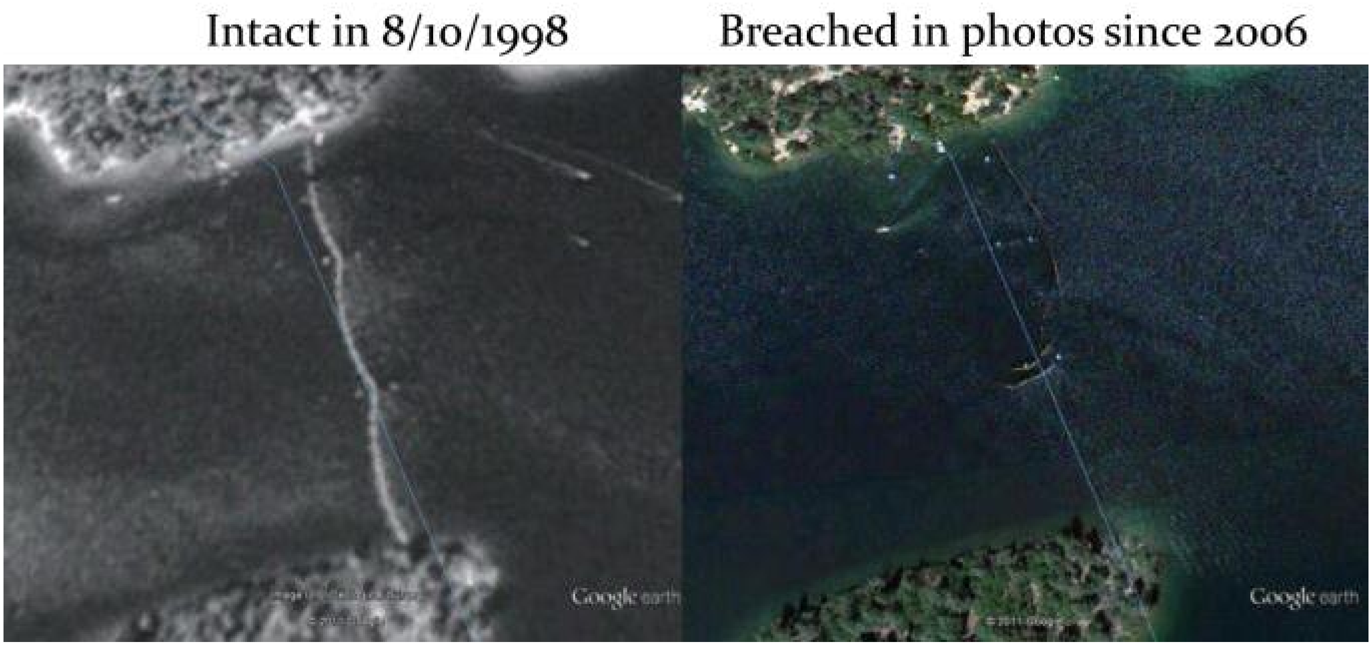

Figure 12 . Aerial photos from Google Earth showing the Oak Bottom Temperature Control Curtain intact on the left and breached on the right.

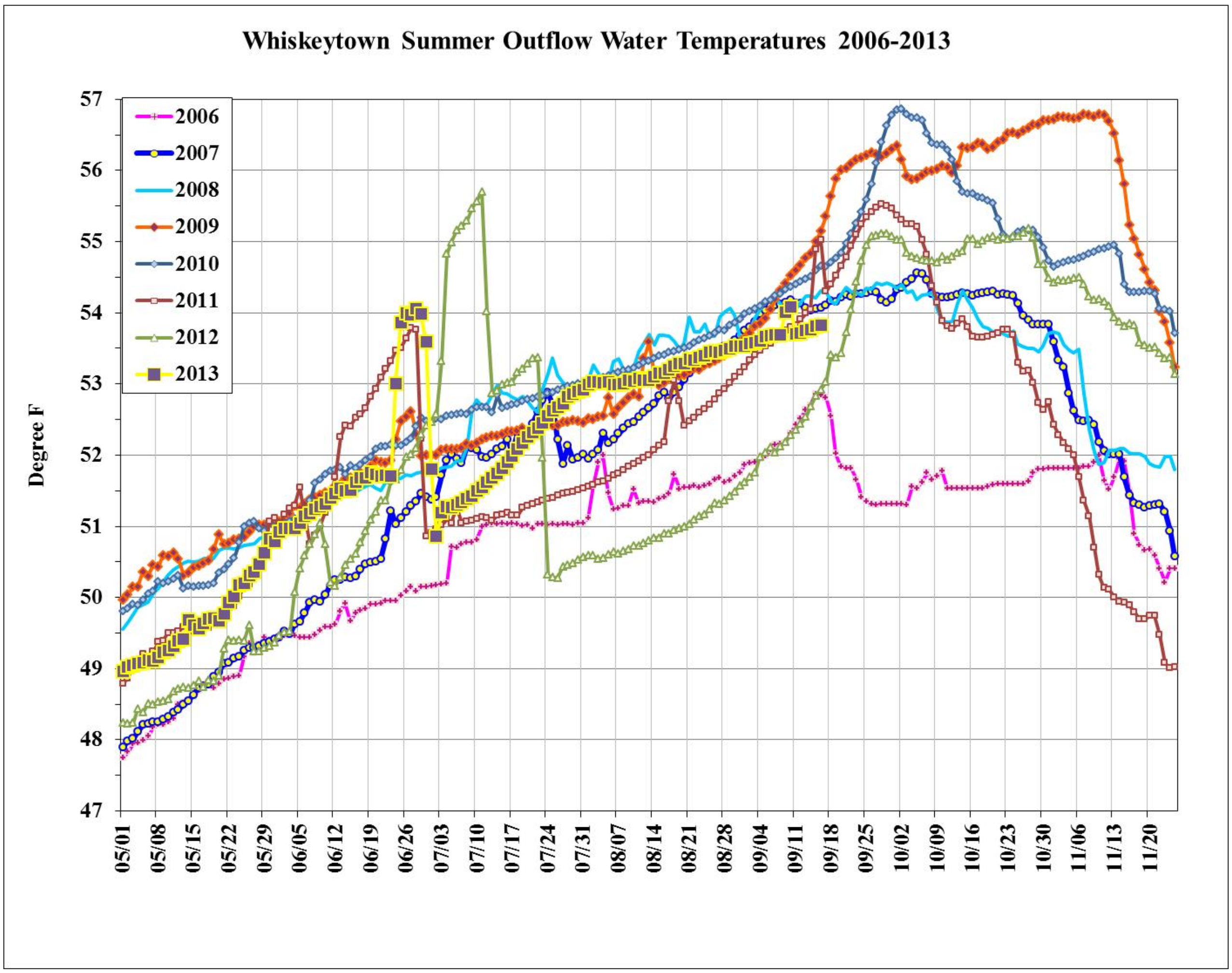

Figure 13. Whiskeytown outflow water temperature 2006 to 2013